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One-Stop-Shops for Energy Renovation of Dwellings in Europe—Approach to the Factors That Determine Success and Future Lines of Action

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Abstract: Energy renovation of buildings in the European Union would lead to considerable energy savings and a 26% reduction in energy consumption. Despite this and the programmes implemented to promote it in the residential environment in Europe and the United States, the barriers that homes, contractors, and finance companies face to undertake these processes have slowed down the results. The emergence of one-stop-shops (OSSs), promoted by European directives, as integrated management entities to promote the energy renovation of dwellings seems to be a central element in the development of future strategies. This paper looks at experiences of implementing OSSs in Europe, tries to identify the main factors of success, and proposes lines of action to strengthen OSS operation in the long term. To achieve this, documents, regulations, and data on the context were studied, and active cases of OSSs were analysed. Experiences of OSSs that are no longer operating were identified to determine why they had closed down. The results suggested that a lack of structural funding is one reason why activities terminated and that the most successful cases applied an 'all inclusive' model and supported families in the entire process.

Keywords: residential energy efficiency; decarbonisation of housing stock; European renovation policies; renovation of buildings; barriers to home renovation

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1. Introduction and General Context

Building stock in Europe is responsible for 36% of greenhouse gas emissions and 40% of energy consumption. This is because around 35% of the buildings are over 50 years old, almost 75% of these are inefficient from an energy perspective, and only between 0.4% and 1.2% of the housing stock is renovated [1]. This situation is critical, if we consider that most of these houses will continue to be in use in 2050 [2]. Greater efforts must be made in relation to European renovation policies to increase the quotas of energy renovations in residential buildings. In this context, building is undoubtedly a strategic sector for intervention to meet commitments to cut emissions and energy consumption. In addition, the intensive nature of labour in the construction sector means that building renovation plays a key role in the economic recovery of Europe in the period after the COVID-19 pandemic, particularly through the creation of local jobs.

To boost the renovation of this obsolete building stock, since 2002 the European Union has developed a legislative framework to promote processes of improving the energy efficiency of buildings, with the enactment of Directive 2002/91/EC, on the energy performance of buildings [3], updated through Directive 2010/31/EU on the energy performance

of buildings (EPBD) [4] and the Energy Efficiency Directive 2012/27/EU [5] that established the need for each member state to design a building renovation strategy, through specific actions, to achieve efficient, decarbonised building stock prior to 2050 [6]. In addition, in this context of needing to renovate the building stock, Directive 2018/844/EU [7] proposes the implementation of new support instruments such as Building Renovation Passports. In terms of developing an integrated management model for renovation, this directive indicates that member states should make available suitable, accessible, transparent advisory mechanisms on energy efficiency (EE) renovations. For this purpose, it proposes the creation of a local or regional network of one-stop-shops (OSSs) that provide integrated services and cover the entire process for the customer, including the provision of information, technical assistance, organisation, financial support, and monitoring of savings. Above all, the directive suggests that this type of services should promote a greater number of projects and generate more solid, reliable associations with local agents (suppliers, financial entities and energy agencies) for their development. Therefore, with variations and different management and business models, OSSs have emerged in the international arena and in Europe in particular.

In the same line as the directives, the EU promotes policies that help to create a stable environment for investment decisions and help consumers and companies to make informed decisions to save money and energy. In the same context, the European Green Deal [8] defines energy renovation of public and private buildings as an essential measure to ensure that Europe is climate neutral by 2050. In October 2020, the European Commission presented the Renovation Wave strategy [9], whose action plan sets out specific measures of regulation, financing and fitting to renovate buildings. The measures include aspects such as reinforcing long-term renovation strategies in European Union countries, the construction of nearly zero energy buildings (nZEB), the consolidation of energy performance certificates (EPC) and the integration in new residential buildings of considerations of health and well-being, electro mobility, and smart technologies.

The set of European regulations combines obligatory and informative instruments. It obliges member states to establish minimum energy efficiency requirements in buildings and their installations, for new buildings and for existing buildings that should be renovated. Member states must decide on these requirements and which calculation methods to apply. As a result, EU member states have implemented various models for transposing EPBD regulations [10]. However, despite the efforts made, the adoption of extensive renovation at European level is still very limited. The annual rate of substantial renovations in the residential sector is considered to be 1% in Europe. Substantial renovations can be defined as those that reduce a building's final energy demand for heating by between 50% and 80% [11].

Like all measures to achieve objectives of general interest, public policy instruments are defined and used by governments to reach common goals [12]. In the area of energy renovation, the efficient implementation of instruments that financially incentivise comprehensive building renovation requires solid structural funding, for example. This kind of funding tends to be subject to uncertainties, such as changes in government policies. In addition, the effectiveness of its application, which is often voluntary, depends on aspects that are far from instrumental, such as the enthusiasm and attitude of those interested, including the public, building developers, professionals, and users of dwellings and/or buildings [13] to take the actions required for suitable renovation of the residential building stock.

