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Author(s)	Paiho, Satu; Abdurafikov, Rinat; Hoang, Ha; Kuusisto, Johanna
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AN ANALYSIS OF DIFFERENT BUSINESS MODELS FOR ENERGY EFFICIENT RENOVATION OF RESIDENTIAL DISTRICTS IN RUSSIAN COLD REGIONS

Satu Paiho[1], Rinat Abdurafikov, Ha Hoang, Johanna Kuusisto
1. Corresponding author, Satu.Paiho@vtt.fi, +358-50-3315160
VTT Technical Research Centre of Finland, P.O. Box 1000, 02044 VTT

ABSTRACT

The Russian apartment building stock is old and its energy efficiency is poor. Due to the technical structure of the district heating used in Russia, energy renovations of single buildings seldom lead to reduced energy production. Energy production demands are reduced only if the residential districts and their various utilities and networks are renovated holistically.

This paper analyzes potential business models for energy efficient renovation of Russian residential districts in cold urban regions. After giving background information on Russian housing, the principle idea and planned contents of the Russian district renovations with main stakeholders and business model components are described. Potential business models are identified and their applicability for the Russian district renovations is analyzed. None of the analyzed business models as such suit for the district renovations in Russia but they all would need modifications. Crucial aspects for modifying the ESCO model, selected as the most potential one, are also addressed.

Keywords

Business models, district renovations, energy efficiency

1. Introduction

About 60% of Russia's total multi-family apartment buildings are in need of extensive capital repair (IFC & EBRD, 2012). The Russian apartment buildings are not energy efficient and the losses in heat distribution networks and electricity transmission grids are high (e.g., Bashmakov et al., 2008; the World Bank & IFC, 2008; McKinsey & Company, 2009; the European Commission & the Russian government, 2013). Building renovation is an important opportunity to upgrade buildings in order to meet current and future energy- and eco-efficiency requirements, including people's increasing needs for improved indoor air quality. The energy saving potential of Russia's residential buildings exceeds 55% of their total energy consumption (UNDP, 2010).

The energy renovation of Russian residential districts requires often improvements to the whole energy chain while many building level renovations would only improve the energy efficiency of the building itself (Paiho et al., 2014b). So in Russia, it is important to consider renovation and modernization of whole residential districts. The district renovations would include renovations of the buildings and all their technical systems, modernization of heating energy production and distribution systems, renovation of local electricity production and transmission systems, renewal of street lighting, renovation of water and wastewater systems, and modernization of waste management systems.

The essence of a business model is in defining the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit (Teece, 2010). According to Osterwalder (2004), a business model is a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams.

Russian Federal Law No. 261-FZ "On Energy Saving and Energy Efficiency…" represents a significant move towards an increase in public awareness of the importance of energy saving, and presents substantial business opportunities for companies working in various sectors of the economy (CMS, 2009). In order to exhaust the opportunities for the reduction of energy and carbon intensity, Russia requires new business models to attract and secure extensive investment funds, and to reduce transactional barriers and risks (Garbuzova & Madlener, 2012).

The aim of this paper is to analyze if there are suitable business models for holistic energy efficient renovations of Russian residential districts in urban cold regions. After giving background information on Russian housing, we introduce the principle idea and planned contents of the Russian district renovations with main stakeholders and business model components. Then, the main features of business models identified from the literature are introduced, following the analysis of their applicability for the Russian district renovations. Finally, we conclude by summarizing the advantages and disadvantages of the identified business models and addressing crucial aspects needing modifications by the most potential business model.

1.1. The methodology used

The research is based on critical review of scientific and non-scientific literature. In addition, statistics, websites, public documents and newspaper articles were used. Besides, data was gathered through semi-structured interviews with selected Finnish and Russian experts who all had a minimum of 10 years' expertise in the Russian market. The research utilized an iterative process where data was cross-checked and updated when relevant references and sources were found. The analysis was carried out in the following steps:

A. Describing typical features of Russian housing forming the general background for the study

B. Introducing the core contents of district renovations establishing the case studied

C. Categorizing and analyzing the main stakeholders who would be involved in district renovations

D. Analyzing the business model components in the context of Russian district renovations

E. Identifying potential business models from the literature

F. Analyzing and discussing the applicability of the identified business models for Russian district renovations

G. Selecting the most potential business model and addressing modifications it would require

2. Russian housing

The housing stock of the Russian Federation amounted to 19,650 thousand buildings of the total floor space 3,177 mln. m^2 as of 2009 year end (IUE, 2011). The housing stock included 3,224 thousand apartment buildings of the total floor space 2,237 mln. m^2. Majority of the apartment buildings were constructed between 1960 and 1985 during the Soviet-era with only a few building types (United Nations, 2004; Trumbull, 2013).

The housing stock in Russia has a rather high level of amenities. An average of 61.4% of housing is provided with all the amenities. In 2009, 89% of urban housing stock had access to water supply, 87% to sewerage, 92% to heat supply, and 80% to hot water. (IUE, 2011)

Total population of Russia is 143 million of which 74% live in urban areas. The average living area per inhabitant is 23.4 m^2 (Federal State Statistics Service, 2014) and the average occupancy rate per flat is 2.7 persons (United Nations, 2004). In 2012 (Federal State Statistics Service, 2014), monthly average per capita money income was 22,880 RUR (approximately €570). As Moscow is the richest Russian region, the average wages there are about the double compared to the national average. Of the money expenditures and savings, purchasing of goods and payment for services forms the biggest share being around 74% while acquisition of real estate is around 4% (Federal State Statistics Service, 2014).

Majority of the Russian housing is privately owned due to the free privatization of the housing stock after the Soviet collapse. The apartments were privatized by the tenants “as is”, and the technical condition of the buildings/apartments was not systematically documented at the time. The law on privatization of apartment buildings of 1992 stipulates an obligation of the former lessors of residential units (the Soviet state and municipalities) to carry out the first capital repairs. This substantial involvement of public authorities in maintenance and renovation of the old housing stock and the so-called yard territories and communal infrastructure is the major significant difference from the practices in Europe. Due to this no-cost transfer of ownership, Russia has become a country of poor owners who cannot afford property maintenance and taxation leading to discussions whether ownerships should be returned back to the municipalities (Shomina & Heywood, 2013).

