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Access to capital for the capital-intensive companies that eliminate the upfront costs for investments in energy improvements by households

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Table of Contents

1. Introduction

Context

The Intergovernmental Panel on Climate Change stated in the fifth assessment (IPCC, 2014) that there is a 95% certainty that global warming is caused by greenhouse gases (GHGs) and other human activities. Likely effects of global warming include extreme weather events, ocean acidification, species extinctions, and food insecurity due to inundation (Hughes, 2000). Carbon Dioxide (CO2) is one of the biggest contributors to GHG-emission (Rodhe, 1990). Anthropogenic CO2-emission is caused by energy generation through combustion of carbon-based fuels, such as wood, coal, oil, and natural gas (Raupach et al., 2007). To slow down global warming a transition in the energy sector is required. This includes a relative reduction of energy use and a transition to a more renewable way of energy generation in order to meet the remaining energy demand (IEA, 2014c). In 2012, the residential sector consumed a total of 2.1 giga ton oil equivalent (gtoe), which is equal to 23% of the total final energy consumption worldwide (IEA, 2014a). Therefore, the residential sector could potentially be an important contributor to the energy transition.

Problem definition & objectives

Relative to the other two main sectors, the energy-intensive industry and the commercial building sector, the residential sector consists of a large number of actors. All households could contribute to the energy transition by investing in *energy improvements,* i.e. either reducing their energy use by investing in energy efficiency measures or generating their own by investing in renewable energy technologies. Energy efficiency does not only concern energy management through insulation, but also includes more energy efficient electrical appliances. Besides a reduction of energy use for the end-user, circular consumption of these appliances creates environmental benefits due to longer useful lifetimes, eco-design, which allows for more recycling of materials, and more efficient use by the end-user (Ellen Macarthur Foundation, 2014). However, although most energy improvements are cost effective, the environmental potential of the residential sector is not met. The high upfront investment is considered among the most important barriers for households to invest in energy improvements (IEA, 2014b; Würtenberger, Bleyl, Menkveld, Vethman, & Van Tilburg, 2012). Different organizations have applied value propositions that eliminate the upfront investments for households. Yet, these business models are capital-intensive. Therefore, access to capital is critical to grow these organizations and eventually utilize the environmental potential in the residential sector. Noteworthy, due to differences in the environmental context, value propositions that eliminate upfront investments and strategies to access capital differ across countries. This study analyzes the exploitation of energy improvements in the Dutch market and compares this with characteristics from the American market in order to identify potentially effective value propositions and strategies to access capital.

Objective 1: to study households' considerations regarding investment in energy improvements.

The World Energy Investment Outlook (IEA, 2014b) expects a rise in annual investments in energy improvements by households from $ 78 billion in 2012 to about $ 142 billion in 2035, resulting in cumulative investments of $ 2.6 trillion up to 2035. Although this is only approximately 5% of the investments in the total energy sector (with a cumulative investment of $ 48 trillion up to 2035), this market is important for companies and policy makers. Since

investments in energy improvements are capital-intensive, capital costs are an important component of the net present value of the investments (Painuly, 2001). Due to the relatively long payback period of such investments and high-risk perception, the cost of capital is generally high (Oliver & Jackson, 2001; Painuly, 2001). Moreover, energy improvements require high upfront investment, which is considered one of the most important barriers to investment (Würtenberger et al., 2012). Besides, the transaction costs and risks related to the investment are considered high. While the upfront investment might be the most important problem for low-income households, the transaction costs and risks could be important considerations for households in higher income scales. An overview of the relevant investment barriers for residential customers provides insight in the options for organizations to create value for residential customers.

Objective 2: to study the structures of organizations, regarding the sort of energy improvements they exploit, the value propositions they apply, and the characteristic of the organization.

Different organizations aim to reduce households' barriers to investment in energy improvements in order to gain market share and stimulate the deployment of energy improvements. This market can be characterized by different sorts of applicable energy improvements and a number of different propositions that aim to create value for their customers (Sorrell, 2007; Würtenberger et al., 2012). The value propositions are a framework that outlines which customer barriers are removed in order to create value for the customer. Therefore, analysis of the value propositions provides insight in the barriers that are considered most important by the market players. Moreover, the characteristics of the energy improvement determine which value propositions can be applied. Besides the propositions, the characteristics of the market players that apply these propositions differ significantly (ACEE, 2014; Agarwal, Ambrose, Chomsisengphet, & Liu, 2006; Bird et al., 2013; Richter, 2012). This research distinguishes financial intermediaries, Energy Service Companies (ESCOs), and utilities. Differences include expertise, customer relations, and collaboration with partners. The structures could be explanatory for the ability to access capital in order to finance the capital-intensive business model.

Objective 3: to understand the challenges regarding the access to capital for the studied capital-intensive companies and identify strategies to gain access to capital.

Access to capital is considered a great challenge for capital intensive companies in the relatively young sector for energy improvements (Ghosh & Nanda, 2010; Würtenberger et al., 2012; Wustenhagen & Teppo, 2006). This study recognizes three stages of capital that are relevant for these companies, including operational capital, credit facilities, and the replenishment of these credit facilities (Dionne & Harchaoui, 2008; Michael Mendelsohn, Urdanick, & Joshi, 2015). Public capital and private capital are distinguished as well as equity and debt investments. The studied organizations deploy different strategies to access capital. The analysis of these strategies provides insight in the critical success factors for access to capital. These are related to the studied different sorts of energy improvements, value propositions, and market players.

Objective 4: to compare the American and Dutch environmental context regarding the regulatory environment and the characteristics of the capital markets.

This study compares the environmental context in the U.S. and the Netherlands. Since the U.S. is known to enable new business models to scale up relatively fast (Van Ark, O'Mahony, & Timmer, 2008), the U.S. might include valuable examples of value propositions and strategies to access capital that could successfully applied in other countries. Besides, an in-depth understanding of the differences between the American and Dutch environmental context could be explanatory for the exploitation of certain energy improvements, the application of certain value propositions, the characteristics of the market players, and the deployment of certain strategies to access capital. Moreover, the differences between the two countries could provide insight in the opportunities for companies as well as policy makers. While companies could benefit from insight in successful cases in the other country, policy makers could benefit from insight in facilitating aspects of the contextual environment, such as the regulatory environment.

Research question

The aim of this research is to establish a solid framework around the aforementioned objectives. To this aim, the following main question will be answered. ***Which strategies to attract capital are potentially effective for capital-intensive organizations in the Netherlands, who eliminate the upfront cost of energy improvements for their customers, and what are the determinative variables for the effectiveness?***

This main question can be answered by the following sub questions:

1. *What are the main considerations for households to invest in energy improvements?*
2. *What kinds of business structures are applied to create value for customers, considering the sort of energy improvements that are exploited, the applied value propositions, and the characteristics of the market player?*
3. *Which strategies do market players deploy to access capital?*
4. *How do the environmental contexts of the U.S. and the Netherlands affect the business structures and strategies to access capital?*

The result of this research will be a framework that describes the market for energy improvements, including the sort of energy improvements, the propositions that include the elimination of the high upfront investments in energy improvements, and the market players that apply these propositions. Since access to capital is of great importance, the relation of the framework's variables to access to capital is assessed. To illustrate, when a certain proposition or the characteristics of a certain market player could result in access to capital on the secondary market, a large market will be accessed. In 2012, institutional investors held $ 83 trillion in assets in OECD countries alone (IEA, 2014b). Apart from the framework that is derived from the literature review, the studied cases will be analyzed on their strategy to attract capital.

2. Literature review

2.1. Households' investment considerations

Households' propensity to invest in energy improvements depends on rational considerations in combination with the specific context of the household (Ameli & Brandt, 2014; IEA, 2014b). Rationally, the willingness to invest mainly depends on a trade-off between costs and benefits. Financial costs occur during the different activities on the value chain that are executed by companies. *Figure 1* shows the value chain for energy improvements, including project development, design, financing, procurement, installation and construction, monitoring, billing, and maintenance. Noteworthy, a large share of the costs occurs before the energy improvements are operational. Additionally, non-financial costs include transaction costs that are caused by imperfect market information. However, energy improvements create financial benefits through energy generation or energy savings. Besides financial benefits, incentives might be caused by satisfaction about contributing to the energy transition or the use of better products, in case of high quality more energy efficient electrical appliances. While companies aim to create value for their customers by affecting these variables, some boundary conditions should be met in order to distribute the costs and benefits to the right actors. 'Split incentives' refer to a situation in which the costs and benefits are not distributed accordingly between two actors, either between landlord and tenant or between consecutive homeowners.

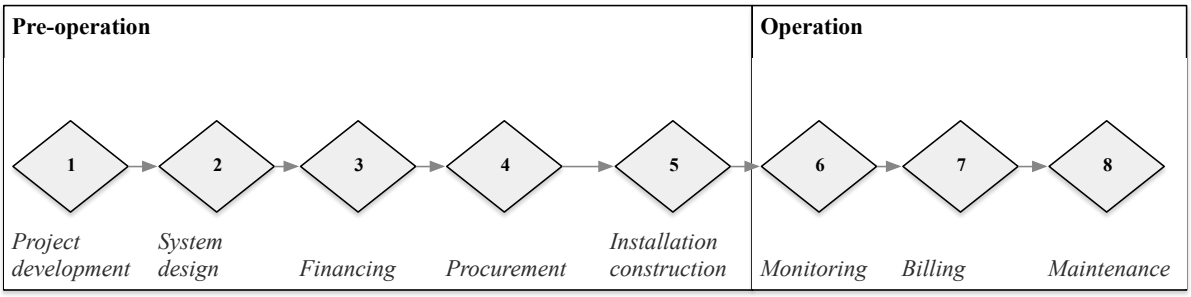

Figure 1: value chain energy improvements (source: author)

High initial costs

The high upfront investment is considered one of the most important barriers to invest in energy improvements (IEA, 2014b; Wurtenberger, Bleyl, Menkveld, Vethman, & Van Tilburg, 2012). Costs for conventional generating technologies are relatively evenly allocated over time, consisting for about one third of upfront investment and two thirds of O&M and fuel costs (Koner, Dutta, & Chopra, 2000). For energy improvements in contrast, the costs before operating largely exceed the operating costs. Cost related to project development, design, financing, procurement, and installation and construction cover approximately 80% of the total costs for energy improvements (Wurtenberger et al., 2012). Households generally give a stronger weight to the initial investment cost than to the present value of future energy savings (Ameli & Brandt, 2014). When they do not have enough equity to invest in energy improvements, capital should be accessed through alternative ways. Access to capital could be an important barrier for households. Households' credit profile, which is derived from the households credit score ore income, might be a reason for limited access to capital or high cost of capital. Since the cost of capital represents a large share of the total costs, household specific costs of capital might affect the profitability of the investment significantly. For high-income households, the high upfront costs are not necessarily a limiting factor.

However, other barriers, such as a low financial incentive, transaction costs, and performance risk, might be considered more important due to the high costs.

Financial incentive

The levelized cost of energy (LCOE) is the most encompassing metric to assess the competiveness of different energy generating technologies (Darling, You, Veselka, & Velosa, 2011). The equivalent for this metric for energy efficiency measures is the cost of energy savings (CES) (EIA, 2014). Both metrics account for all lifetime costs compared with a technology specific assumption regarding utilization and performance (Darling et al., 2011; EIA, 2014). The LCOE or CES can be compared with retail energy prices in order to assess the profitability of an investment. When customers do not finance the investment themselves, the cost of capital is an important component of the lifetime costs for energy improvements. The cost of capital is typically relatively high due to the long maturity of obligations regarding energy improvements (Oliver & Jackson, 2001; Painuly, 2001). The initial investment for energy improvements will be recovered through a reduction of the energy bill. Generally, the repayment period of investments in energy improvements is a function of the initial costs, the performance of the improvement, quantified by the amount of energy reduction, and the price for each reduced unit of energy. Therefore, the end-user energy price is an important variable for the calculation of the net present value of the investment. However, this price is unknown and affected by a large number of variables. Yet, uncertainty regarding the future energy price is referred to as price risk (IEA, 2014b).

Transaction costs

An important cost component from a households' perspective are the transaction costs that are related to an investment in energy improvements (Allcott & Greenstone, 2012; Wurtenberger et al., 2012). Transaction costs occur as a result of the great variety of options in the market, including the sort of energy improvement, the value proposition, and the market players that exploit the different energy improvements. Since the information that is directly available is imperfect, it requires effort to gather sufficient information about the different options to make a decision. Besides information imperfection, transaction costs may occur when different companies perform complementary activities. When companies do not execute all activities in the value chain themselves, customers need to shop at different stops in order to buy a complete product, increasing the required effort. Comparably, transaction costs could occur when agreement with neighbors is required, for example in a multi-tenant building. After all, the effort that is required to make a well-informed decision and arrange all practical issues is referred to as the 'hassle factor' (Wurtenberger et al., 2012). Since households' expenses on energy represent only a relatively small share of their total expenses, the transaction costs might outweigh the net present value of investments in energy improvements. Companies aim to reduce the transaction costs through vertical integration of the value chain, which allows them to apply a proposition that includes a 'one-stop-shopping experience' for the customer, significantly reducing the transaction costs.

Performance risk

The performance is one of the determining variables in the calculation of the LCOE and CES or the net present value of the investment. The performance is quantified as the amount of produced energy or the amount of saved energy for energy generating measures and energy efficiency measures, respectively. Performance monitoring might be a barrier for energy improvements. For energy efficiency measures, the establishment of a reference level is considered a major barrier (Wurtenberger et al., 2012). Also for some energy generating measures the performance might be difficult to monitor. To illustrate, the useful energy, in

the form of heat, which is produced by heat pumps is hard to quantify. Therefore, heat pumps are mostly considered energy efficiency measures. Furthermore, performance estimates are subject to different project-specific uncertainties. Technological performance refers to the efficiency and reliability of the measure (IEA, 2014b). Effective maintenance can be an important determinant for the technological performance of a measure. Bot manufacturers as well as resellers often provide guarantees regarding the technological performance of a product, whether or not including a maintenance contract. Besides technological performance, the effective performance of energy improvements is affected by external factors, such as weather conditions. While the production of solar energy increases through more sun hours, energy savings of insulation increase in case of more extreme weather conditions. Although these external factors could not be influenced, some companies provide comprehensive performance guarantees.

Split incentive

The issue of split incentives deals with the unequal distribution of costs and benefits between two actors. This phenomenon is often referred to as the landlord-tenant agency problem (Gillingham, Harding, & Rapson, 2011). When one of both invests in energy improvements, there is a possible mismatch between the distribution of costs and incentives. When the tenant is accountable for the monthly energy use, the landlord is not incentivized to invest in energy improvements (Gillingham et al., 2011; Neuhoff & De Vries, 2004). Contrary, tenants are most likely reluctant to invest in energy improvements since they will not benefit from the increase of the value of the property. Moreover, split incentives may occur due to the distribution of costs and benefits over time. For a tenant, another reason not to invest in energy improvement is that the payback period of an investment probably exceeds the rental period. Comparably, homeowners may consider the payback period of an investment in relation to the time they are planning to live in the same house. Although researchers argue that the value of the property increases in line with the investment in energy improvements, others question this statement. However, mobile energy improvements, usually energy generating measures, do not have to deal with split incentives over time since they can be removed relatively easily and transferred to the new property of the owner of the measure.

2.2. Sort of energy improvements

Energy improvements in the residential sector either produce or save energy. In case of investments in energy efficiency of residential customers, improvements might concern more efficient electrical appliances or home efficiency improvements, including all measures that improve the building's energy management in order to reduce the energy use for heating and cooling. In order to quantify the demand side of the market for households' investments in energy improvements, this research refers to the New Policy Scenario (NPS) that is used by the International Energy Agency (IEA, 2014a, b). In the NPS, formally adopted measures and policies from mid 2014 and relevant policy proposals are taken into account. Given the expected cumulative investments in energy improvements by households of $ 2.6 trillion up to 2035, households will play a substantial role in the energy transition. Noteworthy, doubling cumulative investments are required to meet the criteria for the 450 Scenario, in which the rise of the average global surface temperature is reduced to two degrees Celsius (2 °C) over the pre-industrial level (IEA, 2014b). The Dutch market is quantified in Urgenda's report: 100% renewable energy in 2030 (Urgenda, 2014). Urgenda is a Dutch organization that aims to stimulate transition in the residential building sector. In order to meet their ambitious goals, about 7 million existing houses need to be renovated and upgraded to energy neutral buildings. This includes exploitation of a combination of energy saving and energy

generating measures. According to their report, the energy use of households will be reduced with 45% by efficiency measures. The remaining energy demand will be met by generation in and around the building. Annually, an investment of € 9 billion is required to finance the reconstruction of 250,00 buildings. Urgenda claims that the average costs of changing existing buildings in 'energy neutral' buildings will soon be reduced to about € 35,000, which can be compared to an average household's energy costs over about 20 years.

Energy generating measures

Although several renewable energy technologies experienced a rapid growth in previous years, the share of low carbon technologies in the energy mix is limited. According to the IEA (2014a, b), renewables account for 13% of the primary energy mix in 2012. With a share of 21% of total electricity generation in 2012, the largest amount of renewables is used to generate electricity. According to the NPS, renewables will account for 33% of electricity generation by 2040. While large-scale hydro power plants are responsible for the majority of renewable generation (IEA, 2014c), the capacity of non-hydro renewable is expected to multiply 6 times. Energy generating measures that are suitable for the residential sector include solar photovoltaic (PV), small wind turbines, small-scale combined heat and power systems, solar thermal collectors, geothermal, and heat pumps. Noteworthy, solar PV is currently the most applied distributed generating measure (Krulewitz, 2012; M Mendelsohn, 2013). Expansion of renewables has been particularly successful in markets where households underpinned deployment of distributed generation. Small-scale projects provide opportunities for new investors and ownership structures (IEA, 2014b; Wurtenberger et al., 2012). In 2012, households and communities owned 19% of the non-hydro renewables worldwide. Households' investments in generating technologies are expected to grow from $ 37 billion in 2012 to $ 71 billion in 2035, resulting in cumulative investments of $ 1.3 trillion up to 2035.

Home efficiency improvements

Besides energy generating technologies, households financed approximately 55% of the energy efficiency projects so far (BNEF, 2014a; IEA, 2014b). Home efficiency improvements include energy conservation measures, often through building refurbishment, including wall and floor insulation, energy efficient windows, and air sealing. Home efficiency improvements are often part of a comprehensive approach, including both efficiency measures as well as energy generating measures, such as solar PV or heat pumps. This category of energy improvements is known to have a relatively short payback period due to their high performance. However, the potential of home efficiency improvements is not met, resulting in a 'efficiency gap' (Allcott & Greenstone, 2012; Ameli & Brandt, 2014; Fuller, 2008). Reasons for the efficiency gap include the relatively high impact of the installation and construction of the measures, insufficient information, and difficulties regarding the monitoring of the performance of the measures (Allcott & Greenstone, 2012; Revelt & Train, 1998; Short, Packey, & Holt, 1995). According to the NPS, the residential sector will be responsible for about half of the investments in energy efficiency in the built environment up to 2035 (IEA, 2014b). The investments in energy efficiency improvements in the residential sector are expected to grow from $ 41 billion annually in 2012 to $ 71 billion in 2035, resulting in a cumulative investment of $ 1.3 trillion up to 2035 (IEA, 2014b). Expenditures concern electricity savings through more energy efficient electrical appliances and lighting and reduction of energy for heating and cooling through better insulation of buildings and improved energy management systems, representing 30% and 70% of the total expenditures, respectively (IEA, 2014b).

Energy efficient electrical appliances

According to the NPS, 30% of total energy savings in the residential sector will be realized by more energy efficient electrical appliances (IEA, 2014b, 2014c). For appliances, the investment price is calculated as the additional price for the more energy efficient electrical appliances as opposed to the average price of the appliance. There is a large number of energy consuming appliances. Typically, research covers larger electrical appliances that use relatively large amounts of energy, such as washing machines, dryers, refrigerators, and dishwashers. However, lighting is often covered as well since it is used in different locations in the building and there is a great difference in the efficiency of traditional lighting and the more efficient alternatives, which creates a large savings potential. Besides the social benefits that are realized through the reduction of energy use through the use of more energy efficient electrical appliances, social benefits can be realized through circular consumption of appliances. In a circular consumption proposition, the appliance remains owned by the manufacturer. The user of the appliance, the household in this case, pays a service fee for the usage of the product.

As a result, in order to maximize its revenue, the producer is incentivized to optimize the lifetime of the product, which increases the competiveness of higher-cost products with increased longevity as opposed to lower-cost products that are consumed in a short time and a linear way (Jawahir, Sikdar, & Huang, n.d.). Since the producer remains owners after the lifetime of the products, he is responsible for the waste disposal process as well. Therefore, he is stimulated to enable dismantling and recycling of the natural resources within the product through eco-design, which reduces material depletion (Ellen Macarthur Foundation, 2014). Thus, longer lifetimes of appliances and a design that accounts for reuse reduces energy use during manufacturing of appliances. Lastly, due to the usage fee, the customer is incentivized to use the appliances in an efficient way, minimizing the number of usages. *Table 1* lists the environmental benefits of energy efficient electrical appliances and circular consumption. The economic benefit of the circular economy is estimated to be worth more than $ 1 trillion in material savings (Ellen Macarthur Foundation, 2014). Accordingly, circular consumption could be enhanced by the deployment of more 'access-over-ownership' and 'take-back' business models.

Environmental benefit	Requirements	Explanation
Energy reduction customer	Energy efficient electrical appliances	Less energy use of customer due to the use of high-quality appliances
Lifetime optimization	Circular consumption: incentive based on lifetime	Optimization of design (Life Cycle Costs), maintenance, and end-use behavior.
Waste disposal	Circular consumption: manufacturer remains owner	Eco-design enables dismantling and re-use of materials, reducing material depletion and energy use for manufacturing.
More efficient use	Circular consumption: costs based on number of usages	More efficient use due to financial incentive to minimize the number of usages.

Table 1: environmental benefits of energy efficient electrical appliances and circular consumption

2.3. Value propositions

Since the high upfront investments are considered one of the most important barriers for households to invest in energy improvements, this research focuses on value propositions that eliminate the upfront costs for their customers. This section describes the different value propositions and the financial products that are offered through these propositions. In this research, loans, lease arrangements, and performance-based incentives are recognized as the

most important propositions. Besides the elimination of upfront costs for the customer, the propositions potentially create value through the reduction of other barriers for households. The cost structures of all propositions include a periodic payment, the loan repayment, lease fee, or performance-based incentive. Therefore, the revenue model includes a steady cash flow from the customers. As a consequence, the companies that apply the value propositions are exposed to credit risk (Dionne & Harchaoui, 2008; Michael Mendelsohn et al., 2015). This refers to the risk that the customer will default on its obligation to make a contractual payment. Concerning credit risk, the most important metrics include the default rate, the recovery rate, and the net loss rate (Bird et al., 2013; McCrone, Usher, Sonntag-O'Brien, Moslener, & Gruning, 2012). While the default rate refers to the share of customers that are not able or willing to meet their obligations, the recovery rate concerns the value that is recovered from the share of customers that default. The net loss rate in turn, concerns the difference between the default rate and the recovery rate, representing the true decline in value of the organization's assts. Credit risk should be considered an additional risk to any other risk that can be internalized by the organization, such as performance risk. Credit risk might be an important factor in the attraction of capital for these companies.

It should be noted that not all proposition are suitable to finance the different categories of energy improvements, which are described in the previous section. The potential value of a measure for a third party after installation is of great importance. This value is correlated with the removability of the measure. While a measure that can be removed remains valuable during its lifetime, the value of an irremovable measure for a third party decreases directly after installation. To illustrate, efficient electrical appliances, such as washing machines, dryers, and refrigerators, can be removed from a residential building relatively easy. While solar panels require a little more effort, including uninstallation of the panels, most energy efficiency measures, such as insulation and double pane windows, have little value when they are removed. To elaborate, for removable measures the 'third party ownership' (TPO) model can be applied (Lowder & Mendelsohn, 2013). In this model, a third party, usually the organization that applies the value proposition, remains owner of the measure while it is installed in the residential building of its customer. Similarly, these measures can function as collateral for a loan. Both structures provide leverage for the organization since they can remove the measure when the customer is in default, which means that the customer does not meet its financial obligations. Due to this leverage, the exposure to credit risk is reduced. The remaining value of the removed energy improvement contributes to the recovery rate. *Table 2* outlines how the removability of the energy improvements affects the applicable value propositions.

	Removable energy improvements (energy generating measures or energy efficient electrical appliances)	**Non-removable energy improvements (home efficiency improvements)**
Loans	V	V
Secured loans	V	-
Lease	V	-
Performance-based (TPO)	V	-
Performance-based	V	V

Table 2: relation between removability of energy improvements and applicable value propositions

Loans

Fundamentally, loans differ in two ways, namely, their flexibility and their use of collateral (Barro, 1976; John, Lynch, & Puri, 2003). First, flexibility refers to the ability to use credit while paying on the account balance. Open-ended loans allow flexible repayments and

continue repurchasing of credit within a certain credit limit, while closed-end loans require a strict repayment scheme for a specific period of time (Chien & Devaney, 2001). Regarding the use of collateral, secured and unsecured loans are distinguished. Secured loans rely on an asset as collateral for the loan of which the lender can take possession in case of loan default, which reduces the credit risk. The most common secured loans used for investments in energy improvements are 'home equity loans' and the 'home equity line of credit', both referred to as second mortgages (Agarwal et al., 2006). In the US and the Netherlands, the interest paid on second mortgages is tax-deductible, resulting in a lower effective interest rate. Second mortgages are used for major purchases, such as home improvement projects. The available amount that can be borrowed depends on the loan to value ratio. When the value that the energy improvement adds to the house is taken into account, more households would get access to financing. According to NEVIN (1999), an energy improvement adds twenty times the yearly energy savings to the value. Unsecured loans, in contrast, rely solely on specific conditions of the borrower, such as credit rating and debt-to-income ratio (Barro, 1976).

