RENONBILL

UPSCALING THE RESIDENTIAL SECTOR WITH ON-BILL SCHEMES

Replicability potential in the EU

2020 NOVEMBER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847056.

Project Acronym	RenOnBIll
Project Name	Residential building energy rENovations with ON-BILL Financing
Project Coordinator	Paolo Michele Sonvilla Senior Manager - Creara pms@creara.es Velázquez 157 - 5ª Planta 28012 – Madrid (Spain)
Project Duration	2019 - 2022
Website	www.renonbill.eu

Deliverable No.	2.3
Dissemination Level	Public
Work Package	2
Lead beneficiary	UNIGE
Contributing beneficiary(ies)	EPTA, adelphi, Creara
Author(s)	Vincenzo Bianco (UNIGE)
Co-author(s)	Paolo Michele Sonvilla (Creara), Michele Russo (Epta Prime), Gianpiero Poddighe (Epta Prime), Chiara Marafioti (UNIGE)
Reviewed by	Sophia Stock (adelphi), Annalisa Marchitto (UNIGE), Adriana Villoslada (Creara), David Perez Navarro (Creara)
Date	02/12/2020
File Name	201202_ROB_WP2_D2.3_Barrier_Analysis_Final_v2

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847056.

Legal Notice

The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither EASME nor the European Commission is responsible for any use that may be made of the information contained therein

TABLE OF CONTENT

CONTENTS

The present document aims at **analysing the possible challenges for the implementation of on-bill schemes (OBS) in the European context**. A specific focus is given to the target countries of the RenOnBill project, namely **Germany, Italy, Spain and Lithuania**, but results can be applied to other countries.

Chapter 1 offers a **general overview of the barriers related to energy efficiency investments**. In particular, the focus is placed on regulatory, end-users, providers of energy services and financing barriers. These challenges are general and therefore they apply to energy renovations realised via OBS as well.

Chapter 2 focuses on **specific barriers related to OBS** which are necessary to consider on top of the general ones discussed in Chapter 1. In particular, we discuss regulatory issues related to financial regulation, challenges connected with final users (especially in connection with the tenant-owner dilemma), and finally concerns related to utilities' strategic and operational management are examined.

Chapter 3 explores the **opportunities for the implementation of OBS in Europe**, with specific focus on Germany, Italy, Spain and Lithuania. The analysis is developed along three dimensions, namely market readiness, legal and regulatory framework and utilities' operational issues.

Chapter 4 introduces the analysis of the **enabling and disabling factors** that can influence the development of OBS. In particular, three dimensions are analysed, namely market readiness, legal & regulatory framework and operational issues for the utilities. The analysis is developed with an in-depth detail for RenOnBill target countries, i.e. Germany, Italy, Spain and Lithuania, and then overall considerations for EU as a whole are given, with a more specific focus on France, Belgium and The Netherlands.

Chapter 5 introduces **eleven OBS business models** which could be implemented in the EU context. The basic structure of the models is discussed, and the main key-players involved in the process are indicated.

Chapter 6 contains the **conclusions**, highlighting the main points discussed in the report.

1 INTRODUCTION

It is well known that nowadays there is availability of reliable and economically convenient technologies to increase energy efficiency of buildings, but there are difficulties in spreading their exploitation. This results in a significant untapped energy efficiency potential, which is necessary to exploit in order to increase the sustainability of the building sector (van Aerschot, 2008).

The comprehension of barriers which are hampering the energy efficiency potential is of fundamental importance, as its exploitation will support massive energy savings and the de-carbonisation of the building sector, which is today responsible for 40% of energy consumption worldwide (EU, 2020).

With respect to other sector of economic activities, **the buildings sector is dominated by a large amount of stakeholders involved in the value chain** and, in general, the dimensions of the companies involved is rather small (van Aerschot, 2008).

This creates a multitude of divergent interests and conflicts all along the value chain, which obstructs the introduction of innovations in its different phases (e.g. design, construction, financing, etc.), since decisions are often driven by short terms benefits. Usually, all the actors involved in the different levels of the value chain work independently from each other, without any degree of integration. **This lack of integration generates inefficiencies and barriers to the implementation of innovative approaches and solutions.**

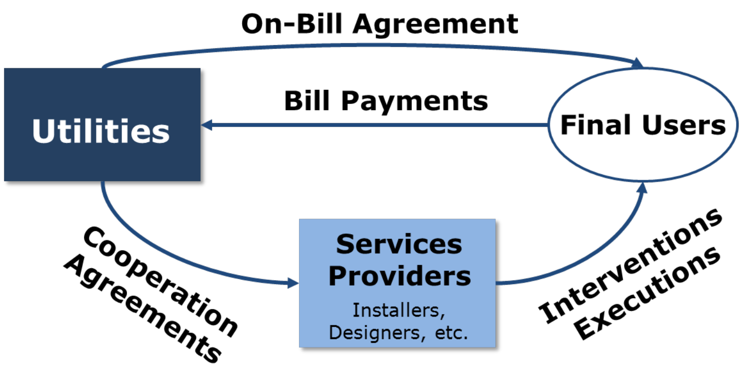

Figure 1.1 – Relationships in the implementation of On-Bill schemes

To face with all the difficulties related to the implementation of energy efficiency measures, especially in the residential sector where final users are often not confident with energy issues, **it is necessary to introduce innovative approaches, which motivate owners and tenants to act.**

On-bill mechanisms have the potential to be a successful approach to stimulate the implementation of energy efficiency measures, as **they can be seen as a "bottom-up" mechanism promoted by the energy utilities**, which directly approaches the final users without the "classical" intermediaries of the buildings value chain (e.g. designers, construction companies, etc.), as shown in Figure 1.1. These actors are involved in the process with the role of "service providers", often engaged by the utilities and not by the final users, i.e. in a B2B relationship.

It is believed that this approach might be effective in supporting the renovation of existing buildings, but, due to the *energy paradox*[1], it is realistic that possible obstacles will limit their effectiveness.

For such a reason, **a detailed analysis of the possible barriers to the implementation and diffusion of energy efficiency measures and on-bill schemes (OBS) will be developed in the following sections**.

In particular, the following issues will be addressed:

- Analysis of the general barriers to the implementation of energy efficiency measures;
- Specific challenges related to the development of on-bill schemes;
- SWOT analysis related to energy utilities;
- Review of the enabling & disabling environment in RenOnBill target countries;
- Presentation of a set of possible business models for the implementation of on-bill schemes.

[1] Energy paradox, as explained by (O'Malley, et al., 2004), refers to *"postulated mechanisms that inhibit investments in technologies that are both energy efficient and economically sound"*.

2 BARRIERS TO THE IMPLEMENTATION OF ENERGY EFFICIENCY INTERVENTIONS

The analysis of the barriers to the large-scale implementation of energy efficiency projects is a topic of relevant interest for many energy economics and policy studies (IEA, 2011). Different reports and analyses trying to understand and explain the reasons behind this somehow "economic irrational" phenomenon is available. **In general, the barriers are classified in four categories**, namely:

- **Policy and regulatory barriers**
- **Barriers related to end users**
- **Barriers related to providers of energy services**
- **Financing barriers**

The main features of each barrier are illustrated in Figure 2.1.

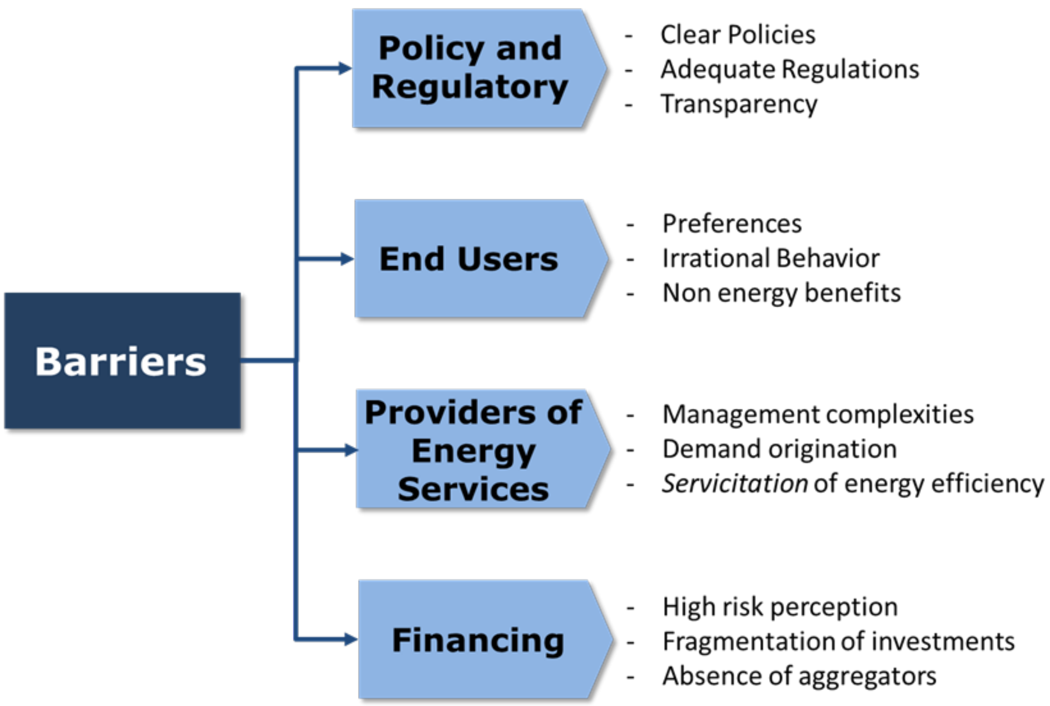

Figure 2.1 – Main features of the identified barriers to investments in energy efficiency

2.1 Policy and regulatory barriers

Policies and regulations have a fundamental role in promoting the development of energy efficiency interventions, thus the availability of a clear and effective framework is a necessary premise.

Usually governments, both at central or local level, develop policies to support the implementation of energy efficiency measures, but if the mechanism is unclear or too complex, market failures are relevant, as is the case of the Green Deal in UK (Rosenow, et al., 2013), and this may also determine a lack of interest of final users in energy efficiency investments.

Supporting policies and regulations should be developed in a harmonised way, as the design of good policies, without a clear regulatory framework which allows their smooth implementation, creates uncertainty conditions.

The definition of clear energy efficiency standards, which consent the undoubted measurement of targeted saving levels, is mandatory to provide clear certain references to final users. In the absence of such a framework, investors are discouraged in investing in energy efficiency as the uncertainties result to be too many and difficult to hedge.

Policy and regulatory barriers are difficult to overcome, as they are symptomatic of the absence or unclearness of the basic rules for evaluating and implementing energy efficiency investments. These barriers can be only removed at governmental level.

2.2 End-Users related Barriers

Final users are often characterised by the presence of specific barriers to the implementation of energy efficiency measures, **namely preferences and irrational behaviour** (Cattaneo, 2019). These two features set a **relevant distance from the classical assumption of rational consumer**, therefore other variables, often difficult to predict, affect the investment of choices provoking effects which are unexpected. Figure 2.2 reports a summary of the different components affecting end users.

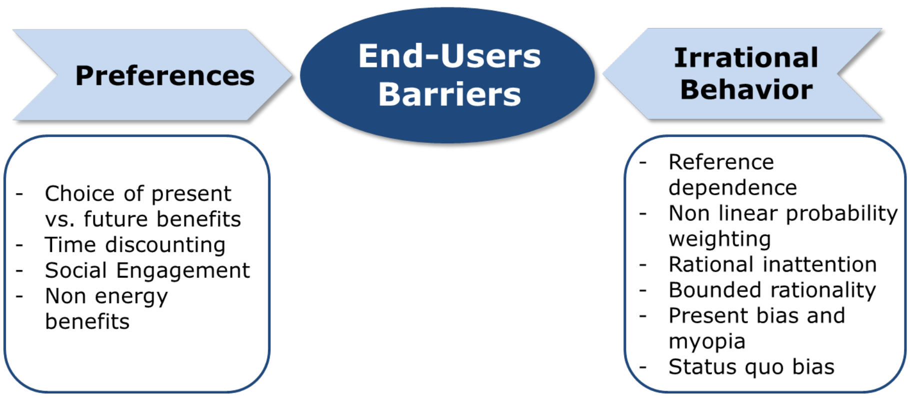

Figure 2.2 – Main components characterizing the end-users' barriers

Investments in energy efficiency are largely affected by these variables, since it is seen as an immaterial investment, whose benefits can be only appreciated in the future.

As discussed in (Schleich, et al., 2016), **consumers have a time preference** which is considered in time discounting, namely how consumers attribute a value to time. In general, it is assumed that **consumers attribute more value to the present rather than to the future**, as they want to obtain immediately the benefits of their investment. The transposition of this principle in the field of energy efficiency leads to the conclusion that, in general, **consumers will opt for energy saving investments with an immediate benefit** (e.g. substitution of an old equipment with a new one more efficient, but with more functionalities) or they opt for other concurrent investments.

In light of this, in order **to promote investments in energy efficiency, it is fundamental to work also on other components**, more **connected with the emotional sphere**. Two examples can be represented respectively by social engagement and non-energy benefits.

As for the social engagement, it is important to communicate the message that energy efficiency is a duty of the society, in order to reduce the environmental pressure on the planet due to our lifestyle. This is valid for both private individuals and companies.

