Renaissance

RENEWABLE INTEGRATION & SUSTAINABILITY IN ENERGY COMMUNITIES

D6.3 – REPORT ON REPLICATION VALIDATION

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RENAISSANCE Consortium

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Executive summary

The purpose if this deliverable is to present the work undertaken in Task 6.4, where the scalability and replicability of the RENAISSANCE methodology took place.

The RENERGiSE tool developed and tested in WP2 is applied and tested globally in terms of scalability and replicability. In addition, the MAMCA tool, as it has been adapted to use in the specific cases of LECs, has also been applied and tested. The application in both cases took place in different types of replication sites, e.g. in terms of areas, grids, level of readiness etc, eleven in total in Europe, Uganda, India, Colombia, Chile, Argentina.

The basic steps undertaken to implement the replication process are:

- Pre-MAMCA survey to assess objectives and stakeholders
- RENERGiSE data collection
- Scenario building
- Data analysis/ Results
- MAMCA workshop and Regulatory final workshop

Finally, a number of conclusions have been reached in three levels of analysis:

- MAMCA process (engagement strategy and LCE development)
- RENERGISE tool (use and requirements)
- Specific suggestions towards each site.

These conclusions are used as input for enhancing the RENAISSANCE tools, methodologies and approach (e.g. stakeholder engagement). Also, the conclusions were presented and discussed with the RENAISSANCE replication sites, in order to provide a first plan of implementation and development of the respective LCE.

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ACRONYM	
RES	Renewable Energy Source
MAMCA	Multi-Actor Multi-Criteria Analysis
GHG	Green House gas
PV	Photovoltaics
EC	European Commission
GA	Grant Agreement

Table 1 – list of acronyms

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1. Introduction

The RENAISSANCE project has developed a very ambitious methodology to support the development of energy communities of different types. With the use of the RENERGiSE tool [1] and the MAMCA[1] methodology [2], RENAISSANCE can assist citizens and stakeholders with the development of the best scenario for their energy community according to the objectives they selected themselves.

This methodology (section 1.1) has been developed during the first phase of the RENAISSANCE implementation, based on the work undertaken at the four pilot sites (Kimmeria, Manzaneda, Eemnes, UZ Brussel). During the second phase consisted of testing the scalability and replicability of the methodology in different geographical areas using different typologies, objectives and sizes, according to the description of T6.4. This procedure will allow the validation of both the RENERGiSE tool and the complete RENAISSANCE methodology.

A big part of the replication procedure is the regulatory analysis because for each replication site, a specific analysis has been made of the local, regional, and national legislations including their barriers and opportunities making the policy dimension admittedly one of the most decisive ones. This work will not be described in this report but will be available in [3].

1.1. Methodology

The replication process has a duration of approximately six months, during which replication sites are required to participate in online and onsite workshops and surveys, provide energy data and discuss the regulatory

[1] https://mobi.research.vub.be/en/multi-actor-multi-criteria-analysis-%E2%80%93-mamca

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aspects of the respective geographical area (local, regional, national, EU if applicable).

The basic steps of the replication process are:

- Pre-MAMCA survey to assess objectives and stakeholders
- RENERGiSE data collection
- Scenario building
- Data analysis/ Results
- MAMCA workshop and Regulatory final workshop

1.1.1. MAMCA: Multi-Actor Multi-Criteria Analysis

Each replication site is responsible of contacting local stakeholders and users and engage them to commit that they will partake in the survey and MAMCA workshops.

First a list of potential stakeholder objectives for joining an energy community initiative is distributed under the form of a questionnaire (online survey). All stakeholders get the chance to indicate how important each of the listed objectives is for them, and whether they would add additional relevant objectives. Together with the collected energy consumption data and with input from meetings with the project initiator(s) the results of this survey are used as input to identify specific potential energy community alternatives (scenarios). Hence these scenarios reflect the goals as well the needs and wants of the engaged stakeholders.

During the final MAMCA workshop with the stakeholders, first a weighting exercise was set up, in which the different stakeholder groups used the MAMCA software to assign weights to each of their selected objectives, according to their importance. The results of this exercise were discussed among all attendants to create mutual understanding of each other's motivations.

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Next, the selected objectives were used as performance indicators to evaluate the different scenarios for each of the stakeholder groups. This evaluation was done by the stakeholders themselves as well as by social and technical experts (using the RENERGiSE tool). The evaluation results show performance scores of the different scenarios for each stakeholder group visualized through the MAMCA software. These graphs were used in the workshop as a basis for discussion as well as consensus building, to test which scenario could gather everyone's support for implementation, and what the boundary conditions would be.

1.1.2. RENERGiSE tool

Each replication site provides the team with current assets and energy data (energy consumption profiles, production profiles, energy costs, investment costs of assets), ideally of at least hourly resolution. This data is used as input to the RENERGiSE optimization tool, and they are analyzed.

In many cases, the data needs to be "cleaned": brought into a workable format, which can be used in the software. For example, in the case of the Indian site, the data required months of "cleaning" before it was possible to analyse them. This "cleaning" process entails multiple steps that go from understanding the structure of the target energy system, collecting data, and defining the possibilities offered by its level of detail, resolution and quality, to selecting the right methodology to recreate synthetic profiles.

The RENERGiSE tool was also used to evaluate to what degree the developed energy community scenarios comply with some of the technical, financial and environmental objectives of the stakeholders.

Results were presented to the users and stakeholders of each site during the MAMCA workshop and formed a base of discussion.

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1.2. Replication Sites Presentation

According to the Grant Agreement (GA), the RENAISSANCE methodology (section 1.1) was planned to be replicated in ten replication sites globally. Some of the potential sites described in the GA are situated in India, China, USA, UK, Poland.

In India, 3 sites were potentially presented and another 3 were expected to be developed. However, the disruptions due to the pandemic lead to only two final replication sites, Auroville and Irumbai. Eventually, Auroville, was the most responsive and cooperative, while Irumbai had to drop out, due to COVID-19 restrictions and also local political issues.

Regarding China, even though Renaissance had confirmation of future cooperation during proposal stage with GEIDCO, no further response was received.

For the sites in the UK and the US, a subcontractor was hired (as planned according to the GA and according to the principles for best value for money and absence of any conflict of interest), and they were in charge of putting the partners in contact with potential sites. Due to COVID, this procedure was heavily delayed and became overwhelmingly difficult, especially for the US, where COVID restrictions and disruptions came as soon as the first lockdown ended in Europe. This practically translated in a lack of responsiveness. For the UK, our subcontractor successfully brought in four potential sites during the 2nd Reporting Period. However, three of them were not interested (as they were relatively large establishments, organizations, mainly interested in financial investors), and one was interested but it wasn't able to get the stakeholders onboard.

The two Polish sites were all participating as replication sites according to plan at first, but with grave delays due to COVID. While cooperation with Szaserow Housing cooperative is ongoing and promising, the City of Kozienice had to drop out, as one of the reference buildings is a hospital.

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Our Polish Partner, NAPE, managed to replace them however with the Beli Bartoka Housing cooperative, also ongoing and promising.
This resulted in three replication sites out of the total list in the Grant Agreement. As RENAISSANCE is supposed to be a global methodology, it has to be tested and validated as such. This is the reason why a target number of ten replication sites was set as a KPI. RENAISSANCE Partners immediately started a campaign to find the remaining seven replication sites.
After this campaign started to bear fruit, a lot of potential sites came up in Africa and South America, in addition to those in Europe (Spain, Italy). Even though they were not originally in our radar, those sites were deemed as highly suitable for a few reasons:

- Data availability and willingness to share
- Strong will to develop or optimize respective LECs, leading to high stakeholder support and participation
- Different level and types of LECs
- Lack of language barriers
- Clear communication channels and immediate cooperation with established projects and/or organizations (H2020 projects, research organizations, a hospital etc) leading to transparency
- Last but not least, the newly added sites and geographical locations allowed the implementation of the work according to the original plan, without affecting the output in any negative way.

In addition, working with those replication sites will not need extra budget. The geographical impact does not influence the validation of the RENAISSANCE approach since it still covers 3 continents. On the contrary, WP6 Partners strongly believe that these new connections (especially to Africa) can bring a lot of added value in terms of exploitation of the

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RENAISSANCE tools as there seems to be great interest for developing energy communities as a response to poverty levels.

1.2.1. Szaserow, Poland

The RENAISSANCE Project Partner NAPE introduced the Szaserow replication site and provided the implementation plan and organized the data collection and the workshops and meetings.

Szaserow, a Housing Association in Warsaw, consists of 28 buildings and over 1400 inhabitants[2].

Stakeholders include the housing co-operative, tenants and owners of dwellings and co-owners of common areas. Involved stakeholders will be the municipality, the municipal company managing district heating, water supply, sewage and waste and public transportation. The key local stakeholder is the Szaserow Housing Cooperative (https://smszaserow.pl/).

The municipality hopes to gain experience in designing business models for the introduction of RES in the municipal economy including the application of smart-grid solutions. A study concerning the potential technologies that could maximize and optimize such systems from an energy and financial perspective especially for the development of electric public transportation and the use RES for heating purposes. GHG emissions in Poland decreased strongly in the period 1990-2002, but then slowly grew until 2015. To achieve its global GHG emissions target for 2050, Poland needs to start investing significantly in RES and prepare the shift to smart grids. The RENAISSANCE project is perfectly aligned with this strategy and is thus an excellent opportunity for the Polish local energy markets.

A feasibility study for the use of building roofs pointed out that 12 of the 28 buildings can be used for the construction of PV installations. So far only the energy consumption in the common parts of the buildings was included

[2] https://www.renaissance-h2020.eu/pilot-site/poland/

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in the calculations. Thanks to the RENAISSANCE project, the Cooperative Szaserow is looking into a novel approach where energy produced from those 12 PV installations could be shared across inhabitants in all 28 buildings. The goal of the Cooperative and its members is the reduction of CO2 emissions and to become more ecological and sustainable energy consumers.

1.2.2. Beli Bartoka, Poland

Another Polish site is Beli Bartoka with the local Housing Association as the main local stakeholder.

Beli Bartoka is a residential building with 128 apartments[3] housing 1500 residents, 4 commercial premises and 150 square meters of underground garages. The building gets frequently modernized with the goal of reducing the overall energy consumption. Throughout the years the following innovations have been installed:

- 2015 | Modernization of lighting – replacement of fluorescent lamps for LED lamps
- 2016 | Installation of the reactive power compensation system
- 2017 | Construction of a photovoltaic installations with a capacity of 4.16kW plus 8.58kW
- 2021 | Replacement of LED lighting in elevators
- 2022 | 2kW wind turbine – under construction

Future investments are:

- 2022 | 150 electric vehicles chargers in the underground garage
- 2023 | Installation of a main advanced energy meter outside the building

[3] https://www.renaissance-h2020.eu/pilot-site/beli-bartoka-poland/

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- 2023 | Additional photovoltaic power installation

The residents are well known for their open-mindedness to innovative solutions and one of the ambitions of the association is to become energy independent. The main objective of the RENAISSANCE MAMCA workshop was to discuss viable solutions for the creation of an energy community to achieve such independence. As a conclusion, the inhabitants decided that increasing the capacity of a PV plant is positive from an economic and climatic point of view.

1.2.3. Vega de Valcarce, Spain

Vega de Valcarce is a small rural town and municipality located in the region of El Bierzo (province of León, Castile and León, Spain)[4]. The Renaissance methodology was used to help the community with the initial formation of a local energy community. The municipality has a population of 865 inhabitants. The village is at an altitude of 631 m, and the average rainfall is around 622.05mm. The village is along the route of the Camino de Santiago, which brings tourists in the spring and summer months. The Valcarce River runs through the village, and there are various tourist attractions throughout and surrounding the village as well.

VUB managed and organized this replication site, and the key Local Stakeholder was the Revieval project[5], an NGO engaged in the revitalization of rural areas in Spain, that also had the support of local authorities and of the H2020 project SCORE (Supporting Consumer Ownership in Renewable Energies - GA No 784960).

[4] https://www.renaissance-h2020.eu/pilot-site/vega-de-valcarce-spain/

[5] https://revieval.org/

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1.2.4. Florence, Italy

The key local stakeholder of this replication site, the local start-up Enco – Energia Collettiva, aims to quick-start ECs by taking away the barriers which citizens often experience. They deal with the potential red tape and take over the installation of smart meters, PV panels and storage systems, the practical set-up and registration of the EC as well as its management. Profits are used to pay back installation costs and are distributed fairly among the participants.

For the replication and scalability of the RENAISSANCE methodology, one of their project sites was chosen in Impruneta, a rural Tuscan town in the south of the Metropolitan City of Florence. An EC initiative will be set up between neighbouring citizens. In a group of eight households that are part of the project there are five consumers and three prosumers.

Using the Renergise and MAMCA tools, calculations and engagement processes were set up to determine together with the citizens what an EC for Impruneta should look like and which structural options could gather the most support for implementation.

Results from this case can teach important lessons on what the main points of attention are for citizens of rural southern towns on the added value engagement efforts can bring here.

1.2.5. Auroville, India

The Auroville replication site, managed by VUB, BAX and Deep Blue, was originally part of the Grant Agreement. A professional cooperation with Auroville Consulting allowed for the actual implementation of the replication site in times when COVID-19 put up a lot of barriers, especially in working outside the EU.

Auroville city is a universal township in development that will be able to house a population of up to 50,000 people from around the world.

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RENAISSANCE is cooperating with H2020 e-Land project (same Pilot Site case) to avoid work repetition (Alignment of energy solutions and simulation models of ELand with the scenarios for MAMCA and our multi-vector analysis).

There are multiple key stakeholders and interested parties[6]:

- CAG – Consumer and civic Action Group
- NITT – National Institute of Technology Tiruchirappali
- NSEFI – National Solar Energy Federation of India
- WRI – World Resource Institute
- IITM – Indian Institute of Technology Madras
- Fourth Partners
- Auroville Consulting
- PTI – Pondicherry Technical Institute
- World Resources Institute

1.2.6. Lacor Hospital, Uganda

St Mary's hospital Lacor in Gulu, Uganda, has an interest in optimizing its energy assets and making their energy system more sustainable with the use of the RENAISSANCE methodology.

It is a private, non-profit Ugandan hospital, whose mission is to guarantee affordable medical services to the local population and serves as a training institute for nurses and doctors. One of its focus points is self-reliance. They have developed a strong technical department that takes care of all construction and maintenance, water supply and waste management. Over the past years, several PV installations have been built, providing most of the energy that is being consumed on site. Next to the hospital activities, there are also a medical training school, residential buildings for staff, visitors and patient families and technical workshop spaces.

[6] https://www.renaissance-h2020.eu/pilot-site/auroville-india/

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One of the interesting aspects of the hospital is that it has an intricate internal electrical system that can operate in island mode (comparable to the Belgian pilot site, the Brussels Health Campus). One of the main energy challenges for the hospital is always guaranteeing a reliable electricity supply. Because of the unstable public grid, local diesel generators are in place to deal with general power outages. In the future a more sustainable solution is desirable. A second element that was tackled in the RENAISSANCE exercise is the fact that some of the electricity that is produced by the PV panels is lost. Overproduction cannot be sold or donated to the general network under current regulations.
There are multiple key stakeholders and interested parties:

- Hospital management and representatives
- Representatives for the residential area on-site
- Representatives of the medical training school
- DSO/energy supplier Umeme

1.2.7. Relleu, Spain

Relleu is a village of approximately 1,300 inhabitants in the hills near Alicante, Spain and is surrounded by olive and almond farms[7]. In Relleu, there is a newly built compound of 37 houses which is the subject of this pilot site. This community has a strong interest in renewable energy systems, in particular solar PV, and is exploring all avenues to achieve this goal. It has a well organised Homeowners' Association (key local stakeholder) which governs all decision-making that applies to the exteriors of the houses and the commons. Most owners are foreigners and typically from the Netherlands and Belgium, with a minority from Spain. The potential energy community is still at its infancy stage and needs a lot of awareness raising and information gathering, and it is for this reason that a small group

[7] https://www.renaissance-h2020.eu/pilot-site/relleu-spain/

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of key homeowners joined the MAMCA workshop. Most of them did not know what an energy community entails and wanted to meet up to learn more about it and see if it was interesting for them to start an energy community initiative.

There are basically two kinds of owners: those who live permanently in Relleu and those who visit occasionally. This makes for a rather interesting and challenging perspective, but at the same time, this is a very typical site in a sense that many communities in the Spanish coastal regions are owned by foreigners. This replication site therefore has allowed the testing of the MAMCA methodology in an alternative way, with a focus on the awareness and knowledge raising potential of the tool.

1.2.8. Medellin, Colombia

The energy community "El Salvador" is an initiative led by the EnergEIA research group of the EIA University of Medellín (Colombia) and sponsored by the local DSO EPM.

The Transactive Energy Colombia Initiative is an industry-academia partnership funded in part by the UK's Royal Academy of Engineering and led by EIA University and University College London[8]. Industry partners include EPM, the local utility in Medellín and one of the largest in Latin America, ERCO, a DER company, and NEU, a digital energy retailer with the potential to become an aggregator. The initiative aims to build an evidence base for the user-centred application of energy systems in the Colombian context and to find the best way to promote and ensure the sustainability of community solar projects in Colombia in a way that benefits both users and the utility, considering cultural and country specificities.

The El Salvador energy community is the second project of this initiative and is in a residential neighbourhood in Colombia's second-largest city, Medellín. This project aims to initiate social and environmental change

[8] https://www.renaissance-h2020.eu/pilot-site/medellin-colombia/

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through the development of energy communities in Colombia. There are 24 households participating in the energy community. The participants' houses are in stratum 3 (the Colombian classification of socio-economic strata goes from 1 to 6 where stratum 3 stands for a low- to middle-income neighbourhood).

Initially, the pilot consisted of a virtual microgrid in which 11 users are connected to a 20 kWp PV system installed on 2 of the users' rooftops.

The key local stakeholders are:

- EIA University https://www.eia.edu.co/
- Transactive Energy Colombia https://www.eng.transactive-energy.co/
- EPM Utility https://cu.epm.com.co/
- ERCO DER https://www.ercoenergia.com.co/
- NEU https://www.neu.com.co/

1.2.9. Cordoba, Argentina

The RENAISSANCE project collaborates in Argentina with two replication sites. One is located at the **Reserva Tajamar**, 30 km away from Córdoba, and the second is the **Brinkman community**. The collaboration between RENAISSANCE and the communities is supported through the local facilitators and stakeholders, such as the University of Cordoba, the municipality of Alta Gracia, the Grupo Canter and Nova Vektors (NDA signed). Both Reserva Tajamar and the Brinkman community are typical residential neighbourhoods in Argentina with the aim to increase the usage of renewables. Reserva Tajamar is a gated community in a rural area and is currently still in the development and construction stage lead by Grupo Canter who is willing to install RES for the future residents. The Brinkmann community is a city of around 10.000 inhabitants, 300km from Cordoba City, with the primary economy relying on agriculture and livestock farming.

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Brinkmann has an engaged mayor who supports the development of RES and who facilitated the entire MAMCA process on ground.

They have followed the development of regulations for Energy Communities in the EU closely and want to investigate how these learnings could be complementing the Argentinian legislation Argentina has passed the "Renewable Energy Distributed Generation Law"[9] which aims to foster renewable energy generation in a decentralized manner. Therefore, cities, small and medium enterprises, citizens, and public institutions are investigating the options and feasibility of ECs.

Currently, Argentina's power supply relies heavily on fossil fuels with wind and solar energy representing only 1% of the entire power supply[10]. Since Argentina has great fossil fuel reserves in form of shale gas and oil, the transition to RES can be specifically challenging.

1.2.10. San Pedro de Atacama, Chile

The replication site of San Pedro de Atacama in Antofagasta, Chile is managed by VUB in cooperation with the H2020 ATLAST Project (GA No 951815, Atacama Large Aperture Submillimeter Telescope). ATLAST aims to develop a renewable energy system at high elevation to make its observatory fully powered by renewable energy. RENAISSANCE is working with the University of Oslo (NDA signed) to study the possibility of creating an energy community by expanding to the adjacent community of San Pedro de Atacama, which is not connected to the Chilean power grid due to its remoteness.

San Pedro de Atacama is a community of the Antofagasta Region located in the central-eastern of the regional territory. Its communal capital is a tourist

[9] https://portalweb.cammesa.com/Documentos%20compartidos/Noticias/Ley%2027424-2017.pdf

[10] https://www.iea.org/countries/argentina

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town with the same name, located 90 km from the provincial capital Calama and 239 km from the regional capital, Antofagasta.

San Pedro de Atacama is situated in the middle of the most arid desert in the world and at more than 2,400 m above sea level. This community is characterized for its tourism which focuses on its important pre-Hispanic heritage and its natural landscape, making this on of the most relevant tourist destinations of Chile and the archaeological capital of Chile.

The territorial area of San Pedro de Atacama is 23,438 km2, being the fifth largest in Chile of which only 0.01% of the land is destined for residential use.

This area is of particular interest for the observatories since it presents favourable weather conditions and high elevations

Even though San Pedro de Atacama is an important zone for tourism it is not connected to the national power grid. To obtain electricity, the local communities of San Pedro de Atacama and Toconao share a small power generation based on diesel and natural gas engines, located between both towns. However, this system is not sufficient leaving some areas without electricity.

On the other hand, the telescopes also have their own fossil fuel-powered generators. The main problems in this case are the necessity of almost daily truck deliveries of fuel for these generators and the difficult access to this place when the roads are covered by snow.

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2. Scalability and replicability validation

2.1.1. Szaserow, Poland

NAPE, the Polish Partner of the RENAISSANCE Consortium, has been managing all communication, contacts, and organization for this replication site. Detailed description and analysis of the work undertaken in the Polish sites can be found in [1] (Section 5: description of scenarios, stakeholder preferences, Regulation etc). Due to COVID-19 restrictions, the workshop was held online, that is why an MCA was easier to conduct than a MAMCA. Figure 1shows the MCA results of the workshop. It shows that the biggest community scenario performs the best on all stakeholder objectives, except for affordability. The participants were very interested in the topic and in favour of the biggest EC. They also gave additional suggestion on how to obtain greater benefits for the community.

