Climate and cultural based design and market valuable technology solutions for Plus Energy Houses

Guidelines for PEBs business models

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Authors:

M.A. Isabelle Christine Büttner, SIZ-Energieplus

Dr. Hermann Leis, SIZ-Energieplus

Reviewers:

Antoine Dugué, NOBATEK/INEF4

Roberto Lollini, Eurac Research

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1. Executive summary

The CULTURAL-E project focuses on the implementation of Plus Energy Buildings (PEBs), and therefore, studies plus energy demonstration buildings in four European climate zones. As a contribution to this research project, this study aims to support the implementation of PEBs with the definition of accompanying business models (BMs).

In view of the multiple crises, we find ourselves in (in particular the climate crisis and the Ukraine crisis), the switch to renewable energy is becoming increasingly important in order to both counteract the climate crisis and to become independent of international energy trading and consequently ensure a secure energy supply.

PEBs are a sustainable way of enabling this fundamental transformation, as they generate more energy than they consume. For the widespread implementation of PEBs, economic incentives are needed in addition to political incentives. In order to incentivize PEBs for house builders and owners, BMs were defined within this study that aim to market the benefits of PEBs in the best possible way. At the same time, these BMs should involve as little effort as possible for the PEB owner so that they remain attractive for the operator and affordable for the end customer. With these considerations in mind, the BMs "All incl. Rent" (Landlord-to-tenant-electricity), "All incl. Rent - Type Contracting" (Contracting), "Energy Budget" (Contracting), and "PEBs for Renewable Energy Communities" (PEBs for RECs) were developed in combination with PEBs.

A qualitative approach was chosen to analyse the obstacles and opportunities associated with the implementation of these new BMs. Semi-structured online interviews with experts from the construction sector from France, Germany and Italy were conducted following the structure of a SWOT analysis. The SWOT results were evaluated with a context analysis to provide an insight into the development of the above-mentioned BMs in terms of their potential. Furthermore, this evaluation contributes to the formulation of policy recommendations, marketing strategies, and guidelines for building owners and investors to facilitate the implementation of PEBs. In this context, our study emphasises the need for policy adjustments and innovative financial mechanisms to overcome the barriers to the implementation of PEBs.

More precisely, concerning political recommendations, the study emphasises among others the adjustment of current legal frameworks to allow for private energy trade, so that more people have the opportunity to purchase cheap local renewable energy, which can contribute to the fight against energy poverty. These and other recommendations can assist decision-makers and stakeholders in regions in and beyond the countries analysed.

In view of the number of respondents, it is not possible to speak of a single preferred BM. Nevertheless, the pure results show that the majority favours the Energy Budget BM. According to the SWOT Analysis the reason for favouring this BM lies in the fact that it is currently the most feasible to implement under consideration of the legal Frameworks of the countries analysed, while it is also comparatively easy to implement in terms of time and costs. In addition, the interviews revealed that the All incl. Rent BM and the All incl. Rent - Type Contracting BM with their all-inclusive "one-contract" rental agreement enjoyed a favourable response from the

interviewees. The one-contract was seen as very attractive from the tenant's point of view, because the simpler the contract, the bigger the incentive for the tenant to buy it. This approach is in the spirit of the time of our fast-moving world driven by globalisation, in which a simple contract means less bureaucracy than many different contracts and thus enables renting on a short-term basis.

From now on, it only needs to be seen whether these BMs will pave the way for a market for PEBs, and thereby help to support the ET in the building sector positively.

2. Introduction

Buildings account for 40% of final energy consumption and 36% of greenhouse gas emissions (GHG) in Europe (Barchi et al., 2023). In order to achieve the decarbonisation goals, renewable energy sources must be used widely. At the same time, energy flexibility on the demand side is critical to manage as well as reduce fluctuating prices, carbon emissions and grid congestion. Therefore, buildings must be able to manage demand and generation based on local climate, user needs and grid requirements (ibid.). This means that the construction sector has an important role to play in the transition to a climate-neutral society (Türk, 2023). In order to ensure a shift towards a climate-neutral construction sector, the EU Commission decided in 2021 on December 15th for a comprehensive revision of the Energy Performance of Buildings Directive (EPBD). This directive aims to accelerate the renovation rate of buildings, reduce GHG as well as energy consumption and furthermore to promote the use of renewable energy in buildings. In addition, a new EU definition of "zero-emission building" is to be introduced, which shall apply to all new buildings from 2027 and to all renovated buildings from 2030 (Dulian, 2023). This target is a central part of the European Green Deal and is in line with the EU's commitment to global climate action under the Paris Agreement (Ala-Juusela et al., 2021). Cultural-E acknowledges the proposal of the EU Commission but advocates for including the aim of implementing more Plus Energy Buildings (PEBs) in the EPBD as well. According to (CULTURAL-E, 2023) a PEB is:

"An energy efficient building that produces more final energy than it uses via locally available renewable sources over a time span of one year. Building uses include both building operation and user related energy consumption. The positive balance shall be reached while ensuring the lowest greenhouse gas emissions and a good dynamic matching between load and generation, according to economic affordability and to technical viability."

Additionally, PEBs are intended to ensure added value for the well-being of users by supporting the energy transition (ET) through an increased share of electro mobility as well as by supporting the public health through improved Indoor Environmental Quality (IEQ) leading to reduced costs for public health (CULTURAL-E, 2023).

Such an ambitious goal entails numerous challenges, as the realization of PEBs involves a complex social transformation, as people have to adapt to new building infrastructures, life in them, and technological advances to balance energy needs (Kerstens & Greco, 2023). At the same time, the importance of a supportive governance structure that supports societal change should not be ignored. In order to allow for this massive change, incentives are needed to promote the widespread implementation of PEBs. In addition to the right incentives within the socio-cultural environment, technological infrastructure and political landscape, economic incentives are also required to realize a change in the build environment. Given this, new BMs emerging alongside PEBs can be an incentive for the construction industry to offer more services focused on PEBs that simultaneously promote their adoption (Kerstens & Greco, 2023).

Against this background this research investigates in how far PEBs and its BMs contain opportunities and chances for the building sector and thereby incentives for implementing

PEBs. The observed BMs within this research link PEBs with Landlord-to-tenant-electricity BMs, Contracting BMs, and Renewable-Energy-Communities (RECs). In order to explore what obstacles hinder and what opportunities push the implementation of these new BMs related to PEBs, this paper uses a qualitative approach. Semi structured expert online-interviews based on a SWOT-Analysis in combination with a context analysis are intended to provide an insight in the development of the before mentioned BMs in terms of potential chances and risks. Thereby this research activity is not only assessing barriers and hindrances in the dissemination of PEBs but also contributing to formulating policy recommendations as well as guidelines for building owners and investors in order to allow for a facilitated implementation of PEBs.

This approach is in line with the research object of Task 4.8 within the Cultural-E research project that focuses on the definition of PEBs tailored solution sets and BMs. More precisely the objective of the Task 4.8 is the definition of BMs (i), the investigation of financial mechanisms (ii), the analysis of soundness of such BMs (iii) and evaluation of possible replication potential in further building developments (iv).

Accordingly, this research proceeds as follows: we begin by introducing the BMs of investigation as well as related funding mechanisms in the countries France, Germany and Italy. We then present the method of analysis and the consequential results that are discussed in more detail in Chapter 6. We conclude with a summary of the main findings and resulting guidelines for building owners and political stakeholders.

To this end, this research activity is especially important since the here introduced BMs aim to contribute to an economically attractive dissemination of Plus Energy Buildings. For their part, these lead to an increased use of renewable energy sources that promote energy efficiency and thus decisively prevent energy poverty. Consequently, this study contributes to the concept of “energy justice” (Pellegrini-Masini, Pirni, Maran, Klöckner, 2020).

3. Theory

The construction of a PEB involves higher investment costs than the construction of a regular multi apartment building. Additional investment is usually justified by the resulting profit. However, in the case of a PEB, only a small amount of value is generated from the surplus that can be sold directly. More precisely, a surplus of PV electricity is generated that can be fed into the grid for a low-price return. Against this background, the feed-in tariff obtained from the PEB electricity cannot be seen as profitable and therefore not as attractive business pushing the market for PEBs. With this in mind, BMs are needed which, as the name suggests, enable an additional business and therefore additional income for PEB owners. However, a business model usually means additional expenditure that shall result in a profit. Therefore, BMs and marketing activities mean more upfront costs that affect the end customer. In order to make PEBs attractive for owners, it was opted for BMs that aim to market what is already there in the best possible way. At the same time, this should involve as little effort as possible, on the one hand, so that the BM and thus the PEB remain attractive for the operator. On the other hand, the BM shall remain affordable for the end customer so that the BM does not fail due to insufficient sales. With these considerations in mind, the BMs "All incl. Rent", "All incl. Rent - Type Contracting", "Energy Budget", and "PEBs for Renewable Energy Communities" (PEBs for RECs) were developed in combination with a PEB.

All incl. Rent is a business model based on a very simple tenant-electricity rental-model. “Energy Budget” and “All incl. Rent – Type Contracting”, as the name already indicates are types of Contracting BMs with the management of assets at its core aiming to relieve the owner of the PEB of the operator tasks and additional necessary know-how. The PEBs for Renewable Energy Communities BM belongs to another type of business that centres around Renewable Energy Communities with the idea to facilitate the participation in renewable energy for everyone. However, what these models all have in common is that they all focus on making self-generated electricity available to the tenant, but in different ways.

The idea for these BMs did not come unexpectedly since Landlord-to-tenant-electricity is already enshrined in law in Germany, Renewable Energy Communities are implemented in Italy and energy-contracting is supported by the EU (Nikolina, 2016). At the same time, these business cases operate on different levels: “Energy Budget” starts before the PEBs are built, the All incl. Rent only comes into action after the buildings have been completed. Such a distinction is not possible for PEBs for Renewable Energy Communities, as these represent a business model from the planning phase right through to the start of operation.

In order to explain the distinct BMs – All incl. Rent, All incl. Rent Type Contracting, Energy Budget, and PEBs for Renewable Energy Communities – in more detail, and to allow for a common understanding on their function, they are going to be described in the following sub-chapter. For explaining the BMs, the Business Model Navigator concept, from the University of St. Gallen is used, since it is less detailed than the Business Model Canvas and therefore, more suitable as an introduction to the topic (Gassmann, Frankenberger & Csik, 2013). The second sub-chapter aims to inform what financial funding mechanisms can be applied when implementing the before mentioned BMs. Thereby, the funding instruments from France, Germany and Italy are

presented in relation to PEBs, Landlord-to-tenant-electricity (All incl. Rent), contracting (All incl. Rent – Type Contracting and Energy Budget), and Energy Communities (PEBs for Renewable Energy Communities).

3.1 Business Models

The BMs that can be used in connection with a PEB and form the basis of this research are described hereafter. First, the business model All incl. Rent is introduced, secondly, the All incl. Rent – Type Contracting business model is presented. Then the business model Energy Budget is described, before the last sub-chapter deals with the PEBs for Renewable Energy Communities BM. For the definition of the BMs it should be noted that these do neither include a calculation of the energy production, nor whether they are using on-site-, battery- or grid energy, as this depends on the size and location of the PEB.

3.1.1 All inclusive Rent

The "All inclusive Rent" business model is characterised by the fact that not only simple residential units are rented out, but also flats that include internet and a heating and electricity tariff. The heat pump installed in the PEB produces the energy for heating and hot water. The electricity is generated by the PEB's PV-systems. Any surplus energy is stored in the building's battery. By selling the electricity generated by the PEB to the tenants as part of the all-inclusive rental package, the landlord has an additional income to the rent. Here it is assumed that the landlord passes on the PEB energy to the tenants at a higher price than the feed-in tariff. At the same time, the tenant can benefit from low energy costs if the energy prices do not exceed the grid price. If the tenant does not use up the electricity-tariff, the landlord makes an additional profit as the energy can be fed into the grid at the feed-in tariff. If, on the other hand, the tenant exceeds the electricity-tariff, the tenant must pay a surcharge. As a practical example, imagine that payment of the all-inclusive rent follows similar rules as a telephone contract: an app shows the number of GB and/or minutes available and how many have been used. Any extra GB/phone minute used is usually charged at a proportionately higher price that has been set in advance. This is to ensure that tenants do not exploit the all-inclusive energy situation and use energy inefficiently. In case the energy generated cannot cover the tenants' needs, which is most likely to be the case in the winter months, the landlord must purchase additional energy from the grid to cover the demand. This contract model is attractive for the landlord because of the potential additional revenue. Also, for tenants, this BM is attractive, as they have a good overview of their monthly costs with one contract for rent and energy (instead of the usual separate contracts). In addition, they receive green electricity from PEB where they live in. However, the proportion of the energy generated by the PEB, as well as the proportion of stored and purchased energy, fluctuates, as this depends on the time of year, the location and the PEB's consumption.

Figure 3.1: Functioning of the business model All incl. Rent (own representation).

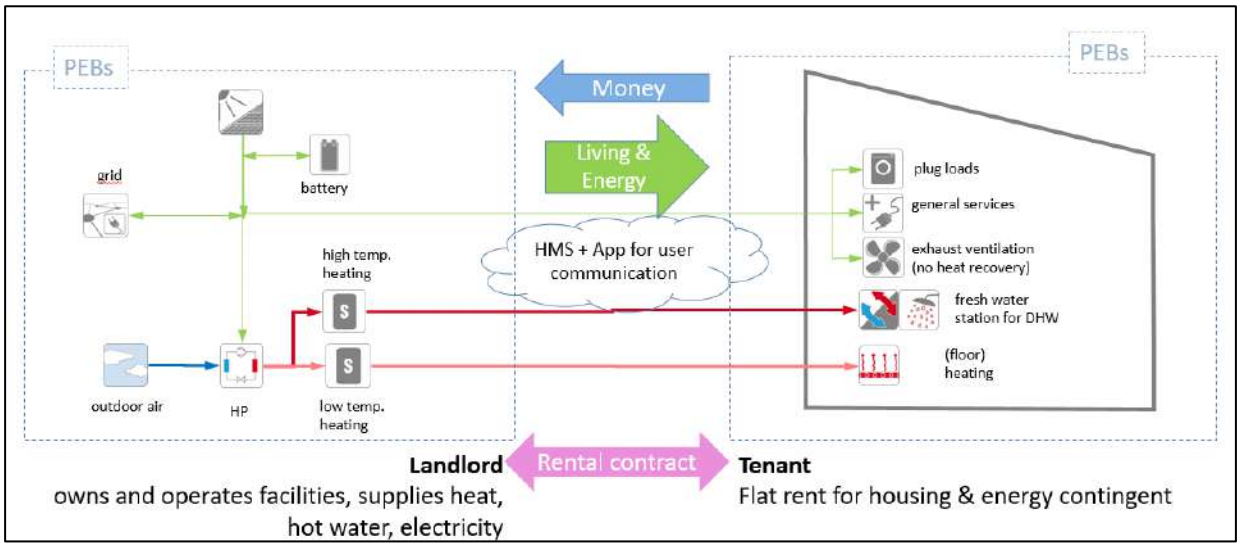
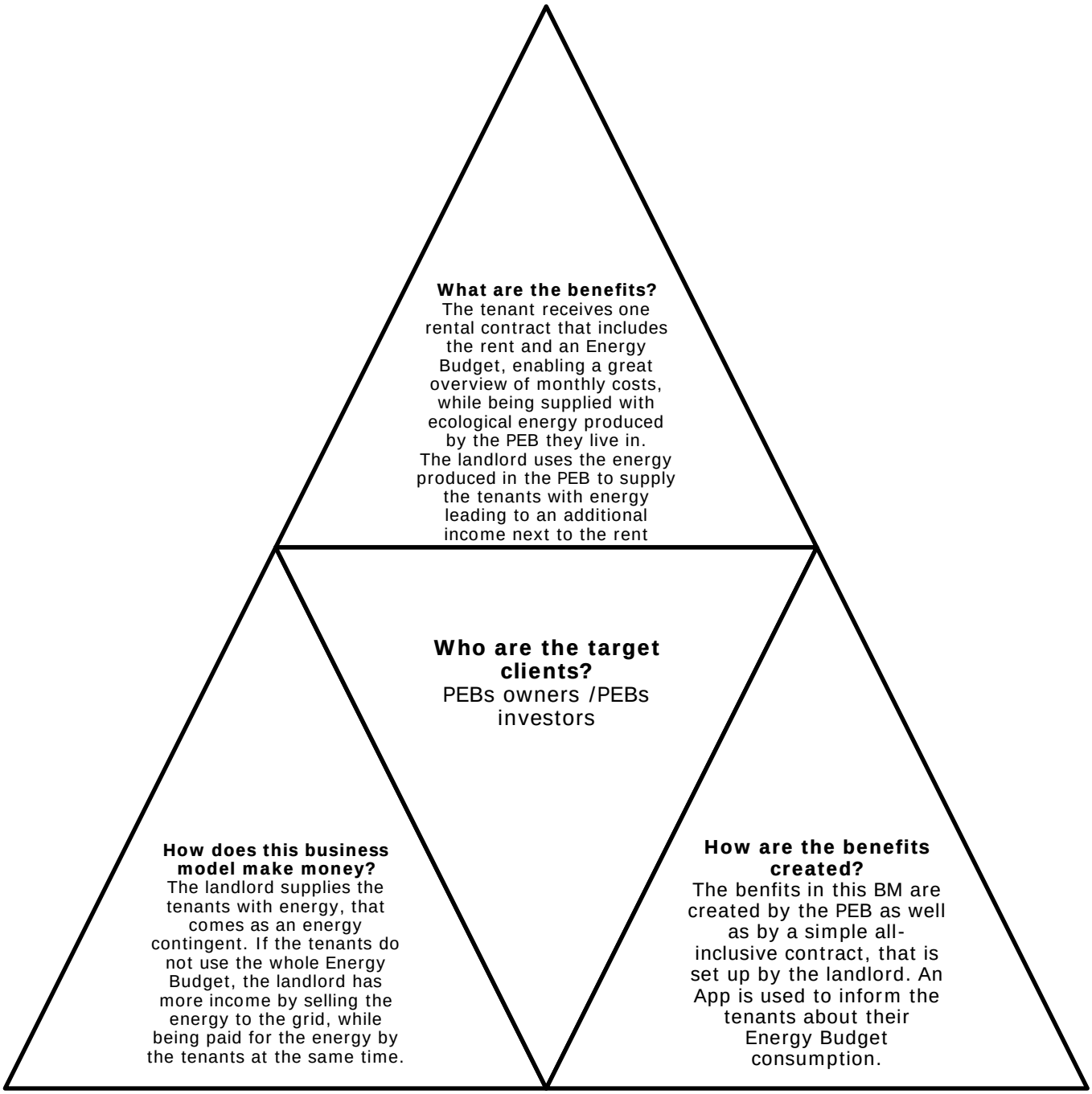


Figure 3.2: Business Model Navigator Concept for All incl. Rent (own representation).



3.1.2 All incl. Rent – Type Contracting

Like the “All incl. Rent” business model (introduced before), the "All incl. Rent - Type Contracting" business model is based on an all-inclusive rental agreement which, in addition to the rent for the flat, includes the supply with energy from the PEB's energy systems (see chapter 3.1.1). In comparison to the previous rental model, nothing changes for the tenants: they only have one contractual partner for the rent including in an electricity-tariff and therefore have a good overview of the monthly costs, while being supplied with ecological energy generated by the PEB.

The difference compared to the previous BM is that a contractor comes into play, who is responsible for the PEB's energy system. The contractor takes care of the delivery of heat, hot water and electricity to the tenants as well as the financing, operation and maintenance of the systems. The advantage for the landlord is that they have given responsibility for financing, operating and maintaining the PEB energy system to the contractor, so that they do not have to worry about any energy system related task. This means that the landlord achieves financial and time savings, while the contractor earns money for the supply of energy. The landlord is contractually in contact with the contractor and the tenant. On the one hand, the landlord has to pay the contractor for the entire energy supply, and on the other hand, the landlord has to settle the rent including the electricity-tariff with the tenants.

This business model is attractive for everyone involved: the landlord does not have to worry about the energy systems; the contractor takes care of this and receives money for the electricity sold; and the tenants only have one contract including rent and ecological energy from the PEB where they live in. It is quite possible that the landlord will pass on the costs of the contractor's service to the tenants (this situation cannot be generalized, as it is up to the landlord). Nevertheless, the costs should be in the margin between the grid feed-in rate and public energy market prices so that the rental concept remains attractive for tenants and they are willing to accept the energy budget

Figure 3.3: Functioning of the business model All incl. Rent - Type Contracting (own representation).

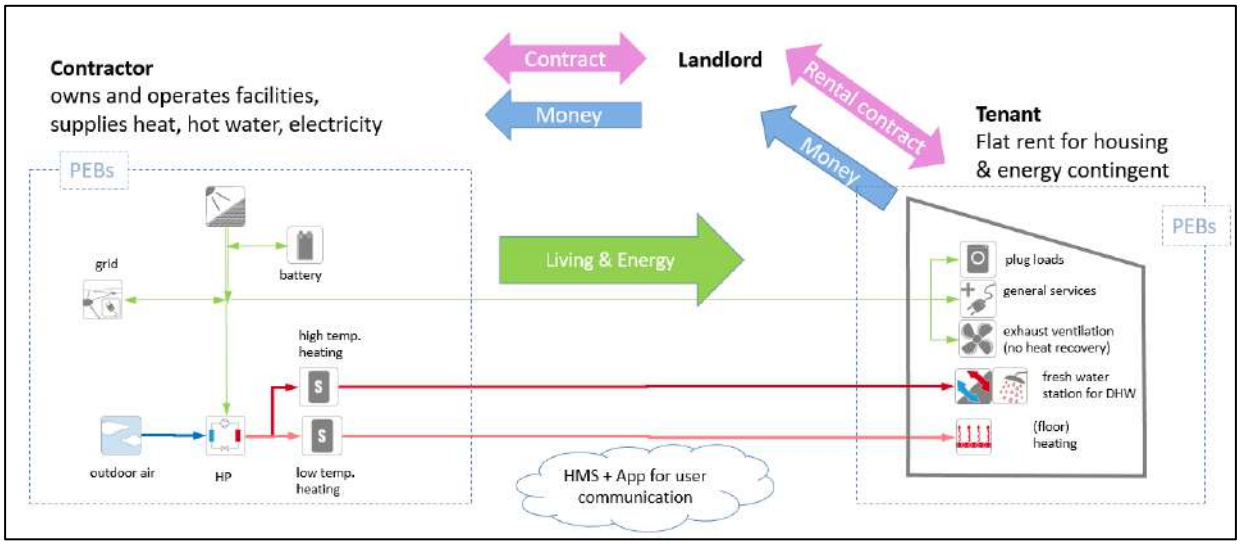
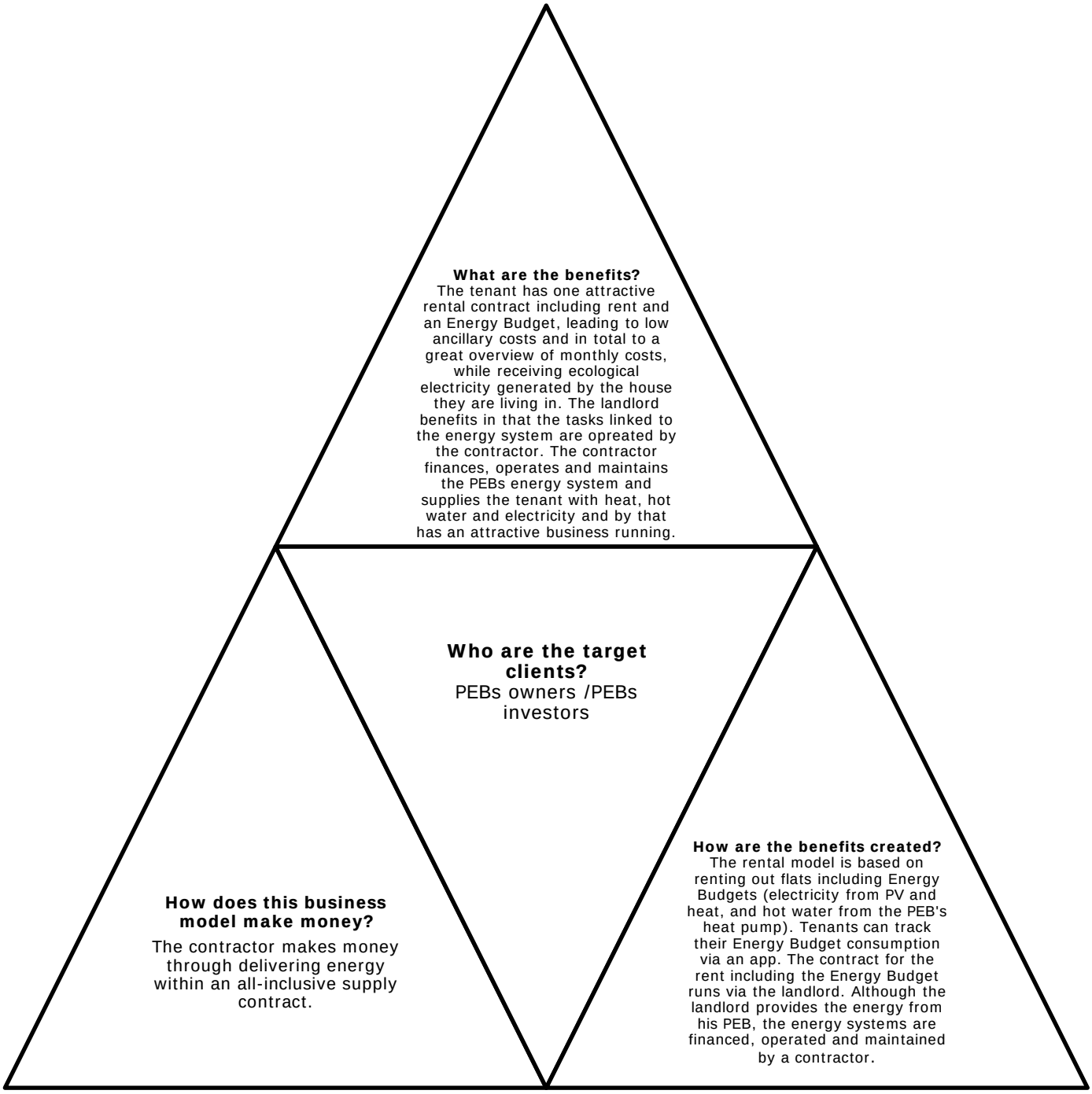


Figure 3.4: Business Model Navigator Concept for All incl. Rent – Type Contracting (own representation).