Irrational Behaviours	Description
Reference Dependence	• Costs and Benefits evaluated with respect an own reference point, rather than with respect to a "neutral baseline"
Non-linear Probability Weighting	• Attitude to overestimate small probabilities having a negative impact with respect to possible large probabilities having a positive impact
Rational Inattention	• Systematic under-evaluation of product attributes. • Energy efficiency measures investments/operating costs usually under/over -estimated leading to wrong choices.
Bounded Rationality	• Average people not able to process all the available information. • Decision often taken on the basis of *instinct or rules of thumb*
Present Bias and Myopia	• Present bias: impact of current conditions on choices affecting the long run • Myopia: lack of foresight ability
Status quo bias	• Inertia opposed by consumers to the change • Preference for current conditions rather than opting for a change/updates

Table 2.1 – Definition of Irrational Behaviours (Cattaneo, 2019), (Schleich, et al., 2016), (Allcott & Wozny, 2014), (Busse, et al., 2013), (Alberini, et al., 2013)

Instead, non-energy benefits are linked with advantages obtained from investments in energy efficiency not directly linked with energy savings. For example, the installation of thermal insulation on the building walls or the introduction glazed windows allows to save energy and recover the investment in the long period, but it also immediately improves the internal comfort of the dwellings. Table 2.1 lists and describes the typical irrational behaviours and Table 2.2 reports the possible impacts and actions to overcome them.

	Dimension	Impact	Action
Preference	Time Preference	• More values attributed to the present • Inclination for energy efficiency investment with immediate benefit • Underestimation of the life cycle impact of the intervention	• Educational information campaign • Data transparency for developing self-developed calculations • Development of simple calculation tools (e.g. web based, app, etc.)
	Social Engagement	• Solicitation of the emotional sphere • Societal impact	• Targeted communication campaigns
	Non-Energy Benefits	• Increased level of convenience • Solution to other issues (e.g. comfort)	• Communication campaigns • Engagement with designers and installers
Irrational Behaviour	Reference Dependence	• Own reference point • Absence of a neutral baseline • Wrong analyses/ conclusions	• Opinion making through opinion leaders • Transparency in communication • Promotion of neutral third parties baseline
	Non Linear Probability Weighting	• Overestimation of small probabilities • Unilaterally high risk perceived	• Educational activity • Support to institutional campaigns delivered by neutral third parties
	Rational Inattention	• Under-evaluation of product attributes • Energy operating cost often underestimated	• Clear communication • Data transparency
	Bounded Rationality	• Inability in processing all the available information • Lack of know-how	• Education activities • Targeted communication campaigns
	Present Bias & Myopia	• Lack of foresight ability • Overestimation of the impact of present conditions on the future development • Inability in having a future view	• Educational activities • Opinion leaders messages • Neutral third parties information
	Status-quo Bias	• Opposition to changes • Behavioural inertia	• Information campaigns • Awareness raising

Table 2.2 – Summary of end-user related barriers, possible impact and actions to overcome them

2.3 Energy Services Providers Barriers

Companies involved in energy services for buildings have a major role in promoting the implementation of energy efficiency measures, but sometime their organisation hampers the diffusion of energy savings actions on large scale.

In particular, to spread the implementation of energy efficiency actions it is relevant to target the residential sector. This sector is difficult to manage, since a significant stimulus and effort are necessary to catch its attention due to the fact that household owners behaviour is far to be rational. In order to reach such a large customer basis, the involvement of energy utilities, which are already in contact with the customers, can be useful.

However, for utilities it can very complicated to structure services for energy efficiency due to management complexities. Specifically, it results problematic to structure all the service line, from its financing to the practical implementation. It is necessary to create ad hoc structures within utilities to provide energy efficiency services, and a very challenging issue is the management of the large number of contractors on the territory in order to implement the concrete interventions.

Furthermore, there is the necessity to invest in marketing and communications actions to stimulate the demand in a targeted way in order to remove the behavioural barriers previously analysed.

On the other hand, it is to be said that the business models of energy utilities are changing and some of them are moving toward a model based on the *servicitation* of energy efficiency (Bianco, 2018). **This means that energy efficiency is sold as a set of services, rather than as an investment in household renovation or in changing of equipment**.

2.4 Financing Barriers

Financing barriers are considered the most challenging obstacle to overcome in order to support the mass market implementation of energy efficiency measures (IEA, 2011). In particular, banks and financial institutions are in general quite sceptical about providing loans for the implementation of energy efficiency investments, even though projects are very profitable. This is probably due to their lack of knowledge regarding energy efficiency, which also determines a risk perception higher than the necessary level (IEA, 2011). As suggested by Limaye (Limaye, 2011), (Limaye & Limaye, 2011), the financing barriers can be classified in five typologies, as shown in Figure 2.3 (IEA, 2011).

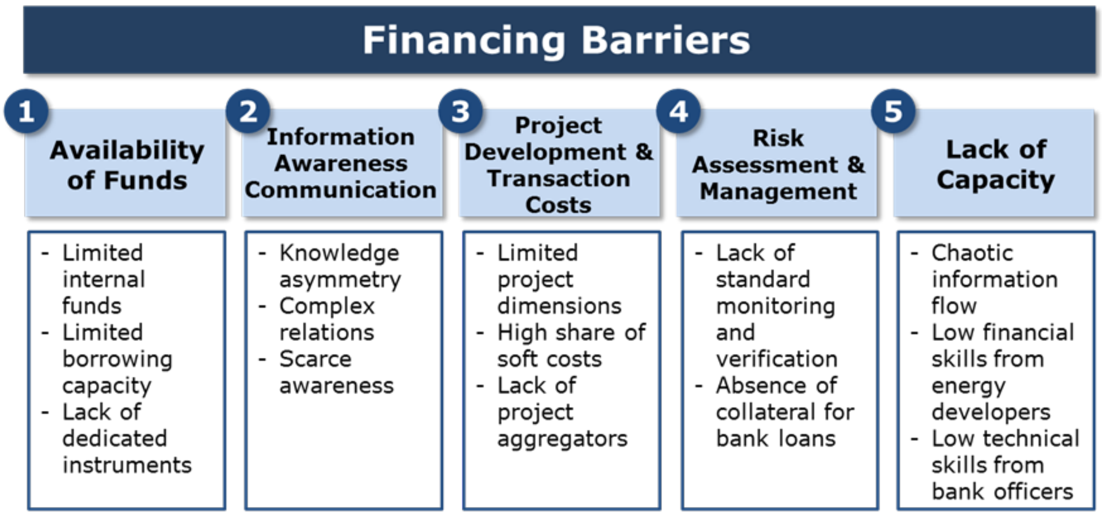

Figure 2.3 – Illustration of the main financing barriers

The main characteristics of each of the highlighted barrier are discussed in the following:

- **Availability of funds.** Households owners usually do not have the capacity to sustain the high upfront costs related to the implementation of energy efficiency measures, thus it is necessary to find third parties sources in order to finance these investments.
- **Information, awareness and communication.** Financial institutions generally highlight a knowledge gap towards investments in energy efficiency measures. This class of investments is perceived as complicated to evaluate and it is required a deep technical knowledge to perform accurate analyses.
- **Project development and transaction costs.** Usually the average dimension of energy efficiency project is quite small, therefore they do not result attractive for financial institutions. The management of a number of small projects is rather expensive, as it is necessary to assist a multitude of fragmented clients, which determines a substantial increase of the transaction costs.
- **Risk assessment and management.** Investments in energy efficiency are perceived as high risky for a number of reasons. Firstly, it can be said that the financed assets have no or little residual operating life, therefore they cannot be used as collateral against a bank loan (IEA, 2011).

  Lack of capacity. The parties involved in the development of energy efficiency projects often have very different backgrounds and this causes chaotic information flow among them.

3 BARRIERS TO THE IMPLEMENTATION OF ON-BILL SCHEMES IN EUROPE

On-bill schemes are one of the possible answers to overcome the barriers to the implementation of energy efficiency measures previously discussed.

In particular, they act on the financing barriers for both end-users and financial institutions. Namely, end-users are supported in facing with high upfront costs of the investments, whereas financial institutions can relate with aggregators, i.e. utilities, which can bundle a set of small investments, in order to reach an optimal investment size for financial institutions by avoiding the fragmentation and the high incidence of transaction costs.

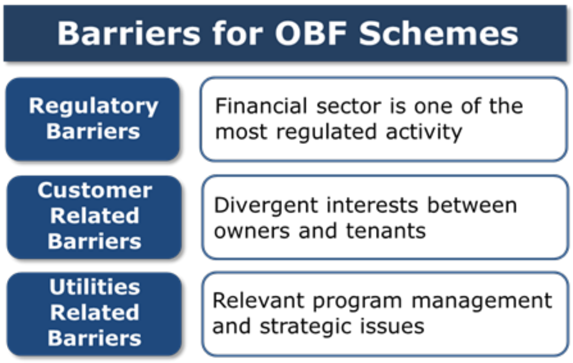

Figure 3.1 – Main barriers categories to the implementation of On-Bill schemes

On-bill mechanisms have proved to be quite successful in the USA context, but the market context is different from the EU one, therefore it is necessary to analyse which are the possible barriers to their implementation in EU.

On top of the obstacles present for the implementation of energy efficiency measures presented in the previous sectors, **the barriers to the diffusion of OBS mechanisms can be framed into three categories, namely regulatory, customers related, and utilities related**, as shown in Figure 3.1.

3.1 Regulatory Barriers

In principle on-bill schemes are frameworks developed by private companies, e.g. utilities in cooperation with financial institutions and installers, **therefore there is not the requirement of specific regulations or legislation framework to run these schemes.**

On the other hand, as also discussed in (ACEEE, 2020), **there could be conflicts with the EU and specific countries regulations on financial institutions**. **On-bill schemes comprise the collection of payments from the utilities**, which is one of the business core competences, **but they also include the lending of money which is a core competence of financial institutions**.

This aspect could represent an impediment to the develop of such a kind of energy efficiency financing mechanisms and it is necessary to structure the programs in a correct way, in order to be compliant with all the related prescriptions.

In particular, EU regulation defines as a **"credit institution"** an *"undertaking the business of which is to take deposits or other repayable funds from the public and to grant credits for its own account"*. No matter the type of credit it grants, a credit institution is required to obtain authorisation from the competent authority (usually the Central Bank) before commencing its activity, which is also subject to prudential supervision. (**Directive 2013/36/EU and Regulation (EU) No 575/2013**).

A creditor not falling into the category of "credit institutions" differs from the latter because it does not collect funds from the public.

If "credit institutions" are always subject to authorisation and oversight, for **creditors "non-credit institutions"** the explicit provision about some form of oversight and control can be found with respect to at least two cases in particular, which are relevant to the OBS: (i) credit agreements for consumers relating to residential immovable property, and (ii) credit agreements for consumers.

With respect to the first case, i.e. for **credit agreements for consumers on residential immovable property, secured** either by a mortgage or by another comparable security commonly used in a Member State or by a right related to residential immovable property[2] and granted for various purposes, **included the renovation of the property**, the EU regulation provides that Member States shall ensure that non-credit institutions are subject to adequate admission process including entering the non-credit institution in a register and supervision arrangements by a competent authority (**Directive 2014/17/EU on credit agreements for consumers relating to residential immovable property**).

With respect to the second case, i.e. **for credit agreements for consumers, granted by a creditor in the course of their trade, business or profession[3]**, and amounting

[2] The directive applies also to credit agreements the purpose of which is to acquire or retain property rights in land or in an existing or projected building.

[3] Credit different, among others, from those secured either by a mortgage or by another comparable security commonly used in a Member State on immovable property or secured by a right related to immovable property, or from those whose purpose is to acquire or retain property rights in land or in an existing or projected building, or from those where the credit is granted free of interest and without any other charges, or from those in the form of an overdraft facility and where the credit has to be repaid within one month, or from those

to a sum between 200 euros and 75.000 euros (but, if finalised to the renovation of a residential property, also to a sum higher than 75.000 euros[4]), the EU regulation provides that Member States shall ensure that creditors are supervised by a body or authority independent from financial institutions, or regulated. (**Directive 2008/48/EC on credit agreements for consumers**).

Therefore, **a utility which performs the above-mentioned lending/credit activity should be subject to a form of oversight in its country by a relevant public authority**. **Implementation of such a regulation in European countries may differ in the level of tightness of the limits**, e.g. in Italy lending activity (with interest) appears to be restricted to entities which hold a financial institution "licence".

Furthermore, there could be ethical and regulatory concerns about the possibility of disconnections from energy supply in case of non-payment of the bills; clarity on this issue is mandatory for utilities which want to develop OBS services.

Usually this matter is regulated at national level by the national regulatory authorities of electricity and natural gas markets, which set the parameters to allow the disconnections for non-paying the supply and the connected services. **Often, there are categories of customers which cannot be disconnected in any case**.

3.2 End user related barriers

The barriers characterizing the final users are many of those discussed in the previous sections, but in the case of OBS some other observations are relevant.

In particular, **there is the issue related to the "split incentives" between tenants and owners**, which is largely debated in the literature (Bird & Hernández, 2012), (Gillingham, et al., 2012), (Charlier, 2015), (Maruejols & Young, 2011) [16-19].