The resulting graph of the objectives weighting exercise can be found in Annex A.

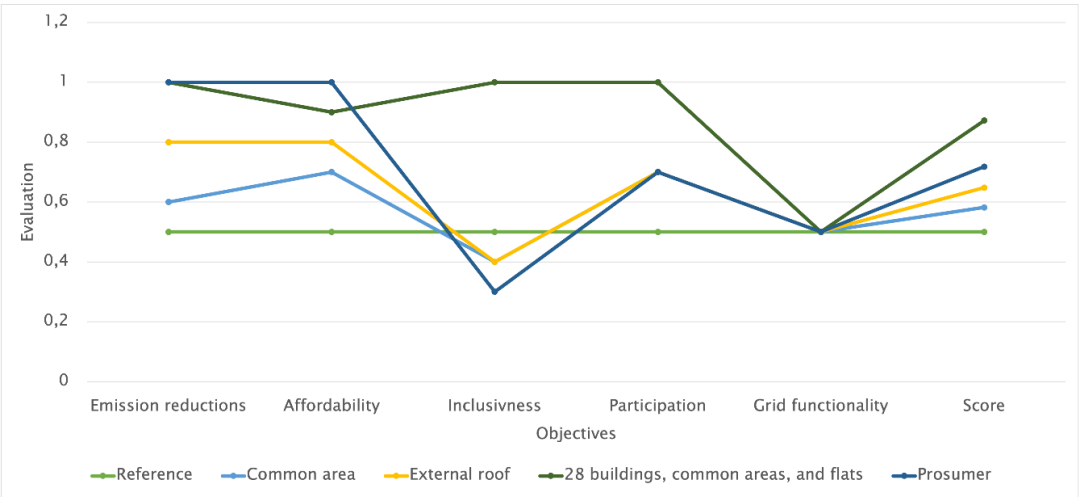

Figure 1 – MCA results for Szaserow

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2.1.2. Beli Bartoka, Poland

Beli Bartoka is the second replication site situated in Poland, managed by NAPE. As described in 2.1.1, all respective analysis can be found in [1], where all respective information has been described and presented.

The information and analysis will not be repeated here, except for the main conclusions for the two Polish replication sites, as they have been reached after the end of the work:

- Administrative barriers strongly deter the emergence of LCEs in Poland
- Regulatory limitations (nationally and regionally)
- Data collection can be heavily interrupted

Figure 2 shows the results of the MCA online workshop for Beli Bartoka. Similar to Szaserow, the biggest EC performs the best on the stated objectives. While the scenario of renting external space for installing PV does not affect grid stability or return on investment, in performs better in terms of increasing renewables and energy autonomy while reducing the energy bill.

The topic of secured energy supply, and energy autonomy through ECs became more important and pre-dominant since Russia launched war against Ukraine.

The resulting graph of the objectives weighting exercise can be found in Annex A.

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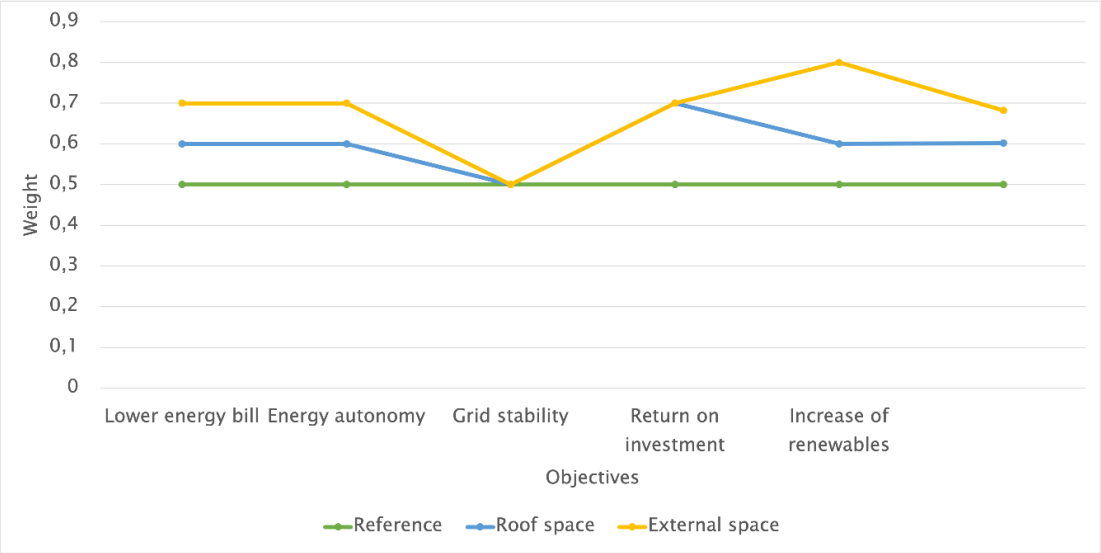

Figure 2 – MCA results for the Beli Bartoka

2.1.3. Vega de Valcarce, Spain

The Spanish replication site was the first Renaissance attempt in replicability, with the constant and full support of REVIEVAL. Thus, the work undertaken and the analysis are described in [1] in great detail.

The main conclusions showed that:

- Regulatory barriers are also important in Spain (national and regional level), for example distance between consumers or non-dynamin regulation of collective self-consumption
- Lack of support, especially on local level (e.g. from municipalities).

For an extensive analysis of the Vega de Valcarce replication site, refer to the report "Coupling rural development with the development of Energy Communities: A participatory study in Vega de Valcarce, Spain" [2].

Figure 3 shows the overall results for Vega de Valcarce. The large community scenario performs the best on the mentioned objectives of all stakeholders. Generally, the results showed that the larger the community in numbers of participants, and installed capacity, and the diversity of types

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of members (school buildings, residential housings), the better the performance of the EC on the stated objectives.

The resulting graphs of the weighting exercise can be found in Annex A.

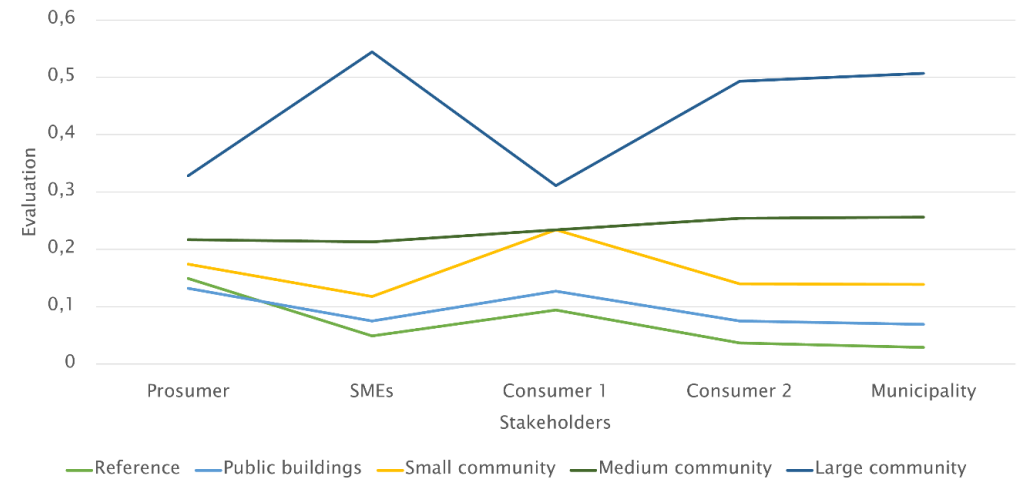

Figure 3 – Multi-Actor view for Vega de Valcarce

2.1.4. Florence, Italy

Data gathering and stakeholder contacting

The Italian start-up Enco – Energia Collettiva is the initiator of the energy community in this site and was the central point of contact for the project. They visited all the involved citizen stakeholders, distributed the survey and arranged the MAMCA workshop. They also provided the RENAISSANCE team with monthly energy bills of all participants.

Stakeholder objectives survey results

Four groups of stakeholders responded to the survey; the consumers, prosumers, the municipality, and the DSO.

Among the consumers, the following objectives were selected as essential: lower energy bill, creation of local added value, increased employment, inclusiveness, energy independence, behavioural change (awareness),

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increased share of renewable energy, emissions reduction and improvement of the daily living environment (low visual and noise impact).

Among the prosumers, the following objectives were selected as essential the most: grid reliability, return on investment, lower energy bill, energy independence, unburdening, increased share of renewable energy and emissions reduction.

The representative of the municipality selected almost all the listed objectives as essential and then indicated the following ones as most important: grid stability, energy independence, lower energy bill, behavioural change (awareness) and direct user participation.

The representative of the DSO selected all but 4 of the listed objectives as essential and did not indicate which can be considered as their top important ones. In following similar surveys, this was avoided by putting a limit on the amount of objectives that could be indicated as most essential.

Energy data analysis

Since digital meters were not installed yet, the RENAISSANCE team was provided only with monthly electricity consumption values and the corresponding bills. The hourly consumption profile was simulated by researchers from Department of Industrial Engineering of the Università degli Studi di Firenze (UNIFI), which collaborate with EnCo, using their in-house load simulator tool. An additional survey was handed out to the participants to know which type of appliances are present in their house and their average usage pattern. This information coupled with the monthly consumption allowed the generation of an hourly consumption profile for each participant. The production profile of the already existing PV was also not available, but by knowing the installation characteristics (such as installed capacity, tilt, orientation, etc.) it was possible to simulate an hourly production profile using weather data from the location.

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Developed scenarios

The scenarios revolved around the new legislation for renewable energy communities (RECs) in Italy, which gives subsidies for PV installations in a REC as well as economic incentives for collectively self-consumed energy. One scenario consisted of installing additional PV for self-consumption by each of the households, without forming an energy community. The second scenario was the installation of additional PV together with the development of an energy community. The third scenario was the same as the second, but on a larger scale, with households in the neighbourhood joining the energy community.

Workshop

A total of 14 local participants (12 residents and 2 municipality representatives) attended the workshop, and discussions that started during the session were vividly continued during the lunch afterwards.

The 2-hour workshop itself had two 2 focus points: one was to give more detailed explanation on the advantages and disadvantages of an EC in general and for Impruneta specifically and to provide an answer to prevailing questions, and another one was to let the participants discuss various aspects of an EC in an interactive way using the MAMCA software. This way, knowledge and awareness could be raised, while at the same time providing an opportunity to the relevant stakeholders to actively participate in the considerations of various EC alternatives, by stimulation their input and mutual discussions.

First, 3 stakeholder groups were formed that had to first give an importance 'weight' to their main motivations for joining an EC initiative. They represented consumers, prosumers, and the municipality. The DSO did not want to join the workshop. The resulting graphs of the objectives weighting exercise can be found in Annex A.

The group of consumers indicated that financial objectives like lower their energy bill were deemed most important, followed by environmental

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objectives such as lower emissions, the raising of their own sustainability awareness and a low visual and noise disturbance. The group of prosumers gave equal weights to environmental (emissions reduction and a higher rate of renewable energy) and financial (lower energy bill and return on investment) motivations, as well as the fact that they would like to have a bigger autonomy in energy matters. The municipality wants a bigger direct say for their inhabitants in the decision making on their own energy supply and more autonomy. It also vows for systems that raise general sustainability awareness among citizens.

For the evaluation of the EC scenarios during the workshop, pre-calculated results for various financial, technical, and environmental objectives were provided. The combined scenario scoring graph that was used for the discussion, called the 'multi-actor view' is depicted below.

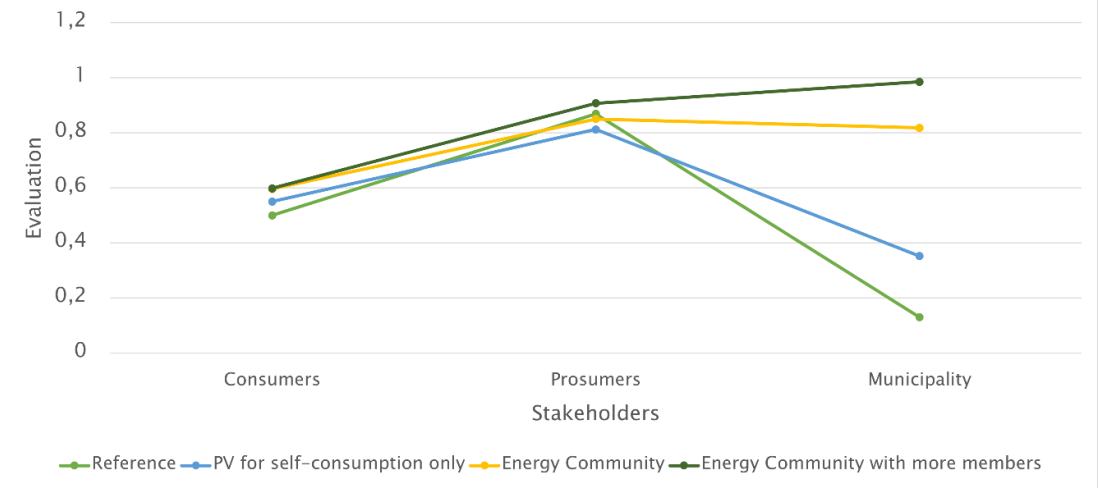

Figure 4 – Multi-actor view for Impruneta

The evaluation results showed that a larger EC that includes a bigger part of the neighbourhood complies more with the objectives of all stakeholders than the one currently under consideration. It was also clear that a scenario in which no energy is exchanged, and people only consume their self-produced energy, scores worse on almost all selected objectives than an EC

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scenario. The business-as-usual scenario with less PV represented the one with the lowest preference among participants. A future in which electricity prices will raise even more will bring more financial benefit to the EC scenarios. A simulation where consumption profiles are shifted towards PV peak production times also has big financial benefits, underlining once more how the awareness of the consumers can be beneficial for energy efficiency.

Conclusions and suggestions for the site

The workshop initiated a lot of discussion amongst participants and gave them the opportunity to voice their concerns and ask questions. Most of the participants were not familiar with the concept of energy communities and the benefits that a REC can bring to their community. There were also only few participants that already knew about the financial incentives available through the transposition of the new European legislation on ECs into the Italian context, or about how their consumer behaviour can have a big impact on their energy bill. In terms of engagement, the general feeling is that the awareness of the opportunities an EC can bring to the neighbourhood was raised, as was knowledge on potential forms this community can take on (and their pros and cons). The fact that not only potential members but also a representative of the municipality was present, made that the discussion reflected different interests and both types of stakeholders gained better insight in the mutual concerns. Willingness to take on the common initiative was sparked and the 'community feeling' that is indispensable to form an EC was further strengthened.

To get a better insight in the specific potential effects of the workshop a pre- and post-survey on expectations and evaluation was conducted. The results indicated that participants felt that they received an answer to the main questions they had on ECs when entering the workshop, they had the chance to voice their concerns and that they gained more insight into the motivations of others and feel more willing to compromise to come to a

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common agreement. Their knowledge on EC opportunities in general and for Impruneta specifically also increased. Most of them did indicate that participation in the workshop did not change their own motivations, and it was also mentioned that a deeper investigation of the potential contract structures would have been a nice addition.

2.1.5. Auroville, India

The replication site in Auroville, India was one of the few sites that were part of the Renaissance concept from the beginning of the project. This has been a case that triggered many and different types of collaboration, not only locally but also in Europe (e.g. H2020 e-Land). As with the Polish sites above, the work undertaken has been described in detail in [1].
Some main lessons learnt:

- Limited central financial assistance
- Low returns and high risks
- A top-down market-oriented market-structure on national level makes the channelling of benefits to local communities difficult

Figure 5 summarizes the main finding for Auroville. The scenario with installed PV and storage capacity to cover yearly blackouts performs the best on the objectives of the community. While this scenario was more exploratory since it oversizes the system, it shows that a scenario in between the PV and storage and the blackout coverage is desirable for the community. The discussions showed that support for and maintenance of the installed assets (PV and storage) plays a crucial role in Auroville and was highlighted as important in the broader context of India, and Southeast Asia.
The resulting graphs of the objectives weighting exercise can be found in Annex A.

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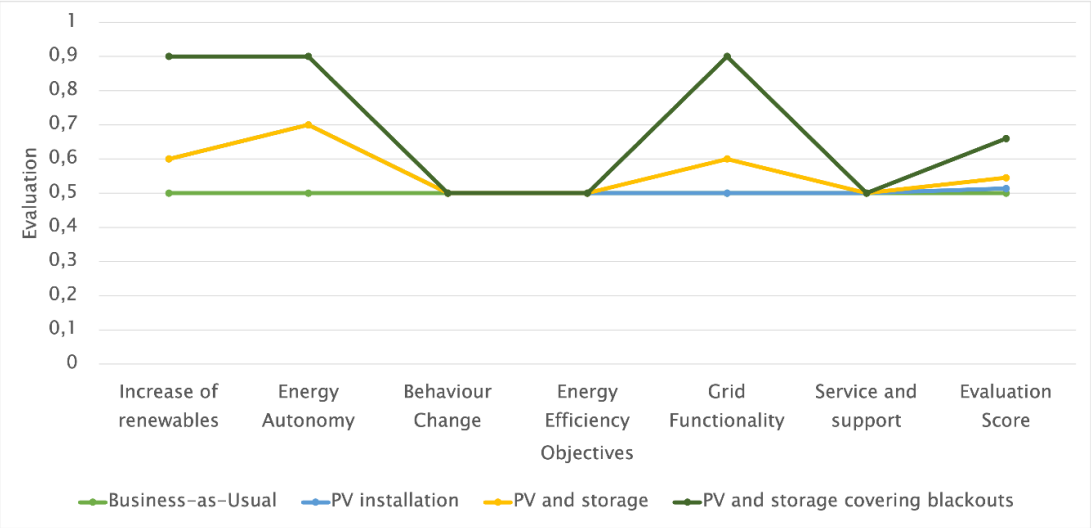

Figure 5 – MCA results for Auroville

2.1.6. Lacor Hospital, Uganda

Data gathering and stakeholder contacting

The local point of contact for this replication site was the Head of the Technical Department of the hospital, Dr. Jacopo Barbieri. He distributed the survey to all relevant stakeholders and oversaw the practical organisation of the MAMCA workshop including the stakeholder invitations. Together with his colleagues he also provided the available energy consumption and production data and assisted in the scenario building.

Stakeholder objectives survey results

Three groups of stakeholders responded to the survey: representatives of the hospital itself, of the residential area on site and of the school of the hospital. The energy distributor UMEME decided not to fill out the survey because they were a bit sceptic about the process beforehand and wanted to discuss the topic in a group session first, but they made their views clear during the meeting.

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Among the representatives of the hospital the following objectives were selected as essential the most: grid reliability, lower energy bill, energy independence and emissions reduction.
Among the representatives of the residential area the following objectives were selected as essential the most: grid reliability, replicability, lower energy bill, safety, and low visual and noise impact.
Only one representative of the school of the hospital filled out the survey and selected the following objectives as essential: return on investment, lower energy bill, safety, community building, (green) image, energy independence, reducing energy poverty and increasing skills and knowledge. They also indicated that it is important to have a sensitization programme to the community to make sure that a new system is maintained well.

Energy data analysis

The hospital is equipped with an advanced metering system that measure energy flows at various point of the local grid. These data are uploaded to an online platform that allows to make quick analysis and visualization, as well as download the various data. For the analysis with the RENERGISE tool data on the off take from the main grid, diesel generator production and PV production were used. The local contact provided the RENAISSANCE team with all the needed information on prices for new installation, prices of electricity and diesel.

Developed scenarios

Two potential scenarios for future energy investments were developed: one in which a battery is installed that can partly counteract the current PV curtailment, and one in which the current diesel generators are replaced by PV and batteries, to guarantee that the hospital can cope with general power outages in a more sustainable way.

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Workshop

A total of 12 stakeholders attended the workshop.

First, an introduction was given on what an energy community is and in what way the concept can be legally applied in a Ugandan context. Then, the results of the survey were presented, and the participants were divided into two groups, representing the hospital and the residential area, to discuss and attribute an importance weight to the selected energy initiative objectives of both groups. Since there were no representatives of the school present, this stakeholder group was not part of the weighting exercise. The resulting graphs of the objectives weighting exercise can be found in Annex A.

The hospital representatives indicated grid stability and reliability as their main concern. Being a not-for-profit institution, they are guided by their mission to offer the best service as possible to the needy, and a reliable power supply is essential to do that. A lower energy bill, that reduces expenses for the hospital as well as the users, was considered their second most important objective, followed by a reduction in emissions. Gaining more autonomy from the central grid can be a nice-to-have but is not considered essential.

The representatives of the residential area explained they lay a clear emphasis on safety for themselves and their families above everything else. New systems therefore need to be installed properly and maintained well to assure this. A lower energy bill as well as low visual and noise disturbance were next on their list of important objectives, followed by grid reliability and replicability that are not considered as essential, as long as safety is guaranteed.

Some important additional boundary conditions and concerns were also mentioned by the respondents. The first one is the fact that a new installation must come with training opportunities for energy technicians, to ensure a secure and efficient installation as well as follow-up. It was also

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mentioned that it is important to have a sensitization programme for the community, to make sure that a new system is maintained well.

In the next part of the workshop the 2 participating stakeholder groups attributed an evaluation score to the scenarios for each of their selected objectives, with the help of some expert calculations for the more technical ones such as 'emission reduction' and 'lower energy bill'. The result, that showed the scenario rankings for both stakeholder groups, was then discussed, addressing the challenges and hurdles that can be encountered before and during implementation.