3.1.3 Energy Budget

This business model is on the side of the contractor, who finances, maintains and operates the PEB's energy systems. In comparison to the previous rental model, within this business model the contractor is in charge of most of the tasks, so that within the Energy Budget BM the landlord has the least additional work.

Consequently, the contractor is not only responsible for the maintenance and operation and the associated funding of the energy systems, but also for billing the tenants for their consumed electricity-tariff. The electricity-tariff is contractually agreed on between the contractor and the tenant at a monthly price. If tenants use more than their electricity-tariff allows, they pay a surcharge. If the own electricity from the PEB cannot cover the energy requirements, the contractor purchases additional electricity from the public supply network.

This business model leads to a win-win-situation for all parties: the landlord does not incur any additional costs, as the contractor is responsible for the financing, operation and maintenance of the systems as well as for billing the tenants. These services result in a lucrative business model for the contractor. This business model is also useful for tenants, as they receive an overview of their energy consumption via an App. At the same time, they obtain ecological energy from their own home at a good price. The financial profit for the contractor comes from selling the energy. Even though the PEB owner has no direct additional income, they have the advantage of financial savings by outsourcing the energy systems and time savings for outsourcing the billing of the tenants to the contractor.

Figure 3.5: Functioning of the business model Energy Budget (own representation).

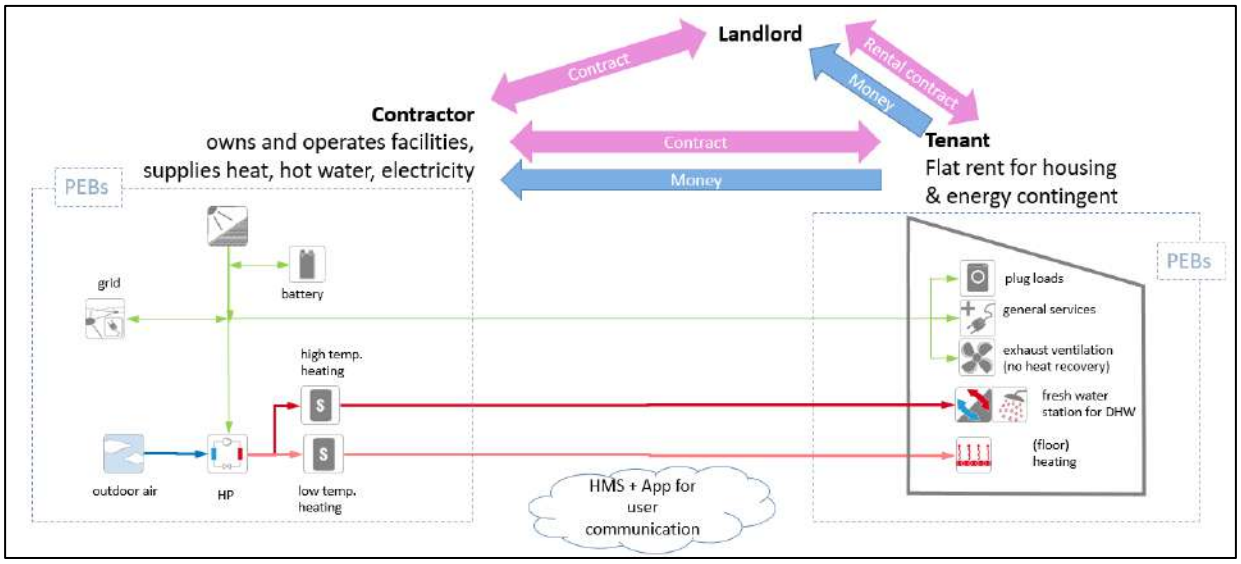
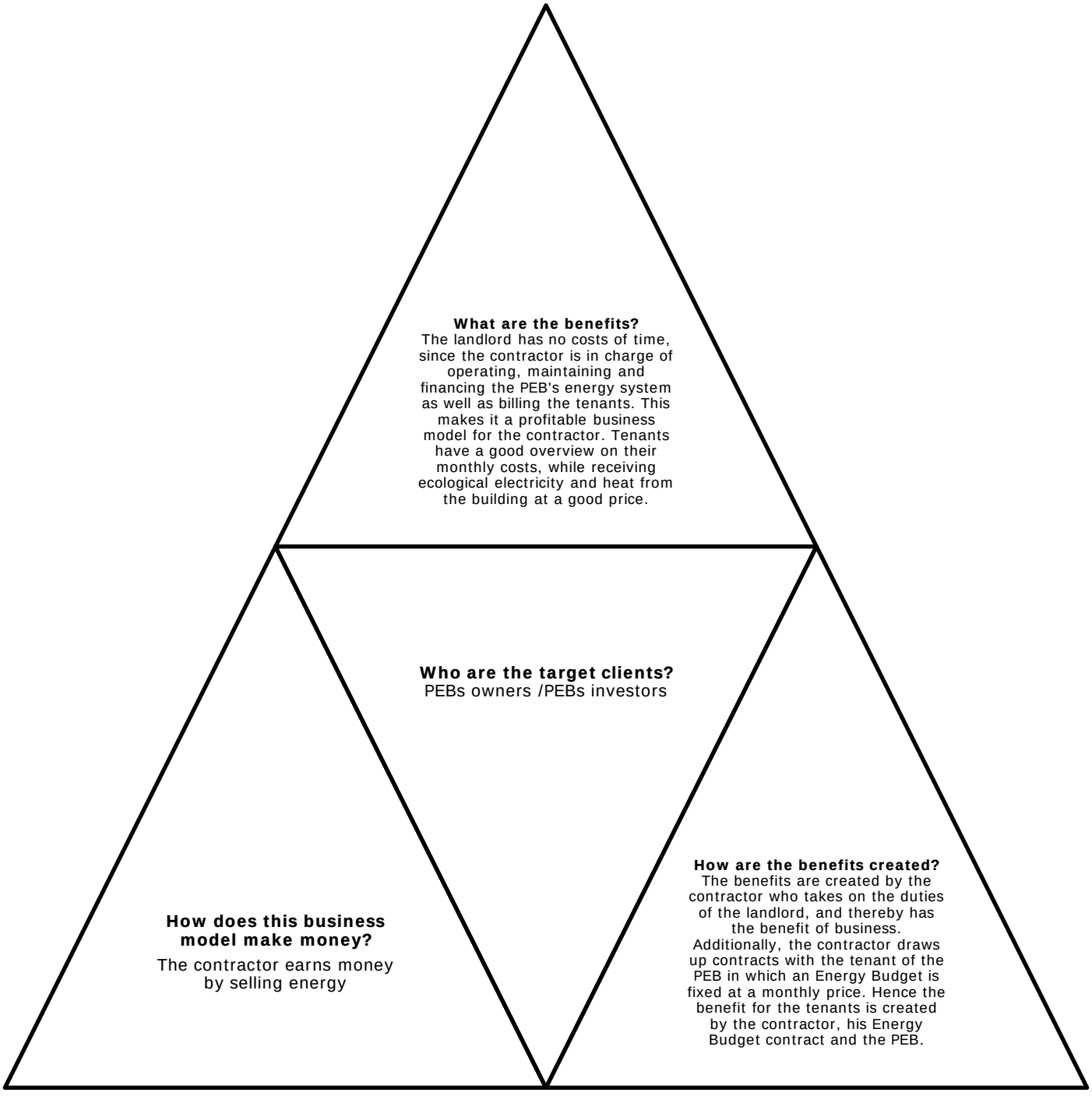


Figure 3.6: Business Model Navigator Concept for Energy Budget (own representation).



3.1.4 PEBs for Renewable Energy Communities

As part of the "PEBs for renewable energy communities" business model, a REC is opened in which users of a PEB join with users of neighbouring buildings to form a REC. A REC can be defined as a legal entity that brings together passive consumers, prosumers and small local producers of renewable energy. The overall objective of a REC is to promote local energy production and use through enabling technologies, e.g. photovoltaics and residential electricity storage. Cultural-E assumes a REC consisting of 20 nodes (see Annex E). The nodes have different renewable installations (photovoltaic, battery-energy-storage-system, heat pump etc.) and overall different characteristics and compositions. In this way, a certain degree of heterogeneity in terms of composition, behaviour and characteristics should be given in order to assume a realistic scenario. The PEB scenario contains a community that is composed of the 20 nodes and has enough renewable installations to fulfil the PEB criterion (see p. 9).

The possible achievable performance of PEBs for REC was analysed in comparison to the exchange of surplus energy to the grid (P2G) (see Annex E). It community energy in comparison to P2G energy leads to an improvement in overall performance (Annex E.). This is due to the fact that the introduction of a community and the consideration of a specific control improves the overall share and consumption of the locally generated energy resource. The relative improvements observed in the PEB scenario are twice as high as in the counterpart without a PEB (Annex E). There are also economic savings for users, as the use of locally generated renewable energy resources leads to a reduction in energy purchased from the grid. These results (for more details see Annex E) show that the presence of larger renewable energy installations improves the technical performance indicators both for the building alone as well as for the whole renewable energy community. In addition, PEBs can be used as enablers for the spread/adoption/developments of RECs. Due to their higher/larger share of renewable energy PEBs can improve technical and environmental indicators and thus performance at the community level. Finally, PEB have higher production and local energy system management capacities compared to non-PEB scenarios (Annex E).In terms of the tasks associated with operating the systems (financing, operation and maintenance), this business model assumes that these are shared among the members of the community. Due to the shared investment costs and therefore lower costs, participation in the renewable energy community is financially possible for more people than if the entire PV system/heat pump had to be purchased by each and every one themselves. Against this background, this renewable energy community model is a very inclusive model, as participation is possible for people of different income levels, as well as for people living in different building types. Various buildings can participate in the renewable energy community, as they benefit from the renewable energy from the PEB and other buildings energy. Consequently, the installation of renewable energy systems is not necessary for every building. For example, older and/or listed buildings where the installation of a renewable energy system is difficult or impossible can also be part of renewable energy generation.

Overall, the resulting advantages can be summarized as follows: The electricity generated locally and used by the community members also contributes to network efficiency, since the direct use can help to shave grid peaks. Furthermore, the shared financing of the energy plants

by the members leads to financial security for the PEB construction company. The financial advantage for the members of the energy community lies in the savings from generating their own electricity compared to purchasing it from the grid. In addition, the social and inclusive aspect of participation in renewable energies through PEBs and energy communities in the spirit of “PEBs for all” is a marketing concept that can lead to more construction contracts for PEBs.

Figure 3.7: Functioning of the business model PEBs for Renewable Energy Communities (own representation).

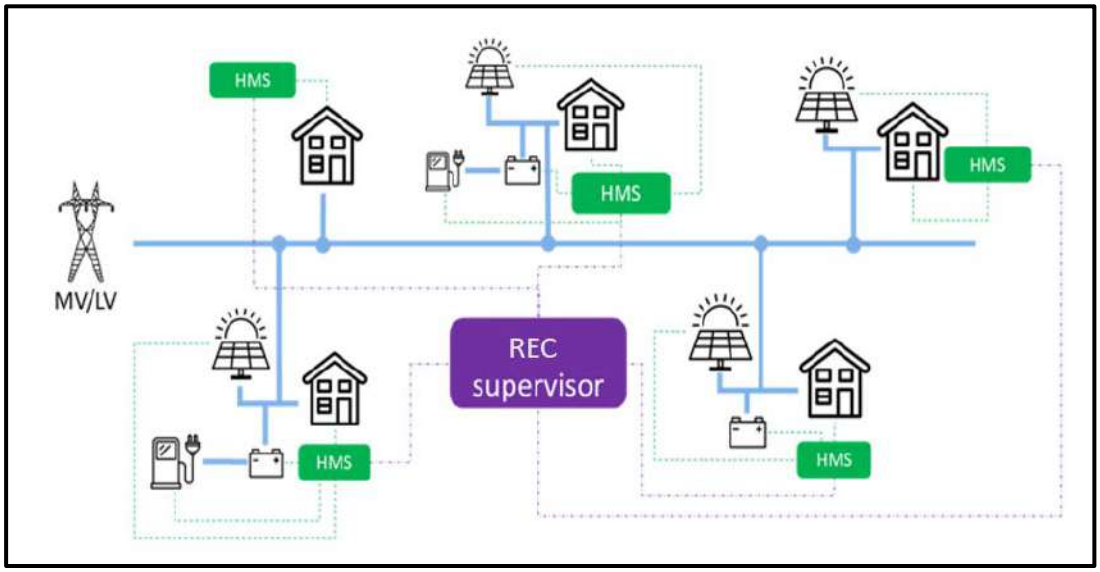
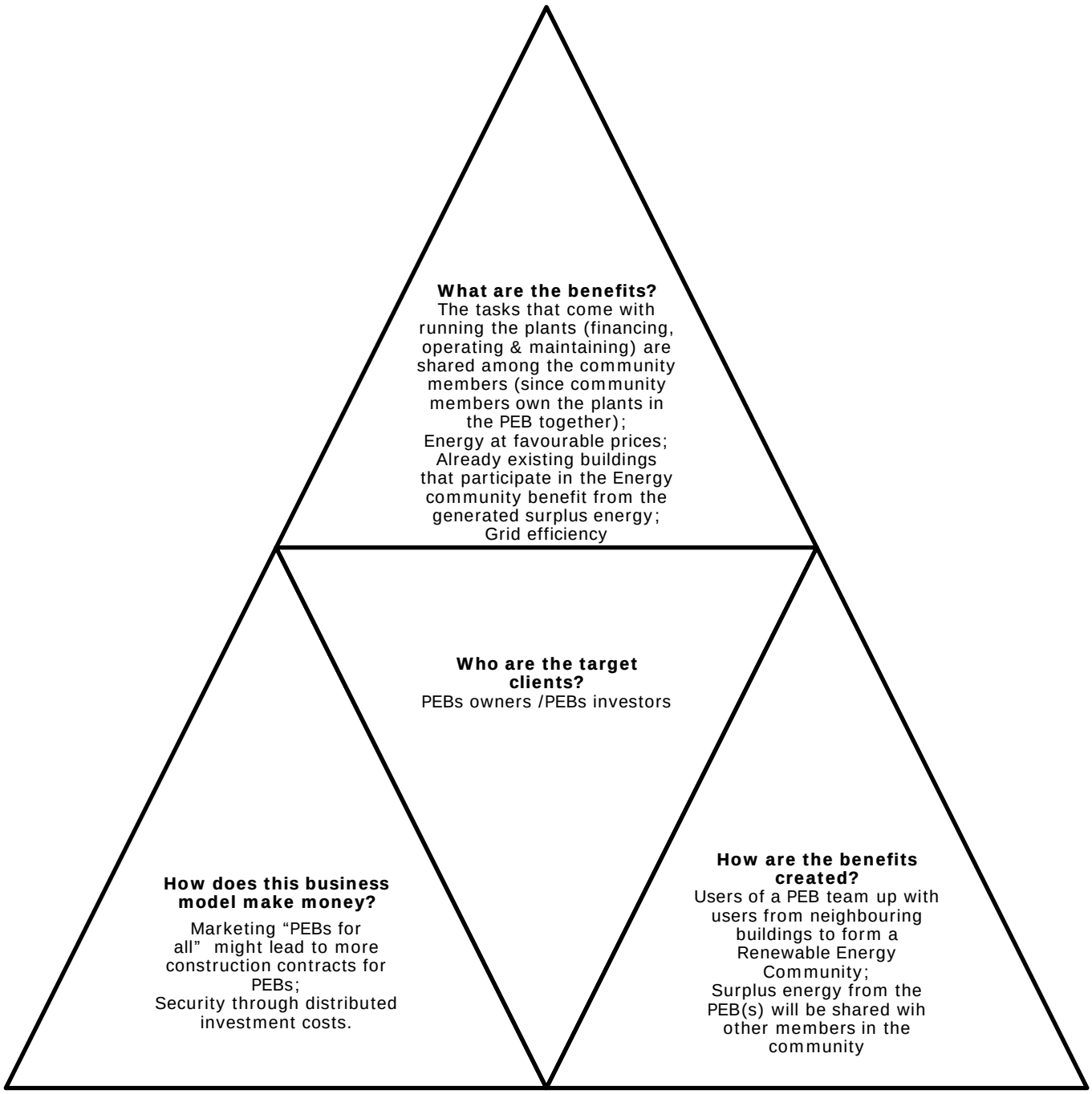


Figure 3.8: Business Model Navigator Concept for PEBs for Renewable Energy Communities (own representation).



3.2 Financial Mechanisms

The following subchapters show the relevant funding landscapes for the aforementioned BMs in the countries analysed. Thereby the funding instruments are presented in the same order as the presentation of the BMs (chapter 3.1), while the countries are presented in alphabetical order with their respective financial mechanisms. Accordingly, in France (i), Germany (ii), and Italy (iii), subsidies for energy-efficient houses and PEBs are examined first, and then financial mechanisms for Landlord-to-tenant-electricity[1] are described. Thirdly, the contracting BM and respective financial instruments are central. Finally, subsidies for energy communities are outlined. However, it must be pointed out in advance that financial funding programs are prone to political and jurisdictional changes and therefore refer to the country specific legislations for the period of the study in winter 2023.

3.2.1 France

In France, subsidy instruments focus on existing buildings and their renovation; those can be combined in many ways (Dena, 2019). In order to be eligible for subsidy programmes in France, a certified company (Dena, 2019) must carry out the efficiency measures. The best known of France's funding instruments is the energy savings certificate, (Certificats d'économie d'énergie), which often contributes to the financing of efficiency measures in the building sector. In addition, this presents an important source of income for financing subsidy structures for energy-efficient refurbishments in France. The amount of funding depends on the recipient's income. In this respect, the lower the income, the higher the subsidy. With this approach, France aims to reduce energy poverty (Dena, 2020). For this reason, there are individual subsidy programmes in France that are specifically aimed at low-income households (Dena, 2019).

Aiming at a global evaluation of the impact of the construction sector, France introduced an experimentation called E+C- in 2016. The objective was to introduce the impact of the locally produced renewable energy and life cycle analysis through the global warming potential criteria. It integrates four different energy efficiency levels (levels 1 to 4) as well as two levels (1 and 2) for environmental compatibility in terms of GHG to be certified. The energy consumption is calculated considering heating, cooling, ventilation, lighting and domestic hot water and at the so-called level 4, the overall balance should be negative. Therefore, it corresponds to a French definition of Positive Energy Building.

In 2022, the new regulation for buildings RE2020 applied to residential buildings (starting 1st January) and office and school buildings (1st July). It is built upon the feedback of the E+C-, and as such introduces maximum energy consumption level and a way to calculate the global environmental impact based on GHG evaluation. There are 6 criteria:

[1] For more information about the Landlord-to-tenant-electricity concept visit: https://www.bmwk.de/Redaktion/EN/Artikel/Energy/landlord-to-tenant-electricity-supply.html

- Bbio : it evaluates the overall passive level of the building
- CEP: the total energy consumption for heating, cooling, ventilation, lighting and domestic hot water
- CEP NR: the share of energy consumption coming from non-renewable energy
- IC énergie: GGH associated to energy consumption
- IC contruction: GGH associated to materials and construction processes
- DH: Confort indicator

Against this background the current legislation and its active main national funding instruments for incentivising energy efficiency in new buildings or, more precisely, PEBs and the BMs, Landlord-to-tenant-electricity, contracting and energy communities are presented in what follows.

3.2.1.1 PEBs & Financial Mechanisms

Since PEBs are newly constructed buildings, only financial mechanisms that are applicable for new buildings similarly to low emission buildings like PEBs are considered in this sub-chapter.

With that in mind, one duty for new buildings in France is that those are not allowed to consume more than 50 kWh/m² of primary energy per year since 2013 in order to comply with the lowest energy standard (Bâtiment basse consommation, BBC). This limit, however, varies depending on the type of building, climate zone and living space. If a building fulfils the BBC label, the owner can benefit from a reduction or even an exemption from property tax (simulation-pinel.fr, 2024).

Another tax incentive is given for highly efficient heating and hot water systems (e.g. heat pumps, solar thermal, geothermal and biomass systems, micro-CHP systems, connection to heating networks) in that owners and tenants can benefit from receiving 30% of the total costs. A maximum of €8,000 for a single-person household or €16,000 for couples can be credited. Minimum efficiency requirements for the installed components or systems must be met, in contrast there are no requirements regarding the overall efficiency of the building. However, the payment is not a tax reduction, but rather a proportional reimbursement of costs that is deducted from the tax burden based on the invoices presented. A credit can therefore be received even if no tax has to be paid (dena, 2019).

There is also the option of applying for grants for efficiency measures. Grants of up to several hundred euros are available for carrying out insulation measures or installing an energy-efficient electricity, hot water or heating supply with a simple application process (ibid.).

In addition, to the national funding programmes, one can also apply for funding offers from the regions, which are often combinable with national funding. These include interest-free microloans, grants for carrying out energy audits and grants for energy-related renovation work (ibid.).

Against this background, there are different tax mechanisms that financially support energy efficiency measures in the building sector that can be used for the highly efficient energy system within a PEB. In addition, regional funding opportunities might be applicable as well.

3.2.1.2 Landlord-to-tenant-electricity & Financial Mechanisms

Funding opportunities for the Landlord-to-tenant-electricity BMs in application with PEBs are presented in the following.

Landlord-to-tenant-electricity and shared self-consumption are practices that have found their way into some European countries. In France, tenders for self-consumption projects have been launched in recent years, which allow community self-consumption (Solarimo, 2019). As a result, the installation of a photovoltaic system benefits from lower Valued Added Tax (VAT) for the installation on the one hand and subsidies for the sale of the electricity generated on the other hand. This instrument applies insofar that in case the electricity produced by the photovoltaic system exceeds self-consumption and the resulting surplus is fed into the grid, this is subsidised with an investment premium (prime à l'investissement). The amount of this premium on the VAT depends on the peak results of the system (expressed in kilowatts peak = kWp). The amount of the premium is renewed each quarter a year and paid over the first 5 years of operation of the system. The remuneration for the surplus fed into the grid continues after the 5 years of premium payment. For photovoltaic systems that are connected to the electricity grid and have an output of 3 kWp or less, VAT of 10 per cent is applied. With an output of more than 3 kWp, the VAT rises to 20% (Zentrum für Europäischen Verbraucherschutz e.V., 2022). Conversely, the prices for feed-in differ depending on whether the surplus electricity is fed into the grid or whether the entire production is sold. In 2022, for example, the feed-in tariff for a system with an output of 3 kWp was €0.10/kWh if only the surplus was fed into the grid. In contrast, total electricity production received €0.1814/kWh (ibid.). It must be emphasised that income from feeding self-generated electricity into the grid is not taxed if

- the output of the system is less than 3 kWp;
- it is connected to the public grid at a maximum of two points;
- it is not intended for the exercise of a professional activity.