District heating covers 70% of the total residential heating market in urban areas (Nuorkivi, 2005). Heat distribution losses and electricity transmission losses are high in Russia (Bashmakov et al., 2008). Residential consumers are charged for communal services such as heat, water, sewage, and waste disposal in one bill (Korppoo & Korobova, 2012), where heat is the dominant item, with regional variations of 47 to 65% of the total. During the last decade (2000–2009), heating tariffs have increased many times in Russia and the rise in heating price has been steeper compared to other utilities (Nekrasov et al., 2012). Regulated tariffs for residential customers are subsidized and do not reflect the costs of producing electricity (Kuleshov et al., 2012) nor heating (Korppoo & Korobova, 2012).

According to the Russian Statistics Service (Federal State Statistics Service, 2014), the average cost of capital repair in 2012 across Russia amounted to 4,500 RUR/m^2 (€110/m^2). The recent version of the Housing Code established the obligation for the residents of apartment buildings to pay renovation fees to a renovation fund, which can be used either by the building association itself, provided the residents decide so with majority of their votes (how big majority is needed varies depending on the measure suggested), or by default by a regional operator (Housing Code of Russian Federation, 2013). In several regions, the amount of contributions varies between €0.1–0.2 /m^2 per month, which is hardly enough to cover the basic costs.

According to a housing survey in St. Petersburg (Herfert et al., 2013), only a small proportion of the inhabitants living in large-scale housing estates have considered their residential satisfaction, since to a large extent alternative options in the form of affordable residential offers are not available and the large majority of city dwellers still live in non-refurbished and traditional older buildings.

3. RUSSIAN DISTRICT RENOVATIONS

This section describes the idea of renovating Russian residential district holistically. The focus is on cold urban areas of Russia. In addition, the main stakeholders who would be involved in such a renovation are introduced. The business model components are also presented.

3.1. The case – district renovations of residential neighborhoods in urban cold regions of Russia

Typically, the energy efficiency of Russian apartment buildings is poor (e.g., Bashmakov et al., 2008; the World Bank & IFC, 2008). So far, the idea of renovating residential districts holistically is not introduced in Russia. However, it is clear that residential buildings and the related infrastructure is in need of major repairs. Due to the technical structure of district heating used in Russia, the buildings do not include any means to control the heating. Thus, in case only the buildings are renovated and their energy efficiency improved the same amount of heating energy will still be produced.

Table 1 shows the main issues to be included in holistic district renovations in Russia. In principle, all the buildings including all the technical systems and the related energy and water infrastructure would be renovated holistically. The renovations would include upgrading the buildings to more energy efficient ones. In addition, in the most advanced cases the district renovations could include distributed energy production solutions from renewable energy sources.

Table 1. Main contents of the district renovation concept.

DISTRICT RENOVATION		
Buildings • Renovating all buildings • Retrofitting building energy, water and other technical systems • Improving ventilation • Improving insulation	**District infrastructure** • Renovating district heating distribution • Renovating electricity transmission • Renewal of street lighting • Renovating water and wastewater systems • Modernizing waste management	**Distributed energy production** • Energy production from renewable sources o Replacing district heating o Reducing electricity demand from the grid • Only in the most advanced cases

Paiho et al. (2013b) developed different holistic energy renovation concepts for the Russian apartment buildings in cold climates (“Buildings” in Table 1). Paiho et al. (2014b) developed corresponding holistic energy renovation concepts for Russian residential districts focusing on energy, water and waste infrastructures and energy production alternatives (“District infrastructure” and “Distributed energy production” in Table 1). In addition, Paiho et al. (2013b) and Paiho et al. (2014b) describe the current status of different systems and present renovation technologies for each individual system within the concepts. In the buildings, the energy improvements would focus on reducing heating and electricity demands and reducing water use. The key technologies in building renovations would include for example improving U-values of structures, improving building air tightness, modernizing heating systems and replacing water fixtures. In addition, for improving indoor conditions ventilation systems would be modernized even if doing so may in some cases increase energy usage. In the district infrastructure, the energy improvements would focus on reducing losses, improving control and replacing old systems. In the most advanced concepts, such technologies as ground source heat pumps and building integrated photovoltaic systems can also be incorporated. This kind of a district renovation approach would reduce the district-scale energy demands and CO_2 emissions considerably (Paiho et al., 2014b). Through economics of scale the district renovations could also have other benefits, such as reducing the unit costs and being more interesting for the private sector.

Paiho et al. (2014a) modified these renovation concepts to renovation packages with real products and solutions available in the Russian market. The economic attractiveness of the suggested holistic energy-efficient renovation packages of multi-family apartment buildings and the related residential districts in a typical Moscow neighborhood were analyzed by comparing the additional improvements to the basic capital repairs that in any case need to be implemented. Simple payback time (i.e., the ratio of initial investment to costs of annual savings) for the additional improvements beyond the basic renovations exceeds 12 years. At the building level, the investment costs of different renovation packages varied between €125/m^2 and €200/m^2 depending on the extent of the selected renovation package. In case the whole district would be renovated (both the buildings and the related energy and water infrastructure) the costs per inhabitant varied between €3,360 and €5,200. The costs of the building renovations formed about 90% of the total costs. The costs per inhabitants of additional alternatives including renewable energy production solutions were over €6,090.

3.2. Stakeholders in Russian district renovations

A stakeholder analysis clarifies which stakeholders there are and how they are connected to each other and what benefits they could achieve through renovation concepts. The different building stakeholders can play an important role in determining how, why, and if retrofit measures will be implemented and the development of methodologies that enhance the interaction amongst these stakeholders (Menessa & Baer, 2014). In the following, only the main stakeholders in Russian district renovations are briefly introduced.

Inhabitants. In Russia, about 76% of housing units in apartment buildings are reported to be in private ownership (IUE, 2011). Apartment buildings in Russian cities are usually rather big, with several hundreds of apartments (owners), where the residents are rarely familiar with each other and may often have substantially different income levels, which complicates common decision-making process (Paiho et al., 2013a).

Homeowners' associations. The housing reform that came into force in 2005 obligates all homeowners to organize the management of their house privately (Vihavainen, 2009). One alternative to this, the establishment of a homeowners' association, has since become increasingly common. The other two alternatives are direct management by the homeowners, without an association, and management by a private company still often municipality controlled. A homeowners' association is, by definition, a non-profit organization, established for the management and maintenance of common property in a multifamily building.