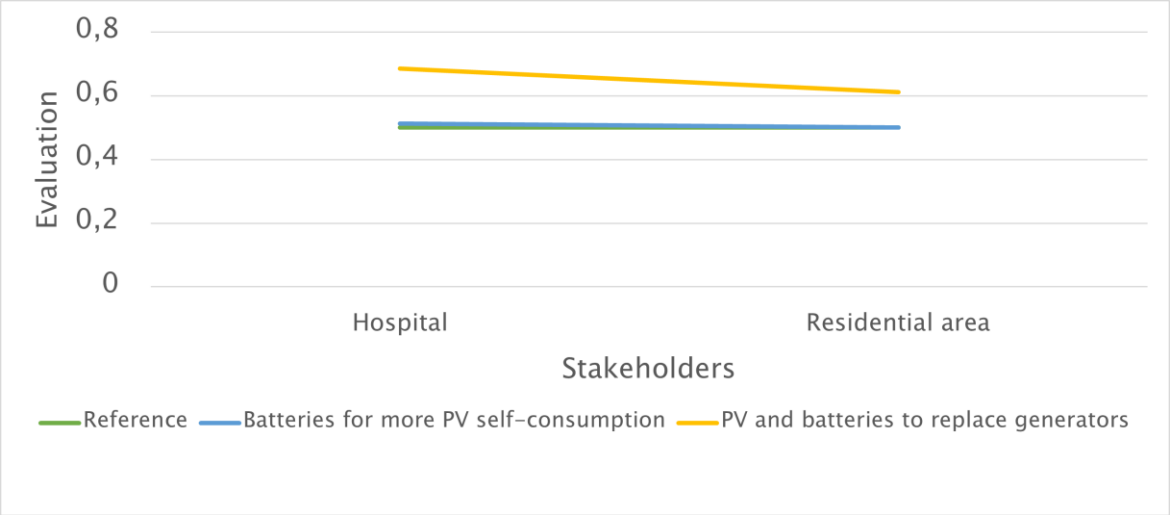

Figure 6 – Multi-actor view of the scenario evaluation results

The evaluation of the scenarios showed that the scenario in which the current generators are replaced by a more sustainable alternative of additional PV with batteries scored better for both stakeholder groups. This was mainly due to the resulting CO2 reduction, lower cost of energy and higher energy reliability

The major disadvantage of this scenario as discussed, is the big initial investment cost that is required, even though the payback time is quite short (around 8 years). The hospital cannot pay this amount itself upfront,

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so other solutions would have to be found. One is applying for project funds from external sources, which was not always successful in the past. Another solution that is suggested is to implement the system in a modular system, in which new assets can be added each year, depending on available financial resources. The calculated scenario is a theoretical model using maximum values, but a smaller similar system can also already generate advantages because any reduction in diesel consumption has a direct impact on costs and emissions due to the current high diesel price and the significant environmental impact.

Energy distributor UMEME was mainly that the new installations will make the hospital self-sustainable and potentially cut them off from the general grid. It is discussed that this is not a desired situation, since the amount of assets that are needed for that is enormous, and the general grid provides essential services to the hospital. The main goal of new energy investments should be geared towards guaranteeing power supply during times when the general grid is out, and not fully replacing it. It is then discussed that a further cooperation between UMEME and the hospital can produce additional advantages for both. With new assets, the latter could for example also offer services (such as grid balancing and local energy supply) to the distributor.

An additional element that was mentioned is the potential role the hospital could play for the local community around the premise. UMEME mentioned that their energy supply at the moment is abundant, but their goal is to provide electricity supply to all Ugandan inhabitants. Together with the fact that electric cooking could solve big environmental problems that are related to the current charcoal cooking, there seems to be a market for additional local electricity supply.

A last issue that was discussed is the current loss of PV-produced electricity because at noon, solar PV peak production time, production is much larger than consumption. Potential solutions that were brought forward is a more

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detailed analysis of power consuming devices at the hospital, to exploit potential flexibility on the demand side and steer consumption towards solar PV peak production times. Another solution could be signing a Purchase Power Agreement with UETCL (TSO), to sell excess energy to the grid. Both options will be investigated further.

Conclusions and suggestions for the site

The participants held enthusiastic discussions, and according to the feedback surveys they filled out afterwards, the workshop contributed to strengthening their understanding of potential energy initiatives for the hospital and their advantages. They also indicated the discussion helped them gain a better insight into the needs and wants of all stakeholders. Future investment in additional PV and batteries can bring gains to all under the form of lower electricity cost, less emissions and a potentially higher grid reliability, but the main issue that needs to be cleared out is finding funding for the initial investment as well as a professional maintenance, to guarantee a safe and efficient operation. In the short-term measures can be taken to decrease curtailment of the PV-produced electricity by making adjustments to the operation hours of some power consuming devices and/or signing a Power Purchase Agreement with UETCL to sell the excess of power to the general grid.

2.1.7. Relleu, Spain

Data gathering and stakeholder contacting

Stakeholders were contacted through the chairman of the Homeowners' Association and directly from the RENAISSANCE project member from VUB. The first sounded out the residents about their interest in participation, and the later took on the practical organisation of the MAMCA workshop.

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No energy data were gathered since the goal of the workshops here was awareness and knowledge building and not creating and discussing concrete specific energy community solutions.

Stakeholder objectives survey results

In this case, no objectives survey was sent out beforehand since the participants did not have enough knowledge on what an energy community entails to fill it out. The survey was distributed during the MAMCA workshop itself, after an introduction to the topic was given, and questions could be asked.

The selected objectives for household 1 were: security, return on investment, lower energy bill and inclusiveness.

The selected objectives for household 2 were: security, return on investment, lower energy bill and inclusiveness.

The selected objectives for household 3 were: grid stability, security return in investment, energy independence and lower energy bill.

The selected objectives for household 4 were: grid stability, energy independence, direct user participation, increase in renewable energy and emissions reduction.

The selected objectives for household 5 were: security, energy independence, return on investment and reducing energy poverty.

Energy data analysis

No energy data were gathered since the goal of the workshops here was awareness and knowledge building and not creating and discussing concrete specific energy community solutions.

Workshop

A total of 10 residents (a mixture of permanent and temporary residents, representing 5 households) attended the workshop.

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The main goal was not to assess the different potential energy solutions, but rather to start with the first step in the process: introduce citizens to the concept of an EC and what it entails. The objective of the workshop was foremost to increase local knowledge by providing information in an interactive way on what an energy community is and what it could look like for Relleu specifically. The workshop eventually allowed to test whether the incentive to establish or join such an initiative also increased in line with the participants' awareness levels.

The MAMCA methodology and its software were used as a tool throughout the different workshop steps. The 3 hours long exercise consisted of the following parts:

1. A small introductory presentation on the ins and outs of renewable energy in general and energy communities specifically
2. A 'live' survey with discussion on the residents' needs and wants from an energy initiative. Importance weights were then attributed to the selected objectives by all participants
3. An interactive session in which the participants were divided into 2 groups, that 'built' their own energy community scenarios, with the help of presented building blocks and a moderator with expertise in the matter.
4. Evaluation of the build scenarios for all participants, by scoring their consistency towards selected objectives, through a MAMCA software exercise. The results were discussed in group.

The first part, that produced some essential basic information, was deliberately kept short, to be able to focus on the interactive parts of the workshop. In the survey a long list of potential objectives for joining an energy initiative were provided. By having to indicate the importance of each objective for them personally, the ten participants were obliged to think

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about not only what they could get out of it but most of all what they would want to get out of an EC. The joint discussion on what they filled out let them get acquainted with different perspectives and showed them all points of view that would have to be taken into account if they were to initiate a joint project. The results of the objectives selecting and weighting exercise for the 5 groups of residential stakeholders can be found in Annex A.

Although, for most of the participants, financial drivers are the main motivation to join an energy initiative, this was less relevant for some. Social as well as technical objectives such as energy independence, grid reliability, safety and energy poverty reduction were all mentioned multiple times as essential objectives. The mutual discussions provided an overview of potential objectives which widened the initial range of personal motivations. The mutual discussions showed that all participants' intentions were relatively similar and all points of views could be mutually understood and taken into account when jointly talked about.

Developed scenarios

In the scenario building work session, the participants were introduced to all the components of an EC and all the questions that needed to be answered when deciding upon the structure of a community. By discussing each of the presented themes (visualized as 'building blocks') they were incentivized to think about which assets they would like to install, how they would be able to join the initiative, how investment costs would be divided, what legal form they would prefer etc. The session also nudged them towards consensus forming by letting them discuss within their working group what each of the building blocks should look like.

Independent from each other, the two groups developed similar potential scenarios: one in which a cooperative energy community is created with all necessary assets to become fully energy self-sufficient as a compound. A second scenario is the creation of a cooperative energy community without batteries.

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In the last workshop, the participants could reflect on whether the build scenarios complied with their previously selected needs, by giving scores, helped by an expert in the matter for the more technical objectives.

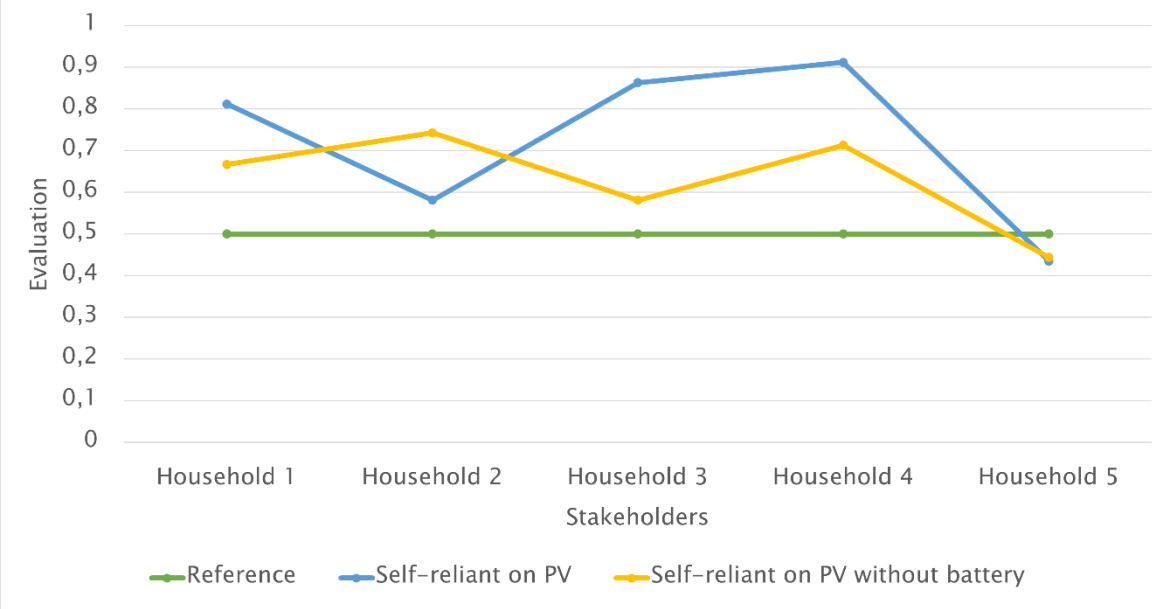

Figure 7 – Multi-actor view of the scenario evaluation results

For almost all stakeholders various types of energy communities scored better on their objectives compared to a business-as-usual scenario. With attention for battery security as an important boundary condition, an agreement on potentially working towards a self-sustainable cooperative community was reached. Although they were scared off a bit at first by the complexity of the matter, the understanding that their constructed energy community scenarios all scored better than maintaining the current situation, as well as the gained knowledge made the participants motivated to immediately start taking concrete action for a joint energy initiative as a result of the workshop.

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Conclusions

The set-up of the engagement strategy in Relleu was different from that of other replication sites because this residential area was the first in which no previous initiative or intention for developing an energy community (EC) had been set up. Even though a lot of potential is present, with a Homeowners' Association already in place, an abundance of sun, and residents willing to invest in renewable energy, knowledge on what an energy community encompasses was low. Since the case and its context is representative for many other places in Southern Europe, the results of this exercise provide useful lessons on what is necessary to incentivise citizens to start their own EC project.

The scenario building workshop allowed participants to better understand the complexities of (the set-up of) energy communities because it let them get acquainted with all the decisions that have to be made (collectively) and the information that needs to be collected.

All participants indicated in the survey afterwards that their knowledge on joint renewable energy initiatives had increased thanks to the workshop. This also raised their awareness of the benefits and their willingness to join or even set up an individual or joint energy initiative in their neighbourhood. Their estimate of the probability that most neighbours could come to an agreement to start a joint project was also significantly increased after the workshop. Everyone indicated that their awareness of other participants' viewpoints was improved and that they felt that their input was considered and could have an impact on the end result.

In general, it can be concluded that the tested engagement process using the different steps of MAMCA had a significant effect on the awareness and knowledge of the participants regarding joint renewable energy initiatives in general and energy communities in specific. This directly resulted in a greater willingness for immediate action towards a joint local initiative.

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Potential savings in the energy bill are the main motivator to join an common energy initiative, but the workshop showed us that uncertainty about each other's motivations and a lack of knowledge on what an EC (process) contains are still a major drawback for many people. When a better insight in both can be offered, motivations go up. The developed engagement format worked on this account and received positive feedback from the participants.

2.1.8. Medellin, Colombia

Data gathering and stakeholder contacting

VUB has initiated the contact with EnergEIA. The energy community "El Salvador" is an initiative led by the EnergEIA research group of the EIA University of Medellín (Colombia) and sponsored by the local DSO EPM. The project aims to develop evidence of the implementation of user-centred energy models, and how to generate a replicable and scalable business model for energy communities under the Colombian regulatory framework. Initially, the pilot will consist of a virtual microgrid in which 11 users will be connected to a 20 kWp PV system installed on 2 of the users' rooftops.

During the engagement phase, the residents had to change their energy supplier. In the first month, the energy bill increased compared to the previous ones which has created some doubts and fears from the community. Just after this event, the survey was launched, and the workshop took place about a month later. Therefore, there was high interest in the activity.

Stakeholder objectives

The stakeholders were involved in a more extensive survey which included the questions about the objectives concerning their energy supply, but also questions which are more related to their daily habits, and demographics.

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The survey was only shared with the residents, while similar questions were covered through interviews with other stakeholders, such as the ministry, municipality, the energy retailer, and the DSO.

The survey received 15 household responses, of which most are the owner of the apartments living with elderly or minor persons in the same apartment. The stakeholders shared that missing information and education on ECs are main barriers to the local energy transition. Further, they stated that the fear of change, the slow speed of the setting-up process and convincing neighbours of the benefits of ECs hinders the EC at the community. Most respondents indicated that they think they pay too much for the quality of energy service they have received in the past six months. To overcome this, they wish to receive guidance in the transition process and to convince new members. This guidance entails accessible information for different levels of education and digital affinity.

The participants of the workshop were mainly residents (around 30), representatives of the agency for environment (local authority), the energy retailer, and the DSO.

During the workshop, an objectives weighting exercise was performed. The resulting graphs can be found in Annex A. The agency for environment selected and scored the objectives energy efficiency, reduction of the energy bill, reduction of the emissions, investment costs, and creation of employment as most important (the order goes from the highest to lowest importance, for the selected most important objectives). One resident group weighted reduction of emissions, reduction of the energy bill, energy efficiency, investment costs, and lastly creation of employment as most important. The other group of residents however scored investment costs, reduction of the energy bill, reduction of emissions, innovation, and energy efficiency as most important. For the energy retailers, represented by NEU and ERCO, the most important objective was innovation, then energy efficiency, replicability, reduction of the energy bill, and lastly investment

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costs. The local DSO, represented by EPM, selected, and scored the objectives in the following order: Energy efficiency, reduction of the energy bill, reduction of emissions, investment costs, and creation of employment. There was time given to the stakeholders to share and present their views to the other groups.

Analysis of energy data

The energy consumption profiles employed in the calculation of the energy scenarios were based on data provided by the pilot site. The data series contained 4 months of hourly measurements that were further extrapolated to recreate a yearly profile. Assumptions on low impact of the seasonality were made following the advice of the pilot site management team.

Conclusions and suggestions

The two scenarios; extended EC with self-consumption and the EC with self-consumption performed best on the objectives mentioned by the stakeholders. Currently, self-consumption is not possibly in Colombia, the results show that there would be great potential for self-consumption at communities like El Salvador. Apart from the scenarios including self-consumption, the extended EC performed best on the mentioned objectives. Also, the residents agreed that it would be a good approach to reach out to more potential members of the community. The participants were eager to continue with the project.

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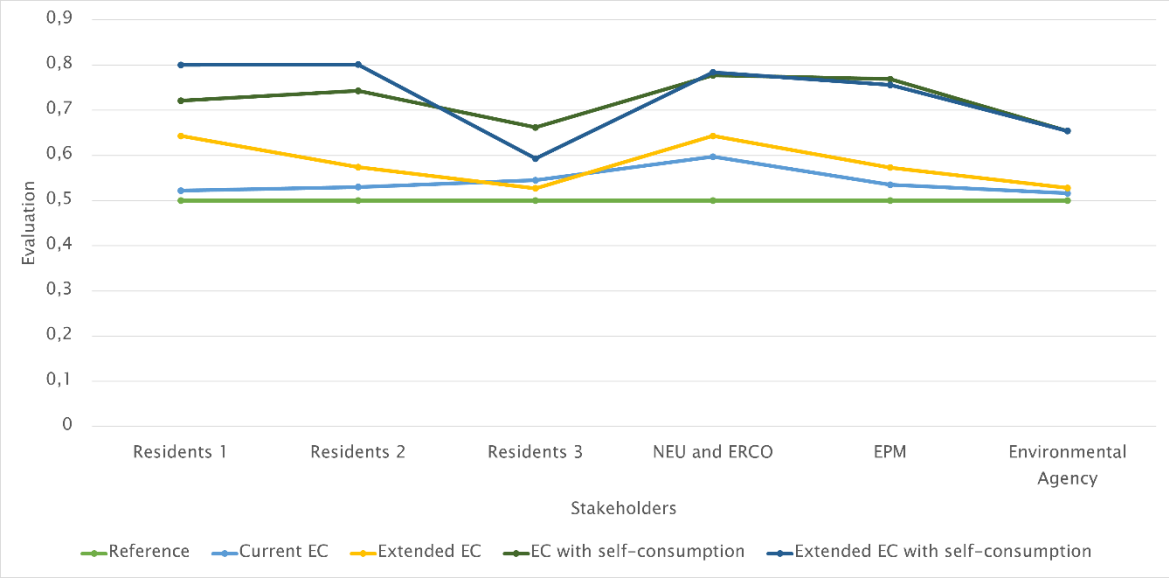

Figure 8 – Multi-Actor view for Medellín

Since mainly residents with differing knowledge on ECs were involved in this workshop, the questions arising from the workshop were rather about clarifying what may be common or obvious to the representatives working in the energy sector. Therefore, it was a challenge to keep the workshop on a level that was understandable and engaging for all. The after-MAMCA survey showed that the participants would have wished to have workshop with easier language, less technical graphs, and more engaging information. However, they also stated to have enjoyed the workshop and learned new information about EC at El Salvador but also from other countries. We have presented the process that we followed in Chile and Argentina to give more relatable examples.

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2.1.9. Brinkmann Community and Reserve Tajamar, Cordoba, Argentina

Data gathering and stakeholder contacting

VUB has contact with NOVA Vectors, an NGO based in Cordoba, Argentina. People from industry, research, and local government are engaged at the NGO which works with local communities and companies (such as Brinkmann, and Canter, the construction company for Reserva Tajamar). NOVA Vectors has facilitated and organized the engagement of different stakeholders at the Brinkmann community as well as at Reserve Tajamar.

Stakeholder objectives

The responses from the survey were used for both sites since the survey only received only few responses from Reserve Tajamar. Also, the energy consumption and production data were used for both sites. Therefore, the sites mainly differ in the stakeholders involved and the weights allocated to the objectives during the different MAMCA workshops.

The survey received 56 complete answers of which only eight were related to respondents from Reserve Tajamar. A stakeholder weighting exercise was set up during the MAMCA workshops in which the stakeholder could give an importance score to the objectives that were selected through the surveys. The resulting graphs of this weighting exercise can be found in Annex A.

Through the survey, the respondents shared several concerns among each other; such as the lack of economic and political incentives to invest in renewables as fossil fuels remain a lot cheaper. They were also concerned about the distance between the initiators of the project and the local population. However, they highlighted that they would like to become a pioneer in the region, and that the government would adopt a legislation that is favouring renewables. The respondents are in favour of direct participation in the energy market, and to sensibilize and educate the

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members of the community concerning the efficiency and positive impacts of the energy transition.

At Brinkmann, representatives of an energy cooperative, the municipality, architects, and citizens were invited and present during the workshop.

Among the entire respondents, reduction of the energy bill, behaviour change, grid liability, energy efficiency, energy autonomy, reduction of emissions, and education were the objectives selected as important.

Among these, the architects rated energy efficiency as most important followed by reduction of emission, reduction of the energy bill, energy autonomy, and behaviour change. The energy cooperative weighted the reduction of the energy bill, then investment costs, behaviour change, reduction of emissions and energy efficiency as most important (in the respective order). The municipality ranked reduction of emissions, change of behaviour, regulatory/legal/financial support, reduction of the energy bill, and employment as most important. The residents scored the reduction of the energy bill, investment costs, inclusion, energy efficiency, and the green image as most important (from most to least important)

At Reserve Tajamar, architects, residents, and the construction company Canter participated the MAMCA workshop. The residents selected and ranked the objectives like the following (from high to lower importance); investment costs, reduction of the energy bill, inclusiveness, green image, and energy efficiency. The architects selected and ranked energy efficiency, behaviour change, reduction of emissions, energy autonomy, and reduction of the energy bill. They further mentioned that for them the choice of material for constructions and to create a nexus design is crucial. Designing an EC from scratch should not only include considerations on energy but also connecting water, waste, and energy.

The construction company Canter selected and ranked investment costs, reduction of the energy bill, energy efficiency, reduction of emissions, and behaviour change.