Loan arrangements differ in terms and conditions, such as interest rates, maturity, and credit underwriting requirements. Since secured loans are backed by collateral, these loans generally have lower interest rates. Compared to secured loans, unsecured loans have high interest rates, short loan terms, and concern small loan amounts. Since unsecured loans are not backed by collateral, the credit underwriting criteria are usually stricter, aiming to lower the credit risk. Loans could be designed for a wide range of energy improvements. However, the removability of the measures determines if they can function as collateral. When the measure can be removed, the loan can be structured as a secured loan, which reduces the credit risks and allows lower interest rates, longer maturity, and more flexible underwriting criteria. Another option to reduce credit risk is to combine loan payments with other obligations, such as property tax or energy bills. As discussed, most generating technologies and almost all energy efficient electrical appliances could function as collateral. Electrical appliance loans are often structured as hire purchase or rent-to-own agreements and offered by manufacturers and resellers. The initial costs are generally not high enough for the development of a specific loan by third parties. Since the customer directly owns electrical appliances, the manufacturer or reseller does not have any incentive to optimize the lifetime of the product and is not obliged to take back the product after its lifetime. Therefore, the environmental benefits of circular consumption are typically not met in case of loans for appliances. For home efficiency improvements, loans are typically unsecured. Yet, since such measures are considered to have the shortest payback period, short-term loans can still be economically feasible.

Lease propositions

While the removability of the energy improvement only determines the potential structure of the loan, either unsecured or secured, the lease proposition can only be applied for energy improvements that can be removed (Agarwal et al., 2006; Lacey, 2013). Since the lease organization owns the measure, the measure should have a value for the organization when it would be removed. Since the lessor can take possession of the measure in case of default, the credit risk is relatively low. Lease arrangements are to a large extent comparable to secured loans. As for secured loans, the proposition can be applied to most energy generating technologies and electrical appliances. Since most energy efficiency measures cannot be removed with preservation of value, these measures are not suitable for such arrangements. Compared to secured loans, the most important difference is that the lease proposition is based on the TPO-model, which means that the organization remains owner of the measure during the full length of the contract. In most cases, the lease organization provides an option

to buy the measure at the end of the contract period. The two prominent forms of lease contracts are operational lease and financial lease. In case of a financial lease of an asset, the rights and duties related to ownership of the asset are transferred to the lessee, referred to as on balance lease. In this case, the lease should contain a bargain option, concerning at least 75% of the asset's lifetime, or worth at least 90% of the asset's value. A financial lease is largely comparable to a hire purchase, rent-to-own agreement, and secured loan. The difference is that the legal title is not transferred at the time of the agreement. An operational lease is more comparable to a rent since the organization remains financially and legally owner of the asset.

In case of an operational lease, the organization usually takes full responsibility for the performance of the asset. This often includes maintenance and performance guarantees. For electrical appliances, the environmental benefits rely on the specific activities of the lessor. Comparable to the loan proposition, the energy use of the customer will be reduced through the use of more efficient appliances (Intlekofer, Bras, & Ferguson, 2010). In contrast to the loan proposition, the lessor would benefit from a maximization of the lifetime of the appliance since he remains owner of the appliance. Since the lessor is paid per leasing period, he would benefit from a maximization of the number of leasing periods. Therefore, the lessor could aim to optimize the lifetime through effective asset management and coaching regarding the use behavior of the lessee. Moreover, the maximization of the lifetime could be an important metric in design considerations, often increasing the initial product costs, but reducing the total life cycle costs (Jawahir et al., n.d.). Furthermore, the lessor is obliged to take back the product when the customer does not purchase the appliance after the lease period. However, the lessor is not incentivized to return the appliances to the manufacturer. Only when the lessor would cooperate with the manufacturer in order to reuse the materials or even adjust the design to make reuse of certain components of the appliance possible, the full environmental and economic potential of the proposition would be utilized.

Performance-based value propositions

Value propositions that include performance-based incentives can be applied for all categories of energy improvements, regardless the removability. However, the removability of the energy improvement does determine if a TPO model could be applied. While removable energy improvements remain owned by the organization, the customer will directly own measures that cannot be removed. Furthermore, the structure of the contract is determined by the energy improvement category. In case of energy generating technologies, the performance-based proposition is structured as a Power Purchase Agreement (PPA). The agreement concerns the purchase of produced energy at a fixed price per unit. Centralized energy producers and energy retailers or large consumers have applied this contract form since the privatization of the energy market. The most important benefit of this contract form for both producers as well as buyers is that they are able to control price risks and supply and demand (ACEE, 2014; Mitchell, Bauknecht, & Connor, 2006). Comparable to large-scale centralized generation, a PPA between a residential customer and a distributed energy producers concerns an agreement about the supply of energy for a fixed price per unit. While this proposition is currently mainly applied for solar panels with a fixed price per kWh of produced electricity, a PPA could theoretically concern a fixed price per unit of heath that is delivered through a heat pump as well.

Performance-based value propositions might be applied to exploit efficiency improvements as well. However, in comparison to energy generating technologies, the performance of efficiency improvements is less straightforward (Short et al., 1995). In order to measure the performance of efficiency improvements, companies should overcome two major barriers. First, a baseline, which is based on historical performance, should be

established. Second, the energy usage after the implementation of the efficiency improvement should be normalized for changes in energy consumption that are not realized by the improvement. This includes correction for internal and external changes over the years, such as the number of users and the temperature. These value propositions differ in the way the benefits and risk are shared between the organization and the customer (Vine, 2005; Würtenberger et al., 2012). Comparable to a PPA, an Energy Service Agreement (ESA) includes a purchase agreement between the customer and the organization concerning the product that is delivered by the organization at a fixed price per unit. However, since the organization does not produces, but saves energy, the customer pays for the saved units of energy, often referred to as 'negawatts' (Sundberg & Sjödin, 2003). Comparable to a PPA, the fixed price per unit is typically lower than the price charged by the energy retailer. When the customer pays a fixed fee for the energy it uses, regardless the amount, the proposition is referred to as Managed Energy Service Agreement. The organization functions as middle person between the customer and the energy retailer. Since the periodic fee is fixed, based on the baseline, the organization is to a maximum incentivized to reduce the energy usage of the customer (Kim, O'Connor, & Bodden, 2012).

As for solar panels, the TPO model can be applied for appliances since they can be removed. The performance of electrical appliances can be quantified as the number of usages. Consumer that pay for usages is in line with circular consumption, an indispensible part of the circular economy (Ellen Macarthur Foundation, 2014). While the organization remains owner of the appliance, the user pays a usage fee based on the number of operations, known as 'pay-per-use principle'. Contracts include a fixed fee per usage and potentially a minimum number of uses in order to cover the fixed costs. Therefore, this model creates a great incentive for the customer to reduce its number of uses, resulting in less energy use. In addition, companies that apply circular consumption models typically focus in their strategy on the optimization of the lifetime of the asset through effective maintenance and coaching of the end-user. Moreover, in the ideal conceptualization of circular consumption, the manufacturer remains owner of the appliance. As a result, cost-savings could be achieved through reuse of the components and materials in the appliances that are taken back and adjustment design of the appliances in order to enable this. *Table 3* provides an overview of the utilization of the potential environmental benefits that are described in table 1 per value proposition. Noteworthy, the predictability of the cash flow of performance-based propositions is limited. While lease and loan payments concerns a predetermined fixed fee, either the cost or revenue structure of performance-based propositions includes a flexible component. The revenue is dependent on the produced energy or the number of usages for propositions that include energy generating technologies or electrical appliances, respectively. In case of efficiency propositions, the number of negawatts or the usage of the customer for ESAs and MESAs, respectively, cannot be calculated in advance.

	Energy reduction customer	Lifetime optimization	Waste disposal	More efficient use
Loans	V	-	-	-
Leases	V	V	-	-
Performance-based	V	V	V	V

Table 3: environmental benefits of energy efficient electrical appliances and circular consumption in relation to the applied value proposition

2.4. Market players

Besides the different sorts of energy improvements and different financial products, the market for energy improvements is characterized by organizations with different characteristics, referred to as market players. In order to provide a structured overview of the playing field, this research categorizes the market players as financial intermediaries, energy service companies (ESCOs), and utilities. While utilities and ESCOs are by origin active in the energy sector, financial intermediaries traditionally provide financial services that are not related to energy specifically. However, recently the number of financial intermediaries that provide financial products that are specifically designed for the energy sector is growing. The nature of the organization that applies the value proposition could be an important variable in order to determine the credit risk. Specifically, companies could utilize existing leverage or competences to manage the credit risk. Moreover, the characteristics of the market player determine which value propositions are applicable. To illustrate, while the financial focus of financial intermediaries limits the applicability of lease and performance-based arrangement, the technical focus of ESCOs results most likely in the application of a proposition with a high service level, namely leases or performance-based incentives. The effect of the characteristics of the market player on the applicability of the value propositions is presented in *table 4*.

	Loans	Leases	Performance-based
Financial intermediaries	V	-	-
ESCOs	-	V	V
Utilities	V	V	V

Table 4: relation between characteristics of market players and the applicable value propositions

Financial intermediary

One of the most important services that are provided by market players in the financial sector is their role as intermediary. This includes the connection of money demand and money supply, facilitating the transfer of money between lenders and borrowers. Activities concern the aggregation of deposits into credit facilities that are used to provide financial products. Lenders aim to make a profit on their surplus savings by indirect lending through a financial intermediary. Financial products could be structured as different forms of loans, such as consumer loans and mortgages, and are provided to borrowers. In the cost structure of the financial intermediary the gross profit concerns the difference between the interest that is received from the borrowers and the interest that is paid to the lenders. *Figure 2* visualizes the intermediate position of financial intermediaries between lenders and borrowers. Banks are the most known financial intermediaries. These traditional financial intermediaries could benefit from competences regarding debt collecting and administration, reducing the credit risk. However, there is a mismatch between the short-term focus of traditional banks and the long payback periods of energy projects (IEA, 2014b). As a result, the number of financial intermediaries that are specialized in the energy sector is significantly increasing. Often, these specialized financial intermediaries provide financial products that are not provided by traditional financial intermediaries. Typically, these intermediaries execute activities through which the risks of the financial products can be assessed and managed. This form of specialization allows them to provide financial products that could not be provided by traditional financial intermediaries. These companies are typically an additional intermediary in between financial intermediaries and specific borrowers. Specifically, different kind of banks and credit unions do not directly fund projects regarding energy improvements, but invest via specialized financial intermediaries.

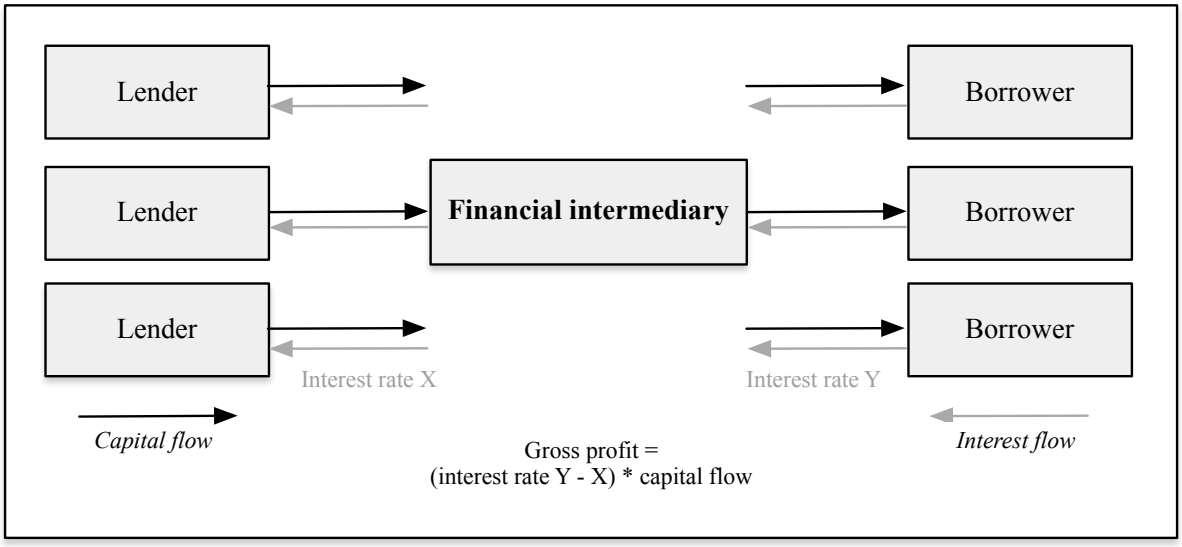

Figure 2: position of financial intermediaries between lenders and borrowers.

Energy service companies

ESCOs execute different activities in the value chain. Compared to financial intermediaries, expertise include more technical aspects such as project development, design, procurement, installation and construction, and maintenance (Sorrell, 2007; Vine, 2005; Wurtenberger et al., 2012). Typically, ESCOs are able to provide a one-stop-shopping experience, which significantly reduces transaction costs for their customers. The degree of vertical integration determines if the value proposition is delivered through collaboration with partners or internal competences. While ESCOs traditionally provide comprehensive service package, including both energy efficiency measures as well as energy generating measures, an increasing number of ESCOs focuses on the exploitation of single a measure, such as solar PV. Noteworthy, this research considers solar lease companies as ESCOs since these companies typically offer all complementary services related to the solar system and therefore meet the description of an ESCO. Depending on the applied value proposition, ESCOs either internalize or share performance risk with their customers. While a lot of ESCOs only provide technical services, this research only include ESCOs that eliminate the customers' upfront costs as well. Comparable to financial intermediaries and utilities, they should access credit facilities in order to account for the upfront investment of the energy improvements. In addition, ESCOs need to develop competences regarding credit risk management, including debt collecting and administrating. After all, the most important difference with financial intermediaries and utilities is the comprehensive character of their proposition. Although some ESCOs outsource most technical aspects or focus on a limited number of measures, ESCOs are known for the technical services and their comprehensive approach. The position of ESCOs with respect to their partners and their customers is visualized in *figure 3*.

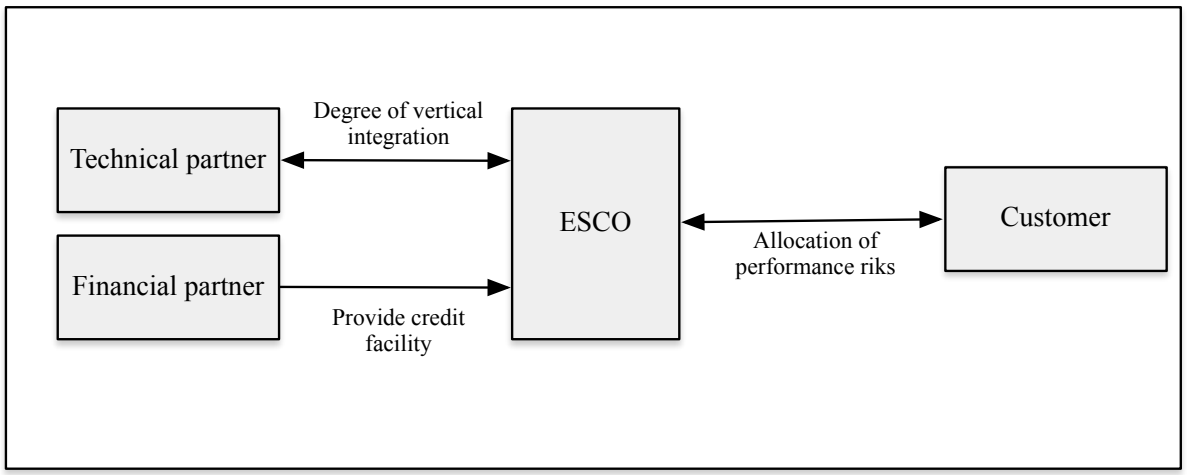

Figure 3: ESCOs relation with customers and partners

Utilities

The transition to more dispersed, small-scale, and renewable generation has had an effect on the business model of utilities, including both large-scale energy producers as well as energy retailers (ACEE, 2014; Richter, 2012). In order to stay competitive, utilities have to adapt their business model to the changing environment. Richter (2012) distinguishes utilities' business models as utility-side or customer-side propositions. The customer-side proposition concerns a large number of small-scale energy generating projects. This new customer-side proposition is in an early stage of development. A common trend is that utilities go through a transition to a more service orientated business model, referred to as the Utility as a Service Provider (UaaSP). In this model utilities create value through additional energy services, such as the elimination of the upfront costs for investments in energy improvements. Scholars agree that utilities could play an important role in the financing of the energy transition (Bird et al., 2013; M Mendelsohn, 2013; Richter, 2012; RMI, 2013). Mendelsohn (2013) argues that utilities have a favorable position to invest in energy improvements since they have access to low-cost capital, both from equity investors as well as through corporate debt. An UaaSP version with a high focus on financial activities is referred to as a 'FinanceCo' (RMI, 2013). The FinanceCo can apply one of the value propositions that are outlined in this literature review, namely loan, lease, or performance-based arrangements. Since utilities can leverage their existing billing relations, including the threat of disconnection, they are able to minimize credit risk (ACEE, 2014). When customers pay their monthly obligation through the regular energy bill, referred to as on-bill repayment (OBR), the default rate is expected to decline significantly.

Business structures

This literature review studied the theoretically feasible business structure, regarding the characteristics of the exploited energy improvement, the value proposition, and the market player. This analysis results in a framework of 16 possible combinations, which are listed in table 5.

Energy generating measure	Value proposition	Market player
Energy generating measures	Loans (potentially secured)	Financial intermediaries
		Utilities
	Leases	ESCOs
		Utilities
	Performance-based (potentially TPO)	ESCOs
		Utilities
Home efficiency improvements	Loans	Financial intermediaries
		Utilities
	Performance-based	ESCOs
		Utilities
Efficient electrical appliances	Loans (potentially secured)	Financial intermediaries
		Utilities
	Leases	ESCOs
		Utilities
	Performance-based (potentially TPO)	ESCOs
		Utilities

Table 5: possible business structures as combination of energy improvement, value proposition, and market player

2.5. Financial

Since the market for investments in residential energy improvements is a relatively young market, companies that apply business models that are specifically designed for this market are considered start-ups. Typically, start-ups cannot rely on reserves and do not possess valuable assets. In order to finance the growth of their business, it is required to attract operational capital. Another common characteristic of the studied companies is that their business model is capital intensive. Since they account for the initial investment that is required for energy improvements, they need to access funds in order to scale their activities. The development of a credit facility allows companies to provide services to their customers, such as the provision of loans or the purchase of energy improvements, resulting in a financial obligation of their customers. The future cash flows that are derived from the financial obligations of customers could be considered assets, which could function as collateral for the attraction of capital. These cash flow generating assets can be used upfront, in order to negotiate the most favorable terms for capital, or later to replenish the credit facility. An attractive way to attract capital could be access to the secondary market. The secondary market is a liquid market where companies issue financial instruments, such as stocks, bonds, and securities, which can be traded among investors (Loutskina & Strahan, 2009). After all, start-ups that invest in energy improvements can only scale-up their activities when they manage to attract operational capital and credit facilities to finance the financial products that they offer to their customers. Most likely, while operational capital concerns an equity investment, debt is attracted to form a credit facility. In order to grow, important strategies might include the replenishment of credit facilities by the use of cash flow generating assets. *Table 6* provides an overview of the different forms of capital that can be accessed.

Investor	Financial product	Stage	Investment aim	Form
Business incubators	Equity shares	Early stage	Operational capital	Private equity
Business angels	Equity shares	Early stage	Operational capital	Private equity
Equity crowdfunding	Equity shares	Early – medium stage	Operational capital	Private equity
Venture capitalist	Equity shares	Medium stage	Operational capital	Private equity
Private equity firms	Equity shares	Established stage	Operational capital	Private equity
Banks	Loans	Established stage	Credit facility	Private debt
Peer-to peer lending	Loans	Early – medium stage	Credit facility	Private debt
Green banks	Loans	Early – established stage	Credit facility	Public debt
Semi-governmental funds	Equity shares	Early – medium stage	Operation capital – credit facility	Public equity
Asset managers	Portfolio sale	Early – established stage	Replenishment of capital	Private debt
Institutional investors	Bonds/Asset backed securities	Early – established stage	Replenishment of capital	Private debt

Table 6: strategies to access capital considering the stage of the organization and the aim of the investment

Operational capital

Startups in the market for energy improvements typically invest with operational capital in their workforce, in their computer systems, and in marketing (Cassar, 2004). The risk profile of start-ups is traditionally too high to qualify for bank loans. However, some programs that are designed by public entities include guarantees for the loans provided to start-ups. In this case, the loans are secured, which means that the bank will be compensated in case of default, for example caused by bankruptcy of the start-up. This allows banks to provide low-interest loans since the credit risk is minimized by the involvement of a governmental organization. Moreover, there is a large diversity of programs that are developed through collaboration of private and public entities, which provide loans in order to stimulate growth of start-ups. Apart from debt, start-ups typically attract capital through private equity investors. In order to attract the first round of financing, referred to as the seed-round, start-ups often aim to connect with a business incubator. These are companies that offer the resources that are required to facilitate growth of the start-up, such as a network with professionals and investors. The most important players in the market for private equity are business angels and venture capitalists. While business angels are wealthy individual investors, venture capitalists are companies. Private equity firms provide equity investments in more established companies, which are not listed on a stock exchange. While venture capitalists are form of private equity investors that specialize in start-ups, they represent a relatively small amount of the total private equity market. Noteworthy, the guidelines between the definitions of the different actors are rather blurry. To illustrate, business incubators often invest in the start-ups they supervise and venture capital firms regularly provide additional experience and access to contacts. Another way to attract early stage equity is crowdfunding, which is considered an alternative for venture capital.

Credit facility

In order to offer financial products, capital is required to lend to customers or to invest in energy improvements, which can be leased or installed in return for a performance-based incentive. As discussed, private equity might be an instrument to attract investments for firms that are not listed. However, private equity firms typically take a stake in the firm and aim to

restructure the organization in order to realize high returns. Due to the short-term focus, private equity is mostly not used to develop a credit facility to finance the offering of financial products. Therefore, the most convenient way to develop a credit facility is to attract debt. In general, two ways through which debt can be accessed are distinguished. In the first model, the organization acts as warehousing facility (SEE-Action, 2014b, 2015). The credit facility is developed by a variety of financial partners, potentially a combination of private equity, private debt, and public capital without any collateral. The credit facility is used to sell financial products to customers. Afterwards, the debt obligations are aggregate and sold to investors. In the up-front model in contrast, a credit facility is developed through the investments of a small number of investors. Capital is usually raised through the issuance of a bond or a loan from a financial entity. In this model, the future cash flows, deriving from the financial obligation of customers after sale of their product, function as collateral. The up-front model might be considered favorable since the secured bonds usually result in a faster development of the credit facility. However, this limits the options for capital replenishment in a later stadium. Besides, for smaller companies, future cash flows might not provide enough security in order to issue a bond or agree upon a large loan. In contrast, issuer should have a strong financial position and track record. *Figure 4* and *5* provide an overview of the capital flows in the two models.

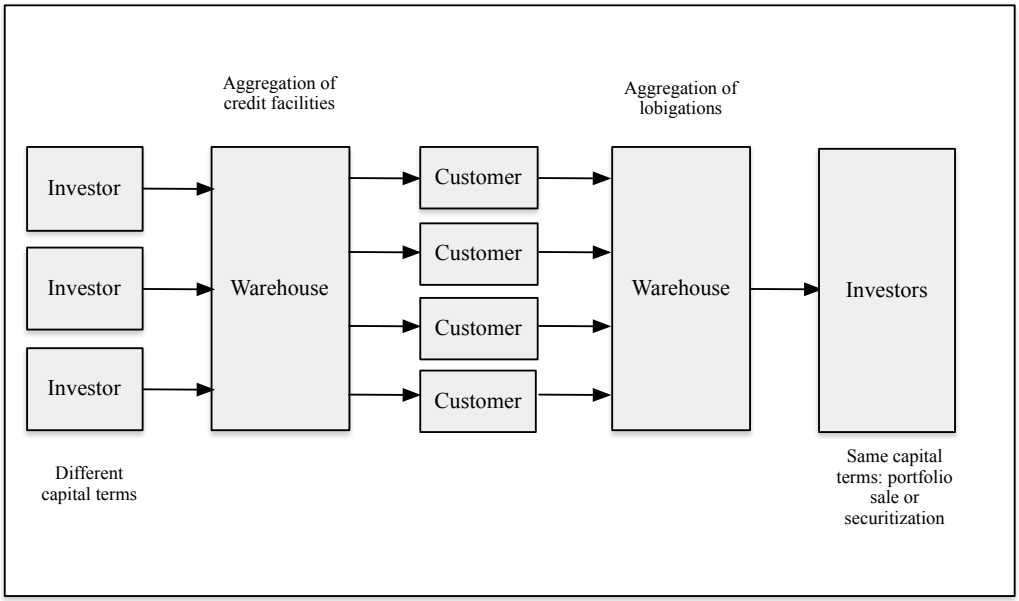

Figure 4: development of credit facility and aggregation of obligations in the warehouse model

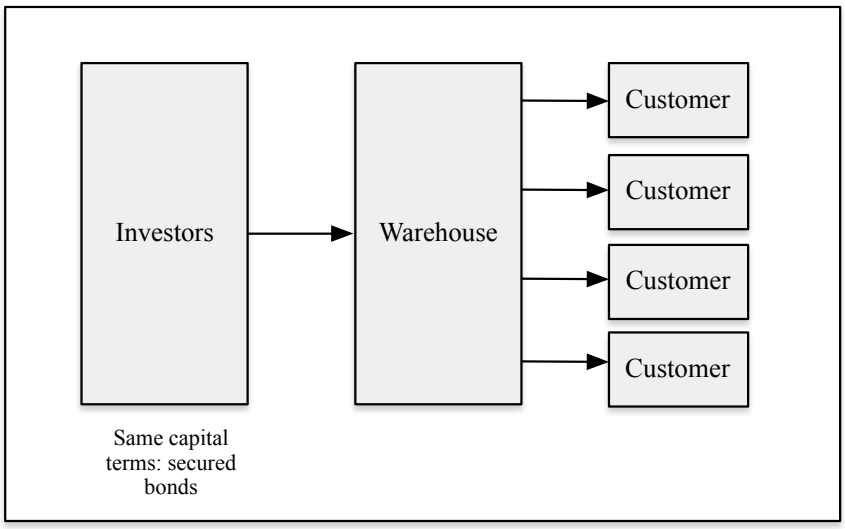

Figure 5: development of credit facility in the up-front model

Regardless the strategy that is applied, capital can be accessed though different sources. Traditionally, bank loans are the most known source of private debt. However, due to tightened regulations, banks are required to hold larger reserves. The long maturity of loans for investments in energy improvements is considered an important barrier for banks to provide loans. Yet, many large banks have specific green investment departments, which may value the social impact of their investment. These account for the investment of savings from customers who specifically assigned for their green activities, typically in return for a lower interest rate. Besides traditional bank loans, alternative strategies to attract private debt could be executed. While equity crowdfunding is considered a promising strategy to attract equity for start-ups, peer-to-peer lending is developing as an instrument to attract debt. Peer-to-peer lending refers to individuals who lend money to entities without a traditional financial intermediary. Instead, a rapid growing amount of online lending platforms are used for credit checking and administrative tasks. While the risk return ratio is the key metric for private investments, social considerations might be taken into account for public investments. Moreover, green banks consider the social impact in their lending decision, which increases the attractiveness of sustainable projects (Ceres, 2014; NREL, 2014). Public entities that participate in such banks include municipality's, county's, and state's treasury departments, development authorities, and housing corporations. Besides green banks, semi-governmental funds with specific destination could be important partner. In the Netherlands, different funds are managed by the government, counties, and municipalities (KplusV, 2014). After all, involvement of public organizations might be critical to reduce risks and create volumes, which is necessary to attract private capital.