Public bodies. The local public sector is involved in the renovation and management of old residential building stock (Paiho et al., 2013a). Firstly, because of an obligation to implement renovations, secondly, because the scope of renovation is enormous and public funds are not sufficient – maintenance is the only way to keep social stability. The housing sector in Russia has a poor reputation due to its non-transparency, inefficiency and corruption. The municipality plans the district and has the overall responsibility for providing comfortable and sustainable living surroundings. The city can influence what is being renovated and how it is being done. The involvement of the municipalities is crucial also in implementing requirements from the federal level.

Utility and network operators. District heating is widely used for space heating in Russia (World Bank & IFC, 2008). The majority of the CHP (Combined Heat and Power) plants now are over 30 years old and are nearing the end of their useful lives (Masokin, 2007). Most CHP installations are controlled by Territorial Generation Companies (“TGKs”) (Boute, 2012). There has been little investment in networks over the last two to three decades in Russia (Cooke et al., 2012). Losses on electricity transmission and distribution networks in Russia are high (World Bank & IFC, 2008).

Construction companies. Typically, the companies implementing the renovations are smaller than those involved in new construction (Paiho et al., 2013a). The qualification of employees is generally at a sufficient level, however, though some errors in the final product are possible (e.g. differences from the design documentation), which appears to be connected with poor quality control of the work.

The financial sector. The interest rates on housing credit in Russia are noticeably high by international comparison (Khmelnitskaya, 2014). On one hand, Russians do not trust the banks (Lipman, 2012), on the other hand, Russian commercial banks are not willing to provide the loans for investments in energy efficiency and carbon mitigation projects, as these are classified as highly risky (Garbuzova & Madlener, 2012). To modernize the Russian heating sector, investors need to rely on tariff methodologies and structures that enable them to recover the capital costs of their energy efficiency investments and to earn a reasonable return on capital (Boute, 2012).

Other relevant actors. There are numerous products needed in energy renovations. So, various product manufacturers and system providers are involved. Russian companies tend to prefer to purchase from Western manufacturers when quality is essential (Lychuk et al., 2012). In addition, the renovations need designing.

3.3. Business model components for Russian residential district renovations

There are many ways to structure business model components, e.g., the U.S. Department of Energy (2012), Hedman & Kalling (2003), Morris et al. (2005) and Osterwalder and Pineur (2010). Following analysis includes some considerations based on the business model canvas developed by Osterwalder and Pineur (2010), shown in Figure 1, of what kind of issues a service-oriented company should consider in able to access energy-efficient renovation market in cold climates of Russia.

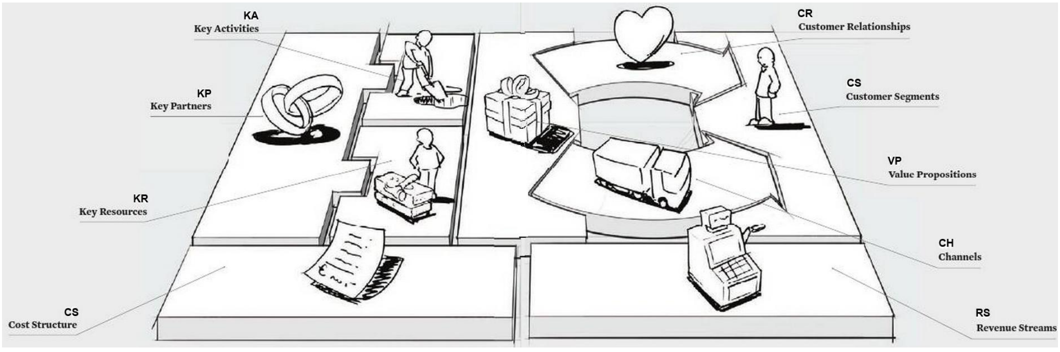

Figure 1. General business model canvas by Osterwalder & Pigneur (2010).

Customer segments. The greatest benefits may be obtained when the whole district is being developed to more energy efficient. Even if the improved energy-efficiency benefits end users, the optimal customers for these larger services are mainly municipalities along with the representatives of the inhabitants, for example homeowners' associations and management companies. Energy-efficient renovation services require knowledgeable customers who are also aware of the key technologies in buildings such as improved insulation, ventilation with heat recovery, energy-efficient windows and doors, energy-efficient lighting and electrical equipment, and efficient heating solutions as well as the key technologies in districts such as efficient district heating solutions, replacing fossil fuels with renewable energy sources, smart metering and energy-efficient street lighting .

Value proposition. Energy-efficiency itself rarely is enough to justify more expensive investments attached to renovation. Legislation can force into some actions, but laws and norms are always behind the technological development. Savings in future energy costs, secure cash flows, reduced technical risks or increased value of the asset are some of the possible benefits to improve energy-efficiency when there are renovation needs.

For single resident in apartment building the improved energy-efficient can bring, for example savings in energy costs or more comfortable indoor conditions. Apartment or utility owners can benefit from reduced risk levels, secure cash flows and perhaps increased value of the asset. Through district renovations, public bodies may for example gain the peoples' trust and meet regulatory requirements. Such systems as the LEED rating system for neighborhood development (Talen et al., 2013) could support information dissemination & awareness rising among the people.

Channels. As marketing channels, organized events for professionals play central role in creating awareness. In addition, the creation of awareness among end users helps to raise the demand for such services. These cannot replace personal contacts. Actions in municipality levels are required too.

Customer relationships. Customer relationship with institutional customers differ also from direct consumer relationships, even different legislation is applied. Here the institutional customers are considered more potential customers for energy-efficient renovation services due to unified decision making. Similar building stock provides opportunity to mass-customization. However, entering to the different sub-markets and features of clients require personalized service, but on the other hand create fruitful ground for co-creation. In Russia, the creation of trust plays important role in business relationships.

Revenue streams. Existing services often try to tie pricing mechanisms with energy prices. There are well based reasons for this, but predicting price development is very risky. Instead, other value propositions than saving money could be included into services.

Key resources. Renovation activities are often labor intensive. Finding knowledgeable people and managing multicultural workforces create own challenges. Economies of scale can bring another challenge that the production capacity is not extensive enough. The size of projects in Russia can be very large compared to for example Nordic residential areas.

Key activities. There might be a need to include several different activities to the service, for example marketing, energy audits, detailed planning of renovation, financing, installation, after sales etc. Customer is easily buying only technical devices, but the service is not comprehensive if, for example the delivery time and quality are not considered.

