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Exploring Business Models for Addressing the Landlord-Tenant Dilemma in the Residential Buildings of Germany

Task 4.7

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Im Rahmen des Kopernikus Projekts ENavi

KOPERNIKUS PROJEKTE
Die Zukunft unserer Energie

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

Forschungsinitiative Kopernikus

The Federal Ministry of Education and Research (BMBF) has allocated a total of EUR 400 million to fund the Kopernikus program until 2025. The objective of the program is to develop innovative technological and economic solutions that can facilitate the transition to a more sustainable energy system. Over a period of 10 years, more than 230 partners from science, business and civil society will conduct research in four subject areas: "New Network Structures", "Storage of Renewable Energies", "Reorientation of Industrial Processes" and "System Integration". Researchers are adopting a holistic approach to these four subprojects in order to examine specific issues relevant to the individuals and institutions that play key roles in energy generation, transmission, supply, and distribution. The program's 10-year lifespan ensures that the initiative will include a long-term interchange between theory and practice.

System integration: ENavi

As a participant in the "ENavi" subproject, IKEM is partnering with roughly 90 institutions from the fields of science, business, and law to develop a navigation system that promotes the transition to sustainable energy. Because system integration is vital to the success of comprehensive energy reforms, the program partners' integrative approach includes research on heat, gas, and fuel use. IKEM plays a key role in ensuring that the findings from theoretical analyses can be applied in practice. From the outset, field tests are conducted to assess the concrete technical, economic, and legal implications of the energy transition. Test results can then be applied to other regions. Program partners intend to expand the initiative to include research on 50 municipally owned power generation and electricity distribution companies, or *Stadtwerke*.

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Abstract

The thesis internship to comply with the requirements of European Joint Masters in Management and Engineering of Environment and Energy program was conducted at the Institute for Climate Protection, Energy and Mobility (IKEM) located in Berlin. The work was an integral part of the ENavi project with the IKEM's Energy Efficiency Team. The ENavi project focuses on system integration to be a key element for achieving not only a transformation of the electricity sector, but rather a comprehensive energy transformation. It also considers issues of public acceptance and develop new business models for this specific area. This research contributes by exploring the potential of existing business models that might further decarbonize the building sector.

In a high house-renting rate city, such as Berlin, one of the major barriers for improving housing energy efficiency performance is the landlord-tenant dilemma. The dilemma refers to a situation when the interests of the landlords and the tenants are not aligned. This misalignment hinders the advancement of the energy transition.

The research aimed to explore business models to address the landlord-tenant dilemma in the residential sector. First, the housing situation in Berlin was researched and the scale of the problem was learned. Second, existing models and best practices from both international and German experiences were identified and examined. Third, a rough analysis was developed to identify the key stakeholders of the dilemma and a survey for these stakeholders, which are the tenants and the landlords, was designed in order obtain first-hand data for further analysis. The questionnaire aimed to explore the interviewees' knowledge on their housing condition, retrofits, and utilities; their behaviors and awareness on energy use; as well as perspectives on the business models. Fourth, the analysis of the survey results was conducted, in particular, some suggestions to the existing business models were discussed.

It was concluded that under the current housing market situation, extra efforts or policy measures would be encouraged to ease the facilitation of the examined business models. Policy also plays an important role as most of the business models are built upon it. Furthermore, raising relevant awareness would play an even more crucial role in the transition. To conclude, the internship had given one the chance to utilize and demonstrate different skills. In particular, research, data analysis, communication, organization, teamworking, presentation, video production, creative skills, and to work under intense pressure. It had also help shaping the future professional path. Working in an international environment and in teams would be preferred. Research is interesting, however, it would only be attractive if it is able to be implemented in a more practical context, such as business development or problem solving. Being innovative and creative was also

validated during the internship, which strengthened the determination to work towards this direction. Last but not least, it was also affirmed that working in the sustainability field was not wrong as it was enjoyable.

Acknowledgements

I would first like to thank Institute for Climate Protection, Energy and Mobility (IKEM) for providing me the internship opportunity. It was a great chance for me to learn and grow professionally. I'd like to thank Dr. Aleksandra Novikova, who brought me on to her team and encouraged me to work on the topic of my interest. I'm also very grateful to my supervisor, Jose Mercado, for his guidance, patience, insightful feedback, and care. I'd also like to express my deepest gratitude to Anika Nicolaas Ponder, who took a chance on me, valued my abilities, and brought me on the projects where I could demonstrate these skills. Last but not least, I'd like to thank my colleagues who jumped to volunteer, the tenants and the homeowners who offered their time to participate in the interview and provided their valuable experiences and opinions.

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Table of Abbreviations

CBRE	The Coldwell Banker Richard Ellis Group
ESCOs	Energy Service Companies
IKEM	Institute for Climate Protection, Energy and Mobility
KfW	Kreditanstalt für Wiederaufbau ("Reconstruction Credit Institute").
LIC	Local Improvement Charges
NGO	Non-Governmental Organization
PACE	Property Assessed Clean Energy

1 Introduction

1.1 Internship aims and tasks

The purpose of the internship required by the master program is for student to identify, acquire, and apply one's skill in a professional context, produce work that adds genuine value to a hosting organization, and to reflect one's future career plans.

The aims I set were to produce great quality reports and create positive value for the company. The tasks included topic proposal, data collection, literature review, data analysis, and report writing. The skills which I aimed to obtain by the end of the internship are the ability to conduct a proper research, and the capability of working independently and in teams.

The internship was conducted at Institute for Climate Protection, Energy and Mobility (IKEM) located in Berlin. The institute provides expertise and ground-breaking research on key questions of a sustainable economic and social order. The institute examines legal and political frameworks in the fields of climate protection, energy and mobility from an interdisciplinary, integrative and international perspective. Since 2009, IKEM is a public charity and associated to Ernst-Moritz-Arndt University Greifswald as an independent research institution; and in late July of this year, IKEM was officially recognized as a non-governmental organization (NGO) and granted it "special consultative status" based on its expertise by the United Nations Economic and Social Council.

There are various on-going projects at IKEM. Apart from the research for the ENavi project, which was my key focus, a portion of the mission was to support the other projects. The next sections detail my work for the Enavi project.

The other projects include the 14th IKEM Summer Academy 'Energy and the Environment', Baltic InteGrid, and the Energy Transition Coloring Book. The tasks undertook for the Summer Academy include organization and moderating the energy efficiency workshop. For the Baltic InteGrid, a stakeholder questionnaire was setup, and the country reports of eight states was also produced from the preceding surveys. Regarding to the Energy Transition Coloring Book project, the input include creativity, propose ideas, method, topics, and the structure of the book, and data research and checking.

1.2 Enavi Project Background

The following study is part of the large-scale German federal research initiative "Kopernikus". The Kopernikus is a series of project that was launched by the Federal Ministry of

Education and Research (BMUB) with the aim of developing innovative technological and economical solutions for the transformation of the energy system. Within a period of 10 years, more than 230 partners from science, industry and civil society will work on the four research topics “new grid structures”, “storage of renewable energy”, “redesign of industrial processes” and “system integration”[1].

Within the Kopernikus project, IKEM conducts research on the topic of “systems integration” under the sub-project named “ENavi”. In this context, system integration is considered to be a key element for achieving not only a transformation of the electricity sector, i.e. the substitution of fossil fuels used in the generation of electrical energy, but rather a comprehensive energy transformation. This holistic approach includes not only electric power but also the sectors heat, gas and fuel. The project will also consider issues of public acceptance and develop new business models for this specific area.

IKEM is analyzing the potential of energy conversion processes (electricity to other energy sources) from technical, economic, social, legal and public relation perspectives. It will derive recommendations for a cross-sector energy supply. Together with the participating partners, IKEM is also developing and implementing practical concepts in several model regions. One of the regions is Berlin, which would be the focus of the following study.

1.3 The Present Thesis Research Background

The following master thesis research contributed to the ongoing research work under the Working Package called "System analysis of the energy transition for the thermal comfort service" under ENavi. As the heating sector accounts for 54% of the final energy consumption in Germany (Brüggemann, 2016), in order to have a successful energy transition, the participation of the heating sector is crucial. The working package´s main objective is to contribute to building’s decarbonization by identifying transformational changes necessary to reinforce the use of low-carbon technologies, including energy efficiency measures and renewable energies, in existing supply chains in the residential building sector.

The present thesis research contributed to the working package by addressing the so-called landlord-tenant dilemma or split-incentive. The dilemma occurs when, while trying to improve energy efficiency, the tenants are impeded by the high investment cost of new retrofits and that landlords, on the other hand, lack the incentives.