In this context, despite all the initiatives of Europe and its member states, the definition and development of public policies to improve buildings' energy efficiency and the target of renovating the building stock to decarbonise is very difficult to achieve. Public policies face many barriers and obstacles. Although these barriers are known and have been studied, they are not always acted on. Hence, most of the building stock has not been renovated. Among other factors, many owners are not interested in improving the energy efficiency of their dwellings. This attitude is accentuated by their lack of knowledge of measures

for carrying out improvements and the benefits that they provide [14]. In this same context of lack of knowledge and misinformation, households have little knowledge of the advantages of energy renovation of buildings, as there is a lack of information [15]. They lack knowledge of the implications of energy certification [16] or the benefits of renovation (such as comfort) and have little capacity to dimension renovations [17]. Perceptions of the co-benefits of energy efficiency may vary depending on the type of household [18]. Furthermore, households may encounter operational and technical difficulties to start renovation processes. Obstacles of a financial nature include difficulties in accessing funding and penalisation in future savings [19].

In general, traditional families don not have enough resources to identify technicians who can advise them on the process of energy housing improvement, analyse the feasibility of the improvements that are offered in the context of financial and comfort benefits, obtain external financing, manage financial aid, reach a consensus with other owners, understand the legal framework and manage the required permits, award contracts for the works (generally to several contractors), monitor and financially control the works, accept the works, put them into operation, and exercise guarantees with the respective definition of responsibilities in case something goes wrong. These processes also require a considerable time investment. All the aspects that are required to undertake a renovation are intrinsic to professional property management. Families are not capable of undertaking them without external assistance. However, it is assumed that they could be self-promoters of the renovation of their dwellings. Recently, due to the introduction of the universal obligation to get the energy performance of buildings certificate, the general knowledge has been improved, not only on its benefits, also in its implementation, technicians, and options.

The main aim of this study was to analyse the various experiences of implementing OSSs in the European context. Among other reasons, OSSs have emerged to firmly promote substantial energy renovation of residential building stock. This analysis aimed to identify and understand the various organisational models of OSSs, the services they offer, the barriers they have faced and overcome, and those that are still to be resolved. All of the above has the ultimate aim of identifying the main factors of success, to propose on the basis of these factors areas of future action to strengthen OSS operation in the long term.

To achieve this aim, the following section explains the methodology that was used. It consisted basically of analysing documents with information on the experiences of operating OSSs and the definition of cases, organised in a database. Then, to understand the context in which OSSs emerge, Section 3 contains a review and systematisation of the main barriers to energy renovation in homes for households who are considering renovating their dwellings and for the other agents who are involved in this process. In Section 4, the one-stop-shops for energy renovations of dwellings in Europe are reviewed, along with their origins, initial experiences, and current situation. In Section 5, OSSs are analysed and discussed based on systematised information that was previously entered in a database. In this process, operating OSSs and those that have shut down are differentiated to identify the main aspects of success. Finally, the conclusions in Section 6 highlight the main results of the study and put them in the context of previous research [20–23], among others], basically in the line of explaining how the OSSs have contributed to overcoming some of the existing barriers.

2. Methodology and Definition of Cases

Now that the general context of the study has been defined, the methodology is explained. The research was a descriptive case study with a qualitative analysis of the main aspects. It was organised into the following stages: (1) identification of OSSs using public documents, official reports, and previous studies (Boza-Kiss and Bertoldi [20], Cicmanova et al. [21], Krosse, L., et al. [22] y Palominos and Taborda [23], among others); research projects (Eracobuild, a network of national R&D programmes focusing on construction and sustainable built environments; INNOVATE, municipalities, regions, energy agencies, private companies and installers' cooperatives, from 11 European territories to develop

and roll out integrated energy retrofit packages for homeowners of single family houses and condominiums, Refurb, a consortium of 13 partners and a number of co-operators, to inspire homeowners to move a step further with their energy renovations and achieve zero energy renovation, and COHERENO, Collaboration for Housing Nearly Zero-Energy Renovation); scientific articles, detailed in Section 3; as well as institutional websites of OSSs focused on energy renovation and energy conservation in multi-family and single-family housing. (2) Preparation and organisation of a database (described below). (3) Selection of cases, according to the study criteria (European area, residential renovation, etc.). (4) Analysis of documentary information and the database. (5) Preparation of results and conclusions.

The study was developed between April and September 2021 and for the analysis the documented OSSs have been reviewed, from the origin of the model (the first being in 2005), to the present.

On the other hand, the existing data to date have been considered and have been structured in a database.

The data included in the database are basically: (a) general data on OSS (geographic location, area of operation, year of start of operations); (b) nature of the OSS (public, private or public–private), type of programme the OSS comes under (European, national or regional), the model according to INNOVATE classification (facilitation, coordination, all-inclusive and ESCO) and the partners of the OSS (suppliers, manufacturers, specialised advisers and financial entities); (c) information on financing for the operation of the OSS (public, private or mixed) and financing of works (public funds, private funding by the owner or joint public–private funding); (d) channels and means used to communicate with clients: offices, mass media and internet, showrooms, home visits (door-to-door), local meetings, or other means; (e) types of improvements offered (active: photovoltaic panels, boilers, heat pumps and heat exchangers; or passive: insulation, ventilation, doors and windows, sunshades and water recycling) including other functional, cosmetic and accessibility improvements; (f) information on the services provided by each OSS (green marketing, energy audits, drawing up the design, financing, management of subsidies, management of permits or works licences, search for suppliers, tendering of the contract for the works, supervision of the works, start up, monitoring of the works and post-work evaluation) and their characteristics; and (g) information on the target customers for whom the services are designed (individual owners, joint owners, tenants or leasing companies, and whether the services are offered for single-family or multi-family housing).