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Canter lied focus on the economic feasibility while the architects highlighted the need for a holistic approach. The residents were also concerned about the costs and maintenance responsibilities but were optimistic about the positive impacts of implementing an EC in terms of inclusiveness and social aspects (such as knowing the neighbours and working together).

Analysis of energy data

In the case of the Argentinian pilot site, multiple datasheets containing data series of energy consumption of a period of 2/3 months were provided. However, the frequency of missing data among the collected measurements of the meters, left us with only one valid data series. These data series was extrapolated based on the monthly consumption provided for two different types of households. Consequently, two different synthetic profiles were recreated and used in the optimization and calculation of the energy scenarios.

Developed scenarios

At both sites, the same scenarios were analysed and evaluated. The first scenario is the reference scenario where energy is directly consumed from the grid and no renewable energy is produced. In the next scenario, the prosumer scenario, citizens produce and consume energy based on their individual generation assets. The next scenario was the Renewable EC, in which citizens jointly invest, produce, and consume renewable energy based on small, collectively owned assets. The last scenario is the distributed generation scenario. This scenario reflects the proposed Argentinian regulation on community energy /ECs. Here, the citizens invest jointly in larger generation assets, located in the proximity but are not dispersed locally. An example would be a closely located PV field that was collectively funded.

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Conclusions and suggestions

Combining both, the weight of the objectives and the performance evaluation, resulted in the multi-actor view. At both sites, there was not one clear scenario that outperformed the others for most stakeholders. At Brinkmann, the renewable EC and the distributed generation scenario were performing best by all stakeholders, with a slight preference for the renewable EC by the residents, the municipality, and the architects.

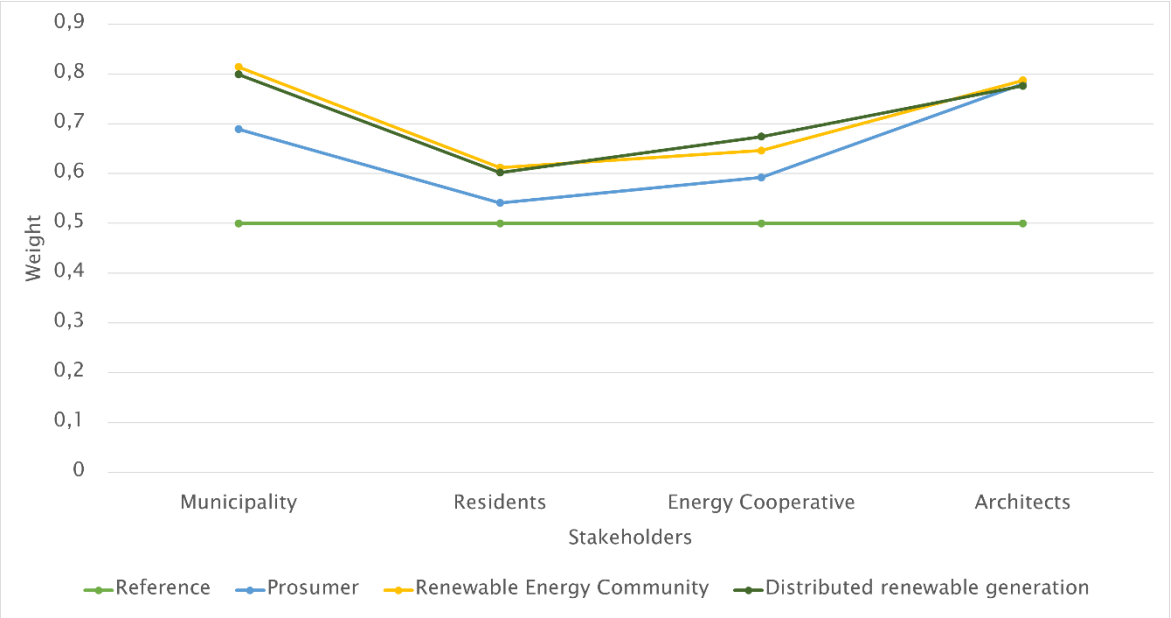

Figure 9 – Multi-Actor view for Brinkmann

At Reserve Tajamar, the renewable EC showed a better performance for the residents and architects. For the Canter company all scenarios performed similarly with a slight advantage for the distributed generation scenario due to its better evaluation on reduction of the energy bill and investment costs (the key objectives of Canter). The prosumer scenario also outperformed the renewable EC scenarios, due to the better performance on energy efficiency. Through discussing the different advantages of the two scenarios renewable EC and distributed generation, all participants agreed that the scenario of

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distributed generation would be easier to implement, also considering the national support for it.

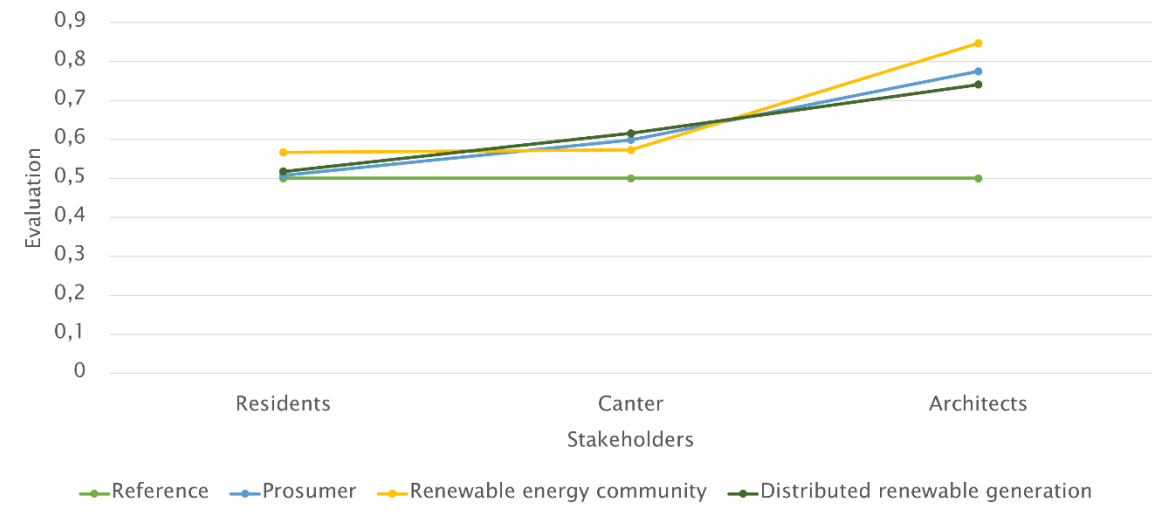

Figure 10 – Multi-Actor view for Tajamar

2.1.10. San Pedro de Atacama, Chile

Data gathering and stakeholder contacting

This is a result of the cooperation between RENAISSANCE and the H2020 ATLAST Project (GA No 951815, Atacama Large Aperture Submillimeter Telescope). Atlast aims to develop a renewable energy system at high elevation to make the observatory fully powered by renewable energy. RENAISSANCE is working with the University of Oslo (NDA signature November 2021) to study the possibility of creating and energy community by expanding such supply to provide electricity to the adjacent community of San Pedro de Atacama in Antofagasta, Chile, a town not connected to the Chilean power grid due to it remoteness.

Stakeholder objectives

The residents, representatives from the observatories, the municipality, and the energy provider (a local energy cooperative) were contacted to fill out

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the survey. Also, commercial entities, such as shop owners in the village, were contacted. In total 54 complete answers were collected, with most people coming from the ayllus San Pedro, Toconao, Socaire, Peine, Camar.
The survey showed several concerns of the participants towards their energy supply, such as the distance between local communities and the people that live and work for the observatories. Further, the spatial and social differences between the nearby ayllus were mentioned, ayllus are traditional political entities in the Andes region representing communities/villages. The respect and consideration of indigenes land was also highlighted as very important by the local respondents.
The current state of cooperation between the municipality of San Pedro and the surrounding ayllus with the national grid was discussed as a key reason why San Pedro has its own energy network. A connection with the national grid is not necessarily seen as a positive development and is a topic that has been discussed over several years. However, the respondents wrote that they are also worried about the responsibilities that my come with owning renewable energy assets, such as maintenance, and other management tasks.
The most important objectives across all the responses of the survey were the reduction of energy costs, and emissions, education, energy efficiency and energy autonomy. During the MAMCA exercise, the local energy cooperative CESPA put most importance (among the most important objectives) on the reduction of emissions, then education, then the reduction of the energy bill, and then on energy autonomy. For the observatories, the reduction of the energy bill and energy autonomy were most important, followed by the investment costs, efficiency, emission reductions, and the landscape impact. The residents weighted replicability as most important, followed by energy autonomy, education, efficiency, emission reductions, and then the costs of energy. They said that replicability would be important to them, so the upscaling of the solution

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would also benefit other ayllus. The municipality was not present during the MAMCA workshop, but VUB visited them two days later and showed the results and did the two exercises with them personally. The municipality weighted energy efficiency, then reduction of the energy bill, energy autonomy, reduction of the emissions, and education as most important. The resulting graphs of the objectives weighting exercise can be found in Annex A.

Several topics were discussed during the MAMCA process; CESPA is currently building a large solar field and has an agenda to decarbonize their energy supply. The observatories were not aware of the constructions and developments, so there were discussions about a potential collaboration which would reflect a new scenario for the energy supply of AtLAST. The municipality shared that the energy supply, but also the provision of other essential needs such as water, education, and internet, is a challenge in the area due to the changing population during the seasons. While San Pedro de Atacama hosts increased local population and a three times higher tourist population in summer times, the village's population reduces more than double in winter times. Therefore, to match permanently and efficiently the local energy production and demand is difficult.

As a result, most participants preferred the scenario of energy sharing, since it would not put managerial and financial responsibilities on the local population. This scenario deemed to have more positive impacts than negative ones on the stated criteria. Only hybrid system performed better for the observatories because it provides more safety in case insufficient energy is produced based on the installed renewable energy assets. To most participants surprise, the energy cooperative was also interested in developed scenarios. The participation of CESPA was not expected by the organizers (VUB/AtLAST), because they did not communicate their participation beforehand. There was apparently also a lack of communication between the different participants before the event.

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Therefore, the presence of CESPA was very informative and the different stakeholders were able to share their visions and doubts with each other. This was a positive achievement of the workshop.

Analysis of energy data

The energy consumption data of the telescope was provided the pilot site through an hourly profile that did not require any further treatment. Then, as per the town of San Pedro de Atacama, a yearly profile was recreated based on a given daily profile per month.

Developed scenarios

In discussion with Atlast and the university of Norway four scenarios were developed which were then compared with the reference scenarios. The first scenario described a hybrid system in which the observatories still rely on fossil fuels to cover for any outages but also invest in renewable assets to cover their demand. The second scenario is that AtLAST invests in an entirely renewable system, any additional energy would be lost or stored. In the third scenario, AtLAST shares such additional energy with San Pedro de Atacama. In the last scenario, AtLAST and San Pedro de Atacama would join an Energy Community and own assets together.

Conclusions and suggestions

At San Pedro de Atacama, sharing surplus energy from the observatories with the surrounding ayllus was the scenario that preferred best for most stakeholders. However, the observatories would prefer an option that does not require them to invest and maintain an entire energy system on their own. Therefore, the observatories were interested in discussing with CESPA if their large-scale renewable energy installation could benefit and supply them with reliable energy too. Therefore, the result of the workshop was to discuss another scenario option too.

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However, such scenario would not actively involve and benefit the surrounding citizens and communities. Due to the unique social and spatial conditions in San Pedro de Atacama, energy planning and decision-making is very complex and can cause unexpected consequences.

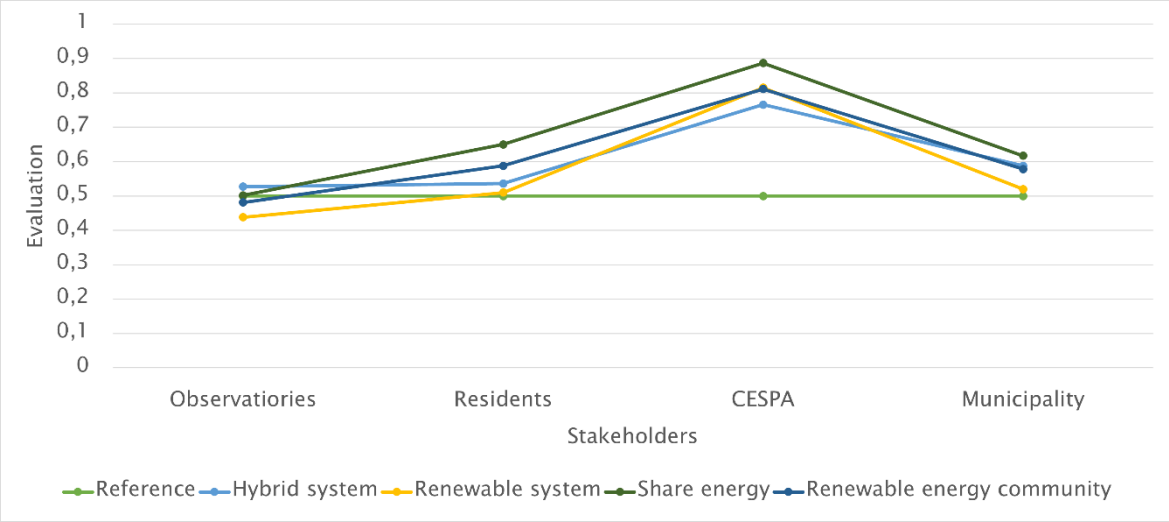

Figure 11 – Multi-Actor view for San Pedro

The MAMCA workshop was useful in bring the different stakeholders to the table and understand the different challenges but also opportunities arising from the potential installation. Yet, the results of the MAMCA showed that socially, and politically insensitive solutions (e.g., CESPA investing in large-scale renewable energy assets with the observatories and residents as consumers) may be the better option to implement rather than a socially, politically, and spatial complex solution such as an EC.

Since there is no internet connection everywhere around San Pedro de Atacama, the software was used using mobile data from a cellphone. To guarantee that MAMCA can also be used offline, an offline version of the software would be useful.

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3. Engagement of local actors and stakeholders

To investigate and understand the general context of LECs in each replication site (on local, regional, and national level), a series of meetings with local actors (policy, governmental, industrial, business) was set up. In most of the replication cases, these actors actively took part in the MAMCA workshops, and their input is included in the analysis of chapter 2.

However, in other cases, as the number of actors may have been larger or due to the lack of explicit bonds between actors and the respective LEC, the meetings were separate.

3.1. India

A list of meetings with multiple Indian associations, research groups and business actors took place.

Through those meetings, multiple topics were discussed and allowed the understanding of the energy landscape, the barriers and the needs of the consumers.

Consumer and civic Action Group (CAG)

CAG is formed by 5 people, focusing on rural planning – covering 10 – 20 thousand consumers in Tamil Nadu. Also under their scope: citizen science, renew infrastructure (transformers and substations), gender parity, energy efficiency and renewable concepts.

Information regarding the Indian Electric System: Generation and Distribution go together in Tamil Nadu. Some other states would separate this, but still with a certain shared percentage of ownership. This redundant constitution goes against efficiency and energy saving, it is a paradox that promotes increasing the consumption of more power. This is especially key in rural areas, where there is a lack of incentive to promote renewables.

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Also, regarding the tariffs, there is a differentiation between High Tension (HT) and Low Tension (LT) consumers and the different tariffs and subsidies applying. LT consumers consuming under 100 units, and people who are unable to bear the power cost are exempted: Temples and small commences don't pay. HT consumers have higher bills but also receive subsidies.

Finally, regarding Renewable Energy Projects: From a governmental point of view, only big scale (100s of MW) is promoted. India is working on a major green energy strategy: Green Energy Corridor.

NITT – National Institute of Technology Tiruchirappali

Vivek leads a group of 6 PhD candidates working on energy management of microgrids and optimization of energy systems. Therefore, his interest about the Renaissance project focuses on the Renergize tool and the modelling of the pilot sites, as well as the decision-making process while dealing with the conflictive objective of the different stakeholders – so the MAMCA tool is presented.

The conversation evolves towards an exchange on the technicalities of the different approaches used by the VUB and NITT to model and assess on energy power systems.

The talk finishes with a discussion on Indo-European calls for proposals for joint research (industry-academy) and the interface and use of the online Renergize app.

NSEFI – National Solar Energy Federation of India

NSEFI is an industrial organization focusing on policy making, focusing on the challenges that are faced at a central level by between major stakeholders from industry and the government. They have a framework for international collaboration with other countries of Asia.

Their main interest is the Renergize tool.

WRI – World Resource Institute

WRI have been supporting stakeholders in Tamil Nadu in order to help them to define a pathway to carbon neutrality. In urban areas, they achieve this

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mainly by focusing on energy efficiency strategies, exploring new technologies and looking at future energetic scenarios. Meanwhile, in agricultural areas, they work hand in hand with industrial partners of the sector by analysing the potential supply and the existing energy demands to enable distributed renewable energy generation.

Generally, they handle multiple areas of influence and different stakeholders. They support them along the whole process: implementation, sharing analysis, support on tariff fractionalization and future energy scenarios.

They achieve this with their own tools for sizing capacities, assessing potential of distributed renewable generation, etc.

IITM – Indian Institute of Technology Madras

IITM is one of the Indian Government fostered excellency centers. They have more than 30 technical departments distributed among many different buildings of their campus. They are aiming at a new grant for optimal models and designs in Microgrids. They also have an ongoing project in gasification, covering Hydrogen and indirect gasification of biomass and methanol.

They want to develop a campus microgrid and the approach of Renaissance and the methodology and tools seem relevant for them.

Fourth Partners

The discussion was focused on net metering (feed in tariffs), on pricing, specific conditions, energy exchange. In addition, mobility schemes were discussed

Auroville Consulting

The meeting was to prepare the upcoming workshop: share the results of the simulations and the different scenarios that will be proposed.

The main points discussed were:

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- Understanding on blackouts and how the assets are connected and performing depending on the grid availability.
- Addition of slides to give better overview of what has been considered for the modelling, especially for the reference scenario. Define the "limits" of Auroville.
- Buildings keep being added to the grid, and there's plans to add 200 kWh of batteries.

Additionally, following up to the conversation with Fourth Partners, targets on mobility were discussed: For 2030 2/3 wheelers and 50% of 4 wheelers need to be electrified.

Finally, a site visit took place, to get acquainted with the sustainable local projects and the installations of the pilot site.

PTI – Pondicherry Technical Institute

Visit to the ATAL – Incubation center, which has a collaboration framework with Auroville Consulting. It is a center focusing on technologic start-ups: fabrication, prototyping, drones, mobility, etc.

Mr. R. Dhasarathan and Mr. Bhavanesh are the leaders of the Sustainable Energy Portfolio, focusing on gasification, biomass, and solar power on remote locations. They have access to pilot sites.

PTU wants to develop a microgrid on campus with 1 MW of Solar rooftop panels, and 1 MW of ground solar panels. They want to resubmit a proposal on the project and would be interested on international collaboration.

3.2. Colombia

In Colombia, a series of meetings were set up and held by BAX, focusing on the preparation of the MAMCA workshop as well as for the analysis, and understanding of the regulatory context and barriers. These meetings/interviews are introduced in [3]. The interviewees came from the

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Ministry of Energy, the Municipality of Medellín and the CREG – Energy and Gas Regulatory Commission.

In the interviews, the survey before the MAMCA workshop was conducted in an oral manner, the RENAISSANCE project was presented, and the interviewees presented their work and connection to existing initiatives. Further, the entities were asked a set of questions including how they understand ECs and how they could be implemented in Medellín, what the impacts of current trends will be on the future of Medellín and its green energy strategy. The government highlighted that it takes a lot of time and resource to sensibilize and develop programs to foster ECs. Especially the low-income population in Medellín should be able to benefit from ECs in their opinion and that small single initiatives should be replicated to benefit a broader public. However, financing remains the greatest barrier to do so.

The interview with CREG was targeting two specific topics more detailed: prosumerism and self-consumption. At the current moment, self-consumption is not allowed in Colombia which limits the possibilities of ECs there. CREG highlighted that the lack of regulation and regulations that are currently not designed for ECs are the greatest barriers to them to the roll-out of ECs in Medellín and Colombia.

In addition, VUB organized a meeting with EIA University (Escuela de Ingenieros de Antioquia). VUB and EIA had a collaborative meeting after the MAMCA workshop to discuss the results and the workshop itself.

Following the feedback of the participants and EIA, they suggest making the MAMCA workshop easier for representatives of the citizens. During the workshop graphs for the performance of each objective within the different EC scenarios were shown, they were perceived too complicated.

However, the discussion part in groups and the sharing of what the resident care about was mentioned as very engaging and fruitful.

Further, EIA and VUB discussed on joint publications and the outline of the manuscript.

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3.3. Chile

The main goal of the meetings in Chile was to conduct interviews with local authorities, policymakers, initiators of energy communities and investigate the possibility to replicate the RENAISSANCE tools in other sites. Meetings took place with the local actors:

- Ciudad Luz, Private company promoting and installing distributed generation (Tomás Steinacker, Project Manager)
- Factor Innovación (Javier Soubelet, Project Manager)
- University of Chile (Professor Felipe Diaz Alvarado)
- CESPA (Five representatives)
- San Pedro Municipality (Five representatives)

Ciudad Luz

Tomás Steinacker is co-founder of the company "Ciudad Luz" and works there as a commercial manager. Ciudad Luz aims to develop and employ options to co-invest or lease PVs and other decentralized RES. They focus mainly on small-scale and low-income communities which are usually not considered or excluded from conventional investment options. To do so, they have a wide portfolio of leasing and investment schemes, as well as funds. They do implement projects that implement self-consumption, and energy sharing.