[1]https://www.kopernikus-projekte.de/projekte/systemintegration

While the project deals with various cases studies across Germany, the city of Berlin has been chosen as case study for the research. Moreover, two municipal housing companies, which own and administrate sustainable housing units, were identified as key sources of information and will provide primary data. Besides the resource from these companies, Berlin was chosen also due to the fact that the population in Berlin has been increasing faster than the rate of the houses being built. The city has also passed the threshold of the healthy house vacancy rate, going under 3%. This further deepens the landlord-tenant dilemma as the demand for flats are much higher than supplies; hence, the owners of the properties usually have no problems finding their next tenants.

To shed a light on the issue, the research will focus on developing "research-based business model and best practices for addressing the landlord-tenant dilemma in residential buildings". It would be an initial proposition as a base to further investigation into the feasibility of implementing the examined model in the future.

2 Methodology

2.1 Literature review on the housing situation

The housing situation in Berlin was researched and the scale of the problem was learned. For this, the housing typology and ownership structure were first looked at. Then, the vacancy and demand for apartments were studied. After, regulations regarding the rental market in Germany were studied.

2.2 Literature review on existing models and best practices

Existing models and best practices from both international and German experiences were identified and examined. The data were gathered in the public domain by using search keywords such as "financing energy efficiency", "overcoming split-incentive", and "business models solving landlord-tenant dilemma". The time frame was narrowed down to the year of 2014 to 2017. These sources include scientific paper from journals, or institutional reports. After the data were gathered, key business models and practices are identified and standardized. They were break down to: "Background", "Mechanism", and "Challenge Overcame".

2.3 Stakeholder identification and analysis

An analysis was developed to identify the key stakeholders of the dilemma, see Figure 1 and Table 1. From this analysis, tenants and landlords were identified as the core group

to start the first-hand data collection from. Other stakeholders would be interviewed in the further research to come.

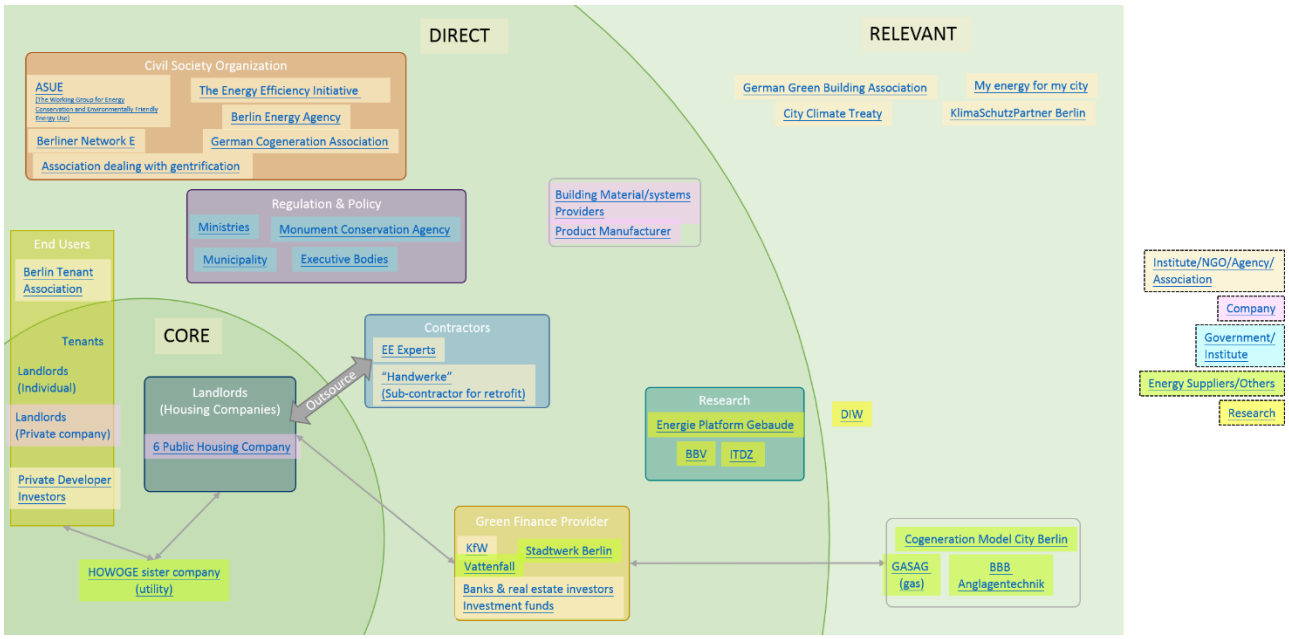


Figure 1 Stakeholder Analysis

Table 1 Stakeholder Analysis Table

	Institution/Company	Relevance	Subgroup
Housing Sector	Tenants	Core	End Users
	Landlords (individual)	Core	End Users
	Landlords (private companies)	Core	End Users
	Landlords (public housing companies)	Core	
	Private Developer Investors	Core	End Users
	Berlin Tenant Association	Direct	End Users
	Association dealing with gentrification	Direct	Civil Society Organization
	Monument Conservation Agency	Direct	Regulation & Policy
	KfW	Direct	Green Finance Provider
	Bank & real estate investors Investmenr funds	Direct	Green Finance Provider
	German Greem Building Association	Relevant	
	City Climate Treaty	Relevant	
Energy Sector	HOWOGE sister company (utility)	Core	
	ASUE (The Working Group for Energy Conservation and Environmentally Friendly Energy Use)	Direct	Civil Society Organization
	Berlin Network E	Direct	Civil Society Organization
	The Energy Efficiency Initiative	Direct	Civil Society Organization
	Berlin Energy Agency	Direct	Civil Society Organization

	German Cogeneration Association	Direct	Civil Society Organization
	Ministries	Direct	Regulation & Policy
	Muncipality	Direct	Regulation & Policy
	Executive Bodies	Direct	Regulation & Policy
	Energy Efficiency Experts	Direct	Contractors
	"Handwerke" (Sub-contractor for retrofit)	Direct	Contractors
	Vattenfall	Direct	Green Finance Provider
	Stadtwerk Berlin (muncipal utility)	Direct	Green Finance Provider
	Cogeneration Model City Berlin	Relevant	
	GASAG (gas)	Relevant	
	BBB	Relevant	
	My energy for my city	Relevant	
	KlimaSchutzPartner Berlin	Relevant	
Research	Energie Platform Gebaude	Direct	Research
	BBV	Direct	Research
	ITDZ	Direct	Research
	DIW	Relevant	Research

2.4 Stakeholder survey

A survey for key stakeholders using semi-structured interviews was designed in order obtain first-hand data for further analysis. The questionnaire aimed to explore the interviewees' knowledge on their housing condition, retrofits, and utilities; their behaviors and awareness on energy use; as well as perspectives on the business models. Each interview lasted for approximately 30 minutes. The conversation was recorded, and field notes were taken. The questionnaire for interviews and interview consent form are provided in Appendix.

The results of the interviews were sorted by the residency length and ownership structure, the housing condition, house and retrofit, utility bills and energy efficiency behaviors, and the tenants' perspective on the business models. Twenty interviews were conducted, including 19 tenants and one homeowner. The interviewees were tenants who live in Berlin and landlords who are renting out their homes are interviewed. The pool consists of Germans and international residents.

2.5 Analysis of results

The analysis of the survey results was conducted and recommendations were developed. The information from the interviews was classified into four different categories: "Background", "House and Retrofit", "Utilities", and "Models". Under the different categories,

identical responses, such as similar experiences, opinions, awareness, were labeled and clustered together to make comparisons. Unanticipated responses were also coded.
Subsequently, the results were analyzed, and were systemized into different subject matter accordingly. They included "Residency Length and Ownership Structure", "House Condition", "House and Retrofit", "Utility Bills and Behavior on Use of Energy", and "Perspective on the Business Models". Under the "Utility Bills and Behavior on Use of Energy", it was further organized into "Rent and Utilities", "Rent Type and Energy Awareness", "Utility Awareness and Energy Efficiency", and "Request for Higher Energy Performance".
The results were reviewed and discussed in the discussion. Then, conclusions were drawn. Suggestions were also made to the existing business models that were studied to better raise the potential of the model implementation in Berlin.

3 Literature Review

3.1 Overview of Housing Sector

3.1.1 Housing Typology and Ownerships Structure

The residential rental sector is relatively big in Germany compared to many other EU countries, which was described as "a nation of renters" (Warburg Research, 2016). By looking at the population distribution in dwelling types, in 2015, 57.3% of the population in Germany lives in flats, while the rest lives in semi-detached, detached house, or others (Eurostat, 2017).