Capital replenishment

The program's debt facility is used to offer financial products and invest in energy improvements. This creates cash flow generating assets in the form of loan, lease, or performance fees. In order to expand their activities, organizations need to replenish capital in order to invest in new financial products. When the warehouse model is applied, which means that the cash flows are not yet used as collateral for the issued bond, the cash flow generating assets can be used for this purpose. The most straightforward transaction type is a portfolio sale from the originator of the obligations to investors. This might be a single investor or a consortium of investors. The terms of the sale of the portfolio could have been pre-negotiated between the originator and the purchaser before the financial products are sold

to their customers, which allow the originator to account for any requirements in the contract specifications. A more advanced method to replenish capital is to access the capital on the secondary market through the issuance of debt instruments that are backed by the cash flow generating assets. In order to access institutional investors on the secondary market, who held $ 83 trillion in assets in OECD countries alone in 2012 (IEA, 2014b), investment products should have large volumes and manageable risks. Debt instruments can be structured as bonds or Asset-Backed Securities (ABSs). The issuance of such debt instruments is referred to as securitization. According to the NREL's report about the potential of securitization, approximately $ 1.34 billion of potentially securitizable solar assets were installed in 2012 alone (Lowder & Mendelsohn, 2013).

Securitization is considered a method with a high potential since it facilitates risk management in order to attract low cost capital. Securitization refers to "the process of transforming illiquid assets into standardized, tradable instruments" (Lowder & Mendelsohn, 2013). The aggregation of small assets creates investment products that meet the size and liquidity requirements of institutional investors (Campbell, Covitz, Nelson, & Pence, 2011; Schwarcz, 1994). The issuer pays an interest rate to the investor, which is typically determined by the rating of the security. Within securitization, covered bonds and asset-backed securities are distinguished. While both debt instruments are backed by cash flows generating assets, the difference concerns the legal ownership of the assets. In case of covered bonds, the issuer remains owner of the assets. The investor has recourse against the issuer, while the assets that are owned by the issuer function as collateral. In case of asset-backed securities, a special purpose vehicle (SPV) is created. The originator of the underlying obligations sells the assets to the SPV and is as 'servicer' responsible for the collection of payments from its customers (Schwarcz, 1994). The obligations can be removed from the balance sheet, allowing the originator to finance its business operations (Dionne & Harchaoui, 2008; Schwarcz, 1994). The issuer pools the assets together and issues the ABS to investors. The investors are usually institutional investors who manage large diversified portfolios (Campbell et al., 2011). Traditionally, contractual debts, such as home equity loans, auto loans, credit card debt obligations, and student loans are used as ABSs (Schwarcz, 1994). The securitization process is illustrated in *figure 6*.

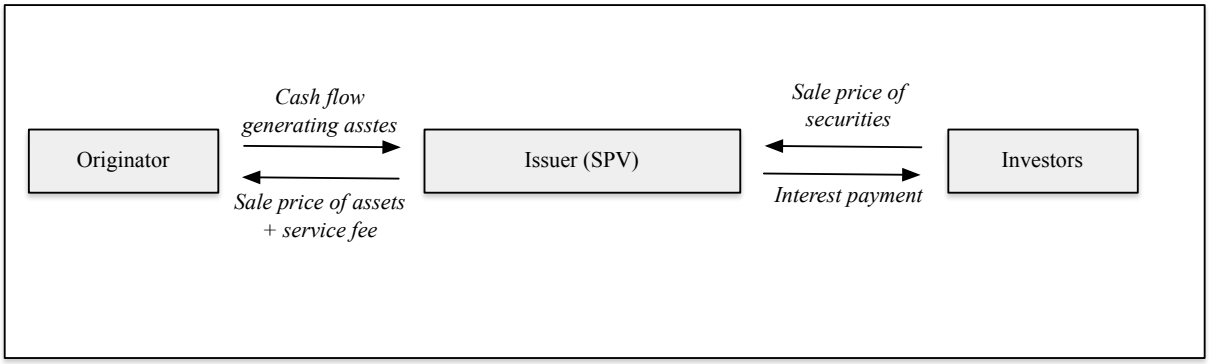

Figure 6: securitization

Some studies have focused on the securitization of green obligations, such as loan payments, lease arrangements, and PPAs (Alafita & Pearce, 2014; BNEF, 2014b; Ceres, 2014; S&P, 2012). According to S&P (2012), securitization could be valuable when future cash flows are monetized in order to provide upfront cash for investments in energy improvements. They expect lower costs of capital since "the creditworthiness of the transaction is dependent upon the collateral pool and not the credit quality of the issuer, which in most cases is the speculative-grade category". Currently, two working groups of the National Renewable

Energy Laboratory (NREL), namely the Banking on Solar and the Solar Access to Public Capital (SAPC) working group, are working together to study the potential of capital market investment in the solar sector via securitization (NREL, 2013, 2014). According to Mendelsohn and Feldman (2013), in their report on behalf of the NREL, the availability of public capital can lower the LCOE of wind and solar by 8% - 16%. NREL's SAPC working group mainly focuses on standardization and data collection (Lowder & Mendelsohn, 2013). First, standardizations of contracts and documents should simplify the pooling of assets, and due diligence and assessment of the securities by investors and rating agencies. Some progress has been realized by the standardization of residential PPA contracts by SAPC (Alafita & Pearce, 2014) and best practices regarding installation (SAPC, 2015a) and operation and maintenance (SAPC, 2015b).

In line with the most convenient rule in economics, concerning the function of risk and return, the cost of capital that is paid by the issuer is determined by the risk of the obligation. In case of securitization of cash flow generating assets, the most important metrics in risk assessment are the net loss rate, the Debt-Service Coverage Ratio (DSCR), and the Debt-Service Reserve Account (DSRA). Typically, historical data is used in order to assess the net loss rate, derived from the default rate subtracted with the recovery rate. However, while the data on solar covers only a limited period of approximately five years, contracts run for periods up to 20 years (S&P, 2012). Moreover, contract default might have specific causes in comparison to other asset classes, such as sale of home and technological development, which are not considered in conventional default rates (Alafita & Pearce, 2014). Therefore, extensive data collection is required (Alafita & Pearce, 2014; BNEF, 2014b; Ceres, 2014). Besides the net loss rate, the DSCR stresses the size of the cash flow that is available to meet interest and principal payments. This refers to the income that is generated by the SPV's assets, as opposed to its financial obligations. The DSRA is an additional security measures since it outlines the value of the reserve account as opposed to the SPV's obligations.

In case of securitization, the cost of capital is determined by the interest rates on the notes or obligations of the SPV and additional costs regarding the issuance. These costs include costs for rating agencies and credit enhancement. Credit enhancement includes measures that are applied by the issuer to reduce the risks for the note holder, aiming to minimize the interest rate. Thus, when the costs for credit enhancement increase, the interest rates on the notes typically decrease (Mendelsohn et al., 2015). The forms of credit enhancement that are covered in this study include overcollateralization and the development of reserve accounts. Overcollateralization, a commonly used form of credit enhancement, refers to a larger face value of the SPV than the obligations that are issued by the SPV (Schwarcz, 1994). In this way, principal and interest payments on the ABS can still be made in case of a high default rate. Overcollateralization results in a higher DSCR. Reserve accounts are developed to cover any unexpected shortfalls. Reserve accounts are typically developed for a specific purpose. Examples include interest reserve accounts and inverter replacement reserves, specifically designed for any costs related to a specific technological part of the solar system. The development of reserve account results in a positive DSRA. Besides these credit enhancement measures, issuers typically stress the measures they take to manage any credit risks, eventually lowering the default rate. These measures are related to specific contract management strategies.

2.6. Contextual environment

Since this research compares the Dutch and the American market, concerning the exiting value propositions, market players, and their ability to attract capital, the contextual

environment should be considered. The most important aspects in the contextual environment are the regulatory framework and the capital markets. The regulatory framework concerns both the regulation of the energy sector as a whole as well as stimulation of energy improvements. Regulations are an important determinant for the business models that are applied in the energy sector. Besides regulation of the energy sector, regulation of the financial markets, developed by the countries' Authority for the Financial Markets, also affects the value propositions. Specifically, regulations include license requirements that should be met by market players that offer financial products, which are studied in this research. Lastly, the shape of the financial markets affects the market player's their ability to attract capital.

Regulatory environment: the energy sector and stimulation of energy improvements
The most important difference between the Dutch and the American energy sector is the amount of deregulation. The traditional energy value chain consists of actors that execute activities regarding the extraction of fossil resources and the generation, transmission and distribution of energy. Since energy is an important factor in a country's economic development, authorities traditionally play a large role in the energy value chain. Typically, generation, transmission, and distribution in a certain region used to be executed by the same player, which was owned by local authorities. In the end of the 20th century, governments decided to deregulate the sector in order to stimulate competition and realize efficiency (Painuly, 2001; Vine, 2005). This resulted in complete deregulated of energy generation in both countries, opening the market for new entrants and more efficient technologies. For transmission and distribution activities however, organizational and maintenance activities should be performed by a single entity. Therefore, actors that are bounded by geographic restrictions and governmental regulations execute these activities. The most important difference between the Dutch and American market is the structure of the retail market. While the retail market is completely deregulated in the Netherlands, end-users are bound to one or a small number of retailers that are active in their geographical area in the U.S. (Kwant, 2003). Although regulations differ per state, in order to realize energy security, energy retail is in most states regulated and geographically determined in the U.S., resulting in regulated energy prices. In the Netherlands, companies are allowed to buy energy on the wholesale market or through PPAs with energy producers and sell this to the end-users. As a consequence, a large number of new energy retailers entered the market after deregulation, resulting in differentiation on price.

Another major difference between the U.S. and the Netherlands is the stimulation of reduction of energy use as well as the generation of renewable energy. While Dutch regulations traditionally focus on the reduction of energy use, the most important American regulations aim to stimulate investments in renewable energy generation (Boonekamp, 2007; Sherwood, 2007). In the Netherlands, the energy price is relatively high due to heavy taxes. This method is referred to as the internalization of external costs. Since energy generation is considered to have negative consequences that are not reflected in the price, the government charges a tax of more than 50% for every used unit of energy. The taxes should motivate the end-user to minimize energy use. An important policy that is implemented in both countries is net metering (Darghouth, Barbose, & Wiser, 2011). This policy allows distributed energy producers to offset generated electricity with electricity that is provided by the retailer. As a consequence, generated electricity does not have to be stored. Due to the high energy prices and net metering, energy generating as well as saving propositions are relatively cost competitive in the Netherlands. In contrast, energy in the American market is relatively inexpensive. The most important policy instrument for the residential sector that aims to stimulate the implementation of energy improvements is an investment incentive for solar

panels (Sherwood, 2007). This policy instrument is structured as a 30% tax credit that can be utilized as a tax return. Noteworthy, the emphasize on the stimulation of the residential solar market resulted in rapid development as opposed to other energy improvements, in particular efficiency improvements. Since the environmental benefits of the residential market for efficiency are considered larger than the residential solar market, critics argue that this focus has a negative effect on the energy transition as a whole (Allcott & Greenstone, 2012).

While the Dutch government charges no energy taxes on electricity that is produced by solar panels that are owned or leased by the customer, taxes are included when the organization that owns the solar panels charges the customer per produced unit of electricity. Therefore, value proposition that include PPAs between the end-user and third parties are not feasible in the Netherlands. Another effect of the different contextual environments in both countries is the governmental effort to lower the credit risk of obligations. While governmental involvement could be considered market distortion in a competitive market, the regulated retail market in the U.S. provides opportunities for semi-governmental organizations to design programs together with energy retailers. As a consequence, different utilities leverage public capital through OBR programs (ACEE, 2012; Guerster, 2012; Johnson, Willoughby, Shimoda, & Volker, 2011). While governmental organizations provide credit facilities, customers pay their obligations to the utility. Another concept that aims to reduce the credit risk is the Property Assessed Clean Energy (PACE) financing program (Ameli & Brandt, 2014; SEE-Action, 2015). In this case, the monthly obligation is repaid through the property tax bill, again reducing the credit risk. Another benefit of both programs is that the financing can be tied to the property, trough the energy meter or the property tax for OBR and PACE, respectively. Since this allows the transfer of debt across owners or tenants, it might be a solution for the split incentives problem.

Regulatory environment: customer credit

The Authority for the Financial Markets (Autoriteit Fiananciële Markten / AFM), which is comparable to the American Securities and Exchange Commission (SEC), is the financial service regulatory authority in the Netherlands. The AFM is an autonomous administrative authority. Among their most important aims is to promote the confidence in the financial markets, which is considered of great importance after the financial crisis that started in 2008. Together with 'De Nederlandse Bank' (DNB), they are responsible for the regulatory framework and the behavior of all actors that offer financial products, including savings, investments, loans, and insurances. The Financial Supervision Act (Wet op het fianceel toezicht / Wft) is a law that is implemented by the AFM and focuses on transparency of the financial products that are offered to the customers. This law provides guidelines regarding advertising, information provision, credit assessment, and contract terms that should be offered regarding the provision of consumer credit. One of the most influential changes in the guidelines is the requirement regarding professional competences, which are strengthened since 2014. According to this law reform, all employees with customer contact should have followed an intensive training and taken an exam in order to receive a certificate for their professional competences. Moreover, companies that execute advice or agency activities should have a license. In the U.S., as a result of the financial crisis, President Obama signed the Dodd-Frank Wall Street Reform and Consumer Protection Act in 2010. Although the law includes the Consumer Financial Protection Act, the degree of consumer protection is low compared to the Dutch law (Mak & Braspenning, 2012). This can be explained by the high public acceptance of consumer credit in the U.S., as opposed to the Netherlands. Nevertheless, the regulations did affect the market for energy improvements. Due to the extensive regulation, specifically in the Netherlands, the entry barriers for new credit

providers enlarged. As a consequence, although designed for energy improvements, debt products are mainly offered by financial intermediaries.

Capital markets: private equity, public capital and the secondary market

In the Netherlands, the relatively market for private equity is significantly smaller than in the U.S. In 2014, Dutch venture capital firms invested approximately € 169 million in 226 start-ups, with a total of € 3.1 billion of private equity in 386 Dutch companies (NVP, 2015). The energy and environment sector accounted with € 13 million and € 150 million for approximately 8% and 5% of the venture capital and private equity investments, respectively. In contrast with the Dutch market, PWC reported that America's cleantech sector alone attracted more than $ 2 billion in venture capital in 2014 (PWC, 2015). Noteworthy, the size of the Dutch market for investments in sustainable start-ups is less than 1% of the size of the American market. For both countries, there are a large number of public-private initiatives to stimulate start-ups. In the Netherlands, the Ministry of Economic Affairs executes the most important public programs. With the development of the innovation fund for small and medium enterprises (SMEs) (Innovatiefonds MKB+), the Ministry aims to stimulate investments in innovative companies. Their total fund concerns € 500 million, which will be distributed between 2012 and 2015. The fund includes two programs. While the Seed Capital program allows business incubators to double their investment in innovative and creative start-ups, the innovation credit program provide direct loans to finance a share of an innovative development project of SMEs. Other programs executed by the Ministry include guarantees for external loans. While the growth program guarantees 50% of the capital provided by either banks or private investors that is used for growth of the organization, the security program guarantees 50% of bank loans when companies cannot provide enough collateral to secure the loans (RVO, 2015).

Companies in both the U.S. as well as the Netherlands are exposed to tightened requirements of banks regarding debt provision. As a result, access to low-cost long-term debt is a critical success factor for companies that exploit energy improvements. In both countries, significant capital is available through green department of traditional banks as well as through commercial ethical banks, such as Triodos and ASN in the Netherlands and Sorebank and New Resource Bank in the U.S. However, these banks focus on a wide range of ethical issues and do not specifically target the market for energy improvements. The most important difference in both countries is the degree of collaboration between the public and private sector. While the development of green banks through public and private collaboration is common practice in the U.S., public-private partnerships are rare in the Netherlands (KplusV, 2014). Two of the most inspiring partnerships are the Green Banks of the states New York and Connecticut. While Connecticut stated an example by the development of the first green bank, New York established the largest banks so far. In 2014, Connecticut Green Bank used $ 74 million public capital, to attract $ 225 million in private capital, resulting in a total annual investment of $ 299 million. The New York Green Bank is leveraging private partnership with established financial entities, including Bank of America, Merrill Lynch, and Citi, aiming to create a public-private fund of $ 1 billion. In the Netherlands, most public capital that is available is structured in funds with a specific aim. According to KplusV (2014), currently 24 revolving funds are focusing on sustainability and energy. Most of the investments in these funds are derived from the sales of shares of the large energy utilities during the privatization of the energy sector.

Although the goals of stock investors, institutional investors, equity investors, and companies that invest in energy investments are equal in the U.S. and Europe, the structure of the markets and the debt instruments in rather different. Specifically, it should be noted that

the ABS is significantly larger in the U.S. According to the securitization data report Q4 2014 of the Association for Financial Markets in Europe (afme) (2015), ABS issuance in 2014 in Europe, the U.S. and Australia reached $ 288 billion, relative to $ 277 billion in 2013. The U.S. markets were responsible for 77% of the issuance, while Europe contributed 21% and Australia 1%. Standard & Poor (S&P) (2014) distinguish auto related, credit card, student loans, equipment lease and other ABS as the main categories ABS. Auto-related ABS constitutes with 44% a significant share of the overall ABS volume in the U.S. (afme, 2015; S&P, 2014b; Sifma, 2014). Regarding bonds that are backed by cash flow generating assets, revenue bonds and covered bonds might be distinguished, which are applied in the U.S. and Europe, respectively. In the U.S., revenue bonds are issued by public or quasi-public organizations and are recognized as low risk investments. Covered bonds in contrast, are only applied in the European market. The U.S. entered the market in 2006, but the economic crisis slowed the growth of the market. The size of the market outweighs the market for ABS. This can be explained by the larger number of asset categories that are used as collateral. To illustrate, while the market for American mortgage-based securities is not included in the ABS market, banks use mortgages as collateral for covered bonds.

2.7. Theoretical framework

This literature review results in a theoretical framework, which is presented in *figure 7*. In summary, the ability to attract capital depends on the choses strategy, which is derived from a combination of the variables that are discussed in this literature review. This includes the organization's business structure, concerning the exploited energy improvement, the value proposition, and the characteristics of the market player that executes the strategy. Besides, the environmental context and the applied strategy to access capital are relevant. Lastly, the measures and strategies regarding contract management and credit enhancement might affect the ability to attract capital.

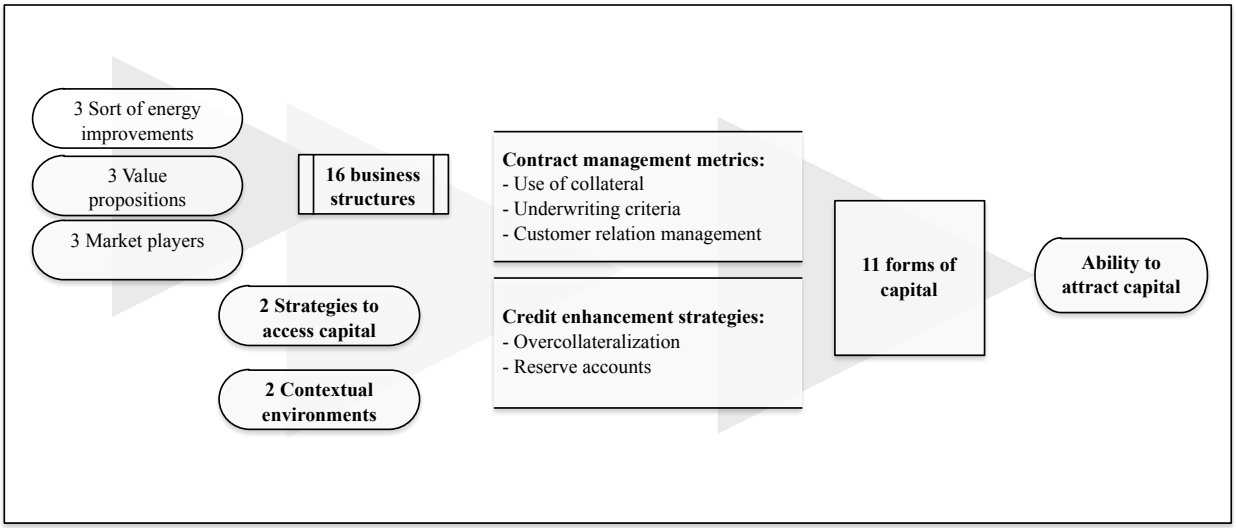

Figure 7: theoretical framework derived from the literature review.

3. Methodology

In this section, the research strategy, research design, and data are justified through an overarching explanation of the research methodology. Concerning the research strategy, this study adopts a qualitative approach. The research strategy is derived from the aim of this research, i.e. answering the main research question and the underlying objectives (Gill & Johnson, 2010). In this research, the ontological framework is identified as the dominant philosophical framework since it deals with questions regarding the construction of reality. This is relevant since this study concerns categorization of concepts and recognition of similarities and differences (Saunders, Lewis, & Thornhill, 2009; Yin, 2003). Next, the constructive perspective is appropriate since it considers the contextual environment and interpretation as important constructs in the process of meaning giving. After defining the research philosophy and the perspective, the research approach is considered. Since the aim of this research is to develop theory about the different strategies that could be deployed to access capital, an inductive approach, which facilitates theory building, is adopted (Gill & Johnson, 2010; Locke, Silverman, & Spirduso, 2004). Moreover, since it is important to understand the context in which the different strategies could be deployed, qualitative research is executed (Eisenhardt, 1989). Qualitative research enables more in depth understanding and interpretation of the contextual environment of the phenomena under investigation.

This research studies the strategies to access capital and the organizational structures, including the exploited energy improvements, the value proposition, and profile of the organization. In the literature review, this study distinguished three value propositions that eliminate the high upfront costs for customers. Moreover, the study found that the removability of the energy improvement is determinative for the value proposition that can be applied. In addition, three profiles of market players that could apply the value proposition are constructed. Besides the market players and the value propositions, the contextual environment could explain certain constructs. Given the objectives of this study, a multiple case study design is considered the most appropriate research design. A multiple case study allows studying of real-life situations, which are not perfectly conditioned (Yin, 2003). A case study is applicable when the boundaries between the phenomena and the environmental context are not directly visible, which is relevant for the cases that are studied that are embedded in their contextual environment. A multiple case study enables analysis of the differences and similarities within and between groups of cases. In this study, cases are grouped according to the applied value proposition. While differences within the same group of value propositions include the sort of energy improvement and the market player that applies the value proposition, the differences between value propositions can be explanative for the ability of organizations to access capital.

In paragraph 4.1, the U.S. market is studied. This includes a description of the market players, their strategy to create value for their customers, and their strategy to access capital. In order to provide a structured overview of the market, this study uses data from different sources, including media sources, public documents, and commercial documents. Public records are official organization documents that are constructed to provide information to shareholders or investors. Commercial documents include statements about the mission, vision, and goals of a organization, usually provide through their website in order to attract customers. This data allows for the identification of the value proposition on the one hand, and collection of facts about the financial strategy and performance on the other hand. Furthermore, in Paragraph 4.2 till 4.4, the Dutch market for each value proposition is covered. Per paragraph, this includes a description of the market players that apply the same value proposition and an in depth study of the selected cases. For this analysis, a combination

of documents and interviews is used. Interviews allow for analysis of the perceptions of the interviewee and the environmental context. Beyond facts, it allows the researcher to understand which considerations and arguments have resulted in the application of a certain strategy (Cassel & Symon, 2004). Noteworthy, specific information about strategies to replenish capital is derived from memorandums, which are provided to investors. This is relevant for large American cases, such as Renovate American and Solar City, as well as relatively small Dutch cases, such as Zelfstroom and 123Energie.