Key partners. Knowing customer or customer segments are not enough, but defining and finding key partners create an essential ground for business. Transferring the production near the market can be required. These activities might require a creation of joint ventures with local actors. Marketing activities and creation of business relationships might also require "a partner, who opens doors".

Cost structure. Energy-efficient renovation services are value driven rather than cost driven. There are possibilities for leaner cost structure after services have been established in the market. Currently studied pre-fabrication methods, and the use of building information modelling during design, planning and production phases can shorten the delivery times in the future. Use of local workforce makes a large difference in cost structure, but requires time and money that necessary people are trained. Russia's residential energy-efficient renovation market provides unique opportunity for companies to offer renovation services.

4. Potential business models identified from the literature

Several business models meant for energy efficiency improvements have been reported, e.g. Frantzis et al. (2008), Huijben & Verbong (2013), Lumijärvi & Ollikainen 2011, Okkonen & Suhonen (2010), Richter (2012), Richter (2013), and Würtenberger et al. (2012). In this section, the main features of these business models are briefly described. At the end of this section, a summary table of the business model components of each model is presented and compared to the needs of the business model components for Russian residential district renovations (see chapter 3.3).

4.1. The ESCO model

Two basic ESCO (Energy Service Company) business models can be distinguished, which provide either useful energy (Energy Supply Contracting - ESC) or energy savings (Energy Performance Contracting - EPC) to the end user. In addition to the two basic models, a hybrid model labelled as Integrated Energy-Contracting (IEC) aims to combine useful energy supply, preferably from renewable sources with energy conservations measures in the entire building (Würtenberger et al., 2012). Bleyl et al. (2008) propose three EPC-models allowing combining (comprehensive) refurbishment measures of buildings with the advantages and long term guarantees of Energy Contracting models.

ESCOs offer energy services to final energy users, including the supply and installation of energy-efficient equipment, and/or building refurbishment, maintenance and operation, facility management, and the supply of energy (Bertoldi et. al, 2006). Street-lighting and district heating using the ESCO concept are developed by municipalities but typically the concept has been used in energy efficiency measures of public, commercial and industrial buildings (Marino et al., 2011). The ESCO model has also been suggested as a business model for local heat entrepreneurship (see chapter 4.5) (Suhonen & Okkonen, 2013).

An important difference between 'do-it-yourself' implementation and outsourcing to an ESCO root in the functional, performance and price *guarantees* provided by the ESCO and the assumption of technical and economic risks by the ESCO (Würtenberger et al., 2012). ESCOs must clearly demonstrate the measureable and observable benefits of their projects (Pätäri & Sinkkonen, 2014). The ESCO takes the technical risks of the investment and gets financial benefits from that risk taking (Bertoldi et. al, 2006). The main share of revenue of an ESCO business model comes from the achieved reduction either of energy costs, energy usage, or carbon emissions (Garbuzova & Madlener, 2012).

4.2. Customer-side renewable business model

In this business model the renewable energy systems are located on the property of the customer (Richter, 2012). The systems can also be owned by the customer (Huijben & Verbong, 2013; Frantzis et al., 2008). In small-scale business, the dominant sources or renewable energy are typically wood pellet stoves, small wind turbines, and small-scale combined heat and power systems (CHP), solar thermal collectors, solar photovoltaic systems, geothermal, and heat pumps (Aslani & Mohaghar, 2013). The size of the systems usually ranges between a few kilowatts and about 1 MW (Richter, 2012). For example, a number of energy companies in the Netherlands are selling PV panels to their customers and providing additional services like installation and monitoring (Huijben & Verbong, 2013).

In Germany, even the utilities that see distributed generation as a potential market severely struggle to develop value propositions for this field (Richter, 2013). Boehnke (2007) lists potential values, such as minimize trouble for final consumers, feature technologies with low maintenance requirements, a single contact for all issues, and moderate initial investments. In Germany, there are new products and services invented but mainly for the creation of political goodwill and customer relationship (Richter, 2013).

Cost structure becomes more complex due to many small instead of few large investments (Richter, 2012). Typically, the feed-in tariff (FIT) payment is sized to cover both installation and operating costs, but the tariff is only paid for actual energy production (Gifford et al., 2011). This makes it most suitable for technologies that are available off-the-shelf (Würtenberger et al., 2012).

4.3. Utility-side renewable business model

In this model, the projects range from one to some hundred megawatts (Richter, 2012). In large-scale business, the dominant sources of renewable energy are typically biomass and biogas plants (or CHP plants), on/offshore wind energy, large-scale photovoltaic systems, and solar thermal energy like concentrated solar power (Aslani & Mohaghar, 2013).

Customer segmentation allows increasing customer base and earning “eco” price premium (Richter, 2012). For the utility management, clean energy and energy efficiency are often a lower priority than reliability and cost (U.S. Department of Energy, 2012).

Revenue models for the utility-side business model exist and can easily be adapted by utilities (Richter, 2012). Decoupling and cost-recovery mechanisms allow utilities to recover some of the revenue lost from demand side management or other energy efficiency programs (U.S. Department of Energy, 2012).

Cost structures are in favor of utilities experiences with large scale infrastructure financing (Richter, 2012). Demand response services may reduce the electricity bill of a final customer with distributed generation capacity by over 15% (Gordijn & Akkermans, 2007).

4.4. Mankala company

In a Mankala arrangement the shareholders establish a limited liability project company, the purpose of which is to operate like a zero-profit cooperative to supply electricity to shareholders at cost price (Lumijärvi and Ollikainen, 2011). The owners gain electricity in proportion to their ownership at a cost price. The owners, consisting mostly of wholesalers and retailers and on the other hand of companies with large energy consumption, such as large industrial companies, can use the electricity in their own production or sell it on through the exchange or bilaterally (Puikkonen, 2010).

Market risks are taken by the end users (Lumijärvi and Ollikainen, 2011). The joint owners get the profit, other earning, through low procurement costs. This other earning is tax free, which is one of the main benefits of the model (Puikkonen, 2010).

So far the Mankala principle has been applied in several energy investments in Finland, including for example wind, hydro and nuclear power (Lumijärvi and Ollikainen, 2011). In Finland, The Mankala-model can be described as a long, and in principle a forever-lasting contract, in which the companies bind themselves to the obligations of the joint owners, which in turn leads to the fact that new companies' entry to the partnership is hindered (Puikkonen, 2010).