Ciudad Luz elaborates with larger fossil fuel companies, such as Gasco, how they can transition to green energy. They also work together with the government to develop public programs that benefit the average energy end-consumer in Chile, one of the programs is "Programa Casa Solar" that installed PVs for low-income residents on publica buildings (e.g., school, administrative buildings) in 84 different locations. Further, Tomás Steinacker highlighted the challenges to ECs in Chile, and at San Pedro de Atacama which are related to the size of the country, the fragmentation or

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regulations and authorities, the low disposable income of residents, and the high costs for loans and credits. Further, there exist general suspicion towards energy projects because they are often connected with multi-national companies and their mining activities, especially close to San Pedro de Atacama in Calama.

He was very interested in RENAISSANCE and its replication sites in South America and stressed that a clear regulation in Chile and better financing options would help to fasten the green energy transition the most, since the potential for RES are extremely high.

Factor Innovación

In the interview, VUB introduced the RENAISSANCE project and shared the information gathered for the workshops in San Pedro de Atacama. Javier Soubelet introduced "Factor Innovación", the company he is working for and that is active in various project supporting the local energy transition.

For example, the company is working on autonomous electric vehicles and helps to promote regulation on electric mobility, and automation.

Pr. Felipe Diaz Avarado

Professor Felipe Diaz Avarado invited the RENAISSANCE and AtLAST team to discuss potential collaboration and to share current efforts to set-up ECs in Chile. During the meeting, he highlighted the project with a community located close to Viña del Mar where they work together with citizens, the municipality, and public schools to jointly discuss and develop a wind farm. Especially, their close collaboration with schools was discussed together with the AtLAST team, since they also focus on educational activities during the project time horizon.

CESPA

CESPA attended the MAMCA workshop and invited the VUB and AtLAST team to visit their office buildings and the PV field that is currently under construction.

San Pedro Municipality

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Since the municipality was not able to attend the workshop, VUB and the AtLAST team conducted the weighting exercise with the municipality in a separate meeting. Further, the municipality shared their views on a potential EC at San Pedro de Atacama. The interview was dominated by stating the challenges to an EC which can be summarized as:

- Floating population makes energy planning difficult
- Unreliable and limited energy access
- Tourism (higher energy consumption of tourists, seasonality)
- Limited resources (funding, knowledge, support)
- Long-term planning difficult due to changing authorities
- Distance between the different communities (/the observatories)

3.4. Argentina

As in section 3.3, interviews were also organized in Argentina, with:

- Secretaría de Biocombustibles y Energías Renovables (Secretariat for Renewable Energy)
- Municipality of Brinkmann
- Municipality of Reserva Tajamar
- Radio interview on Locutor radio 88.9 FM with Alejandor Boreo

Secretariat for Renewable Energy

VUB presented RENAISSANCE and the work done at Brinkmann and Reserva Tajamar. The representatives of the government explained the current law on distributed renewable energy generation which focuses on installing distributed yet larger scale assets (e.g., it is not targeting to increase systems on individual house level). They also explained on how the Law was developed and that they are interested in how ECs are going to be rolled-out in the EU.

Municipality of Brinkmann and Reserva Tajamar

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In the two interviews with the local authorities of Brinkmann and Reserva Tajamar, the majors stressed their interest in RES. Especially the mayor of Brinkmann was supporting the idea of setting up an EC at Brinkmann that could benefit the residents and reduce the rising electricity costs. In contrast to Brinkmann, Reserva Tajamar is not yet habited but both sites were not yet sure on of how the concept and new law on distributed renewable energy generation could be practically implemented on site. Therefore, the VUB team also explained the concept of ECs and how the new law helps to realize an EC in the Argentinian context. The mayor of Brinkmann also participated the MAMCA workshop.

Radio Interview

The topic of the radio show was the energy transition. In this context, the VUB team and NOVA Vectors were invited to share information about the Brinkmann and Tajamar replication sites in the RENAISSANCE project. During the interview, information on the new law was shared, as well as a general recap of the RENAISSANCE project was given.

3.5. Uganda

Meetings with African actors and market stakeholders also took Kampala for research purposes (that will be described in T7.5):

- Utility 2.0 Twaake: first-of-its-kind integrated energy pilot in Uganda; a rural micro-grid bridging the gap between no-grid to main grid connection.
- UMEME: main DSO and supplier in Uganda.
- Equatorial power: renewable energy project developer in Uganda, responsible for day-to-day management of the Twaake pilot. Specialized in off-grid energy projects in sub-saharan africa.

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4. Conclusions

4.1. MAMCA

4.1.1. Representation and participation

In all replication sites, a workshop could be conducted with the support of local facilitators who also translated where necessary and who contacted the stakeholders on site. The success of the workshops was highly connected with the effort of the local facilitators as setting up a participatory transition process such as MAMCA requires prior engagement efforts to build trust and convince stakeholders to come and participate to the workshop. Here, we could see that facilitators that worked over longer time/and are actively involved in the community managed to organize more participants or convince them more easily (e.g., Vega de Valcarce, Comunidad El Salvador, Florence).

The distributed stakeholder objective surveys allowed to reach out to more people to respond than people who were able to participate in the workshops. This dual approach allowed to have criteria presented from a wider population making the selection of criteria more representative than the weighting of it.

The survey demographics show that the invitations have mainly reached respondents from medium to high income classes with higher educational levels. Even considering that people with higher educational background were participating the workshop, in some cases participants mentioned that the language and content of the workshop is too specific and professional (seen in some feedback of the post MAMCA survey).

Future workshops should include a strategy on how to specifically address, incorporate, and engage under-represented social groups also with a lower educational background. For the workshops this could mean to invite specific stakeholders first to focus groups, and then to events where everyone is coming. Also, rather than inviting individuals from mentioned

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social groups, one could invite representatives of unions who are used to speak in public.

Generally, the MAMCA workshop is not suitable for mass participation in its current form but rather is tailored to around maximum 30 participants. While this is not necessarily negative, it does require that MAMCA is seen as a tool within a longer engagement process.

In the survey distributed after the RENAISSANCE workshop survey asking participants about their opinion on the workshop, most respondents evaluated the process positively. They mentioned the visualisation of the survey and scenario evaluation results as a positive element that worked clarifying, as well as the straightforward moderating and the offered opportunities for joint discussions and asking questions. The most cited points of attention were the fact that enough time needs to be allowed for the workshop since it handles complex matters, and that elements of concrete implementation could receive more focus in the workshop.

4.1.2. Phases of EC building and implications for MAMCA

At the replication sites, the MAMCA tool was used at different stages of community building and set-up of an EC. While some communities (e.g., El Comunidad Solar), were already involved in a transition and community building process over some time, other communities (e.g., San Pedro de Atacama, Reserve Tajamar, Relleu) had never been engaged or heard about ECs before.

In case it is the first informative meeting on ECs, conducting a MAMCA workshop could be overwhelming the different participants with information. MAMCA should be regarded as part of a larger transition process that requires multiple steps of action.

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Such a transition process is visualized in Figure 12, modified from Lode et al.[1]. Depending on the goal of the MAMCA workshop the approach needs to be adapted.

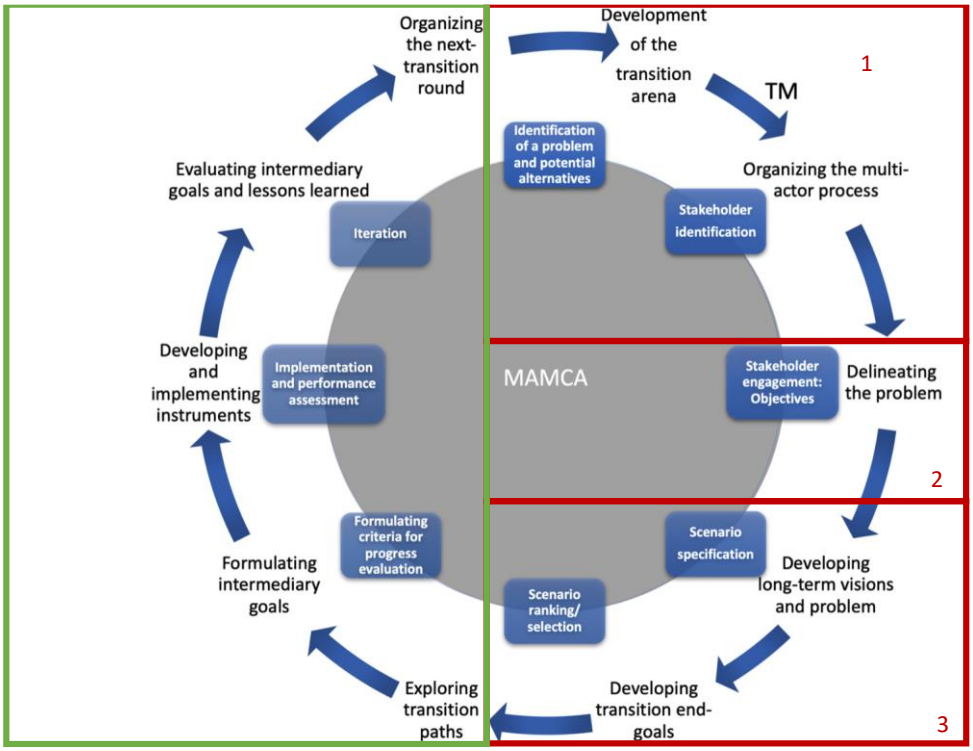

Figure 12: Transition Process

In RENAISSACE, the focus lied more on the participatory evaluation of different EC scenarios rather than on the first steps of a transition process (green part of Figure 12). However, many of the pilot and replication sites were still in the first three phases, shown in the red part in Figure 12. The phases can be differentiated in stakeholder analysis, problem definition, and scenario building. These phases were not clearly defined or addressed in the project proposal and were mainly the responsibility of the local facilitators. As a result, the extend of how much time and effort was placed into these steps differed across the communities and often depended on whether there was already an existing sense of community. Especially in the

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case where communities or initiators of ECs are at the very beginning of ECs, tools that are supporting the first three steps should be applied before a MAMCA workshop is conducted that is geared towards EC scenario evaluation. For example, an extensive stakeholder analysis under consideration of underrepresented groups, participatory scenarios building, and focus groups could enhance a fairer transition process. In Relleu, the MAMCA workshop was much more elaborated and geared specifically towards knowledge building and the first phases of the process instead of deciding on an implementable evaluation of EC alternatives. It received positive feedback from the participants, which shows that the MAMCA approach can be used in the multiple phases of the transition process but needs to be adapted to fit the specific goals of the phase it is being used in, supported by additional tools.

4.1.3. The effect of MAMCA on knowledge and awareness raising

In a pre and post workshop survey the participants to the RENAISSANCE MAMCA workshops were asked about their knowledge of ECs, their acquaintance with other stakeholders' viewpoints, their estimation of the feasibility of an EC project for the neighbourhood and how their own viewpoints changed by participating in the workshop.

Almost all participants indicated that by participating in the MAMCA workshop their knowledge on energy communities in general increased, and even more so their knowledge on what an EC for their neighbourhood could encompass.

The survey results also show that the insight in and awareness of other stakeholders' objectives significantly increased through the workshop, which also affected the personal viewpoints of about ¾ of the participants. On average, willingness to compromise however stayed more or less the same, and their assessment of how easy or difficult it would be to reach a

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compromise also was not affected significantly by the workshop participation.

4.2. RENERGiSE

The key point for a successful usage of the RENERGiSE tool is the quality of the data used as inputs, especially the energy consumption profile and the energy prices. While energy prices can be rather easily gathered from energy bills and/or energy provider publicly available prices, energy consumption data with at least hourly resolution are more difficult to obtain and sometimes the format can be unsuitable. In fact, only two of the replicator sites were able to provide such detailed measurements of energy consumption: the Lacor hospital and the energy community "El Salvador" in Medellin. With no surprise these sites are the ones where energy related projects were already ongoing. Regarding the other cases, thanks to energy bills, standard load profiles, building information and surveys; it was possible to reconstruct energy consumption profiles with the required time-resolution. However, various assumptions must be taken during this activity which could potentially undermine the accuracy of the results. This risk was mitigated by involving the stakeholders when assumptions had to be taken. Generally, the tool proved to be robust enough to test all the different replicator site without any adaptation needed.

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5. References

[1] R. C. Alex Felice (VUB), "D2.4 – Refined Multi-Vector Optimization Software Tool," 2021.

[2] R. C. Maria Luis Lode (VUB), "D2.1 Ranking of technology – business designs | version 2.0," 2021.

[3] R. Consortium, "D6.5 Regulatory Barriers Analysis," BAX, 2022.

[4] R. Hueting, "RENAISSANCE H2020," 2019. [Online]. Available: www.renaissance-h2020.eu.

[5] A. F. A. M. A. J. D. S. M. L. J. Lode ML, "Coupling Rural Development with the Development of Energy Communities: A Participatory Study in Vega De Valcarce, Spain," *SSRN,* p. https://doi.org/10.2139/ssrn.4084306, 2022.

[6] R. Consortium, "D3.2 Benchmarking business case report version 2," 2022.

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Annex A – Objectives weighting results

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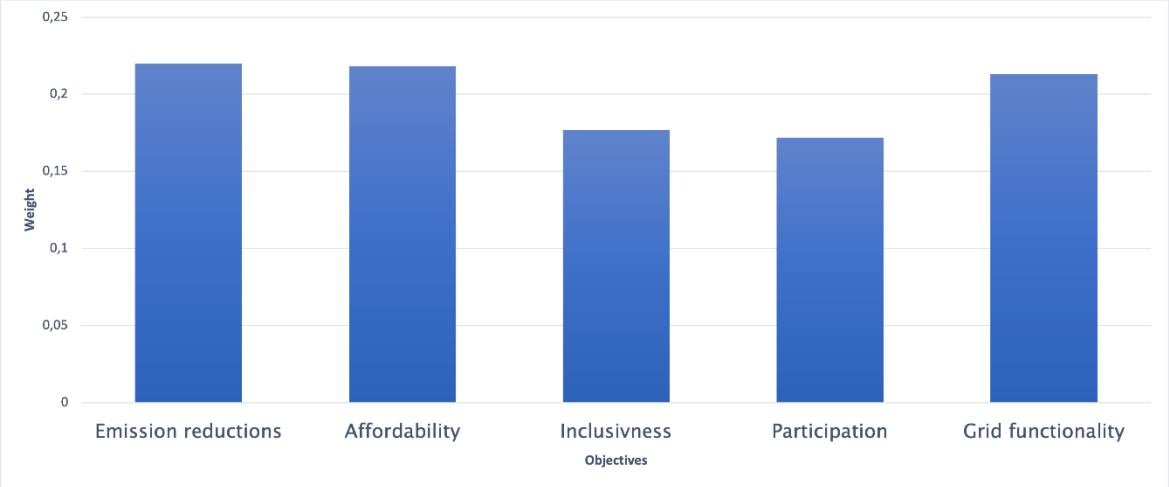

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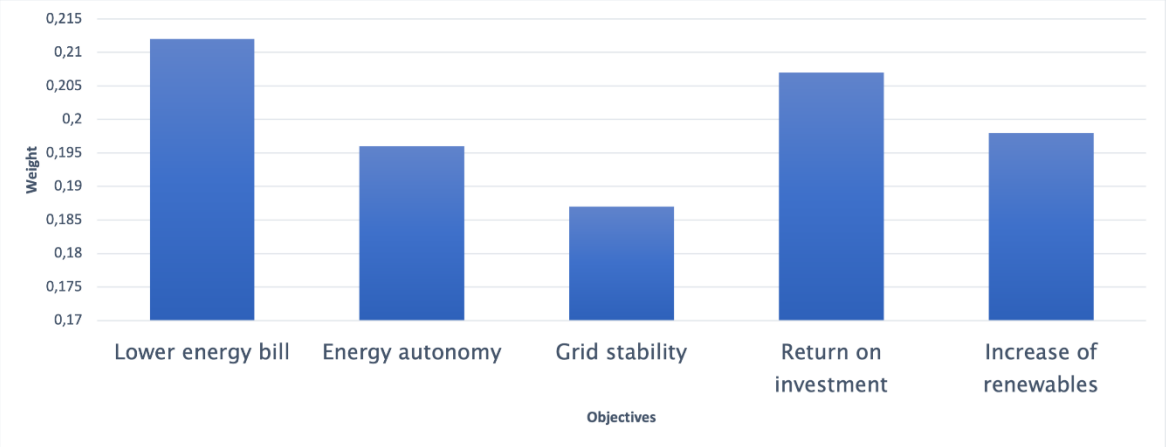

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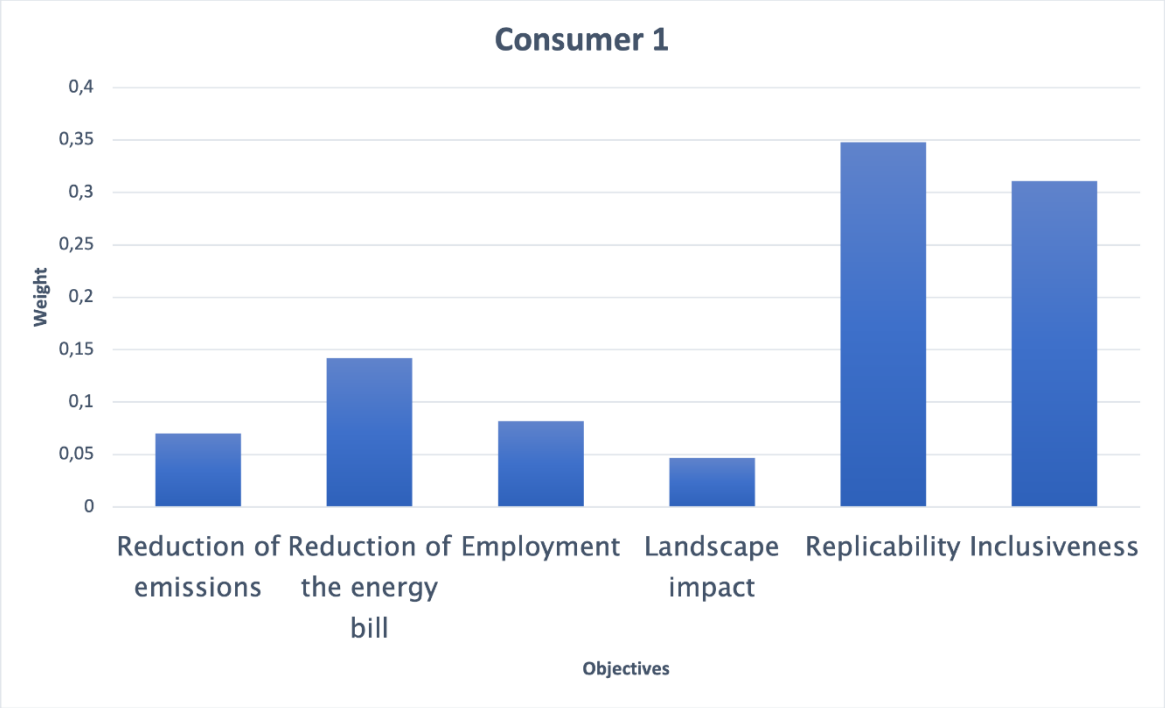

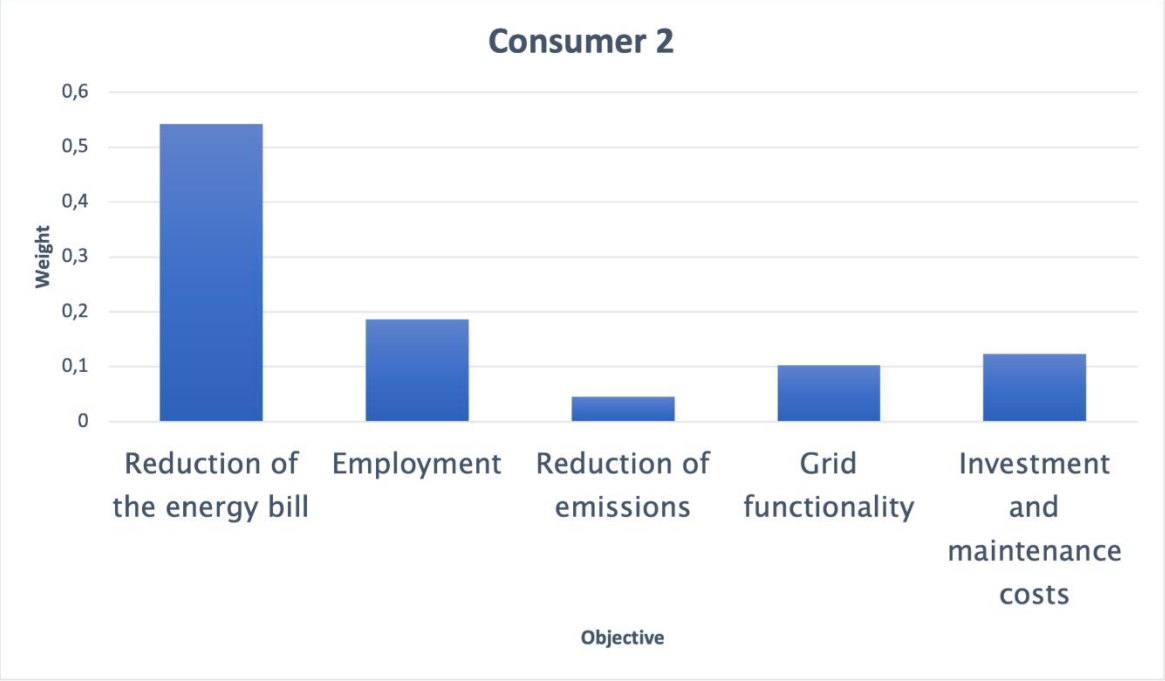

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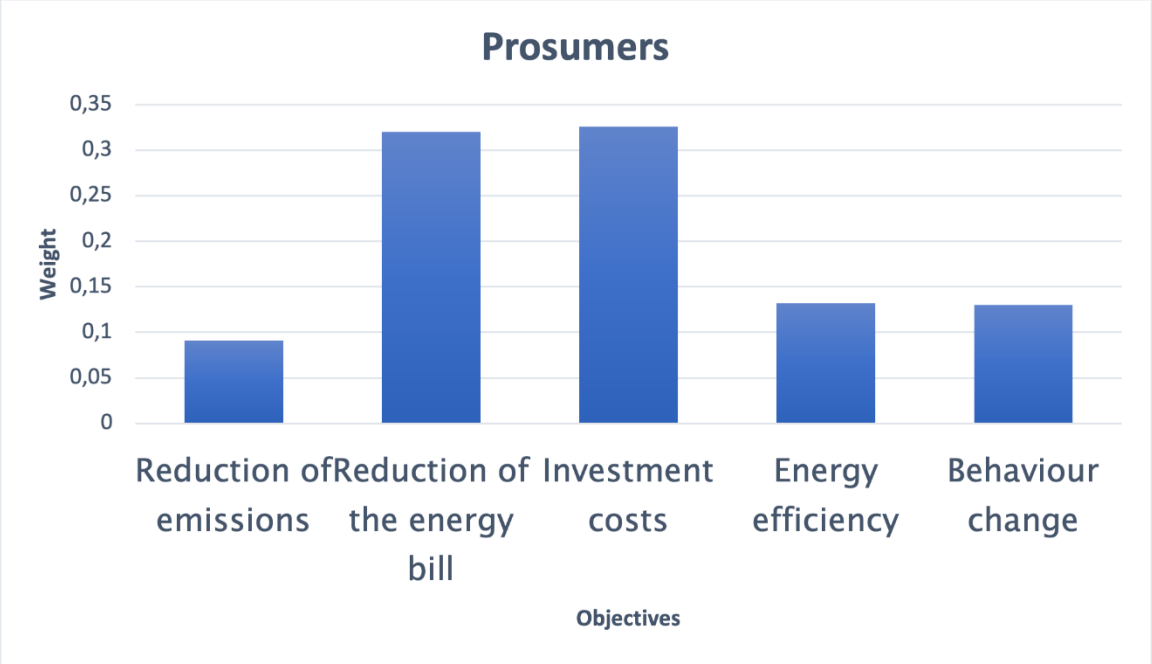