3.1. Case selection

The first step in data collection is the case selection. For this study, the selection of American and Dutch cases should be distinguished. For the American cases, an overview of organizations that exploit energy improvements and eliminate the high upfront costs for their customers was constructed through systematical electronic data search (Schafraad, Wester, & Scheepers, 2006). The aim was to find cases that represent the different business structures, including combinations of the sorts of energy improvements, the value propositions, and the market players that were presented in the literature review. First, the cases were grouped according to the energy improvement they exploit. It became clear that the majority of the organizations exploit generating measures in the form of solar panels. All the different propositions are applied to exploit solar. For all propositions the initiator of the proposition was selected as representative case. Specifically, while Solar City was the first organization that exploited solar through lease and performance-based arrangements, Sungage was the first organization that introduced the solar loan. In order to gain more in depth understanding in the market for energy improvements, the aim was to include cases that exploit other sorts of energy improvements as well. This includes the three most prominent program administrators that exploit home energy efficiency programs, Kilowatt, Renewable Funding, and Renovate America, who either utilize PACE programs or design their own loan programs. Besides, the largest OBR program, administrated by the Tennessee Valley Authority, is included in the research. Regarding, the exploitation of appliances, this study included the two largest providers of hire-purchase arrangements, which is considered a combination between loans and leases. *Table 6* provides insight in the studied American cases, considering possible business structures.

Energy generating measure	Value proposition	Market player	American cases
Energy generating measures	Loans (potentially secured)	Financial intermediaries	**Sungage**
		Utilities	**Tennessee Valley Authority**
	Leases	ESCOs	**Solar City**
		Utilities	
	Performance-based (potentially TPO)	ESCOs	**Solar City**
		Utilities	
Home efficiency improvements	Loans	Financial intermediaries	**Kilowatt, Renewable Funding, Renovate America**
		Utilities	**Tennessee Valley Authority**
	Performance-based	ESCOs	
		Utilities	
Efficient electrical appliances	Loans (potentially secured)	Financial intermediaries	**Rent-A-Center** **Aaron's**
		Utilities	
	Leases	ESCOs	**Rent-A-Center** **Aaron's**
		Utilities	
	Performance-based (potentially TPO)	ESCOs	
		Utilities	

Table 7: representative cases for the American market for energy improvements

Comparable to the American market, the number of players that are active on the Dutch market is limited. Therefore, this study is able to cover all cases that are recognized to eliminate the upfront costs of energy improvements for their customers. In line with the American case selection process, an overview of the market players was constructed through systematical electronic data search (Schafraad et al., 2006). However, this is complemented by interviews with stakeholders in the Dutch energy transition, including consulting companies, non-governmental organization (NGO), and market players in the financial sector. Interviews with representatives of the following companies are conducted: Turntoo and Platform31 (consulting); Urgenda (NGO); Rabobank and Triodos (financial sector). These interviews provide a structured overview of the market. *Table 7* provides insight in the studied Dutch cases, considering possible business structure. Noteworthy, the loans that are offered on the Dutch market can be used for generating as well as efficiency measures. In comparison to the American market, there are no utilities that offer loan arrangements and no market players that offer performance-based incentives for energy generating technologies. As described in the literature review, the PPA arrangement is not suitable for the Dutch market due to the energy taxes. Another difference is the application of the performance-based proposition for electrical appliances, which is not visible in the U.S. Bundles is considered one of the most innovative companies that is studied in this research.

Energy generating measure	Value proposition	Market player	American cases
Energy generating measures	Loans (potentially secured)	Financial intermediaries	**Greenloans** **Energiebespaarlening** **Duurzaamheidslening**
		Utilities	
	Leases	ESCOs	**Big Solar** **123Energie** **Solease**
		Utilities	**Zelfstroom**
	Performance-based (potentially TPO)	ESCOs	
		Utilities	
Home efficiency improvements	Loans	Financial intermediaries	**Greenloans** **Energiebespaarlening** **Duurzaamheidslening**
		Utilities	
	Performance-based	ESCOs	
		Utilities	
Efficient electrical appliances	Loans (potentially secured)	Financial intermediaries	
		Utilities	
	Leases	ESCOs	
		Utilities	
	Performance-based (potentially TPO)	ESCOs	**Bundles**
		Utilities	

Table 8: representative cases for the Dutch market for energy improvements

3.2. Data collection

This study uses documents to gain in depth understanding about the American cases and a combination of documents and semi-structured interviews to analyze the Dutch cases. Documents include announcements, public documents, and commercial statements. Announcements can be made public by different sources, including the organization under investigation and independent media. Besides organization's own publications, the following media were searched for publications about the cases under investigation: 'Green Tech Media', 'Greenbiz', and 'Clean Technica'. Public documents include information that is provided to shareholder or investors, such as memorandums, ratings of securities, and annual reports. Commercial statements include information that is provided to customers through websites and commercials. Besides data about the studied cases, more general information about the Dutch and American market is collected through market insight reports, road maps, and recommendations, which are constructed by different organizations. The same media that are searched for announcements, as well as 'Bloomberg New Energy Finance' and the 'Macarthur Foundation', are used for this purpose. A full list of the data sources per case or subject is attached in Appendix 1. It should be noted that the number of documents for the American cases is significantly larger than the number of document that provide information about the Dutch cases. Since documents are mainly used to gain insight in controllable facts about the studied cases, the replicability is considered high. The sources are well known media in the sector. When data would be collected through other sources, such as financial media or smaller media in the same sector, the data would be identical.

Beside documents, interviews with Dutch organizations were conducted since these are more approachable for interviews. All studied Dutch cases have been approached for an interview. While some representatives agreed on a personal meeting or phone conversation, others were not able to react within sufficient time. Besides interviews that aim to gain information about the studied cases, interviews with other stakeholders aim to gain more general information about the market for energy improvements and strategies to access capital. Appendix 2 includes a list of all organizations and people that are approached for this research. After all, for each case that is analyzed, one representative organization is interviewed, knowingly Greenloans, Big Solar, and Bundles for the value propositions loans, leases, and performance-based, respectively. According to Saunders et al. (2009), semi-structured interviews allow for interpretation and flexibility. In order to allow flexibility, the interview guides that were used during the interviews consist of a list of topics that should be covered in the interview, which were based on the information that was gathered during the research till the moment of the interview. The order of the topics is flexible even as the opportunity to ask additional questions in reaction on answers of the interviewee. Compared to data from documents, the replicability of data derived from interviews is relatively low since the influence of the interviewer and the interviewee is high. Specifically, the interpretation of the strategies that have been applied could differ among employees of the companies. To illustrate, the head of sales of Greenloans might have another interpretations of the organization' strategy that the organization's CEO. However, since the CEOs of Bundles and Big Solar are interviewed, the risk on interpretation biases is limited.

3.3. Validity

This section covers the validity of this research, including the justification of the data and variables that are used to explain a certain concept. In this way the relation between the conclusions and the objectives of the research is tested. Yin (2003) distinguishes between construct, internal, and external validity. Construct validity covers the construct that is assessed in the research (Yin, 1989, 2003). In this study, the strategies to attract capital are the construct under investigation. This strategy includes the business structure and the environmental context. The literature review found that these variables are an important part of the strategy to access capital. As explained in the literature review, there are 16 possible business structures, derived from a combination of the sort of energy improvements, the value proposition, and the market player. Moreover, two dominant strategies to access capital are recognized. This study shows how the business structure, environmental context, and strategy to access capital affect their contract management and credit enhancement strategies. Finally, the metrics of these strategies, including the use of collateral, underwriting criteria, customer relation management measures, and credit enhancement measures, form the constructed that is related to the ability to attract capital.

Internal validity concerns the causality of the conclusions (Yin, 2003), i.e. can an organization's ability to access capital be explained by the business structure, the environmental context, and the strategy that is deployed to access capital. It is difficult to measure why certain organizations were able to attract capital since this study does not have insight in the exact considerations of the investors concerning the specific investment decisions. However, representatives of the Rabobank and Triodos have been interviewed in order to provide insight in general investment decisions. Besides, the organizations that replenished capital provided insight in key metrics that are used by investors to decide whether to invest, including the use of collateral, underwriting criteria, customer relation management measures, and credit enhancement measures. Information is provided through

rating agencies or the organization's own investment memorandum. Besides, the environmental context is evaluated in the investor information as well. In order to maintain the internal validity, it is important to correct for the environmental context. Ideally, a metrics determine if an organization is able to attract capital, regardless the contextual environment. Therefore, it is important to analyze differences in environmental context to guarantee internal validity.

External validity covers the generalizability of the findings (Yin, 2003). Considering the limited number of cases that is studied it might be hard to prove external validity. The most appropriate way to improve the external validity is literal replication. This includes a large number of cases that show the same results. However, the number of cases that is studied is limited. This could be explained by the research design, a multiple case study, as well as the young market for energy improvement. Case study research includes in-depth analysis of the cases, which is an extensive process and limits the total number of cases that could be studied. Moreover, the number of organizations that exploit energy improvements is limited. In order to optimize the external validity, this study includes all organizations on the Dutch market. Besides, comparison with the American market improves the external validity. Moreover, theoretical replication is relevant when different cases show opposing results. This strategy could be effective to increase the external validity of this research.

3.4. Data analysis

The literature review provides a theoretical framework to answer the four sub questions and eventually the main question. This includes an overview of households' considerations regarding investments in energy improvements, an overview of the possible business structures, an explanation of the two strategies to access capital, and an explanation of the differences and similarities between relevant aspects of the contextual environment in the U.S. and the Netherlands. The literature review is used for the construction of concepts and their causal relation with the attraction of capital. The collected data should provide insight in the relevance and practical implication of these theoretical concepts. For each concept, the relevance is assessed separately. In general, the existence of a certain concept is proven when the data that is collected outlines the relevance of that concept, i.e. one of the sources specifically mentions the relevance. However, when the relevance of a certain concept is proven, it is not directly proven that concept or variable is determinative for the organizations ability to attract capital. The causal relation can be 'proven' in two ways. Either an investment assessment valuates an expected causal relation or the organization mentions the causal relation explicitly in the investment information they provide and the organization succeeds in the attraction of capital for the same investment round. *Table 7* provides insight in the concepts and causal relations that are expected on the basis of the literature review.

Topic	Concepts	Causal relation
Value proposition	Performance-based incentive limits predictability cash-flow	Limits access
Value proposition	Use of collateral creates leverage	Create access
Market player	Financial intermediary could leverage expertise	Create access
Market player	Utility could leverage customer relations (OBR)	Create access
Strategy to access capital	Warehouse models uses cash flows to replenish capital	Create access
Environmental context	PACE programs leverage property tax bill	Create access

Table 9: concepts and potential effect on the access to capital derived from the literature review

3.5. Limitations

The amount of data about the propositions that eliminate the upfront costs for energy improvements is relatively limited. Therefore, the internal and external validity of the findings is limited. Specifically, the literal replication of the findings will be limited since the number of cases that either apply the warehouse or the upfront model will be limited. Moreover, the theoretical replication is questionable since 123Energie and Bundles applied the up-front model successful in their first rounds, but Zelfstroom, 123Energie, and Bundles also failed to raise capital through the up-front model. Nevertheless, the construct validity is considered high since the metrics that represent the construct, which are identified in the literature review, are explicitly mentioned in the collected data. Besides, the replicability of the research is high since the sources that are used are mostly official documents that include information that is used for decision-making by investors, which could be accessed by researchers. In addition, due to the limited size of the market, comparable research would include the same cases since the number of cases is relatively limited.

4. Results and discussion

This section presents the actual results of the study. First, for each of the cash-flow generating value propositions, the relevant companies that apply the value proposition in the Dutch market are considered. All propositions create accessibility to energy improvements through the elimination of the most important barrier, the high initial costs. The propositions are assessed on the degree to which they create additional value for the customers. Value creation is considered a combination of the reduction of transaction cost and associated risks on the one side and the creation of a financial incentive on the other side. Companies generally charge their customers a fee for the reduction of transaction costs and for the internalization of risks. Therefore, the trade-off between the minimization of the negative aspects, transaction costs and risk, and the maximization of the positive aspects, financial incentives is considered in the definition and assessment of the value proposition. Beside the assessment of the proposition's customer value, the capability of the companies to develop and refinance funds is assessed. In this assessment, the organization's value proposition as well as the nature of the organization is considered. Lastly, in the cross-case analysis, the different companies and their value propositions are compared.

4.1. The American market: the cases

American companies that apply value propositions regarding residential energy improvements can be categorized according to the energy improvements they exploit. Founded in 2006, Solar City was one of the first companies that developed a successful proposition in the American residential solar market. With almost 220,000 customers and over 6,000 employees they are currently the largest player in this market (SolarCity, 2015b). While they started with TPO propositions, including lease arrangements and PPAs, they currently also provide purchase and loan options in which the customer becomes legal owner of the solar system. After the success of Solar City, a number of other players who offer a combination of lease, PPA, loan, and purchase options have entered the market. Besides the different contract forms that are offered by the companies in the market, they differ in the amount of vertical integration. Solar City is to a large extent vertically integrated, which means that they execute technical activities, such as project development, system design, installation and construction, and maintenance (GTM-Research, 2015a). Their strategy even includes up scaling of their manufacturing activities (SolarCity, 2014). This strategy allows them to secure enough supply to meet demand, minimize costs through economies of scale and scope, and secure the quality of their services. Other players, such as Clean Power Finance, Kilowatt Financial, Sungage, Mosaic, and Renewable Funding solely focus on the financing of the solar systems. They partner with installation companies and other parties in order to provide technical services. Their strategy aims to minimize costs trough specialization.

While the American solar market is relatively organized with different value propositions but high comparability between companies that apply the same proposition, the market for efficiency improvements is somewhat blurrier. Due to the investment incentives for solar panels, a large number of companies developed business models around the financing of solar panels. As a consequence, the residential solar market is more developed than the efficiency market, while the last is potentially significantly larger (Allcott & Greenstone, 2012; IEA, 2007). While the loan market for efficiency improvement in the residential sector increases steadily, performance-based value proposition focus mainly on the commercial building stock since larger savings can be achieved in this sector due to higher usage levels. Therefore, it is easier to recover high costs related to the monitoring of the performance of

the efficiency improvements, including the establishment of a baseline and normalization for changes in energy consumption. However, in the U.S., the number of companies that apply performance-based propositions in the residential sector is increasing. Concerning efficiency improvements that are marketed through loans, programs that are designed with public involvement, such as OBR and PACE programs have an important role. While OBR programs are launched by utilities, different 'program administrators' design specific loan programs to utilize PACE opportunities. Companies such as Renewable Funding and Renovate America developed specific PACE programs through collaborations with financial partners. They execute activities, such as lead generation, sales, and replenishment of capital on the secondary market.

Since consumer credit is relatively normal and accepted in the U.S., electrical appliances are often bought under installment credit terms. However, it should be noted that most companies that eliminate the high upfront investments do not consider the environmental benefits that can be achieved. When companies do neither focus on energy efficient electrical appliances nor stimulate the reuse of materials at the end of the appliance's lifetime, this is not considered as a sustainable proposition in this research. Besides installment credit, consumers can access specific loans through PACE and OBR programs, which often include energy generating technologies and energy efficient electrical appliances as well. Concerning the leasing proposition, leasing of furniture, consumer appliances, and electronics is widely adopted in the American market. With a revenue of both $ 2.7 billion, Rent-A-Center and Aaron's are the dominant players in the market. However, these companies do not consider the environmental potential of their TPO models, such as the recollection after the appliance's lifetime. Noteworthy, most propositions include hire purchases, in which the environmental benefits of lifetime optimization and reuse of materials is not accounted for. Lastly, the performance-based proposition, structured as the pay-per-use incentives, is not applied in the residential sector.

4.1.1. American value propositions

This research compares the application of value proposition in the U.S. and the Netherlands and covers loans, leases, and performance-based incentives. In the U.S., a substantial number of companies is active in the residential solar sector and applies one or a combination of these value propositions. Herein, lease and performance-based propositions, which are facilitated by the TPO-model, are the most applied solutions so far. Currently, TPO arrangements account for approximately 70% of the residential solar market in the U.S. However, the popularity of loans is increasing and is expected to gain a 40% market share in 2015 (GTM-Research, 2014). Sungage was among the first companies that developed a specific solar loan. This loan is innovative in two ways. First, it includes two complements, one short-term loan, which is repaid through the tax incentive, and a loan with a longer maturity that is repaid through the savings on the energy bill. Sungage minimizes the risk of the short-term loan since they help their customers with their tax incentive application, which allows them to offer a loan with a low interest rate. Secondly, they were the first to develop a loan in which the solar system functions as collateral. Again, this minimizes the credit risks and enables Sungage to lower interest rates (GTM-Research, 2014; Sungage-Financial, 2015).

While TPO-models are prominent in the solar sector, the American efficiency sector is dominated by loan proposition. Although the size of these activities represents only a small share of their total business, since 2010 Solar City offers financial products for efficiency retrofits to residential customer as well. The required knowledge was accessed through the acquisition of a firm that developed software for energy audits. SolarCity claimed to posses a tool that largely simplified the purchase decision for customers through the delivery of a one-

stop-shop experience. However, it turned out that the vertical integration strategy that is executed in the solar market was hard to implement due to the large range of efficiency measures and the low degree of standardization. Therefore, the installation of the efficiency improvements is outsourced to local contractors. Thus, comparable to the value proposition of Sungage in the solar market, SolarCity currently only provide financial services in the efficiency market. Since the audit software cannot exactly monitor the performance of the measures, a performance-based incentive structure could not be applied. In contrast to Sungage's solar loan, the loans are unsecured because most of the efficiency measures cannot be removed. Moreover, relative to the loans that are offered through PACE or OBR programs, the credit risk of these loans are relatively high since no additional leverage is realized through repayment of the loans through the property tax or the energy bill, respectively. Moreover, all contracts include personal obligation that cannot be attached to the homes.

Next to SolarCity, different program administrators successfully offer loans to American customers. Program administrators are specialized in the design and structuring of energy improvement programs, which enable leverage of public-private partnerships. Kilowatt Financial and Renewable Funding are two of the largest providers of unsecured loans for home efficiency improvements. Renewable Funding offers unsecured financing for home efficiency improvements in the states Pennsylvania, Kentucky, and New York. Their loan program is referred to as the ReHome Loan Program (Renewable-Funding, 2015). Comparably, Kilowatt provides unsecured Energy-Efficiency Installment Sale Contracts throughout the U.S., which includes loans for efficiency retrofits that are purchased from one of their approved contractors (Kilowatt-Financial, 2015). Besides the personal loans offered in the ReHome program, Renewable Funding administrates the CaliforniaFIRST program, one of California's largest PACE programs. The program raised $ 300 million to support retrofits. The largest PACE program is initiated by Renovate America. Their HERO program financed over $ 600 million in home efficiency improvements in California. The last category of loans that is discussed in this research concerns loans that are repaid through the energy bill, referred to as OBR. In 2014, over 20 programs in the residential sector represented more than $ 1 billion in outstanding loans (SEE-Action, 2014b). The largest loan portfolio is administrated by the Tennessee Valley Authority, which provides electricity in seven states in the U.S. An overview of the different loans that are used to exploit home efficiency improvements in the U.S. is provided in *table 10*.

	Loan programs		
	Unsecured loans	**PACE**	**On-bill repayment**
Renewable Funding	ReHome	CaliforniaFIRST	
Kilowatt	Energy-Efficiency Installment Sale Contracts		
Renovate America		HERO	
Tennessee Valley Authority			OBR program Tennessee

Table 10: loan programs that deploy home efficiency improvements

The tasks of program administrators are twofold, namely the design of an attractive program with a high service level in order to increase customer demand and the development of a solid program structure that enable replenishment of the credit facility. This includes the standardization of contract terms and the monitoring of pool performance, which allow the aggregation of loans and the rating of bonds, respectively (Michael Mendelsohn et al., 2015; SEE-Action, 2014a, 2015). While their internal resources are related to credit expertise and

software systems in order to increase efficiency, program administrators typically collaborate with a large network of partners to offer a valuable value proposition. In order to protect the customers, programs that offer unsecured loans, such as the ReHome program and the Energy-Efficiency Installment Sale Contracts, typically include close collaboration with contractors and installation companies. Renewable Funding focuses on certification of the contractors in their partner network. Moreover, they developed a dispute resolution service in order to solve potential conflicts between homeowners and contractors. Comparable to Sungage, the program's technical partners offer the financial product to their customer as a complementary product. The PACE programs generally concern a larger degree of vertical integration. In California, customers can utilize the program for investments in both energy improvements as well as measures that reduce water consumption. Therefore, a great number of measures meet the specific requirements. As a result, the program administrator offers the measures through collaboration with a wide range of manufacturers, installers and contractors.

SolarCity is the largest market player that applies TPO-model based value propositions. Due to their vertical integration strategy, they are able to minimize costs, resulting in the lowest costs per installed watt in the industry. In 2014, they had a 34% market share in the residential solar sector (GTM-Research, 2015b). The residential and commercial solar sectors are expected to grow 46% in 2015, which might result in significant changes in the distribution of market share between SolarCity and its competitors (Cleantechnica, 2015; GTM-Research, 2014). Compared to loans, lease arrangements reduce the transaction costs for the customer due to additional technical services, such as maintenance. In addition, SolarCity provides a guarantee for the performance of the solar panel, including compensation in case of lower performance. This guarantee covers both the technical performance of the panel as well as external influences, such as weather condition. Besides the lease fees, American lease companies receives a 30% tax incentive due to the policy stimulation for residential solar in the U.S. since they remain owner of the solar system (Lowder & Mendelsohn, 2013). One of the most used objections from customers to the TPO-model arrangements is the low transparency of the cost structure and the high profit of the companies. This resulted in the development of new value propositions, such as the solar loan of Sungage.

Similar to lease arrangements, performance-based propositions are particularly applied for solar panels in the U.S., which are structured as PPAs. In this contract form, the organization remains owner of the solar panels that are installed on the roof of the customer. The customer agrees to purchase the electricity that is generated by the solar panel for a fixed price per unit, typically with a small discount as opposed to the electricity price that is offered by competing retailers (SolarCity, 2015a). The same companies that apply the lease and the loan proposition apply this model. For other energy improvements, monitoring is known as the main hurdle. As discussed, software that can monitor the performance of home efficiency improvements is lacking. Therefore, the performance-based value proposition is not yet suitable for home efficiency improvements. As for efficiency improvements, monitoring might be a problem for energy generating technologies as well. To illustrate, geothermal heat pumps would fit for a performance-based model comparable to the solar PPAs if monitoring solutions would be widely available. Since monitoring is not included in the standard product, such value propositions are rare. However, in 2014, Orca Energy applied a value proposition in which its customers are charged for the heat produced by a geothermal heat pump. For this model, they collaborate with Bosch Thermotechnology, who manufactures, installs, and maintains the equipment (Supplyht, 2014).

4.1.2. Development of credit facility

Besides the development of a valuable customer proposition to increase customer demand, access to a credit facility is required in order to meet demand. In order to attract capital, program administrators should convince investors that the investment risk is minimized and the effectiveness of the investment is optimized. In order to reduce the investment risk, program administrators aim to minimize credit risk. The optimization of the effectiveness of the program includes the minimization of overhead costs through automating and simplifying of the execution of the programs. This requires the development of financial software. Venture capitalists in the U.S. value the potential of such developments. To illustrate, in order to expend their activities, Renewable Funding received 32.2 million in private equity from different venture capital firms (Crunchbase, 2014). Most often, program administrators leverage public-private partnerships. This concerns public capital investments, which are supplemented by private capital. Through this method, public entities can increase the effectiveness of their investments. While they benefit from the expertise of an experienced program administrator on the one hand, they increase the scale through the leverage of private capital that is invested through the program on the other hand.

ReHome's first program in Pennsylvania, the Keystone HELP program, financed over $ 100 million of loans. Their credit facility was created by a mix of public and private money, including public entities such as the Pennsylvania Treasury and Pennsylvania Department of Environmental Protection. Comparably, ReHome's Kentucky Home Performance program allows the public entities that are involved in the program, such as the Kentucky Housing Corporation, to finance five times as many homeowners as it would without the private support. The new fund in New York of $ 100 million is funded by the semi-public Green Bank New York and the commercial bank Citi (NY-Green-Bank, 2015). Comparably, Sungage received a $ 100 million credit facility by Connecticut's green bank (Connecticut-Green-Bank, 2015). Kilowatt announced in June 2015 that Citi expands the $ 100 million debt facility that they closed in the beginning of 2014 for their nationwide loan program to a total of $ 225 million. Noteworthy, as the track record of unsecured loans grows, up-front investments from established financial partners, such as Citi, increase. For PACE program, the initial debt facility is typically created through a variety of sources organized by participating municipalities, counties, states, or other public entities. Funds might be attracted through different instruments, including the issuance of bonds, debt from banks, and public capital. Comparable to municipalities, the risk association for utilities is typically low, which allows them to attract finance up-front through loans or the issuance of bonds. The $ 500 million OBR fund that is administrated by the Tennessee Valley Authority concerns loans from regional banks. Since the utility provides a full guarantee against losses to the bank, they can provide low-cost capital at interest rate, which is two percent above the U.S. treasury rate (SEE-Action, 2014b).

SolarCity is known for its innovative financing solutions for the development of financial facilities as well as for the replenishment of capital. In 2011, the organization received a large investment of $ 280 million from Google. Furthermore, in order to access project finance, SolarCity partnered with established players, including Bank of America, Merrill Lunch, Morgan Stanley, U.S. Bankcorp, and Citi. Recently they developed a new financial instrument to access financial facilities, knowing solar bonds. These bonds provide individual investors the opportunity to invest amounts as low as $ 1 thousand, resulting in an aggregated pool of capital of more than $ 100 million already. Other companies in the residential solar sector that apply innovative financing methods include Clean Power Finance and Mosaic Finance. Clean Power Finance has built an online business-to-business marketplace where they connect capital providers with solar marketers and installers. Since their founding in

2006, they raised over $ 1 billion in financing from fortune 500 corporations, electric power companies, and established financial entities. Mosaic developed a comparable platform, only they target individual investors who could invest as less as $ 25 in different solar projects. Their innovative approach has received significant media attention. They funded approximately $ 10 million in solar projects.