The structure is heavy, entails extensive legal and financial arrangements and documentation, and therefore high transaction costs (Lumijärvi and Ollikainen, 2011). The price of other earning from the company is defined in the shareholder and other agreements and is the same for all owners within the different production forms (Puikkonen, 2010).

4.5. Heat entrepreneurship model

"Heat entrepreneurship" refers to a business model which is to some extent similar to traditional energy companies' district heating business but in small scale (Lumijärvi & Ollikainen, 2011). A heat entrepreneur or enterprise can be a single entrepreneur, entrepreneur consortium, company or cooperative providing heating for a community (Okkonen & Suhonen, 2010). Often the scale of the heating units are small, at the maximum a few megawatts (Motiva, 2013).

The heat entrepreneur develops designs, constructs and invests in the heat system (Lumijärvi & Ollikainen, 2011). The entrepreneur can either sell the heat directly to a building, or it can sell the heat to the local heating network (Motiva, 2013). It could also be possible to include other services, such as property management and guarding, to the offering (Pakkanen & Tuuri, 2012). The heat entrepreneur requires constant fuel supply. For example, low quality forest fuel could cause unscheduled stoppages and lower the profitability of cost sensitive heat production (Laihanen et al., 2013).

4.6. On-bill financing

On-bill tariffs are a mechanism for charging customers for energy efficiency investments or upgrades provided as a service by the utility (Bell et al., 2011). Preferably the overall utility bill should still be lowered, because of the associated energy cost savings (Würtenberger et al., 2012).

This model is originally targeted to owner-occupied single-family houses and small commercial buildings (Würtenberger et al., 2012) but it could be extended to apartment buildings at least if energy is billed based on building-level metering. There are examples from the United States where this model has been applied to large multi-family buildings (ACEEE, 2012). In case of billing based on apartment level sub metering the model is more challenging. Offering standard information and programs to customers can help to avoid some agent problems (Sweatman & Managan, 2010).

On-bill financing generally needs to be complemented with other approaches such as technical assistance, contractor training, and cash incentives to reduce the amount of loan needed or buy down interest rates (Bell et al., 2011). The utility may rely on additional partners for financing, such as banks or government bodies (Würtenberger et al., 2012). These programs are most successful when the application process is simple and straightforward and the contractors receive prompt payment for their services (Johnson et al., 2012). Installers of renewable energy equipment may be involved by partnering with the utility (Würtenberger et al., 2012).

4.7. Energy leasing

Energy leasing enables a building owner to use an energy installation without having to buy it. There are two main types of leases: operational lease and financial lease. Leasing can be a central component of the business model of an Energy Service Company (see chapter 4.1). Leasing can also be a central component of the business model of a company that introduces a specific new technology to the market via a leasing arrangement, including a service and maintenance package. (Würtenberger et al., 2012)

In a leasing arrangement the leasing company ("lessor") owns the equipment and makes an agreement with the customer ("lessee") on the use of the equipment (Lumijärvi & Ollikainen, 2011). The latter pays a monthly fee to the former for the right to use the equipment. The transaction costs involved in leasing on a small scale would be high, relative to consumer credit, and there would be greater risk for the lender, and cost for the borrower, in projects with a low component of physical assets (OECD/IEA & AFD, 2008). Leasing is not suitable for renovating certain vital building parts or components, like windows, façades or ceilings, which cannot be removed after the end of the lease term (Würtenberger et al., 2012).

The equipment given for clients to produce or save energy provide the main service offered. In addition, the leasing also covers the funding of these investments. By leasing via an energy service contractor, the building owners may profit from additional services such as specific financial, legal, fiscal and administrative consultancy, and operation and maintenance services (Würtenberger et al., 2012).

4.8. Business model components compared to the main aspects in Russian district renovation

In chapter 3.3, some issues were considered which are relevant for a service-oriented company to access the energy-efficient renovation market in cold urban Russian areas. The analysis was based on the business model canvas by Osterwalder & Pineur (2010). In Table 2, the main aspects of these components are shown in relation to the corresponding components of business models presented. In addition, the main scopes of the models are listed.

Table 2. The main aspects of the business model components and the corresponding aspects in Russian district renovations.

	Russian district renovation	ESCO model	Customer-side renewable energy business model	Utility-side renewable business model	Mankala company	Heat entrepreneurship	On-bill financing	Energy leasing
Scope	energy-efficient renovation of residential districts including renovations of both the buildings and the related infrastructure	energy services (Bertoldi et al., 2006)	energy production from renewable sources at customer-side (Richter, 2012)	renewable energy production (Aslani & Mohaghar, 2013)	energy company ownership (Lumijärvi & Ollikainen, 2011)	providing heating for a community (Okkonen & Suhonen, 2010)	utilities providing financing for renewable energy and energy efficiency measures (Würtenberger et al., 2012)	transferable energy installation without having to buy it (Würtenberger et al., 2012)
Customer segments	renovated buildings and the related infrastructure, knowledgeable customers required	final energy users (Bertoldi et al., 2006)	energy end users (Richter, 2012)	customers valuing clean energy (Richter, 2012)	joint owners (Puikkonen, 2010)	public buildings, private houses and industrial estates (Okkonen & Suhonen, 2010)	originally targeted to owner-occupied single-family houses and small commercial buildings (Würtenberger et al., 2012)	all types of buildings (Würtenberger et al., 2012)
Value proposition	energy-efficiency in combination to other values	functional, performance and price guarantees (Würtenberger et al., 2012)	not clear yet (Richter, 2013)	possibilities to additional environmental value (Richter, 2012)	no market risks (Lumijärvi & Ollikainen, 2011)	heat service (Motiva, 2013)	providing services for energy efficiency investments and upgrades (Bell et al., 2011)	opportunity to use an equipment without initial investments (Würtenberger et al., 2012)
Channels	several needed due to many involved	further experience	improved information	existing ones used (Richter,	marketing is not needed	local media and direct contacts	can leverage utility's	need development