Moreover, it was concluded that, of the total residential stock (41.3m units), 50.35% are multi-story buildings, which are more relevant to the rental sector. From the relevant stocks, owner occupiers take up 14.4%, small private landlords, 42.3%, and professional commercial landlords, 42.8%. Professional commercial landlords include private enterprise housing companies (18.8%), local housing companies (11.5%), property co-operatives (10.1%), public housing companies (1.0%), and others (1.4%) (such as church, trade union, etc.) (Warburg Research, 2016, p. 12).
In addition, dwellings with 1 room takes up 4% of the stock, and 2 rooms with 17.9%, 3 rooms, 33.2%, 4 rooms, 27.1%, and 5 and more, with 17.8%. (Amt für Statistik Berlin-Brandenburg, 2016, p. 34)
In another word, 57.3% of the population lives in the residential building stocks, and that 85.1% of them has to deal with landlords. It also stood out that Berlin, in particular, has the lowest ownership rate in Germany, with 16% (Warburg Research, 2016, p. 19).

3.1.2 Vacancy and Demand

In the research published by Deutsche Bank showed that the marketable vacancy rates in the housing stock of Berlin had a sharp decrease from approximately 2.6% in 2010 to 1.2% in 2015 (Deutche Bank Research, 2017). The prices of the existing housing stock also rose by 13% in 2016, double the price compared to 2005, due to shortages, high job growth, low unemployment rates, lack of development (ibid.).

According to the Secretary of State for Construction and Housing, Professor Engelbert Lütke Daldrup, there would be a need of at least 15,000 to 20,000 new apartments per year, and that two thirds of the housing development would have to come from the private sector, whether they are owner-occupants or tenant-occupants (CBRE GmbH; Berlin Hyp AG, 2016).

3.1.3 Regulations

The EU ranked Germany as the fifth on the list of most regulated rental market. The rent cap (*Kappungsgrenze*) of existing rents is limited to no more than 20% within three years. Furthermore, landlords are only allowed to charge tenants 11% of retrofitting costs annually (*Modernisierungskostenbegrenzung*). It is now in discussion, whether it should be cut to 10%. In addition, rent control was introduced on June 1, 2015. The legislation stated that the rent for tenants entering new rental contracts could only be raised at a maximum of 10% of the normal local rent (Warburg Research, 2016, p. 27).

The rent growth in Berlin is reduced to 15% within three years as the supplies of affordable stocks are limited. Apart from the lower rent growth limit, and being the earliest state to implement the rent control, Berlin also has its own scheme called the “Berlin Model”. It is a model that grants 25% of the planning consent to social housing, and 75% to private developers (Berlin Hyp AG; CBRE GmbH, 2016).

3.2 Landlord-tenant Dilemma

The landlord-tenant dilemma can also be called the investor-user dilemma, split-incentives, principal-agent, agency dilemma, or misaligned financial incentives (Forni & Zajaros, 2014). “The landlord-tenant dilemma” is a special case of the “investor-user dilemma” or “split incentives” (Ostertag, 2012), or “principal-agent” (Papineau, 2015).

In the case where the utility bills are included in the rent, the tenants have little incentives to reduce their consumption. However, even if there are interests in investing better energy efficiency technologies or products, the initial transaction cost, or upfront cost, is usually too high for the tenants and that they are most likely to move out before making their investment return.

On the other hand, if the utility bills are excluded from the rent, the tenants would be stuck with the (usually) less energy efficient choices that were made by the landlord. Albeit by the fact if the landlords are enthusiastic about retrofitting, it would still be a barrier if they are not able to recoup the cost through asking for higher rents.

As a result, the dilemma can easily lead to the over consumption of energy (Papineau, 2015). Furthermore, it was found that asymmetric information is also a crucial point to the dilemma (Schleich & Gruber, 2008). Also, it was mentioned that comparing to owner-occupant buildings, landlords produce less energy efficient homes (Kholodilina & Michelsena, 2014). Papineau summarized various supportive findings, of which include that tenant-occupied homes are less well insulated than owner-occupied ones, and usually with lower energy efficiency appliances; also, renters of utility inclusive rents keep their apartment 2 degrees Celsius warmer, and those of exclusive rents change their heat settings more often. In conclusion, the landlord-tenant dilemma is a significant barrier to energy efficiency (Papineau, 2015).

3.3 Financing Energy Efficiency

There are various barriers when trying to improve the energy efficiency performance in the residential building sector. The obstacles can be summarized into the following category: economic or financial barriers, governmental barriers, knowledge and learning barriers, market related barriers, organizational and social barriers, and technological barriers. From the financial aspect, the factors include the insufficient funds, questionable profitability, lack of good quality assessments of financial benefits, flawed assessment from ignored hidden costs, and last but least, lack of financial planning (Gupta, Anand, & Gupta, 2017). All in all, financing retrofits remain one of the most crucial barrier to overcome.

3.4 Existing Business Models and Best Practices

The landlord-tenant dilemma can be overcome in several ways. It can be policy-oriented approach, for instance, as implementing energy labeling as the base for policies, along with legislative changes, financial incentives, and better dissemination of information. These arrays of tools should be integrated and come together as a package solution, which will then overcome the dilemma (Ástmarsson, PerAnkerJensen, & EsmirMaslesa, 2013). As funding is the most commonly faced issue, the following research focuses on the existing business models and best practices that addresses the financing of the energy efficiency retrofits.

3.4.1 International

3.4.1.1 Utility on-bill financing

3.4.1.1.1 Background

The utility on-bill financing model can be found in Canada and the U.S. The model can be initiated by the municipality, the partnership of the local government and the utility company or the utility company alone. The trigger could be new governmental policy or simply request for efficiency upgrade from consumers.

3.4.1.1.2 Mechanism

The utility on-bill financing can be seen as a loan made to the utility end-users. The utility company finances the upgrade of the facilities, such as heating or cooling system, furnace, heat pump, or hot water tank. It would then recover the cost through repayment from customer bills. The energy cost savings from the retrofit of the systems would be the source of the funds for the repayment. This design allows the relation between the upgrade cost and the gain from the energy cost savings to be seen on the same bill.

3.4.1.1.3 Challenges Overcame

One of the challenges overcame is the upfront cost. For property owners who would like to retrofit their homes but do not have the means to finance the replacement could also use the utility on-bill financing scheme to do so. The temporal split incentive is addressed as the loan is transferable since the repayment is via the utility bill. Moreover, tenant could ask for the energy efficiency improvement without the concern of the upfront cost and repay with the utility bill.

However, in the case of Canada, this model was not always successful. Some provinces have ended the program and reassigned it to third-party financing, which will be explained in the following section. It was reported that the determinants are the condition of the jurisdiction, the body executing the financing, and the design of the program. In addition, the experiences on credit risk and administrative costs are not always adaptable from one administration to another (Energy and Mines Ministers' Conference, 2016). In the same report, it was concluded that some of the factors for the on-bill financing plan to work best is when the energy cost savings can shortly be seen, the interest rate is competitive, the mechanism being streamlined, the administrative and compliance system being ready to adapt, and that the burden of the administration is low.

3.4.1.2 Third-party financing

3.4.1.2.1 Background

As mentioned in the last section that a few of the Canadian provinces have switched to third-party financing. It is a commonly seen model for not only energy efficiency retrofit but also in many other areas. Therefore, this form of funding can be identified in different parts of the world. This scheme is usually prompt and financed by commercial lending institutes. The investors invest as they see the potential of obtaining higher returns.

3.4.1.2.2 Mechanism

Energy efficiency retrofit programs have a variety of funding choices to select from, one of which is the third-party financing. As mentioned previously, the funding comes from fiscal establishments. There are different reasons that a program would choose this model. The logic might be that the utility company is not able to afford the high-priced upgrade without a loan, or that the investment risk is too high. The monetary body would screen the credit with tools, and recoup through repayment via separate billing system from the utility company (Energy and Mines Ministers' Conference, 2016).

3.4.1.2.3 Challenges Overcame

Although this approach of financing energy efficiency retrofit disconnects the relation between the energy cost savings and the loan repayment costs, this model provides flexibility and risk reduction. It settles the issue of the high upfront cost in the system transition. However, as the financial entity uses risk screening that rely on past credit history, some candidates might be ruled out. To resolve the issue of disconnection, the scheme can be improved by setting up information system that presents reports of the energy cost savings and the loan repayments on a regular basis to the debtor.

The third-party financing option are usually not the primary preference due to possibly higher borrowing costs. Nonetheless, if the interest rate is relatively lower than commercial standards and backed by strong business case, or under poor circumstance, the model could be one of the strongest alternatives (Energy and Mines Ministers' Conference, 2016).