4.1.3. Capital replenishment

Noteworthy, all American cases that are studied in this research do apply the warehouse method. Therefore, they are able to apply innovative methods in order to replenish capital. Specifically, SolarCity, Renovate America, and Renewable Funding are frontrunners in the field. They have been the first program administrators that issued ABSs that are backed by solar obligations, PACE loans, and unsecured consumer loans for efficiency improvements, respectively.

SolarCity was the first provider of financial products for investments in residential energy improvements that developed a product for the secondary market. In 2013, SolarCity initiated their first solar backed security of $ 54 million, followed by a second and third in 2014 of $ 70 and $ 201.5 million, respectively (Alafita & Pearce, 2014). While Credit Suisse Securities structured all issuances, S&P Rating services was responsible for the rating of the securities. The costs of securitization for green obligations are high compared to traditional ABS due to the costs for credit enhancement. While the over-collateralization of Solar City's first issuance was 61%, an over-collateralization of maximum 10% is more typical (Michael Mendelsohn et al., 2015; S&P, 2014a). The second issuances included an over-collateralization of 51%, while the credit enhancement for the third issuance was 37% for the class B notes and 73% for the class A notes. Besides over-collateralization, all securitizations included an interest reserve account, with the size of 6 months for the first and second issuance and 13 months for the third issuance. Additionally, subordination was applied as the most important credit enhancement method for the third issuance. With a BB rating for the class A notes of the third issuance as an exception, all issuances receive a BBB+ rating from S&P's Rating Agency. The yield of the notes was 4.8%, 4.59%, 4.03%, and 5.45% for the first, second, third class A, and third class B notes, respectively. *Table 11* provides insight in the credit enhancement strategy for all issuances of Solar City, the corresponding rating provided by S&P, and the yield of the notes.

Credit enhancement	SolarCity 2013-1	SolarCity 2014-1	SolarCity 2014-2
Overcollateralization	61%	51%	37% (class B) 73% (class A)
Interest reserve amount	6 months	6 months	13 months
Subordination	No	No	Yes
Preliminary rating	BBB+	BBB+	BB (class A) BBB+ (class B)
Interest rate (yield) (%)	4.8	4.59	4.03 (class A) 5.45 (class B); 4.3 (weighted average)

Table 11: credit enhancement green securitizations

S&P Rating Services assesses the stability of the future cash flows, including predictions regarding the default rate and recovery rate. They based their analysis on Solar City's track record, which is limited, and additional measures regarding contract management. Weaknesses include limited customer performance history, the direct effect of the renegotiation of customer agreements on the cash flow, a highly competitive industry with

traditional utilities as well as other solar developers, and competiveness of alternative sources. In order to overcome weaknesses regarding reassignment, Solar City evaluates the potential customer's credit quality to determine whether to enter into a PPA or lease agreement. Restrictions regarding the credit quality of the borrower are considered among the most important contract management measures that aim to reduce the exposure to credit risk for Solar City. The credit score, FICO, which is applied by Solar City, is an excepted credit underwriting criteria in the U.S. This measure could be extended with other borrower information, such as income, employment history, and housing profile. Solar City's credit underwriting policy requires a FICO score of at least 680. Their underwriting requirements resulted in a minimal average FICO score of 762, which is better than two-third of the U.S. citizens (S&P Rating Services, 2013, 2014a, 2014b). In *table X,* the average FICO score and corresponding cash flow assumptions are presented per issuance.

Cash flow assumptions	SolarCity 2013-1	SolarCity 2014-1	SolarCity 2014-2
Weighted avg. FICO score (residential customers)	762	767	763
Contract reassignment (%) (default rate)	2.4	2.07	2.2
Full recovery (%)	91	92	92
Less than full recovery (%)	9	8	8
Total Recovery (%)	97	98	98
Net loss rate (%)	2.33	2.03	2.16

Table 12: Cash flow assumptions green securitizations

After SolarCity, Renovate America was the first program administrator that aggregated and securitized PACE loans, concerning the loans from the HERO program. While Renovate America was responsible for the structuring of the loan, Western Riverside Council of Governments (WRCOG) issued the ABS (KBRA, 2014a). After their first issuance of $ 104 million in 2014, they issued ABSs of $ 129 million, $ 240 million, and $ 160 million later in 2014 and in 2015, respectively (KBRA, 2014a, 2014b, 2015a, 2015b). The Deutche Bank Securities functioned as structuring agent. Kroll Bond Rating Agency (KBRA) rated all ABSs AA. An important difference with the issuances of ABS by SolarCity is the creditworthiness of the issuer. While the track record of SolarCity is limited, WRCOG's financial standing does not act as a constraint on the rating of the notes. The yields of the bonds were all below 5%, while overcollateralization was only 3% of the aggregate PACE Bond principal amount. Comparable to the solar assets, the PACE bonds are a new asset class with minimal assessment default or foreclosure experience available. However, KBRA used historical residential real estate tax default data for the County and surrounding counties since the loan payments are paid through the property tax bill. Due to this method, any constraints due to the lack of historical data are prevented.

In June 2015, Citi and Renewable Funding structured the first ABS of personal unsecured home efficiency loans. This concerned a $ 12.58 million issue, called RF 2015-1A, which was entirely purchased by Calvert Investment Management. Since the obligations were sold to a single investor, the transaction is comparable to a portfolio sale. However, the financial instrument is referred to as an ABS since all obligations are transferred to a SPV. According to Renewable Funding, this issuance should function as an example for the refinancing of the remaining loans that are organized in the WHEEL program (Renewable-Funding, 2015). Similarly, Kilowatt and Citi are planning to securitize the first batch of consumer loans in 2015. The most important goal of the program that is administrated by Renewable Funding is to create a marketplace for securitization of loans for home efficiency improvements in order to open the market to large institutional investors. Since the programs are structured to

provide standardized loans, Renewable Funding is able to aggregate the loans in large pools. Such a pool is referred to as a Warehouse for Energy Efficiency Loans (WHEEL).

4.2. Value proposition 1: Loans

In the Netherlands, three organizations offer loan products that are specifically designed for investments in energy improvements. Two of these loan products, the 'Duurzaamheidslening' and 'Energiebespaarlening', are financed by semi-governmental funds, which are managed by the 'Stimuleringsfonds Volkshuisvesting' (SVn) (*see box 1 for a description of the SVn and their loan products)*. The third market player is a commercial organization named 'Greenloans', which is a direct subsidiary of the ABN AMRO Bank. The loan requirements and conditions differ among the different loan products. The conditions include the loan amount, the interest rate and the maturity of the investment. Theoretically, loans are suitable for all investments, regardless the sort of energy improvement. However, the requirements of the loan products include guidelines regarding the specifications of the energy improvements. To illustrate, while only a limited share of the Energiebespaarlening can be invested in RETs, the Duurzaamheidslening can only be invested in a specific selection of energy improvements. Greenloans offers two different loan products, which are individually designed for either energy generation or energy efficiency measures. The characteristics of the different loan products are described in *table 13*. Besides the conditions and requirements, this table outlines the investors who are responsible for the development of the credit facility. Currently, Greenloans is the only organization that is independent from governmental involvement.

Loan product	Investors	Energy improvement measures	Secured/ Unsecured	Maturity (years)	Loan amount (€)	Size (€ million)
Duurzaam-heidslening	Municipalities	Depends on municipality	Unsecured	5, 10, or 15		38.6
Energiebes-paarlening	Government, Rabobank and ASN Bank	Specific selection	Unsecured	7, 10, or 15	2,500 – 25,000	5.5
Greenloan's loan	ABN AMRO	Energy efficiency	Unsecured	5 – 10	2,500 – 50,000	?
Greenloan's ecoloan	ABN AMRO	Energy generation	Unsecured	5 – 15	5,000 – 50,000	?

Table 13: specific loan products for investments in energy improvements offered on the Dutch market

Besides these organizations, customers have a wide range of options regarding traditional loan providers, ranging from second mortgages with a relatively low interest rate to unsecured consumer credit with high interest rates. According to the head of sales of Greenloans, a significant share of the investments in energy improvements is financed through traditional consumer loans, such as the financial products of DEFAM, a fund that is also managed by ALFAM. This is due to the brokers that function as private advisor for a great number of Dutch households. They receive a commission when they sell a financial product from DEFAM consumer loans. Greenloans in contrast, does not include a broker fee and can be accessed by the customers themselves. Furthermore, numerous mortgage providers allow a higher loan to value ratio when the additional loan amount is used for energy improvements, referred to as extended mortgages. Specifically, the mortgage may cover an amount equal to 106% of the value of the house, instead of the 103% that is usually allowed. While the maximum amount is € 9 thousand in case of a regular energy improvement, € 25 thousand is allowed when the energy improvements realize an energy

neutral building. Another initiative, the 'green mortgage', not only allows borrowers to extend their mortgage, but also offers a discount on the interest rate. The amount that can be borrowed depends on the improvement, quantified by the energy label. The interest discount is approximately 1%. Different financial entities, such as the Triodos Bank, which is considered an 'ethical' bank, offer interest discount when the borrower improves the energy label of the building. However, this research focuses on the loans that are specifically designed for investments in energy improvements.

Although solar panels could function as collateral, which is the case for Sungage's specifically designed solar loans, no secured loans are offered in the Netherlands. Most likely, the market players that offer the loan products are the most important reason for the unsecured structure of the loans. Since the Dutch regulatory framework requires a wft license for organizations that provide consumer credit, financial intermediaries are the only actors that are active in the loan market. Since financial intermediaries' core competence is related to the management of financial assets, they aim to avoid involvement in activities related to the exploitation of energy improvements. When RETs would be used as collateral, they would have to take the sources in custody in case of default. Besides, Greenloans argues that the only reason to include collateral would be to reduce default rate and interest rate. However, since they benefit from an extraordinary low default rate of 0.01%, only a limited reduction of the net loss rate is expected. Besides, a low interest rate would reduce the profitability of the organization. According to Greenloans, license application is an intensive and bureaucratic process. ALFAM Consumer Credit, a subsidiary of the ABN AMRO Bank who also manages mortgage, car loans and consumer credits, manages Greenloans' credit facility. They are specialized in consumer credit provision and meet the license requirements. However, Greenloans' business activities are affected by the new regulation since their partnership with Essent, a Dutch energy retailer who used to be a reseller of Greenloans' loan products, is considered illegitimate because Essent does not meet the license requirements. In the U.S. in contrast, utilities as well as ESCOs offer different loan products. This might result in a more valuable value proposition as opposed to standard loans offered by financial intermediaries.

Box 1: SVn and loan products

Stimuleringsfonds Volkshuisvesting (SVn)

SVn is an independent financial institution that cooperates and partners with municipalities, counties, and housing cooperatives. In 1996, 120 municipalities who were active in projects regarding urban development initiated the non-profit organization (SVn, 2015). SVn introduced the revolving fund in which repayment and interest flows back in the fund and can be used for new loans. SVn stimulates private investments in societal issues, which are usually less attractive for profit driven companies. One of their largest successes was the 'starters loan', which fills the gap between a mortgage that is available for starters on the labor market and the actual real estate prices. Currently, the SVn is responsible for the 'Duurzaamheidslening', which they initiated in 2009, and the management of the 'National Energiebespaarfonds' in which the Rabobank, ASN Bank, and the government participates.

Duurzaamheidslening

Since 2009 the SVn offers the Duurzaamheidslening or 'sustainable loan'. This loan facilitates investment in home improvements against favorable conditions. The loan amount concerns a minimum of € 2.5 thousand and a maximum of € 25 thousand. The duration is 10 or 15 years, depending on the loan amount; under or above € 7.5 thousand respectively. The SVn always provides an interest discount of 3% as opposed to their standard interest. The municipalities provide the fund that is available for consumers in their region and set boundary conditions for consumer selection. Boundary conditions might include the building segment, the maximum loan amount, or the sustainable measures that can be selected. In 2014, 2.4 thousand loans have been completed, resulting in a total fund amount of € 38.6 million by the end of the year.

National Energiebespaarfonds / Energiebespaarlening

The Energiebespaarlening or 'energy savings loan' is financed from a revolving fund of € 300 million, initiated after the 'Woonakkoord' deal in 2013. The government contributes for € 75 million, which is completed by the co-financers Rabobank and ASN bank. Unlike the sustainable loan, the energy savings loan is available in the whole country and does not rely on participation of municipalities or counties. The minimum and maximum loan amount correspond to the sustainable loan. The duration is 7 or 10 years, depending on the loan amount; under or above €5 thousand respectively. The applied measures should fit specific measures in order to qualify for the loan program. To illustrate, not more than 75% of the total loan amount can be used for an investment in Solar PV.

Green loans

Greenloans is a subsidiary of ABN AMRO. They offer two products, Greenloans' Loan and Greenloans' Ecoloan. While the Ecoloan is meant for investments in energy efficiency improvements, the regular loan targets households who invest in distributed energy generation. The Greenloans Ecoloan has a duration of 5 to 10 years and consists of € 2.5 thousand minimum and € 50 thousand maximum. The investment should concern energy efficient measures, such as insulation or a high efficiency boiler. The interest rate for an Ecoloan is currently 6.2%. The regular loan has a maximum duration of 15 years. The minimum loan amount is €5 thousand while the maximum is in line with the Ecoloan. The interest rate is with 5.5%, which is lower than the Ecoloan.

4.2.1. Value creation

Compared to the other value propositions, lease arrangements and performance-based incentives, loan products typically result in the highest financial incentives for the customer. However, reduction of transaction costs as well as risk reduction is limited in comparison to other propositions. Thus, loan providers do not create value through the reduction of transaction costs or performance risks. Since the loan providers fully specialize in the financial part of the agreement, they are able to minimize costs. Largely simplified, the gross profit of the companies that offer loan products is determined by the interest rate received from the customers subtracted with the costs of capital that is paid to their investors (see *figure 2*). This should be corrected for additional costs related to business activities, such as the net loss rate, the credit check that is conducted after a loan application, the administration of the loan and the loan payments, and additional customer specific services during the maturity of the loan. According to Greenloans, the initial costs related to the credit check together with the loan administration are the most important cost component. To illustrate, small loans that are solely used for solar panels, typically under the € 5 thousand and for a short period, are hardly profitable with the current interest rate of 5.5%. Therefore, in order to reduce the costs relative to the loan amount, Greenloans and other loan providers would benefit from longer maturities and higher loan amount.

Noteworthy, the loans that are supported by the local or national government have significantly lower interest rates than the commercial loans offered by Greenloans. The difference is in line with SVn's claim that they offer an interest rate that is 3% lower than the commercial interest rate. Greenloans considers these semi-governmental players with lower interest rates as important competitors. However, Greenloans argues that the interest rates provide a biased view of the real financial incentives it provides for the customer. Specifically, the Energiebespaarlening includes a brokerage fee, which increases the costs of capital. Moreover, they argue that the interest rate does not result in any financial profit for the participating commercial parties, Rabobank and ASN. This is in line with the annual report of 2014 that sows a net loss of approximately € 1 million (Energiebespaarlening, 2015). While the non-commercial interest rate of the semi-governmental loans is affected by governmental involvement, Greenloans is able to offer competitive interest rates due to low default rate and costs-driven business structure. *Table 14* provides an overview of the interest rates per contract type in relation to the maturity of the loan. Greenloans currently offers two different loans with different interest rates and duration. However, Greenloans explains that they aim to reduce their propositions to only one variant in order to offer clear and logical information and prevent confusion.

Initiative	Interest rate			
	5 year	7 year	10 year	15 year
Duurzaamheidslening	2.8%		3.2%	3.7%
Energiebespaarlening		2.9%	3.3%	3.7%
Greenloan loan	6.2%	*	*	
Greenloan ecoloan	5.5%	*	*	*

* Equal to the previous interest rate

Table 14: interest rates loan providers for energy improvements in the Netherlands

Thus, the loan products that are offered on the Dutch market include competitive interest rates, but little additional customer value. Compared to the U.S., loan providers offer little complementary services. The most important reason for limited vertical integration is that financial entities are the only players in the market and loans for energy improvements only represent a small amount of their activities. Although Greenloans solely focuses on loans for

energy improvements, ALFAM, who is responsible for the strategy, has a differentiated portfolio. Since financing of energy improvements is only to a small degree comparable to their traditional activities, they do not execute complementary activities. In the U.S. in contrast, SolarCity and Sungage provide loans that are specifically designed for solar investments. They do not only finance the systems, but also execute other activities, such as project development, system design, procurement, installation and construction, monitoring and maintenance. While SolarCity is fully vertically integrated through the insourcing of these activities, including the manufacturing of solar panels, Sungage utilizes its network of technical partners that provide all related activities. This strategy allows SolarCity to minimize costs and optimize their services, including performance guarantees and a one-stop-shopping experience. Comparably to Sungage, the WHEEL program collaborates with contractors, which operate as resellers. When they visit customers for maintenance or replacement purposes, they can offer a complete package of energy improvement, which is complemented by attractive finance through the WHEEL program. The financing itself is provided through OBR, PACE or other sponsored programs, which creates additional customer value.

The core competences of ALFAM, which are far from energy related, might explain that Greenloans' strategy does not include vertical integration through insourcing, which is executed by SolarCity. However, Greenloans cooperates with other partners to reduce customer's transaction costs. Comparable to Sungage and WHEEL, Greenloans cooperates with contractors who are able to complement their services with their loan product. These contractors mainly function as resellers of their product. Other than for Sungage, Greenloans is not involved in the construction or operating process. While Sungage provides a one-stop-shopping experience since they account for the payment to the contractors after construction, organize the collection of financial incentives from governmental organizations, and take responsibility for maintenance during operation, Greenloans only provides the payment to the customer. The customer is responsible for the management of the contact with the contractor and potential guarantees are dependent on the contractor or manufacturer. Due to the large number of contractors, resellers, and different energy improvements, a market with imperfect information is created. This might be among the most important reason for the limited utilization of the savings potential in the Netherlands. According to Greenloans, Dutch customers collect on average ten offers from different actors before they make their investment decision. The collection of sufficient information to overcome the imperfect information results in high transaction costs. Moreover, customers may be reluctant toward small companies whose value proposition includes performance guarantees or warrants. The risk of bankruptcy of these companies might create a barrier for customers to enter a long during obligation with a loan provider.

Besides contractors, Greenloans cooperates with resellers of energy improvements as well as utilities. One of the most remarkable resellers of energy improvements, in the form of solar panels, is IKEA. Comparable to contractors they provide information about Greenloans' Ecoloan to customers who are interested in the acquisition of solar panels. In addition, Greenloans aims to establish a more extensive collaboration with Essent. They aimed to develop an OBR program for Essent's customers, utilizing the available credit facility of Greenloans. However, since the utility would execute activities related to the provision of consumer credit, Essent would need a wft license. According to Greenloans, this would be a time consuming and expensive process, which would outweigh the benefits of the program. Another consequence of the wft regulation is the marketing strategy that might be applied by Greenloans. In collaboration with 'Milieu Centraal', a Dutch environmental non-profit organization, Greenloans developed key metrics to inform the consumers about the financial

and environment benefits of investments in solar panels. After they communicated the numbers, regarding the monthly savings in relation to the monthly interest and principal payments, they were accused of unilateral information provision. Since this information would trigger customers to engage in loan obligations, the financial services regulatory authority obliged them to change their communication strategy. Currently, Greenloans lobbies to reduce the regulatory framework for loans related to energy improvements, allowing providers without a wft license to enter the market and create a more effective marketing strategy.

According to the annual report of the Energiebespaarlening (2015), strategies regarding collaboration with other actors in the value chain as well as communication of the value proposition were developed after it turned out that the demand for the loan was low as opposed to the expectations. After six months in 2014, the fund invested € 0.6 million in a marketing campaign. Although the number of visitors on the website increased, the number of loan applications did not increase significantly. This resulted in a shift of focus towards collaboration with partners. This includes the adjustments of dispersed governmental policies towards a comprehensive, instead of a competing, proposition together with the Energiebespaarlening (2015). Comparable to Greenloans, collaboration with contractors, such as installation and insulation companies, mainly concerns the provision of information about the loan product. In this way, contractors could provide advise to their customers about financing, which enables them to include energy improvements in their proposition. A notable strategy is the collaboration with energy retailer Eneco. Although this collaboration is subject to the same restrictions of the regulatory framework as the collaboration between Greenloans and Essent, concerning the requirements regarding provision of consumer credit, they aim to start a pilot project in 2015. For the Duurzaamheidslening, the municipalities that invest in the fund are the most important actors that aim to create awareness among the potential customers.

It may be concluded that the Dutch loan market is characterized by high transaction costs and risk, which are compensated by high incentives for the customer. This is due to the strict regulations regarding the provision of consumer credit, limiting the collaboration with companies that are specialized in energy improvements and the potential communication methods. However, this conclusion is even more applicable for the semi-governmental loans. While the interest rates are lower than Greenloans' loans, there is no collaboration with contractors or other resellers and the information provision is limited. Especially the Duurzaamheidslening, which conditions differ according to the relevant municipality, is characterized by imperfect information. This may be the reason for the limited utilization of the two funds. The metrics of the Energiebespaarlening are striking. With an attractive interest rate, which is significantly lower than the rate for commercial loans, they realized a utilization of less than two percent in more than a year. The production of the Duurzaamheidslening doubled in 2014 as opposed to 2013 and was almost four times the size of the annual production of the Energiebespaarlening (SVn, 2015). According to Greenloans, who does not provide information about the size or utilization of its credit facility, their performance is significantly better than the semi-governmental funds. Since the launch of the Greenloans in 2009, they annually doubled their operations. According to their own perception, their commercial service level could explain their success. While customers disvalue the long lead times for the semi-governmental loans, Greenloans stresses the importance of service orientation in their customer relationships.

4.2.2. Development of credit facility

All loans that are available on the Dutch markets are part of funds that are initially developed through governmental involvement. While Greenloans is currently fully independent from governmental involvement, the other funds rely to a certain amount on governmental support. In 2009, the Fortis Bank developed Greenloans on behalf of governmental demand. At that time, the proposition benefited from two governmental regulations, which are currently both inactive. First, Greenloans could access capital at low-cost through the 'green regulation'. This included an option for customers to receive lower interest rates on their saving account in exchange for the guarantee that their savings would be invested in sustainable enterprises, such as Greenloans. In addition, the government mitigated credit risk since they guaranteed the repayment, allowing banks to offer lower interest rates. At that time, authorities demanded the emphasize of investments in energy generating technologies, as opposed to savings measures, resulting in a lower interest rate and longer maximum maturity for Greenloans' Ecoloan. After the merger of Fortis Bank and ABN AMRO and the reform of the governmental policies, Greenloans became an independent organization, which does not rely on any policies. The loans that they provide to their customers are derived from a fund that is acquired from its parent ANB AMRO and includes favorable terms. Due to the constant replenishment of the credit facility, the strategy to access capital could be considered an up-front model. However, since the ABN AMRO uses the cash flow generating assets to replenish the credit facility, Greenloans' strategy might be considered an intermediate model in which they utilize the benefit of continue access to capital in combination with access to capital on the secondary market.

The Energiebespaarlening's credit facility of € 300 million was developed in 2013 as a result from the negotiations between market players and governmental bodies regarding housing and energy policies, resulting in the National Energy Agreement and the National Housing Agreement. The contribution of the Rabobank and ASN, who committed a contribution of € 225 million together, is considered a voluntary initiative to contribute to a more sustainable building stock since the expected profits are relatively low. The credit facility is substituted with a € 75 million investment from the national government, resulting in a total value of € 300 million. Both banks received a commission fee after agreement about the financing of the fund, with a total value of just over € 0.5 million. Besides the commission fee, the investing banks receive a commitment fee of approximately 0.5% over the committed amount that is not yet incorporated in the fund. The Duurzaamheidslening exists since 2009. Currently the total amount of the fund is almost € 63 million. Both municipalities as well as counties contribute to the funds, resulting in the involvement of a total of 151 governmental organizations. Due to the dispersed character of the funds and the dependency of a large number of different organizations, it is hard to predict the development of the funds. However, according to the SVn the fund succeeds in stimulation of the implementation of energy improvements and is considered a success among the participants (SVn, 2015). Both funds rely on up-front investment of either public capital or a combination of public and private capital. Since the cash flow generating assets are not used to replenish capital, their strategy to access capital is identified as the up-front model.

4.2.3. Capital replenishment

The two funds that are managed by the SVn are revolving funds. This means that the size of the funds constantly increases because the principal and interest that is paid by the customers is used to replenish the fund. According to the SVn, this is one of the most important requirements for a sustainable collaboration with their partners. However, since both the interest rate as well as the outstanding amount of the funds is relatively limited, the growth of the funds is limited as well. Since 2009, due to the received interest, the funds of the

Duurzaamheidslening grow with € 1.3 million in total. However, since the fund is continuously growing trough additional investments of different municipalities, a comprehensive refinancing strategy is not yet relevant. The growth of the Energiebespaarlening due to interest and commission fee was only € 190 thousands, which can be explained by the limited size of their operations and short time since the start of the funds. Since only a small share of the fund is utilized, refinancing strategies are not yet developed. However, as discussed in the literature review, a strategy to allow replenishment of capital might include standardization of contracts and other contract managements measures, which should be implemented during the distribution of the fund (Michael Mendelsohn et al., 2015; SEE-Action, 2015). Noteworthy, the growth that is noted is not corrected for the costs of operations. Effectively, the growth of the Energiebespaarlening was negative since the costs significantly exceeded the profit in the first operational year. The growth of the funds for the Duurzaamheidslening should be corrected for a management fee for SVn of approximately € 0.5 million, resulting in a remaining growth of € 0.8 million.