	stakeholders	needed (Marino et al., 2010)	exchange between the utility and the customer (Richter, 2012)	2012)	(Puikkonen, 2010)		relationship with energy customers (Bell et al., 2011)	(Würtenberger et al., 2012)
Customer relationships	trust creation is mandatory	mutual trust and confidence needed (Marino et al., 2011)	business-to-business relationship (Richter, 2013)	no change to current ones needed (Richter, 2012)	business-to-business relationship (Puikkonen, 2010)	no resources for developing customer relationships	for example targeted programs (Würtenberger et al., 2012)	not many examples since the model is not common
Revenue streams	perhaps partly tied to tariffs and partly to services	through reduction in energy costs, energy usage or carbon emissions (Garbuzova & Madlener, 2012)	new ones needed (Richter, 2012)	existing models can be adapted (Richter, 2012)	no taxable profit (Puikkone, 2010)	selling heat (Motiva, 2013)	additional charges (ACEEE, 2012)	leasing arrangement (Lumijärvi & Ollikainen, 2011)
Key resources	skillful labor	financing (Bertoldi et al., 2006)	operating decentralized renewable energy systems (Richter, 2012)	energy generation and distribution assets (Lumijärvi & Ollikainen, 2011)	energy production equipment	heat production and distribution systems	service providers (Brown, 2009)	depend on the model structure, can be the same as in ESCO
Key activities	comprehensive services	a general contractor (Würtenberger et al., 2012)	new approaches needed (Richter, 2012)	possibly the whole value chain (Richter, 2012)	participating investors (Lumijärvi & Ollikainen, 2011)	designing, constructing and investing in the heating system (Lumijärvi & Ollikainen, 2011)	linking payments to utility bills (Würtenberger et al., 2012)	equipment provided for clients to produce or save energy (Würtenberger et al., 2012)
Key partners	local actors including public	financial institutions,	system manufacturers,	knowledge and experience not	involved shareholders	fuel supplier (Laihanen et al.,	technical assistance,	ESCO or a building owner

	bodies	technology providers and energy suppliers (Marino et al., 2011)	installation companies and financing services (Richter, 2012; Boehnke, 2007)	available in the organization (Richter, 2012)	(Lumijärvi & Ollikainen, 2011)	2013)	contactor training, financing services and installers (Bell et al., 2011; Würtenberger et al., 2012)	and a bank (Würtenberger et al., 2012)
Cost structure	value driven	cost driven (Bertoldi et al., 2006; Bleyl et al., 2008)	possibly feed in tariffs (Gifford et al., 2011)	for example demand response services (Gordijn & Akkermans, 2007)	same price for all owners (Puikkonen, 2010)	customer paying for energy consumed (Lumijärvi & Ollikainen, 2011)	financing mechanisms (Bell et al., 2011)	physical assets form greater bulk of the expenditure (OECD/IEA & AFD, 2008)

5. APPLICABILITY OF THE IDENTIFIED BUSINESS MODELS FOR THE RUSSIAN DISTRICT RENOVATIONS

In this section, it is evaluated how the business models identified from the literature would fit to energy-efficient renovations of Russian residential districts.

5.1. The ESCO model

In Russia, ESCO activities are still in a nascent stage at least when referred to a “Western-ESCO”. Energy Performance Contracting (EPC) is not used in the Russian ESCO model. According to Russian legislation, leasing schemes seem to be very promising for the Russian ESCOs. (Garbuzova & Madlener, 2012)

Lack of appropriate forms of finance, public procurement rules, unstable customers, and a perceived high business and technological risk are seen as strong overarching barriers that hinder ESCO market development in Russia (Marino et al., 2010). Other constraints for ESCOs are: the lack of stability for operations of small and medium business and with the traditional economic system of centralized planning, low energy tariffs which fail to provide incentives for energy saving and fairly high end-user prices compared to the average income level (United Nations, 2010).

Companies operating as providers of energy services are of quite small size; some offer ESCO-type contracts as an added value to their core business, such as energy equipment manufactures integrating the ESCO concept into energy supply business (Marino et al., 2010). Further sources of revenues of the Russian ESCOs are based on the energy audit and technical services for the implemented equipment during the project, and not on the energy savings as in Western-ESCOs (Garbuzova & Madlener, 2012).

An important aspect for ESCO projects' implementation relates to ensuring payback guarantees as risk control would be problematic at all phases of project implementation. Such guarantees may be ensured by financial institutions or Russian government authorities. ESCO operations in the Russian Federation need to be supported by a corresponding clearly-defined legislation and predictable taxes. Improving public awareness of the energy saving issue and ESCOs as an energy saving tool is to become a priority task. (United Nations, 2010)

For the Russian district renovations, this model could be applicable in a modified form provided that the ESCO business becomes more common in Russia. This would perhaps require completely new actors in this field.

5.2. Customer-side renewable energy business model

Because of the flexibility in choosing categories and tariffs, government can use a feed-in scheme to stimulate private sector investments into specific technologies or niche markets (Würtenberger et al., 2012). Even though feed-in policies are widely used around the world Russia has not adopted them yet (REN21, 2013). Customer-side energy production needs a feed-in scheme so that the possible extra production could be sold to other energy users.

For the Russian district renovations (Paiho et al., 2013a), the energy production units serving only one building would be within this size limit. In this business model, there exists two key actors both producing energy, namely the energy utility and the distributed renewable energy producers at customer locations. In

Russia, the energy utility, also owning the energy networks, is most often a public body. The energy production facilities and the energy distribution equipment are old and in need of renewal. In case, whole residential districts would be renovated the energy demands of these districts would be smaller as well as the required energy production capacities. This smaller energy need could be produced at the customer-side by renewable energy. The energy would have ecological value and at the same time result in smaller transfer losses compared to the current situation. The business for the energy producers could be, in this case, to maintain and “rent” the distribution capacity and offer maintenance services (maintenance, balancing, storage capacity etc.) regarding the customer owned energy systems.

5.3. Utility-side renewable business model

For the district renovations, the energy production units serving the whole district would be within this size limit (Paiho et al., 2013a). Municipal and state owned companies play a major role in the energy business, even if it is becoming more privatized and opened for competition in Russia. Since 2003, the Russian electricity market has gradually opened to competition, and the end of 2010 marks the final stage of this transition (Boute, 2012). The heat market is still regulated (Boute, 2012). Due to the dominating role of the traditional energy companies, any considerable change in the energy generation mix will include involvement by the municipal and state (and industry’s) energy companies. On the other hand, experiences indicate that the energy companies are not typical early adopters of new technologies and business models (Lumijärvi and Ollikainen, 2011).

If residential districts in Russia were renovated to more energy-efficient ones, their energy demand would reduce. The needed energy could thereby be produced locally from renewable energy sources. From the utilities point of view the business would change in the way that they would sell less energy but the energy that they generate would contain ecological value, and at the same time result in smaller losses and infrastructure costs (instead of long distance transfer and maintenance of distribution network).