The problem of split incentives arises whenever there is an unbalanced distribution of the benefits of any transaction. In the context of energy efficiency in buildings, split incentives are linked to the cost recovery issues related to energy efficiency investments (Castellazzi, et al., 2017).

In general, in order to overcome the issue of the split incentives, it is necessary that the benefits of energy efficiency programs are split between the owner and tenant. For example, a share of the energy benefits could be used to for investment repayments (Economidou, 2014).

---

under the terms of which the credit has to be repaid within three months and only insignificant charges are payable.

[4] Provision amended by Directive 2014/17/EU.

In fact, **owners are not interested in investing in energy savings measures which will be exploited by tenants and tenants are not willing to make investments in units they do not own**. Furthermore, the implementation of energy measures is supposed to determine an increase in the value of the property. On **the other hand, the owner will materially appreciate this increase**, if recognised by the market, only **if the property is sold or rent** is **increased**. **On the contrary, the benefit for the owner is only theoretical**.

This situation may result in inaction from both the actors involved in the process, namely the owner and the tenant, despite the fact that many of the investments have a positive NPV. Split incentives can be classified in four different categories (Castellazzi, et al., 2017):

- **Energy related split incentives** (ESI): in this situation the tenant is in charge of paying bills, but it cannot implement interventions for reducing energy consumption. At the same time, the landlord is not interested in performing energy efficiency investments, since the financial benefits (i.e. reduced bills) will be exploited by the tenant.
- **Usage related split incentives** (USI): this situation happens when tenants do not pay energy bills, which are included in the monthly rent. Under these conditions tenants are not interested in reducing their energy consumption and possible investments in energy efficiency measures by the owners are discouraged.
- **Multi tenants, multi owners split incentives** (MSI): this issue affects multi-tenants and multi-owners buildings, where collective decisions are to be taken. In these situations, it is evident the conflict among the interests of the different stakeholders (e.g. tenants-owner, tenants paying rent, owners of rented dwellings). Renovation projects can be implemented only if the majority of the consensus is obtained and this represents a relevant barrier to the development of energy efficiency measures.
- **Temporal split incentives** (TSI): this condition refers to the situation where the energy efficiency investment will not pay-back before the transfer of the property to the next tenant or owner. This uncertainty prevents the implementation of energy efficiency measures.

Successful OBS should consider incentives for all the stakeholders involved in the process, in particular owners, tenants, utilities and banks. Specifically, a form of incentive should be foreseen for owners in OBS targeting rented dwellings (Economidou, 2014).

The most relevant typologies of split incentives for OBS are represented by ESI and TSI. OBS allow to solve partially the issue of sourcing upfront capital (e.g. ESI for tenants paying rent, but authorisation from the owner still necessary), but **the temporal dilemma is an open issue to be addressed**.

USI and MSI are to be taken into account, but they do not appear relevant for OBS, as they cannot be addressed with such a mechanism. In particular, USI is to be approached with a stimulus towards *behavioural changes* and MSI is an issue of *administrative nature*.

Two different cases of TSI can be considered in the cases of OBS.

3.2.1 OBS subscribed by a tenant paying the rent

This case is the most complex to consider. A tenant may subscribe an OBS scheme and before paying back the energy efficiency investment, the property is left. In such a case it is necessary the somebody else substitutes the tenant. To overcome this issue, a possible solution could be *to attach* the OBS to the meter, so that the next tenant will take care of the payment of the remaining instalments of the OBS.

This solution is reasonable from the economic point of view, as the subject who benefits from efficiency measures (e.g. cheaper bills) repays the investment. On the other hand, this mechanism works in areas where the renting market is dynamic, and it is unlikely to have unused dwellings.

In different conditions the mechanism is complicated to implement, and different solutions need to be found. Furthermore, there could be a regulatory problem at EU level, as the next tenant is not free to choose its energy supplier. It needs to keep the previous one in order to complete the repayment of the OBS attached to the meter. To avoid such issues, utilities usually target small investments with quick pay-back for their on-bill programs. If larger investments are targeted, it is necessary to introduce other solutions, such as regulatory ones, that may permit the transfer of the debt between utilities.

A possible idea to overcome this issue could be to consider the DSOs as a servicer for OBS. The DSO may collect the repayments from final users and then distribute them to the corresponding utilities. In this way, if the final user decides to change utility, the energy component can be paid to the new supplier, whereas the on-bill program is paid to the DSO which in turn transfers the money to the utility which originally implemented the energy renovation. A more in-depth discussion related to this scheme is reported in section 5.7.1.

3.2.2 OBS subscribed by an owner

In this situation the meter attachment criterion can be applied as well and, in case of sale, the new owner will substitute the previous one. Alternatively, the remaining instalments of the OBS might be paid to the utilities in one solution and transfer this payment in the value of the property which is sold. This is reasonable from the economic point of view as the next owner will get the benefit for the remaining part of the operating life of the energy efficiency measures.

It can be said that the first case can be much more frequent with respect to the second one and it is therefore necessary to find possible solutions to be included in OBS for the EU market.

3.3 Utilities related barriers

Other reasons which can prevent the implementation of OBF mechanisms are to be found within the utilities, which may show inertia to their introduction due to concerns in two main areas, namely corporate strategy and programs operation.

3.3.1 Corporate strategy

This concern is sensitive for companies which integrate the generation and/or extraction of energy (e.g. electric and natural gas utilities) with sales to final customers. Conceptually, the support to implementation of energy efficiency measures may cause losses on energy sales, therefore there is a complex debate within these organisations on the estimations of costs and benefits of OBS or similar programs.

Actually, for electricity utilities the issue can be simpler, since they may push the switching from fossil fuels to electricity of some services, as illustrated in (Bianco, et al., 2017) and (Abd Alla, et al., 2018), where heat pumps are considered for building heating purposes by determining an increase of electricity demand.

More complicated is the situation of utilities distributing natural gas, whose reasons for promoting on-bill schemes may only have the role of a mechanisms for containing the losses or to re-position on the energy market. Energy efficiency may represent for them what renewables, namely an aggressive competitor, represented for thermoelectric generators.

On the contrary, retailers are in a more favourable position, as they may sell "energy efficiency" as another of their supply services.

3.3.2 Programs Operation

On-bill schemes present a specific degree of complexity which needs to be addressed by utilities and this may prevent their implementation. In particular, three areas of complexity are identified, namely billing process, market segmentation and management of suppliers & installers, as reported in Figure 3.2.

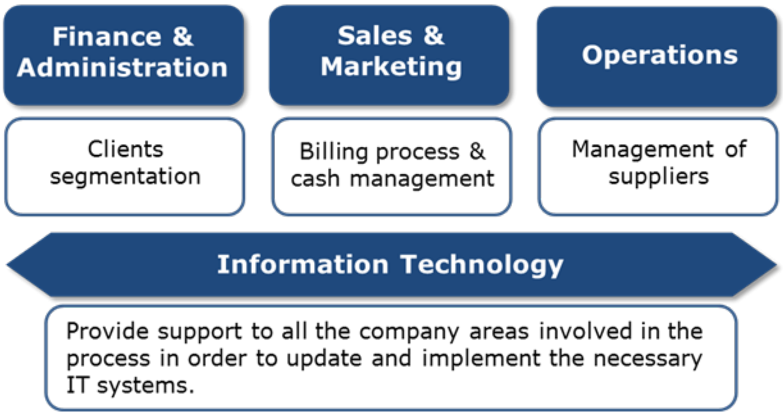

Figure 3.2 – Main company functions and corresponding activities for the implementation of OBF schemes

3.3.2.1 Billing Process

The implementation of OBS implies the modification of the billing process, since the bill needs to include also a line for this service. The processes behind these modifications are not necessarily easy. Apart from IT modifications, according to the typology of on-bill programs, the accounting and financial treatment of this amount can be complex, and it may necessitate the organisation of ad-hoc processes.

3.3.2.2 Market Segmentation

The customer basis segmentation is of fundamental importance, since it allows to propose targeted interventions to selected clients, in order to maximise the conversion rate of client contacts and minimise the default rate for the customers. Such a process is a milestone of the on-bill programs because it allows to extract the highest possible value from customers. On the other hand, it is necessary to have qualified personnel and resources to develop and structure this data intensive activity and to create the corresponding ad-hoc processes. In some cases, this may result difficult and prevent the company in launching OB programs.

3.3.2.3 Management of Suppliers and Installers

Another relevant barrier is represented by the management of a large network of suppliers and installers for the practical implementation of the energy efficiency interventions. This is a critical point, as this large amount of external personnel has a critical role, since they will be the direct contact point with the customer basis. For a utility with a nationwide market, this means to manage (e.g. to contact, to control, to support, etc.) thousands of installers, therefore the activity is again very intensive, and it requires investments in time and resources, which may prevent companies from developing OB initiatives.

3.4 Implications for utilities: SWOT analysis

According to the different typology of utility, different implications can derive from the setting-up of energy efficiency programs in general and OBS in the specific case. The level of impact and degree of complementarity with the current business can be highly variable for power utilities, natural gas utilities, district heating operators and retailers, as illustrated in the following.

- **Electric Power Utilities**: utilities that have invested in power generation facilities, such as **Endesa** in Spain, **RWE** in Germany or **Enel** in Italy. Such utilities are interested in pushing the electricity demand in order to increase their power generation and sales and they may use OBS to pursue demand electrification strategies, i.e. implementing EE measures that use electricity instead of gas to provide heat (e.g. electric heat pumps, electrical cooking, etc.). They are in a *win-win* position, since they can support and further develop their traditional business by promoting EE measures. They can be aggressive on the market and exploit the current positive political and public opinion support.
- **Natural Gas Utilities**: utilities that have invested in gas production facilities, such as **Natural Gas Fenosa** in Spain, **ENI** in Italy, **GDF** in France, etc. Such utilities may be threatened by the electrification of demand, and in general by reducing heating demands that are usually fuelled by natural gas. These utilities need to reposition on the market. OBS can serve as a measure for repositioning or for limiting the losses on energy sales. In fact, it is unlikely that earning on the energy efficiency market may offset losses of energy (i.e. natural gas) sales.
- **District Heating Utilities**: it is the case of utilities providing heat (or cold) to final users via a thermal network, e.g. **Kauno Energija**, **Vattenfall.** These utilities may use the implementation of EE measures in order to free capacity in the network, leading to losses reduction and the possibility to expand the customer base. Therefore, they may have the possibility to connect more clients to the network with limited investments on the repowering of their power plants. Another opportunity may be the ability to provide cooling services based on the newly available capacity.
- **Retailers**: the case of utilities selling both gas and electricity to final users, e.g. **Bluenergy** and **Feníe Energia**. These utilities do not have any particular issue in proposing any kind of EE measures to final users. Basically, they can substitute a commercial offer with another (e.g. sales of natural gas with sales in energy efficiency services) without many concerns, since they did not perform any infrastructural investment (e.g. pipelines, gasification/re-gasification terminal, etc.). They mainly need a re-organisation of their commercial units; therefore, they are characterised by a high degree of flexibility.

- **Distributors (DSOs):** This is a complex case that may require significant regulatory changes. In utility bills, DSO charges are applied to the users. Such charges are independent of the retailer chosen by the user and are maintained in case the user switches suppliers. On this basis, they can offer a repayment service to the market and act as a *"facilitator"*. This decouples the subscription of on-bill services with the permanence with the same energy supplier for long time (i.e. until the on-bill investment is completely payed back). Furthermore, in some countries, DSOs are also obligated parties for energy efficiency obligations (EEOs) arising from article 7 of the EED. Further, in other cases, under certain conditions DSOs are also directly allowed to invoice to certain customers. Where it is allowed by the regulatory framework, DSOs may implement EE measures in the end-users, complying with their EEOs, and recover the investment via a correspondent DSO charge, that may be kept whichever retailer is chosen by the final user.

Optimal Interventions for Different Categories of Utilities			
Electric Power Utilities	**Natural Gas Utilities**	**Heat Supply Utilities**	**Retailers and DSOs**
• Installations of heat pumps • Envelope insulation • Windows substitution • Air sealing	• Lamp substitution • Installation of more efficient electrical devices (e.g. refrigerators)	• Envelope insulation • Windows substitution • Installation of more efficient appliances	• All measures

Table 3.1 - Optimal Interventions for Different Categories of Utilities

In view of their interests and capabilities, the different utility types will have an interest to support and implement energy efficiency measures that do not constitute a threat to their traditional sales, as illustrated in Table 3.1.

The SWOT analysis towards the adaptation and replication of OBS may be done initially taking into account these categories as illustrated in Table 3.2.