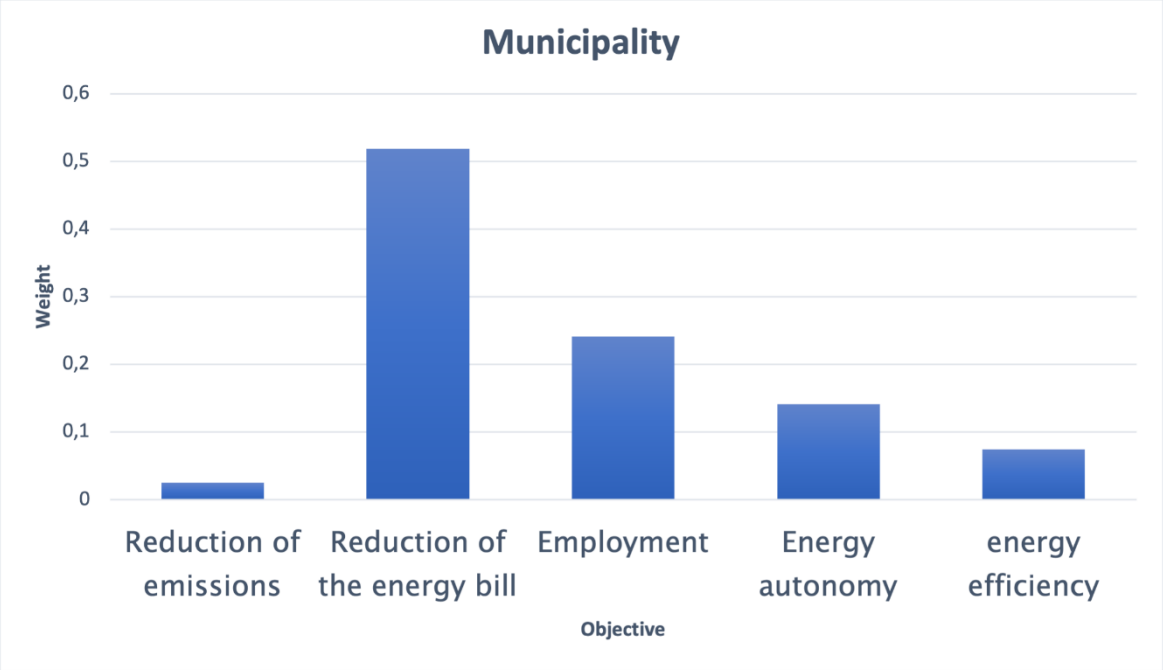

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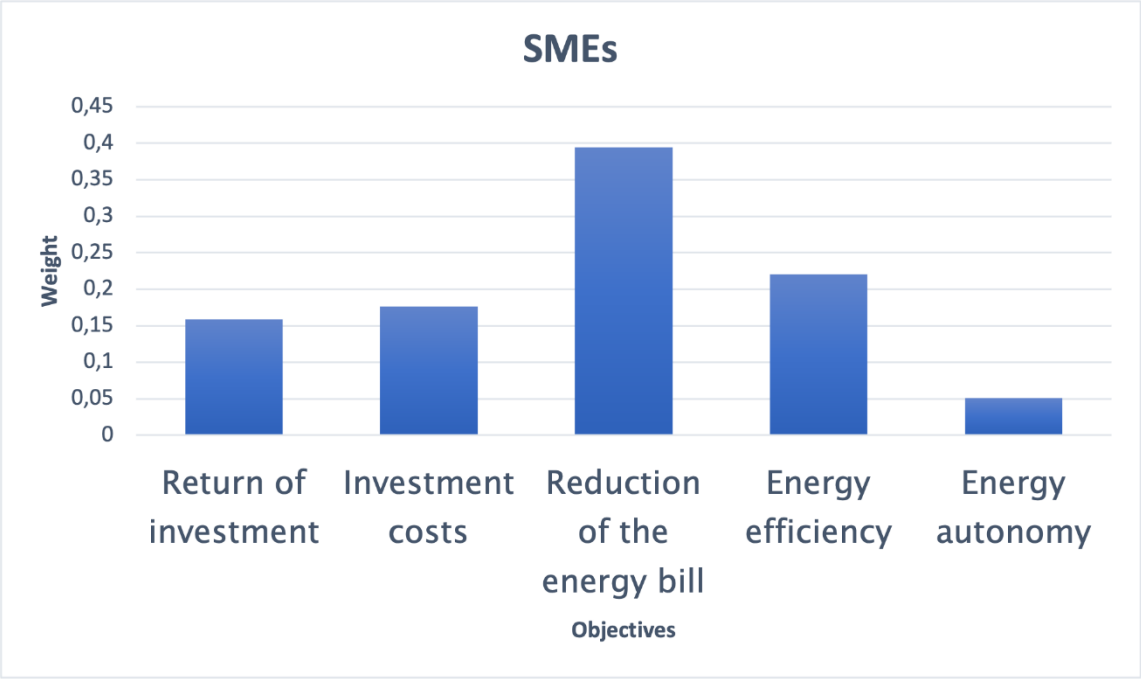

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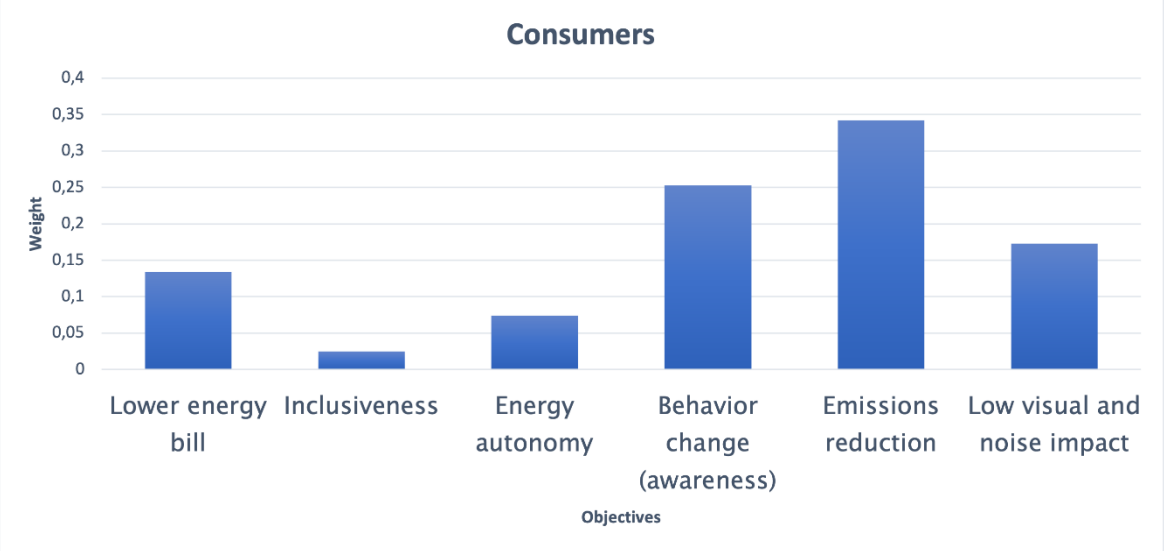

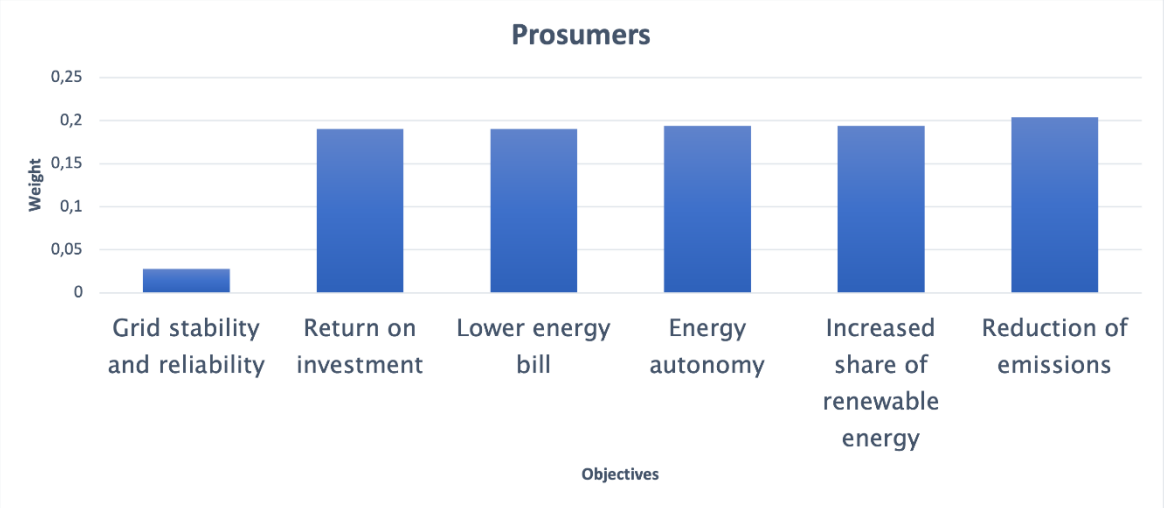

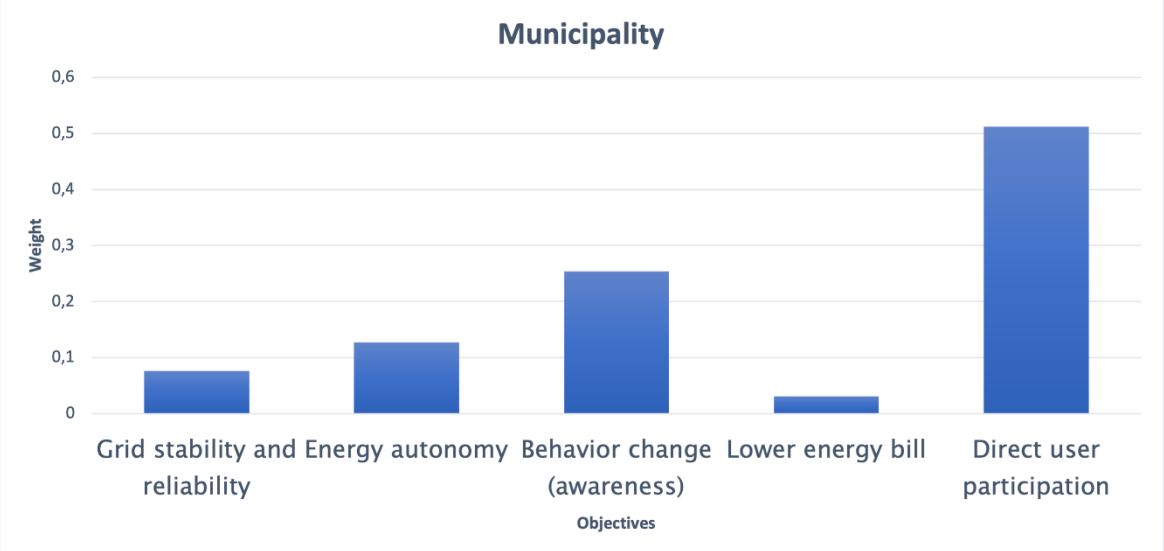

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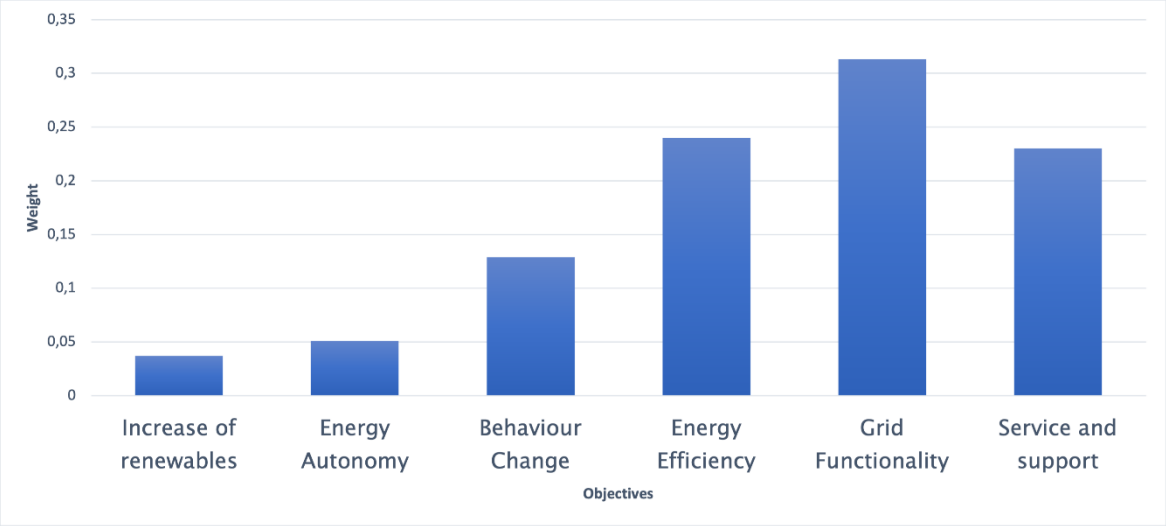

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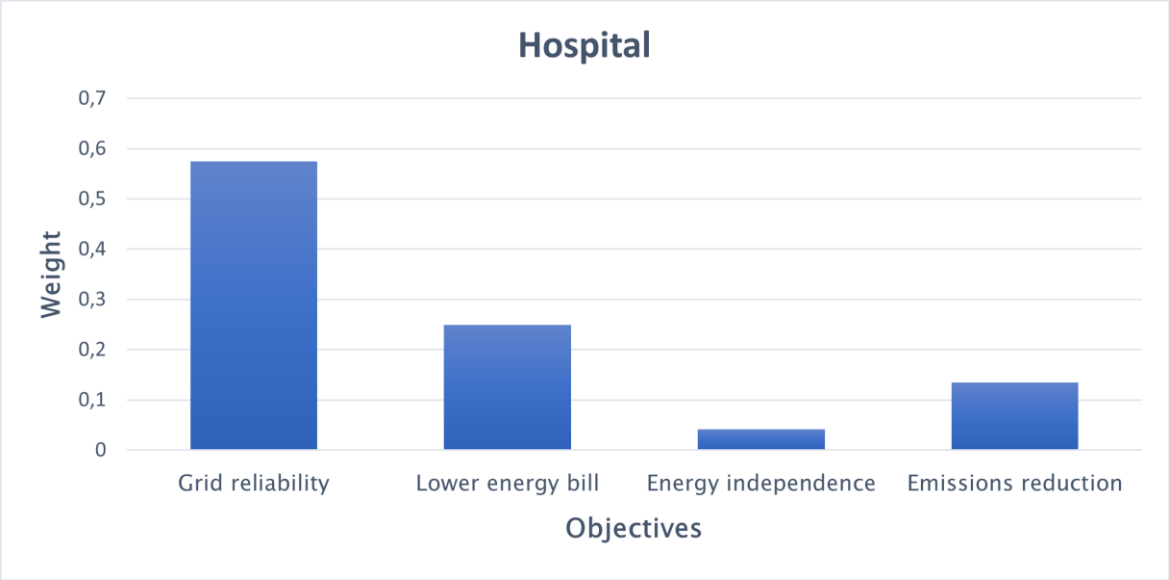

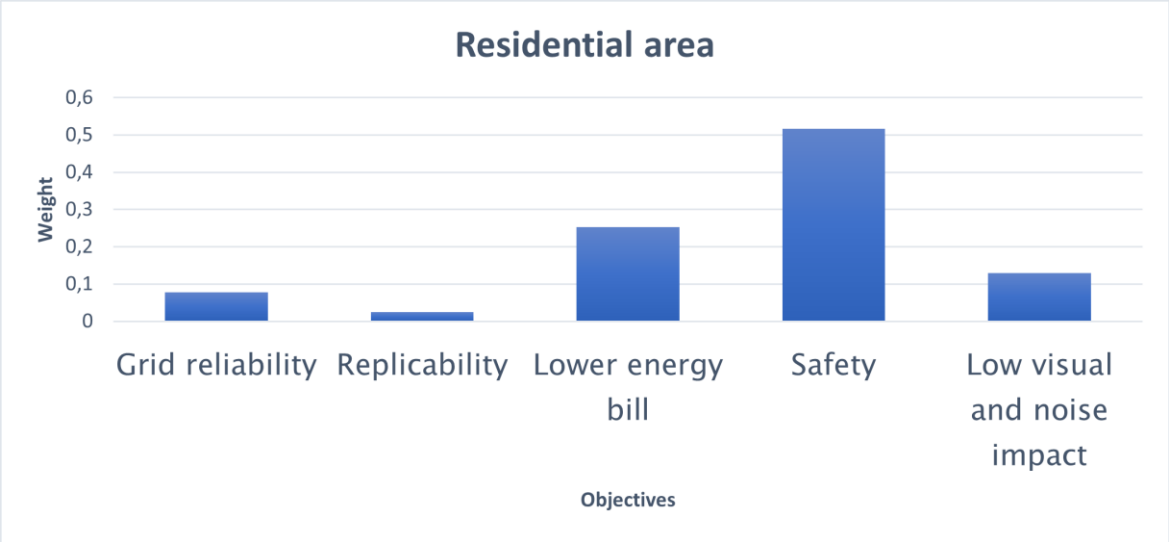

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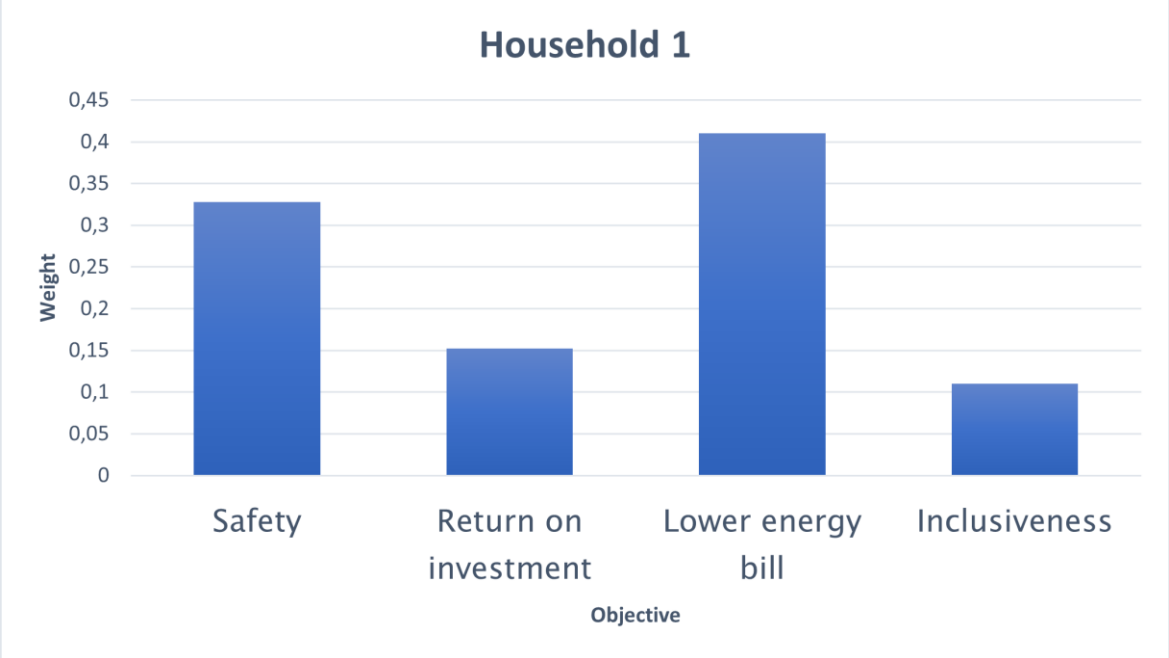