For the district renovations, the implemented new energy production units would serve the whole district. They could be owned by the homeowner's associations in the area, by the building operations and maintenance companies, by the municipalities or by the energy utility. In the Netherlands, there are examples of community shared projects where apartment complexes own the PV production facilities (Huijben & Verbong, 2013). If there is periodically or always more electricity produced than needed in the area, this can be sold to the grid for profit. If the heating energy is locally produced from renewable energy sources only the local district heating network will be in need of renewal.

5.4. Mankala company

In Finland, the Mankala model has been used in very large energy investment projects quite different to those needed in Russian residential districts. The model is complicated and it contains questionable features, such as competition issues (Puikkonen, 2010). However, in some lighter and revised form it could perhaps be adapted to energy-efficient renovations of Russian residential districts. This would require a several number of bodies or stakeholders to have a common vision and will towards energy-efficiency improvements of residential districts. Then, the model could perhaps be utilized in other similar cases as well.

5.5. Heat entrepreneurship model

In Finland, heat entrepreneurship is typically very local and quite small-scale heat production (Lumijärvi & Ollikainen, 2011). In Russia, in general private industrial enterprises (especially large-scale) have been involved in provision of district heating services to communities (Solanko, 2006). For example, in Moscow third-party investors own two heating plants: one on the territory of the former ZIL truck plant and another one – a heating plant converted from using coal to gas and supplying heat to an area of high-rise office buildings known as “Moscow-City”. The size of these plants is typically over 100 MW (City of Moscow, 2009). So, this model may have certain potential in Russia but in different scale than in Finland. The main idea is that a local actor is in charge of heat (or in general energy) production.

5.6. On-bill financing

The regional authorities can require heat companies to implement ambitious energy efficiency improvement measures and guarantee the financial viability of these measures by adopting appropriate tariffs (Boute, 2012). The cost-plus tariff methodology used in Russia discourages heating suppliers from investing in any measures that save operating and maintenance costs (which include energy costs) (World Bank & IFC, 2008). However, energy efficiency measures improve the reliability of heat supply and reduce the dependency on primary energy fuels for regions that do not produce energy and are dependent on energy imports from other regions in the Russian Federation (Boute, 2012).

Heating tariffs fail to cover the costs of production, distribution, and the massive need for modernization (Korppoo & Korobova, 2012). Some estimates suggest that residential electricity prices may need to nearly double to reach cost-reflective levels (Cooke et al., 2012). Precise estimations of the financial value of cross-subsidization are problematic because its existence is partially denied by the state (Kuleshov et al., 2012). At the federal level, short-term (heat) price increases are a very sensitive issue and a serious obstacle to the implementation of energy efficiency and renewable energy initiatives (Boute, 2012).

The local authorities have a vital role in boosting towards energy-efficiency. Renovated buildings must be equipped with heat meters to the extent technologically possible (Korppoo & Korobova, 2012). So, on-bill financing could be one suitable model even though it would, even dramatically, increase the customer payments. However, Russian tariff law strictly regulates the type and amount of costs that investors can recoup through tariffs (Boute, 2012). One major challenge would also be the persistent non-payment of energy bills (Garbuzova & Madlener, 2012; AEB, 2013).

5.7. Energy leasing

In Russia, implementation of leasing schemes is advisable in order to minimize the financial risks of ESCO in its relationships with the Client and to obtain an additional mechanism of control over the Client’s operations within the frame of the energy-saving system and technologies (Efremov et al., 2004). Leasing is only suitable for equipment and different services systems. So, when renovating Russian residential districts leasing could be used for example for renewal of energy equipment but it could not be used for renovation of parts integrated in buildings.

6. THE MOST POTENTIAL BUSINESS MODEL

This section first summarizes the advantages and disadvantages of the identified business models and then addresses relevant aspects needing modifications by the most potential business model, the ESCO model, in order to suit for the district renovations.

6.1. Advantages and disadvantages of the identified business models

As can be seen from Table 3 the business models identified from the literature are mainly meant for some large-scale energy production solution or for limited energy-efficiency improvements in buildings. None of the models as such is suitable for holistic energy-efficient renovations of Russian residential districts in cold urban regions. If one actor takes the responsibility of all the renovation needs, the business model should also include all the construction renovations or modernizations in the district, such as building structures and systems, heating distribution networks, electrical systems, street lighting systems, water and waste water systems, and waste management systems.

Table 3. Pros and cons of different business models in Russian residential district renovations (authors' analysis).

Business model	Advantages	Disadvantages
ESCO model	• One actor takes responsibility of all renovations	• "Western-ESCO" not common in Russia • Current ESCO companies are small • Requires tangible guarantees of the benefits • Existing low energy tariffs limit revenues
Customer-side renewable energy business model	• Final consumers less depended on municipal energy production	• Suitable only for energy production units serving just one building • Another model needed for other renovations • Feed-in tariffs not adopted in Russia
Utility-side renewable business model	• Same energy utility serves the whole district • Optimization and balancing of production	• Covers only modernization of district energy production
Mankala company	• Joint ownership between end users and energy companies • In a modified form could be applied to all district renovation aspects	• Complicated heavy structure
Heat entrepreneurship	• Local actors specialized in local conditions involved	• Basic model aimed solely to heat production
On-bill financing	• Local authorities can require heat companies to implement energy-efficiency measures • Simple financing mechanism	• Consumer payments for energy are subsidized • Russian laws regulate tariffs • Heat consumption is not currently metered, however heat metering installations are mandatory in renovations
Energy leasing	• No need to buy the energy production units • Russian legislation supports leasing schemes	• Not suitable for renovations of systems integrated in the district • Leasing contracts could involve long-term agreements and several stakeholder which could make it complicated to reach an agreement

6.2. Crucial aspects for the modified ESCO model

Creation of ESCOs was suggested for heating system modernization in St. Petersburg already in 2001 (Chistovich et al., 2001). Since among the business models identified, the ESCO model is the only one already somehow known in Russia (Garbuzova-Schlifter & Madlener, 2013; IFC, 2011) it was selected as the most potential one in the long run. This section addresses some key issues which need to be further developed for the ESCO model to be suitable for district renovations in the Russian market. In this relation, the new model needed is referred as “the modified ESCO”.