Finally, macroeconomic and environmental variables were added, such as GDP per capita in 2019 (isolating the effect of the COVID-19 pandemic), carbon dioxide emissions per capita in 2016, and the percentage of renewable energy out of each country's total energy consumption in 2015, obtained from World Bank databases of indicators [24]. The renewable energy data were used to determine the relationships between OSS models and the country in which they operate (income, CO_2 emissions, and renewable energy consumption), to establish whether there is a desire to address the effects of climate change through the promotion of OSSs for energy efficiency renovation of residential stock.

A synthesis of the structure of the variables used in the analysis and its contents is detailed in Table 1.

All these variables are analysed individually, within each group, detecting for each one, the most prominent in terms of percentage. Those most significant are detected, that is, those that are repeated in the greatest number of OSSs. Once these are obtained, the analyses are carried out based on: nature and initiative, financing for their operation, communication channels and means, types of improvements offered, services provided, and customer target.

Table 1. Structure and variables included in the database.

Group of Contents	Variable	Description (Content)
General OSS data	OSS	Name of the OSS
	Leader entity	Type, public, private, PPP or cooperative
	Country	Country of operation
	Operating since	Opening year
	Program/project	Framework program of the initial operation
	European Plan	If have received a support plan (0/1)
	National Plan	If have received a support plan (0/1)
	Regional Plan	If have received a support plan (0/1)
	Current website	Official website
	Another website	Another
Type of dwelling in which the OSS works	Single family	If the OSS works in this type of housing (0/1)
	Multi-family	If the OSS works in this type of housing (0/1)
Macroeconomic and environmental variables	GDP	Value of the Gross domestic product per capita in 2019
	CO2PC	CO2 emissions of the country
	Renewable Energy %	Country % of renewable energy vs. total energy consumption in 2015
Mass media	Massive internet	If the OSS applies this broadcast medium (0/1)
	Showroom	If the OSS applies this broadcast medium (0/1)
	Office	If the OSS applies this broadcast medium (0/1)
	To the door	If the OSS applies this broadcast medium (0/1)
	Others	If the OSS applies another broadcast medium (0/1) *
Passive improvements	Isolation	If the OSS applies this type of improvement (0/1)
	Ventilation	If the OSS applies this type of improvement (0/1)
	Enclosures (doors and windows)	If the OSS applies this type of improvement (0/1)
	Solar protection devices	If the OSS applies this type of improvement (0/1)
	Water recycling	If the OSS applies this type of improvement (0/1)
Active improvements	Photovoltaic plates	If the OSS applies this type of improvement (0/1)
	Boilers	If the OSS applies this type of improvement (0/1)
	Heat pumps	If the OSS applies this type of improvement (0/1)
	Heat recovery	If the OSS applies this type of improvement (0/1)
Other type of improvements (not energy)	Functional	If the OSS applies this type of improvement (0/1)
	Aesthetic	If the OSS applies this type of improvement (0/1)
	Accessibility	If the OSS applies this type of improvement (0/1)
Responsibility for the works	OSS	If the OSS takes over the works (0/1)
	Contractor	If a contractor takes over the works (0/1)

Table 1. *Cont.*

Group of Contents	Variable	Description (Content)
Offered services	Green marketing	If the OSS offers this service (0/1)
	Energy audit	If the OSS offers this service (0/1)
	Project redaction	If the OSS offers this service (0/1)
	Financing	If the OSS offers this service (0/1)
	Grant management	If the OSS offers this service (0/1)
	Permission management	If the OSS offers this service (0/1)
	Search of suppliers	If the OSS offers this service (0/1)
	Bidding for works	If the OSS offers this service (0/1)
	Supervision of works	If the OSS offers this service (0/1)
	Set up	If the OSS offers this service (0/1)
	Monitoring of works	If the OSS offers this service (0/1)
	Post-construction evaluation	If the OSS offers this service (0/1)
Customers	Private owners	If the OSS works with this type of customer (0/1)
	Co-owners	If the OSS works with this type of customer (0/1)
	Companies	If the OSS works with this type of customer (0/1)
	Tenants	If the OSS works with this type of customer (0/1)
	No information	No customer type information
Partners	Providers	If the OSS has such partners (0/1)
	Manufacturers	If the OSS has such partners (0/1)
	Specialised advisers	If the OSS has such partners (0/1)
	Financial entities	If the OSS has such partners (0/1)
	No information	No partners type information

* As additional information is included the type or modality. Source: developed by authors, based on the various sources that were used.

In the search process, around 70 initial cases of OSSs were found, which previously to their inclusion in the database, were filtered based on the requirements and parameters required for their classification and the systematisation of the data. The most relevant parameters and requirements were that: (a) they operated in European Union countries (including the United Kingdom), taking as a reference some external cases that were relevant to the study; (b) their purpose was the energy renovation of housing (single- and multi-family); (c) they were in operation; and (d) with available information on all the variables included at the database. Therefore, the database for the analyses includes 34 cases. In addition, OSSs that had closed down were included if there was sufficient information for their analysis, to discover the main causes of their closure.