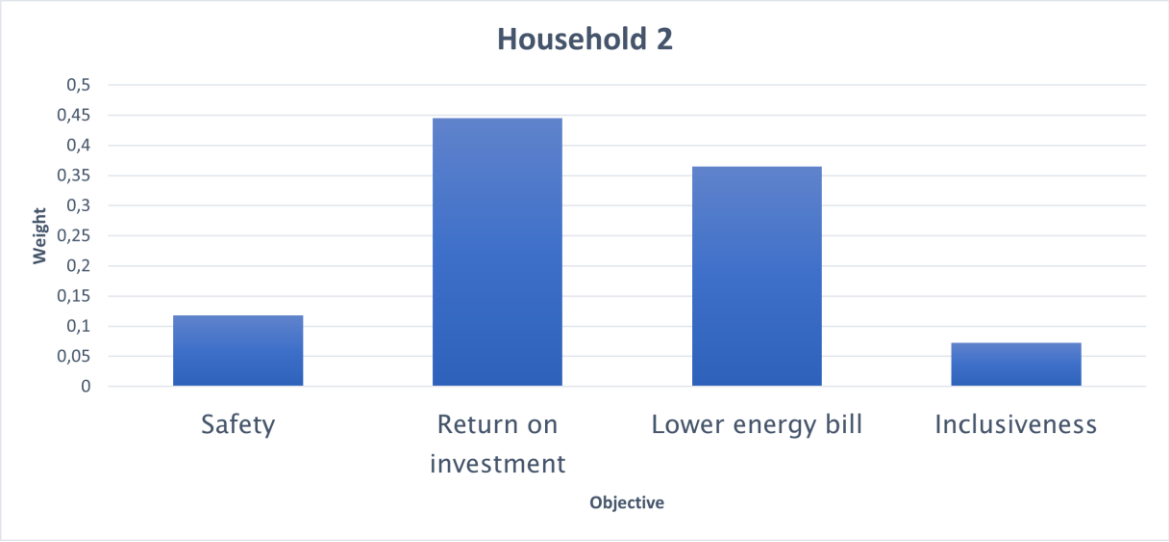

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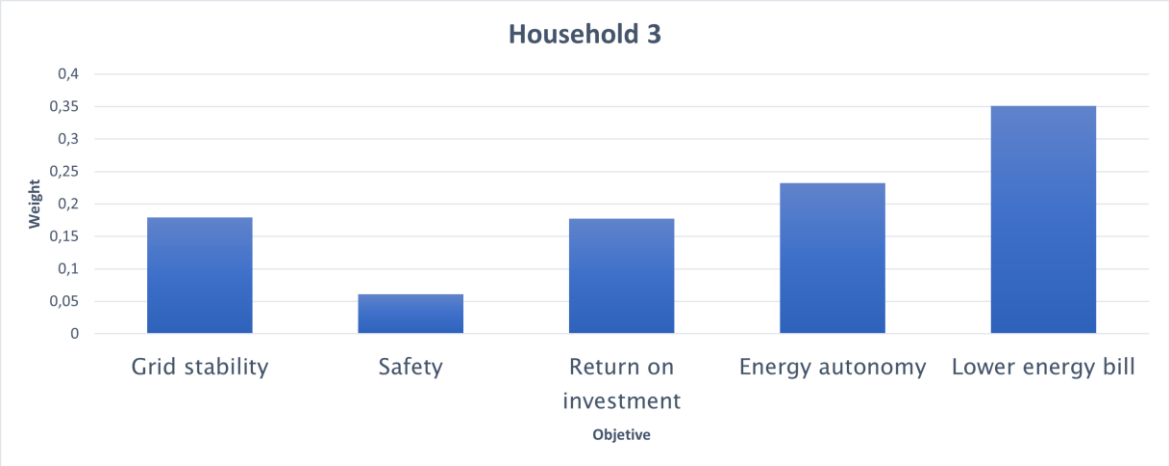

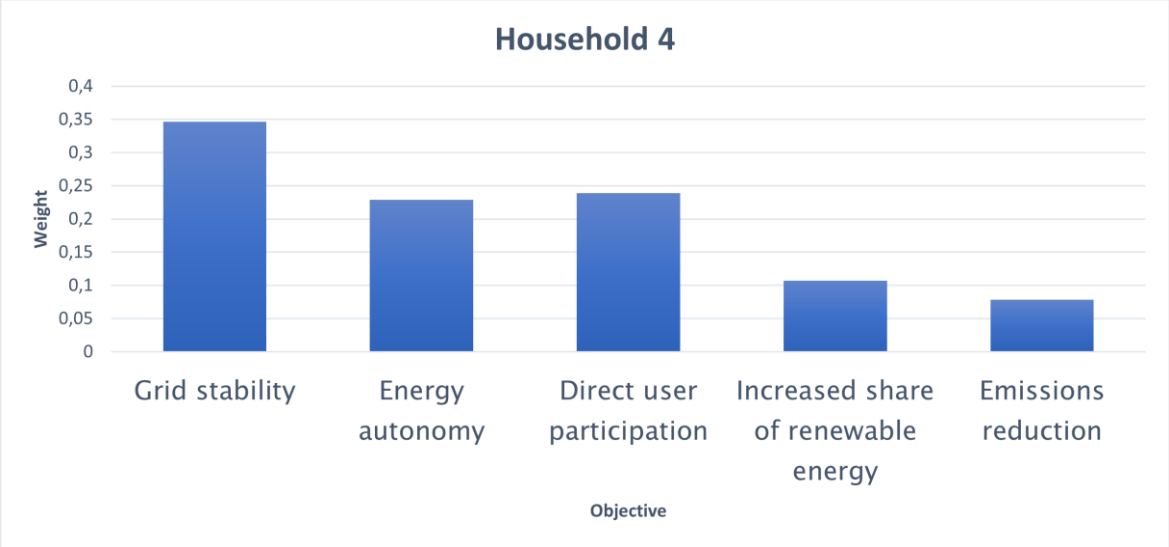

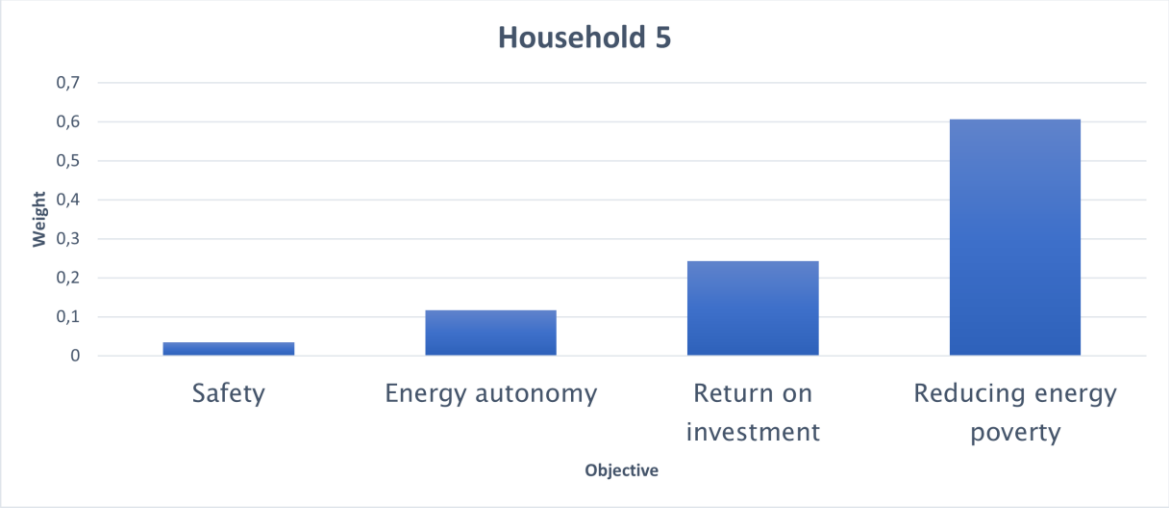

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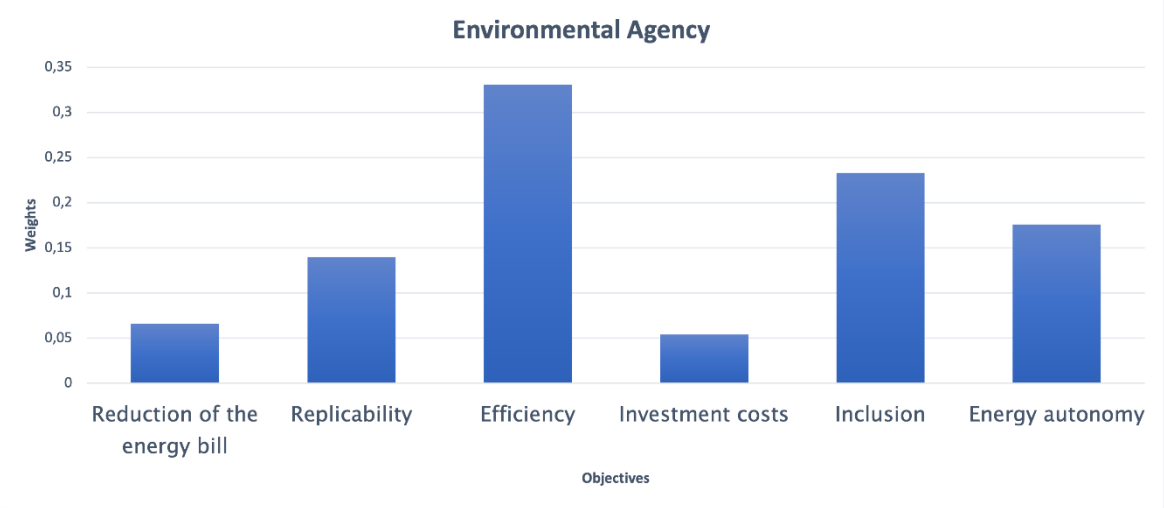

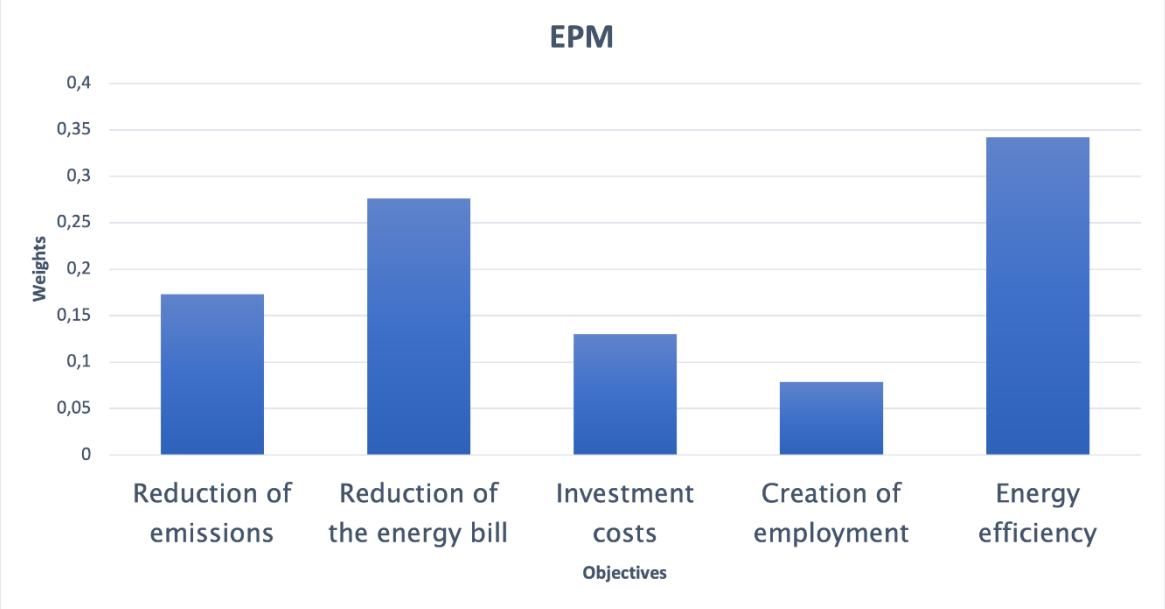

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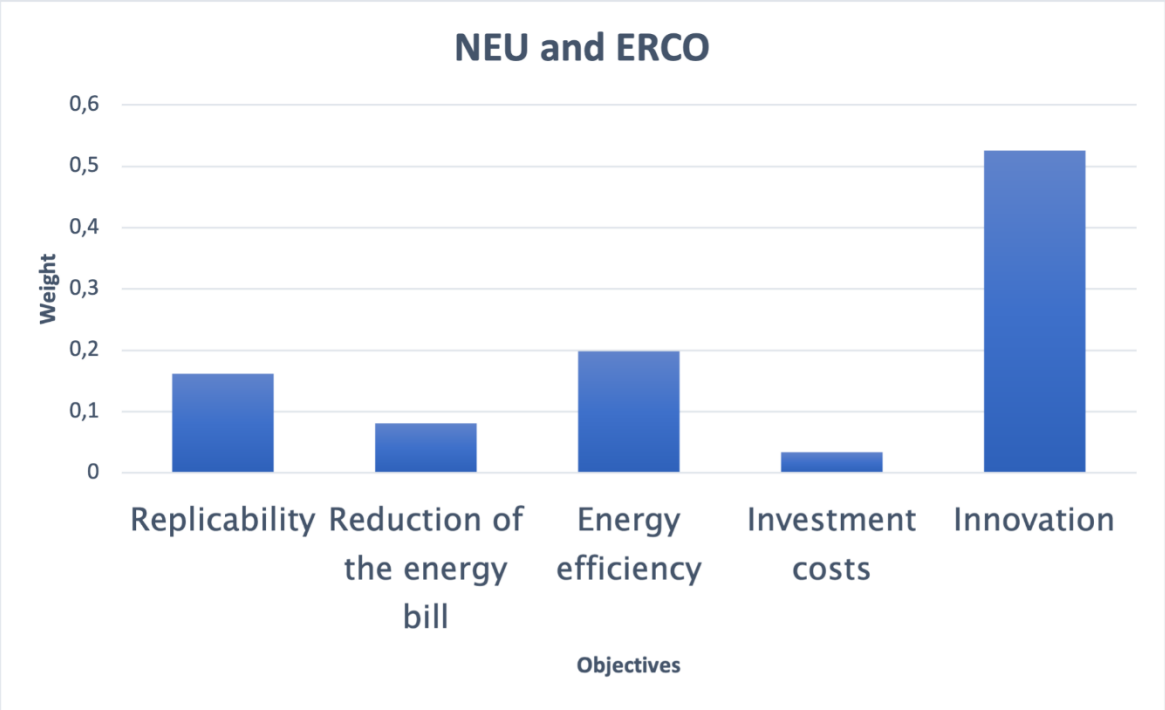

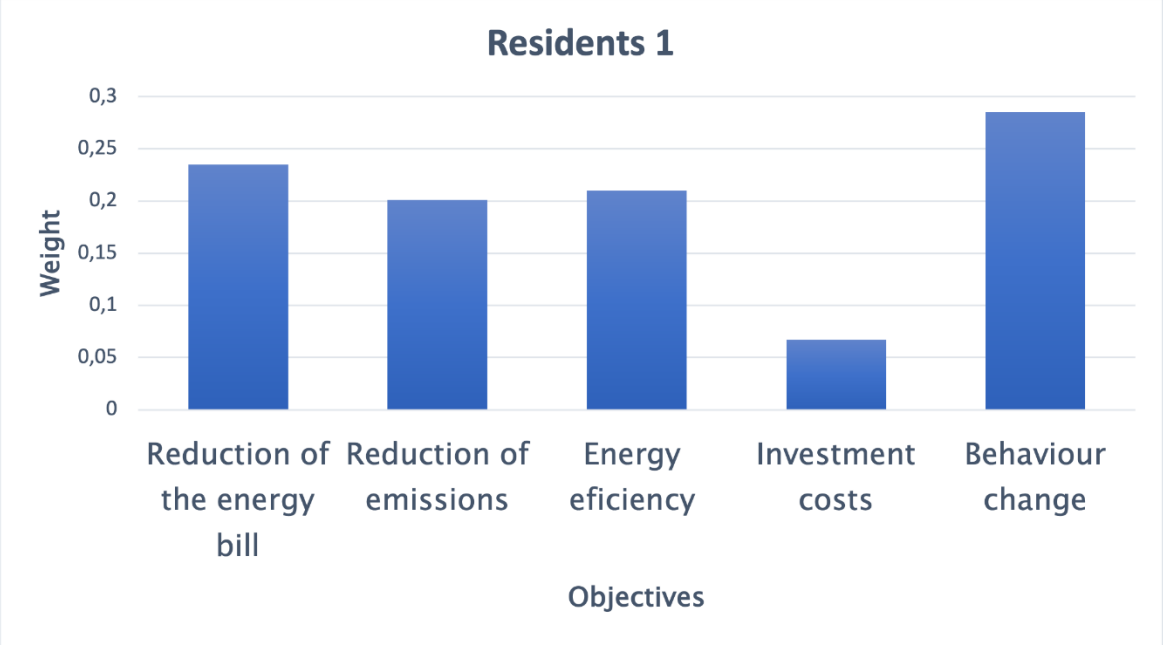

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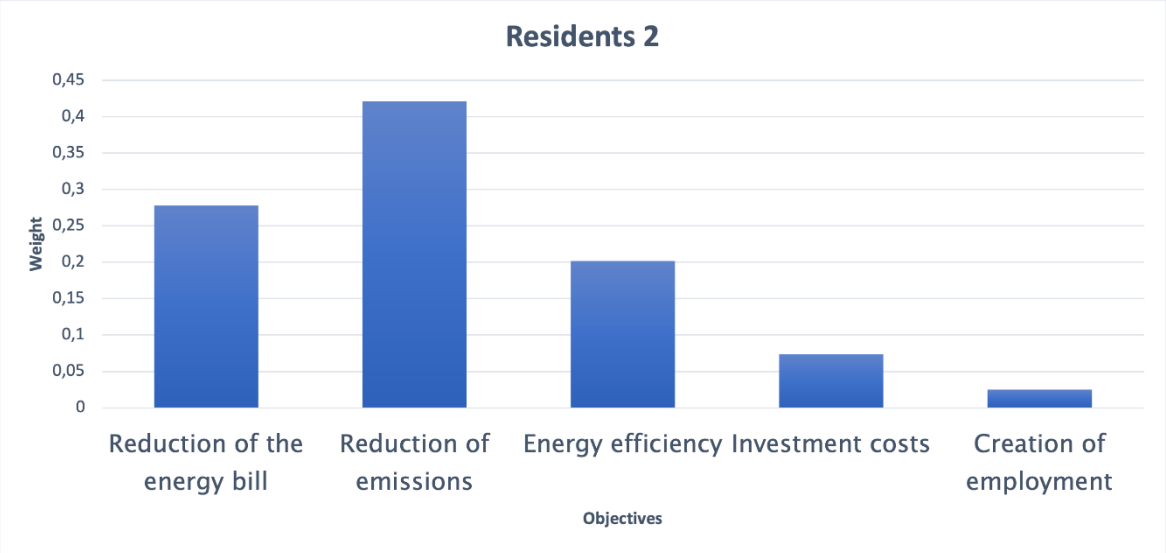

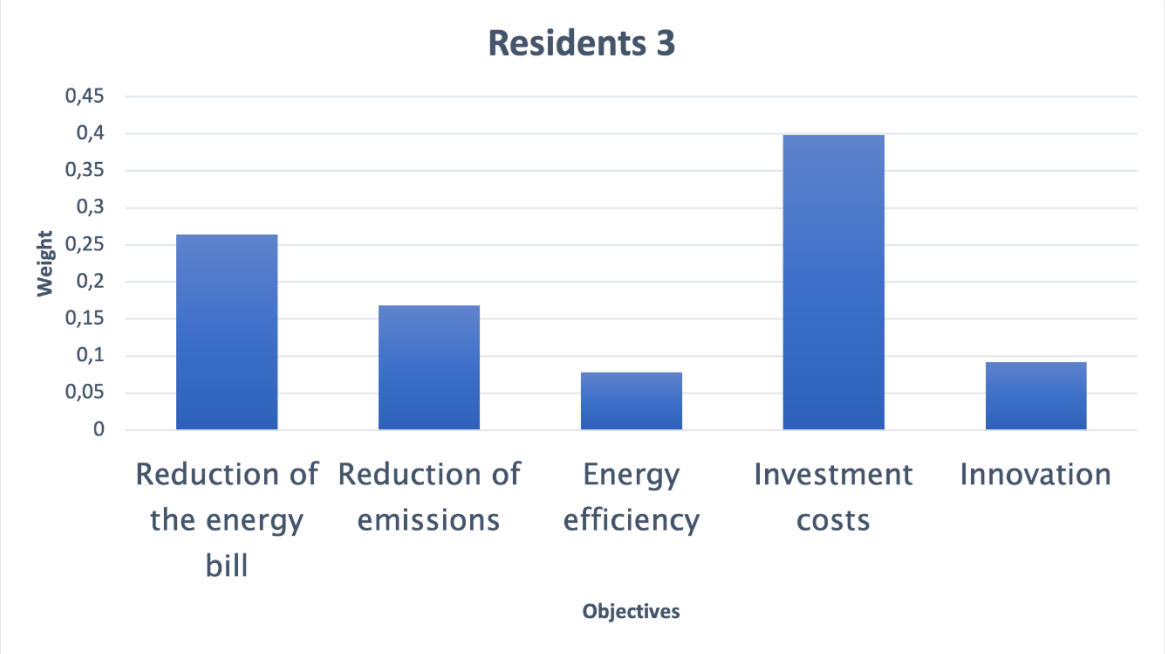

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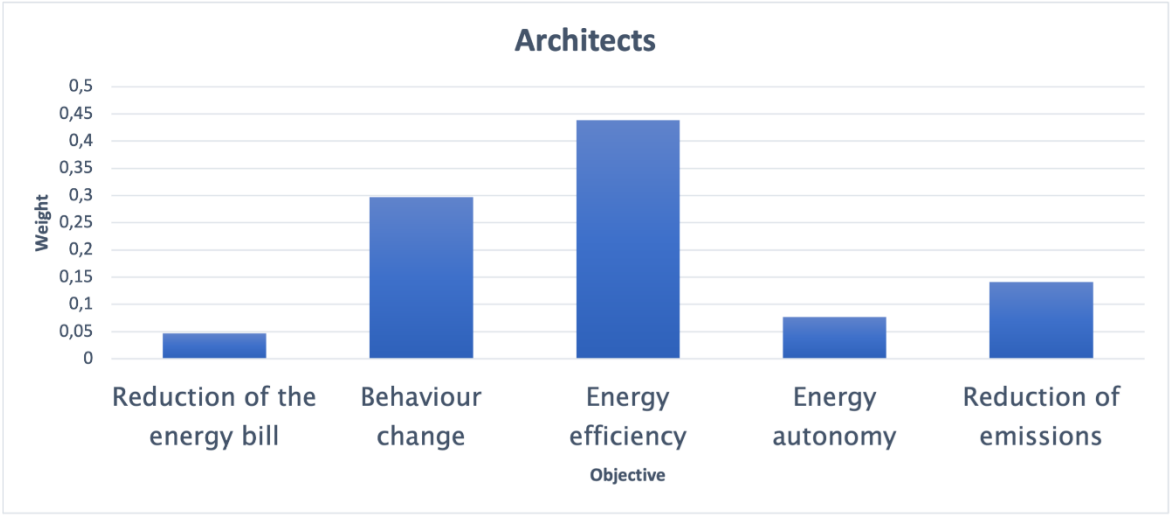