If the output of the system is more than 3 kWp, the income from it must be declared in the income tax return (ibid.).

Following this, BMs based on Landlord-to-tenant-electricity (here All incl. Rent) benefit in France from a subsidy on PV systems, as well as from a subsidy on the sale of electricity. Under further conditions, Landlord-to-tenant-electricity also benefits from not being taxed.

3.2.1.3 Energy supply contracting & Financial Mechanisms

This sub-chapter deals with the business of contracting and respective funding instruments available in France. In this regard it can be examined that semi-governmental organisations (sociétés d'économie mixte) have been successfully established in several regions in France, that, in addition to information and consulting services, also offer financing for energy refurbishments in some cases, with which they refinance their investments based on the energy costs saved. One example of this is a company that provides technical and financial advice for refurbishments in owners' associations and develops financing plans. With such an overall offer, a great energy efficiency can be gained (dena, 2019). Although this kind of contracting helps to enable energy efficiency, there is a lack of incentivising subsidies in this field in France in that there are currently no financial mechanisms for contracting in France available.

3.2.1.4 Energy Communities & Financial Mechanisms

Renewable energy communities are authorised under EU law to produce, consume, store and sell renewable energy from their own regional plants and to share the renewable energy produced within the REC. This practice is known as energy sharing (Official Journal of the European Union, 2018). In accordance with the Renewable Energy Directive (RED II) of December 11th, 2018, the member states had to ensure that the rights of renewable energy communities were transposed into national law by June 30th, 2021 (Zygierewicz & Salvador Sanz, 2021).

In 2021, France revised and extended the Collective Self Consumption law to fulfil the requirements of the EU directives on energy sharing. Accordingly, an energy sharing initiative may be set up within a radius of 2 kilometres and supplied by the same provider. The organising legal entity can apply to the Ministry of Energy for an extension to 20 km if the initiative is located in areas with low population density (BBEn, 2023). The maximum installed capacity should be 3 MW within the energy sharing initiative. Any type of power generation technology is allowed. A smart meter is mandatory. No special inverter is required as PV electricity benefits from a priority feed-in scheme (ibid.).

Concerning financial mechanisms REC where the participants are supplied by the same substation (i.e. rather small initiatives) have the option of opting for a special grid fee scheme. This scheme is more dynamic and includes seasonal tariffs, peak and off-peak tariffs and different values for the whole year. It can be financially attractive in situations of high self-production. However, most initiatives seem to be opting for the conventional grid fee system for the time being (BBEn, 2023). However, energy sharing has no impact on taxes and levies in France. There is only an incentive in that individual self-consumers can opt for a feed-in tariff specifically designed for the surplus they feed-in; a tariff just as high as the full feed-in. Alternatively, they can sell their production outright. In this case, they have access to the regular tariff (ibid.).

In short, in France there exist no direct positive incentives for energy sharing other than a special grid feed-in tariff.

3.2.2 Germany

In the beginning it was mentioned that in theory laws are subject to changes, this is not pure theory but can also be observed in practice, as the German legislation is currently changing. This can be seen in that the Federal Constitutional Court announcement from November 15th, 2023, which affected the 2nd supplementary budget 2021 insofar that the Federal Ministry of Finance imposed an immediate budget freeze. According to this change, no new financial commitments associated with payments for the years from 2024 onwards will be permitted. This is now significantly influencing the funding landscape of Germany, so that both the acceptance and the approval of funding applications have been paused until further notice (Bundesamt für Wirtschaft und Ausfuhrkontrolle, 2023).

Nevertheless, it was decided to present German funding instruments that were active up to this time in the following subchapters.

3.2.2.1 PEBs & Financial Mechanisms

In Germany, subsidies are granted independent of income, but dependent on the impact of the measures taken. Hence, many subsidies are linked to the achievement of a standard (Deutsche Energie-Agentur, dena, 2019).

Similarly, the “Klimafreundlicher Neubau” (Climate-friendly new building) funding programme, which the Federal Ministry of Housing, Urban Development and Building launched on January 1st, 2023, as funding for new buildings, also aims at reaching a standard. More specifically, the construction of climate-friendly and energy-efficient residential and non-residential buildings that fall below specific limits for GHG in the life cycle analysis and meet the energy standard of an Efficiency House 40 for new buildings[2] can benefit from the funding. The aforementioned residential Efficiency House 40 buildings comply with the requirements for the sustainability labels " Quality label for Sustainable Buildings -PLUS" or "Quality label for Sustainable Buildings - PREMIUM". This is important to consider, since a distinction is made between buildings with and without the Quality label for Sustainable Buildings (QNG) when awarding subsidies (Bundesministerium für Wohnen, Stadtentwicklung und Bauwesen, 2023).

Following this, subsidies are granted as a loan with a minimum term of 4 years. The amount of funding is up to 100 per cent of eligible costs, up to a maximum of

- €100,000 per residential unit for buildings without QNG and

[2] The index 40 indicates that the efficiency house requires only 40 % primary energy compared to a reference building (in accordance with the Building Energy Act). In addition, the transmission heat loss is only 55 % of the reference building. The building's structural thermal insulation is therefore 45 % better.

- €150,000 per residential unit for buildings with QNG

and covers:

- Construction costs,

- Costs for specialist planning and construction support services including services for life cycle analyses or sustainability certification and

- own contributions

Following this, the here demonstrated “Climate-friendly new building" funding programme is applicable for Plus Energy Buildings.

3.2.2.2 Landlord-to-tenant-electricity & Financial Mechanisms

After introducing the funding programme for PEBs, now funding possibilities for the tenant-electricity business model are going to be presented. In order to call to mind, this business model comprises the following characteristics:

- renewable energy is generated in-house
- which is primarily supplied to the residents (without using the grid) within the customer system and consumed in the building
- and fed into the grid as "surplus feed-in"

Foremost, this Landlord-to-tenant-electricity model is subsidised in that no grid fees, levies and charges need to be paid for electricity that is generated, supplied and consumed within the residential complex (Bundesnetzagentur, 2023).

In addition to the aforementioned savings on grid fees, levies and charges, further funding instruments can be applied when the Landlord-to-tenant-electricity model is based on solar energy. In this case, the system operator can claim two types of subsidies:

- the "tenant electricity bonus" for the Landlord-to-tenant-electricity supply quantities
- the feed-in tariff for the surplus electricity fed into the grid

Even though, the amount of the tenant electricity bonus is connected to the feed-in tariff rates for solar electricity, the tenant electricity bonus does not correspond exactly to the feed-in tariff. This is because the Landlord-to-tenant-electricity provider not only receives the tenant electricity bonus, but also the income from the sale of the Landlord-to-tenant-electricity. Against this background, the tenant electricity bonus is lower than the feed-in tariff, as the Landlord-to-tenant-electricity provider also receives the income from the sale of the Landlord-to-tenant-electricity in addition to the bonus. In 2023, the tenant electricity bonus for new PV systems up

to 10 kW is 2.67 cents, up to 40 kW 2.48 cents and up to 100 kW 1.67 cents. In the case of feed-in remuneration, the (surplus) feed-in to the grid is balanced by the grid operator. In the case of direct marketing, the contracted direct marketer takes care of balancing and marketing (Bundesnetzagentur, 2023).

In summary, the Landlord-to-tenant-electricity model is not only profitable due to the selling of energy, but also when the here presented financial mechanisms are applied. Hence, this model can profit from three lines of income: revenue from tenants, feed-in tariff and tenant electricity bonus.

3.2.2.3 Energy supply contracting & Financial Mechanisms

The option of the so-called Landlord-to-tenant-electricity described in the previous sub-chapter is one way of achieving profitability with the operation of solar installations. Another option is Landlord-to-tenant-electricity supply via third parties. In this case, the system operator can also receive the aforementioned subsidy through the tenant electricity bonus. Therefore, the electricity from the solar system needs to be passed on (without feeding it into the grid) to a third party, who in turn supplies this electricity to the participating "Landlord-to-tenant-electricity customer" (end consumer) in compliance with the requirements of the tenant electricity bonus. In this case, this third party is the responsible electricity supplier and usually a company that focuses on the business of contracting (Bundesnetzagentur, 2023). Following this, the tenant electricity bonus can be required when implementing All incl. Rent – Type Contracting or the BM Energy Budget. However, there is no direct funding measure available in Germany for the application of contracting in the private sector.

3.2.2.4 Energy Communities & Financial Mechanisms

In accordance with the Renewable Energy Directive II (RED II) of December 11th, 2018, the member states had to ensure that the rights of renewable energy communities were transposed into national law by 30 June 2021 (Standal & Aakre, 2021). In March 2023, Section 15a was added to EU Regulation 2019/943 on the internal electricity market, which specifies the organisation of energy sharing (European Commission, 2023), an enactment central for energy communities.

In Germany, there are two incentives guaranteed by the state for energy sharing. However, only one can be considered a funding mechanism, whereas the other entails an administrative incentive but no direct financial support mechanism. The new "Citizens' Energy Communities" funding programme to support new wind turbines was launched on January 1st, 2023, and aims to lower the hindrance of high costs in the planning and approval phase of onshore wind energy plants for citizen energy communities. The subsidy, which comes in the form of a proportional financing of the planning and approval costs, only has to be repaid if the respective onshore wind turbines have received:

- a permit in accordance with the Federal Emission Control Act or

- an award in a Renewable Energy Act (EEG) tendering procedure within two and a half years or
- a registration outside of the tendering procedure in accordance with Section 22b EEG 2023

(Bundesamt für Wirtschaft und Ausfuhrkontrolle, 2022).

For the purpose of this funding guideline, costs for the planning and authorisation of onshore wind turbines up to a total size of 25 MW per applicant are eligible for funding. The amount of funding is 70% of the total planning and authorisation costs, up to a maximum of €200,000 (maximum funding limit under the De-minimis Regulation[3] within three fiscal years). If the funding exceeds the maximum funding limit of 200,000€ permitted under the De-minimis Regulation, it will be reduced accordingly and will be provided as partial funding. Financial support under this funding guideline can only be combined with other funding to the extent that this is permitted under the De-minimis Regulation (Bundesamt für Wirtschaft und Ausfuhrkontrolle, 2023).

Another impetus provides the law by strengthening the local acceptance and anchoring of the ET. For example, wind and solar projects from energy community corporations will be excluded from tenders from 2023 and can therefore be realised with less bureaucracy. This shall enable citizen energy projects to receive remuneration even without tendering (Presse- und Informationsamt der Bundesregierung, 2023).

Against this background, it is clear that the financial support for energy communities is aimed exclusively at those with wind energy. Thus, energy communities that rely on other energy sources are excluded. However, in order to provide a real incentive and promote the spread of energy communities in Germany, more comprehensive support measures are needed that also include energy communities that primarily rely on energy sources other than wind power in order to fulfil geographical requirements.

3.2.3 Italy

In the introduction of the chapter about financial mechanisms, it was emphasized that laws are subject to changes. Currently, in Italy, this is the case where they are waiting for the adoption of the new law for energy communities. The decree to be adopted focuses on two measures: a support tariff for the renewable energy produced and shared and an investment contribution

[3] The De-Minimis Regulation sets the threshold up to which aid is considered a measure that does not fulfil all the characteristics of Article 107(1) of the Treaty on the Functioning of the European Union. (For further information, see: https://www.foerderdatenbank.de/FDB/Content/DE/Foerderprogramm/EU/de-minimis-beihilfen.html and https://eur-lex.europa.eu/legal-content/DE/ALL/?uri=CELEX%3A32013R1407)

(Südtiroler Energieverband, 2023). However, since the law has not been finally adopted, the funding instruments that were active so far are presented in the following subchapters.

3.2.3.1 PEBs & Financial Mechanisms

In line with the objectives of the EU "Clean Energy for All Europeans" package and the 2018 /2002, Directives the implementation of Legislative Decree No. 48 of 17 June 2020 and Legislative Decree No. 73 of 14 July 2020 in Italy started. These directives introduced various tax incentives to promote the energy efficiency and decarbonisation of buildings, such as those with nearly zero energy (so-called nZEB) or nearly zero emissions (so-called nZCB), as well as the energy renovation of existing buildings. To incentivise this, the Superbonus funding instrument was set up, (Döhne, 2021).

The new Superbonus 2023 will change the regulations that were previously in force. The most striking change with the Superbonus 2023 is probably that the amount of the subsidy has been reduced from 110% to 90%. To qualify for the 90% subsidy, applicants must own a property that is used as their main residence (1), have rights of use (e.g. mere ownership) (2), and have an income of less than €15,000 (according to the new calculation method) (Di Gianni Trovati, 2023).

Consequently, the 2023 Superbonus is aimed exclusively at low-income families. In addition, it should be noted that the super bonus is not compatible with other funding instruments.

3.2.3.2 Landlord-to-tenant-electricity & Financial Mechanisms

With the entry into force of Decree-Law 162/19 (Article 42), such as ARERA Resolution 318/2020/R/eel and the MiSE Ministerial Decree of 16 September 2020, electricity consumers can now form so-called self-consumption groups to generate and share the electricity they need from renewable sources on site (Gestore die Servizi Energetici, 2024).

A self-consumer group is a group of at least two self-consumers of renewable energy who act together based on a private agreement and are located in the same block of flats or building. A self-consumer of renewable energy is defined as a final consumer who generates renewable energy for self-consumption at his own site within certain limits and who can store or sell self-generated renewable energy, provided that, for a self-consumer of renewable energy who is not a household, these activities do not constitute his main commercial or professional activity. The renewable energy self-consumer's generation facility may be owned and/or operated by a third party, given that the third party remains subject to the instructions of the renewable energy self-consumer (ibid.).

The group of self-consumers of renewable energies must consist of end customers and/or producers who meet the following requirements:

1. They must be the owner of connection points located in the same building or condominium;

2. They may not carry out the production and exchange of electricity as their main activity;

3. They have signed a contract under private law that meets the requirements established in Article 42 of Legislative Decree 162/19 and described in section 2.1.1 of the Technical Regulations;

4. They have assigned a contact person to set up and manage the configuration as well as to apply to the Energy Services Operator (Gestore Servizi Energetici - GSE) and to take advantage of the benefits of the service for shared electricity utilization and discounts

(ibid.).

If the above points are met, it is a self-consumer group. This means they have the right to apply for funding for the renewable energy system. Eligible for funding are newly built or modernized generation systems that are operated with renewable energies, will be put into operation from March 1, 2020, and have an output of a maximum of 200 kW (ibid.). A generation plant that is powered by renewable energy includes a power generation plant that uses wind, solar, aerothermal, geothermal, hydrothermal and oceanic energy, hydraulic energy, biomass, landfill gas, waste gas from sewage treatment processes and biogas to generate electricity (ibid.).

For each kWh of shared electricity, the GSE grants a uniform remuneration made up of the sum of the transmission tariff for low-voltage users and the highest value of the variable component of the distribution tariff for users other than low-voltage users. In the case of groups of self-consumers of renewable energy acting together, there is an additional contribution due to the avoided network losses (which varies depending on the voltage level and hourly zone price of electricity[4]) and a premium tariff (of 100 €/MWh for groups of self-consumers) (ibid.). Once the GSE has all the calculations submitted by the network operators, it carries out the full calculation of the following economic items on a monthly basis:

- the contribution due, including, where appropriate, the standard fee and the premium rate provided for in the resolution;
- as well as the value of the electricity fed into the grid, or the value of the energy withdrawn.

[4] In December 2022, the price in Italy was €0.51 per kWh; the minimum feed-in tariff in the northern market area was €0.368 per kWh (Südtiroler Landtag, 2023).

The GSE will then pay, within the following month the publication of the contributions, the amounts due for the uniform fee provided for in the resolution and the premium rate calculated on the shared electricity upon reaching a minimum amount of €100 and the remuneration of the withdrawn by the GSE electricity (ibid.).

The fee to be paid is therefore made up of a fixed fee and a variable fee, which depends on the performance of the investment in question, as shown in the following table:

Table 3.2.1: GSE payment scheme (Adopted from Gestore die Servizi Energetici, 2024).

Electricity	Fixed return payment	Variable return payment
kW	€/year	€/kW
P<=3	0	0
3<P<=20	30	0
20<P<=200	30	1

After all, it can be concluded that Landlord-to-tenant-electricity benefits from subsidies for the renewable energy system, feed-in tariffs and premiums for avoiding grid utilisation.

3.2.3.3 Energy supply contracting & Financial Mechanisms

The implementation of the European Union Directive 2006/32/EC on the end-use efficiency of energy and energy services of Italy in Legislative Decree No. 115 of May 30, 2008, gave rise to the first Italian definition of Energy Service Company (ESCO). This is defined as "a natural or legal person who provides energy services or other measures to improve energy efficiency in the user's facilities or premises and thereby assumes a certain financial risk. Payment for the services provided is based in whole or in part on the achieved energy efficiency improvement and the achievement of the other specified performance criteria."

The Italian ESCO market is regarded as one of the biggest ones in Europe (Boza-Kiss et al., 2017). Accordingly, it was worth €3.7 billion in 2018, with 42% of its revenues coming from EE and consulting projects, 35% from energy-performance contracting services, and 23% from sales of white certificates (AmBIENCe, 2020). Support schemes that have driven this markets' growth in the recent years has been the "Conto Termico" scheme, dedicated to the promotion of energy efficiency investments and thermal energy production from renewable sources in the public administration. The Conto Termico instrument was launched in 2016 and subsidises public authorities to improve energy efficiency and install renewable energy sources in their buildings. With 100,000 applications in 2021 and 496.1 million euros in public funding, it is a very popular funding instrument in Italy (De la Vega, 2023). However, it is currently only aimed

at new buildings and public administration renovations. However, according to the draft National Energy Climate Plan, a future reform will extend the Conto Termico to private non-residential buildings, as well as investments in district heating connections and renewable energy communities (De la Vega, 2023).

The self-consumers can also purchase their energy via generation plants owned by a third party, if the third party remains subject to the instructions of the self-consumer of renewable energy (GSE, 2024). In the context of this premise, this third party can be a contracting company in the sense of the All incl. Rent -Type Contracting and Energy Budget BMs. Consequently, this third party can benefit from Landlord-to-tenant-electricity advantages, such as subsidies for the renewable energy system, feed-in tariffs and premiums for avoiding grid utilisation.

Nonetheless, it should be noted that there are no direct subsidies for contracting BMs. Whether the future reform of Conto Termico will support contracting for private building needs to be seen.

3.2.3.4 Energy Communities & Financial Mechanisms

In May 2019, the EU incorporated the concept of energy communities into its legislation through the Clean Energy for All Europeans package. In particular, the revised Renewable Energy Directive (RED II) and the Internal Market in Electricity Directive (IEMD) contain provisions that create a supportive EU legal framework for common ownership. In Italy, the implementation of this directive took place through Decree-Law n.199 of November 8, 2021, and came into force on December 15, 2021 (Norattiva, 2022).

This means that electricity consumers can now join together to form energy communities to generate the electricity they need locally from renewable sources and share it.

A renewable energy community is a legal entity:

1. which is based on open and voluntary participation (provided that participation in the renewable energy community is not the main commercial and/or industrial activity for private companies) and which is autonomous;

2. whose shareholders or members with control powers are natural persons, small and medium-sized enterprises (SMEs), regional authorities or local authorities and are located in the same municipalities in which the Community production facilities are located;

3. whose main objective is not to achieve financial profits, but to provide environmental, economic or social benefits at community level to their shareholders or members or to the local areas in which they operate

(GSE, 2024).

The renewable energy community must be established as a separate legal entity (such as an association, third sector entity, cooperative, non-profit cooperative, consortium, partnership, non-profit organization) that acts, exercises rights and assumes obligations in its own name (ibid.). The renewable energy community must then be the owner or have full availability of the production facilities belonging to the configuration based on a legal title (e.g. right of use or other contractual title).[5]

If the above points are met, it is a renewable energy community. This means they have the right to apply for funding for the renewable energy system. Eligible for funding are newly built or modernized generation systems that are operated with renewable energies, will be put into operation from March 1, 2020, and have an output of a maximum of 200 kW (ibid.). A generation plant that is powered by renewable energy includes a power generation plant that uses wind, solar, aerothermal, geothermal, hydrothermal and oceanic energy, hydraulic energy, biomass, landfill gas, waste gas from sewage treatment processes and biogas to generate electricity (ibid.).

For each kWh of shared electricity, the GSE grants a uniform remuneration made up of the sum of the transmission tariff for low-voltage users and the highest value of the variable component of the distribution tariff for users other than low-voltage users. In the case of groups of self-consumers of renewable energy acting together, there is an additional contribution due to the avoided network losses (which varies depending on the voltage level and hourly zone price of electricity[6]) and a premium tariff (of 110 €/MWh for renewable energy communities) (ibid.).

Once the GSE has all the calculations submitted by the network operators, it carries out the full calculation of the following economic items on a monthly basis:

- the contribution due, including, where appropriate, the standard fee and the premium rate provided for in the resolution;
- and the value of the electricity fed into the grid or the value of the energy withdrawn

(ibid.).

The GSE will then pay, within the month following the publication of the contributions, the amounts due for the uniform fee provided for in the resolution and the premium rate calculated on the shared electricity upon reaching a minimum amount of €100 and the remuneration of the withdrawn by the GSE electricity (ibid.). The fee to be paid is therefore made up of a fixed fee and a variable fee, which depends on the performance of the investment in question, as shown in the following table:

[5] For more information on the requirements for renewable energy communities see Annex E or Gestore die Servizi Energetici (2024).

[6] In December 2022, the price in Italy was €0.51 per kWh; the minimum feed-in tariff in the northern market area was €0.368 per kWh. The additional funding for energy communities, which is in addition to the minimum feed-in tariff, was €0.11/kWh (Südtiroler Landtag, 2023).

Table 3.2.2: GSE payment scheme (adopted from Gestore die Servizi Energetici, 2024).

Electricity	Fixed return payment	Variable return payment
kW	€/year	€/kW
P<=3	0	0
3<P<=20	30	0
20<P<=200	30	1

Within the Italian National Integrated Energy and Climate Plan (PNIEC) 2020, the REC is considered one of the central instruments to realize an ET including decarbonisation and decentralization of the energy system. Furthermore, it is emphasized that renewable energy installations in self-consumption systems and RECs can be a valid tool to combat energy poverty by supporting economic efficiency through the use of local resources (Ministero dell'Ambiente e della Sicurezza Energetica, 2023).

3.2.4 Summary

When looking at the various funding instruments in France, Germany and Italy, even though they are based on similar funding instruments, the diverse compositions and amounts of these lead to differences. One general difference is their focus, so that in France, funding is dependent on income, while in Germany, funding is not dependent on income, but tied to the achievement of a certain standard or certificate.

According to the latter, in Germany funding for PEBs can be claimed by achieving a certificate. While in France tax credits for highly efficient heating and hot water systems are guaranteed, with their height depending on the applicant's household size. France also approved grants of up to several hundred euros for the implementation of insulation measures or the installation of energy-efficient electricity systems. Additionally, there are also various regional funding measures in France. Also in Italy, tax incentives were used to accelerate energy efficiency and the decarbonisation of buildings. The corresponding funding measures are aimed at buildings with nearly zero energy (so-called nZEB) or nearly zero emissions (so-called nZCB), categories to which PEBs belong.

The funding instruments for Landlord-to-tenant-electricity in France and Italy do not go further than rewarding a bonus or premium tariff higher than the usual feed-in tariff. In Germany, the subsidies for Landlord-to-tenant-electricity go a little further in that, in addition to an approved bonus, no network fees or charges have to be paid.

The subsidies for contracting are the same for all countries; insofar that only contracting for public buildings is subsidized. Hence, there is no funding for contracting applicable for private buildings.

The funding landscape for energy communities is the least developed in Germany. Only energy communities that obtain their energy from their own wind turbines are supported. The only incentive for collectively generated solar energy will be a reduction in bureaucracy in the coming years. The funding landscape is more extensive in France, where the grid feed-in for energy communities is higher than for self-generation. Similarly, Italy supports REC by paying a premium feed-in tariff to energy communities. In addition, RECs in Italy receive funding for the renewable energy system they use and funding for when they do not use the public grid.

Against this background, it is clear that there is room for improvement or in other words room for investment in energy efficiency in the frame of the construction sector in all countries. For example, it becomes clear that there are no tax advantages for REC and Landlord-to-tenant-electricity and that there are no support measures for contracting in the private sector in the countries examined. Consequently, further funding mechanisms shall be implemented, especially for private houses in the field of contracting.