	S	W	O	T
Electric Power Utilities	• Possibility to enlarge the business to propose a large range of measures • Limited or positive impact on the core business • Pivotal role in the energy efficiency "game" • To leverage on the existing customer basis	• Necessity to invest for acquiring adequate know-how in EE	• To improve the revenue stream • To increase client loyalty • To act as leaders in supporting energy efficiency • To offer an integrated smart energy package (e.g. e-mobility, domotics, energy efficiency) • Get new clients	• Necessary organisational change more tough than expected • Other competitors can arise (e.g. ESCOs) • Low level of engagement from the customer basis
Natural Gas Utilities	• To leverage on the existing customer basis	• Necessity to invest for acquiring adequate know-how in EE • Reduction of natural gas sales	• To increase client loyalty • To limit losses deriving by energy efficiency measures promoted by competitors • Get new clients	• Decrease of gas demand due to EE improvements • Low level of engagement from the customer basis • Financial issues for the repayment of previous infrastructural investments
Heat Supply Utilities	• Reduction of re-powering costs • To leverage on the existing customer basis	• Necessity to invest for acquiring adequate know-how in EE	• To increase client loyalty • To connect more users to the heat supply network	• Reduction of revenues from heat supply not compensated by new customers • Low level of engagement from the customer basis

	S	W	O	T
Retailers	• To leverage on the existing customer basis • smaller utilities can take the risk of entering into new markets • They are usually more dynamic when it comes to enter into new business	• Necessity to invest for acquiring adequate know-how in EE • Lack of *financial muscle* to put the schemes in place (for the cases when utilities make the up-front investment) • They may lack of resources (marketing staff or IT systems or administrative support) to offer on-bill renovation	• To increase client loyalty • Get new clients • Possible to enter into new market niches • It can constitute a way to differential themselves from others • The name of the retailer can benefit from undertaking "sustainable projects"	• New competitors (e.g. large white goods retailers, ESCO, etc.) could appear • Necessity to manage more complex processes • They may not have the purchase power of bigger agents, which mean less bargaining power when negotiating with banks (in case of third- party financing) and with renovating services providers
DSOs	• Possibility to enlarge the business as an *active* or *passive* player • Possibility to leverage on an extensive customer basis	• Necessity to invest for acquiring appropriate know-how in EE • For an *active* role, there is a change of approach from *regulated* to free *market*	• To increase the market offer in case of *active* role • To increase the influence on the business in case of *passive* role	• Compliance to regulations to be carefully assessed • An *active role* may determine a strong reaction from usual free market players

Table 3.2 – SWOT analysis for the different typologies of utilities

4 OPPORTUNITIES FOR ON-BILL REPLICABILITY IN EUROPE

4.1 Enabling and disabling environment

To check the possibility of implementing OBS it is necessary to analyse the market and regulatory context of the target country. We will base this part of the analysis on the four target countries of the RenOnBill project: Germany, Italy, Spain and Lithuania.

The analysis is developed along the three following main dimensions:

- **Market Readiness**: analysis of the market context in terms of possible areas of demand and already available offers
- **Legal and Regulatory Framework**: assessment of the main legal principles on the basis of which to propose possible on-bill schemes
- **Operational Issues for Utilities**: individuation of possible limitations and or opportunities in the commercial area and market structure.

The study of these three dimensions will provide a first set of relevant input to assess the feasibility of OBS and to design optimised programs in relation to the country context.

4.1.1 Market Readiness

The understanding of the current market context is pivotal for evaluating the scaling-up possibilities of energy efficiency measures in the European context. A detailed analysis is provided for the RenOnBill target countries, namely Germany, Italy, Lithuania and Spain.

The four considered countries offer a picture of very different contexts along various dimensions, e.g. consistency of the building stock, climatic conditions, buildings archetypes, market typologies, etc. Therefore, they are likely to cover situations available in many European Union countries. Some of them, e.g. Italy and Spain, have also common features, especially in terms of climatic conditions, building typologies and market conditions.

From the quantitative point of view, it can be said that Germany, Italy and Spain are comparable and characterised by a residential building stock of over 10 million buildings. Additionally, these countries at the end of the 1970s and beginning of 1980s approved regulations for energy savings in buildings. On the contrary, Lithuania is a much smaller market having only about half million buildings, and the first regulation for energy saving came into force only in the beginning of 1990s (it is to be said that before Lithuania was part of Soviet Union and subjected to the corresponding regulations). All this lets us observe that the analysis, at least from the conceptual point of view, can be similar in Germany, Italy and Spain, whereas Lithuania needs a different approach.

Country	Germany	Italy	Lithuania	Spain
Total number of residential buildings	18.8 million *(3.2 million multi-family buildings)*	12 million *(9 million multi-family buildings)*	0.58 million *(44.000 multi-family buildings)*	10 million *(2 million multi-family buildings)*
% of the building stock that should be renovated	84%	46%	50%	49%
Target segments for renovation	Buildings between 1950-1970 Bi-family houses built before 1979	Buildings in North West/North East Buildings built before 1960	Soviet -type multi-apartment buildings built before 1992	Buildings built before 1980
Potential (number of buildings that should be renovated)	7.9 million buildings	5.5 million buildings	0.3 million buildings	4.8 million buildings
Corresponding achievable yearly energy savings from 2030	42 TWh/year	67 TWh/year	5 TWh/year	38 TWh/year

Table 4.1 - Main figures of the analysed target markets

Table 4.1 recaps the main quantitative indicators for Germany, Italy, Spain and Lithuania (RenOnBill, 2020). It can be observed that the potential number of buildings to renovate in DE, IT and ES is substantial, varying between ~5 and 8 million depending on the country, with an achievable energy saving between 38 and 67 TWh/year. Lithuania, as previously mentioned, shows different figures with ~0.3 Mill. of buildings to renovate and a potential energy saving of 5 TWh/year.

In terms of potential market consistency, even though with different dimensions, it can be said that all the analysed countries are attractive, since, in principle, at least ~50% of the building stock necessitates energy efficiency renovation.

On the other hand, there are different factors, variable from one country to another, hampering the implementation of energy renovation measures.

Germany. As shown in Table 4.1, it represents the largest market and it can be considered as a *proxy* also for neighbouring countries like Netherlands, Austria, Denmark, Belgium and France (to a certain extent); in fact buildings typologies and technologies are similar, also in light of the similar climatic conditions. Despite the highlighted potential, the demand for energy renovation is limited by the difficulty for common people in understanding and estimating the benefits deriving from energy renovation (i.e. *bounded rationality* in Table 2.1) and they are often considered only when repair measures are needed anyway. Furthermore, the decision-making process can be complicated when ownership associations are involved resulting in another obstacle to energy efficiency interventions. In terms of existent market offer, it can be said that the offer for the residential segment is quite limited and hindered by administrative and bureaucratic issues, unsecure energy savings and lack of financial solutions for owners' associations.

Italy. The country shows a potential of 5.5 million buildings to be renovated mainly located in the northern part of the country, where the climate is colder and the average family income is higher. These two variables should foster the energy renovation process. On the other hand, the factors hampering the renovation process seem to prevail. In particular, the market seems to be at an early stage and the interest of people is still limited. Also, there is a lack of information and people is often unaware of the possible benefits they may obtain (e.g. tax discount). It is to be said that in the very last period the situation is quickly changing. Furthermore, most of the buildings are multifamily and the decision-making process is quite complicated, since qualified majorities are necessary to take any decision. As for the market offer, there is a lack of structured products from the largest energy players and, often, interventions are based on the initiatives of small or very small companies, mainly from the construction sector.

Spain. The country highlights a potential of ~5 million buildings to renovate, but the demand level is very low, especially for deep renovations. This is mainly due to a lack of information and awareness among people, that is sceptical about the savings deriving from energy renovations and they do not attribute any value to the non-energy benefits connected with the renovation process. Furthermore, some people, especially old ones, got used to the lack of comfort in a way that they do not value energy investments. In terms of market context, there is a lack of companies offering a structured offer and utilities often refuse to enter in the market of renovation because they see an unfair competition with the informal market.

Lithuania. The residential building stock in needs of energy renovation is estimated in 0.3 million and it represents about a half of the total stock. Most of Lithuanian buildings were built during the Soviet period with poor insulation materials and scarce energy efficiency consideration. On the other hand, as in many former Soviet countries, a relevant share of buildings is connected to district heating networks. These technical limitations connected with the cold climatic conditions make the need for energy renovation a critical issue for the country. On the contrary, the largest majority of the buildings is multifamily, therefore a certain consensus is necessary for implementing renovations. Furthermore, there is a fragmentation of the offer for energy renovations, which are often developed by small construction companies, since utilities are allowed to operate only in the energy supply business, without the possibility to offer energy renovation services. Regulatory changes appear necessary for developing at a larger extent the energy renovation market.

Table 4.2 summarises the key features of the analysed countries. In particular, it can be concluded that they have a relevant potential in terms of market for energy renovation, which is currently unexpressed. Therefore, it is fundamental to develop and implement market initiatives which allows to exploit the maximum potential.

Country	Germany	Italy	Lithuania	Spain
Available Support Schemes	- CO_2 Buildings Rehabilitation Program (KfW CO_2)	- Tax credits	- Grants - Soft loans	- Grants - Soft loans - VAT reductions
Target Energy Renovation Measures	- Envelope insulation - Windows substitution - Renewables	- Envelope insulation - Heat pumps - Windows substitution - Renewables	- Envelope insulation - Windows substitution	- Envelope insulation - Heat pumps - Windows substitution - Renewables
Level of Demand	- High potential - Currently moderate	- High potential - Currently limited	- Very high potential - Currently limited	- High potential - Currently limited

Table 4.2 - Summary of key market readiness features for RenOnBill countries

4.1.2 Legal and Regulatory Framework

The analysis of the legal and regulatory context is pivotal for understanding the possibilities of implementing energy renovation measures. Often the barriers arising in this context represent the main obstacle to implement efficiency measures.

To overcome regulatory barriers changes are necessary at high level. Such changes are often implemented when there are specific and well justified inquires to the authorities. This often happens when large companies are involved in the business or when the interest of citizens is very relevant. From the analysis developed in the previous sections, it can be noticed that both these conditions are currently lacking, since the energy renovation market is currently characterised by small or very small companies (i.e. the degree of fragmentation is very high) and the current level of demand is moderate or low, therefore there is not a *push* from the public to modify regulations which hamper energy renovations.

The analysis is individually developed for each of RenOnBill countries, i.e. Germany, Italy, Spain and Lithuania, and five dimensions are considered, namely the decision making process for the implementation of energy renovation measures in different context (e.g. single owner vs. multi owners buildings), debt sharing in multi families buildings, distribution of renovation costs between owner and tenant, possible disconnection in case of non-payment and financial service law. Table 4.4 to Table 4.6 report the main findings for the target countries.

Decision on ER measures implementation • *Single owner building*: only landlord can decide for ER measure (tenants rarely can oppose/delay) • *Multi-owner buildings*: all owners must agree (decision quorums are set by law "WEG-Recht" currently under revision)
Debt distribution in a multi-family building • *External relationship*: condominium owners are liable to the bank in proportion to their co-ownership share (§ 10 Abs. 8 WEG) • *Internal relationship*: all owners liable/ unlimited obligation to make additional payments, if it comes to payment defaults of individual owners.
Distribution of ER cost between owner and tenant • **Tenant law:** "Modernisation levy" allows to apportion part of the ER costs to the tenant (German tenancy law) – For refurbishments up to 10.000 € (per residential unit) 70% of the costs can be shared with tenant – Rent increase cap: max. 3€/m² (when rent below 7€/m²: max. 2€/m²) – Time cap: 6 years
Disconnection in case of non-payment • Strictly regulated/technically not possible • In case of non-payment end users fall back to default provider (the latter can claim payments in strictly regulated process)
Financial services law • Ltd.-law ("GmbH-law"): Ltd. only allowed to conduct business compatible with corporate purpose (described in company statute) • Potentially allowed loans: e.g. advance on future salary payments to an employee, credit to a customer for the financing of orders to the Ltd. • Non-allowed loans: loan to third parties without reference to the purpose of the company • German Banking Act (KWG): commercial credit granting subject to approval (by the Federal Financial Supervisory Authority) • Utilities might need to comply with financial service and market stability regulation (e.g. liquidity requirements)

Table 4.3 – Legal and Regulatory framework in Germany

The illustration of legal and regulatory issues reported in the tables highlights the differences among the considered countries, but also emphasises some common issues. A **very relevant matter**, common in all the considered countries, is **represented by the necessity of reaching qualified majorities f**or implementing ER in multifamily buildings. Usually, in these contexts, the decision-making process can be very conflictual, and this is a relevant limitation.

Furthermore, the **debt distribution** in multifamily buildings can be another common and **relevant issue for the setting-up of any financial scheme**, including OBS.

Decision on ER measures implementation • Usually, the homeowner community takes the decision, which often require qualified majorities among homeowners. **Debt distribution in a multi-family building** • Each owner is liable, but under the Horizontal Property Law, in case of default the debts have to be claimed in Court. **Distribution of ER cost between owner and tenant** • Unclear. In any case, owners normally do the works in the gap between tenant contracts and increase the rent to the next tenant. **Disconnection in case of non-payment** • In theory possible, but in general utility rarely disconnect customers. There are also laws protecting the most vulnerable families from disconnection. **Financial services law** • Unclear. However, utilities do offer operating leasing for energy assets (i.e.: boilers) • Utilities/ESCOs are likely to have a financial service licence to offer financial services connected with energy services

Table 4.4 – Legal and Regulatory framework in Spain

Decision on ER measures implementation • *Single owner buildings:* only the owner can decide for ER measure. Since the rental contract ensure to the tenant the full utilisation of the building/unit, in case of major renovation the owner may need to have the agreement of the tenant. • *Multi-owner buildings:* if the intervention affects common parts of the building, the owner assembly must reach an agreement (decision quorums are set by law). **Debt distribution in a multi-family building** • According to two Supreme Court Decisions (2148/2008 and 199/2017) condominium owners are liable to the creditors in proportion to their co-ownership share (no co-obligation by owners). **Distribution of ER cost between owner and tenant** • Only if agreed with the tenant. **Disconnection in case of non-payment** • *Regulated market* ("servizio di maggior tutela"): strictly regulated/almost not possible • *Free market*: apparently possible, but only in case of ex novo contract whose payments include both energy supply and repayment of the credit for renovation **Financial services law** • Lending constraints: not clear if a utility (even through a fully owned ESCO) can make loan with interest (EU and Italian law allows EPC to ESCOs, but Italian banking law restricts actors able to grant loan with interest).