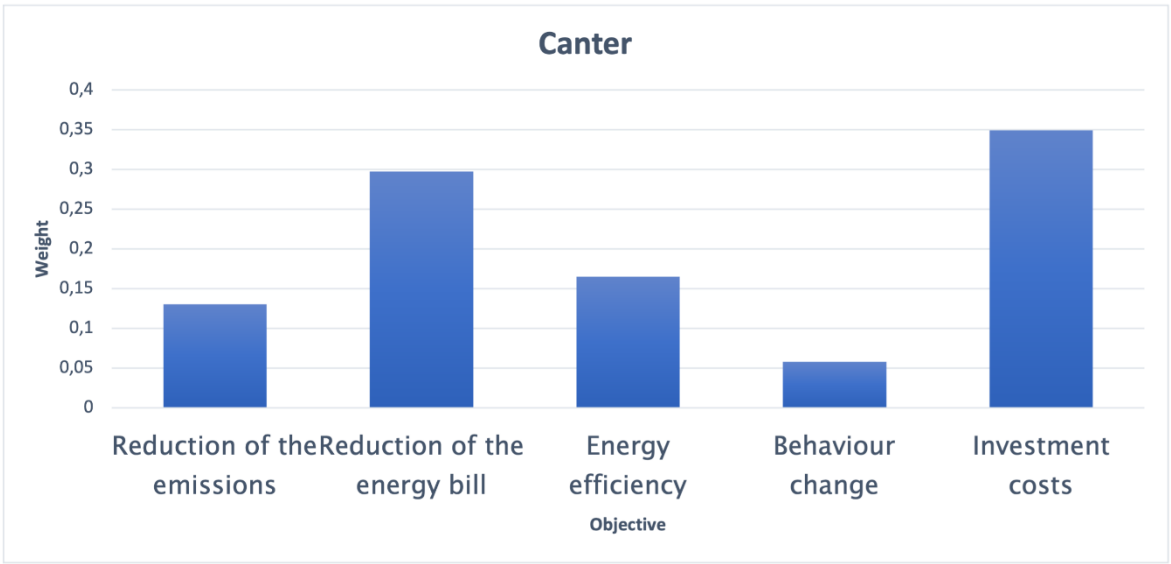

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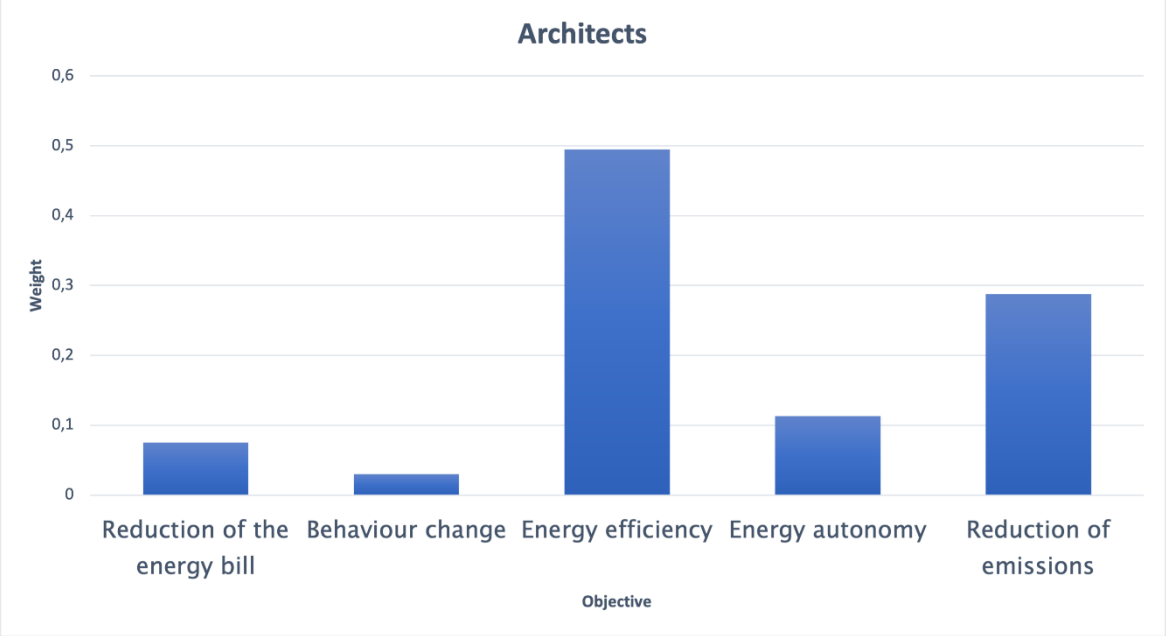

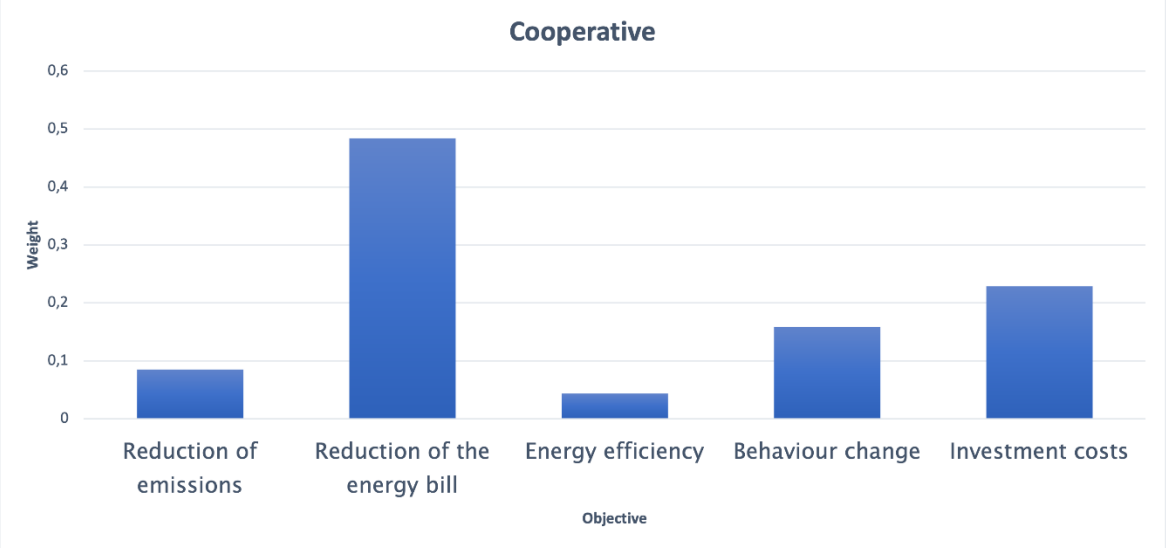

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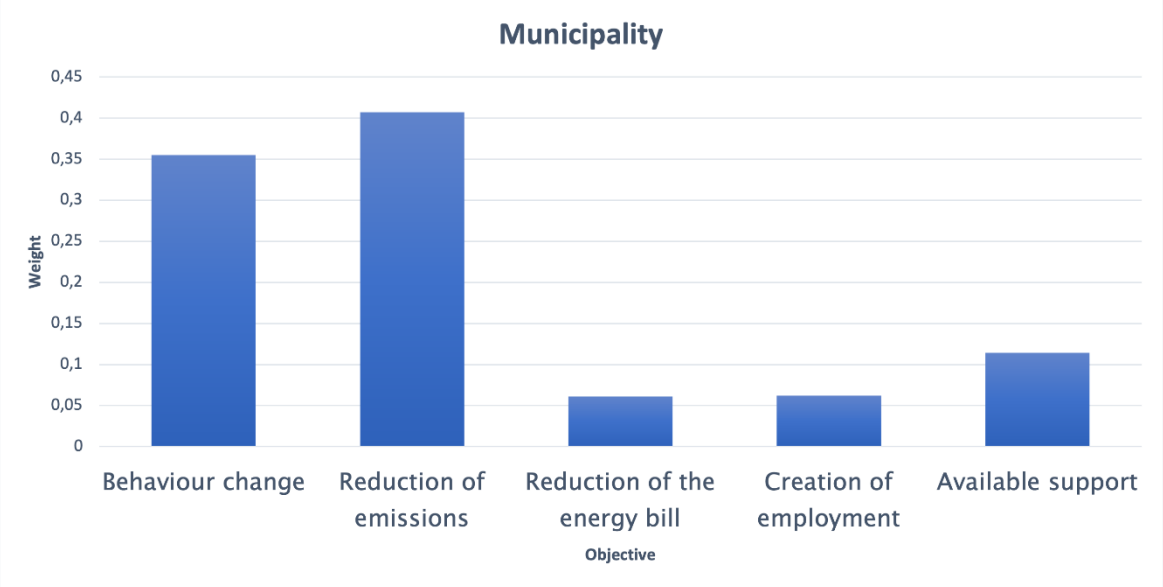

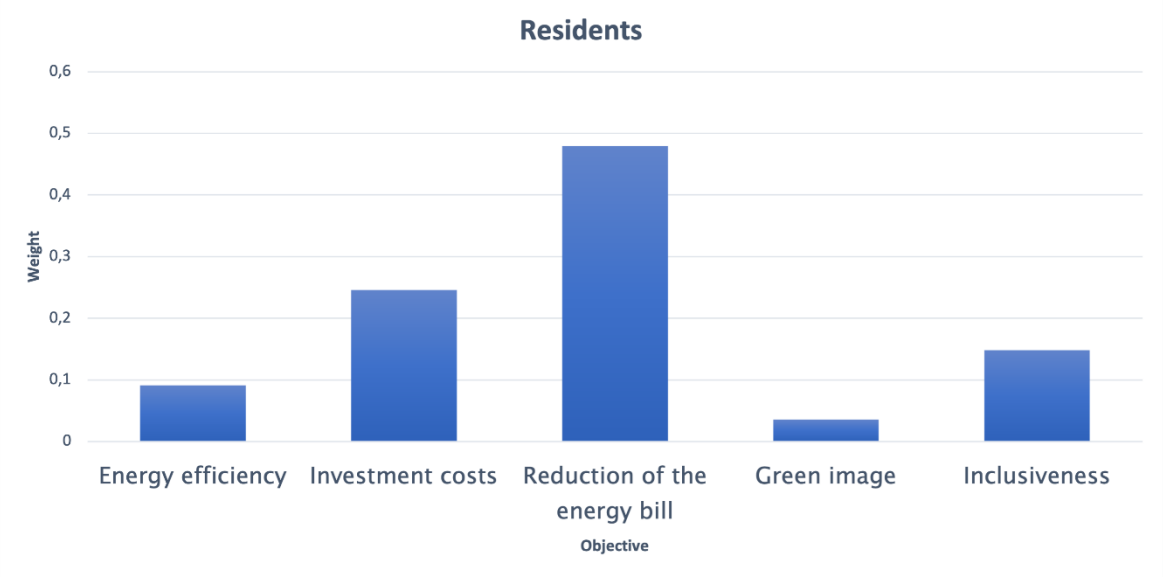

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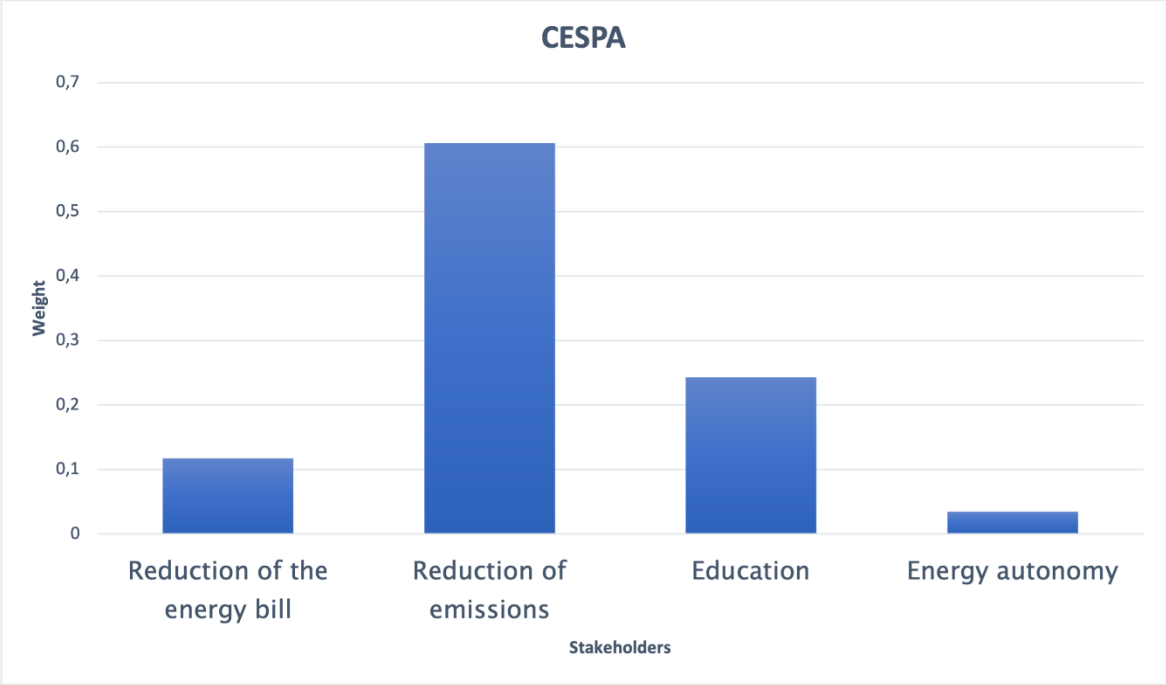
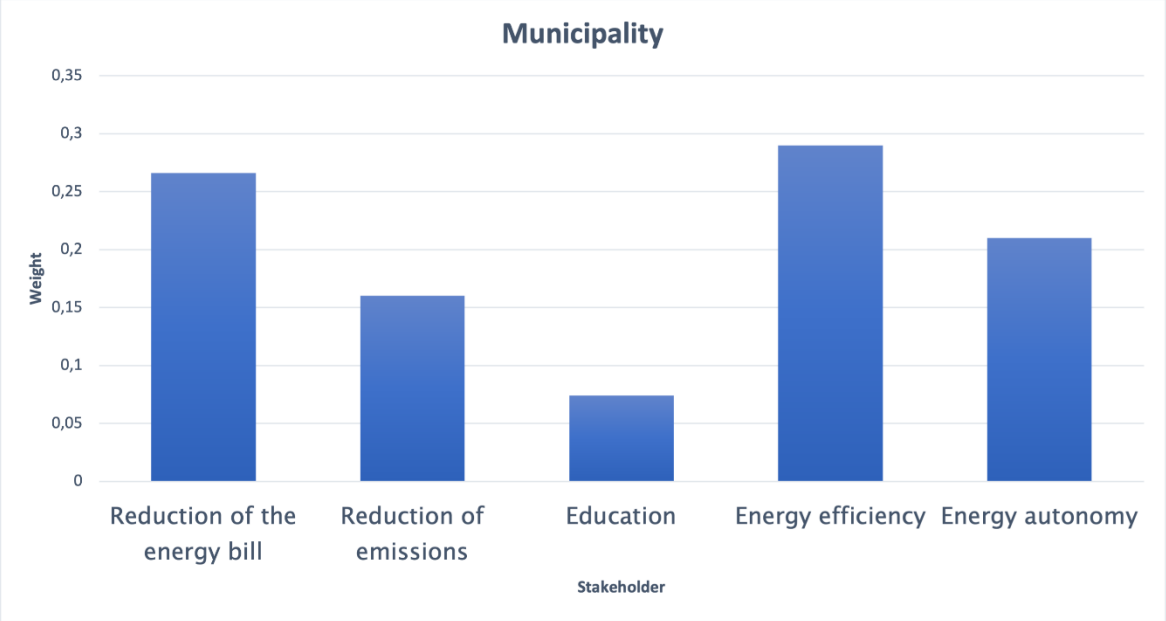
San Pedro de Atacama, Chile





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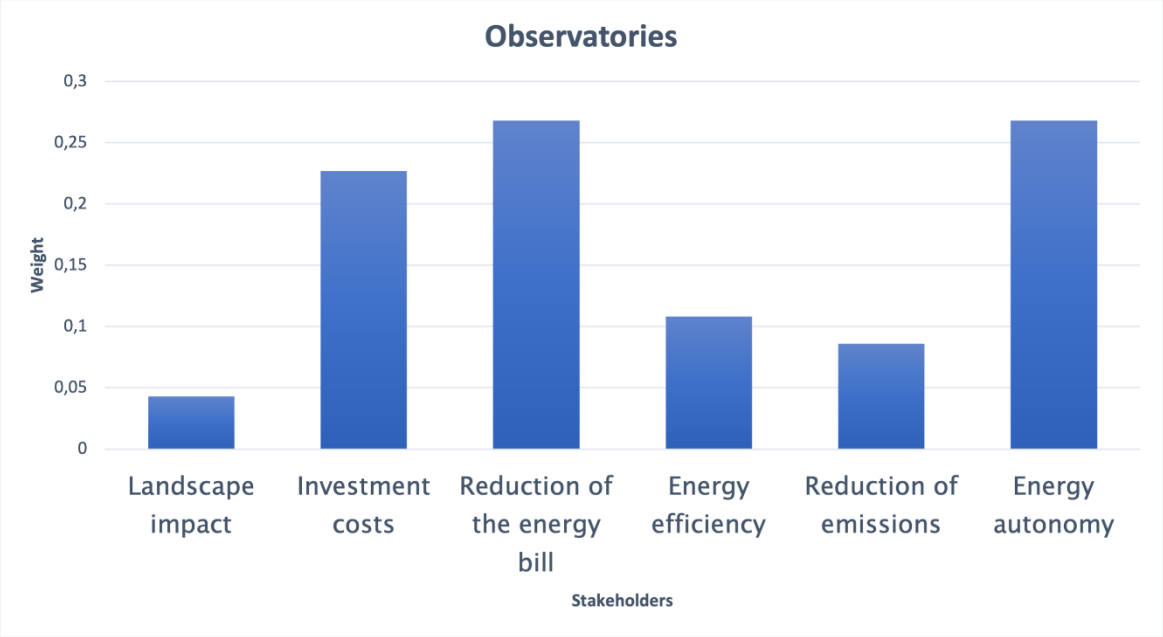

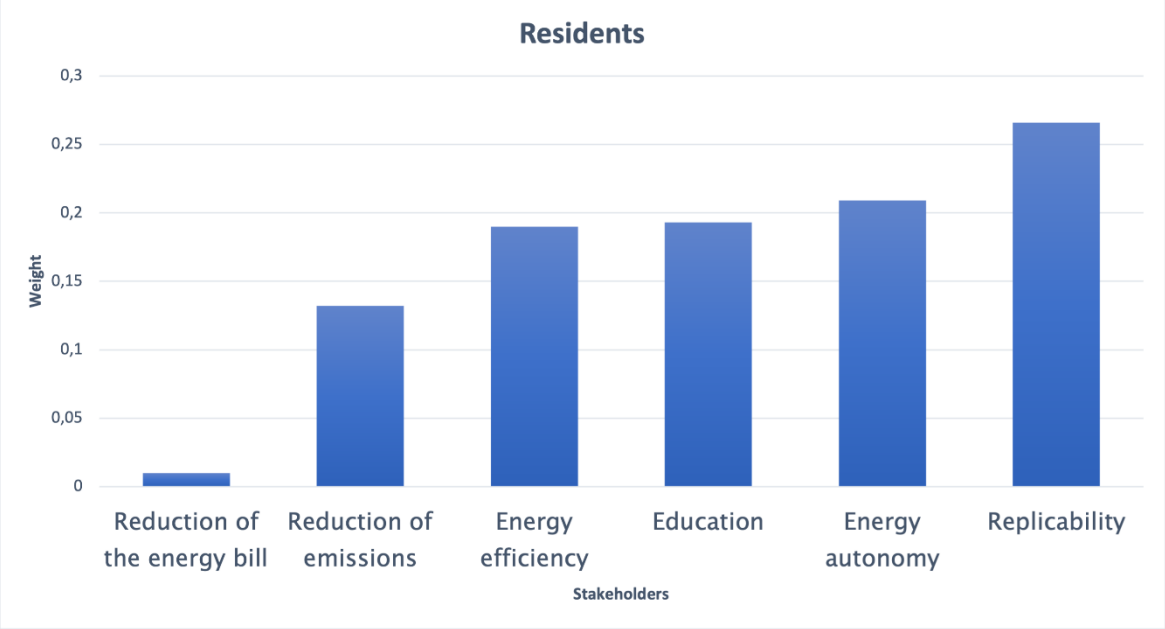

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