3.4.1.3 Local improvement charges (LICs) or Property Assessment Clean Energy (PACE)

3.4.1.3.1 Background

The Local improvement charges (LICs) of Canada and Property Assessment Clean Energy (PACE) of the U.S. have similar approach to financing energy efficiency retrofits. Both of

the programs were initiated by the government, and the method of repayment for the borrowers is identical.

3.4.1.3.2 Mechanism

The LIC is funded by the Government of Canada through the Federation of Canadian Municipalities' Green Municipal Fund, and was first launched in 2014 (Energy and Mines Ministers' Conference, 2016). On the other hand, PACE was funded through special bonds issued by the municipal government to investors (Econmidou, 2014).

These programs allow the homeowners to retrofit their homes with financial support from the municipality and pay back the loan through property tax bills. The differences between the LICs/PACE and a normal loan are that the interests are lower and the terms are longer (10-20 years compared to 5 years). The tax assessment is imposed on the property instead of the property owner. Since the lien is on the property, the default risk of the loan is reduced. This level of security enables the LICs and PACE to maintain their low interest rates.

3.4.1.3.3 Challenges Overcame

Similar to many other practices, the LICs/PACE eliminates the upfront capital cost, and the consumers are able to reduce their energy bills and are more resilient from the increase in the energy price. Furthermore, since the tax is placed on the property itself, this model is able to address the temporal split incentive as it allows the costs and benefits to be transferred between the current and the subsequent owners. Also, it is able to avoid the security of the repayment that normally depends on the creditworthiness of the individuals, which makes the scheme appealing to both the investors and the owners. In addition, LICs/PACE can overcome the split incentives among tenants and landlords, and multi-tenant residential buildings (Econmidou, 2014). Last but not least, the improved energy efficiency performance or energy labeled homes could increase their property values.

Program of this characteristic is not yet being implemented in Europe. From the Canadian experience, it was suggested that a strong LIC/PACE base model should be fully supported by the local municipality. The entity should also set guidelines to help the consumer from over-investing, simplify the qualification and the contract processes, and look for low-cost financing. A scaled implementation of the program can reduce the cost (Energy and Mines Ministers' Conference, 2016). Also, in the case of the U.S., the PACE program was once suspended due to the mortgage entity's refusal to finance as a result of the decision that

it was to pay the municipality prior to the main mortgage is paid to the lender in the case of default (Econmidou, 2014). Therefore, investors and insurers should be involved in early stages for consulting purposes to prevent the suspension case from happening.

3.4.1.4 Energy service companies (ESCOs)

3.4.1.4.1 Background

Similar to third-party financing, energy service companies (ESCOs) funding programs can be found in various places around the world. It was introduced in Europe more than a century ago as there was calls for the energy sector to be more sustainable due to the electricity and gas restructuring (Bertoldi & Rezessy, 2005).

3.4.1.4.2 Mechanism

The financial resource of ESCOs generally comes from private capitals. ESCO specializes in energy efficiency upgrades. When the clients give the green light to go ahead with the retrofit, the ESCO will take over and provide the full package service. The service includes evaluation to identifying the suitable systems to implementing the upgrades. The finance of the retrofit can either be from the ESCO or the owner itself, usually complex agreement would be made for the management of the daily building operations, such as the heating, lighting or other energy relevant system in the building. The energy cost savings would go to the repayment of the loan (Energy and Mines Ministers' Conference, 2016).

3.4.1.4.3 Challenges Overcame

ESCO takes the long process of evaluation, system selection, technicality of system implementation off the hands of the customers. This model usually addresses at large scale projects. It is thus generally most suited for sizable building or institute. With the scale of the project, it allows the ESCO to adopt more sophisticated tools for evaluation, and provide solutions that might otherwise be unaffordable by individuals or smaller scale consumers. The upfront cost of the installation can usually be balanced out by the energy cost savings due to the scale of the project.

The ESCO model would be favorable to those who wish to transfer the risks to third parties. Outsourcing to the energy service company also strengthen investors' confidence as the approach of the retrofit is more consistent. This model is also easily adaptable to other sources of funding, such as commercial or public financing (Energy and Mines Ministers' Conference, 2016).

3.4.1.5 Cross-selling of PV systems with prefabricated homes

3.4.1.5.1 Background

The cross-selling of PV systems with prefabricated homes were seen in Japan. Nearly 60% of all the prefabricated houses were sold with a PV system in 2011 (Strupeit & Palm, 2016). The ready-made homes sectors are led by ten major companies, which composes 20% of the new houses in the market in Japan.

The driver that enabled this business model can be dated back to the 1990s. The Japanese government launched several different nationwide and regional subsidies for residential solar PV. With the promised steady subsidies from the administration, the home building manufacturers were encouraged to incorporate solar panels into their products. Subsequently, the integrated PV systems became a standard equipment with the prefabricated houses.

3.4.1.5.2 Mechanism

House producing companies manufacture prefabricated homes equipped with solar PV systems. The cost for the system is merged into house loan agreement, thus reducing transaction costs and interest rates for the consumer. From the perspective of the financial institutes, the proceeds from the generation of the solar panels strengthen the credit worth of the borrower. The expenses saved from the mass production in the sector are usually invested back to other component choices, such as energy management systems, or energy storage systems, etc. In Figure 2 below, the morphology of the model can be seen.

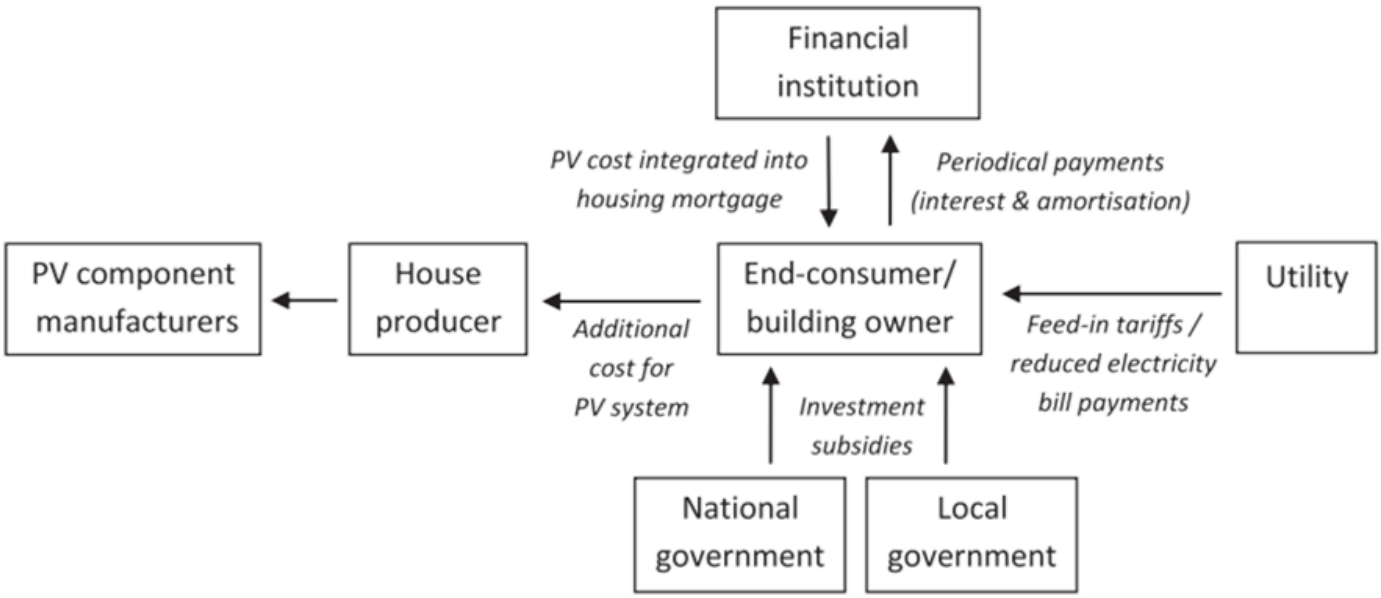


Figure 2 Financial Flow of the Cross-selling Model (Strupeit & Palm, 2016)

3.4.1.5.3 Challenges Overcame

The solar system is sold as a package along with the house. Therefore, the upfront cost for the investment in the system is fused. The additional paperwork from add-on solar panels is also diluted among the others for the consumers. From the solar panel company's angle, the cross-selling model reduces their customer-acquisition cost since it would be business to business rather than business to consumer.

Besides the barriers that this model overcame, it bears another advantage. Compared to a retrofitted solar system, the infused system is typically 10% cheaper, and aesthetically more appealing. The consumers are able to reduce their electricity bills, and purchase at competitive prices.