To determine the success of OSSs, the general scheme proposed by Krosse, L. et al. [22] was adapted. In addition to an analysis of the OSS commercial model, the parties involved, and the circumstances of the country, in the most relevant cases the main achievements were described (such as the turnover and the number of projects executed). Although criteria of failure were not proposed for operating OSS, their shortfalls were analysed in comparison with successful cases. Above all, reasons for closure were analysed in OSSs that are no longer operating. Likewise, the specific factors developed by Boza-Kiss et al. [25] were considered including a personal approach, guidance, independent decisions and advice, focused attraction of customers, collaborators and free experts, incentives and energy saving guarantees, among others.

Based on these considerations, a final sample of 34 operating OSSs was studied (Table 2). Separately, to a varying extent, six experiences of OSSs that have closed down

were examined. As less information was available on these, they were not included in the database.

Table 2. Operating European OSSs that were analysed.

OSS	Leader Entity	Country	Operating Since	Program/Project	E. Plan	N. Plan	R. Plan
RenoBooster	PPP	Austria	2019	Horizon2020	0	1	0
Huisdokter	PPP	Belgium	2005	Horizon2020	0	0	1
HomeGrade	Pub	Belgium	2017	Citizens for the energy transition (C4ET)	0	1	0
Energ. Effic. and Renewable Sources Fund—EERSF	PPP	Bulgaria	2005	Horizon2020	0	1	1
Aradippou Municipality OSS	Pub, PPP	Cyprus	2018	Innovate	0	0	1
ProjectZero (ZEROhome)	Pub	Denmark	2009	Clinton Climate Positive Development Project	0	0	1
BedreBolig	Pub	Denmark	2013	SparEnergi	1	0	1
PKA—Sustain Solutions	PPP	Denmark	2015	N/A	0	0	0
Frederikshavn	Pub	Denmark	2017	Horizon 2020-Energy Cities- EU Infinite Solutions	0	0	1
Ecofurb	Pr	England (UK)	2009	Parity Projects	1	0	0
Parity Projects and Retrofit Works	Pr, Coo	England (UK)	2013	Parity Project—EU H2020	1	1	0
KredEx	Pub	Estonia	2009	Estonian Ministry of Economic Affairs	0	1	0
Île-de-France Énergies (Energies POSIT'IF)	Pub, Coo	France	2013	Energies Positif	0	0	1
Pass Rénovation (SPEE Picardie)	Pub, Coo	France	2013	Picardie Pass/CITYNVEST	0	0	1
ARTÉÉ	Pub	France	2015	FEDER	1	1	1
OKTAVE	Pub	France	2017	Climaxion	0	1	0
RenoHub	PPP	Hungary	2019	Horizon2020	1	0	0
SuperHomes	Pr	Ireland	2015	Horizon2020	0	1	1
Mantova	Pub	Italy	2020	Energy Cities	1	1	1
Slim Wonen met energie (Leeuwarden)	Pr	Netherlands	2013	SLIM living with energy	0	1	1
Woon Wijzer Winkel	Pr	Netherlands	2015	N/A	0	1	1
Huizenaanpak	Pr, Coo	Netherlands	2014	N/A	0	0	0
Stroomversnelling	Pr, Coo	Netherlands	2015	Horizon2020	1	0	0
Reinmarkt	Pub	Netherlands	2014	Nueva empresa	0	1	0
Bolig Enøk	Pr	Norway	2009	N/A	0	0	0
Tighean Innse Gall (TIG)	Pr	Scotland (UK)	2014	Scottish Government Home Heating Support Fund	0	0	1
ALIEnergy	Pub	Scotland (UK)	2011	EU 'SAVE' programme	0	0	1
MunSEFF	Pub	Slovak Republic	2011	BERD SlovSEFF	0	1	0
Slovseff	Pub	Slovak Republic	2014	BERD SlovSEFF	0	1	0
OSIR	Pub	Spain	2020	Innovate, HousEEnvest, Horizon2020	1	0	0
Opengela	Pub	Spain	2019	Horizon 2020	0	0	1
HolaDomus (GarrotxaDomus)	Pub, PPP	Spain	2020	Horizon 2020	1	0	0
Energiesprong	Pr	UK, France, Germany	2013	Horizon 2020/TRANSITION ZERO/Mustbe0	1	1	0
FinEERGo	Pub	Various *	2019	Horizon 2020	1	0	0

* Poland, Slovakia, Austria, Romania, Bulgaria, the Netherlands, and Latvia. Source: compiled by authors, based on the various sources that were used.

3. Main Barriers to Energy Renovation

As indicated above, energy efficiency has many benefits for all of society and for private entities [26]. It has intrinsic environmental, economic, and social advantages, and its integrating perspective is based on the pillars of sustainability [27]. Nevertheless, the processes of renovating the housing stock are limited by a series of barriers that affect families (economic, lack of knowledge and information, lack of capacity to implement renovations, etc.), and the rest of the agents involved (professionals and technicians, suppliers, etc.). Frequently, the decision to renovate is affected by owners' bad previous experiences involving a lack of trust and credibility regarding market agents such as energy advisors and contractors [28] and is also influenced by the "do it yourself" culture [21]. Consequently, continuous training of energy advisors and contractors is necessary so that they can provide suitable assistance, create a relationship of trust with homeowners [29], and provide sound advice for owners in the various stages of renovating their homes.