Table 4.5 – Legal and Regulatory framework in Italy

Decision on ER measures implementation • *Single family building:* only landlord can decide for ER measures • *Multi-family buildings:* >55% of all owners must agree for ER measures
Debt distribution in a multi-family building • Flat owners are liable to the bank in proportion to their co-ownership share
Distribution of ER cost between owner and tenant • Tenants have no rights (owners hold all rights); it is not regulated by law and it just a subject of negotiation between landlord and tenant
Disconnection in case of non-payment • Electricity, gas and hot tap water disconnection is possible for separate apartment; but not space heating part (technically unfeasible) and cold water • In case of default for ER measures implemented, an owner cannot be dislodged from the flat
Financial services law • Utilities can only hand out bills to apartment owners (no ESCO, condominiums)

Table 4.6 – Legal and Regulatory framework in Lithuania

Finally, the issue of "**disconnection for payments**", which works quite well as a sort of *collateral* in the North American context, has a more **problematic application in the European context**, since energy is considered a primary and necessary good for everybody, therefore the disconnection of basic energy services can be considered not acceptable from the social point of view.

4.1.3 Operational Issues for Utilities

The analysis of the **operational limitations is a relevant variable for utilities willing to enter the ER market**. In particular, commercial issues and market structure are the two dimensions considered. For utilities interested in developing OBS, it is significant to have a truly understanding of the operational perimeter to work in and the corresponding effort to dedicate.

Germany. The market has been liberalised from 1998 onwards, and therefore the level of competition in the retail market is relevant. The typology of market operators is quite different, ranging from small municipal utilities to very large companies with worldwide operations. The market is characterised by the presence of four supra-regional companies and a multitude of local or municipal utilities. **There is not a specific incumbent which with a dominant position**. **Operators are free to launch different commercial offers, including on-bill schemes.** On the other hand, some regulatory constraints are present, such as a maximum contract duration of two years for energy supply services. Furthermore, the possibility to add a line on the bill for on-bill services may be subjected to the approval of the market authority.

Italy. The market has been liberalised from 1999 onwards and It is characterised by a relevant level of competition. About 400 electricity and 50 natural gas retailers are currently active in Italy, ranging from very small companies to a few large companies. **The market is characterised by the presence of an incumbent operator** (e.g. the former market monopolists) **both in the electricity and natural gas markets**. Retailers are free to structure their commercial offer, including OBS. Regulations do not foresee any cap for contract duration and it is possible to add a line on the bill for extra on-bill services.

Spain. The Spanish market has been liberalised from 2005 onward. **The market is characterised by the presence of five main companies, including an incumbent** (e.g. the former monopolist), which account for 65% of the market in terms of volumes. The remaining 35% is split among **smaller operators**, which **increased their share over the years**. The main companies operate on both the electricity and natural gas market. Companies are free to propose commercial offers to their free market customers, including on-bill schemes. In general, contracts have a duration of one year and it is possible to add a position on the bill for OBS.

Lithuania. The Lithuanian context is characterised by the presence of electricity, natural gas and district heating utilities. Natural gas is often used only for cooking purposes, whereas **heating is often based on district heating which is widespread across the country. District heating represents a natural monopoly in a specific location**. Furthermore, **electricity is provided by a state-owned company and by private suppliers**, but, at moment, prices offered by the state owned company are more competitive for the residential sector, therefore there is a "quasi-monopolistic" structure. District heating utilities can only supply heat and, according to the present regulatory context, they cannot offer other services to final customers. This is to prevent abuses by companies in a monopolistic position. Currently, on bill schemes can be offered by electricity and natural gas utilities. Energy supply contract duration is not regulated, therefore it can be established on the basis of the agreement between utilities and final users, whereas **it is necessary to obtain an authorisation from the regulatory authority to add an extra position on the bill for possible OBS**.

The developed analysis illustrates that Germany, Italy and Spain are characterised by similar contexts. The existing differences are minimal and it is likely that the core framework of OBS can be the same in these three countries. Clearly the commercial offer and market segmentation are to be adjusted to the peculiarities of the considered country.

As for Lithuania the situation is a little bit different, in particular a limiting factor for OBS is represented by the fact that district heating utilities can only supply heat and, strictly, they cannot offer other services. On the other hand, a very promising factor is represented by the potential high demand for energy renovation, because most of the building stock is represented by old Soviet buildings with poor energy performances which necessitate urgent refurbishment.

4.2 Overall Considerations

The previous context analysis focused on four EU countries, namely Germany, Italy, Spain and Lithuania, nevertheless some considerations can be generalised to other EU countries with similar contexts.

In particular, **what emerged from Germany, Italy and Spain can be applied to the other contexts where the free energy market has been fully established and former vertically integrated monopolistic companies were separated at least partially**. In the following paragraphs, we give an overview of three additional countries (Belgium, France and the Netherlands) and offer some considerations which can be generally applied to the EU context.

Belgium

According to IEA, in 2018 the Belgian residential sector accounted for 24% of the total final energy consumption. It ranked third after the industrial and transport sectors. In Belgium, the implementation of Energy Performance Building Directive (EPBD) is under the responsibility of regions, namely Brussels Capital Region, Walloon Region and Flemish Region, therefore the landscape is quite fragmented and variable from region to region. Oppositely, the potential demand for energy efficiency renovation is quite high, since less than a half of the residential buildings have insulated walls2. Most of the primary energy consumed in the Belgian residential sector is represented by natural gas which is mainly used for heating purposes. Belgium has one of the oldest building stocks in the EU and, within Belgium, the Walloon Region has the oldest stock, with over 50% of the homes built before 19453. Belgium offers interesting perspectives for the development of on-bill schemes, since the internal demand for renovation is relevant. Standard energy efficiency measures, such as wall insulation and windows substitution are necessary, and they could be tackled with on-bill schemes.

France

According to IEA, in 2018 the final energy consumption in the French residential sector accounted for 27% and it ranked second after the transport sector. Heating consumption represents, in average, the 50% of the total, but it can reach 75% in some cases. The construction period of the buildings largely affects the corresponding heating demand. Buildings can be roughly categorised in three groups, namely those built before 1948, between 1948-1975 and after 1975[1] characterised by the corresponding average heating demand 250 kWh/m^2/year, 400 to 900 kWh/m^2/year and 150 kWh/m^2/year. The overall energy demand is ~240 kWh/m^2/year. To improve the energy efficiency of the building stock two actions are considered, namely the refurbishment of existing buildings and mandatory energy efficiency standards for the newly built. Currently, 7 million buildings have very bad thermal insulation and necessitate urgent interventions. The main schemes for supporting renovation are based on subsidies and tax discounts. The context appears favourable for the introduction of on-bill schemes due to the relevant potential demand for renovation.

The Netherlands

According to IEA, in 2018 the Dutch residential sector accounted for 21% of the total final energy consumption. It ranked third after industrial and transport sectors. Most of the energy is used for space heating due to the cold climate of the country. Energy consumption in the residential sector decreased by 11% from 2000 to 2017 thanks to the implementation of energy efficiency measures. A large part of this decrease is due to the growing penetration of highly efficient condensation boilers, which also determined a reduction in the energy consumption for sanitary water production[4]. Ambitious targets have been set to reduce energy consumption of buildings within 2020, so that from 2020 onward new buildings are supposed to be energy neutral. The energy retrofitting of existing buildings is pivotal in the proposed strategy and it has been promoted with instruments based on tax incentives. On the basis of this, it can be said that the internal demand for energy renovation is expected to be consistent, and this suggests that the Netherlands can result attractive for on-bill schemes. Different schemes could be proposed to support different levels of renovation ranging from small interventions to deep renovation.

Some of the considerations that can be generally applied to the EU context are below:

- **Market Readiness.** There is the potential for the implementation of relevant EE refurbishments in the residential building stock, but this is hampered by difficulty of common people in understanding/estimating the benefits deriving from energy renovation. On the other hand, the attitude of people towards EE is positively changing. Furthermore, the decision-making process can be a barrier in multifamily buildings.

- **Legal/Regulatory Framework.** This dimension is largely country dependent, since it is linked to specific regulations. On the other hand, some general issues can be detected. In particular, a main barrier is represented by the qualified majority to reach in multifamily buildings to agree on renovation and on the corresponding debt distribution and liability. Furthermore, the issue of "disconnection for non-payment" can be differently perceived with respect the context of application, i.e. higher or lower sensitivity towards social issues.
- **Operational Issues for Utilities.** For fully liberalised markets, the issues are similar and could relate to possible caps on energy supply contracts duration or on the possibility to add a position on the bill for the on-bill scheme. A commercial solution could be found to solve these situations. Furthermore, the possible presence of an incumbent may slow down the process of offering innovative services. The implementation of OBS to supporting energy efficiency measures can support the utilities, e.g. power, natural gas, district heating and DSOs where applicable, to comply with the Art. 7 of the Energy Efficiency Directive, which imposes a reduction of 1.5% per year of energy sales to final customers[5]. In order to reach this target, companies have to carry out actions which help final users to be more efficient.

In light of these considerations, it can be said that OBS may represent a powerful tool to support energy transition, to attract private capital on the energy efficiency market and to originate new business. One of the main aspects to be emphasized is that **OBS** are extremely **flexible in terms of dimension** of the promoted interventions, **market segment** to address and **source of capital**. Therefore, utilities can set-up the scheme in the most convenient way.

[5] http://www.article7eed.eu/index.php/article-7-insight/article-7-eed-explained

5 MODELS FOR REPLICATION OF ON-BILL SCHEMES

The north American experience demonstrated that on-bill schemes are effective in supporting the implementation of energy efficiency measures in the residential sector on a market-based approach. In most of cases, energy utilities offer on-bill services to their clients and the results are quite successful, because the default rates are quite low.

On the basis of this experience, it is possible to support their replication in the European context by adopting similar schemes. In particular, the schemes can be included in two macro-categories, namely on-bill financing and on-bill repayment. In the first case the utility finances the program with its own resources, whereas in the second case there is a cooperation with financial institutions.

Starting from these two categories different variants are proposed in order to fit variable market needs and operating contexts. Table 5.1 summarises the different models described in the following.

Acronym	Short Description
OBF	Standard on-bill financing model
OBR	Standard on-bill repayment with two variants: • Deposit on a utility's escrow account • Works paid directly by the financial institutions Involved
OBSEP	On-bill scheme model targeting energy poor customers
OBRSPV	On-bill repayment scheme operated through a SPV
OBRM	On-bill repayment scheme operated by a master-servicer
OBRMS	On-bill repayment scheme operated by a master-servicer under the control of a state agency
OBSI	On-bill scheme, i.e. both OBF and/or OBR, for supporting Valued Added Energy Services (VAES)
DSOF	On-bill scheme, i.e. both OBF and/or OBR, with DSO acting as a facilitator
DSOA	On-bill scheme, i.e. both OBF and/or OBR, with DSO actively engaged in supporting EE measures.

Table 5.1 - Possible Business Models for the EU Context

5.1 Standard On-Bill Financing Model (OBF)

A standard OBF scheme consists in a commercial offer by a utility which provides the upfront cost for an energy efficiency investment, usually in the range of 1.000-20.000 €, which is repaid by the final user "on the bill", namely by an

additional amount added to energy bill (e.g. electricity, natural gas, district heating, etc.).

This amount of money can be lower than the amount corresponding to the energy saved, i.e. the "Golden Rule" is applied therefore an immediate money saving is guaranteed, or the user will simply pay an amount of money to repay the upfront cost, without any relation to the possible energy savings.

In OBF schemes the capital to promote the final users' investments is originated by own sources of the company, including public funds, without any contribution from financial institutions.