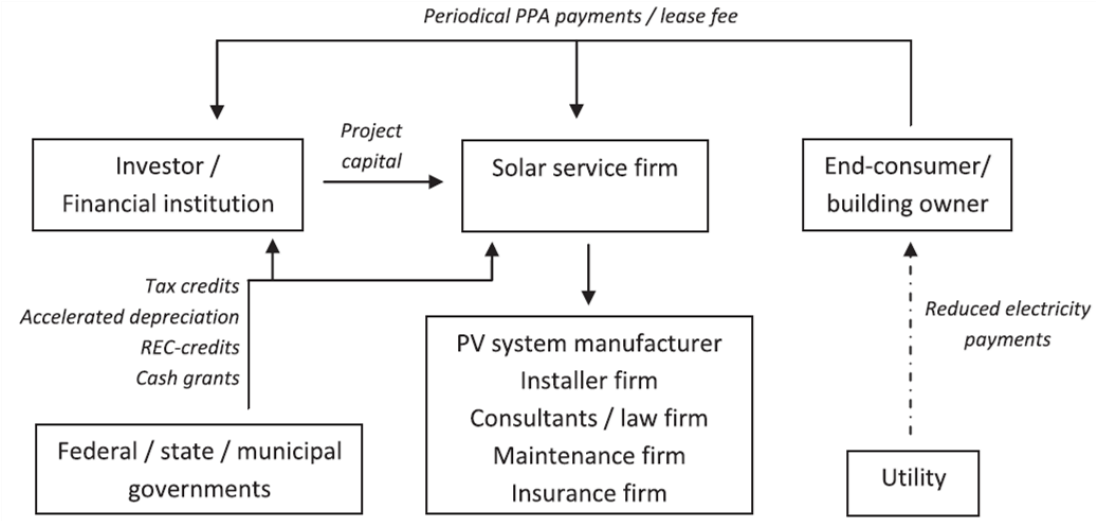
3.4.1.6 Solar leasing Model

3.4.1.6.1 Background

The solar leasing model is similar to the third-party financing model, but with some modifications. This model was originated in the U.S. in 2005. It was primitively for customer from the commercial sector or institutions. However, it has spread rapidly in the residential sector following 2010 (Strupeit & Palm, 2016). This scheme became attractive due to the lack of solar loan products and the financial crisis, which prevent homeowners from affording the upfront investment for the solar system.

3.4.1.6.2 Mechanism

Similar to the ESCOs model, the solar service firms also provide the full-package service to the customer. The service would include planning, installation, maintenance, paperwork such as procuring permits, governmental incentives and tax discounts, and negotiation with the utility company on the interconnections. The panels are financed by a third-party. The homeowners then purchase the electricity produced from the panel (Strupeit & Palm, 2016). There are two different plans for the consumer to choose from. First, the property owner can choose to pay for the amount that was consumed each month. The other choice is called the Power Purchase Agreement (PPA). This agreement allows the owner to pay a fixed amount each month for the use of the system. The pricing is calculated by the predicted price for the 15-20-year period. At the end of the contract, the customer can choose among purchasing the solar system, removing the system, or extending the agreement (Strupeit & Palm, 2016). In the following figure, see Figure 3, the chart



gives a clear view on the financial flow of the solar leasing model.

Figure 3 Financial flow of the solar leasing model

However, as seen in the figure, any incentives such as tax breaks, cash grants, or credits would belong to the service companies instead of the customers. These firms are also able to profit from the sale of Renewable Energy Certificates.

3.4.1.6.3 Challenges Overcame

The solar leasing model overcomes the initial upfront cost to the homeowners who would like to install the solar panels, some solar service provider would even further include free installation and maintenance. This model also addresses the excessive paperwork and the complicated installation challenges that the house owner faces.

The leasing model would have the ability to enable the wide spread of solar PV on the rooftop. Also, it has the potential of overcoming various barriers that can be realized by the private sector.

3.4.2 Germany

3.4.2.1 Host-owned feed-in model

3.4.2.1.1 Background

In 2000, the feed-in tariff rate was introduced in the Renewable Energy Act in Germany. This tariff was intended to set at a certain rate that make sure the return of the investment that is competitive to other investment opportunities by the lawmakers. The scheme for low-interest loans from the KfW bank is also offered by the government to the borrowers. The KfW bank is a state-owned bank that specifically finance energy efficiency retrofits.

3.4.2.1.2 Mechanism

In this model, the customers have to finance the upfront cost of the PV system by themselves. The electricity produced by the solar panels will be feed back to the electrical grid at the feed-in tariff rate. The consumers will thus gain their investment return from selling the electricity to the utility company. They are also able to acquire reduction on their income tax (Strupeit & Palm, 2016). The morphology of the mechanism can be seen in Figure 4 below.

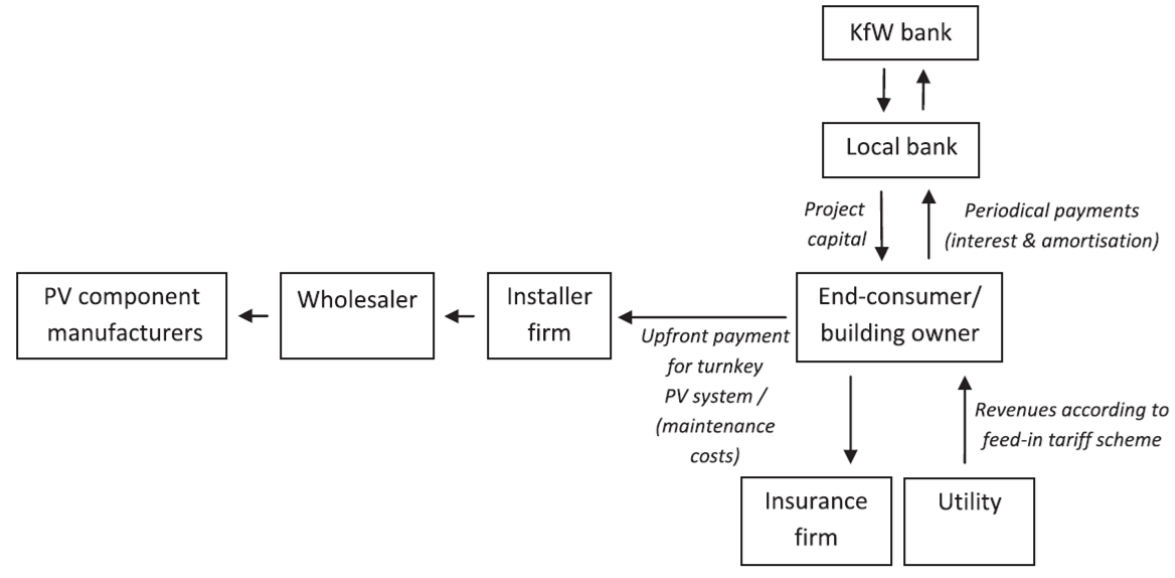


Figure 4 Financial flows of the host-owned feed-in model (Strupeit & Palm, 2016)

3.4.2.1.3 Challenges Overcame

Although this model is not able to overcome the initial upfront cost for the customers compared to many other models, with the element of competitive return rate of investments, it acts as a low-risk financial investment choice for investors.

As a result of the push for a more sustainable energy source from the government, by the end of 2013, the PV capacity installed in Germany accounted for one fourth of the global capacity. Of which, 75% of the capacity came from these add-on solar panel systems acquired by the building owners (Strupeit & Palm, 2016).

4 Results

4.1 Residency Length and Ownership Structure

The residency length of the tenants interviewed ranges from two months to six years. The number of people they share the apartment with varies from none to four persons. The seen landlord types are private housing companies or private individuals. However, for some, housing managing companies are hired to manage the properties for individual owners. Most of the private individual owners who handles the apartments themselves either live in the same house with the tenants or as neighbors.

4.2 House Condition

For houses that are around a century year old or built before World War II, the thermal performance of the flats tends to perform poorly in the different weather conditions. Tenants who live in this type of property tend to feel hot in the summer and cold in the winter, or that it is always colder in the building than the outside environment.

"... it's always hotter in the flat in the summer and colder in the winter." (TNX02)

"The temperature in the flat always seem to be colder throughout the year, both in the summer and the winter..." (TNX08)

For most buildings that were built after the 1940s but before the early 2010s, the tenants experience either always warmer or always cooler in the building than the outside temperature. Buildings that were built within the last five years or had newly retrofitted walls and windows experienced more comfort in terms of temperature within the household.