Beyond households' level of knowledge of the benefits of energy renovations, there are several barriers whose relevance is not clear that discourage renovation processes. One of these is economic barriers, due to lack of funding and because families do not have sufficient resources to carry out a substantial renovation. This is sufficient, as is a lack of knowledge of the technical and administrative process, to cause difficulties in: identifying technicians who can carry out the renovation, analysing the feasibility of improvements that are offered in terms of financial and nonfinancial benefits (that are hard to measure), obtaining external financing, managing financial aid, reaching consensus with other homeowners, understanding the legal framework and managing the required permits, awarding the contract for the works (generally to several contractors), monitoring and financially controlling the works, and accepting the works and exercising guarantees, with the respective definition of responsibilities if something goes wrong. Logically, these processes require a considerable time investment. They also require abilities, resources, and knowledge that are those of professional property managers.

The purpose of this study is to examine the various experiences of implementing OSSs in Europe to strengthen their operation in the long term, and to highlight the opportunity that they represent as emerging models in the management of renovation. Based on the above, it is important to frame these in the context of barriers and determining factors for residential energy renovation in Europe, which in many cases influence their success. Therefore, this section reviews barriers that limit energy efficiency improvements in the residential environment, which affect owners (households), contractors (technicians), and finance companies (banks) and act as barriers to the implementation of OSSs [30]. This will doubtless enable us to stress the need for and importance of implementing one-stop-shops, as facilitators in the development of these renovation processes, whose implementation and analysis will be addressed in the following section.

3.1. Barriers That Affect Households and Other Agents

As stated by Bertoldi (2020), barriers can affect not only households but also contractors (need for publicity/self-promotion, excessive time/cost of the transaction, lack of trust due to 'bad' contractors, need to respond to complaints and diversify offerings, among others) and finance companies (lack of understanding of the potential of energy efficiency, of technical knowledge or experience in assessing energy efficiency projects and their customers). For greater clarity in this area, some of the principles are presented below.

3.1.1. Complex Legal Framework and Multilevel Regulations

As indicated previously, the current Energy Performance of Buildings Directive (EPBD) requires member states to develop long-term renovation strategies, to decarbonise building stock before the target of 2050. It determines that nearly zero energy buildings (nZEB) will be the norm for all new buildings (public buildings from 2019 and private buildings from 2021). However, the problem is that energy efficiency programmes and policies tend to be designed based only on energy savings. Their overall impact is usually underestimated [31].

Consequently, not all of the policies applied in member states are suitable. To meet energy efficiency and decarbonisation targets, a better understanding is needed of the efficacy of the wide range of policies introduced in member states, whose regulatory frameworks are already saturated in many cases [32]. Some studies suggest that the national energy efficiency action plans of some members states might not be adequate, and new policies may be required [33]. The creation of policies is increasingly complex as power is distributed nationally between bodies, and externally. Multilevel governments with numerous actors need combined policies that consider the decisions of others to meet targets (subsidiaries, tax deductions for users, energy producers and contractors, among others). This is a factor that is not always easy to attain, as there is not enough clarity about the various combinations of energy efficiency policies used in different countries or studies that analyse the complementarity and compensation between the various saturated instruments [34]. This aspect can be found in almost all member states, particularly those that have decentralised, multilevel governments. It is a situation that slows down and discourages the execution of energy renovation processes and clearly constitutes a barrier, mainly for households that cannot understand the complex regulations and tend to be unaware of the potential financial aid derived from European funds.

3.1.2. Information Asymmetry and Lack of Knowledge of Energy Efficiency

Hunkin and Krell [18] noted that some of the actors involved in the residential renovation process do not have the required knowledge of energy efficiency. They indicated that among the actors, financial entities find it hard to assess credit risk or repayment without the assistance of specialised technicians (as they do not know the real savings of energy improvements and their future benefits). Likewise, householders generally lack knowledge of the type of suppliers, contractors and specialists who can help them to renovate their homes or simply, according to Pardalis et al. [35], do not have time to investigate this, which is another problem. Similarly, Mahapatra et al. [14] highlighted the difficulty in finding reliable suppliers in the renovation sector, which tends to be small-scale and does not always guarantee energy savings. This is a strongly fragmented market that offers specific measures (carpentry, boilers, or insulation), with the clear difficulty that this entails in assessing the overall effect of improvements or the responsibilities. Consequently, the lack of professional, integrated, reliable energy efficiency services is another barrier that limits renovation [36]. It could be stated, as Haavik et al. indicated, that for owners who want to improve their dwelling, decision-making is a learning processes, because in general they do not know what they should or could do [37]. Information asymmetry is another very widespread problem [15] that consists in the impossibility of households understanding, a priori and without specialised knowledge, the benefits and intangible implications of energy efficiency (attributes that are not always visible) and implies that these are not considered in the householders' choice. Similarly, the lack of knowledge of benefits means that families do not consider renovating their dwelling with energy efficiency improvements [18] or, worse, that they renovate without introducing these improvements. Likewise, the EPC scheme is unknown and the energy performance is confused with the architectural quality attributes of the home [38]. Perhaps the two most negative aspects of this would be that: (1) an attribute that is irrelevant for users will also be irrelevant for producers and will discourage a market of specialised energy renovators; and (2) more is paid for a dwelling with deficient environmental services [39]. As a solution to this, the EPBD (2002) introduced Energy Performance Certificates (EPC). The 2010 EPBD reform made it compulsory to include the associated energy labels in the promotion of buildings for real estate sales. In addition, Giraudet [40] differentiated "asymmetrical information", in reference to the difficulties that arise when information is incomplete and imperfect. This includes uncertainty in the evolution of energy prices, which makes the recovery of investments less certain, obsolesce of equipment due to future technological innovation, lack of knowledge of the exact consumption of each element and item of equipment, or a simple lack of knowledge of the above by those offering and requesting services.