The district renovation can be regarded as project business since for example it will be limited in time and customers will be delivered predefined products and systems. Typically projects involve a range of actors, firms and experts with sometimes conflicting ideas and priorities (Wikström et al., 2010). This would also be the case in the Russian district renovations. Services will also be provided between and for the stakeholders before, during and perhaps even after the renovations. Thus, the district renovation can also be classified as service business (Artto et al., 2008). Both project and service business related items would be needed to be included in the modified ESCO model.

Studying the need to renew the ESCO business model Pätäri & Sinkkonen (2014) conclude that a strong emphasis ought to be put on both the visible and the invisible benefits. This is apparent in Russian district renovations in cold urban areas since both the idea of renovating districts holistically and the ESCO business model in general and as a means for realizing renovations need to be better known and understood among the common people and the municipalities.

The Russian ESCOs often provide only consulting services and they are not ready to take investment risks (IFC, 2011). The offering of the modified ESCO should include at least: all the renovation works, engineering, financing, product and system deliveries, installations, providing the mandatory permits, collecting agreements from the apartment owners and arranging the financial guarantees (bonds) for the construction period. In addition, the offering could include other services such as energy auditing, design, operation and maintenance after the renovations and consulting. Due to the extensive offering needed partnering places a central role in the modified ESCO model. Garbuzova-Schlifter & Madlener (2013) highlight that the Russian ESCO market could extremely benefit from joint venturing with foreign partners by securing know-how, financing, risk management, and technology transfer. However, it is of vital importance to also involve Russian organizations since they are needed for trust creation and contacting between stakeholders.

The contractual form “guaranteed savings” is more important in the Russian ESCO market, while “shared savings”, presumably due to risk-sharing with a client, does not seem to be an attractive option for the emerging market (Garbuzova-Schlifter & Madlener, 2013). In a guaranteed savings, the client essentially applies for a loan, finances the project and makes periodic debt service payments to a financial institution (IFC, 2011). In Russian district renovations, financing is one of the key issues needed for the renovations. Thus, even if the actual financial contracts were made between the financial institution and the client, the ESCO should at least identify the actual financer and perhaps even negotiate the contracts.

Pätäri & Sinkkonen (2014) address several common external and internal barriers limiting growth in the ESCO market in general. Some of them equal to those Garbuzova-Schlifter & Madlener (2013) point out in the Russian energy service industry. The main problems addressed in the Russian market are: lack of government support, high credit risk of energy efficiency projects, lack of awareness of the energy efficient potential, weak legal and contract enforcement framework, and bureaucracy. These cannot be solved through ESCOs alone but need policy actions as well.

Perhaps the major obstacle for applying ESCOs in the Russian residential sector is the decision-making of apartment owners. While housing laws require 50% agreement of all residents, the energy saving law demands 100% agreement confirmed in writing (AEB, 2013). Convincing the inhabitants and collecting the signatures in big apartment buildings will be a huge effort.

7. DISCUSSION AND CONCLUSIONS

In urban Russian residential districts in cold regions, building renovations alone are seldom sufficient, since typically the district heating supply cannot be controlled. So, if only building structures and systems are renewed, the same amount of heating energy will be produced and no energy savings will be achieved. So, the whole districts, instead of just single buildings, should be renovated. This led to analyzing potential business models from holistic district renovations points of view.

Since the business models identified from the literature are mainly meant for some large-scale energy production solution or for limited energy-efficiency improvements in buildings, they do not as such suit for Russian district renovations including renovations of both the buildings in the area and modernizing the related energy and water infrastructure. The scope of Russian district renovations is much wider and includes much more stakeholders. Integration of various services into the offering of an existing business model is difficult (Wikström et al., 2010). Thus, developing a completely new business model for the Russian district renovations may be needed but the new business model can also be sort of a "hybrid" model of the ones identified. However, all the identified models include features which could be included in the most idealistic model depending on the responsible actor involved. Which of the existing actors would take the lead is to be seen. In addition, this analysis pointed out some features of the identified models which should rather be excluded from the actual business models for the district renovations.

Renovation of whole districts could offer business opportunities for new actors providing full service concepts such as the one-stop-shop business model (Mahapatra et al., 2013) introduced for single-family houses in Nordic countries. In addition, all the possible business models somehow include energy saving obligations (Würtenberger et al., 2012) which are one form of policy instruments. It is estimated that tariff reform can do the most to improve energy efficiency in the Russian heating sector (World Bank & IFC, 2008). So, this could form one basis of a suitable business model. Since the role of the public sector is pronounced in Russia, some form of Public-Private-People Partnership (4P) could also be suitable (Kuronen et al., 2011).

In district renovations, there are various stakeholders involved. Value networks could be utilized to show the relationships and the value transferred between key stakeholders, as was done by Frantzis et al. (2008) when analyzing photovoltaic business models. Therefore, analyzing the value networks of different possible business models could be helpful for forming the most relevant business model.

Since some ESCO activities have been realized in Russia it was assessed to be the most potential business model for district renovations. However, it would need modifications which were also addressed. Even in the Western countries, ESCO activities have been realized mainly in public, commercial and industrial buildings (Bertoldi et al., 2006; Marino et al., 2011; Würtenberger et al., 2012) while the residential sector is found to be more challenging. Due to the large offering required perhaps only parts of district renovations may be realized through ESCO activities, such as the district infrastructure renovations.

Since the idea of holistic district renovations of Russian residential districts is just recently introduced (Paiho et al., 2014b) it is to some extend a hypothetical case. However, it is evident that such an approach would have obvious benefits, such as guaranteed energy savings and reduced emissions through the improvements to the whole energy chain. In addition, compared to just renovating individual buildings industry actors could be more interested in the approach due to the bigger scale. For the public sector, the district renovations would provide better opportunities to enforce higher-level environmental and social policy targets. Also the inhabitants would profit through upscale of the whole district.

Technical solutions exist for the district renovations though new ones could also be developed. Still, the challenges and obstacles are mainly related to other than technical issues. Perhaps, the two dominant challenges would be financing of the renovations and joint decision-making among apartment owners. The business models would need to include features to overcome these challenges. New policy instrument may also be needed to support the implementation. In addition, Russian stakeholders ought to be responsible for collecting the mandatory agreements from the apartment owners and acquiring the construction and other permits. This is recommended since trust forms a vital part in the Russian business environment and even for fluent Russian speakers such partly bureaucratic issues are more difficult to handle than for native Russian citizens.

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