4. Research method

The main objective of the used method is to elaborate the SWOT-factors for the previously introduced PEB BMs to determine the future opportunities and main obstacles for their implementation. In general, the SWOT-analysis or Strengths-Weaknesses-Opportunities and Threats analysis aims at a systematic consideration of a new product, technology or management strategy by analysing future factors that influence a company's BM (Baycheva-Merger & Wolfslehner, 2016). Here, the before mentioned BMs related to the emergence of PEBs are examined. SWOT papers have so far been published in various journals from different disciplines and are not limited to one field, which speaks for the application of the SWOT technique (Ghazinoory, Abdi & Azadegan-Mehr, 2011). The aim is that this structured examination of factors provides a good overview of the main issues and concerns of the construction sector that are important for understanding and conceiving PEBs and the related BMs. How the SWOT analysis and the interviews are designed and how the resulting findings are analysed is explained in more detail in the following sub-chapters.

4.1 Method of data collection

In order to improve the understanding and to identify drivers and barriers for the implementation of the studied BMs, experts were invited to semi-structured online interviews. It was decided to use semi-structured interviews because this form of interview provides the freedom to digress from the core question, so that communication between the researcher and the interviewee is as comprehensive and detailed as possible (Berg, 1995).

Within the online interviews, a SWOT analysis was conducted in order to elaborate Strengths, Weaknesses, Opportunities and Threats. SWOT itself comprises two categories of factors: internal factors (strengths and weaknesses) and external factors (opportunities and threats). These are processed in this order in the interviews. However, before the implementation of the interviews, the first step was to prepare the interviews in the best possible way. To this end, the SWOT-factors were adapted to the purposes of this study and suitable interview questions were developed for each sub-area of the SWOT analysis per business model. The prepared questions were asked as stimulating questions in order to guarantee the most accurate reflection possible and thus a good, complete SWOT analysis. The respective questions can be found in Appendix B. Furthermore, summaries were written as handouts for the respective BMs (see

Annex A) in order to familiarise the interview participants with them. The interviews were supported by a DRAW.IO board, which the interview participants could use as a guide when working on the SWOT-factors (see Annex C for an example).

Having worked out the interview execution, the interview enactment was pre-tested with an external person. On the one hand, to guarantee the comprehensibility of the questions. On the other hand, to be able to estimate the length of the interview. With the adaptation of the interview questions, the preparation of the interview was completed, and the interview could begin.

In this regard, experts from the building sector were invited. The interviews took place online between November 2nd and December 7th, 2023 and in person on the 16th of November 2023 as shown in the overview in Table 4.1.

Table 4.1: Overview of expert interviews conducted.

Country of observation	Interview number	Interview dates
France	#01	2nd November 2023
	#02	4th November 2023
	#03	22nd November 2023
Germany	#04	16th November 2023
	#05	27th November 2023
	#06	30th November 2023
Italy	#07	4th December 2023
	#08	7th December 2023

The experts that were interviewed represent housing construction companies from France, Germany and Italy. The diverse cultural backgrounds, allow investigating whether the BMs are applicable for different countries or whether there are country specific hindrances or preferences. The aim of interviewing experts lies in gaining an in-depth understanding of factors affecting the implementation of PEBs and the associated BMs. The experts were therefore not selected based on representativeness but according to theoretical aspects (Baycheva -Merger & Wolfslehner, 2016). The total number of interviewees who provided information on the strength, weaknesses, opportunities and threats amounted to eight (see Table 4.1).

When the interviews started, the interview partners were asked for consent of transcription of the interview. Afterwards, the interview began by introducing the methodology of the SWOT analysis and the Cultural-E project and its concept of a PEB. First, basic questions were asked about the interviewee's company in order to gather information. Subsequently, the SWOT analyses for the hypothetical implementation of the BM of All incl. Rent, All incl. Rent – Type Contracting, Energy Budget and PEBs for Renewable Energy Communities were carried out. Finally, the interviewees were asked to evaluate their reflections by naming the BMs they found most interesting and could imagine best to be implemented.

In a second round of interviews, further experts were asked for their assessments based on the results of the SWOT analyses of the first interview partners. The most frequently occurring strengths, weaknesses, opportunities and threats were presented. The interview participants in the second round were then asked to provide feedback and additional insights. This process helped to determine whether the participants' perspectives were consistent within the

construction industry and whether or not different interview participants could confirm the replication potential of the BMs.

4.2 Method of data analysis

After all interviews were conducted, they were transcribed. In a further step, the analysis of the interviews began, based on the method of the study by Baycheva-Merger & Wolfslehner (2016). The analysis began by carefully reviewing and coding the interview transcripts to identify the predominant SWOT-factors. This coding process allowed key themes to be identified from the interview data. This research method is called content analysis and aims to quantify qualitative data for the purpose of generalisation by identifying recurring themes (Thomas, 2003). The priority of each factor was determined based on the frequency of their occurrence in the text, with the aim of determining the importance of the SWOT-factors found in the data rather than relying solely on the impression of the interviews and assumptions (Creswell, 2003; Patton, 2002). The frequency of occurrence was calculated in relation to the total number of responses relevant to each SWOT-factor (Baycheva-Merger & Wolfslehner, 2016).

5. Results

This chapter presents the results of the content analysis of the interviews. The results are structured in that the individual strengths-, weaknesses-, opportunities- and threat-factors (hereinafter referred to as S-factor, W-factor, O-factor and T-factor) are analysed successively for each BM. Each business model is regarded in a separate sub-chapter. Following this chapter 5.1 focuses on the SWOT-factors reported to All incl. Rent. This is followed by the All incl. Rent – Type Contracting business model and its SWOT-factors. Chapter 5.3 deals with the SWOT-factors for Energy Budget BM, and Chapter 5.4 examines the SWOT-factors for PEBs for Renewable Energy Communities. Chapter 5.5 summarizes the dominant themes from the SWOT analysis.

5.1 All incl. Rent

The total number of responses with respect to the strength of the All incl. Rent business model was 21 (Table 5.1). The most frequently mentioned S-factor was *One contract* (S1: 38,0%). The strength is seen in the fact that with this type of contract "for the tenants, it's, easier for them because they only have one contract" (Interviewee FR #01). *All-around carefree package* was also frequently mentioned (S2: 13,0%) by the respondents who emphasized that "for the tenant it's definitely the most uncomplicated or carefree option" (Interviewee DE #05) as it is "way easier […] because it's one less thing to have in mind when you are a tenant" (Interviewee FR #01). Equally often mentioned was the strength that the All incl. Rent model is a *Variable model* (S4: 14,3%), where the landlord can "maybe even include […] telephone" (Interviewee DE#06). The strength of *Predictable prices for tenant* elicited the same frequency of occurrence (S5: 14,3%), since within this business model tenants can "be prepared in advance and know what is left for groceries, etcetera." (Interviewee FR #03). Some respondents highlighted also the strength of *Predictable prices for Landlord* (S6: 9,5%) and *The shorter the rental period, the greater the advantage for the tenant* (S3: 8,7%). The strength in the latter is seen in that if a "rental period [is] only 6 months or 12 months or 2 years, then it has a much greater incentive that it's uncomplicated" (Interviewee DE#05).

Table 5.1: Frequency of occurrence of the S-factors per Interview.

Strength		Response distribution per Interview								Total	Ratio of total number of responses
S-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
S1	One contract	x	x	x	x	x	x	x	x	8	38,0
S2	All-around care free package	x				x	x			3	14,3
S3	The shorter the rental period, the greater the advantage for the tenant					x	x			2	9,5
S4	Variable model (incl. Wi-Fi, waste disposal etc.)					x	x		x	3	14,3
S5	Predictable prices for tenant	x	x	x						3	14,3
S6	Predictable prices for Landlord		x	x						2	9,5

The total number of responses on the S-factors: 21. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

The total number of responses (n) relevant to the weaknesses of the All incl. Rent business model was 23 (Table 5.2). Most often mentioned was the weakness *More technology, more costs* (W1: 30,4%), since the opinion prevails that "building those super-efficient dwellings is costing too much" (Interviewee FR #01). Also frequently mentioned were *Internal expanses due to billing tenants (W2: 13%), Still dependent on electricity market price (W3: 13%), Time-consuming BM (W4: 13%)* and *Acting as energy supplier means extra effort (W6: 13%).* The respondents who emphasized that argued concerning W4 that they are not independent because they still have to buy in and then they are still dependent on electricity market prices (see Interviewee DE #06). All incl. Rent as being a *Time-consuming BM* was connected with "higher administrative expenses and also higher […] maintenance and care costs" (Interviewee DE #05). For W-factor 7, it was argued "as a landlord you have more to do on the financial side for the accountability as the maintenance of the sensors. [Resulting in] more work." (Interviewee FR #01).
The lowest frequency of occurrence with 8,7% was on the *Energy management = complex, time-consuming & costly (W5)* meaning that the complexity of the systems is regarded as relatively higher by a few interviewees.

Table 5.2: Frequency of occurrence of the W-factors per Interview.

Weaknesses		Response distribution per Interview								Total	Ratio of total number of responses
W-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
W1	More technology, more costs	x	x	x	x		x	x	x	7	30,4
W2	Internal expanses due to billing tenants				x	x	x			3	13,0
W3	Still dependent on electricity market price				x	x	x			3	13,0
W4	Time consuming BM					x		x	x	3	13,0
W5	Energy management = complex, time consuming & costly							x	x	2	8,7
W6	Acting as energy supplier means extra effort	x	x	x						3	13,0

The total number of responses on the W-factors: 23.
#01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

The total number of responses in relation to the opportunities for the business model All incl. Rent amounted to 22 (Table 5.3). The most frequently mentioned opportunities for the All incl. Rent business model centred around the *Legal framework allowing for private energy trade* (O7: 13,6%) and *PEBs financial sustainable* (O10: 13,6%). For the former O-factor, one interviewee said, “it's interesting, but regulations need to change (at least in France)” (Interviewee FR #02). For the later interviewee DE#06 argued, “I still have to buy electricity, but what the alternative is, I buy everything”.

Less often mentioned were the opportunities *General public is interested in ecological energy* (O9: 9,1%) and *Sustainable projects are preferred* (O4: 9,1%). In this regard, an interviewee said, “often when I look at the large health insurance companies or similar, they are also trying to orientate their portfolio towards a green focus” (Interviewee DE #06). Another Opportunity that was not often mentioned was *Financial exchange rate protection* (O5: 9,1%). This opportunity means hedging the network energy price on the capital market in order to receive a risk premium in the event of rising prices. Other least often mentioned Opportunities were *Standardization* (O6: 9,1%) and *Battery storages* (O8: 9,1%). For *Standardization* it was argued that as with prefabricated houses, that are all more or less build with the same systems, there is the possibility of being built and sold as standard houses and with that the opportunity of less work and less costs. With respect to *Battery storages,* Interviewee FR #01 argued “the biggest opportunity is the battery […] because you are allowed to produce a lot in, in summer, store it until winter and then only consume in winter what you have produced”.

Table 5.3: Frequency of occurrence of the O-factors per Interview.

Opportunities		Response distribution per Interview								Total	Ratio of total number of responses
O-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
O1	Decentralised energy supply				x	x				2	9,1
O2	Raising tenants' awareness on energy related matters				x	x				2	9,1
O3	Improved PV performance					x	x			2	9,1
O4	Sustainable projects are preferred				x		x			2	9,1
O5	Financial exchange rate protection					x			x	2	9,1
O6	Standardization							x	x	2	9,1
O7	Legal framework allowing for private energy trade		x	x					x	3	13,6
O8	Battery storage	x		x						2	9,1
O9	General public is interested in ecological energy	x		x						2	9,1
O10	PEBs financial sustainable		x	x			x			3	13,6

The total number of responses on the O-factors: 22. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

As Table 5.4 shows the *EU Law of freedom to choose energy provider* elicited the highest frequency of occurrence (T1: 50%) with respect to the total number of responses (n = 14) on the threats of the All incl. Rent model. The respondents considered this law as a fundamental risk for the business model All incl. Rent that is based on a binding contract and in deviates from the EU Law insofar that tenants cannot choose a different energy provider than their landlord.

The second most frequently mentioned T-factor was the *Unpredictable unstable energy market price* (T4: 21,4%). In this regard the interviewees considered that "in the case of an apartment building, if […] prices go through the roof, then of course there is also an economic risk" (Interviewee DE #06).

Moreover, *Inefficient behaviour by tenant* meaning inefficient energy consumption by the tenant is considered a possible hindrance that can prevent achieving the plus in the PEB and thus the economic advantages of it (T2: 14,3%). In addition, *New BM, new risks (T3)* was emphasized by 14,3% of the interviewees as a hindrance for implementing the new business model All incl. Rent.

Table 5.4: Frequency of occurrence of the T-factors per Interview.

Threats		Response distribution per Interview								Total	Ratio of total number of responses
T-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
T1	EU Law of freedom to choose energy provider	x	x	x	x	x	x	x		7	50,0
T2	Inefficient behaviour by tenant					x	x			2	14,3
T3	New BM, new risks				x	x				2	14,3
T4	Unpredictable unstable energy market price						x	x	x	3	21,4

The total number of responses on the T-factors: 14. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

5.2 All incl. Rent – Type Contracting

The total number of responses (n) relevant to the strengths (S-factors) for the business model All incl. Rent – Type Contracting was 22 (Table 5.5). As can be seen below, the S-factors are *One contract for tenant (S1), Forecastable monthly costs (S2), If no staff/expertise the contractor is a solution (S39, Energy difference = extra income (S4), Technological risks outsourced to contractor (S5), Less work for landlord (S6)*. From these S-factors the Strength *If no staff/expertise the contractor is a solution* was most frequently mentioned (S3: 27,3%), particularly in relation to improving the missing expertise of the former business model All incl. Rent. The second most frequently mentioned S-factor was the characteristic of the business model that there is only *One contract for tenants* (S1: 22,7%). Also frequently mentioned was the strength that *Energy difference = extra income* (S4: 18,2%) and that the business model enables *Forecastable monthly costs* (S2: 13,6%).

Table 5.5: Frequency of occurrence of the S-factors per Interview.

Strength		Response distribution per Interview								Total	Ratio of total number of responses
S-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
S1	One contract for tenants	x	x	x	x	x				5	22,7
S2	Forecastable monthly costs	x	x	x						3	13,6
S3	If no staff/expertise the contractor is a solution		x		x	x	x	x	x	6	27,3
S4	Energy difference = extra income				x	x	x	x		4	18,2
S5	Technological risks outsourced to contractor				x		x			2	9,1
S6	Less work for landlord				x		x			2	9,1

The total number of responses on the S-factors: 22. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

The absolute number of responses for the weaknesses (W-factors) regarding the All incl. Rent – Type Contracting business model was 14 (Table 5.6). Within the interviews the W-factor *Landlord as middleman means extra effort* was most often mentioned (W3: 35,7%). To describe this weakness in the words of interviewee FR #01: "So one weakness is, yeah, more work for the for the landlord and that we are not used to more contracts". With 28,6%, the second most often mentioned W-factor is accounted to *External contractor might exploit the situation (W1)*. Some respondents (W2: 21,5%) considered also the need of *Time and expertise to set up precise contract* as a weakness of the business model, since "[The contract] would need to be super precise for for everything. So yeah, a lot of time spent on the legal procedure I would say" (Interviewee FR #02). The lowest frequency of occurrence was on being *Still dependent on energy market price* with 14,3% (W4).

Table 5.6: Frequency of occurrence of the W-factors per Interview.

Weaknesses		Response distribution per Interview								Total	Ratio of total number of responses
W-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
W1	External contractor might exploit the situation	x	x	x		x				4	28,6
W2	Time and expertise to set up precise contract	x	x	x						3	21,5
W3	Landlord as middleman means extra effort	x	x		x	x	x			5	35,7
W4	Still dependent on energy market price				x	x				2	14,3

The total number of responses on the W-factors: 14. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

The total number of answers amounts to eight for the Opportunities for the business model All incl. Rent – Type Contracting (Table 5.7). The identified O-factors are *With many dwellings company could debate for a low price (O1), Contractor has expertise leading to efficiency (O2),* and *Contractor with standardised system (O3).* The first two O-factors received both the most responses with 37,5%. The Opportunity, that the interviewees associate with the O-factor *With many dwellings company could debate for a low price* (O1) is that "[A company] could do like one contract with one contractor on several buildings to have like a a grouped price for the tenants" (Interviewee FR #01). With the O-factor *Contractor has expertise leading to efficiency* (O2) the interviewees see "the opportunity […] that the contract, of course, by being professional and focussing only on that, perhaps in the future somehow either through technology or by doing a lot of objects in the area or whatever, that it will increase efficiency" (Interviewee DE #05). Twenty five percent of the respondents mentioned the O-factor *Contractor with standardised system* (O3) focused on the idea of standardising the contracting business model to make it more efficient and ultimately more economic.

Table 5.7: Frequency of occurrence of the O-factors per Interview.

Opportunities		Response distribution per Interview								Total	Ratio of total number of responses
O-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
O1	With many dwellings company could debate for a low price	x	x				x			3	37,5
O2	Contractor has expertise leading to efficiency				x	x	x			3	37,5
O3	Contractor with standardised system							x	x	2	25,0

The total number of responses on the O-factors: 8. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

Table 5.8 shows that within the interviews 16 times threats for the business model All incl. Rent – Type Contracting were reported. By that means *EU Law of freedom to choose energy provider* is the threat with the highest frequency of occurrence (T3: 37,5%) for the same reason as the former business model (s.chapter 5.1). Second most often mentioned (25%) were both the T-factors *Contractor is in power of price* (T1) and *Dependent on the contractor (in times of crisis)* (T4). Also often mentioned was the T-factor *Low quality maintenance by contractor* (T5: 18,75%). Furthermore, a threat was seen in the uncertainty *What if contractor quits* (T2:12,5%) or in other words "what if the contractor terminates the contract" (Interviewee DE #05). Another threat was mentioned concerning the power of the contractor: *Contractor might increase price when they know that you do not want to change contractor* (T6: 12,5%). Concerning this threat, Interviewee IT #07 imagined the scenario that "the contractor works well. Knows about this and […] will try to increase the size even above the market price for that service because you are not going to change anyway, so that […] the conditions for this contract will uh get the worse. Because you don't want to change if you are already on board, you will never change more or less. This is a risk, I think ".

Table 5.8: Frequency of occurrence of the T-factors per Interview.

Threats		Response distribution per Interview								Total	Ratio of total number of responses
T-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
T1	Contractor is in power of price	x	x	x		x				4	25,0
T2	What if contractor quits		x			x				2	12,5
T3	EU Law of freedom to choose energy provider	x	x	x	x	x		x		6	37,5
T4	Dependent on the contractor (in times of crisis)				x	x	x	x		4	25,0
T5	Low quality maintenance by contractor		x					x	x	3	18,75
T6	Contractor might increase price when they know that you do not want to change contractor							x	x	2	12,5

The total number of responses on the T-factors: 16. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

5.3 Energy Budget

The total number of responses for strength regarding the business model Energy Budget amounts for 10 (Table 5.9). Most of these responses centred around the S-factor *Less work for landlord as tasks (investment, maintenance and billing) are outsourced* (S1: 60%). The reason for this is that the respondents from the perspective of the landlord saw a strength in having "one less administrative task, I store it all out, so that's the minimum, so to speak, the most minimal involvement from the landlord's side" (Interviewee DE #05). A strength that was emphasized by 20% of the respondents was *Direct communication between tenant and contractor (no need to involve landlord)* (S3). In this regard it was reported that "Another strength in terms of energy [budget], uh the tenants don't speak with the landlord, so they speak only with the contractor and the landlord has less problems with the with the tenants" (interview IT #07). Another 20% of respondents mentioned the strength that the *Contractor has expertise* (S2), which can be quite helpful in the case of an unexperienced landlord.

Table 5.9: Frequency of occurrence of the S-factors per Interview.

Strength		Response distribution per Interview								Total	Ratio of total number of responses
S-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
S1	Less work for landlord as tasks (investment, maintenance and billing) are outsourced	x			x	x	x	x	x	6	60,0
S2	Contractor has expertise							x	x	2	20,0
S3	Direct communication between tenant and contractor (no need to involve landlord)							x	x	2	20,0

The total number of responses on the S-factors: 10. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

The table below (Table 5.10) shows that the total number of responses for the W-factors concerning the Energy Budget business model was n=8. The most commonly mentioned W-factor was *Dependence on contractor* (W1: 62,5%). In contrast, the lowest frequency of occurrence was on the W-factor *No one-contract → attractiveness is lost* (W2: 37,5%). In regard to this W-factor the respondents mentioned the weakness […] in comparison to the first model

[…] that it's not this seamless experience for the tenant, or it's not this simple offer [of one contract]" (Interviewee IT #08).

Table 5.10: Frequency of occurrence of the W-factors per Interview.

Weaknesses		Response distribution per Interview								Total	Ratio of total number of responses
W-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
W1	Dependence on contractor					x	x	x x	x	5	62,5
W2	No one-contract → attractiveness is lost						x	x	x	3	37,5

The total number of responses on the W-factors: 8. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

The total number of answers concerning opportunities for improvement was 4 (Table 5.11). Those responses were equally divided up on the two O-factors *Energy efficiency ensured by contractor* and *Applied on big buildings more economically* with 50% each. The former O-factor about *Energy efficiency ensured by contractor* (O1) was connected to the "one possibility [that] is optimisation" (Interviewee IT #08). The later O-factor, namely, *Applied on big buildings more economically* (O2) was reasoned with the thought: "Of course it's perhaps more feasible for large buildings than for small buildings, which is too expensive" (Interviewee IT #08).

Table 5.11: Frequency of occurrence of the O-factors per Interview.

Opportunities		Response distribution per Interview								Total	Ratio of total number of responses
O-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
O1	Energy efficiency ensured by contractor						x		x	2	50,0
O2	Applied on big buildings more economically							x	x	2	50,0

The total number of responses on the O-factors: 4. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

For the T-factors on the business model Energy Budget, the number of total responses amounted for 19. Thereby, the most often mentioned Threat was *Contractor could impact tenants' satisfaction with housing situation* (T1: 29,4%). With this factor, it is meant that the contractor may not have a good way of dealing with customers or tenants. However, there is a risk that the landlord will not notice that because he has no insight into the communication between the tenant and the contractor. In the worst-case scenario, the tenants may move away without the landlord noticing the reason for it (see Interview DE #05). Second most commonly mentioned was the threat that the *Contractor could exploit with too high prices* (T6: 23,5%). Thereby, the respondents see a risk in that "the contractor can set the prices as he likes and basically with this model it's basically no longer a free market, because you have a contractor who owns the plant, so everything would have to be regulated somehow" (Interviewee IT #08). Further threats that the interviewees associated with the Energy Budget business model were *Financial costs for contractor too high* (T2: 11,8%), *Produced energy not cheaper than grid energy* (T3: 11,8%), *Tenants might not choose PEB energy* (T4: 11,8%), *Law permits contractor only as energy provider means bureaucratic obstacles* (T5: 11,8%).

Table 5.12: Frequency of occurrence of the T-factors per Interview.

Threats		Response distribution per Interview								Total	Ratio of total number of responses
T-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
T1	Contractor could impact tenants' satisfaction with housing situation			x		x	x	x	x	5	29,4
T2	Financial costs for contractor too high	x	x							2	11,8
T3	Produced energy not cheaper than grid energy		x						x	2	11,8
T4	Tenants might not choose PEB energy			x			x			2	11,8
T5	Law permits contractor only as energy provider means bureaucratic obstacles							x	x	2	11,8
T6	Contractor could exploit with too high prices	x		x				x	x	4	23,5

The total number of responses on the T-factors: 17. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

5.4 PEBs for Renewable Energy Communities

The total response number concerning the strengths (S-factors) of the PEBs for Renewable Energy Community business model was 20 (Table 5.13). With a ratio of 15,0% respondents mentioned most often the S-factors *Internal energy prosumption* (S2), *Members have the possibility to participate in low-cost electricity generation* (S4), *Community idea is attractive* and *EU law supports EC.* In order to elucidate on the last two S-factors, the former factor *Community idea is attractive* (S5) can be explained by citing Interviewee FR #02: "you know humans are social animals. *Laughing* So it's it's it's good. People are proud to live in a building that is part of the community, producing locally etcetera, etcetera." The later S-factor *EU law supports EC* (S8) can be explained by citing Interviewee FR #03: "The European regulations are pushing towards energy, local energy communities. So, it's a strength because if you have the legal backup easier to put in place".