3.1.3. Economic Factors

Substantial energy renovations are generally capital intensive. Except in conditions of energy poverty, they usually represent a saving in energy bills. However, the recovery of the investment is long-term and uncertain, for the reasons given above. Consequently, empirical evidence indicates considerable penalisation (for example, significant update rates) of future savings [19]. Similarly, the loan market does not tend to offer long-term loans with affordable interest rates. All of this represents a major barrier for lower income homes. To overcome it, in addition to the traditional subsidies and tax credits, strongly reinforced with NextGeneration EU recovery funds, a set of new financing instruments have emerged. These include energy efficiency mortgages with lower interest rates for the purchase of efficient homes and/or increased capital for renovation of inefficient dwellings; energy performance contracts in which energy savings cover repayment of the improvements financed by an external entity; public guarantee funds that enable financial entities to offer soft loans (with favourable conditions for borrowers) to disadvantaged groups; or property assessed clean energy financing (PACE) in which local administrations fund works and issue a guaranteed debt in the property registry entries of the dwellings that have benefitted. The capital is then recovered through a surcharge in the property tax [41].

3.1.4. Behaviourism

There is evidence that groups of individuals have different attitudes when they carry out renovation works. Ebrahimigharehbagh et al. [28] indicated that homeowners' decision to carry out renovations is influenced by a series of personal (awareness, attitudes, beliefs, experiences, and skills), contextual and external factors. In a study in Sweden that analysed the attitudes of homeowners to future renovations and OSSs for renovation, Pardalis et al. [42] suggested that priority is still not given to substantial renovations and there is more willingness to change specific components gradually. In addition, cosmetic renovations occupy a prominent place, followed by some structural and energy renovations. Homeowners between 29 and 49 years old could be the customer segment that should be attracted for more substantial renovations. Similarly, Poortinga et al. [43] found that Dutch survey respondents preferred to undertake technical home improvements rather than change habits or patterns of consumption (use of household appliances, among others), except in the case of homes with low financial resources, whose only alternatives are changing habits and cutting consumption. The level of environmental awareness also plays an important role. In this respect, homeowners who have greater environmental awareness may be more interested in renovating, as they understand the environmental impacts of the use of energy and feel that they are contributing to a greater goal, such as mitigating climate change [42]. However, in contrast, Faiers and Neame [44] suggested that consumers who are more aware of environmental preservation are reluctant to carry out home improvements because they know that other actions in their daily life compensate for the inefficiency of their dwelling (responsible household energy use, and in other areas, use of efficient means of transport and waste separation, among others).

3.1.5. Split incentives and Disaggregation of Demand

Gillingham and Palmer [19] indicated the existence of split incentives caused by the classic principal-agent problem. Landlords are not willing to invest in energy efficiency measures if they cannot recover the capital in the rent (because there is no willingness to pay for these measures or because the property is rent controlled), so the tenants do not benefit from such renovations. It has also been indicated that subsidies to alleviate energy poverty, without intervening in the dwelling (such as financial aid to help pay utilities bills), discourage households from carrying out improvements [18], particularly in homes at risk of energy poverty. In terms of disaggregation of demand, Boza-Kiss and Bertoldi [20] noted that a lack of demand aggregation causes high transaction costs (for example, the management of multiple contracts). In addition, advantage is not taken of the economies of scale resulting from interventions at the level of entire buildings or

building complexes. This leads to higher individual costs of an intervention. In this regard, Salom and Pascual [45] applied a sensitivity analysis of a financial model and showed that demand aggregation is a key element that makes renovations more affordable.

All these aspects of information, knowledge, time, or even behavioural factors mean that, in many cases, households' decisions are far from optimum. To sum up, it could be said that energy renovations occur when the tenant or landlord wants their residential building to be renovated and decarbonised and not when the participating renovation agents, banks, and politicians of the country want to opt for improving the building stock to achieve decarbonisation.

3.2. Determining Factors in Renovation Processes

3.2.1. Problems in the Process of Deciding to Renovate

De Vries et al. [46] indicated that the decision to renovate is not dichotomous, but a process with specific problems in each stage. In fact, if the set of problems is greater than the potential benefits, households will decide not to renovate. Likewise, if the problems in one stage are considerable, the next stage will not be started. According to these authors, the first stage is that of "raising awareness". In this stage, people should be informed in an understandable way about the benefits of energy improvements. In fact, if they perceive that the implementation of improvements will have more problems than advantages, they will not go beyond this stage. In the next stage of "assessment", households encounter two types of problems: the first refers to the search for reliable contractors (technicians and industrialists) and the second is the perception of the discomfort that the works will cause. Again, a frustrating experience or an aversion to this discomfort could halt the process. According to the authors, the last stage, that of "decision", involves the search for funding and subsidies. In this stage, a lack of understanding of the financial implications of the specific investments that are required and the potential savings or a complicated process for managing any loans or subsidies could appear to be enough of a problem to reject the renovation. Bjørneboe et al. [47] added that the decision process is in itself a learning process.