"The apartment was completely renovated 2 months before we moved in, the windows, kitchen, appliances, etc…., [the apartment] is in good condition. I have no complains." (TNX11)

4.3 House and Retrofit

Approximately half of the interviewees had the knowledge on the when the apartment was last renovated. Some falls in the year between 1990s and 2000s, and the rest were done between 1.5 to 3 years prior or 1 to 2 months before the renters moved in. The retrofit sometimes includes the windows, the façade, but mostly furnishing work such as wall paint, floor, or kitchen are done. Known reasons for owners' intent to make the change include making the property more attractive and having a good reason the raise the rent. Although not all interviewee knows whether the cost was passed down to the tenant since the retrofit is usually done in between the change of the tenants, they suspect that it was included in the rent. One had mentioned that the rent of the flat was twice as much as his neighbor with the same structure but without the renovation,

"I ran into my neighbor one day in the hallway..., and they said, '… you guys are paying twice as much as we do…'" (TNX11)

One tenant had also stated that the rent would increase 2% each year for 4 years without any retrofit. This was disclosed in the agreement when the contract was signed at the beginning. The source of the funding to finance the retrofit and the availability of governmental incentives are little known.

When asked whether the interviewees would like to have the apartment retrofitted, only a handful would like to. Other than additional heating, most would like to have better efficiency windows. However, many mentioned a contradiction, which was that they would like to have better housing energy performances, but they would like to keep the aesthetic of the original windows. It is not likely that the landlords would spend more and go out of their ways to use better insulated and designed windows. Another conflict was that they would not want to go through the hustle of requesting and installation process.

4.4 Utility Bills and Behaviors on Use of Energy

4.4.1 Rent and Utilities

Utility bills are the amount that a household should pay for their use of electricity, heating, and hot water (here in this report, internet and other ancillary cost is excluded). There are different ways of payment found among the interviewees, which can be separated into two groups: exclusive and inclusive rent. Exclusive rent would be those who pays the rent and the amount used of

the utility. On the other hand, inclusive rent includes all costs at a fixed price that a tenant would pay each month.

There are various types of contracts that one can make with his or her landlord under the exclusive rent category. One arrangement is to pay solely the rent to the landlord and the utilities would have to be taken care of by the tenants themselves. Another form would be that the rent includes heating and hot water, and the electricity would be responsible by the tenants. For the last type, the landlord would ask for rent including electricity, heating, and hot water. The difference between inclusive rent and the preceding two mentioned arrangements is whether the tenants would have to pay or receive the difference between the paid and the revised version[2] at the end of the year or not.

4.4.2 Rent Type and Energy Awareness

Despite the different kinds of agreement, the interviewees do not change their behaviors accordingly. They only consume what is necessary. This is due to their habits and consciousness to be eco-friendly. The awareness can come from family background, school education, having work in relevant fields, or from the media. Parental habits or family education were the most commonly seen factors among the interviewees. It can range from "turning off lights and TV when not in use" to making better insulation within the household or building drip irrigation system for plants. School, college education, other education such as scouts or media also further enhance the attention. Majority of the respondents who work in the environmental and energy field also take extra steps and actions to be even more resource efficient or raise awareness among others.

> *"...in fact, my dad was the more [environmentally] aware one. The insulation improvement that I do it by myself now, I learn mostly from him. He would make sure the windows are well sealed.... He even created his own drip irrigation system."*

> *"When I moved in at the beginning, my flat mates just throw everything in one trash can. I taught them how to recycle. Now, they [recycle] and some even became vegans."*

[2] Utility companies check the meters at the house to register the actual amount used by the household annually. They would then ask for or give back the differences between the actual consumption and the fixed prepaid amount.

4.4.3 Utility Awareness and Energy Efficiency

The interviewees were asked about their knowledge on the utility companies that they are using. Those who pay inclusive rent have little to no knowledge on the subject. On the other hand, exclusive renters often have to go through the process of making decision on at least the electricity provider. Therefore, almost all of the interviewees from this category were aware of their power service. However, as for heating or hot water services, only a few respondents have the knowledge. This is due to the fact that the service is already included in the monthly rent payment, and that it does not come across their mind to request more information (such as name of service provider, energy source, or their consumption) about it from their landlords or housing managing companies.

Regarding to the choice of the electricity providers, it is noticed that online platforms were used by the tenants to compare the different prices offered by various service providers to assist them on choosing the most suitable one. Also, most respondents who work or possess environmental or energy background have already taken actions to change their original service providers to "green" electricity providers. It was mentioned that the price of "green" electricity might not be necessary higher than that of the traditional energy sources. Many have also made remarks that they do not mind the small increase in the bill to use renewable sources. There are several reasons. Besides the friendly service that was offered by the company, the original motive for one of the renters to make the switch was the occurrence of the Fukushima Daiichi nuclear incident.

> *"After Fukushima [Daiichi nuclear incident] happened, I had an impulse to stop supporting nuclear energy… and [the price of] green electricity is actually not that much higher"*

After the event happened, it was decided that supports for nuclear energy should be stopped. For others, changing to renewable sourced electricity is an easy way to contribute to fighting climate change.

In Berlin, there are default utility providers set for each region, which are typically providing services from traditional energy sources. This means that people who live in the property will be automatically provided traditional energy generated electricity if they do not take actions to change their service provider. For the renters that did not consider changing their providers, there are several factors. Some find it too troubling to do additional work. In addition, for Berlin being such a diverse and international city, foreign renters finds language as a notable barrier in the circumstance. Some dwellers were not aware of

the option. One had mentioned that considering that the landlord work in the renewable energy sector, it was assumed that the owner would already provide the tenant with green electricity.

4.4.4 Requests for Higher Energy Performance

4.4.4.1 Initiative

When the interviewees were asked about whether they have thought about requesting higher housing energy performance from their landlords, only two had thought about asking, but did not also make further requests. They assumed that their landlords will not agree to the request. For the other interviewees, there are a number of explanations for not making the inquiry. Many stated that uncertainty and the length of stay would be the main concern. The uncertainty would include employment or simply not knowing the possibility of extending the rental contract. Another common feedback is that the respondents assumed or observed that the landlords or the housing managing companies would only carry out changes when necessary or required by law. For inclusive-rent residents, it would not influence the monthly payment, therefore, it does not come to their concern to improve the housing energy performance. Furthermore, the majority of the interview participants had mentioned that they try to avoid the contact with their landlords as little as possible due to language barriers, bureaucracy, or the risk of their rent raised.
However, the most vital factor is that despite when tenants are living at the property for several years, they still feel detached to the apartment since it still belongs to other people. They feel that it is not their responsibility to improve the energy performance of the house, and that the investment would not be valued in the end.

4.4.4.2 Awareness and willingness to ask for better housing energy performance

Regarding to the matter of awareness, it did not come across all the tenants' mind to ask for better energy performing retrofit. However, nearly all interviewees who do have the awareness were reluctant to make requests. Many mentioned that they were not on good terms with their landlords. Another reason was the risk of the rent being increased or being marked as 'difficult' tenants, which would lead to the possibility of not being able to extend the contract once it ends. With the current housing situation in Berlin, they were more concerned about having a place to live rather than good energy efficiency standard in the household. There was also the issue of persuasion, in case that there are needs to temporarily move out of the apartment while the construction is being carried out, it

would be another challenging task to manage. For occupants who pay inclusive rent, it would only be more inconvenience for them.

4.5 Perspective on the Business Models

Model such as the solar leasing model was presented to the interviewees to learn their views and thoughts about the model. The solar leasing model was chosen to be given as an example, because it is more within the reach of the tenants. While as most of the other models, the property owners would have more power over the decision making.

4.5.1 Willingness to Adapt the Business Models

In terms of willingness, there are strong interest in using the leasing model service by the tenants personally. Most would be inclined to use the solar leasing model, and would consider asking their landlords via telephone calls or email. However, the majority would not make extra effort to persuade the owners. They stated that the process is slow, lengthy, and frustrating, not to mention the probability of being marked as 'difficult' and lose the opportunity of continuing the rental contract. Furthermore, despite that the leasing model highlights the little to no additional work for the landlords, a few tenants believe that extra efforts would still need to be fulfilled by the owners. For instance, the private individual owners would need to come to agreement with other landlords if it is a multi-ownership building. In addition, if several parties within the same building were also interested in the service, there would be competition for the rooftop spaces.
Nonetheless, on the aspect of installing solar panels, one interviewee from the inclusive rent category was willing to ask and introduce it to the landlord as it will benefit the owner financially as well as being sustainable.

5 Discussion

The result of the interview has shown the perspectives from the experiences of the tenants on the subjects of the retrofit of the apartment, knowledge on the utilities, their energy behaviors and awareness, and their willingness to use the models presented.