With a ratio of 10,0% the least responses are connected to the S-factors *Bringing people together* (S1), *Different types of owners, Shared investment and maintenance costs* (S6) and *Communities might be looking for energy efficient houses as PEBs* (S7). Regarding the S-factor *Different types of owners* (S3) it was meant that an energy community can be assembled with "a mix between various type of entities" (Interviewee FR #01), for example "You could have social housing companies, you could have private companies […] a pharmacy, a garage that they have PV panels on the roof and they produce for anyone else. You also have private owners of small houses" (Interviewee FR #01). In total, this mix makes an energy community "really interesting because everyone can participate" (Interviewee FR #01).

Table 5.13: Frequency of occurrence of the S-factors per Interview.

Strength		Response distribution per Interview								Total	Ratio of total number of responses
S-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
S1	Bringing people together	x	x							2	10,0
S2	Internal energy prosumption	x	x						x	3	15,0
S3	Different types of owners	x		x						2	10,0
S4	Members have the possibility to participate in low-cost electricity generation				x	x	x			3	15,0
S5	Community idea is attractive		x			x	x			3	15,0
S6	Shared investment and maintenance costs	x			x					2	10,0
S7	Communities might be looking for energy efficient houses as PEBs							x	x	2	10,0
S8	EU law supports EC			x				x	x	3	15,0

The total number of responses on the S-factors: 20. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

The total number of responses with respect to the weaknesses for the PEBs for REC business model amounts to 8 (Table 5.14). The reported W-factors are *Costly RE system, Connection of buildings is costly, Proof of concept* and *Administrative effort.* These W-factors share the same frequency of occurrence with a ratio of 25% each.

With mentioning the W-factor of a *Costly RE system* (W1) the respondents reported that "the whole thing is associated with large costs in production and then also in maintenance" (Interviewee DE #06). Regarding the reported weakness of *Connection of buildings is costly* (W2) the interviewees agreed that with an energy community "you have a construction cost which is quite high." (Interviewee IT #07). Another weakness was seen in a missing *Proof of concept* (W3). More precisely one common critique was that a "test concept is missing, the concept itself is unclear, so the initial investment in the concept is unclear." (Interviewee DE #05). In relation to the W-factor *Administrative effort* (W4), Interviewee DE#05 argued "Exactly, that's exactly what we have in the middle here: the bureaucratic effort, the administration that does it and how much does it cost? Yes?"

Table 5.14: Frequency of occurrence of the W-factors per Interview.

Weaknesses		Response distribution per Interview								Total	Ratio of total number of responses
W-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
W1	Costly RE system	x					x			2	25,0
W2	Connection of buildings is costly	x						x		2	25,0
W3	Proof of concept					x	x			2	25,0
W4	Administrative effort					x	x			2	25,0

The total number of responses of the W-factors: 8. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

The total number of responses (n) concerning the opportunities (O-factors) of the business model PEBs for REC was 12 (Table 5.15). As with the weaknesses in the former paragraph also the opportunities presented here share the same frequency of occurrence with 16,7% each.

In order to explain each O-factor, we begin with the expressed opportunity of *Mixture of infrastructure (shops and housing) to reduce grid peaks* (O1). With this Opportunity, the interviewees associated the idea of having a diverse infrastructure. In other word of Interviewee FR #03: “maybe you could have a pharmacy; maybe you could have just the local shop, the dwelling, the, etcetera”. Another Opportunity in this business model was seen in *Raising awareness for energy related topics* (O2). In this regard, the respondents affiliated that “Pride will certainly contribute and yes, then we are back to the topic of raising awareness for energy” (Interviewee DE #06). Furthermore, the interviewees emphasized that an energy community has the opportunity to be a *Portfolio community* (O3). In that respect, Interviewee FR#02 imagined “If we do a big energy community and we can also because some of our dwellings we are not able, as you said, to install green electricity production, but they could also benefit from it”. Those imagination touches upon the O-factor of *Integration of older buildings* (O4). This thought mainly centres on aiding restricted buildings such as historical buildings with the supply of on-site renewable energy generation, since old buildings do not have the best conditions for renewable energy system installations. In regard to the O-factor of *Technical opportunities* (O5) the opportunity for improvement of this business model was seen in storage technologies (see interview FR #03). Moreover, an opportunity was evaluated in *Certifications (as levels, SRI and so on) as a requirement to join community* (O6).

Table 5.15: Frequency of occurrence of the O-factors per Interview.

Opportunities		Response distribution per Interview								Total	Ratio of total number of responses
O-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
O1	Mixture of infrastructure (shops and housing) to reduce grid peaks			x					x	2	16,7
O2	Raising awareness for energy related topics				x		x			2	16,7
O3	Portfolio community		x		x					2	16,7
O4	Integration of older buildings				x		x			2	16,7
O5	Technical opportunities (e.g. wastewater energy)			x			x			2	16,7
O6	Certifications (as levels, SRI and so on) as a requirement to join community							x	x	2	16,7

The total number of responses on the O-factors: 12. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

As Table 5.16 shows, the total number of responses on the threats for the business model PEBs for REC is 15. The most commonly mentioned threats were *State law is a hindrance* (T1: 26,7%) for the implementation of energy communities and *Members leaving* (T4: 26,7%). With the latter, the threat was associated that as a tenant "I probably won't be able to get out of it even if I want to at some point" (Interviewee DE #06). The second most often reported Threat was *Social headwinds* (T3: 20,0%). In this sense, interviewees could imagine the threat of "Social headwind, yes, I would say headwind from those involved" (Interviewees DE #05).

Furthermore, the threat of *Liability risks* was commonly mentioned (T2: 13,3%). Some respondents highlighted also that *Possible issues in realization* (T5: 13,3%) could present a threat. According to the interviewees issues in realization could arise within the "financial distribution" (Interviewee FR #01) as well as with environmental circumstances ("some regions where the sun is not as much where you don't have so much winds, where people live so, so far away from each other [etc.]" (Interviewee FR #01)).

Table 5.16: Frequency of occurrence of the T-factors per Interview.

Threats		Response distribution per Interview								Total	Ratio of total number of responses
T-factor		#01 FR	#02 FR	#03 FR	#04 DE	#05 DE	#06 DE	#07 IT	#08 IT	n	%
T1	State law is a hindrance	x	x				x		x	4	26,7
T2	Liability risks				x	x				2	13,3
T3	Social headwinds				x	x	x			3	20,0
T4	Members leaving				x	x	x	x		4	26,7
T5	Possible issues in realization	x							x	2	13,3

The total number of responses on the T-factors: 15. #01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

5.5 Summary

Table 5.17 summarizes the main results for the first business model All incl. Rent. From this, it can be summarized that the strength is seen in the characteristic of *One contract* (S1) for the tenant. Opposed to that a weakness is the higher costs resulting from the implemented technology in the PEB (W1). An Opportunity to counter fight the weakness of *More technology, more costs* (W1) is seen in building PEBs based on *Standardization* (O7). In addition, an opportunity for marketing is seen in that the *General public is interested in ecological energy* (O10). Nevertheless, a real threat that can only be eliminated by changing the law is the *EU Law of freedom to choose energy provider* (T1).

Table 5.17: SWOT-factors reported for the All incl. Rent business model.

Strength (S-factors)		Weaknesses (W-factors)	
S1	One contract	W1	More technology, more costs
S2	All-around carefree package	W2	Legal framework needs to be analysed in advance
S3	The shorter the rental period, the greater the advantage for the tenant	W3	Internal expanses due to billing tenants
S4	Variable model (incl. Wi-Fi, waste disposal etc.)	W4	Still dependent on electricity market price
S5	where energy comes from does not matter, but the price does	W5	Time-consuming BM
S6	Predictable prices for tenant	W6	Energy management = complex, time-consuming & costly
S7	Predictable prices for Landlord	W7	Acting as energy supplier means extra effort
Opportunities (O-factors)		**Threats (T-factors)**	
O1	Decentralised energy supply	T1	EU Law of freedom to choose energy provider
O2	Raising tenants' awareness on energy related matters	T2	Inefficient behaviour by tenant
O3	Improved PV performance	T3	New BM, new risks
O4	Sustainable projects are preferred		
O5	Financial exchange rate protection		
O7	Standardization		
O8	Legal framework allowing for private energy trade		
O9	Battery storage		
O10	General public is interested in ecological energy		
O11	PEBs financial sustainable		

Strengths (S-factors), weaknesses (W-factors), opportunities (O-factors) and threats (T-factors) of the All incl. Rent business model.

For the business model All incl. Rent – Type Contracting Table 5.18 summarizes the reported SWOT-factors. Thereby, the factors with the highest frequency of occurrence were as follows: For strength, it can be noted that *If no staff/expertise the contractor is a solution* (S1). However, this means at the same time that the Landlord acts as intermediary and therefore faces extra effort (W3) which was regarded as a weakness. An opportunity was seen in the possible efficiency gains due to the contractors' expertise (O2). Another opportunity for this business model is: With many dwellings, company could debate for a low price (O1). As for the former business model, also here the threat that was most often mentioned is seen in the EU Law of freedom to choose energy provider (T3).

Table 5.18: SWOT-factors reported for the All incl. Rent – Type Contracting business model.

Strength (S-factors)		**Weaknesses (W-factors)**	
S1	One contract for tenant	W1	External contractor might exploit the situation
S2	Forecastable monthly costs	W2	Time and expertise to set up precise contract
S3	If no staff/expertise the contractor is a solution	W3	Landlord as middleman means extra effort
S4	Energy difference = extra income	W4	Still dependent on energy market price
S5	Technological risks outsourced to contractor		
S6	Less work for landlord		
Opportunities (O-factors)		**Threats (T-factors)**	
O1	With many dwellings company could debate for a low price	T1	Contractor is in power of price
O2	Contractor has expertise leading to efficiency	T2	What if contractor quits
O3	Contractor with standardised system	T3	EU Law of freedom to choose energy provider
		T4	Dependent on the contractor (in crisis times)
		T5	Low quality maintenance by contractor
		T6	Contractor might increase price when they know that you do not want to change contractor

Strengths (S-factors), weaknesses (W-factors), opportunities (O-factors) and threats (T-factors) of the All incl. Rent – Type Contracting business model.

In summary the main results for the business model Energy Budget are, as Table 5.19 shows, that this business model is associated with *Less work for landlord as tasks (investment, maintenance and billing) are outsourced* (S2). However, this strength goes hand-in-hand with the reported weakness of *Dependence on contractor* (W2). Simultaneously, the role of the contractor entails an opportunity, as there is the possibility that *Energy efficiency (is) ensured by contractor* (O1). Another opportunity for improving this business model is seen in applying Energy Budget on big buildings as it is regarded to be more economically (O2). A threat is considered in the possibility that *Contractor could impact tenants' satisfaction with housing situation* (T1).

Table 5.19: SWOT-factors reported for the Energy Budget business model.

Strength (S-factors)		**Weaknesses (W-factors)**	
S1	Energy Budget	W1	Contractor could exploit with too high prices
S2	Less work for landlord as tasks (investment, maintenance and billing) are outsourced	W2	Dependence on contractor
S3	Contractor has expertise	W3	No one-contract → attractiveness is lost
S4	Direct communication between tenant and contractor (no need to involve landlord)		
Opportunities (O-factors)		**Threats (T-factors)**	
O1	Energy efficiency ensured by contractor	T1	Contractor could impact tenants' satisfaction with housing situation
O2	Applied on big buildings more economically	T2	Financial costs for contractor too high
		T3	Produced energy not cheaper than grid energy
		T4	tenants might not choose PEB energy
		T5	Law permits contractor only as energy provider means bureaucratic obstacles
		T6	If one tenant opts out others have o cover the price (law in Italy)

Strengths (S-factors), weaknesses (W-factors), opportunities (O-factors) and threats (T-factors) of the Energy Budget business model.

For the PEBs for RECs business model, it can be summarised that there were SWOT-factors with the same frequency of occurrence. Therefore, to make it short, the main S-factors in regard to the PEBs for REC business model are: *Internal energy prosumption* (S2), *Members have the possibility to participate in low-cost electricity generation* (S4), *Community idea is attractive* (S5), and that the *EU law supports EC* (S8). However, in order to allow for the realization of the before mentioned strength, the following weaknesses that centre on costs need to be taken into account: *Costly RE system* (W1), *Connection of buildings is costly* (W2), *Proof of concept* (W3), and *Administrative effort* (W4). Identified opportunities in this business model were identified in a *Mixture of infrastructure (shops and housing) to reduce grid peaks* (O1), the possibility of *Raising awareness for energy related topics* (O2) within the community, the implementation of a *Portfolio community* (O3), and the *Integration of older buildings* (O4) as well as the integration of

Technical opportunities (e.g. waste water energy) (O5). Furthermore, *Certifications (e.g. Level, SRI, LEED etc.*[7]*) as a requirement to join community* (O6) were seen as an Opportunity. Nevertheless, also two dominant threats were identified. One possible threat is seen in the possibility of *Members leaving* the energy community (T4). The state law that hinders the implementation of energy communities (T1) presents the other threat.

[7] For more information see: and https://www.deepki.com/blog/regulations-certifications-labels-esg-scoring/

Table 5.20 :SWOT-factors reported for the PEBs for Renewable Energy Communities business model.

Strength (S-factors)		Weaknesses (W-factors)	
S1	Bringing people together	W1	Costly RE system
S2	Internal energy prosumption	W2	Connection of buildings is costly
S3	Different types of owners	W3	Proof of concept
S4	Members have the possibility to participate in low-cost electricity generation	W4	Administrative effort
S5	Community idea is attractive		
S6	Shared investment and maintenance costs		
S7	Communities might be looking for energy efficient houses as PEBs		
S8	EU law supports EC		

Opportunities (O-factors)		Threats (T-factors)	
O1	Mixture of infrastructure (shops and housing) to reduce grid peaks	T1	State law is a hindrance
O2	Raising awareness for energy related topics	T2	Liability risks
O3	Portfolio community	T3	Social headwinds
O4	Integration of older buildings	T4	Members leaving
O5	Technical opportunities (e.g. wastewater energy)	T5	Effort in realization
O6	Certifications (as levels, SRI and so on) as a requirement to join community		

Strengths (S-factors), weaknesses (W-factors), opportunities (O-factors) and threats (T-factors) of the PEBs for Renewable Energy Communities business model.

5.6 Additional results

In the following paragraphs, the side results that emerged within the interviews are presented.

5.6.1 Preferred business model

In view of the number of respondents, it is not possible to speak of a distinct preferred BM. However, Table 5.21 shows that the energy budget BM tends to be preferred by the experts surveyed. Apart from the pure preference expressed by the interviewees for the energy budget BM, it was argued that this business model is convincing if it can be assumed that the contractor in this model comes from a subsidiary of their own company.

The other BMs are all favoured with two votes each.

The All incl. Rent business model is favoured because of its simplicity for the tenant. In addition, the company of one respondent has the personnel resources required to run this business. At the same time, billing does not represent any additional expense from the respondent's perspective, as they generally commission account centres for this. This means that there would be no additional work internally, resulting in two positive effects for tenants: low costs and an attractive rental model.

For the All incl. Rent - Type Contracting business model, it was reflected that by hiring a contractor, this would facilitate the implementation of an energy performance contract for the housing company, as the company as landlord has less interest in being the owner of an energy system than in efficiently operating systems.

The interviewees expressed their preference for the PEBs business model for renewable energy communities for different reasons. In connection with PEBs for REC, one interviewee could well imagine that this model would make it possible to realise a huge energy community for all the company's flats. Another interviewee, on the other hand, favoured this business model because it enables interaction between people living in the community.

Table 5.21: Overview of the votes on the preferred business model.

All incl. Rent	All incl. Rent – Type Contracting	Energy Budget	PEBs for Renewable Energy Communities
DE #05	DE #06	DE #04	FR #02
IT #08	FR #03	FR #02	FR #01
		IT #07	

#01 FR, #02 FR, #03 FR, #04 DE, #05 DE, #06 DE, #07 IT, #08 IT, #09 IT = Interview participant code.

5.6.2 Trust question

Within the interviews with the French experts the topic came up that, tenants trust their landlord more than they trust their energy provider (Interviewee FR #01). This motivated the researchers to follow-up on the here called "trust question" within further French and Italian interviews in order to reveal first, if this statement can be confirmed for France and to reveal in a second step, whether this statement is valid or different in other cultures.

Following this, a French respondent in a second interview reported that in France people trust more their landlord than their energy provider (Interviewee FR #02). Thereby, the interviewee confirmed the statement from the first interview. In another interview, a French expert described that this is less about trust and more about the conditions in France (interviewee FR #03). In France, there is a rule that says that tenants who do not pay their rent during the winter months cannot have their tenancy agreement cancelled. The aim of this rule is to ensure that there are no people on the street in winter. Under this premise, it becomes clear why it is interesting for the tenant to have an all-inclusive contract. On the one hand, the all-inclusive contract includes the electricity bill, so the tenant does not have to worry about not having electricity if he does not pay the electricity bill. On the other hand, an all-inclusive contract means predictable costs for the tenant, making it easier for the tenant to plan for and ultimately pay this expense. At the same time, the landlord benefits from predictable income.

For the Italian context, Interviewee IT #07 stated that the energy provider is a company you have to choose and hence a company you have to accept. In another interviewee with an Italian respondent concerning the trust question, it was said that People in Italy neither like Co-ownership nor complex ownership structures, since a majority of people does not trust third parties (Interviewee IT #08). The Interview partner reflected further that a lot in Italy is based on image and on handshake theme and that most prefer a personal relation to a company in that they know a person working there (Interviewee IT #08).

From these statements, it can be concluded that in France there is a tendency that people trust their landlord more than they trust their energy provider. However, this thought might be based rather on prioritisation as in case of not paying energy bills, the energy provider can cancel the energy delivery whereas the landlord cannot cancel the rental agreement in winter month. A similar tendency was observed for Italy. There people prefer to have a contract with personal relationships and people they know, as they trust them more.

5.6.3 Student housing

Another side result was brought in by Interviewee IT #08 who associated the characteristic of "one-contract" within the BMs All incl. Rent and All incl. Rent – Type Contracting with the student housing market. According to Interviewee IT #08 the student housing market has huge problems since houses are not renovated and therefore lack quality. Another issue is that in many Italian cities housing stock was converted into short-term rentals. As a result, many of the houses that were available for students are not available anymore. Since for the university rankings, also the student housing is taken into account, universities might be interested in having quality student housing, including the opportunity of short-term rentals. Against this background, the student-housing field may present a good sales market for PEBs.

6. Discussion

In the following, the results of chapter 5 are going to be discussed in more detail. By doing so, first the results for the All incl. Rent BM are considered. Secondly, the results for All incl. Rent – Type Contracting are examined. In the third sub-chapter, central are the results for the business model Energy Budget. Then, the results for the PEBs for Renewable Energy Communities BM are discussed. Afterwards, additional results are in the spotlight of the discussion. The discussion is closed with a sub-chapter summarizing the main results.

6.1 All incl. Rent

From the SWOT-analysis results for the All incl. Rent model, four main topics could be identified: the strength of (i) simplifying the rent model, (ii) the law as a hindrance as well as (iii) costs, and (iv) the dependency on the energy grid. These themes are discussed in the following paragraphs.

(i) Simplifying the rent model

In the interviews regarding the All incl. Rent model the strengths of Simplifying the rent model emerged. One dominant strength was seen from a tenant perspective in having “one-contract” (S1: 38,0%) instead of several contracts for rent, energy, water etcetera. The simplifying one-contract goes hand-in-hand with the identified strength All-around carefree package (S2: 14,3%), since the tenants do not have to care about various contracts. Another strength was seen in that the All incl. Rent model is a variable model (S4: 14,3%), and enables the “one-contract” to cover many different contracts resulting in a simple rental contract for the tenant.

The idea of simplification meets the ravages of time: the ravages of times of crisis, and the ravages of the fast pace of life. In the wake of multiple crises, resulting higher energy prices are a direct burden for citizens with low income (Breitschopf, Büttner, Burghard, 2023). Within this situation of uncertainty in times of crisis and unstable prices, predictability becomes more important to people as it gives them a sense of control and security. The quest for the predictable is mirrored in results of the interviews where it was seen as a strength that one-contract allows for predictable prices for tenants (S5: 14,3%), since within this business model tenants can predict their monthly expenses and hence know how much money is left each month for free time, groceries etcetera. Apart from that, the ravages of the fast pace of life are a result of globalisation that has made the modern world faster moving than ever before. Against this background, it is important for people to be independent, and to move from one country to the next country, in search of better work and lifestyle (Tacoli & Okali, 2001). Concerning this trend, a strength was seen in having one-contract allowing for short-term rental of some month, since one contract makes renting an uncomplicated matter of realization.

In a nutshell: the shorter the rental period, the greater the advantage for the tenant (S3: 9,5%). Following this, the simpler the contract, the bigger the incentive for the tenant. Against this background, the advantages of one-contract become clear. However, this is only one side of the coin.

On the other side of the coin, there is the threat that even though one-contract is good for the tenants, this could lead to inefficient behaviour by tenants (T2: 14,3%), using the energy as an endless source (as the price does not depend on consumption). This event could hinder achieving the plus in the PEB and thereby the achievement of being energy efficient. Nonetheless, it needs to be mentioned that this event depends a lot on how the tenants, having one-contract, are informed on the use of a PEB or whether they are sensitized on their impact of consumption on energy efficiency. Overall, with regard to the characteristics of the one-contract, it can be said that this model is particularly attractive for tenants, as it contains predictable prices that make calculations easier and create a sense of security. In addition, the rental model allows flexibility in handling and therefore represents a unique selling point. In addition, it must be emphasised that from a business psychology perspective, the all-inclusive concept associated with the one-contract makes consumers believe that they will receive the individual services within this all-inclusive package at a lower price or almost free of charge. Getting something for free or cheaper triggers people emotionally and generally increases the attractiveness of an offer (Weller, 2019).

(ii) The law as a hindrance

As positive as this might sound, the All incl. Rent BM does not come without any downsides, so that a threat was identified in the EU Law of freedom to choose an energy provider (T1: 50%). With that, the EU Directive 2019/944[8] on common rules for the internal market for electricity stays in stark contrast to the BM All incl. Rent which is based on a binding contract and does not allow tenants to choose a different energy provider than their landlord. An opportunity to eliminate this threat is a change in law, so that the legal framework allows for private energy trade (O7: 13,6%).

(iii) Costs

Many weaknesses concerning the All incl. Rent model were mentioned concerning associated costs. On one side, there are costs related to the installed technology in a PEB and the resulting higher investment costs (W1: 30,4%). On the other side, costs of time that arise for the landlord when acting as energy supplier (W6: 13%) and billing tenants (W2: 13%) results in a time-consuming BM (W4: 13%). Thereby, not only the BM itself was seen as time-consuming but also the energy system of the PEB that needs expertise and maintenance (W5: 8,7% & W6: 13%) that in turn cost time.

[8] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32019L0944

An opportunity to overcome the time-consuming All incl. Rent BM presents Building Standardization (O6: 9,1%). To elaborate on this, prefabricated PEBs entailing the same systems might lead to less upfront and maintenance costs.

(iv) Dependency on the energy grid

A further threat in terms of costs was identified regarding the dependency on the energy grid. Since mostly for winter months, the produced energy of a PEB may not be sufficient so that additional energy has to be bought from the grid. This grid energy, however, is prone to unstable energy market prices (T4: 21,4%) that if prices are rising for energy from the public grid, people face an economic risk. However, this topic belongs kind of to the question of whether one sees the glass half-full or half empty. Hence, another perspective could be positively evaluating that PEBs are financially sustainable (O10: 13,6%). Following this, it should be noted that houses usually are supplied with 100% public grid energy, whereas in a PEB the additional purchase is limited to a few months, so that eventually one has to buy less than is usually the case. Nevertheless, in order to allow for the best incentives for customers and the construction industry to build PEBs, there is the need to overcome the obstacle of the dependency on the energy grid. One possible opportunity to do so present battery storages (O8: 9,1%). In theory, storages allow to produce a lot of energy in summer in order to use this energy in winter. Thereby, battery storages can be seen as a technical opportunity on the way to energy autarky. Nevertheless, this idea only exists in theory, since in practice seasonal storage of electricity, e.g. storing energy from the summer for the winter, is currently not feasible with a battery storage system. However, there is an opportunity for improvement coming, namely the possibility of hydrogen storages on which research is currently being conducted (Verbraucherzentrale, 2023).

A non-technical and more feasible opportunity to overcome the issue of the dependency on the energy grid price could be a financial exchange rate protection (O5: 9,1%). This opportunity is about hedging the network energy price on the capital market in order to receive a risk premium in the event of rising prices.