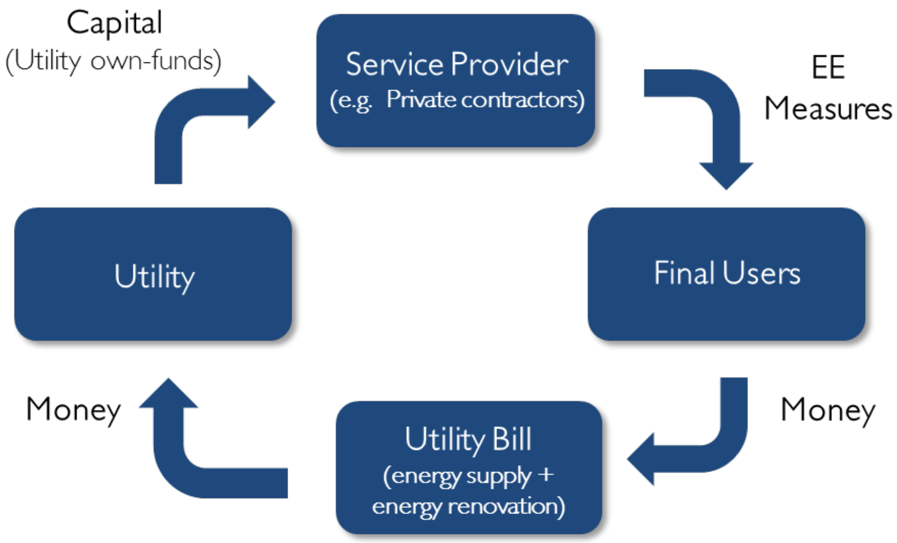

Figure 5.1 - Schematic of OBF business model

Being directly managed by utilities, OBF schemes have the advantage of guaranteeing a shorter value chain and higher added value, but, on the other hand, large programs would increase the amount of credits[6] of the companies and alter the corresponding financial ratios. This may result in a higher cost of capital.

Figure 5.1 reports the basic schematic for an OBF program, where the utility directly engages its customers. Once they step in the program, the utility usually refers to service providers (also in-house companies can be used) for the implementation of the renovation measures at the client place. Providers are directly paid by the utilities (e.g. scale economies could be achieved) and afterward the users start to pay the OBF component in their bill.

[6] Credits are included in the calculation of the working capital. If the share of credits in the working capital is relevant, the solvency of the company is evaluated as lower, since there is a risk connected with the collection of credits.

Usually, in the case the final user wants to change its energy supplier, it has to pay in one solution the remaining part of the program.

The main advantage of the OBF scheme is that the debt position of the final user is not altered, since OBF is not a loan, but an additional cost on the bill.

A possible limitation to OBF program is represented by the banking regulation, as discussed in section 3.1, since the providing of the upfront cost could be seen as a money lending activity.

5.2 On-Bill Repayment Model (OBR)

The On-Bill Repayment (OBR) model is similar to the OBF one, but it foresees the presence of a financial institution which provides the necessary capital. The advantage of such a solution consists in the fact that the debt position of the utilities is not altered, but the value chain is longer with respect to an OBF scheme, therefore the margin is lower.

The advantage of financial institutions is represented by the fact that they work in a synergic cooperation with the utilities which have a deep knowledge of the energy market and are supposed to minimise technical and solvency risks (e.g. utilities have the bill payment history of their clients).

OBR schemes can be based on two different approaches, namely financial institutions transfer the capital to the utility on an escrow account[7], as shown in Figure 5.2, or they directly pay the service provider for the implementation of energy efficiency measures, as shown in Figure 5.3.

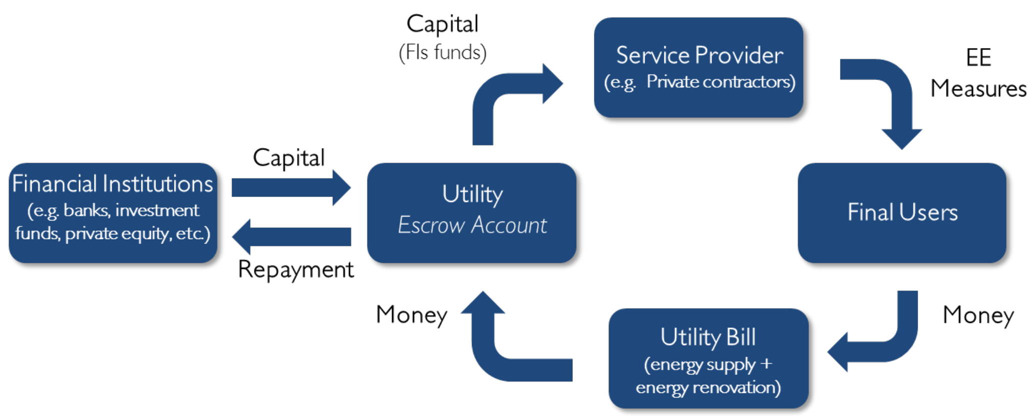

Figure 5.2 – Schematic of OBR business model based on the *escrow account*

[7] An escrow account is a sort of temporary deposit of funds of the financial institution participating in the OBR. The utility will keep the funds until the contractual agreement related to the OBR between the financial institution and the final customer is concluded. Thus, funds placed on an escrow account does not represent a debt or a loan for the utility.

According to Figure 5.2, once the utility receives the capital from the partner financial institution, the scheme substantially works as an OBF scheme, except for the fact that the utility will convey the repayment to the financial institutions after taking its share of the margin.

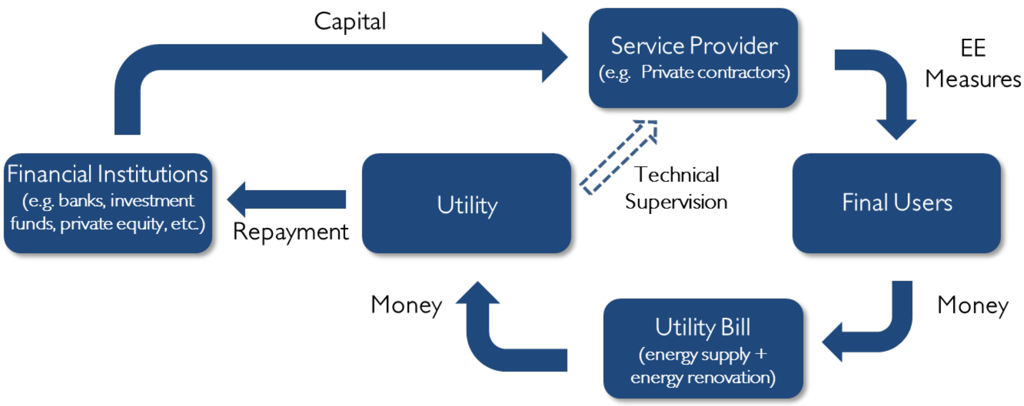

Figure 5.3 – Schematic of OBR business model based on the *direct payment* to the service provider

When the capital per each intervention is directly provided to the service provider, the scheme is similar to an OBF organisation, except for the fact that the utility has to convey the repayment to the financial institution as in the previous case.

In both the case the utility has the technical supervision of the works and manage the commercial and marketing aspects of the program. Financial institutions are only capital providers.

5.3 On-Bill Schemes Model Targeting Energy Poor Customers (OBSEP)

OBS targeting energy poor customers (OBSEP) can be programs which have a social value, since they can be designed to help vulnerable people in upgrading their devices in order to have a better comfort, to modernise their home and to reduce their energy consumption.

These programs target small investments which have a quick pay-back time, e.g. lamps substitutions, small air-conditioning systems, refrigerators, etc. They can have the form of on-bill financing or on-bill repayment programs indifferently.

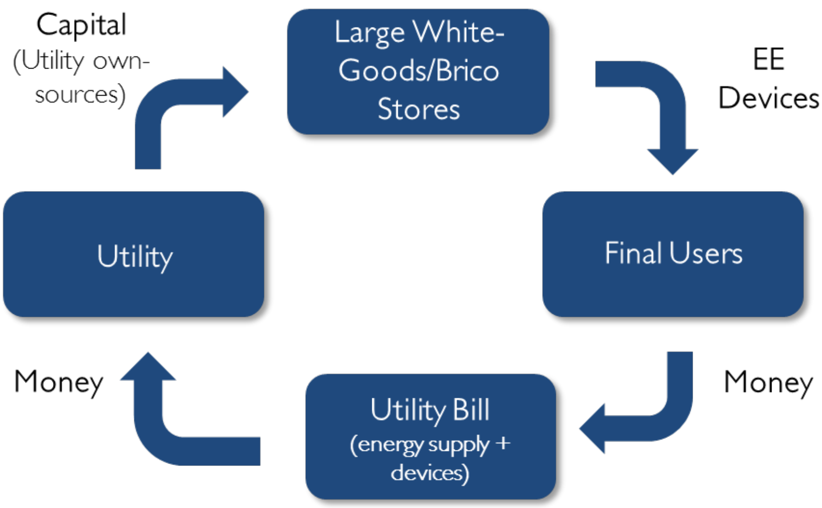

Figure 5.4 – Schematic of OBF business model targeting energy poor customers

Differently from the schemes reported in the previous section, OBSEP could be based on a partnership with large white goods or Brico stores, where final users may collect their equipment (or the stores can deliver the equipment when a small installation is necessary) and then they can start to repay on the bill. The utilisation of more efficient devices will allow to decrease the energy component of the bill and after a couple of years net savings will be experienced by the users.

5.4 On-Bill Repayment Model via a Special Purpose Vehicle (OBRSPV)

On-bill repayment scheme implemented with the definition of Special Purpose Vehicle (SPV) is a more articulated definition of the model, which may include the presence of more institutions with respect to the basic form discussed in section 5.2.

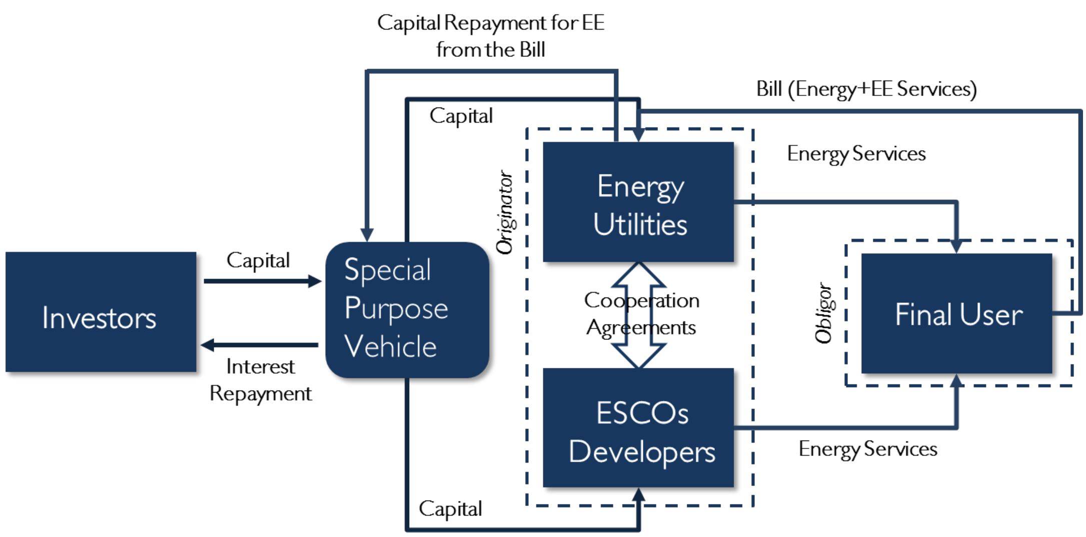

Figure 5.5 – Scheme of a possible OBR model with SPV

Figure 5.5 highlights a possible scheme of a SPV based OBR model. **In this model, the final user is the obligor and energy services are originated by a company, e.g. utilities or ESCOs, whereas the SPV is the investment vehicle.** Form one side it provides the capital to the originators on the basis of a bundle of projects they propose to SPV, which evaluates their attractiveness for investment and from the other side the SPV will attract capitals from financial institutions (e.g. funds, investment banks, etc.).

Once the investment decision is taken, the capital is provided by SPV and utilities or ESCOs or other companies implement (i.e. by subcontracting and supervising the works or by executing the works directly) **the energy efficiency measures at final users' places.** Once the intervention is completed, final users will start repaying with an on-bill mechanism and each of the subject in the value chain (e.g. utilities, SPV, financial investors) is repaid. Therefore, the role of the utility is in any case pivotal for the repayments collection.

The advantage of this scheme is that there is not just one financial investor, as described in 5.2, but a bunch of investors can decide to invest in the SPV. At the same time, the SPV can decide to work not only with one company (utility, ESCO or others), **but with a number of them**. The investment conditions of the SPV may change in relationship to the project originator, the geographic distribution, typology of the investments, etc.

This model is more structured and flexible from the point of view of the financial investors, but it has higher transaction costs with respect to the previously considered business models and a longer value chain.

5.5 On-Bill Repayment Model Operated Through a "Master Servicer" (OBRM)

This OBR scheme is based on the presence of a "Master Servicer", which is an intermediate infrastructure between utilities and financial institutions. Figure 5.6 reports a schematic of the possible business model.