While the refinancing or growth of the two funds that are managed by the SVn are restricted to the profit on interest and the growing investments of semi-governmental organizations, Greenloans participated in a progressive initiative to replenish their credit facilities. This concerns the first green bond that is issued in Europe by ABN AMRO. The proceeds of the € 500 million green bond will finance and refinance energy improvements on commercial and residential buildings (ABN-AMRO, 2015). After ABN presented the underlying assets of the bonds to their investors, they recognized a high demand. This motivated them to raise the issuance size with € 150 million. It turned out that the bond was significantly over scribed wit orders reaching approximately € 1 billion. The bond has a maturity of 5 years and a fixed interest rate of 0.75%. Noteworthy, the loan product that is offered by Greenloans only contributed for a certain amount to the green bond. In order to prevent sensitive information distribution, neither Greenloans nor ABN releases the total share of Greenloans' loans in the green bond portfolio. The bond concerns a covered bond. The means that the assets remain on the issuer's consolidated balance sheet. This results in an obligation of the issuer to the investors. Due to the high rating and moderate risk profile of ABN AMRO, the bond received a high credit rating, resulting in low-cost capital.

4.3. Value proposition 2: lease and rent arrangements

In order to develop a solid business case that includes a leasing revenue model, the energy improvement that is offered should be removable so it has value for the third party owner. In case of default, the measure will be removed and should be applied for another customer. Most lease propositions that include energy improvements concern solar panels and efficient electrical appliances, but propositions that include heat pumps are developing as well. In the Netherlands, besides car leases, which is considered an important financing tool worldwide, private lease is particularly used for electrical appliances. Companies, such as Skala, Easy4Service, and Elbuco, provide lease arrangements for, among others, washing machines, dryers, computers, and televisions. Besides access to high quality products without high initial costs, these companies try to distinguish themselves through high service levels regarding installation, transport, and maintenance. However, although these companies provide access to high quality appliances, which generally are more efficient than less expensive alternatives, these companies do not utilize the environmental and economic potential of circular consumption. Since the payment is based on the length of the lease and not the number of uses, the customer is not incentivized to minimize its number of uses. Moreover, although the lessor would benefit form a longer lifetime of the appliance, these companies typically do not adopt a lifetime optimization strategy, including coaching and

maintenance. There is usually no cooperation with the manufacturer of the appliances in order to reuse the applied materials after they are taken back at the end of the appliance's lifetime. The performance-based (pay-per-use) construction that does utilize these environmental benefits, which is offered by companies such as Bundles, is covered in the following section.

Leasing is one of the propositions in which a third party remain owner of the solar systems, referred to as TPO. In the Netherlands, the number of companies that provide access to solar trough leasing arrangements is relatively low. 'Zonline' was one of the first players in the Dutch solar leasing market. Comparable to the American propositions, they provided lease arrangements for solar systems. The American lease organization Sungevity was one of their investors. However, sales lagged behind their expectations. Noteworthy, when Sungevity acquired Zonline, they reduced their activities and decided to focus on project development, system design, and sales of the solar panels, but excluded financing through TPO-models. Other actors that engaged in the Dutch solar lease market are the energy retailers Greenchoice and Eneco. While Greenchoice participated in a pilot with Zonline, Eneco decided that market potential was to low after they conducted a market analysis. The pilot project could be considered a financial lease, in which the lessee owns the system after the contractual period. However, the incentive was performance-based, based on the produced amount of electricity. Currently, only a few companies apply lease propositions that target residential customers. 123Energie and Solease are two market players that currently serve approximately 500 and 1,000 customers and are founded in 2013 and 2012, respectively. Big Solar is a new player that is considered to play an important role in the Dutch solar lease market since they received a lot of media attention, have an experienced management team, and succeeded in collaboration with a number of important financial partners (Simons, 2015). Lastly, Zelfstroom applies a proposition in which they combine lease arrangements with the delivery of the remaining energy demand, which could be considered an OBR program.

4.3.1. Value creation

Most companies that offer lease arrangements for energy improvements emphasize the financial incentive as well as the reduction of transaction costs. The financial incentive concerns the incentive as opposed to the traditional situation in which energy is bought from the retailer. Noteworthy, the payback period of energy improvements is typically lower in the Netherlands as opposed to the U.S. due to the energy taxation and the higher energy prices in the Netherlands. However, since Big Solar aims to minimize the length of the contract, it was challenging to develop a profitable business case. Compared to the U.S., where contracts last typically 20 years, Big Solar offers a variety of contracts lasting either 10, 17, or 25 years (BigSolar, 2015). As done by 123Energie, Big Solar includes LED-lighting in their proposal to realize sufficient savings. Critics argue that savings would not exceed the monthly lease payments if these lighting would not be included. According to Big Solar, scale advantages concerning procurement of the solar panels and the reduction of the cost of capital are the most convenient ways to minimize costs for the organization. Although financial incentives are limited to maximum a few hundred euros annually, Big Solar expects the financial incentive in combination with the environmental benefits to be sufficient to convince customers. The Dutch consumer association however, stresses the reduction of financial benefits as opposed to direct purchase of energy improvements. Noteworthy, Dutch customers are traditionally risk averse. As described in the literature review, the acceptance towards financial obligations and long-term contracts in general is significantly lower than in the U.S. As a consequence, the potential of the Dutch lease market is never met.

The founder of Big Solar, Van den Biggelaar, emphasizes that the reduction of the transaction costs is among their main goals. He defines the Dutch market for solar panels as cluttered due to a large number of players, such as installation companies and resellers of solar panels, resulting in high transaction costs (Allcott & Greenstone, 2012). Since a strong player with substantial market share in the residential market was missing and the quality of the proposals of the existing market players was low, he decided to start an organization based on the business model of the American Solar City. Thus, one of the most important aspects of the value propositions is the reduction of transaction costs (BigSolar, 2015). Compared to actors that offer loan products, lease providers offer close to a one-stop-shopping experience. The vertical integration of the players in the Dutch market is to a large extent comparable. All take responsibility for the technical aspects of the value chain, including project development, design, installation and construction, and maintenance. Due to their limited size, the realization of economies of scope through vertical integration in the value chain is not relevant. Thus, in order to provide this services, extensive collaboration with technical partners, such as engineers and installation companies, is required. While such partners mainly function as resellers in the loan proposition, more long-term relations are required in the lease proposition. In the U.S., critics argue that customer service is relatively low for companies that are not fully vertically integrated. Since their technical partners receive payment after installation of the system, incentives to provide high quality services during operation are lacking. As a result, customers have to deal with relatively long response time and insufficient maintenance (GTM-Research, 2015a).

Comparably to lease arrangements, Zelfstroom exploit lease arrangements through rental agreements. Their customers pay a non-recurring installation fee at the start of the rental period and a recurring rental fee during the full length of the agreement (Zelfstroom, 2015b). Noteworthy, with a total length of ten years, the contract period of Zelfstroom's offering is low compared to competitors. Most importantly, Zelfstroom delivers the remaining energy demand, which significantly reduces the transaction costs for customers since they only have to deal with a single provider, who delivers the solar system as well as the remaining energy. Besides this strategy to offer a high service level, Zelfstroom's business structure shows a relatively high degree of vertical integration. It is structured in three business units. The holding organization is responsible for lead generation and sales. In contrast to competitors, Zelfstroom internalizes the installation of the solar system through their technical business unit, 'Zelfstroom Installation'. This business unit cooperates with a technical partner regarding installation and a partner that is responsible for quality management during operation. The business unit internalizes all risks regarding installation and operation. Lastly, the business unit 'Zelfstroom Administration' takes account of the management of the portfolio and provides services to the SPV, such as administration and contract management (Zelfstroom, 2015a).

As opposed to loans or investments with own financial resources, the lease proposition substantially reduces the risk for the customer. First, exposure to risks related to bankruptcy of one of the companies in the value chain is diminished. Lease providers adopt all guarantees and warrants from the installation companies and manufacturers. Since customers pay a monthly fee, bankruptcy of a leasing organization would not affect a customer's exposure to risk. Instead, the curator would most certainly offer the customers an option in which they could take over the system. Second, lease arrangements reduce the customer's exposure to performance risks to a certain amount. Lease companies typically provide maintenance services and guarantees for the functionality of the system. However, they do not internalize the full performance risk. Since other factors, such as weather conditions, affect the performance of the system, the customer is still exposed to certain aspects of

performance risk. Moreover, the customer is exposed to regulatory risks. When the current regulations regarding net metering would change, demand response measures would be required to realize the same financial incentives. In the U.S., companies complement their lease propositions with full performance guarantees, including financial compensation when the production estimates are not met. After all, companies that provide lease arrangements significantly reduce the risks for customers. However, the financial incentive is limited compared to the loan propositions and might be variable according to weather conditions. An important reason for the limited financial incentives might be that not all measures are suitable for lease arrangements. While propositions typically include only one measure, a more comprehensive approach, which includes home efficiency improvements, could create larger financial incentives.

4.3.2. Development of credit facility

According to Mr. Dijk, managing director of Rabobank's sustainability department, the Rabobank's willingness to provide a credit facility to businesses that apply cash flow generating value propositions depends mainly on the organization's balance sheet and track record. The asset coverage ratio is the most important metric to assess the credibility of the organization. This concerns the organization's ability to cover its debt obligations with its assets. Although this ratio should be favorable for companies that apply TPO models, banks are not used to assess the value of these relatively small assets, such as solar panels, heat pumps or washing machines. Moreover, the track record of most companies that apply TPO models is relatively limited, which results in low predictability of the default and recovery rate. As a result, the Rabobank is reluctant to provide credit facilities to start-ups that apply TPO models. While Solease got its first investments from two accelerators, namely UtrechtInc and Climate-KIC, they did not provide any information about their strategies to access capital. For Big Solar, an interview and announcements provide insight in the creation of their credit facility, but a strategy to replenish capital is not yet developed. For 123Energie and Zelfstroom, their strategy was clearly outlined in the investor information, which they provided in order to attract investments from the crowd.

While other companies, such as Solease and 123Energie, exploit comparable business models, Big Solar aims to distinguish themselves through scale and quality. The most important difference with the other companies is the extensive collaboration with their partners from the start of the organization, which allows them to finance approximately 5 thousand solar systems. Big Solar's CEO explains that the team spend more than a year to prepare their credit facility before they launched. This preparation included extensive collaboration with semi governmental funds. The Energy and Climate funds from the municipality Amsterdam and three funds that are managed by counties, the Energy fund Utrecht, Drentse Energy Organization, and the Frisian Energy Fund (FSFE), invested together € 3.4 million in Big Solar. Big Solar developed separate legal entities for the different geographical areas. The credit facilities for the different companies are completed through the attraction of debt from different financial partners, such as banks. Since the equity shareholders will be the first to capture any losses, for example due to customer defaults, the risk for debt financers is significantly reduced. This strategy turns out to be very effective since the total value of the credit facilities of the different companies is over € 10 million. Big Solar aims to increase their total facility to € 25 million by the end of 2015 en € 100 million by the end of 2016. They aim to create these funds through accessing funds that are developed in order to stimulate the transition to a sustainable energy sector by counties and municipalities. The strategy of Big Solar to access funds with a social function might be compared to strategies of players on the American market, where the development of initial

credit facilities is typically stimulated by investments of green banks (Connecticut-Green-Bank, 2015; NY-Green-Bank, 2015).

Zelfstroom applied a different strategy to attract capital in order to finance their activities. In contrast to Big Solar, they did not cooperate with semi-governmental funds to attract capital. Instead, they used a mix of informal investors, equity investors, and the crowd to attract equity and different sources to attract debt. The equity investor Punch & Judy, which is focused on sustainable investments, is together with informal investors responsible for the initial equity investments in the organization. A few months after their launch, Zelfstroom successfully competed two equity crowdfunding rounds, for € 100 thousand and € 150 thousand at a organization validation of € 5 million and € 5.5 million, respectively (Zelfstroom, 2015b). Comparable to Big Solar, Zelfstroom utilizes their equity to attract debt. The equity investment that is collected through crowdfunding together with the remaining equity share has been used to collect a total of € 1.6 million in debt financing. Noteworthy, for most of their capital, Zelfstroom does not directly distinguish between credit facilities that are developed for the acquisition of solar panels and operational capital to finance other business activities. Therefore, in line with the warehouse model, the cash flow generating assets that are created through investment of the credit facility might be used to replenish capital (SEE-Action, 2014b). Besides equity crowdfunding, Zelfstroom launched a peer-to-peer lending campaign via the crowdfunding platform Green Crowd to attract debt. This campaign aimed to create a credit facility of € 80 thousand, which would allow the purchase of approximately 25 solar systems. However, the campaign was only partially successful since € 37.4 thousand of debt was attracted through 21 individual participants. The relatively low interest that was offered by Zelfstroom, consisting of 4%, might be the reason for the limited success. Since they offered the future cash flows as collateral, this strategy is considered the up-front model (SEE-Action, 2014b).

123Energie developed an innovative investment product, which uses a tax credit that targets entrepreneurs, referred to as the Energy Investment Reduction (EIA). They allow investors to buy a share in a commercial partnership, comparable to a Limited Liability Partnership, with an expected return on investment of 13.8% annually. Additionally they sell obligations with an interest rate of 7.2% annually to debt investors. While both shares as well as obligations are sold for € 5 thousand each, investors can participate with a minimum of one share or two obligations (123Energie, 2013, 2014). Noteworthy, the shareholders of the organization are allowed to depreciate their investment as well as the relative share of the debt of the organization, derived from the issued obligation, in five years from their taxable income. After these 5 years, the legal form of the organization is restructured to a Limited (Ltd). In this manner, 123Energie funded three companies with a total value of approximately € 4.2 million. The first organization had a value of € 1.35 million, which would be backed by the cash flow of 315 solar systems. Assuming the financial structure of the first organization, which is funded for less than 30% with own capital, shareholders receive more than € 7 thousand on an investment of € 5 thousand solely from tax incentives. However, it should be noted that the second organization had a larger share of own capital and less debt, while the third capital round only attracted a small number of share investors. The complex investment model was criticized in different investment analysis, which could explain the decrease of interest from investors. After all, 123Energy developed a complex investment product, which could be applied theoretically, but relies on governmental policies. Specifically, the largest share of the expected return is derived from policy incentives instead of a profitable business model.

4.3.3. Capital replenishment

The cash flow generating assets that are developed through investments can be used for the replenishment of the credit facility. However, the organization's capital strategy, either the warehouse strategy or the up-front model, determines if these assets can be used to replenish capital. In case of the up-front model, the assets are already used to back up the credit facility before they were developed. To illustrate, the cash flows that are generated by 123Energie are directly owned by the commercial partnership that is specifically created to exploit the credit facility (123Energie, 2013, 2014). Comparably, the capital that is attracted through the peer-to-peer lending campaign on Green Crowd by Zelfstroom is already backed by the future cash flows (Zelfstroom, 2015b). As a consequence, the asset portfolio cannot be sold or used to back a specific bond in order to replenish capital. Thus, when the future cash flows are used as collateral to attract capital in the first place, referred to the up-front model, replenishment of the funds is not relevant. However, it could be stated that the reduction of the risk is larger when the cash flows actually are confirmed through a contract with the customer. In this case, the organization acts as a warehouse facility that aggregates the obligations. For the cash flows that are generated through investment of the credit facilities of Big Solar and Zelfstroom, except the peer-to-peer lent capital by Zelfstroom, replenishment of capital is possible.

Big Solar aims to access funds that are managed by institutional investors when the value of their portfolio exceeds € 25 million. In 2016, they aim to access a total of € 75 million through institutional investors in order to reach a portfolio value of € 100 million by the end of 2016. After the credit facilities are invested in solar panels, the holding organization exists of different companies, partly owned by semi governmental funds and financed by debt. Comparable to Solar City, the Big Solar creates predictable cash flows from their customers. However, the net value of these cash flows is not comparable to the value of the American portfolios due to the smaller market and the early stage of implementation of the model in the Netherlands. While Solar City accessed the secondary market through securitization of ABSs, Big Solar's size is most likely not large enough to execute this method. The coming year, Big Solar will study what is the best strategy to refinance these assets and attract capital from institutional investors. According to Big Solar's CEO, a direct portfolio sale could be an option to attract capital from an asset management firm, which potentially manages capital from institutional investors. However, maybe a more obvious method would be to issue a high yield covered bond, which would be backed by the cash flow generating assets. However, due to the short track record, the organization risk profile of Big Solar could be considered a hurdle. To overcome this barrier, the assets could be isolated in a separate organization.

Zelfstroom's strategy to replenish capital is largely comparable to the innovative securitization of cash flow generating assets, which is done by Solar City. Comparably, they both aggregate their cash flow generating assets together in a SPV. Subsequently, the SPV issues obligations, which are backed by the assets that are owned by the SPV. The most important difference is clearly the size of the operations. While Solar City collected over $ 300 million in three securitization rounds, including more than 27,000 solar systems, the first two SPVs that are generated by Zelfstroom consist of 8 and 20 systems, respectively. However, apart from the size, the strategy is largely comparable. The SPV with a face value of € 82 thousand remains partly owned by the organization in order to manage any risks, for example to be able to compensate for customer default. The second issuance concerned 124 notes of € 500 with a total value of € 62 thousand, resulting in an overcollateralization of 32%. Zelfstroom assumes a default rate of 1%, which is based on an average of historical data of energy retailers and mortgages (Zelfstroom, 2015a). The notes have a maturity of 10

years and an interest rate of 5%. Noteworthy, Zelfstroom creates an interest reserve, which has the same value as 6 months of interest and principal payments. Besides, they execute a credit check and require customers to have a credit score of 4 or higher according to Experian, who exploits a large database of customer information. The obligations are sold through the platform Duurzaam Investeren, which is specialized in obligations with a sustainable character. It should be noted the cost of capital for this strategy is comparable to the cost of capital of much larger and more established companies, such as Solar City.

4.4. Value proposition 3: performance-based incentives

Compared to the other propositions, the performance-based value proposition offers the highest service level. The most important aspect of this value proposition is that the organization is exposed to all performance risks. As discussed, the performance-based proposition can be applied for all categories of energy improvements, but due to the regulatory framework in the Netherlands, performance-based propositions for the exploitation of electricity generating technologies through PPAs are not economically feasible due to energy taxes. As in the U.S., in the Netherlands are no companies that exploit efficiency improvements through performance-based value propositions in the residential sector. This is specifically due to the hurdles that are related to the monitoring of the performance of efficiency improvements (Allcott & Greenstone, 2012; Sorrell, 2007). However, as described in *box 2*, the innovation program 'Energiesprong' has encouraged collaboration between installation and construction companies, and financial entities. As a result, an increasing number of small companies apply ESCO inspired value propositions. According to Platform 31, the executor of the program, a comprehensive value proposition that includes financing of home efficiency improvements in combination with a performance-based incentive structure, will be realized in the near future. However, currently, this study considers Bundles as the only case that applies the performance-based proposition in the Netherlands.

Besides performance-based value propositions that apply home efficiency improvements, there is a small number of companies that developed performance-based value propositions for appliances. As in the U.S., a lighting as a service proposition is applied in the commercial sector since this concerns larger scales per customer. In the Netherlands, Philips worked together with Turntoo to develop a value proposition that sell light in a pay-per-lux model. Besides the commercial sector, Bundles developed an innovative value proposition for the residential sector. They work together with Miele in order to create access to high quality washing machines for residential customers without initial investment. They remain owner of the washing machine and charge their customers for the number of time they use their washing machine, with a minimum of 15 uses for € 22.95. Moreover, in cooperation with their technical partners, Bundles developed an application that provides insight in the use statistics of the customer. The actual energy use of the machine during operation provides insight in the amount of soap that is used and the use of capacity. Based on this statistics, Bundles provides advice about more sustainable use in order to decrease energy, soap, and water use and prevent damage on clothing and the appliance itself. Besides, based on the information that is accessed through the application, Bundles coaches the end-user to use the washing machine in a way that the lifetime is optimized.

Box 2: Innovation program 'Energiesprong'

The organization behind the program is Platform31, a knowledge and network organization that applies scientific knowledge, with a focus on social, economic and geographical development in the urban and regional environment. The program is initiated on behalf of the Ministry of the Interior and Kingdom Relations, the Ministry responsible for Home Affairs, Civil services and Intelligence. The aim of the program is to stimulate demand and supply for 'energy neutral' buildings, in the residential as well as the commercial sector. Energy neutral is defined as no net consumption of energy. This is realized by a reduction of energy consumption trough insulation and efficient installations and electricity generation by renewable sources with for example solar PV. By the supporting different projects, the different actors in the field are connected and new business models are tested. The most remarkable projects are the 'Stroomversnelling' for residential homeowners and tenants.

Stroomversnelling homeowners

One of the most innovative achievements is the development of a construction method in which the renovation can be conducted in a period of less than 10 days. This is enabled by a large contribution of prefabrication in the production factory. The renovation includes the replacement of the roof and façade, for well-insulated alternatives with solar PV integrated in the roof, and the installation of a heath pump for heating purposes. Typically, energy provision is fully covered by electrical devices, which dismisses the dependency on gas. This project targets homeowners with buildings that have been built in between 1950 and 1980, covering a target group of about 1.3 million households. It is assumed that the average monthly energy bill of these buildings is about € 175. Concerning the financing of the renovation, each household is treated as an individual case. Depending on the individual conditions, such as loan-to-value ratio, one of the eight financial institutions, which is connected to the initiative offers a tailored financial solution, ranging from a second mortgage to a personal loan. The current energy costs will be used for repayment and interest as a monthly annuity after renovation. According to the business case, the annuity of € 175 results in a maximum investment amount of € 45 thousand. Assuming a duration of 30 years, the case uses an interest rate of 2,5%. Consumer representatives, such as Vereniging Eigen Huis (VEH), stimulate the program, but note that performance guarantees should be included and that dependency on subsidies and regulations should be reduced. By this way, an increased valuation is more likely.

Stroomversnelling tenants

This project concerns the reconstruction of 111 thousand apartments, which have been built in between 1950 and 1970. The cost of renovation is about € 60 thousand per apartment, resulting in a total project size of € 6.5 billion. The deal for the first 11 thousand apartments is closed in June 2013 and the first apartments are recently completed. Six housing cooperatives and four contractors are involved in the project. The projects include a change in payment structure. Instead of paying the monthly energy bill to the energy provider, the tenants will pay an 'energy performance compensation' (EPC) to the housing cooperatives. The amount of this EPC is based on an average energy consumption of the past three years and average climatological conditions. This creates a cash flow for the cooperatives that is used as the collateral for a loan of one of their financial partners, such as 'Waarborgfonds Sociale Woningbouw' (WSW). The loan amount is invested in the renovation. As a result, the resident benefits from a renovation of the apartment and comfort improvement without a higher monthly rent. Noteworthy, depending on the remaining debt for the buildings, the loan-to-value ratio could be a barrier. However, WSW overlooks the debt position of the cooperative as a whole and does assesses the financial position of individual buildings.

Stroomversnelling financial metrics

Although all renovation projects are treated like stand alone projects with individual parameters, the general business case can be evaluated. Assuming renovation costs of € 60 thousand and an agreed EPC of € 170, the model is far from a valid business case on itself. Validation is based on an expected lifetime of 25 to 50 years. Regarding the minimum ROI, the 'Centraal fonds Volkshuisvesting' (CfV), the supervisory authority of the housing cooperatives, has set a boundary condition of 5,25%. Assuming a lifetime of 50 years and a discount rate of 5,25%, the renovation costs should be reduced to under € 36 thousand to realize a positive Net Present Value. A lifetime of 50 years is, in addition, very unlikely to be part of a market proposition. In their proposition, the contractors aim to optimize the construction process so that the costs can be fully covered by the energy performance compensation, benefits regarding the increased lifetime and comfort should not be included.

Bundles is an effective example of the environmental and economic potential of performance-based value propositions that are applied to electrical appliance according to the principles of circular consumption. Comparable to loans and lease arrangements, the proposition creates access to energy efficient electrical appliances, which reduces the energy use. Besides, Bundles invests in optimization of the lifetime of the washing machine through coaching and optimization of the maintenance. In order to deliver an effective maintenance strategy, Bundles utilizes a maintenance agreement with Miele. According to Bundles, this allows them to depreciate the appliances in ten years, compared to five years that are applied by most traditional lease companies. Moreover, Bundles has an extensive collaboration with Miele, which includes an agreement about the return of the appliances at the end of their lifetime when larger volumes are realized. In this way, Miele can potentially reuse full components of the washing machine and finally optimize its design and material use in order to enable reuse. Lastly, since the customer pays for the number of uses, Bundles provides an incentive for their customers when they reduce the number of uses of their washing machine, for example through larger washing volumes. As an effect, the lifetime of the machine in years will increase and the energy use per year will decrease. Thus, compared to traditional lease contracts, the performance-based proposition creates vale through optimization of the lifetime, enabling of material reuse, and more efficient use by the end-user.

4.4.1. Value creation

Companies that apply the performance-based value proposition offer a high service level to their customers. They create a one-stop-shop experience with minimum transaction costs, which includes project development, design, installation, monitoring, maintenance, and replacement. Compared to the lease proposition, companies that apply the performance propositions internalize all performance risks since the customer is only charged for the generated, saved, or used units of energy. Performance risk includes technical as well as external risks, such as the weather condition for solar panels. Since the service level is high, companies seek to find strategies to minimize the costs in order to offer a unit price that is lower than the competing prices. While competing prices for energy generating and energy saving measures are the prices per unit of energy, the performance-based price of electrical appliances could be compared to the purchase price or lease fee. As applied by SolarCity, cost reduction strategies include vertical integration in order to realize economies of scale and scope. Furthermore, cost reduction can be achieved through extensive collaboration with

partners, such as the manufacturer, the installer, and the maintainer. This might be an effective strategy for companies that don't have the resources to aim for vertical integration, such as Bundles who cooperates with Miele and the Firma Vonk & CO for maintenance. Besides, Bundles aims to minimize costs through automation of their activities, such as customer support and coaching. Moreover, Bundles aims to reduce costs through economies of scale. A greater number of customers will reduce the fixed costs per user, allowing them to offer better deals.