Another non-technical opportunity for the realization of PEBs and the BM All incl. Rent can be seen as sustainable projects are preferred (O4: 9,1%). This preference is based on the importance of the topic of sustainability nowadays that pushes personal motivations and regulations as well as public and private entities towards sustainable investments. Therefore, as a rule of thumbs sustainable projects are preferred over non-sustainable projects. Against this background, it is quite likely that PEBs as sustainable buildings and as the core of the presented BMs in general have a good reputation and therefore a good standpoint on the market and with that a good chance for implementation.

6.2 All incl. Rent – Type Contracting

For the business model All incl. Rent – Type Contracting some reoccurring themes were identified. Thereby, similar topics as for the All incl. Rent BM, came up, so that the aspects of

discussion here are: the strength of simplifying the rent model (i), the law as a hindrance (ii) as well as costs (iii), and risks in relation to the contractor (iv).

(i) Simplifying the rent model

As for the previous BM, also for the All incl. Rent – Type Contracting business model, there is the characteristic of one-contract for the tenants (S1: 22,7%). Following this, these two BMs share the strength of being a simple rent model and incentivizing tenants with an easy contract that enables them to forecast monthly costs (S2: 13,6%).

(ii) The law as a hindrance

Similarly, to the aspect of simplifying the rent model, also the consideration of the law as a hindrance arose not only in connection to the All incl. Rent model but also in relation to the All incl. Rent - Type Contracting business model. For both, the EU Law of freedom to choose energy provider (T3: 37,5%) was identified as a threat for the same reason as the former business model (s. chapter 6.1). Even though the opportunity of changing this law was not explicitly mentioned in regards to this BM, as for the former BM a change in law towards private energy trade would aid this BM in offering one-contract and with that aid the offering of an attractive and easy rental model.

(iii) Costs

For the former BM, the cost of time in regard to maintenance and billing was mentioned. For this limitation, the All incl. Rent – Type Contracting entails a solution insofar that the contractor in this BM undertakes the maintenance with expertise. This was seen as a strength by 27,3% (S3). Contrary, some respondents (W2: 21,5%) identified costs of time in relationship with the contractor as a weakness, in that there is the need to set up a precise contract that in turn needs expertise and time. When evaluating the former aspects of saved costs of time versus spent costs of time, it is about weighing up investing costs of time upfront in form of a precise contract with a contractor resulting in less time spend on maintenance, or having less upfront legal procedures, in other words no contractor, resulting in higher post costs of time. When weighing up these aspects, one should not neglect that a contractor with the strength of expertise can also use this expertise to keep the building's system as energy efficient as possible. Particularly, a contractor might increase efficiency by advancing technology or increasing the amount of buildings and their energy systems to be maintained and operated. Keeping the system as efficient as possible is also in the interest of the contractor, as he can increase his margins with energy-efficient system operation (dena, 2023). Next to the opportunity of advancing the system with new technology, the idea was mentioned that also a standardised contracting business model (O3: 25%) could transform the All incl. Rent – Type Contracting itself in being more efficient and with that less costly for the customer. Another opportunity to ensure an inexpensive contractor imagined by the interviewees was to debate with the contractor for a

grouped price for several buildings (O1: 37,5%) in order to ensure a low energy price. However, whether this can be realized needs further evaluation and therefore, is a matter of future research.

(iv) Risks in relation to the contractor

Nevertheless, a good working contractor is not coming without any threats. It may be that a contractor works well, is aware of this and uses this position to price his service higher, knowing that his customers will not switch to another contractor even if prices rise because of the quality of the service. Therefore, less the dependency on energy market prices (W4: 14,3%) is associated as a downside, but the dependency on the contractor, since the contractor is in power of price (T1: 25%). Further threats in connection with the contractor that were mentioned were: Dependency on the contractor (in times of crisis) (T4: 25%), Low quality maintenance by contractor (T5: 18,75%), and risk of contractor quitting (T2: 12,5%). As negative as this may sound, as simple the solution seems. Even though it needs time and expertise to set up a precise contract (W2: 21,5%), there is nothing, a precise contract cannot address. Against this background, the dreaded threats and their occurrence depend a lot on the contract.

6.3 Energy Budget

For the Energy Budget business model, the identified themes were different to the former BMs. For example, the topic of the dependency on the energy grid has not been mentioned at all. Following this, the topics of discussion within this sub-chapter are: no simplified rent model (i), low costs (ii), the law as a hindrance (iii), and risks in relation to the contractor (iv).

(i) No simplified rent model

The first two BMs were able to convince the interviewees with their unique selling point of one-contract. However, the Energy Budget does not have this characteristic, so the interviewees missed this advantage and incentive for tenants in the Energy Budget BM and emphasised it as a weakness (W2: 37,5%). The attention generated by the absence of this advantage underlines its attractiveness.

Linked to the absence of one-contract is the fact that the tenant is having two contracts. Thus, the tenant is in direct contact with the Contractor. In this regard, a threat (T1: 29,4%) was identified: Since the landlord has no insight into the communication between tenant and contractor, in case the contractor has a negative way of dealing with tenants, it will remain unnoticed by the landlord. In the worst-case scenario, this may result in tenants moving away without the landlord noticing the reason for it (see Interview DE #05). Against this background, it becomes clear that this direct communication between tenant and contractor is not only a disadvantage, but also offers a clear advantage, namely that there is no need for involvement

on the side of the landlord (S3: 20%). To elaborate on this, if a problem arises regarding the energy supply, the tenant can directly contact the contractor instead of contacting the landlord who then contacts the contractor. Following this, this advantage is linked up with the strength of less work for the landlord as tasks (investment, maintenance and billing) are outsourced (S1: 60%). To sum up, the strengths of the Energy Budget clearly lie on the side of the landlord who is saving costs of time and investment within this BM.

(ii) Low costs

As with the previous BM All incl. Rent - Type Contracting, some of the advantages of the contractor were also recognised for this BM. These focus on the contractor's expertise, which enables the contractor to carry out the maintenance of the systems more quickly than the landlord, and in turn leads to saving costs of time (S2: 20%). Additionally, the maintenance with expertise by the contractor leads to efficiency gains and thus to lower costs (O1: 50%). Another opportunity to lower costs mentioned was recognized by the interviewees in applying this BM on big buildings, as this might be more economical (O2: 50%).

Regardless of the opportunities to lower costs, the threat was mentioned that the energy produced by the PEB and sold by the Contractor might not be cheaper than the grid energy (T3: 11,8%). This identified threat is closely related to the reported threat that the financial costs for the contractor might be too high in general (T2: 11,8%), or that the contractor could exploit the tenant with increasing prices and ultimately too high prices (T6: 23,5%). Against this background, the mentioned threats are nearly all associated with the contractor. Therefore, one can argue as for the All incl. Rent - Type Contracting BM (see Chapter 6.2) that a good and precise contract can already address most of the feared threats.

(iii) The law as a hindrance

The former sub-chapter elaborated on the threats regarding the contractor. However, there are also associated threats concerning the tenants. More precisely it was mentioned that tenants might not choose PEB energy (T4: 11,8%), since in the EU everyone is free to choose their energy supplier (EU Directive 2019/944). However, it can be assumed that as long as the price of the flat and the price of the energy bill are fair and not higher than average living costs, this will not be a knockout criterion for tenants. Nevertheless, the financial calculation and the remaining costs for the tenants need to be considered with great attention, since financial costs and energy costs are an important factor for people (Breitschopf, Büttner, Burghard, 2023).

Regarding the law, another threat was mentioned, namely that the law permits a contractor only as an energy provider means bureaucratic obstacles (T5: 11,8%). This is no false information, however, there are already companies available specialising in the field of contracting. Consequently, contracting so far became a business within the European Union in Austria, the Czech Republic, France, Germany and the United Kingdom (Nikolina, 2016). This shows, that the associated bureaucratic tasks do not hinder the emergence of contracting businesses.

6.4 PEBs for Renewable Energy Communities

For PEBs for Renewable Energy Communities, the identified themes are not as similar as for the previous BMs. Nevertheless, it is important to bear in mind that the business model is also different, as it is not a rental model like the previous BMs. Ultimately, the identified topics for the PEBs for Renewable Energy Communities business model centred around: Community (i), Law (ii), community related risks (iii), and costs (iv).

(i) Community

The focus within the BM PEBs for Renewable Energy Communities is – as the name indicates – on the Community. The factor of the Community is perceived by most of the respondents as attractive (S5: 15%) and it is assumed that people are proud to live in a community and to produce energy locally. The fact that community life is seen as attractive can, be explained by the fact that humans are social beings who have lived in communities (e.g. extended families, clans, villages, clans) for thousands of years. Contrarily, living alone is a relatively new construct that only emerged with the enlightenment and early capitalism in the 18th century. Even if this trend exists for many, the sheer advantages of living in a community prevail. In communities, resources are shared, from living space and cars to income and assets. This ultimately leads to more available resources and lower costs. This is usually cheaper and more efficient than if everyone takes care of everything themselves. On top of that, people help, support, and are there for each other. It is therefore not surprising that there is a growing trend towards community living (Fishman, 2023).

This strength goes hand-in-hand with the mentioned strength of bringing people together (S1: 10%) which entails various advantages: Since diverse people start to live together – may it be from different age, different social class or cultural background – it allows for social mixing and in best case for a better mutual understanding and learning from each other. For example, the problem of having to manage a lot on an individual basis in a small family is eliminated. The reason for this lies in the support of others (e.g. in the case of illness). For families with small children, living in a community has many advantages. The little ones always have someone to play with and many different adult care persons. They learn early on how to orientate themselves in a community and how to cope with very different perspectives on the world (Fishman, 2023). At the same time, this model can prevent loneliness. These social advantages are even more likely to happen in this kind of community where people are necessarily in exchange with each other, than if diverse tenants live next to each other in an apartment house but do not have any reason to interact. A further strength in terms of mixing was seen in the possibility of different types of owners (S3: 10%) and types of entities, in the sense of incorporating private owners, social housing, shops etcetera. This is possible due to the characteristic that everyone can participate in a REC, which makes the concept very inclusive and by that possibly incentivises participation.

Additionally, people are curious and have a desire to experience the unknown. This curiosity is an additional incentive for people to try an inclusive and inviting REC (Weller, 2019). The mixture

of various entities however is not only drawing an incentive for participation but at the same time a mixture of infrastructure (shops and housing) also aids to reduce grid peaks (O1: 16,7%) and by that assembles an opportunity that is further incentivizing. All these advantages not only promote the BM itself but also help to raise awareness for the topics of energy efficiency and renewable energy (O2: 16,7%). This assumption is validated by a study of Schweizer-Ries et al. (2010) and their finding that comprehensive participation opportunities are relevant for the acceptance of renewable energies. Consequently, participation in energy from renewables supports the use of renewable energy and contributes to fighting energy poverty. These are amongst others the reasons why the EU law supports ECs (S8: 15%) (European Commission, 2024).

(ii) Law

Unfortunately, this best case stands in stark contrast to the legal frameworks of the member states, where there is room for improvement to leverage Renewable Energy Communities (as chapter 3.2 shows) with funding mechanisms, less bureaucracy and less limitations regarding the distance of the community grid. Hence, it is not surprising that the most commonly mentioned threat was State law as a hindrance (T1: 26,7%).

(iii) Community related risks

Interviewees saw a strength as within a Renewable Energy Community members have the possibility to participate in low-cost electricity generation (S4: 15%) and that shared investment and maintenance costs (S6: 10%) as a characteristic of the PEBs for Renewable Energy Communities lead to lower costs per member. Shared investment and maintenance costs however only show one side of the medal, so that other interview participants considered the administrative effort (W4: 25%) the community has to shoulder as a weakness. To elaborate on this, as in all communities, also in a renewable energy community there are tasks that must either be distributed among the members, assigned to one of them or delegated to an external person. The same applies for administrative tasks. Furthermore, decisions should be made as amicably as possible so that as many people as possible can live with these decisions, in order to be able to avoid disagreements and problems through mutual agreement (Fishman, 2023). Similarly, also the question on how to address liability risks (T2: 13,3%), and members leaving (T4: 26,7%) has to be considered by the respective community members as well as the topic of financial distribution. These threats are all of administrative and legal nature, therefore, as for the contractor, there is the possibility to decide on these matters within a contractual framework in advance, in order to secure that none of these threats appear. Of course, it is still possible that social headwinds (T3: 20,0%) arise. But how likely is it that social headwinds will arise if only those who want to take part in the REC do so? In order to prevent such a worst-case scenario, in advance thought should be given to a risk management system just as much as to the contractual framework.

(iv) Costs

Further weaknesses that were identified are referring to financial costs, since the PEBs for a Renewable Energy Community BM is associated with a costly RE system (W1: 25%) and an expensive connection of buildings (W2: 25%). An opportunity to counter fight the financial costs was seen in storage technologies (interviewee FR #03) that could pave the way for autarky and with that independence from energy grid prices. Another opportunity focuses on the integration of older buildings (O4: 16,7%) in the sense that restricted buildings such as historical buildings (that usually do not have the best conditions for renewable energy system installations) have the possibility to participate in renewable energy via other houses with renewables or PEBs within the community grid. Thereby, the BM helps restricted buildings to benefit from lower energy costs.

Moreover, one opportunity was mentioned that can be seen as a BM within the BM, namely a portfolio community (O3: 16,7%). With this, it was imagined that housing companies could connect their buildings towards a Renewable Energy Community and in doing so aid the older buildings within the portfolio to benefit from green electricity production, in the sense of the afore mentioned opportunity, as well as to offer their tenants green energy.

Contrarily, the opportunity of only allowing buildings with certifications (as levels, SRI and so on) as a requirement to join the REC (O6: 16,7%) was evaluated. This would mean that the before mentioned opportunities of aiding restricted, old, or historical buildings would not be possible. Nevertheless, the topic of certifications could be a great marketing strategy for PEBs. With the help of a certificate, a PEB could be promoted like a prestigious object and eventually become a brand, with the target clientele of people that are interested in innovative sustainable living. The certificate for PEB should be visible on the house wall, so that visitors can become aware of this new living standard and spread the word about the new Tesla in the Building Sector. From a business psychology perspective, word-of-mouth propaganda is particularly important because the opinions of others reinforce the credibility of an advertising message (Weller, 2019).

6.5 Additional results

Chapter 5.6 shows that additional results arose within the interviews. These center on the preferred BM, the trust question and student housing, which are going to be discussed in more depth in the following paragraphs.

Preferred business model

The results for the preferred business model (see chapter 5.6.1) have shown that the All incl. Rent business model is favoured by two interviewees. The reason for this, according to the interviewees lies in the simplicity of this rent model. This aspect was reported to be a strength for this BM because of the characteristic of one-contract, which – as the discussion before has shown – as a unique selling point is adding on the attractiveness of this business model. Furthermore, if a company has the human resources, it is feasible to realize this BM internally, resulting in an attractive rental model with low costs.

Equally, two interviewees expressed their preference for the PEBs business model for renewable energy communities. Their reason for preference was on one the hand the possibility of interaction between community members. On the other hand, the possibility to realise a huge energy community for the company's flats was imagined. These reasons reflect the strengths mentioned in relation to this BM, which were already addressed in the discussion. Chapter 6.4 showed that the idea of a community is attractive. The idea of a large energy community from an entrepreneurial perspective was mentioned in both French and German interviews. The idea of efficiency and savings, which goes hand in hand with an energy community and promises greater economic efficiency, is of paramount importance to the interviewees.

Likewise, two other interviewees preferred the All-inclusive Rent - Type Contracting BM. The preference was justified with pointing to the contractor, who would facilitate the implementation of an energy performance contract for the housing company, resulting in less work for the company and notwithstanding still having an efficiently operating system. This makes it clear that the basic idea of this business model, to relieve the landlord of work with the help of a contractor when no internal human resources are available (as is the case with All Inclusive Rent BM), is also seen positively by those surveyed.

As explained above, an essential reason for preference of the experts is less work. This is also one reason why the interviewees in total preferred the business model Energy Budget the most, as by definition, this business model is the most carefree option for the landlord. Additionally, the possibility of implementing a contractor who is in charge of the building service management as a subsidiary within the company led also to preferring this BM, which makes this BM very economic. Albeit not mentioned directly, but what might had an influence on the vote of preference for this BM, is that this model is the most feasible and applicable business model nowadays when considering legal frameworks.

Overall, it can be said that the votes of preference are distributed very evenly. Nevertheless, the Energy Budget BM is preferred by most of those surveyed with one vote ahead. It may well be

that the fact that the Energy Budget model is the easiest to implement these days when laws are taken into account has influenced the bias of preferences. The equal distribution of votes for the preferred BMs can be attributed to the fact that the different BMs fulfil different requirements set by the interviewees. This means that there is ultimately a business model for diverse requirements in order to implement PEBs in the best possible way.

Trust Question

Another side-result that came up is the topic of trust within the rental agreements. In this regard, the French interviewees reported that "[tenants] trust their landlord more than the[ir] energy provider" (Interviewee FR #01). When assessing if this is true for the other interview partners, it was found that this is perceived to be true also for another French interviewee. A third French interview partner revealed that from their perspective it is less about trust but rather a matter of priority since in France during winter it is not possible to cancel a rental agreement, if tenants are not paying their rent. Contrarary, if tenants are not paying their energy bill, the delivery of energy can be cancelled by the energy provider. For Italy, it was revealed that people prefer to enter into a contract with personal relationships and people they know, as they trust them more. The results from the interviews are in line with the study of Albanese & de Blasio (2014) that shows self-declared trust is comparatively low in southern countries, like Italy with a mean value of trust of 4.41 (0= no trust, 10= trust in all), while trust in France (4.50) or in Germany (4.68) is not significantly higher. Against this background, the importance of trust for human transactions, and increasingly also for economics (Albanese & de Blasio, 2014), becomes clear. To elaborate on this, trust is one of the strongest psychological motives FOR decisions. If trust is placed in someone or something, positive characteristics tend to be attributed to it (Weller, 2019). Consequently, the question of trust is important when it comes to applying one of the BMs presented here, as the trust factor definitely plays a role when dealing with various parties (landlord, contractor, municipality).

Student Housing

As can be drawn from the sub-chapter (chapter 5.6) on additional results, the characteristic of "one-contract" in combination with a PEB has been associated as a good opportunity to market for modern student housing. On the one hand, the reputation of student housing by the general public is not quite good (Brown, 2023; Smith, 2018; Wank et al., 2009) in that student housing is often associated with old, cheap, and low-quality apartments. On the other hand, qualitative student housing is important for the university reputation. Therefore, an innovative approach in this field, as offering PEBs for students could meet with great interest from universities. Eventually, the PEBs do not only present the advantage of energy efficiency, but also incorporate the benefit of IEQ and the possibility to offer one-contract and short-term rental when applying the BM All incl. Rent or All incl. Rent - Type Contracting. These advantages would have a positive effect on the university's reputation. Against this background, the student-housing field may present a good sales market for PEBs. Hence, it is not surprising that there is already a PEB for the purpose of student housing. In this regard, the "Campo V" PEB particularly built for student housing presents a good example of future student housing (Architekten AG). Nevertheless, it needs to be confirmed by future investigations whether the student-housing field presents

indeed a good sales market for PEBs. Hence, researchers are invited to conduct studies on the profitability of the student housing market for PEBs.

6.6 Summary

All incl. Rent

To sum up, the most important result for the All incl. Rent BM is its characteristic of one-contract. This makes this BM quite attractive as the simpler the contract, the bigger the incentive for the tenant to buy it. A threat was identified in the EU Law of freedom to choose an energy provider (T1: 50%) since the EU Directive 2019/944 stays in stark contrast to the BM All incl. Rent which is based on a binding contract. An opportunity to eliminate this threat is a change in law, so that the legal framework allows for private energy trade (O7: 13,6%). Weaknesses for this BM are costs of time that arise for the landlord when acting as energy supplier (W6: 13%) and billing tenants (W2: 13%) which in total means a time-consuming BM (W4: 13%). An opportunity to overcome the time-consuming All incl. Rent BM presents Building Standardization (O6: 9,1%). To elaborate on this, prefabricated PEBs entailing the same systems might lead to less upfront and maintenance costs. Since the All incl. Rent model is dependent on energy grid prices, this was seen as a threat by some respondents (T4: 21,4%) whereas other respondents pointed to the fact that PEBs are financial sustainable (O10: 13,6%), as the alternative is to be 100% dependent on the energy grid.

All incl. Rent – Type Contracting

Also for the All incl. Rent - Type Contracting BM, the characteristic of one-contract for the tenants (S1: 22,7%) was perceived as a huge strength, as it enables to forecast monthly costs (S2: 13,6%). Furthermore, also the EU Law of freedom to choose an energy provider (T3: 37,5%) was identified as a threat for this BM as for the former BM. The before mentioned costs of time regarding the All incl. Rent BM are addressed within this BM, since a contractor undertakes the maintenance (S3: 27,3%). On the flipside, the contractor was spotted as a weakness (W2: 21,5%) in that there is the need to set up precise contracts. Eventually, whether one favours to hire a contractor (All incl. Rent – Type Contracting) or to do it themselves (All incl. Rent), is a matter of personal preferences. A downside linked to the contractor remains: the contractor is in power of price (T1: 25%). However, this is something a precise contract can address.

Energy Budget

To sum up, the strengths of the Energy Budget clearly lie on the side of the landlord who is saving costs of time and investment within this BM. A disadvantage was emphasized in regard to a missing one-contract emphasising its attractiveness. However, two contracts allow for an easy direct communication between tenant and contractor. Nevertheless, this involves the issue that problems in communication might remain unnoticed by the landlord and in worst-case leads to tenants moving away which was the most often addressed threats centred on the contractor in this BM. However, in this regard a precise contract can cover most of the issues

in advance. Still an advantage of the contractor was seen in their expertise leading to efficiency gains and thus to lower costs (O1: 50%).

PEBs for Renewable Energy Communities

For the PEBs for REC, the core of a community is perceived by most of the respondents as attractive. This is in line with a growing trend towards community living (Fishman, 2023). A reported opportunity is the integration of older buildings (O4: 16,7%) that enables restricted buildings to participate in renewable energy via other houses within the community grid. Another opportunity was seen in raising awareness for the topic of renewable energy (O2: 16,7%). These are amongst others the reasons why the EU law supports ECs (S8: 15%). Unfortunately, most of the legal frameworks of the member states leave room for promoting RECs (chapter 3.2). Hence, the most commonly mentioned threat was State law as a hindrance (T1: 26,7%). Further threats were identified in the set-up of the community. These are all of administrative and legal nature, therefore, as for the contractor, there is the possibility to decide on these matters within a contractual framework in advance.

Preferred BM

The votes for the preferred BM are distributed very evenly. Nevertheless, in total, with a small deviation, the Energy Budget BM is favoured by most of those interviewed.

Trust Question

The question of trust is important when it comes to applying one of the BMs presented here, as the trust factor definitely plays a role when dealing with various parties (i.e. landlord, contractor, municipality).

Student housing

In short, it was evaluated that the student-housing field may present a good sales market for PEBs.

Marketing

Possible marketing strategies have emerged from the above discussion. Firstly, the interviews on the All incl. Rent model revealed that one-contract as a unique selling point represents an attractive incentive to the buyer. Furthermore, it was reflected that the trend towards more sustainability may be a push factor in the realisation of PEBs and can be used helpfully in marketing. A strategy to overcome the dependence on the energy grid is a financial exchange rate protection. When applying these opportunities in practice, their advantages can be emphasised in marketing.

For the All incl. Rent – Type Contracting two opportunities aiming at an inexpensive contractor were revealed: First, a standardised contracting business model as being more efficient and

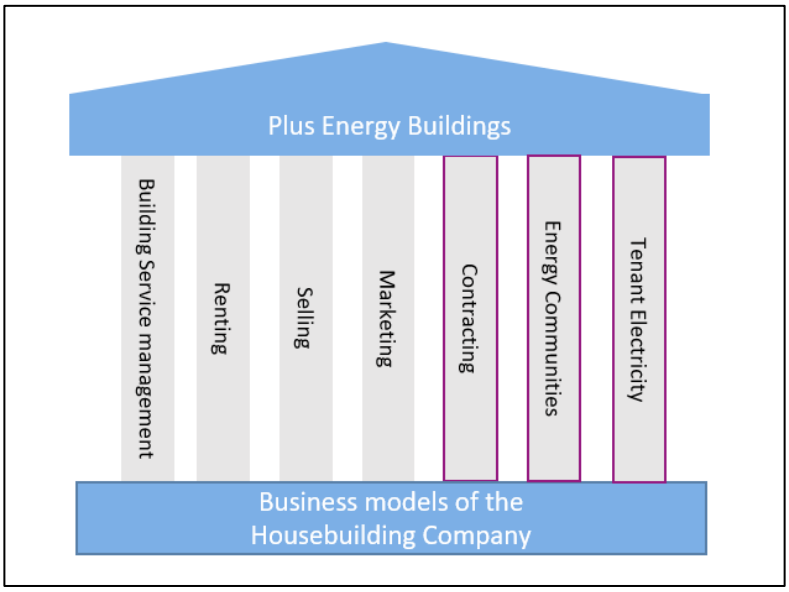
with that less costly. Secondly, the opportunity to debate with the contractor for a grouped price for several buildings resulting in a low price.