Regarding to the scene of the housing market in Berlin, with the high demand for apartments in this German capital, it does not take much efforts for landlords to find new tenant. Also, since the ownership of the house does not belong to the tenants, it is not the tenants' interest put efforts in taking care of the properties. On the same element of the small availability of flats, many respondents are fearful of not being able to extend their contracts on the current dwellings. Furthermore, a large number of the respondents had stated that they are not on good terms with their landlords,

which cause them to be hesitant about making requests or even minimize the contact with the homeowner as low as possible. However, the homeowner that was interviewed, on the other hand, stated that he or she tries to keep good relationship with the tenant. The good tie will lead to the renter to take care of the property. With the outlook of the housing market in the near future, the demand for apartments does not seem to decline. To rely on the proactiveness of the landlords to improve their housing energy performance is not optimal. Therefore, to improve the energy efficiency in residential buildings would depend heavily on policies, or otherwise, social pressure coming from the awareness of the tenants.

On the subject of the tenants' behavior corresponding to the rent type, it was anticipated that those who pay inclusive rent would have change in behavior since they do not have to be concern about the use of the energy and water resources. However, it is not the case. Despite the type of arrangement that was made, there are no change of behavior in the interviewees even when all bills are included in the rent, which usually induce an 'all-you-can-use' mindset that frequently lead to wastefulness. This is by virtue of the habits or awareness that was already established either by the family or school education, media, or having to work in the relevant sector. It was also interesting to find the influence of the individuals. Many respondents who work or possess environmental or energy background had one way or another made impact on those in their surroundings, such as persuading their house mates to change from a traditional source utility company to a more sustainable energy source provider.

The finding on the use of solar panel was also intriguing. Given that there are a variety of choices in Berlin regarding to green electricity, it is much easier to switch the utility company rather than installing an actual solar panel on the house. However, for those who were still willing to invest in the panel, it showed that the grounding feeling on knowing the source of the energy used is imperative to the respondents. This shows that the transparency and the access to the information is a crucial point. It would be of green electricity providers' interest to enhance their communication to transparently display the renewable energy source share in their energy mix through different channels such as the company website or enclose the information in the invoice issued.

Regarding to the business models and best practices, there are still room to improve the clarity of the information and the raise of awareness. Clearness includes the mechanism of the model, and for the solar leasing model in particular, whether there will be needs to keep the connection to the grid as there might be double cost (i.e., minimum fees) for having both systems. For this reason, it would be best to include energy storage system to ensure that it is sufficient to have the solar panels instead of carrying two different services. Also, if the contracts allow the transfer among tenants, it can also overcome the temporary split-incentives. In addition, being such an international city with residents from all over the world, if the business models would feature English

service, or even translator service to support the consumer to negotiate with the landlords, it might open more opportunities.

To raise the awareness on the models to improve housing energy performance, advertisement or short animations that would allow consumers to understand the mechanism of the scheme, or the advantages of having better energy efficiency performance, etc. Visible display on the real-time consumption would also have a significant effect on dwellers' awareness and attention.

6 Conclusion

This study looked at the international and national business models and best practices that can address the landlord-tenant dilemma. Interviews were conducted to understand the experience and perspective of the tenants of Berlin to explore the potential of implementing the models in this German capital. With the current high demand housing market, it would be tough for the business models to be implemented at the moment. Extra effort is needed for tenants to apply energy efficient measures to their living spaces. Business models initiated by the private sector are appealing as it is more proactive, and more efficient due to its flexibility to response to the need of the market. However, the majority of the time, these models are established upon the implementation of new policy measures.

This research serve as a groundwork to explore the potential implementing business models or best practices seen from different parts of the world. In Berlin, the high ratio of apartment renting, the tenants were much more accessible to landlords as many properties are managed or outsourced to housing management companies. Therefore, the next step would be to learn the perspectives of the individual landlords and housing companies on the business models and the practices. Once the angles from all the stakeholders are clear, adjustment to existing models or proposal of new models to overcome the landlord-tenant dilemma could be made.

7 References

Amt für Statistik Berlin-Brandenburg. (2016, 12). *Die kleine Berlin-Statistik 2016.* Retrieved 5 9, 2017, from statistik-berlin-brandenburg: www.statistik-berlin-brandenburg.de

Ástmarsson, B., PerAnkerJensen, & EsmirMaslesa. (2013, 9 3). Sustainable renovation of residential buildings and the landlord/tenant dilemma. *Energy Policy*, pp. 355-362.

Berlin Hyp AG; CBRE GmbH. (2016). *Housing Market Report Berlin 2016.* Retrieved 4 25, 2017, from Berlin Hyp: https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjis9Toxb_TAhUEM5oKHS_YCRUQFgglMAA&url=http%3A%2F%2Fwww.berlinhyp.de%2Fuploads%2Fmedia%2FWMR_2016_EN_WWW_20160111.pdf&usg=AFQjCNFRbYLAzPtwu5iCVAWPAJKA_EX1fg&sig2=i3xP0

Bertoldi, P., & Rezessy, S. (2005). *ENERGY SERVICE COMPANIES IN EUROPE .* Retrieved from http://www.energetska-efikasnost.ba/: http://www.energetska-efikasnost.ba/Publikacije/Literatura/ENERGY_SERVICE_COMPANIES_IN_EUROPE.pdf

Brüggemann, A. (2016, 6 9). *The energy transition will not work without a heating transition.* Retrieved from KfW: https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-Fokus-Volkswirtschaft/Fokus-englische-Dateien/Focus-No.-129-June-2016-Heating-transition.pdf

CBRE GmbH; Berlin Hyp AG. (2016). *Housing Market Report Berlin 2016.* Retrieved 4 12, 2017, from berlinhyp: www.berlinhyp.de; www.cbre.de

Deutche Bank Research. (2017, 1 13). *Outlook on the German housing market in 2017.* Retrieved 4 12, 2017, from dbresearch: www.dbresearch.com

DeVries, C. (2010, 1 27). *How innovative financing is changing energy in America*. Retrieved 4 25, 2017, from Grist: http://grist.org/article/2010-01-26-how-innovative-financing-is-changing-energy-in-america/

Econmidou, M. (2014). *Overcoming the split incentive barrier in the building sector.* Retrieved 5 9, 2017, from https://ec.europa.eu/jrc: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC90407/2014_jrc_sci_pol_rep_cov_template_online_final.pdf

Energy and Mines Ministers' Conference. (2016, 8). *Financing Energy Efficiency Retrofits in the Built Environment.* Retrieved 5 31, 2017, from www.nrcan.gc.ca: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/emmc/pdf/Financing%20Report-acc_en.pdf

Eurostat. (2017, 3 28). *Distribution of population by degree of urbanisation, dwelling type and income group - EU-SILC survey*. Retrieved 5 9, 2017, from Eurostat: http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

Forni, D., & Zajaros, A. (2014, 11 26). *Split Incentives.* Retrieved 5 9, 2017, from Energy Efficiency Directive: b. https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjqt97s5uLTAhWiFZoKHSf_AOsQFggnMAA&url=http%3A%2F%2Fwww.ca-eed.eu%2Fprivate-area%2Fthemes%2Fenergy-services-ct5%2FExecutive-Summary-5.4-Split-incentives&usg=AFQjCNEpY7m5zkANee0KX0

Gupta, P., Anand, S., & Gupta, H. (2017, 5). Developing a roadmap to overcome barriers to energy efficiency in buildings using best worst method. *Sustainable Cities and Society*, pp. 244-259.

Hiskes, J. (2010, 11 20). *6 ways to solve the 'renter's dilemma' for home energy*. Retrieved 4 25, 2017, from Grist: http://grist.org/article/2010-11-19-6-ways-to-solve-the-renters-dilemma-for-home-energy/

Kholodilina, K. A., & Michelsena, C. (2014).

Ostertag, K. (2012). *No-regret Potentials in Energy Conservation: An Analysis of Their Relevance, Size and Determinants.* Springer Science & Business Media.

Papineau, M. (2015, 3 31). *Understanding Energy Consumption Behavior in a Landlord-Tenant Context: What do the numbers tell us?* Retrieved 5 17, 2017, from Carleton University: https://carleton.ca/cserc/wp-content/uploads/Landlord-Tenant_CSERC_2015.pdf

Schleich, J., & Gruber, E. (2008). Beyond case studies: Barriers to energy efficiency in. *Energy Economics*.

Strupeit, L., & Palm, A. (2016, 6 1). Overcoming barriers to renewable energy diffusion: business models for customer-sited solar photovoltaics in Japan, Germany and the United States. *Journal of Cleaner Production*, 124-136.

Warburg Research. (2016, 1 7). Retrieved 5 8, 2017, from Sector Report Residential Real Estate.