3.2.2. Renovation as a Process of Adapting a Dwelling to Needs and Aspirations

Thøgersen [48] argued that renovations should be considered a process of adapting a dwelling to the needs (for example, functional, habitability, and accessibility needs) and aspirations (for example, cosmetic aspirations) of households. This adaptation is strongly correlated with lifestyle, so that homemaking does not only consist of choosing decoration or furniture, but also in extending, altering, or improving residential features. Haavik et al. [37] determined that home renovation is a learning process in which the occupants gain an awareness of which measures should be implemented to improve energy performance. Risholt and Baker [36] indicated that energy improvements should be introduced in the "window of opportunity" that opens in the adaptation of a dwelling to the needs and aspirations of households, and therefore should be considered in an integrated, synergic way. These needs and aspirations evolve at the same time as changes in income and family sociology, and in short, with changes in the dynamics of domestic life [49]. According to Cicmanova et al. [21] this window of opportunity also encompasses moving house, reconfiguration of the coexistence unit, or changes in the needs of its members. In fact, empirical evidence indicates that energy improvements are generally not carried out per se, but in response to obsolescence of equipment, maintenance of architectural structures, or improvement in terms of function, accessibility, habitability, structure, or aesthetics [50].

3.2.3. Person-Focused Renovation

Risholt and Berker [36] noted that one of the keys to success in the implementation of energy efficiency improvements lies in the active participation of users in the design and planning of interventions, generally assisted by specialist technicians who are respon-

sible for the design or suppliers of the improvements. This leading role enables users to appropriate the aforementioned process of renovating the dwelling. For this reason, recent proposals of renovation management instruments such as the Building Passport, PAS-E from Cíclica and the Green Building Council Spain incorporate a "community support plan" that can put users of dwellings at the centre of the process [51]. Likewise, the involvement of households as renovation agents in the context of multi-family housing enables a participative process (solutions can be customised to individual needs and aspirations), community management (reaching agreements in homeowners' meetings) and, above all, learning (for example, understanding the relationships of causality between the measures and their impact on efficiency, health and comfort). Salom and Pascual [45] agreed that this involvement is vital to aggregate demand for renovation processes at the scale of the neighbourhood or district. However, people can also participate in the execution of the works through "do it yourself" solutions [21].

3.2.4. Renovation as a Gradual Process over Time

One notable factor is how households approach the implementation of improvements. These are rarely carried out at the same time. Instead, people tend to consider "packages" of measures and carry out a step-by-step process [52]. In response to this logic, the EPBD 2018 reform opted for building renovation passports, which have existed for some time in other countries in our environment [53], as a way to create 'road maps' of gradual improvements with energy implications. It is important to draw up these road maps based on a cost-effectiveness analysis of energy efficiency measures. Any renovation that does not include such measures in a substantial way is a wasted opportunity, as it "fossilises" situations of inefficiency during the time required to amortise the renovations [54]. In general, empirical evidence suggests that any improvement that is undertaken in the past limits the willingness to undertake further improvements, although the level of education and income favours the implementation of energy measures [17,35]. In this line, national proposals such as the aforementioned PAS-E or the *Pasaporte del Edificio* (Building Passport) of the *Fundación la Casa que Ahorra* are progressing. These adapt the road map of the renovation to a programme of tax incentives and financing mechanisms linked with energy companies' savings obligations or green mortgages with interest rates subsidised with resources from the Spanish National Energy Efficiency Fund.

There may be other barriers that have an impact on renovation and have not been detected in this study, and there are other ways of classifying them. Nevertheless, the above discussion indicates that a wide range of obstacles exist. Therefore, a set of solutions is required. These include the creation of one-stop-shops as crucial instruments that promote and facilitate the renovation of dwellings. Furthermore, the process of residential energy renovation goes beyond a mere passive perception of its functional, habitability, accessibility, structural, aesthetic, and decarbonisation benefits by landlords or tenants. It will depend on the energy improvements transmitted over time as positive inputs through all participating renovation agents, banks, and the country's policies.

4. One-Stop-Shops as Instruments for Energy Renovation

One-stop-shops (OSSs) have a certain similarity to energy service companies (ESCO), which emerged in the USA after the oil crisis of the last century for energy renovation of federal buildings. The investment was recovered through energy savings and consequently no disbursement of public resources was required.