For the PEBs for Renewable Energy Communities a BM within this BM was identified, namely a Portfolio community. This opportunity might be attractive for housing companies. Further, the idea of certifications as a requirement to join the REC were brought up. With the help of a certificate, a PEB could be promoted like a prestigious object and eventually become a brand, with the target clientele of people that are interested in innovative sustainable living.

7. Conclusion

Even if PEBs are just one of many puzzle pieces that together, contribute to a successful ET, every single piece is needed to complete the puzzle. In order for PEBs to contribute to the success of the ET, the implementation of PEBs must function in the best possible way. To this end, economically successful pillars must support PEBs, as following figure illustrates.

Figure 7.9: Business Pillars of PEBs (own representation).



The supporting pillars, or more precisely the BMs All incl. Rent (Landlord-to-tenant-electricity), PEBs for Renewable Energy Communities (Energy Communities), All incl. Rent -Type Contracting and Energy Budget (Contracting) were presented within this study and evaluated in relation to the implementation of PEBs. These BMs are key for PEBs as they provide an incentive for companies to implement them despite their higher costs. This study showed that these BMs encounter country-specific hurdles. The future will show whether addressing the obstacles, but also the strengths and opportunities, will find a response from stakeholders so as to create greater room to maneuver for the implementation of PEBs.

Even if a majority of the interviewees is in favour of the Energy Budget BM, the votes for the preferred BMs are distributed very evenly on average. Meaning that all the BMs presented here appear to meet the different requirements that the companies place on the BMs and that there is ultimately a business model for every requirement in order to bring PEBs into the field with a suitable business model.

Table 7.1 :SWOT Analysis summary table.

Business Model	S (Strength)	W (Weaknesses)	O (Opportunities)	T (Threats)
All incl. Rent	S1: One contract	W1: More technology, more costs	O7: Standardization O10: General public is interested in ecological energy	T1: EU Law of freedom to choose energy provider
All incl. Rent – Type Contracting	S1: If no staff/expertise the contractor is a solution	W3: Landlord as middleman means extra effort	O1: With many dwellings company could debate for a low price O2: Contractor has expertise leading to efficiency	T3: EU Law of freedom to choose energy provider
Energy Budget	S2: Less work for landlord as tasks are outsourced	W2: Dependence on contractor	O1: Energy efficiency (is) ensured by contractor O2: Applied on big buildings more economically	T1: Contractor could impact tenants' satisfaction with housing situation
PEBs for Renewable Energy Communities	S2: Internal energy prosumption S4: Members have the possibility to participate in low-cost electricity generation S5: Community idea is attractive S8: the EU law supports EC	W1: Costly RE system W2: Connection of buildings is costly W3: Proof of concept W4: Administrative effort	O1: Mixture of infrastructure (shops and housing) to reduce grid peaks O2: the possibility of Raising awareness for energy related topics O3: the implementation of a Portfolio community O4: Integration of older buildings O5: the integration of Technical opportunities (e.g. waste water energy)	T1: The state law that hinders the implementation of energy communities T4: Members leaving the energy community

As the SWOT Analysis summary above shows (see Table 7.1), several obstacles need to be removed before the BMs of observation can be implemented.

Political implications

In particular, the SWOT analysis carried out as part of the expert interviews crystalized that the current legal framework conditions in all of the countries analysed represent an obstacle to the implementation of BMs that need consideration by political actors.

On the one hand, the EU Directive for Renewable Energy Communities, the RED II, has been implemented in national law. However, implementation into national law was done in such a way that the interviewees see the existing legal framework as an obstacle rather than an enabler. The reason for this is that the financial levies for energy fed into the grid and grid fees do not provide any incentive. On the other hand, RED II states that renewable energy communities may not act in a profit-orientated manner, which is an obstacle to investment and innovative BMs, such as a portfolio RECs. Furthermore, private energy trading within Landlord-to-tenant-electricity is seen to be hindered, as private individuals who want to sell their surplus energy to other individuals face a high administrative burden as they are defined as energy suppliers. The creation of a better legal framework for private energy trading would enable more people to purchase local renewable energy. In addition, there is room for improvement in the subsidisation options for Landlord-to-tenant-electricity. Germany is setting a good example in this field, promoting Landlord-to-tenant-electricity in that no grid fees, levies and charges need to be paid for electricity that is generated, supplied and consumed within the residential complex (Bundesnetzagentur, 2023).

Against this background, we appeal to legislators in and beyond the EU Member states, to take the lead in setting precedents, showing what is possible and, accordingly defining a legal framework that promotes sustainable BMs and thereby takes decisive action to combat climate change (Heldeweg & Saintier, 2020).

As recognised by the Italian National Integrated Energy and Climate Plan (PNIEC) 2020, in the fight against climate change, renewable energy installations in self-consumption systems and RECs can be a valid tool to also combat energy poverty by supporting economic efficiency through the use of local resources (Ministero dell'Ambiente e della Sicurezza Energetica, 2023). At the same time, RECs offer social benefits for their members (see Chapter 6.4) that by joint-decision making and participatory processes may help to revitalise the democratic life. For these benefits to be realised, however, the implementation of RECs and Landlord-to-tenant-electricity must be promoted in the best possible way in order to create incentives. Beyond mere financial support, the exemption from or reduction of grid charges, levies and surcharges on self-consumed electricity could already provide a good incentive.

As there are no support measures for contracting in the private sector in the countries analysed (see Chapter 6.4), consideration should also be given in this field to exempting private

households from grid charges etcetera in order to help them on the way to greater energy efficiency and consumption of renewable energy.

Guidelines for PEB investors

As outlined above, funding is an important financial instrument to incentivise the implementation of PEBs and related BMs. The use of funding is also important to incentivise PEB investors. Besides this, there are other things for PEB owners and investors to consider when contemplating the construction of a PEB.

Accordingly, investors should keep in mind cultural circumstances, such as the importance of trust, when applying one of the BMs presented here. Since the level of trust in third parties needs to be different for the BMs, as various settings of parties are involved.

In regard to costs, investors should give consideration to the opportunity to debate for a grouped price with a contractor for several buildings (O1: 37,5%), as this not only helps to reduce costs for the contractor, but also to reduce investment, maintenance and operating costs for the energy system. Even though, a contractor presents a great opportunity for costs reduction and levelling of energy efficiency, some threats concerning the contractor were associated within the expert interviews. However, it needs to be emphasized that a precise contract can already prevent most of the worst-case scenarios. Hence, PEB owners and investors should take time and expertise for setting up a precise contract when hiring third parties.

As mentioned earlier, PEBs are associated with high investment costs. Therefore, the opportunity to debate for a grouped price with a contractor has been recommended. Additionally, there is the opportunity to lower costs by creating a portfolio community. With this, it was imagined that housing companies could connect their buildings towards a Renewable Energy Community and in doing so aid the older buildings within the portfolio to benefit from green electricity production. This business model is aimed at property owners that can set up PEBs for REC exclusively for their buildings in order to offer their tenants green energy and by that to save money by efficiency gains. This advantage goes hand-in-hand with the strength that the Community idea is generally perceived as attractive, so that there is currently a trend towards community living. Accordingly, a REC leads to a win-win situation for investors and tenants, in that a portfolio community is of financial benefit to the investor and at the same time meets the demand from tenants.

Marketing for PEBs

The above-mentioned advantages associated with the PEBs for REC BM can be used well for the marketing of PEBs. (As can be seen from the description of the PEBs for Renewable Energy Communities BM,) the inclusive financing approach based on shared investments can enable many people to participate in a PEBs for REC and thus also to actively participate in the ET.

Thus, the BM PEBs for REC could be promoted in the sense of "PEBs for all", which could increase the sales of PEBs. At the same time, the social benefits RECs and PEBs (community living, IEQ etc.) offer (see Chapter 6.4) should be emphasised in marketing.

The attractiveness of community living (as shown in this study) is most likely linked to the biological origin of humans as social beings. It is also possible that the trend towards more sustainability – driven by the presence of climate change and the associated social change – also has an influence on the trend towards community living. Closely connected with the trend towards sustainability is the preference for sustainable projects pulling public and private entities towards sustainable investments. Against this background, it is quite likely that PEBs as sustainable buildings as a core of the here presented BMs in general have a good reputation and therefore a good standpoint on the market and with that a good chance for implementation.

In addition to the idea of sustainability, certification could also have a positive effect on the sale of PEBs. With the help of a certificate, a PEB could be advertised as a prestigious object and ultimately become a brand. As is usual for brands, a PEB should also have a highly visible trademark so that people become aware of it and talk about “the new Tesla in the construction sector”.

Furthermore, the possibility of a one-contract should be advertised as a unique selling point. This marketing opportunity was seen as a major strength during the interviews. Overall, the characteristics of the one-contract are seen as a simplified rental model, as it is an all-round carefree package for the tenant, as one-contract regulates what would otherwise require several contracts. The use of a simple rental contract is a particularly interesting option for the short-term rental field and student housing. Therefore, the BM All incl. Rent and All incl. Rent - Type contracting, which are based on a one-contract, should be promoted in this sector in order to take advantage of the demand there and transform it sustainably.

In general, for the implementation of PEBs on the market, the marketing must emphasise the advantages. Otherwise, as in the SWOT analyses, disadvantages are seen that do actually not exist. For example, the dependency on fluctuating energy grid prices with a PEB has often been mentioned. However, it depends very much on the presentation and whether the glass is seen as half full or half empty, because PEBs themselves generate more energy than they consume. With that being said, PEBs are less dependent on the public grid than non-PEBs. Emphasising and correctly presenting this advantage should not be neglected in the marketing of PEBs.

Limitations & Future research

As with the majority of studies, the design of the current study is subject to limitations.

There are two major limitations in this study that could be addressed in future research. First, one limitation to the generalization of these results is that interviewees’ opinions are deeply influenced by social and cultural norms (Shove, 2003). For addressing this problem, diverse perspectives within the interviews were taken into account to allow for generalization. However,

in order to verify the results presented here, future studies should attest the generalization of the results by conducting interviews with a higher number of respondents.

Secondly, the study focused on three European countries namely, France, Germany, and Italy. Future research could expand a similar analysis to other European countries in order to validate the results or alternatively show how results vary for different countries. Also, an European wide or even global comparison of best-practices that facilitate the implementation of PEBs and the here reviewed BMs as well as a comparison of financial mechanisms for energy efficiency could be conducted. Such a global comparative analysis would enable the identification of best practices in supporting an ET in the building sector.

PEBs are in their infancy and will only become well established in the coming years. As a result, it was not possible to carry out a practice-orientated analysis in the course of this research on this topic. It remains to be seen which BMs will be successful as well as which companies will make a substantial contribution to the developing PEB market. Against this background, no market suitability can be derived from the SWOT analyses carried out. Following this, additional tests and studies should be undertaken in order to verify the marketability of the presented BMs.

In this regard, future studies should additionally take into account in how far the cultural variable of trust in third parties influences the preferences of the different BMs presented and with that the marketability of these. Furthermore, to what extend the mentioned opportunity of a financial exchange rate protection (O5) to overcome fluctuating energy grid prices are realizable, can be addressed in future research. Likewise, in how far the opportunity of standardization of PEBs (O6) per se as well as standardization of the contracting business model (O3) lead to cost reductions are matter of future studies.

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Annexes

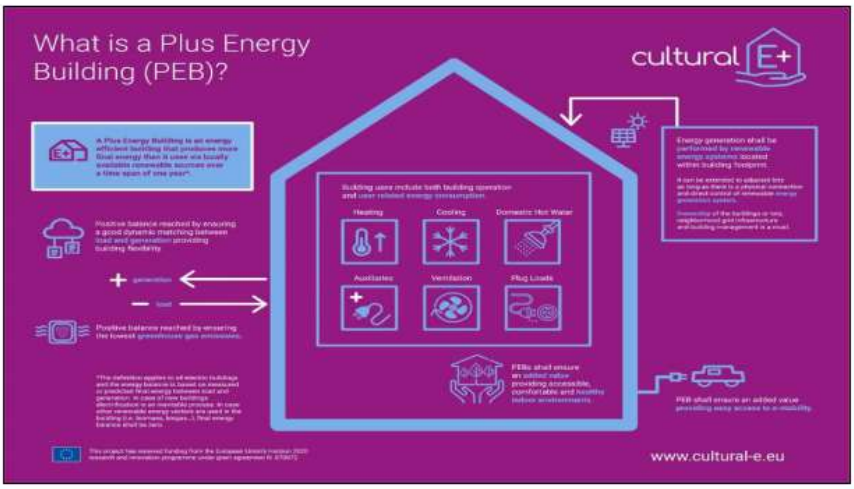
Annex A

Handout

What is a Plus Energy Building (PEB)?

A Plus Energy Building is characterised by the fact that...

... it is an **energy-efficient building** that produces more final energy than it consumes over a period of one year
... the building contributes to **improved indoor comfort**
... an **app** shows the energy balance of the building to the end-user

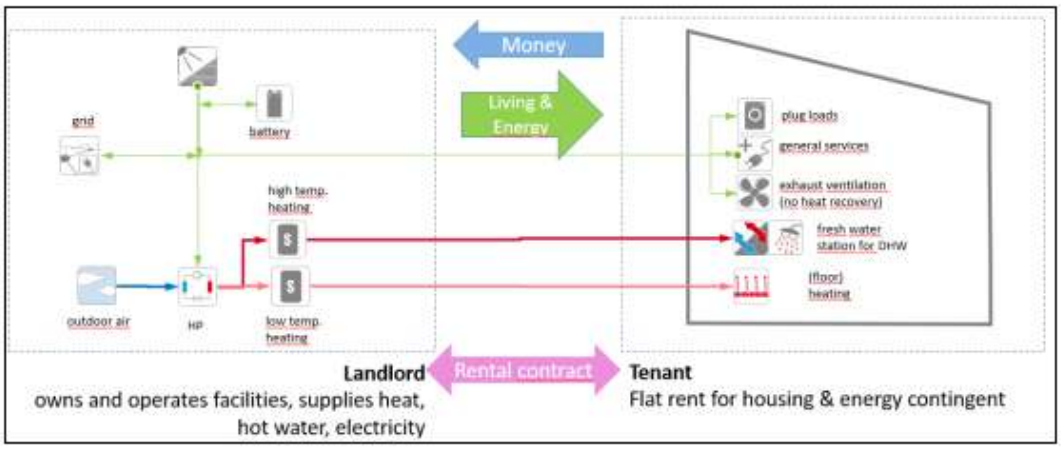


1

Business model 1: "All incl. Rent".

The business model "All incl. Rent" is characterised by the fact that not only simple residential units are rented out, but flats that include internet as well as a heat and electricity budget. The energy comes directly from the PEB, which generates electricity from PV systems and heat with the help of a heat pump. The systems are owned by the landlords.

This gives the **landlords** the advantage that they receive additional income from the energy production which is included in the costs, above and beyond the mere rent. If the tenant exceeds the energy budget, they have to pay extra. If the energy budget is not used up, the landlords have an additional profit. However, this contract model is also attractive for the **tenants**, as they have a good overview of their monthly costs with one contract for rent and energy. In addition, they receive ecological electricity from their own house.

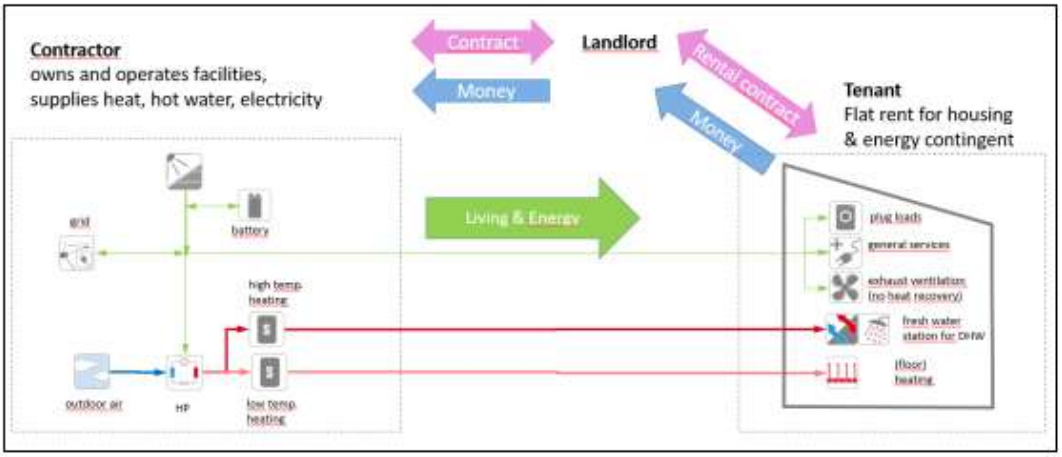


Business model 2: "All incl. Rent Type Contracting"

The core business of "All incl. Rent Type Contracting" is the rental model, which, in contrast to the traditional rental contract, also covers the provision of energy from the PEB's energy plants. For this purpose, the landlords rent out the flats including an energy budget (electricity from PV) and a heat budget (heat, domestic hot water from heat pump). The tenant can view the current energy consumption via an app, with usage included in the rent.

This business model is particularly attractive for **tenants**, as they only have one contractual partner for the rent including the energy budget, which gives them a good overview of the monthly costs. In addition, they are supplied with ecological electricity from their own house. The **contractor** takes care of the delivery of heat, hot water and electricity to the tenants, as well as the financing, operation and maintenance of the systems, which finances them. The benefit for the **landlords** is that they have transferred responsibility for the financing, operation and maintenance of the systems.

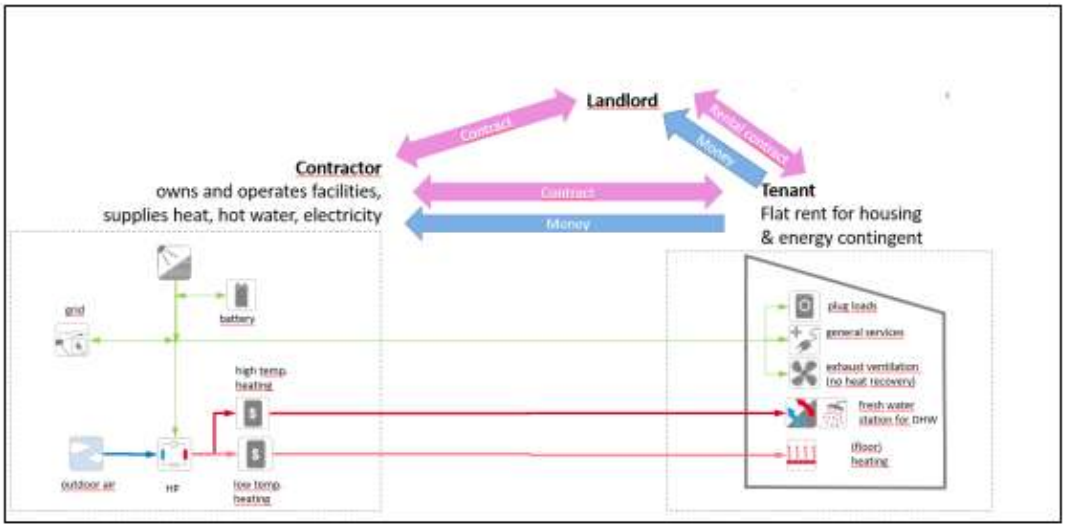
From a **financial perspective**, this means that the landlord makes savings by outsourcing the tasks. The contractor earns money through a flat-rate supply contract. If the energy quota is exceeded, the tenant has to pay extra. If the energy quota is not used up, the Contractor makes an additional profit.



Business model 3: „All incl. Energy“

The business model here lies on the side of the contractor, who finances, maintains and operates the energy systems of the PEB. The contractor draws up contracts with the tenants of the PEB in which an energy contingent is fixed at a monthly price. If the tenants consume more than the contingent allows, they pay extra. If the in-house electricity cannot cover the energy demand, the contractor buys additional electricity from the general supply grid.

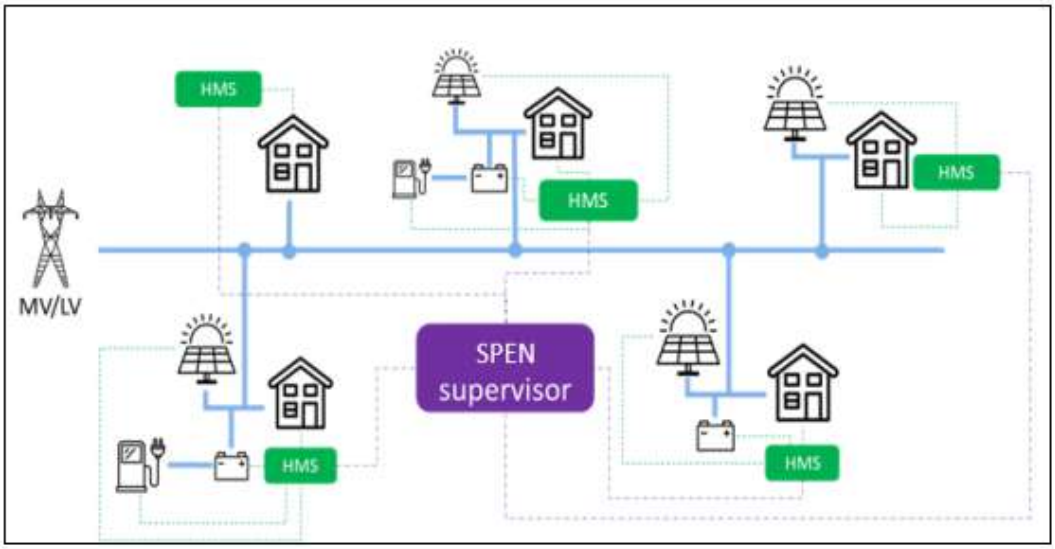
This business model is a **win-win situation** for everyone involved: The landlords do not have any additional expenses, as the contractor is responsible for financing, operating and maintaining the systems as well as for billing the tenants. These services result in a lucrative business model for the contractor. This business model is also useful for the tenants, as the app gives them an overview of their energy consumption. At the same time, they receive the ecological energy from their own house at a good price. The financial gain for the contractor comes from the sale of the energy, and for the homeowner from savings due to the outsourcing of the systems and billing.



Business model 4: PEBs 4 Energy Communities

Users of a PEB join together with users from neighbouring buildings to form an energy community. The surplus energy from the PEB is passed on to other users in the community. An HMS (House Management System) in combination with the supervisor (control hardware) controls the transfer. The tasks associated with operating the systems (financing, operation and maintenance) are distributed among the members of the community. This means that the users are also the entrepreneurs. The shared investment costs mean that participation in the Energy Community can be made possible for everyone. Not only regardless of financial means, but also regardless of the type of building they live in, as they benefit from the renewable energies in the PEB and do not have to install them in their building. At the same time, the multiple investors lead to financial security for the construction company of the PEB. The financial benefit for the Energy Community participants lies in the savings made by producing their own electricity compared to buying it from the grid.

The electricity is used on a non-profit basis. In addition to energy at favourable prices, the locally generated and used energy also contributes to grid efficiency. Furthermore, the social aspect, the opening up of participation in renewable energy through PEBs and energy communities in the sense of "PEBs for all" is a marketing concept that can lead to more construction orders for PEBs.



Annex B

All incl. Rent

Strengths	Weaknesses
• Where do you see strengths in the business model All incl. Rent for your company? • What is crucial for a successful business model All incl. Rent? • Can you do All incl. Rent better than your competitors can? • In what way does All incl. Rent fit particularly well with your target groups? • Which core competences and resources in the company help you to implement All incl. Rent?	• Where do you see the weaknesses in the business model All incl. Rent for your company? • In what way are you worse at All incl. Rent compared to your competitors? • What is missing in products, services or processes for the best possible implementation of All incl. Rent? • Why are orders for All incl. Rent lost to competitors? • What competences are missing in the company to implement All incl. Rent in the best possible way? • What hinders the implementation technically and in terms of staff? • Where is there a lack of budget for the implementation of All incl. Rent? • Where is there a lack of expertise?
Opportunities	**Threats**
• What opportunities are there for the implementation of All incl. Rent? • What future opportunities support this business model? • What possible future changes do you see as beneficial for offering All-incl. Rent? • Which developments in the economy and society promote the successful implementation of All incl. Rent? • Which social or political currents or opinions support your business in the implementation of All incl. Rent? • Which laws or regulations are conducive to the implementation of All incl. Rent? • Which technological developments can you take up in your business for the implementation of All incl. Rent? • Which socio-demographic factors are changing positively for you (new sales opportunities)?	• Where do dangers threaten the new business model All incl. Rent? • Which factors and changes could possibly have an unfavourable effect on the new business model? • What developments in technology, the economy, society or politics are more likely to hinder the offering of All incl. Rent? • Which trends could have a negative impact on All incl. Rent?