In order to assess the cost component of the value proposition that is offered by Bundles, their pay-per-use contract is compared to direct purchase, a loan that includes purchase with installment credit, and lease of the appliance. The cheapest place to purchase the exact same washing machine is Wehkamp. The purchase price of the appliance, including a five year maintenance service contract and extended guarantee, is € 1,230. Instead, when the number of washes are purchased from Bundles, the total price in five years would be € 1,377, assuming the smallest bundle of 15 uses per month. Thus, in case of direct purchase with the customer's own equity, the discount price as opposed to the purchase of monthly Bundles is € 147 over five years. However, in favor of the direct purchase option, the customer owns the appliance for the rest of the appliance's lifetime. Yet, Bundles' contract can be ended after one year, which creates flexibility for the customer. Moreover, in line with the launch of new versions by Miele, every three years the customer is offered a reduction of the price or the installation of Miele's latest version. When the purchase price could not be financed by the customer's equity, the customer could agree upon a loan. Assuming a five-year agreement, the price of the lowest bundle corresponds to a 4.5% interest rate, both resulting in a monthly payment of 22.95. However, when the customer would use the installment credit that is offered by Wehkamp, who uses an interest rate of 14%, the monthly annuity would be € 28.60, resulting in a premium of € 340 after five years as opposed to Bundles' offering. Noteworthy, in case of a loan, the customer owns the appliance after the contract period. Compared to the standard lease contracts offered by Skala, Bundles' price is equal to a ten-year contract. However, since this proposition neither includes access to the newest appliances nor a reduction of the monthly payment, Bundles proposition is considered more valuable.

Noteworthy, while Bundles applies the performance-based proposition for washing machines and dryers at the moment, different kinds of electrical appliances can be included in the proposition. According to Bundles' CEO, they are currently working on a proposition that includes heat pumps. Proposition that include a greater number of appliances could be more valuable since this could reduce the transaction costs per appliance. Moreover, a value proposition that includes energy retail could strengthen the proposition. Currently, Bundles offers a discount on a contract with Delta Energy, a Dutch energy retailer. In the future, Bundles aims to create a proposition in which the customer is charged for its number of uses through the energy bill. Similar to OBR programs, in this model, the additional costs of the energy improvement are directly compensated by a lower energy bill. However, since the costs for the use of electrical appliances exceed the value of the decrease in energy use, this will not automatically result in a lower energy bill, as is the case in most OBR programs.

4.4.2. Development of credit facility

According to the principles of the circular economy, the manufacturer of the appliances should remain owner during the full lifetime of the appliance and be responsible for the recycling of the applied materials. Innovative companies, such as Turntoo, work together with established manufacturers in order to develop circular value propositions. However, since these value propositions significantly conflict with their traditional value proposition,

companies are typically reluctant towards implementation. Therefore, in order to avoid risks, it could be valuable to cooperate with start-ups that apply certain value propositions. This situation is applicable for the established manufacturer Miele and the start-up Bundles. Miele is a traditional organization that manufactures products and sells them through different retail channels to final customers. Competing with these retailers could be problematic since retail contracts include non-competing agreements. Moreover, the circular consumption model requires restructuring of their competences and activities. Currently, Miele sells their products to resellers in large batches. Therefore, they are able to focus on their core competences, such as value chain management, research & development, and production. Their resellers developed capabilities such as lead generation, distribution and installation, billing, and debt collection. When Miele would apply a circular proposition themselves, this would largely conflict with their traditional activities. Therefore, Miele benefits from a reseller that applies a circular proposition with their product instead. This allows them to increase sales, offer their product through a sustainable proposition, and reduce costs in the future through the reuse of materials.

Since Miele benefits from the activities of Bundles, they are one of the most important investors in the organization. However, before Bundles received an investment, they joined the Rockstart accelerator program, an Amsterdam based business incubator with a department that is specialized in sustainable businesses. Afterwards, Bundles received a € 300 thousand investments from four investors, including Miele and the foundation 'Stichting Doen', who also invested in Big Solar. This concerns an equity investment in order to provide operational capital to grow their business. In order to develop a credit facility, Bundles applied the up-front model in which they used the future cash flows as collateral to attract capital. They started a campaign on a peer-to-peer lending platform, called 'geldvoorelkaar'. In their first round they collected a total of € 100 thousand, which enabled them to fund the first 100 washing machines. This strategy is comparable to Zelfstroom's attempt to finance a package of solar panels up-front. For Bundles' obligations, there is no minimum amount. The maturity of the obligations is 7 years with an interest rate of 7.7%. Recently, Bundles launched its second campaign through which they aimed to collect another € 300 thousand to finance the following 300 appliances. However, they did not succeed in this attempt. Since a few weeks, they also sell obligations directly to investors, without the mediation of a platform. Nevertheless, Bundles experiences the development of a credit facility as one of the most important hurdles to up scaling due to the required time and effort to launch peer-to-peer lending campaigns.

4.4.3. Capital replenishment

Since Bundles applies the up-front model to attract capital they cannot use their cash flow generating assets to replenish their credit facility. However, Bundles collaborates with different partners to develop a strategy to access capital for companies that apply circular models. Issues concern, among others, the valuation of relatively small, dispersed assets and the approximation of the default, recovery, and net loss rate. In this collaboration, Bundles works together with the Rabobank and MVO Netherlands, an organization that stimulates social responsible behavior in the commercial sector. According to the managing director of Rabobank's sustainability department, who is not directly involved in this partnership, the most important controllable factor in this approximation is the credit quality of the customers. This can be affected through strong credit underwriting criteria related to the income or credit score of customers. Besides, he argued for more innovative strategies to reduce the default rate, such as the development of a personal insurance, in which the customer is required to put forward an individual who takes responsibility for his obligation. In this system, this individual would be charged in case of default of the original customer. Due to this social

pressure, the default rate will be reduced. However, this will most likely create a barrier to application. A more customer friendly strategy to leverage social pressure might be a customer cooperative. Currently, Bundles manages an active community of users of their products, which increases the involvement and potentially reduces the default rate. Concerning the different strategies for capital replenishment, Bundles' CEO is open for different options. According to him, the most important barrier to attract finance is the difficulties regarding the risk assessment of their business model. Besides their limited track record, this is due to limited recognition of circular consumption

4.5. Cross case analysis and discussion

In this research, propositions that stimulate the deployment of energy improvements through the elimination of upfront costs have been analyzed. These organizations differ in their contextual environment, in which the Dutch and American context are distinguished, the energy improvement they exploit, the value propositions they apply, the nature of the market players that execute the initiative, and their strategies to access capital. Access top capital is considered an important factor that determines the ability of the initiative to grow. In this section, the different organizations are compared and assessed. The aim is to identify the most suitable strategies to access capital and the variables that allow the deployment of these strategies.

4.5.1. Value proposition

All value propositions that are covered in this research provide financial products that eliminate the upfront costs for energy improvements. Therefore, these propositions provide a solution for one of the most important barriers for households to invest in energy improvements, the high initial costs. Most likely, this investment will result in a financial benefit for the customer. Since the companies need to collect the payments that are derived from the financial obligations of their customers, the companies are exposed to credit risk. Besides, the market players who deliver the financial propositions provide services that will reduce the transaction costs and potentially take over a certain amount of performance risk from the customer. Considering the different cases, it might be concluded that value propositions include a trade-off between the financial incentives for the customer and the additional services regarding the minimization of transaction costs and the reduction of performance risks. Rationally, this could be explained as a service fee that is charged by the organization for the services they deliver to their customers. Due to the service fees and the costs related to the internalization of risks, the financial benefits for the customer would be reduced when the service level increases. While loan propositions offer maximum profits for the customer, the reduction of transaction costs and performance risks is limited. For performance-based propositions in contrast, the financial benefits is limited, but the customers do benefit form reduction of risks and transaction costs. *Figure 8* provides a categorization of the typical value propositions based on this trade-off.

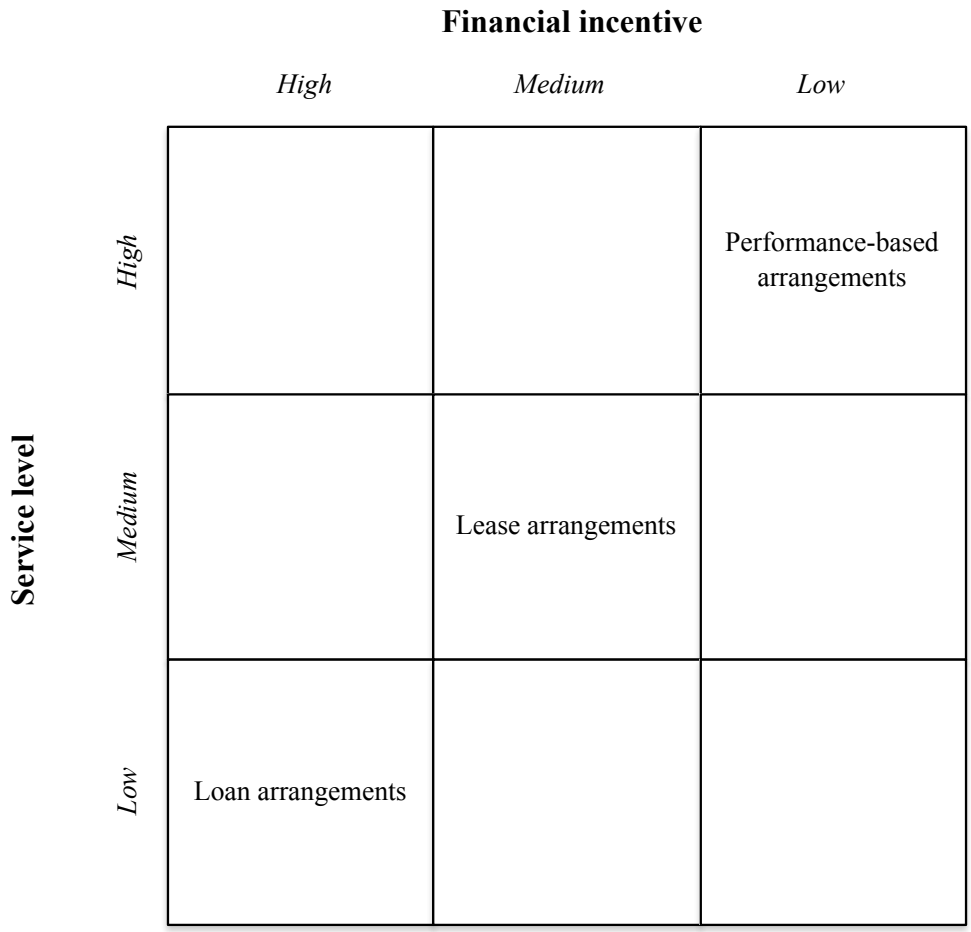

Figure 8: categorization of value propositions

As shown in the literature review, there is a strong relation between the characteristics of the energy improvement and the applicable value proposition. Most importantly, the removability of the measure determines if the measure can be applied in a TPO model or used as collateral in a loan arrangement. It should be noted that the market for energy generating measures is currently more developed than the market for home efficiency improvements in both the Netherlands as well as in the U.S. This might be explained by the ease of removability of distrusted generating measures such as solar panels as opposed to efficiency improvements such as floor insulation and air sealing, which include more extensive building refurbishment. This means that these measures cannot be used as collateral in a loan arrangement or in any TPO arrangement. Therefore, the only financial products that are offered to finance home energy efficiency improvements in both countries are unsecured loan arrangements. Besides this explanation, this difference can be explained by the investment incentives for distributed solar that are offered by American authorities. In the U.S., the organizations that do exploit home efficiency improvements largely depend on stimulation programs, such as PACE and OBR programs. For energy efficient appliances, the number of business models is limited, regardless the removability of the appliances. Although this study does not provide a clear explanation, the relatively short existence of the concept of circular consumption is a possible explanation. Alternatively, the relatively limited costs of high quality appliances as opposed to average appliance could be an explanation.

Regarding the application of value proposition, it should be noted that the application of performance-based value propositions is limited in the U.S. as well as the Netherlands. This could be explained by difficulties regarding monitoring of home efficiency

improvements in both countries and the regulatory environment of the Netherlands for generating measures, which includes taxation of produced energy. However, the performance-based proposition might be valuable to create goodwill from customers since the financial incentives are typically shared between the customer and the organization, which creates a comparable exposure to risks. Although it is difficult to develop a transparent proposition that includes a fixed fee per negawatt for the residential sector, this might have a stimulating effect of the deployment of home efficiency improvements. Besides, the performance-based proposition that exploit energy efficient electrical appliances is received positive by media and customers. This proposition enables optimization of the environmental benefits of such appliances. The propositions that are developed in the Energiesprong program, which exploit energy neutral buildings, could be considered a combination of performance-based and loans. Since the monthly payment could be approached by an assessment of the previous energy costs and do not differ due to performance, the financial product could be considered a loan. However, since the ESCO guarantees the performance of the measures, no energy use, the proposition could be marketed as a performance-based proposition. Such a marketing strategy, which emphasizes the reduction of risk and transaction costs for the customer, might stimulate the demand for the program.

Considering the studied cases, it should be noted that there are numerous differences and similarities between the market players that apply the different value propositions. It can be concluded that the boundaries between the different categories are hard to define. While Greenloans and Zelfstroom are clear representatives for the categories financial intermediary and utilities, respectively, the differences between financial intermediaries and ESCOs are more difficult to recognize. As discussed, numerous companies complement their financial proposition with services that reduce the transaction costs and the performance risks for their customers. This includes the execution of more technical services, such as design, installation and construction, and maintenance, but also additional financial and administrative services, such as project development, procurement, monitoring, and billing. To illustrate, while Greenloans, Energiebespaarlening, and Duurzaamheidslening solely provides investment capital when customers can prove that they invested in energy improvements, the American loan providers Sungage, Kilowatt Financial, Renewable Funding, and Renovate America provide additional services through collaboration with technical partners, such as manufacturers and installation and construction companies. Moreover, entities that apply lease and performance-based incentive propositions, such as Big Solar, 123Energie, Solease, Zelfstroom, Bundles, and SolarCity automatically provide additional services since they are responsible for the procurement of the energy improvements.

Based on this analysis, the provided service level distinguishes the Dutch and American cases that are identified as financial intermediaries in the case selection. The service level that is offered by American organizations is high, as opposed to Dutch organizations, specifically for the lower service limit, loan propositions. Moreover, this study recognizes the importance of a new category, which is established by American market players that design loan programs. These entities, such as Kilowatt Financial, Renewable Funding, and Renovate America, are referred to as ‘program administrators’ and generally leverage public-private partnerships. These companies utilize internal resources regarding credit expertise, concerning underwriting and application tools, together with a network of technical partners. Their partner network is utilized for the development of a high service level proposition. This allows them to provide a comparable service level to the more service oriented ESCOs, which should result in growing demand. Their capabilities regarding credit expertise, on the other hand, should result in the structuring of the contracts in a way that enables them to

attract capital from their financial partners or on the secondary market, which allows them to meet demand by sufficient capital supply.

While the profile of the Dutch financial intermediaries Energiebespaarlening and Duurzaamheidslening is largely comparable, they offer a significantly lower service level. This could be explained by differences in the contextual environments. First, the Dutch financial market includes strict regulations regarding information provision for financial products. As a consequence, financial intermediaries are not allowed to offer any information about the benefits of investments in energy improvements since this would stimulate customer to enter financial obligations. Additionally, entities are only allowed to offer financial products to their customers if they do not have a license. As a consequence, companies such as ESCOs and utilities are not allowed to provide financial products. Since financial intermediaries are not active in the energy industry, they are not able to provide additional services, resulting in high transaction costs and exposure to performance risks for customers. Thus, policy makers should consider the effect of the strict Dutch regulation on the deployment of energy improvements. Besides strict regulation, the attitude towards financial obligations in the Netherlands as opposed to the U.S. could be explanatory for the low service level. To elaborate, the Dutch customer is relatively suspicious towards financial products. While financial products are widely accepted in the American markets, Dutch consumer organizations launch specific programs to inform customers about the costs and risks of financial obligations. This is illustrated by the CEO of Urgenda, who specifically stresses the lack of transparency of commercial organizations who offer financial products for investments in energy improvements. She argues that the Dutch customer will not be interested in expensive financial products since they are well informed about the potential financial benefits that can be realized.

Within the ESCO category, an additional distinction between entities might be based on the degree of vertical integration. While entities with a high level of vertical integration deliver services through utilization of their own resources, other companies leverage their partner network in order to increase their customer value. An obvious example of this strategy includes the internal resources of SolarCity, as opposed to the utilization of networks of technical partners by other companies. Vertically integrated ESCOs might be able to increase the quality of their services, for example through performance guarantees. As a result they are able to reach the service level that is offered through performance-based propositions. Overall, it might be concluded that the service of the market players that offer the same value propositions in the U.S. and the Netherlands differs. This might be explained by the new categories that are identified in this study, namely the program administrators who offer loans and the vertically integrated ESCOs that offer leases. Comparably, energy retailers who offer loans or leases are able to increase their service level since they supply the remaining energy demand of the customer, which creates a one-stop-shopping experience. While *table 15* provides an overview of the new categorization of the studied cases, *figure 9* presents the shift of the value propositions through the higher service level that is offered by the American cases.

	Financial intermediaries	*Program administrators*	*ESCOs*	*Vertically integrated ESCOs*	*Retail utilities*
U.S.		Kilowatt Financial Renewable Funding Renovate America Sungage		Solar City	Tennessee Valley Authority
Nether-lands	Greenloans Energiebespaarlening Duurzaamheidslening		Big Solar 123Energie Solease Bundles		Zelfstroom

Table 15: categorization of studied cases regarding the characteristic of the market player

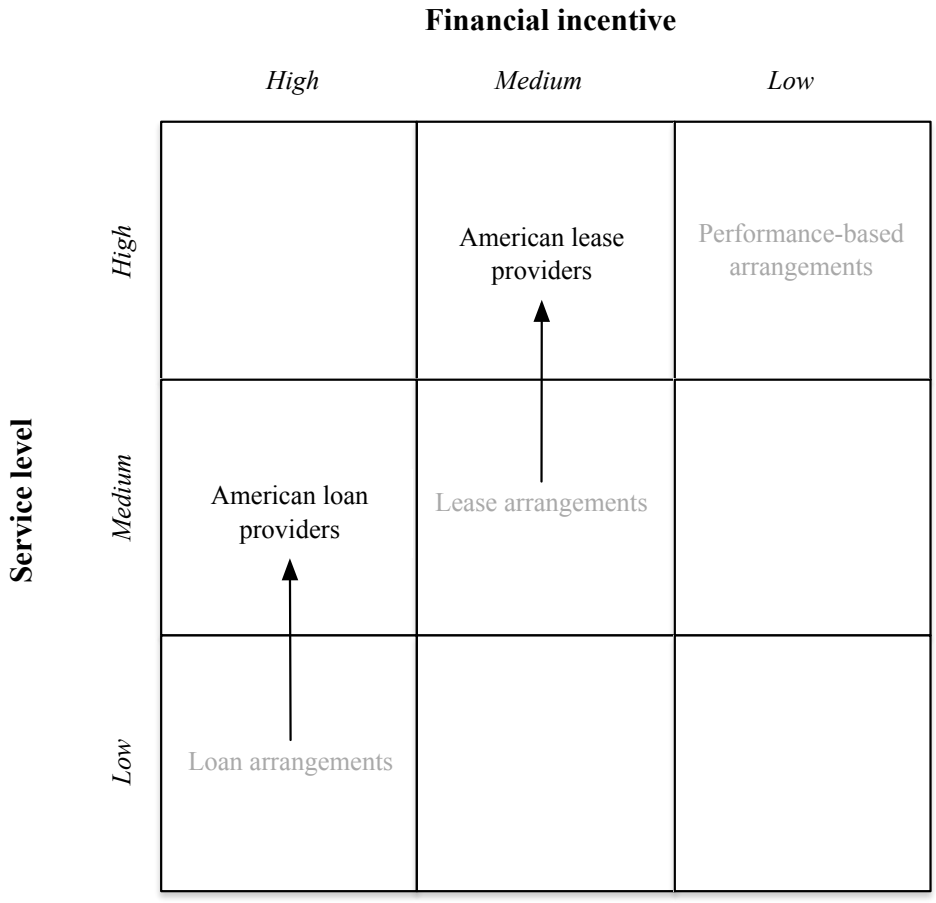

Figure 9: shift in value propositions due to higher service level

Thus, the Dutch loan providers Greenloans, Energiebespaarlening, and Duurzaamheidslening could benefit form a comprehensive value proposition. However, the attitude of the Dutch customer towards financial obligations should be taken into account. This suggests that transparency is of great importance. Transparency concerns the explanation of the organization's structure, its partners, and the cost structure of the value proposition, requiring a clear distribution in capital costs and complementary services and risks. Therefore, their business structure and business model should remain transparent in order to meet the information demand from Dutch customers. On the other side, the Dutch ESCOs that depend on complementary partners to deliver their value proposition, such as Big Solar, 123Enegie,

Solease, and Bundles, might also benefit from a role as program administrator. These companies suffer from the Dutch attitude towards financial products, stressing the lack of transparency of their business model and suggesting high profits for the companies. A more transparent role as program administrator, would allow them to clarify their business structure and explain the costs that are charged to their customers. Although Big Solar's and Bundles' CEO argue that their profit is very limited, non-profit organizations, such as Urgenda, stress the commercial character of such companies. Therefore, simplifying and clarifying their model could result in more market acceptance. Alternatively, a move towards an ESCO model with a more vertically integrated strategy or even as retail utility would allow the companies to emphasize the high service level of their proposition, limiting the need for explanation of the cost structure. However, Zelfstroom shows that the offering of an optimal combination with a high degree of transparency together with the highest service level is possible as well. After all, it could be stated that the successful interpretation of a certain value proposition most likely depended on the market player that applies the value proposition.

4.5.2. Credit facility

An important aspect of this study concerns the organization's ability to attract capital. Since all studied cases have a capital-intensive business model because they account for the initial costs of the energy improvements, access to capital is of great importance. Concerning operating capital, Bundles and Solease did cooperate with a business incubator to finance their early stage operations. Zelfstroom utilized an alternative approach to attract equity investment, namely through a crowdfunding campaign. Besides, Big Solar and Bundles attracted equity investments through non-profit foundations and angel investors, such as Stichting Doen. Besides crowdfunding, Zelfstroom attracted an equity investment from a venture capitalist that is specifically focused on sustainable investments. However, it should be noted that the amount of investments in operational capital in the Dutch market is significantly lower than the investments in the American market. This could be explained by the important role of venture capitalists in the U.S. market for funding of start-up. While Renewable Funding attracted 32.2 million in venture capital, the amount received by Solar City is significantly larger. When this is compared to the investment in Zelfstroom, it might be concluded that the attraction of capital is difficult in the Dutch market. This can be explained by the limited growth potential, the less developed capital market, or the lower requirements of start-ups since scaling potential is limited.

The development of a credit facility to finance the capital-intensive business model is of great importance. In the literature, the warehouse and up-front model are distinguished. The most important difference is the use of cash flow generating assets as collateral to create the credit facility or replenish the credit facility for the up-front and warehouse model, respectively. In the Netherlands, commercial companies find it hard to attract substantial credit facilities. As illustrated by Zelfstroom and Bundles, the use of the up-front model to attract debt from the crowd via a peer-to-peer lending platform turned out to be only limited successful. In the up-front model, different sources can be accessed to develop a credit facility. While Bundles and Zelfstroom applied peer-to-peer lending, 123Energie used an innovative combination between equity crowdfunding through the development of a Limited Liability Partnership. Zelfstroom aimed to attract € 80 thousand against an interest rate of 4%, which would be backed by the future cash flows from 25 solar systems, but only landed € 37.4 thousand. Bundles in comparison, first raised € 100 thousand against an interest rate of 7.7%, which would be backed by the future cash flow from 100 washing machines. However, their second campaign, in which they aimed to reach € 300 thousand with the same loan terms, was not successful. Noteworthy, while Bundles utilized the peer-to-peer

platform ‘geldvoorelkaar’, Zelfstroom used the platform Green Crow, which has a strong focus on sustainable investments. The strategy of 123Energy was less straightforward. They created separate companies that were backed by future cash flows, for which they sold equity stakes and attracted debt. However, with this complex model they attracted in total more than € 4.2 million, which is the largest credit facility fully developed by private capital in the Netherlands.

Besides the up-front model in which the future cash flows are used to attract capital, Zelfstroom and Big Solar applied the warehouse model. This concerns the attraction of capital without any direct collateral. Typically, different strategies to attract capital are combined in this model. Both Zelfstroom as well as Big Solar used equity to attract complementary debt in order to increase the size of their credit facility. Zelfstroom attracted equity through different sources, such as venture capitalists and crowdfunding. However, in their financial statements they do not distinguish between operational capital and credit facilities to invest in solar systems. Big Solar’s strategy is more straightforward. Before the launch of their organization, they put significant effort in the attraction of equity from semi governmental funds, which operate regionally. For each equity investment, they developed a legal entity. The equity share of the legal entity was used to attract a debt investment. The risk for the debt investors is limited since the equity investors take account for the first losses. Overall, this strategy turns out to be the most effective since Big Solar attracted € 3.4 million in equity, which was complemented by € 6.6 million in debt, creating a total credit facility of € 10 million. Noteworthy, the Energiebespaarlening created the largest credit facility with a total value of € 300 million. This concerns a public-private partnership in which commercial banks and the national government join forces. Lastly, Greenloans accesses credit facilities through its parent, the ABN AMRO Bank. They constantly release new facilities, which allow them to meet any demand.