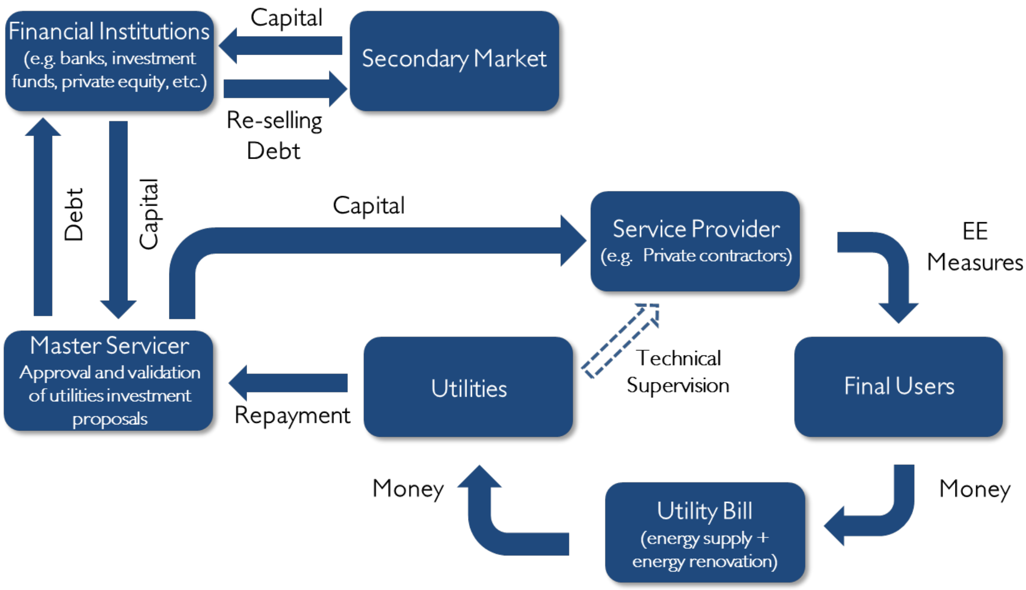

Figure 5.6 – Scheme of a possible OBR model with Master Servicer

In this model the Master Servicer (MS) manages the capital from the financial institutions that wants to invest in on-bill services, it has the role of scrutinizing the investments proposed by the utilities and taking the Final Investment Decisions (FIDs). Once FIDs are taken, the capital is provided by the financial institutions to the MS which pays the Service Providers for the implementation of energy efficiency measures.

It is important to highlight that the MS offers the services, from one side, to all the utilities which are interested in on-bill schemes and, from the other side, to all the financial institutions interested in investing. This organisation should allow to attract a relevant amount of capital and to deploy a substantial quantity of energy efficiency interventions.

When the activity is completed, final users start to repay on the bill and the utility conveys the repayments to the MS, which in turn transfers the due amounts to the different financial institutions. Furthermore, financial institutions can develop specific products to sell this debt on the secondary market in order to obtain more capital to invest in on-bill schemes or in another initiatives.

The differences with respect to the OBR with SPV is related to the fact that the MS is a service provider, whereas the SPV is an investor which uses the capital raised from a pool of financial institutions.

5.5.1 On-bill repayment scheme operated by a master-servicer under the control of a state agency (OBRMS)

The previous scheme may be further elaborated to include the presence of a public based agency, as shown in Figure 5.7, which has the role of supervising all the process. This represents a warranty for final users, especially in contexts where there are a few operators with a large market power.

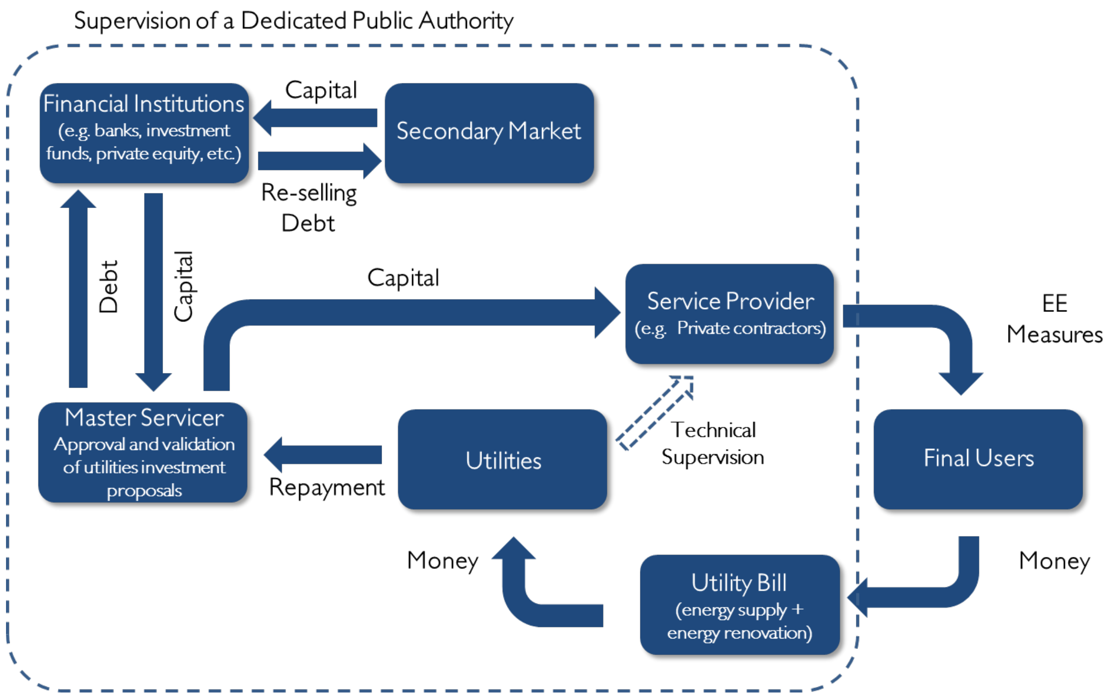

Figure 5.7 – Scheme of a possible OBR model with Master Servicer and PA supervision

5.6 On-Bill Schemes for Supporting Value Added Energy Services (OBSI)

On-bill schemes can be used for supporting the commercialisation of *Value Added Energy Services* (VAES), namely innovative services such as charging columns for e-vehicles, storage systems, etc.

These services are supposed to have a relevant increase in the next years and are considered fundamental pillars for achieving a green energy transition. Furthermore, they are pivotal in the "*servicitation*" of energy utilities, namely the transformation from commodities suppliers to service providers.

VAES could be offered via on-bill mechanisms, either OBS or OBR, by using the bill as repayment vehicles. The concept of OBS/OBR is a little bit changed, since there is not any energy savings, oppositely in some cases, e.g. e-vehicles, there will be an increase of the consumption, but overall they contribute to global primary energy savings (e.g. less fuel consumption in case of e-vehicles) and energy transition.

A schematic of a possible reference model is illustrated in Figure 5.8.

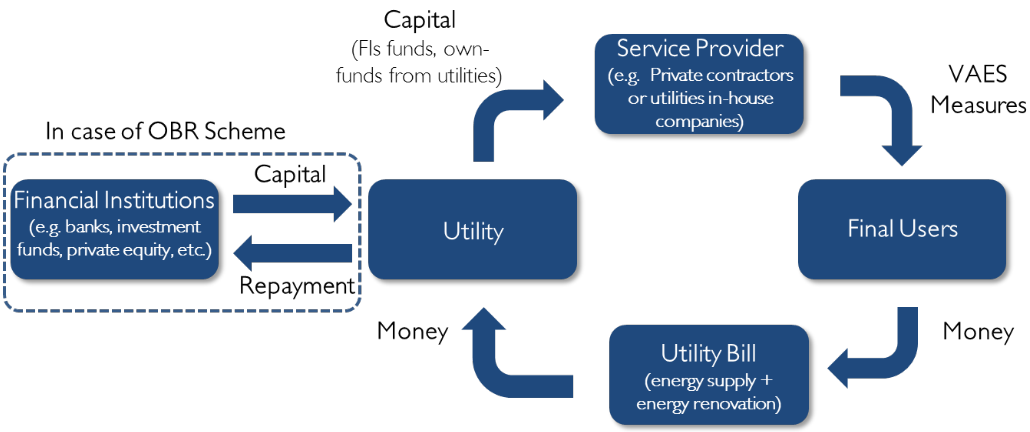

Figure 5.8 – Scheme of a possible OBF/OBR model for VAES

The illustrated model is quite simple. The utility is the service provider and the only interface with the final users. Utilities will manage the relationship with third party installers and financial institutions, if any, and provide the service. Final users will repay for the service (e.g. energy storage, charging columns, etc.) on their bill. Such a scheme could be a *win-win* organisation for both utilities and final users, since the first can use it to increase customers loyalty, whereas the latter can benefit of innovative services by relating only with one entity.

In more articulated schemes, cooperation with e-vehicles (e.g. cars, scooters, etc.) manufacturers could be envisaged in order to offer an integrated on-bill service, which ranges from the buying of the vehicle till to its recharging station, possibly integrated with the energy infrastructure available on the buildings (e.g. PV generation). The connection of recharging stations to PV plants of the building can be seen as an enhanced flexibility as the connected e-vehicle represents a storage.

These range of services can become popular in the next future and to support their diffusion it is necessary to set-up appropriate financial measures, on-bill schemes can be an effective instrument.

5.7 On-Bill Models Including Distributor System Operators

5.7.1 On-bill scheme with DSO acting as a facilitator (DSOF)

Distributor System Operators (DSOs) are the company in charge of managing the distribution network, namely the network which distributes electricity or natural gas from the transportation network to final users. These companies are natural monopolies, since the network is unique, and it cannot be managed by different companies in the same area.

DSOs provide services for ensuring the correct working conditions of the network and they are paid by charges paid by all customers on their bills. In light of this, **DSOs could help in setting up more effective on-bill schemes** and a possible framework is reported in Figure 5.9.

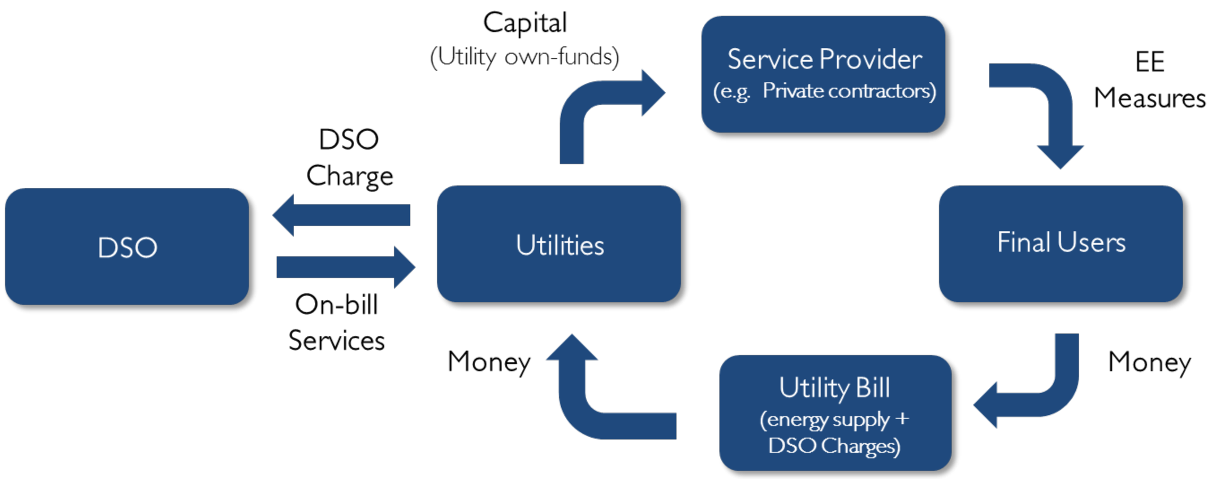

Figure 5.9 – On-bill model with DSO acting as a facilitator

In the illustrated scheme **the repayments for on-bill services is paid via a DSO charge, afterward the DSO will convey the repayments to the utility which developed the service**. This step allows to add a relevant degree of freedom to the customers who are in on-bill programs, that may change their energy supplier without the issue of quitting the on-bill program by paying the remaining part of their service in one solution. **In the proposed model, the customer can change the energy supplier and continue to pay the on-bill fees, since, if they are DSO charges, they can be moved to the bill of the next energy supplier**. The DSOs will continue to convey to the initial utility the on-bill fees.

This mechanism avoids that final users are constrained to stay with the same utility supplier for a long period, i.e. until the on-bill repayments are finished, and allows them the flexibility to change after a minimum period, without any issue for the on-bill program they are involved. Therefore, DSOs would act as *facilitators* for the spreading and development of on-bill services.

The negative aspect with respect to classical OBF/OBR is that the value chain is longer, since also DSOs have to be remunerated for their service.