8 Appendix

8.1 Interview Questions

Interview Questions – Tenants

*Name/email/consent form/recording consent

Icebreaking Questions

1. Background:
   a. What did you **study**?
   b. What do you **do**?
2. **How long** have you been a tenant at this property?
   Do you have any flat mates or **roommates**? **How many**?
3. What is the **type** of your **landlord**?
   Private individual/Private housing company/Public housing company
4. Does your **landlord live with you**? Y/N

House and Retrofit

5. Do you know **how old** the house is? How old?
   How's the **condition** of the house? (i.e., do you feel cooler in the house in the summer and warmer in the winter compared to the temperature outside?)
6. When was the **last time** that your apartment was **renovated**?
   (Yes Renovation)
   a. What was renovated?
      i. Did you have to **contribute** to the renovation in any form or shape? (direct contribution asked by the landlord, or raise in rent)
   b. Do you know **why** the landlord decided to renovate the property? (were there housing standards/policies that (s)he has to comply)
   c. Do you know if (s)he has received any financial (or other) **incentives** from the government or other institutes for renovating the property? From whom?

(No Renovation)
If you didn't experience any renovation,

   a. Do you know when the **last renovation** was?
   d. Would you **like to have** it renovated? **Why**?

Utilities

7. About the rent, **do you pay the utility bills (such as gas, water, heat, electricity) or does the landlord takes care of it?**
   a. Inclusive: since the rent is inclusive,
      i. Are you still **concerned with energy saving** or water saving? Why?
      ii. Do you ask the landlord about your **usage** (maybe with the goal of reducing the usage)? Why?
      iii. Do you know the **energy sources** or the companies of your utility services?
   b. Exclusive:
      i. Do you know which **utility companies**/service provider that you're using? (heating/electricity/hot water)
      ii. Do you get to have the **choice of choosing** the company to your likings? If not, how did you deal with it?
8. Are you **satisfied** with the current service?
9. Have you (or your flat mate) ever thought about using or **requesting a higher energy efficiency** or appliances (better heater; different utility company; solar panels (to reduce your bill or other reasons)? What were the reasons?
   a. If yes, how did you become having this **awareness**?
   b. If no, are you aware of it? Are you considering requesting renovation now? Why?

10. And did you end up having it?
    a. If yes,
        i. Who **paid** for it? Landlord/you (and flat mates)
        ii. How was the **decision** made?
            1. Did you run into any **challenges** or difficulties? What was it?
    b. If no,
        1. What was the **reason**? (high investment, not your responsibility, the landlord disagrees?)
        2. What kind of **barriers** did you encounter?
11. Have you had any **other experience** as a tenant in other places? What were the experiences regarding to the previous questions?

Model

So, this issue between you and the landlord on whether who should invest in the retrofitting is called the landlord-tenant dilemma or the split-incentive. And here are some of the models and practices that hope to overcome this problem.
[present models (ones that can directly reduce their bills, i.e., SolarCity, PACE)]

12. Many of the models mentioned is able to take away the upfront costs, would you consider **asking**/negotiating your **landlord** to **implement** it? Or do you think that your landlord would be **willing** to implement it then? Why?
13. Which **model attracts** you the most? Why?

14. If you could make **changes** to any of the model, what kind of changes would you have made to make it more suitable to your need/situation? Why?
15. Do you have any other things that you would like to **add**?

Interview Questions – Landlords

*Name/email/consent form/recording consent

Icebreaking Questions

1. How long have you been a landlord?
2. Is this your only property or are there others?
3. How many tenants have there been?
4. What are the common period that they stay or the type of contract that you give?
5. Are there any particular reasons that you give this kind of contract?

House and Renovation

6. How old is the house? How is the condition of the house? (i.e., Does one feel cooler than the outside temperature in the house during summer, and warmer in the winter?)
7. How long have you been the landlord of this house?
8. When was the last time that you renovated the house?
9. To what extend was the house renovated?
10. Why did you decide to renovate? Was there some sort of standard that you have to meet?
11. How did you pay for it? Did you receive any incentives from the government or other institutions?

Utilities

12. How about the utilities? How did you choose your utility companies (gas, water, heat)? Do you know the type of energy source that you use from the energy company, and how it's delivered (e.g. district heating network)?
13. Do you pay for the utility bills, or does your tenant pay it themselves directly? Why did you decide to do it this way (either inclusive or exclusive)?

Models Questions

14. Have you ever encountered any experiences where the tenants had asked you to upgrade/install certain appliances (such as implementation of solar PV, solar thermal, higher energy efficiency heater, etc.) to better reduce their energy bills?

(No experiences)

a. If no, would you agree to such request in the future? Why?
b. If you ask for exclusive rent, (since the tenants are paying the bills), are you willing to retrofit your property? What are the incentives for you to do so? If not, under what conditions would you consider retrofitting?
c. If you ask for inclusive rent, would you consider retrofitting your property to cut down the energy costs (or even increase property value?)

('Yes' to retrofit)

d. If yes,
   i. What were the request?
   ii. Why did you agree, what were the motivations?
   iii. How did you finance it? Did you receive any reimbursement from the government?
   iv. Was the retrofit considered successful?
e. If you ask for exclusive rent, what were the reasons to retrofit your properties since your tenants are paying the energy bill?
f. If you ask for inclusive rent, are there other reasons for retrofitting other than that it can cut down on the energy bills?

15. For both,
   a. Were there any incentives from the government for the financial support?
   b. Was there a third party (company) that was able to help you with the finance of the refurbishment or the choices/implementation of the upgrades?

('No' to retrofit) + Business Models

16. If no, why? What were the reasons/ barriers? (finance barriers? Too much work?)
17. Are you aware of any policies/businesses that could help with this issue?
18. For both rent,
   a. If there are financial incentives from the government, to what extend would you consider retrofitting? (financial incentives such as direct reimbursement, tax deduction)
      i. Explanation of Business Models/plans
         1. Direct reimbursement from the government,
      taking away part of the financial burden
         2. Tax deduction,
      The possibility of reducing the amount of tax to be paid
   b. If there are governmental plan or third-party companies that are able to take away the upfront cost, and the hustle bustle of the retrofit, would you consider the upgrade? (plans such as paying the retrofit with lower interests along with the tax bill; or leasing)
      i. Explanation of BM/plans
         1. Local improvement charges (LICs) or Property Assessed Clean Energy (PACE)
            a. No upfront cost
            b. Payback along with tax bills
            c. Lower interests than normal loans
         2. Green lease
            a. Example: Solar City
            b. Monthly lease/Pay as you go
            c. No upfront cost, no maintenance, no complex paperwork
         3. Energy Service Companies (ESCOs)
            a. They do the retrofits, you do nothing

b. No change on bill (business as usual)
c. Repay by energy saved

4. Third-party financing
   a. Financing retrofitting by a commercial lending institution.

c. (For large buildings or # of clients) Another model, ESCOs (the energy service companies), would be able to provide the retrofit and not cost you the upfront payment. The cost would be repaid by the energy cost savings. Would this be of interest to you?
   i. No upfront cost
   ii. No complex procedures

d. If the refurbishment can increase the value of your property, in case of selling in the future, would you consider the retrofit then?
   i. A study mentioned that with energy labelled houses, the market price would increase 9%

19. Does any of these models attract you? What kind of changes would you made to it to make it more suitable to your need?
20. Do you have any other things that you would like to add?

8.2 Interview Consent Form

Consent for Participation in Interview Research

I was invited to participate in a research project conducted by IKEM, Institute for Climate Protection, Energy, and Mobility. I understand that the project is designed to gather information on the business models and practices that can address the split-incentives when implementing energy efficiency measures in residential buildings.

Hereby, I declare that:

1. My participation in this project is voluntary. I understand and agree that I will not be paid for my participation. I may withdraw and discontinue participation at any time without penalty. If I decline to participate or withdraw from the research, no one on my campus will be told.
2. I understand that most interviewees will find the discussion interesting and thought-provoking. If, however, I feel uncomfortable in any way during the interview, I have the right to decline to answer or to end the interview.
3. My participation involves being interviewed by Pauline Horng from IKEM. The interview will last approximately 30-45 minutes. Notes will be written during the interview.
4. **I consent to being recorded during the interview. An audio tape of the interview and subsequent dialogue will be made.**
5. **I am aware and agree that the information provided by me in the interview will be used for research purposes within the project mentioned above.**
6. I understand that the research will not quote me in any reports using information obtained from this interview, and will not disclose my personal information to third parties. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions.
7. I have read and understood the above and agree to abide by these terms and conditions. All my questions have been answered satisfactorily, and I voluntarily agree to participate in this research.
8. I have been given a copy of this consent form.

_____ _____

Signature Date

_____ _____

Name Signature of the Researcher/Interviewer

Ansprechpartner

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