All incl. Rent Type Contracting

Strengths	Weaknesses
• Where do you see the strengths of the business model All incl. Rent Type Contracting for your company? • What is crucial for a successful business model All incl. Rent Type Contracting? • Can you do All incl. Rent Type Contracting better than your competitors? • What unique selling propositions does your company have that enable you to do All incl. Rent Type Contracting? • In what way does this business model fit your target groups particularly well? • What are the benefits of All incl. Rent Type Contracting for your target group? • Which core competences and resources in your company help you to implement All incl. Rent Type Contracting?	• Where do you see the weaknesses in the business model All incl. Rent Type Contracting for your company? • What is missing in products, services or processes for the best possible implementation of All incl. Rent Type Contracting? • What competences are missing in the company to implement All incl. Rent Type Contracting in the best possible way? • What hinders the implementation technically and in terms of personnel? • Where is the budget for the implementation of All incl. Rent Type Contracting lacking?
Opportunities	**Threats**
• What opportunities are there for implementing All incl. Rent Type Contracting? • What trends will benefit your company in offering All incl. Rent Type Contracting? • Which developments in the economy and society promote the successful implementation of All incl. Rent Type Contracting? • Which social or political currents or opinions support your business in the implementation of All incl. Rent Type Contracting? • Which laws or regulations are conducive to the implementation of All incl. Rent Type Contracting? • Which technological developments can you use in your company to implement All incl. Rent Type Contracting? • What socio-demographic factors are changing positively for it (new sales opportunities)?	• Where do dangers threaten the new business model ? • Which factors and changes in the environment could possibly have an unfavourable effect on the new business model? • What developments in technology, the economy, society or politics are more likely to hinder the offering of All incl. Rent Type Contracting? • Which trends could have a negative impact on All incl. Rent Type Contracting?

All incl. Energy

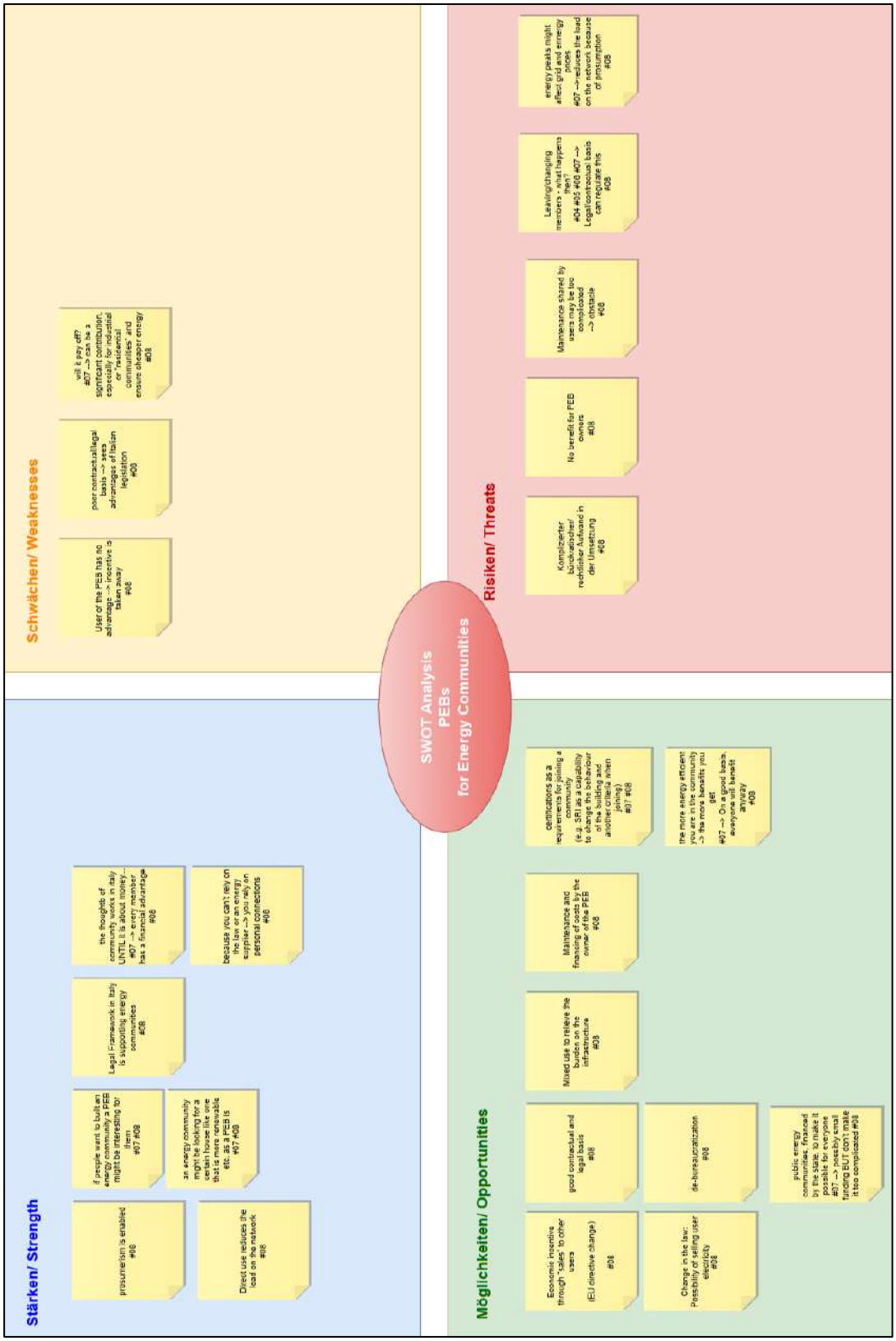
Strengths	Weaknesses
• Where do you see strengths in the business model All incl. Energy for your company? • What is crucial for a successful business model All incl. Energy? • Can you do All incl. Energy better than your competitors can? • In what way does All incl. Energy fit particularly well with your target groups? • Which core competences and resources in the company help you to implement All incl. Energy?	• Where do you see the weaknesses in the business model All incl. Energy for your company? • In what way are you worse at All incl. Energy compared to your competitors? • What is missing in products, services or processes for the best possible implementation of All incl. Energy? • Why are orders for All incl. Energy lost to competitors? • What competences are missing in the company to implement All incl. Energy in the best possible way? • What hinders the implementation technically and in terms of staff? • Where is there a lack of budget for the implementation of All incl. Energy? • Where is there a lack of expertise?
Opportunities	**Threats**
• What opportunities are there for the implementation of All incl. Energy? • What future opportunities support this business model? • What possible future changes do you see as beneficial for offering All-incl. Rent? • Which developments in the economy and society promote the successful implementation of All incl. Energy? • Which social or political currents or opinions support your business in the implementation of All incl. Energy? • Which laws or regulations are conducive to the implementation of All incl. Energy? • Which technological developments can you take up in your business for the implementation of All incl. Energy? • Which socio-demographic factors are changing positively for you (new sales opportunities)?	• Where do dangers threaten the new business model All incl. Energy? • Which factors and changes could possibly have an unfavourable effect on the new business model? • What developments in technology, the economy, society or politics are more likely to hinder the offering of All incl. Energy? • Which trends could have a negative impact on All incl. Energy?

PEBs 4 Energy Communities

Strengths	Weaknesses
• Where do you see strengths of the business model PEBs 4 Energy Communities for your company? • What is crucial for a successful business model PEBs 4 Energy Communities? • Are you better at PEBs 4 Energy Communities than your competitors are? • What are the unique selling points of your company that enable you to create PEBs 4 Energy Communities? • In what way are PEBs 4 Energy Communities particularly well suited to your target groups? • Which core competences and resources in your company help you to implement PEBs 4 Energy Communities?	• Where do you see the weaknesses in the business model PEBs 4 Energy Communities? • What is missing in products, services or processes for the best possible implementation for PEBs 4 Energy Communities? • What competences are missing in the company to implement PEBs 4 Energy Communities in the best possible way? • What hinders the implementation technically and in terms of staff? • Where is the budget for the implementation of PEBs 4 Energy Communities lacking? • Where is there a lack of expertise?
Opportunities	**Threats**
• What are the opportunities of implementing PEBs 4 Energy Communities? • What future opportunities are supportive for PEBs 4 Energy Communities? • Which trends will benefit your company by offering PEBs 4 Energy Communities? • What possible future changes do you see • as beneficial for offering PEBs 4 Energy Communities? • Which developments in the economy and society promote the successful implementation of PEBs 4 Energy Communities? • Which social or political currents or opinions support the implementation of PEBs 4 Energy Communities? • Which laws or regulations are beneficial for the implementation of PEBs 4 Energy Communities? • Which technological developments can you use in your company to implement PEBs 4 Energy Communities? • Which socio-demographic factors are changing in a positive way for PEBs 4 Energy Communities (new sales opportunities)?	• Where do dangers threaten the new business model? • Which factors and changes in the environment could possibly have an unfavourable impact on the new business model? • What developments in technology, the economy, society or politics are more likely to hinder the offering of PEBs 4 Energy Communities? • Which trends could have a negative impact on PEBs 4 Energy Communities?

Annex C

SWOT analysis table



Annex D

The statutes or articles of association of the renewable energy community must contain the following essential elements:

a. have as their primary corporate purpose the achievement of environmental, economic or social benefits at community level for their shareholders or members or for the local areas in which they operate, rather than the achievement of financial profits;

b. indicate that the shareholders or members exercising the power of control are natural persons, small and medium-sized enterprises (SMEs), regional authorities or local authorities and are established in the territory of the same municipalities in which the Community production facilities are located

c. to establish that the community is autonomous and provides for open and voluntary participation

d. stipulate that the participation of the members of the community provides for the maintenance of the rights of the end customers, including the right to choose the seller themselves, and that they can exit the configuration at any time without, in the event of an early exit, receiving a fair and adequate consideration for the distribution of the investments made is agreed

e. appoint a delegated party responsible for allocating the shared electricity.

Those involved in the renewable energy community configuration must meet all of the following requirements:

1. to be shareholders or members of the same legal entity (the Renewable Energy Community);

2. in the case of shareholders or members exercising control powers, be natural persons, small and medium-sized enterprises (SMEs), regional authorities or local authorities, and located in the territory of the same municipalities in which the Community's renewable energy production facilities are located condition;

3. in the case of private companies, participation in the renewable energy community may not constitute the main activity of their commercial and/or industrial activity

4. Be the owner of connection points located on low-voltage power networks supplied by the same medium/low voltage substation

The connection points of the final customers and/or generators and the generating facilities, including any storage systems or columns, whose electricity is relevant for determining the electricity shared by the group of self-consumers, must be located in the area of the same building or residential complex.

The connection points of the companies that are members or shareholders belonging to the configuration of the renewable energy community and the generating facilities whose energy is relevant to the configuration must be located in the same low-voltage/medium-voltage substation.

5. instructed the Renewable Energy Community to submit an application to the GSE and take advantage of the shared electricity exploitation and incentive service

(Gestore die Servizi Energetici, 2024).

Annex E

The potential role of PEB as an enabler of the REC framework

Results of minor simulations carried out based on the outcomes of T4.4 with a focus on the potential impact of PEB in a REC framework.

Objective

The objective of the current activity is the exploration of the expected potential impact and behaviour of plus energy buildings (PEB) (core of the mandate of the Cultural-E project) as members of a renewable energy community (REC). The overall mechanism beyond the different declination of the REC general definitions was widely introduced and discussed in the deliverable D4.4 section 4 [1]. As a general statement, a REC is a legal entity aggregating passive consumers, prosumers, and local small renewable energy producers. The main aim beyond such entity is to encourage local energy production, buffer, and exploitation through enabling technologies for example photovoltaics and residential electrical storage. This is done by applying economic incentives to valorise the energy produced and consumed on-site or shared at the community level.

The current work is based on the tools and outcomes from the previous task of the Cultural-E project and namely: D3.11 for part of the simulation tool [2], D4.3 for the definition of the case study and the building models [3], and D4.4 for the introduction of the REC topic and the building level outcomes [1].

Methodology

We define a REC composed of 20 nodes. The nodes have different adoption rates of the renewable assets identified (PV, EV, BESS) and overall different characteristics and composition. This is done to build a base REC with a certain rate of heterogeneity in composition, behaviour, and characteristics to propose a realistic scenario. According to the availability of profiles from the previous simulations, the two reference buildings described in D4.3 [3] are inserted as single nodes of the community. We select the profiles with the advanced control logic from [1] localized in the Mediterranean geo-cluster. The same irradiation time-series is adopted to generate the photovoltaic profiles of the other nodes, adopting a set of different slope/azimuth angle combinations to simulate different building roofs or façades. The Cultural-E derived reference building inherits from the previous step of the work the load profile describing their consumption/production behaviour. For the other nodes, we use a tool to generate synthetic load profiles of the building electricity use according to different family compositions and other parameters, another time to provide a good composition of community members.

The simulation framework is similar to the one applied in the work discussed in [2] with the addition of a community-level control to simulate the scenario with so-called peer-2-peer P2P energy sharing. The same simplifications and assumptions from [2] hold. This scenario requires the presence of a coordinator at the community level that manages the power flows among members of the community to enhance the energy share among the community members. More details about the possible energy-sharing approaches are provided in the discussion of RECs in D4.4 section 4 [1] and also in [4].

Simulation parameters and scenarios

Given the community described in the previous section, we define two separate scenarios to address the impact of PEB on the REC performance. The PEB-scenario contains a community composed of the aforementioned nodes with enough renewable assets to respond to the PEB criterion. Decreasing the deployed PV and battery we obtained the second scenario (noPEB-scenario) with the same nodes and consumption behaviours but not matching the PEB criterion. Battery and photovoltaic nominal values are reduced and adapted to the granularity offered by potential real products (therefore considering potential module level nominal capacity both for PV panels and battery modules). The installed PV/battery capacity is slightly below the PEB criterion retaining as much as possible the ratio of the scenario with PEB nodes (PEB-scenario).

Table E.2

Table with the composition of the community and preliminary data and parameters that define the nodes of the community: nominal installed PV, nominal installed electrical storage capacity and presence of EV in the building. ITLR and ITHR are the reference buildings of the Cultural-E project.

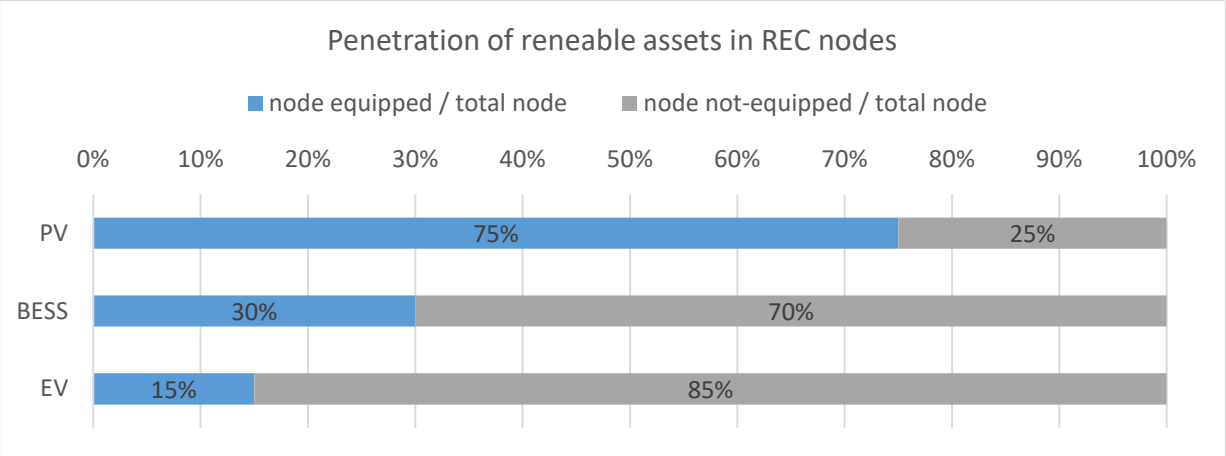
	noPEB scenario				PEB scenario		
NODE ID	**PV (kWp)**	**BESS (kWh)**	**node with EV**	**NODE ID**	**PV (kWp)**	**BESS (kWh)**	**node with EV**
node 0	1.45			node 0	7.25		
node 1	2.32			node 1	5.8		
node 2				node 2			
node 3	2.03	7	x	node 3	4.64	11.4	x
node 4	3.77			node 4	3.77		
node 5	2.61	7	x	node 5	5.8	11.4	x
node 6				node 6			
node 7	1.45			node 7	4.64		

node 8				node 8			
node 9	2.61			node 9	5.8		
node 10	2.32	7	x	node 10	7.54	11.4	x
node 11	3.48			node 11	7.54		
node 12	2.32			node 12	4.64		
node 13	0.87	7		node 13	7.54	11.4	
node 14				node 14			
node 15				node 15			
node 16	4.64			node 16	4.64		
node 17	2.32			node 17	4.64		
ITLR[9]	23.2	30		ITLR[9]	32.63	46	
ITHR[9]	100.92	30		ITHR[9]	136.25	48	

Table E.2 reports the parameters related to the members of the community in the two scenarios. Respectively on the left we have the values related to the node no-PEB and on the right the ones related to scenario PEB. The table reports the available equipment by any nodes of the community, the same information is provided also in Figure E..

[9] ITLR and ITHR represents respectively the Italian low-rise building and the Italian high-rise building. In such nodes are located the building with the characteristics described in the deliverable D4.3 for the definition of the case study and the building models [3]

Figure E.10 : Percentage adoption of renewable assets by the community nodes.



Results

We compute a one-year-long simulation with one-hour time resolution with different control approaches applied at the community level. Table E.3 reports the obtained results with values of the technical KPIs at the community level [5]. The first two columns contain the performance of the community respectively relying on the grid (P2G) and the other members (P2P) for the excess energy exchange. The movement from P2G to P2P community control logic introduces an improvement in the overall performance. The third column highlights this improvement, presenting the relative variation between P2G and P2P logic.

Table E.3

Community-level KPIs resulting from the simulations done in the two different scenarios (PEB, no-PEB).[10]

noPEB scenario				PEB scenario			
Community level control logic	**P2G**	**P2P**	***Rel. Var.*[11]**	**Community level control logic**	**P2G**	**P2P**	***Rel. Var.*[11]**
Self-Consumption %	73.30%	75.20%	*+2.53%*	**Self-Consumption %**	54.40%	57.50%	*+5.39%*
Self-Production %	53.60%	55.00%	*+2.55%*	**Self-Production %**	62.90%	67.00%	*+6.12%*

[10] All KPI except "to grid %" has the following behaviour: better performance for higher values. Equivalent CO_2 reduction is estimated internally to the provided tool considering the energy not imported thanks to the exploitation of the local energy resource. Parameters consider the Italian energy mix, with no consideration of the embodied emission for the computation of this indicator.
[11] Relative variation (P2P-P2G)/P2P

Energy to grid %	27.80%	24.80%	*-12.10%*	**Energy to grid %**	46.30%	42.50%	*-8.94%*
Energy from grid %	47.40%	45.00%	*-5.33%*	**Energy from grid %**	37.60%	33.00%	*-13.94%*
CO2 reduction from energy not imported from the grid %	52.50%	54.90%	*+4.37%*	**CO2 reduction from energy not imported from the grid %**	62.40%	67.00%	*+6.87%*
Energy shared normalized over total annual production	4.10%	4.89%	*+16.23%*	**Energy shared normalized over total annual production**	3.34%	4.75%	*+29.77%*

As an overall trend, the introduction of a community and the consideration of a dedicated control improves the overall share and consumption of the locally produced energy resource. Considering the PEB scenario, it is possible to detect a better performance in absolute values of the community. The Self-consumption indicator decreases as a symptom of the higher availability of renewable resources and therefore lower local exploitation and more export due to residual mismatch between actual production and consumption. In the PEB definition, there is a clear statement that the building should produce more than the actual consumption. Self-consumption will consequently decrease and the "to grid" indicator increase. Moreover, PEB community presents in Table E.3 a higher relative improvement with the introduction of a dedicated control logic as done for the P2P case. We can spot relative improvements that are double in the PEB scenario with respect to the no-PEB counterpart. This holds for all the KPIs which means better performance for larger values (all except the "to grid %" KPI). Finally, we have an increase in the energy-shared index that highlights the members overproduction that is consumed internally to the community, and it is the base for the computation of the remuneration at the community level (according to values reported in Table E.3). Such remuneration adds to the economic savings that each user can experience from a direct reduction of the acquisition of energy from the grid thanks to the exploitation of the locally produced (and stored, in presence of a battery system) renewable energy resource. Please notice that each scenario has a significant renewable generation that is comparable to the actual load of the members of the community or even higher in the case of PEB. In this case, the shared energy reported at the bottom of Table E.3 may be small compared to the overall production as the production is so high and consistent (all members are located in the same geographical zone) compared to loads and we may still have a high load-production mismatch and a consequent high rate of residual overproduction exported to the grid. In the PEB case, we observe an increase in the absolute value of the energy shared in the community (in MWh) but we observe at the same time a higher increase in the produced energy due to PEB requirements

on PV sizing. This brings to a reduction in relative terms of the values shown in Table E.3 moving from nonPEB to PEB scenario. This holds as the energy-shared KPI is reported normalized by the total PV production (at the numerator).

These results show that the presence of larger renewable energy assets improves the technical performance indicators both considering the building alone and the entire community level. Moreover, we can promote PEB buildings as enablers of REC spread/adoption/developments. Due to their higher/larger renewable assets, they may increase the technical and environmental KPIs and therefore performance at the community level. PEB building has higher production and local energy asset management capability compared to non-PEB building scenarios.

A final consideration covers a qualitative evaluation of the economic aspects of the setup of the system. We provide in the main economic parameters related to the proposed system setup. We report CAPEX and OPEX suggestions for the PV and Battery storage system and the value of the expected remuneration of the energy shared in a REC according to the latest Italian regulation[12].

Table E.4

Values for an economic evaluation. CAPEX of the system components and remuneration of the shared energy in a REC[12]. Values are reported considering the Italian scenarios adopted in the provided simulations.

Description	Value
CAPEX PV system (fixed + variable)	2300€ + 1000 €/kWp
CAPEX BESS system	1900€ + 500€/kWh
OPEX (suggested value)	2% CAPEX / year
Remuneration for shared energy among member of REC [12]	120 €/MWh[13]

[12] Qualitative values expressed according to the Italian regulation *(Decreto CER (Comunità Energetiche Rinnovabili) / Decreto MASE n. 414 del 07.12.2023 published 23.01.2024)*
[13] Qualitative indication considering as reference the city of Bolzano (nordern Italy) values around from 0.113 €/MWh to 0.131€/MWh considering the year 2023.

Reference

[1] F. Turrin, G. Barchi, and E. Dalla Maria, 'Report on multi-system control strategies for HMS - Deliverable D4.4 (final)', D4.4, Nov. 2022. [Online]. Available: https://www.cultural-e.eu/wp-content/uploads/2023/05/CULTURAL-E_D4.4.pdf

[2] G. Barchi, E. Dalla Maria, H. T. Walnum, M. Bagle, and K. Thunshelle, 'Report on strategy for building flexibility. Deliverable D3.11', Sep. 2023.

[3] R. Gazzin, F. Turrin, F. Isaia, and C. Pozza, 'Repository of reference building models and related solution-sets Deliverable D4.3', D4.3, Sep. 2022. [Online]. Available: https://www.cultural-e.eu/wp-content/uploads/2022/11/CULTURAL-E_D4.3.pdf

[4] G. Barchi, M. Pierro, and D. Moser, 'The impact of photovoltaic power estimation modeling on distribution grid voltages', in *2021 IEEE International Conference on Environment and Electrical Engineering and 2021 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe)*, Bari, Italy: IEEE, Sep. 2021, pp. 1–6. doi: 10.1109/EEEIC/ICPSEurope51590.2021.9584797.

[5] G. Barchi, M. Pierro, M. Secchi, and D. Moser, 'Residential Renewable Energy Community: a Techno-Economic Analysis of the Italian Approach', presented at the 2023 IEEE International Conference on Environment and Electrical Engineering and 2023 IEEE Industrial and Commercial Power Systems Europe (EEEIC/I&CPS Europe), IEEE, 2023, pp. 1–6.