5.7.2 On-bill scheme with DSO actively engaged in supporting EE measures (DSOA)

Another possibility for DSOs is to engage directly with final users for the implementation of energy efficiency measures to be repaid with on bill charges. This would represent a direct engagement of the DSOs as on-bill players. A possible scheme is reported in Figure 5.10

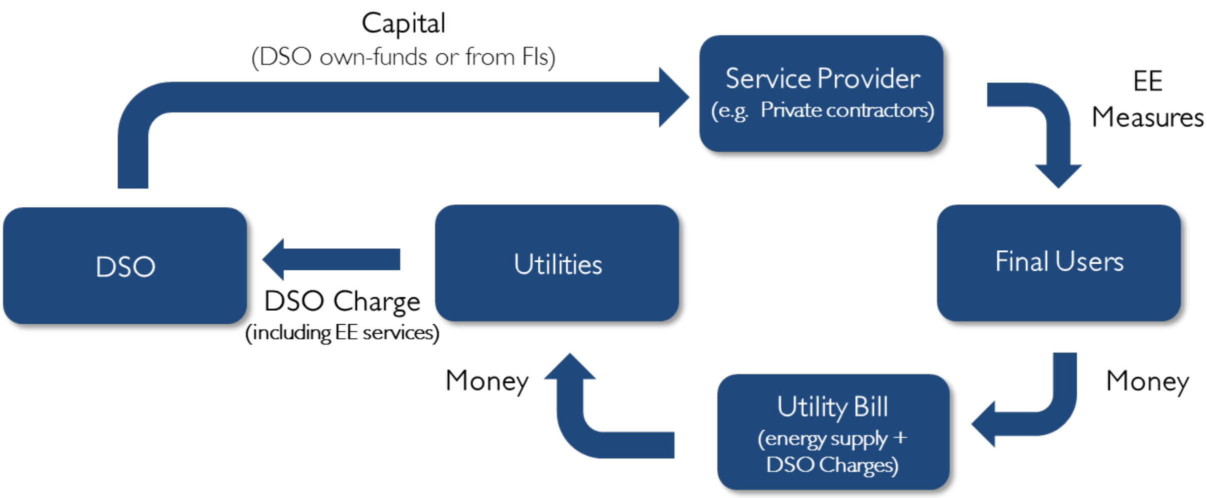

Figure 5.10 – Schematic of on-bill models with direct intervention of DSOs

This possibility should be checked according to the regulation of each country, since, as previously mentioned, DSOs are natural monopolies and they often act on the basis of state concessions. Their possible engagement with final users through on-bill schemes would represents a clear interference with free market players.

Nevertheless, in some EU countries this scheme could be applicable, as DSOs are subjects entitled to implement the Article 7 of the Energy Efficiency Directive, which imposes specific reduction targets in the energy delivered to final users by implementing energy efficiency actions. For example, electricity and natural gas distributors are obligated parties in Italy[8] and a similar situation is available in Lithuania[8], where also district heating companies are included. On the contrary, in Spain[8] the obligated parties are suppliers of electricity and gas and wholesalers of oil products.

On the basis of this, DSOs may conceptually implement on-bill schemes both in Italy and Lithuania, since they are obliged under the article 7 of the EED to pursue

[8]https://www.europarl.europa.eu/RegData/etudes/STUD/2016/579327/EPRS_STU%282016%29579327_EN.pdf

activities to reduce the supply of energy to final customers. The same conditions apply also to Croatia, Malta and Denmark, which indicated distributors as obligated parties[8].

5.8 Summary of the Analysed On-Bill Models

On the basis of the analysed models, it is possible to summarize the main aspects of the proposed models and the key players involved in the different processes.

All the proposed models originate from the two main schemes, namely OBF and OBR, and then different variants are proposed and examined by including different level of complexity in terms of intermediary subjects which act as facilitators and service providers for setting up the schemes. **Table 5.2** recaps the different frameworks with their main features and possible commercial applications.

Model	Main Features	Possible Applications
Standard on-bill financing (OBF)	• Financed with utilities own resources or public funds • Short value chain, higher margin for the utilities • Possible impact on financial ratios of the company (i.e. depending on the dimension of the program)	• Suitable for the implementation of small or large interventions • Large flexibility in defining the format of the program
Standard on-bill repayment (OBR)	• Financed with capital from financial institutions • Longer value chain with respect to OBF, lower margin for the utilities • Possibility to implement large programs targeting a high number of final users.	• Suitable for the implementation of small or large interventions • Possible agreements with financial institutions financing the program on the typology of interventions and clients to target
On-bill model targeting vulnerable energy consumers (OBSEP)	• Social value of the initiative • To establish partnership with large retailers • Dedicated to specific client segments	• Suitable for the implementation of small interventions
On-bill repayment scheme operated through a SPV (OBRSPV)	• Creation of an "ad-hoc" financial vehicle for supporting specific on-bill schemes • Different typologies of originators (not necessarily utilities) • Necessary agreements with utilities for the collection of the repayments on the bill	• Suitable for the implementation of a large amount of interventions • Profitability of the programs evaluated by the SPV

Model	Main Features	Possible Applications
On-bill repayment scheme operated by a master servicer (OBRM /OBRMS)	• Master servicer as an intermediate infrastructure between utilities and financial institutions • Services offered to all the utilities on the market, differently from the OBR with SPV • Possible to consider a dedicated authority that supervises all the process	• Suitable for small or large interventions • Flexibility in designing the programs • Programs subjected to the approval of the Master Services
On-bill financing (or repayment) schemes for supporting VAES (OBSI)	• Opportunity for promoting the utilization of innovative services/products (e.g. e-vehicles with connected recharge infrastructure) • Useful for innovative companies	• Possibility to orient the market • Development of innovative services (e.g. DSM, storage, etc.)
On-bill schemes for DSOs (DSOF/DSOA)	• Strategy for compliance with Energy Efficiency Obligations where applicable • Possibility to support all the utilities with dedicated services • Possible issues deriving from the fact that DSOs are natural monopolies	• Large flexibility in designing the programs • Possibility to solve the issues related to users changing utility during the program duration

Table 5.2 - Summary of key features of the proposed on-bill frameworks

	OBF	OBR	OBSEP	OBRSPV	OBRM	OBRMS	OBSI	DSOF	DSOA
Utilities	X	X	X	X	X	X	X	X	X
Financial Institutions		X	X	X	X	X	X		X
Technical Service Provider	X	X	X	X	X	X	X		X
Master Servicer					X	X			
SPV				X					
DSO								X	X
Public Authority						X			

Table 5.3 - Key-Players involved in the proposed Business Models

Apart from the main features and possible commercial applications, the proposed schemes can be characterized also according to the main players involved in the value chain. Table 5.3 highlights that in some cases, e.g. OBF, the number of organizations involved in the process is quite limited, therefore the value chain is short, and the margins of the program should be shared with a limited number of players. On the contrary, other schemes, e.g. OBRMS, include the presence of a number of actors which participate to the value chain and each of them must be remunerated, therefore the margin for the utility could be more limited.

When more complex structures are considered, it is necessary to consider carefully the impact of transaction costs, which are usually justified only if the dimension of the program is relevant, namely many interventions are foreseen.

Furthermore, when choosing one of the proposed models, it is necessary to understand if the considered market is ready for the proposed structure. Some of the proposed models, e.g. OBRSPV or OBSI, are more suitable for mature and advanced markets and they could encounter difficulties to be implemented in less developed contexts due to the complexity of the structure or to the nature of the offered services.

6 CONCLUSIONS

The present report outlines the main challenges for the implementation of on-bill schemes in the European context with particular reference to the RenOnBill target countries: Germany, Italy, Spain and Lithuania.

The previous sections presented a description and analysis of conceptual business models for the implementation of on-bill schemes. This section aims at summarising the models in order to provide a snapshot of their main features and to propose a comparative analysis.

Table 5.2 illustrates the key features of the proposed model and it emerges that on-bill schemes are flexible instruments which can be easily adapted to specific market and utility requirements. **On-Bill Financing schemes are by far the most flexible solution, but they may have a relevant impact on the financial ratios of the companies**, therefore they are not suitable for small utilities or for the implementation of large programs.

On-Bill Repayment schemes solve these issues, but they can result less flexible, since the financial institutions providing the resources may set constraints on the typologies of interventions to implement as well as on the market segment to approach.

Starting from these two general models, several variants are considered in which different service infrastructures are considered (i.e. the master servicer) or different typologies of financial arrangements are relevant (e.g. a SPV). Furthermore, on-bill schemes can also adapt in their scope and be aimed, for instance, at supporting vulnerable customers (e.g. to fight energy poverty) or to support the spreading of very innovative products and services.

On the basis of the developed analysis a set of main conclusions can be obtained as reported in the following:

- **On-bill schemes support the overcoming of some typical barriers** for the implementation of energy efficiency measures, **especially those related to the financing aspects**.
- The implementation of on-bill schemes is characterised by some specific challenges related to regulatory aspects, final users and utilities themselves. The **most complex regulatory issue is represented by the regulation of the financial sector** (e.g. on-bill schemes might be seen as a form of financing), in relation to final users **the owner-tenant dilemma is crucial** and, finally, **with regards to the utilities**, there are **relevant strategic and operational issues**.
- The analysis demonstrates that for specific types of utilities (e.g. power and retailers), on-bill schemes can be useful for opening new markets, offering

innovative services and consolidating the market position. For natural gas utilities the situation is more complex.

- The considered target markets, e.g. Germany, Italy, Spain and Lithuania, are attractive. In particular, Germany, Italy and Spain have similar features in terms of market structure and building stock, therefore there is a substantial market potential, despite the difficulties in addressing this potential demand.
- Lithuania is a little bit different, since district heating utilities serving the five largest cites cannot offer energy efficiency services to final users, therefore regulatory changes could be necessary to open the market.
- **On-bill schemes demonstrate to be flexible mechanisms for offering a number of energy efficiency and innovative services**. If well-conceived they may represent a breakthrough for the energy market.

The information included in the present report can support the development of detailed business models of on-bill schemes tailored on EU market. In particular, the findings reported for Germany, Spain and Italy can be reasonably extended to similar markets, such as France, Belgium and the Netherlands, which need to refurbish their building stock, especially for reducing space heating demand. For example, on-bill schemes can be used to support renovation in this specific segment as largely demonstrated by the North American experience.

LIST OF FIGURES

LIST OF TABLES

REFERENCES

Abd Alla, S. et al., 2018. *Impact of the utilization of heat pumps for buildings heating in the Italian power market.* Lodz, s.n.

ACEEE, 2020. *ACEEE.* [Online] Available at: https://aceee.org/sector/state-policy/toolkit/on-bill-financing

Alberini, A., Banfi, S. & C, R., 2013. Energy Efficiency Investments in the Home: Swiss Homeowners and Expectations about Future Energy Prices. *Energy Journal,* 34(1), pp. 220-256.

Allcott, H. & Wozny, N., 2014. Gasoline Prices, Fuel Economy, and the Energy Paradox. *Review of Economics and Statistics,* 96(5), pp. 779-795.

Bianco, V., 2018. The Future of the Italian Electricity Generation Sector. *Foresight and STI Governance,* 12(3), pp. 20-28.

Bianco, V., Scarpa, F. & Tagliafico, L., 2017. Estimation of primary energy savings by using heat pumps for heating purposes in the residential sector. *Applied Thermal Engineering,* Volume 114, pp. 938-947.

Bird, S. & Hernández, D., 2012. Policy options for the split incentive: Increasing energy efficiency for low-income renters. *Energy Policy,* Volume 48, pp. 506-514.

Busse, M., Knittel, C. & Zettelmeyer, F., 2013. Are Consumers Myopic? Evidence from New and Used Car Purchases. *American Economic Review,* 103(1), pp. 220-256.

Castellazzi, L., Bertoldi, P. & Economidou, M., 2017. *Overcoming the split incentive,* s.l.: JRC Technical Report.

Cattaneo, C., 2019. Internal and external barriers to energy efficiency: which role for policy interventions?. *Energy Efficiency,* Volume 12, pp. 1293-1311.

Charlier, D., 2015. Energy efficiency investments in the context of split incentives among French households. *Energy Policy,* Volume 87, pp. 465-479.

Deloitte, 2016. *Energy Efficiency in Europe. The levers to deliver potential.,* s.l.: s.n.

Economidou, M., 2014. *Overcoming the split incentive barrier in the building sector,* s.l.: JRC Institute for Energy and Transport.

EU, 2020. *European Commission.* [Online] Available at: https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-performance-of-buildings

Gillingham, K., Harding, M. & Rapson, D., 2012. Split Incentives in Residential Energy Consumption. *The Energy Journal,* 33(2), p. art. n. 2476.

IEA, 2011. *Joint Public-Private Approaches for Energy Efficiency Finance,* Paris: International Energy Agency.

Limaye, D., 2011. *Lessons Learned from Innovative Financing of Energy Efficiency Programs.* Manila, s.n.

Limaye, D. R. & Limaye, E. S., 2011. Scaling up energy efficiency: the case for a Super ESCO. *Energy Efficiency,* Volume 4, pp. 133-144.

Maruejols, L. & Young, D., 2011. Split incentives and energy efficiency in Canadian multi-family dwellings. *Energy Policy,* 39(6), pp. 3665-3668.

O'Malley, E., Schleich, J., Scott, S. & Sorrell, S., 2004. *The Economics Of Energy Efficiency: Barriers to Cost-Effective Investment.* Cheltenham: Edward Elgar Pub.

Palm, J. & Reindl, K., 2018. Understanding barriers to energy-efficiency renovations of multifamily dwellings. *Energy Efficiency,* Volume 11, pp. 53-65.

RenOnBill, 2020. *The Residential Building Renovation Market in Germany, Italy, Spain and Lithuania,* s.l.: s.n.

Rosenow, J., Eyre, N., Burger, V. & Rohde, C., 2013. Overcoming the upfront investment barrier – Comparing the German CO2 Building Rehabilitation Program and the British Green Deal. *Energy and Environment,* 24(1-2), pp. 83-103.

Schleich, J., Gassmann, X., Faure, C. & T, M., 2016. Making the Implicit Explicit: A Look inside the Implicit Discount Rate. *Energy Policy,* Volume 97, pp. 321-331.

van Aerschot, C., 2008. *Barriers to Greater Energy Efficiency within the Building Industry.* s.l., s.n.

RENONBILL

www.renonbill.eu

@RenOnBill

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847056.