Noteworthy, the method that is applied by all studied American cases could be assessed as the warehouse method since all of them aim to replenish their credit facility through the use of the cash flow generating assets. This could be explained by the minimum size of credit facilities that they are able to attract. Since all cases succeeded in the attraction of sufficient capital, there was no need to apply more complex methods, such as the up-front model, in order to reach larger sizes. Their strategy to develop the credit facility in the first place often concerns the combination of public and private capital. In the U.S., public capital is one of the main drivers of new programs and commercial companies. Public capital is aggregated in green banks or governmental departments, who distribute the capital among commercial companies and program administrators.

Considering the different cases and the strategies that are applied to attract capital, this study distinguishes three strategies, the up-front model, leverage of public-private capital, and leverage of equity to attract debt. The strategies are not mutually exclusive, which means that they might be combined. The up-front model was (partly) successful applied by Zelfstroom and Bundles. 123Energie combined the up-front model with the leverage of equity to attract debt. Although they attracted a relatively large credit facility, the use of a tax credit for entrepreneurs for shareholders is questionable. Since this is the most likely reason that investors buy their equity shares, the applicability of the model in other cases is considered limited. Big Solar combines the leverage of public-private capital with the leverage of equity to attract debt. They realized the development of the largest Dutch credit facility for a commercial organization. Besides their upfront peer-to-peer lending campaign, Zelfstroom leveraged equity to attract debt. While the Energiebespaarlening leverages public-private capital, the Duurzaamheidslening relies only on public capital. *Table 16* categorizes the Dutch cases on the strategy they apply to create a credit facility.

	Up-front model	*Public-private capital*	*Equity-debt*
Up-front model	Zelfstroom (one campaign) Bundles		123Energie
Public-private capital		Energiebespaarlening	Big Solar
Equity-debt			Zelfstroom

Table 16: strategies to develop a credit facility

In the studied cases, the green banks as well as the green investment departments of commercial banks play an important role. All three ReHome programs, administrated by Renewable Funding, rely on public capital provided by public entities such as the treasury department, environmental organizations, housing corporation, and green banks. Green banks typically manage large funds, which are created by public as well as private capital. They provide financial services, which are comparable to traditional banks, only focusing on green initiatives. For the studied cases, green banks funded ReHome's program in New York as well as Sungage's credit facility. Since the program administrators are able to convince private investors of their financial expertise, they increase the effectiveness of the public capital through the leverage of private capital. Moreover, private capital is accessed through facilities of large commercial banks that are assigned to have social impact. This is illustrated by the large role of Citi, which invested in the Green Bank New York, the ReHome program in New York, Killowatt's nation wide program, and Solar City. Alternative ways of financing are deployed by Solar City and Mosaic, who used the crowd via obligations and peer-to-peer lending, respectively.

Most of the strategies could be identified as the leverage of public-private capital. Large credit facilities are provided by public entities, such as green banks, and complemented by public capital. In the Netherlands, semi governmental funds manage large amounts of public capital due to the privatization of utilities. They are the only entities that have enough capital to execute distributive activities, which could be compared to the activities executed by American Green Banks. So far, only Big Solar created access to multiple large facilities through these funds. Yet, while green banks as well as semi governmental funds are often bound to regional borders, the operation area's in the Netherlands are small compared to the U.S. The studied commercial companies need scale since their added value per unit is relatively low. While American companies can access credit facilities of approximately € 100 million if they are active in only one county through cooperation with the county's green bank, Dutch companies need to operate nation-wide to reach the same scale. To access the required credit facility to reach this scale, collaboration with a large number of semi governmental funds would be required. However, collaboration with many public partners might be difficult. The only Dutch initiative that realized such a scale, the Energiebespaarlening, did apply the public-private capital strategy. They created a credit facility, which is outstanding large compared to the other credit facilities. While it is a multiple of the value of Dutch credit facilities, it is even large compared to credit facilities of American programs, such as the ReHome program.

4.5.3. Capital replenishment

When the warehouse method is used to attract capital, the originator of the financial obligations owns the cash flow generating assets. Therefore, these assets could be used for the replenishment of credit facilities. The literature review showed that portfolio sale and securitization are the most convenient ways to use these assets in order to attract capital. In the U.S. these methods are applied to meet demand of large investors, such as institutional investors. This success might be explained by the ability of American organizations to create

a sufficient size of credit facilities on the one hand, and by the high level of development of the American capital market on the other hand. Due to provision of large credit facilities by their facility partners, the American organizations are able to wait with the attraction of capital till the aggregated pool of financial obligation is large enough to access capital on the secondary market. This is shown by Kilowatt and Renewable Funding, who are able to manage credit facilities of multiple hundreds million dollar without direct requirement to replenish their credit facility. Besides, the market for ABSs in the U.S. alone is three times larger than the total European market. Although the European market for covered bonds is significantly larger, the issuance of the ABN AMRO Bank showed that an issuance in Europe is a more complex process than in the U.S. due to the different nations in which the bond should be issued in order to reach enough investors.

While the American cases and Greenloans showed that it is indeed possible to access capital that is managed by large institutional investors, Dutch cases applied methods to access debt from smaller individual investors that are derived from securitization. Bundles and Zelfstroom applied the use of cash flows as collateral to attract debt capital in the up-front method. However, as stressed by S&P, the credit quality of the issuer of this kind of obligations is most often in the speculative-grade category. This is specifically relevant for the studied Dutch start-ups due to their limited size and track record. Yet, S&P states that the development of a SPV is an effective method to bypass this limited credit quality of the issuer since it transfers the dependency of the creditworthiness of the transaction from the organization to the collateral pool. Zelfstroom applied this theory and developed SPVs that exploit solar systems, from which they successfully sold obligations. Although the size of the SPV significantly differs with the American issuances, the structure is largely comparable. Obviously, the size of Zelfstroom's SPV did not meet the demand of institutional investors. Instead, Zelfstroom utilized a peer-to-peer lending platform to attract capital from individual private debt investors. While the issuance did not require any expensive credit rating, comparable to the American issuances, credit enhancement has been applied.

Methods that utilize the cash flow generating assets in order to attract capital have two main goals. First, it is a way to create access to capital, which could be difficult for companies with limited equity and track record. Second, it aims to minimize the costs of capital. Regardless the size of the issuance, the most important metrics that determines the cost of capital are the net loss rate, derived from the default rate and recovery rate, and the coverage ratios DSCR and DSRA. This study distinguishes between two different types of measures that aim to reduce the cost of capital, measures that are taken to manage the contract with the customer and measures that provide securities for investors. While contract management measures aim to reduce the default rate in the first place, credit enhancement measures are structured in order to reduce the risk for investors. Since credit enhancement details about Renewable Funding's portfolio sale are lacking, only the issuances of Solar City and Renovate America, and the obligation sale of Zelfstroom's SPV can be compared on their credit enhancement strategy. Concerning contract management, all cases, regardless their involvement in capital replenishment, are relevant in the analysis.

While Solar City's and Renovate America's issuances were rated by established rating agencies in order to provide sufficient information for investors, Zelfstroom only provided an information memorandum, which they prepared themselves. Nevertheless, this memo provides enough information to compare the credit enhancement among the cases. In all cases, the most important form of credit enhancement is overcollateralization. Solar City incurred the largest costs for overcollateralization. With an overcollateralization of 32%, Zelfstroom relative costs are close to Solar City's. Moreover, reserve accounts that are developed by Solar City and Zelfstroom are to a large extent comparable. While Solar City's

first two issuances as well as Zelfstroom's first issuance includes a reserve of 6 months of interest, this reserve account is enlarged to 13 months for Solar City's last issuance. Since the incoming cash flow that is not distributed to the note holders is invested in the reserve account, this account is constantly growing. Regardless Solar City's heavy investments in credit enhancement, only the senior notes of their last issuance, with a preliminary rating of BB, received a higher rating than the lowest possible rating, BBB+. According to S&P' rating services, the most important reason for this low rating is the limited track record of Solar City's as well as for solar asset in general, which result in a lack of customer performance history. Noteworthy, all Renovate America's issuances received an AA rating from KBRA. The most important reason for the significantly higher rating is that the rating agency used the performance history of real estate tax payments since the loan is repaid through the property tax. Due to their investments in credit enhancement, Solar City and Zelfstroom also realized to attract capital at a relatively low cost of 5% or less. However, when the costs for credit enhancement are reflected in the costs of capital, these costs are significantly higher.

Besides the credit enhancement measures, different contract management strategies to minimize the credit risk have been applied. The use of collateral is widely accepted as an effective measure to manage the credit risk. This research illustrates that the applicability of this measure is dependent on the nature of the energy improvement. While electrical appliances and generating measures can be used as collateral since they are removable and have a remaining value for a third party, home efficiency measures can typically not be used as collateral. In addition, the value proposition that is applied determines if collateral is used. While collateral is used in TPO- models, including both lease as well as performance-based propositions, loans that use collateral are considered secured loans. Considering the studied cases, Solar City, Sungage, Big Solar, 123Energie, Zelfstroom, and Bundles all applied a strategy that includes collateral. While Solar City and Zelfstroom already replenished capital by the use of cash flow generating assets, Sungage and Big Solar aim to apply a comparable strategy. Noteworthy, in the rating analysis and the investment memorandum of Solar City and Zelfstroom, respectively, the use of collateral is explicitly stated to be a valuable way to reduce the credit risk. Kilowatt and Renewable Funding in contrast, provide unsecured loans. However, both of them are willing to participate in securitization sooner or later. Given the costs for credit enhancement, Renovate America showed that repayment through the property tax bill is valued as a stronger measure to reduce credit risk than the use of collateral.

Besides collateral, the application of credit underwriting criteria is considered a strong measure to reduce credit risk. In the U.S., the FICO score is applied as the most convenient underwriting metric. In the Netherlands, while the debt-to-income ratio could be used as a determinative metric, different organizations offer a credit check. Moreover, a BKR check could provide insight in the customers credit history. Both Solar City as well as Zelfstroom emphasizes the reduction of credit risk due to the executed credit check. However, Urgenda argues for credit underwriting criteria that do not take into account any of these metrics of checks. According to Ms. Minnesma, only the reduction of energy costs should be taken into account. When the reduction of the energy bill exceeds the monthly payment, the customer's total energy costs are reduced, which implies that the customer should be considered suitable. This approach is in line with Renewable Funding's ReHome program, through which they provide unsecured loans and apply as less credit underwriting criteria as possible. Although both Solar City as well as Zelfstroom emphasize the reduction of energy costs for their customers, it is unknown how investors will respond to 'a reduction of the total energy costs' as the only credit underwriting criteria.

While collateral and credit underwriting criteria are used in multiple sectors, different organizations execute strategies that are only visible for the studied companies. These strategies include the leverage of OBR and PACE programs. In case of PACE programs, the repayment of the loans is attached to the property tax bill. Since rating agencies use the performance history of real estate taxes, Renovate America realized high credit ratings with little costs for credit enhancement. The showed that leverage of invoices with a long and positive performance history is highly effective. According to this result, it could be argued that the effectiveness of the leverage of another existing invoice, the traditional energy bills, would be comparable. In case of OBR programs, the obligations are paid through the energy bill. Since energy retailers have the leverage to cut households off from the grid, the default rate for energy bills is traditionally low. Comparable to the Tennessee Valley Authority, Zelfstroom does utilize this leverage since they deliver the remaining energy demand. Zelfstroom uses the average default rate of energy bills to approach the expected default rate for their SPV. According to a number of large energy retailer, this default rate is between 1.8% and 2.0%. Unfortunately, a credit rating agency never analyzed and assessed a certain construction.

This study recognizes Zelfstroom as the first organization that securitizes obligations that leverage the energy bill. Although Zelfstroom did argue that their default rate would be low based on the performance history of energy bills, they did not minimize the costs for credit enhancement. Potentially, Zelfstroom aimed to optimize their risk-return ratio of their obligations in order to prove the potential of securitization for the peer-to-peer lending market. However, based on this study, it could be argued that credit rating agencies would provide high ratings to securitization of obligations that leverage OBR programs, such as Zelfstroom and the Tennessee Valley Authority. Therefore, the delivery of the remaining energy demand, which is done by Zelfstroom, could be an effective strategy for the other studied cases. Besides, utilities have an advantage as opposed to new entrants to apply propositions that are studied in this research. Noteworthy, GTM-Research (2014) predicts the entrance of utilities in the market for the financing of residential solar as one of the most important changes in the coming years.

Besides leverage through repayment via bills with a positive performance history, strategies to manage credit risk are more focused on the customer. Renewable Funding for example, developed a dispute resolution service in order to protect the customer and increase customer satisfaction, which eventually should result in lower default rates. In line with Ms. Minnesma considerations, Renewable Funding prefers the use of a ‘reduction of the total energy costs’ as the only underwriting criteria. However, given the high valuation of collateral and underwriting criteria in the rating of Solar City’s issuances, it might be argued that the cost of capital for unsecured loans with limited underwriting criteria is high. This might be caused by either a high yield on the notes or extensive costs for credit enhancement. Nevertheless, the perceived credit risk can be significantly reduced through the development of a track record. Therefore, a certain strategy could be more effective after a number of years, when a track record of obligations related to energy improvements is developed. Besides traditional contract management methods, innovative methods that manage credit risk should be considered. As recognized by Renewable Funding, Mr. Dijk of the Rabobank, and Bundles, a more psychological approach that emphasizes social factors, such as engagement and the membership of a community, could be value to manage credit risk. While Mr. Dijk stresses the importance of social engagement in associations and energy cooperatives, Bundles manages its customers as a community, which increases the involvement. Potentially, the social pressure among members of an association, cooperative,

or community will reduce the default rate. The full framework, including all activities that should be considered in the process of capital replenishment is provided in *figure 10*.

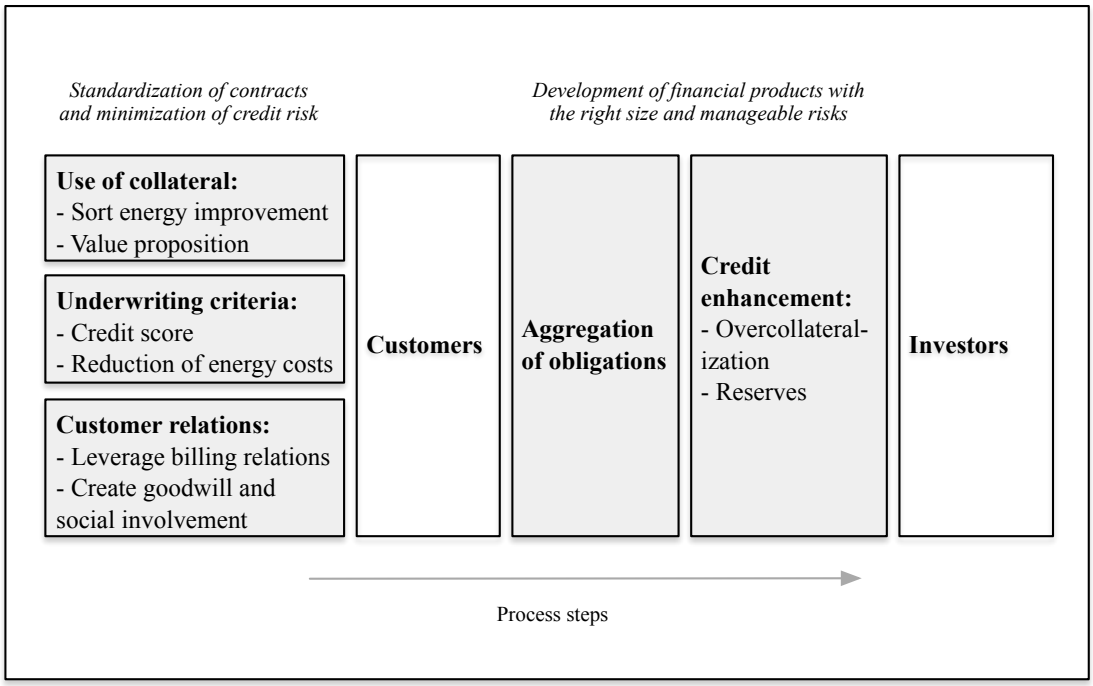

Figure 10: activities in the process of capital replenishment

5. Conclusion

This research found that the upfront cost is one of the most important considerations for households to invest in energy improvements. Therefore, value propositions that eliminate the upfront costs for customers emerged. Securitization is assessed as a highly effective strategy to attract capital for capital-intensive organization in the Netherlands, when it is combined with the warehouse model, as well as in the U.S. An organization's ability to deploy this strategy successfully depends on a number of variables, such as their business structure, including their financial expertise regarding the structuring of financial products, and contract management strategies. The ability to create a sufficient package of obligation that can be securitized depends on their ability to create a credit facility and stimulate demand through a valuable proposition, including positioning on the trade-off between financial incentives and service, and sufficient marketing. For these purposes, the contextual environment is of great influence.

While the high upfront investments are considered a significant barrier for most energy improvements, only Bundles exploits efficient electrical appliances through such as proposition. For appliances, the difference between the upfront costs compared to the average costs is limited, which suggests that the high upfront costs are less important. Besides, suspicion against financial obligations and long-term contracts in the Netherlands should be considered. This might be a larger barrier than the upfront costs itself, resulting in a low deployment of financial products in the Netherlands. For organizations, transparency is of great importance to manage customer suspicion. Besides, this study found that propositions that offer a high service level, including reduction of transaction costs and risks, usually provide a lower incentive for their customers. This trade-off is visualized in *figure 8*.

In the literature review, 16 potential business structures, derived from a combination of energy improvements, value propositions, and market players, were identified. Through study of the American cases, the additional market program administrators and vertically integrated ESCOs were identified. Specifically the business structure of the program administer is considered potentially valuable. This is reflected in the financial expertise of the market player, which enables them to structure financial products for the secondary market, including the required credit enhancement, and design contract management standards, regarding the use of collateral, underwriting criteria, and customer relation management. Thus, business structures can be accessed on their ability to create value for customers on the one hand, and enable access to capital on the other hand.

The cases showed that the distinction between the up-front and warehouse model as strategies to access capital are highly relevant. The Dutch cases used these strategies to access capital from individual investors. In order to create credit facilities in the warehouse model, public capital is combined with private capital and equity is leveraged to attract debt. For American cases, a distinction between the two strategies is not relevant since all cases are able to access large credit facilities without the use of collateral, which allows them to replenish capital on the secondary market. A combination between public and private capital is the most applied strategy to create a credit facility in the U.S. For the replenishment of capital, securitization is considered an effective method, regardless the sort of investor.

Regarding the contextual environment, the limited opportunity to access capital and reach sufficient scale is striking for the Dutch cases. This limits access to operational capital to develop resources to increase efficiency and to the secondary market that could limit the cost of capital. This is explained by the relatively dispersed character of the market for public capital, given the size of the Dutch market. Besides, the Dutch regulatory environment limits the marketing activities of market players and the ability to apply certain value propositions

for some market players. In addition, American policies, such as the tax incentive for solar and PACE programs, have a large effect on the development of the market.

5.1. Recommendations for future research

Currently, propositions that eliminate the upfront costs for energy improvements are applied relatively recently. Most likely, the business number of organizations that apply such propositions will increase and the business structure will diversify. Besides, multiple interviewees emphasized that the regulatory environment could change due to advanced knowledge about the effectiveness of certain regulations. Thus, the market that is studied in this research is expected to change. Future research could study the data that will develop in the coming years to increase the validity of the findings of this research. Specifically, the internal and external validity might be increased due to complementary studies. More cases that provide data regarding their contract management strategy and the applied credit enhancement measures, including the use of collateral, underwriting criteria, customer relation management measures, and credit enhancement measures, and the correlation with the ability to attract capital would increase the internal validity. Besides, an increased number of cases would most likely increase literal and theoretical replications, which would increase the external validity of the findings.

Besides the improvement of the validity, future research could focus on the potential of innovative methods, regarding customers relations, to minimize credit risks. Since empirical data form such methods for the exploitation of energy improvements is lacking, research might include experiments executed by organizations that exploit energy improvements or research to the effect of social involvement on credit risks in other sectors. Options could be the comparison of traditional default rates for certain products or services as opposed to the default rate for the same products or services when they are accessed through the membership of a community or cooperative. Another high potential strategy, which could be applied more extensively in the Netherlands, is the leverage of billing relations through OBR programs. Future research could study the potential for this method to minimize credit risk. This research found that costs for credit enhancement are significantly high. Future research might focus on the effect of the different contract management measures, including the use of collateral, credit underwriting criteria, and customer relation management, on the required costs for credit enhancement. This would enable organizations to effectively structure their contracts in order to minimize credit risk.

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Appendix 1: data sources case study

	Organization	Document	Reference
American market	State & Local Energy Efficiency Action Network (SEE-Action)	Market insight report / roadmap: efficiency financing programs	(SEE-Action, 2014a)
	SEE-Action	Market insight report / roadmap: accessing the secondary market as capital source	(SEE-Action, 2015)
	Sifma	Market insight report	(Sifma, 2014)
	Solar Access to Public Capital (SAPC)	Market insight report / roadmap: best practices in PV System Installation	(SAPC, 2015a)
	SAPC	Market insight report / roadmap: best Practices in PV System Operations and Maintenance	(SAPC, 2015b)
	National Renewable Energy Laboratory (NREL)	Market insight report	(NREL, 2014)
	NREL	Market insight report	(NREL, 2013)
	PWC	Market insight report	(PWC, 2015)
	Bloomberg New Energy Finance (BNEF)	Market insight report	(BNEF, 2014b)
	BNEF	Market insight report	(BNEF, 2014a)
Sungage	Sungage	Commercial statement	(Sungage-Financial, 2015)
	Sungage	Announcement	(Sungage-Financial, 2014)
Solar City	Solar City	Public document: annual report 2014	(SolarCity, 2015a)
	S&P Rating services	Public document: Rating first issuance	(S&P Rating Services, 2013)
	S&P Rating services	Public document: Rating second issuance	(S&P Rating Services, 2014a)
	S&P Rating services	Public document: Rating third issuance	(S&P Rating Services, 2014b)
Kilowatt	Kilowatt	Commercial statement	(Kilowatt-Financial, 2015)
Renewable Funding	Renewable Funding	Commercial statement	(Renewable-Funding, 2015)
	Crunchbase	Announcement	(Crunchbase, 2014)
Renovate America	Kroll Bond Rating Agency (KBRA)	Public document: Rating first issuance	(KBRA, 2014a)
	KBRA	Public document: Rating second issuance	(KBRA, 2014b)
	KBRA	Public document: Rating third issuance	(KBRA, 2015a)
	KBRA	Public document: Rating fourth issuance	(KBRA, 2015b)
	SEE-Action	Market insight report: secondary market	(SEE-Action, 2015)
Tennessee Valley	SEE-Action	Market insight report: on-bill	(SEE-Action, 2014b)

Authority		financing	
Rent-A-Center	Rent-A-Center	Public document: annual report 2014	(Rent-A-Center, 2015)
Aaron's	Aaron's	Public document: annual report 2014	(Aaron's, 2015)
Dutch market	Urgenda	Roadmap	(Urgenda, 2014)
	Zelfstroom	Public document: Investor information	(Zelfstroom, 2015b)
	Nederlandse Vereniging voor Participatiemaat-schappijen	Market insight report: capital markets 2014	(NVP, 2015)
	KplusV	Market insight report: semi-governmental funds	(KplusV, 2014)
	AFME	Market insight report: financial market	(afme, 2015)
Greenloans	Greenloans	Commercial statement: Customer information brochure	(Greenloans, 2015)
	ABN AMRO	Announcement	(ABN-AMRO, 2015)
Energiebespaar-lening	Energiebespaarlening	Commercial statement: Customer information brochure	(Energiebespaarlening, 2014)
	Energiebespaarlening	Public document: annual report 2014	(Energiebespaarlening, 2015)
	SVn	Public document: annual report 2014	(SVn, 2015)
Duurzaamheids-lening	SVn	Public document: annual report 2014	(SVn, 2015)
Big Solar	Big Solar	Commercial statement: Customer information brochure	(BigSolar, 2015)
	Financieel Dagblad	Announcement: Organization profile	(Simons, 2015)
123Energie	123Energie	Public document: Information memorandum: 1st series	(123Energie, 2013)
	123Energie	Public document: Information memorandum: 2nd series	(123Energie, 2014)
Solease	Soleae	Public document: Customer information brochure	(Solease, 2015)
Zelfstroom	Zelfstroom	Public document: Information memorandum: equity shares Zelfstroom B.V.	(Zelfstroom, 2015b)
	Zelfstroom	Public document: Information memorandum: obligations Zelfstroom SPV 2 B.V.	(Zelfstroom, 2015a)
	Zelfstroom	Public document: Investor information: cash flow predictions	(Zelfstroom, 2015c)
Bundles	Bundles	Commercial statement: Customer information brochure	(Bundles, 2015)

Appendix 2: approached stakeholders

Stakeholder category	Name	Person	Status
Organization / organization	Greenloans	Mr. Van der Scheur	Interview
	ABN AMRO	Mr. Bikker	Not available for comments
		Mr. Cracau	Not available for comments
	Energiebespaarlening	Mr. de Roo	Not available for comments
		Mr. Krom	Not available for comments
	Ministry	Mr. Smallenbroek	Not available for comments
	SVn	Mr. Veldman	Questions per mail
	Big Solar	Mr. Elias	Interview
	Solease	Info	Not available for comments
	123Energie	Info	Not available for comments
	Zelfstroom	Info	Not available for comments
	Bundles	Mr. Peters	Interview
NGOs	Urgenda	Ms. Minnesma	Interview
Financial entities	Triodos	Mr. Van Donk	Interview
	Rabobank	Mr. Dijk	Interview
Consultancy	Turntoo	Anonymous	Interview
	Platform31	Mr. Van den Groep	Interview
Different	Qurrent	Mr. Slieker	Not available for comments