The innovative, transparent, accessible business model of OSSs operates in various sectors of the economy. They are based on the idea that consumers can purchase almost everything they need in the same place, as happened in the area of family consumption when supermarkets appeared in 1916. This concept is popularly associated with public administrations establishing one front office for all the procedures that citizens need to carry out in their relationship with government. From an economic perspective, the *Farley Financial Dictionary* defines OSSs as entities that aim to attract customers by enabling

them to save the time and energy that they would otherwise expend in going to different companies to carry out different activities. In the field of energy renovation, an OSS is an entity that supplies in an integrated way the services and materials required throughout the process: information on benefits and co-benefits; diagnosis (technical reports, energy audits, etc.); technical proposals of potential improvements; cost–benefit analyses (design, quote, feasibility study, etc.); study of financing means, management of licences and subsidies; search for and hiring of suppliers and industrialists; site management; putting into operation; post-intervention assessment and even maintenance [55]. Among OSS functions, financing and energy saving guarantees stand out. These are key factors in making renovation decisions, as households' resources are limited. All these functions facilitate the management of energy renovation processes (which should lead to an increase in renovation rates of residential building stock) and mean that the development and spread of OSS in the European Union is fundamental to reach the Paris Agreement targets (2015) and reduce the emissions of greenhouse gases by at least 55% by 2030, compared to 1990 levels.

OSSs are a fundamental element of the "Smart financing for smart buildings" (2018) initiative of the European Commission and Directive 2018/844/EU. Article 2 bis of this directive on long-term strategy includes OSSs in the mechanisms that states should provide to support the mobilisation of investments in renovation of building stock. Article 20, Section 2 indicates that member states shall provide information through accessible and transparent advisory tools such as renovation advice and one-stop-shops. The creation and development of OSSs is also supported by various initiatives: (a) exchange of good practices through ManagEnergy, the network of energy agencies of EU states and regions; (b) direct financing from the Horizon 2020 programme, through calls and specific agreements; and (c) mechanisms of grants to support the development of projects. In addition, OSSs are supported by specific regulations such as financing mechanisms for building renovation included in Regulation (EC) No. 1080/2006 of the European Parliament; the European Regional Development Fund; the association of public and private sectors in an initiative on "Energy efficient buildings"; the European Investment Bank (BEI) through the "Initiative to finance sustainable energy"; the "Marguerite Fund"; the European Fund for Energy, Climate Change and Infrastructure; Directive 2006/112EC; the framework programme for Innovation and Competitiveness; Europa II; ELENA; Covenant of Mayors; Programme for Business Initiative and Innovation; ICT Policy Support Programme 2010; and the European Bank for Reconstruction and Development, among others. Consequently, and considering that OSSs are presented as a single representative for households, they are considered a facilitator for the various EU energy financing programmes. This is because they constitute a point of contact between all the agents involved (user/owner, suppliers, technicians, banks, local authorities) in energy renovation processes, particularly in single- and multi-family housing. In addition, they serve to promote work and local labourers; combat the energy poverty of dwellings; accelerate renovations by informing, encouraging and managing licenses; and accompanying the user/owner from start to finish. All these benefits are equally important to individuals and society, as they are an opportunity to overcome the barriers that we described above. Particularly, the fact that the OSSs are visible points of contact between families (users/owners), and the rest of the agents—suppliers, technicians (contractors), banks (financial institutions), and local authorities—helps to overcome the mentioned barriers in the energy renovations process of dwellings. Additionally, the OSSs, as informative entities of the benefits of energy rehabilitation, help to improve the existing confusion in this regard, on the part of the families. In addition, as technical entities, with executive capacity in diagnosis, project elaboration, and even in the evaluation of the resulting efficiency, once the works have been executed, they help to improve the results, and even to the development of the rehabilitation in stages. On the other hand, they make it possible to overcome economic barriers, by participating in the search for financial aid and its management, and even by acting to finance the works. This helps to the families, not only from obtaining resources, but also in terms of return of the investment. These are

some of the aspects in which the OSSs stand out as entities that contribute to overcoming some of the previously indicated barriers.

These OSSs have gradually emerged, mainly in Europe and the USA, in various national, regional, or even local settings, with a range of regulatory frameworks (with the adaptations to these and difficulties that this implies). Several studies—such as Boza-Kiss and Bertoldi [20], Cicmanova et al. [21], Krosse, L., et al. [22], or Palominos and Taborda [23], among others—review OSSs that have been implemented, many of which have been promoted by some of the aforementioned European initiatives.

Notably, the general model of the OSS guides homeowners through several or all stages of the renovation. They enable measures to be adopted that improve the energy efficiency of the dwelling, at the same time as they offer a renovated dwelling that meets the homeowner's real needs [35].

To overcome the barriers of lack of information and lack of knowledge, a one-stop-shop should consider, in accordance with the model and considering its scope, the active participation of the owners of dwellings to be renovated. Identification of their market segment is essential [56].

According to the classification of the INNOVATE programme [56], based on the degree of support offered to users and in the context of energy renovation of dwellings, four models of OSS operation are identified:

- Facilitation: offers a first approach of the client to the benefits of energy renovation. Provides advice and information at no cost that is oriented towards the customer, and acts as a facilitator of the processes.
- Coordination: contacts the customer with a portfolio of suppliers, who have generally been endorsed and carry out energy renovation works, and with financial entities if financial assistance is required. They can control the process but do not take responsibility for the results of the works.
- All-inclusive: acts as a contractor, offering packages of renovation services that include advice, coordination with suppliers, constructors and financing. They take responsibility for the process and in some cases guarantee energy saving after the works.
- ESCO: acts in a similar way to the all-inclusive model in terms of services, but also guarantees energy savings after the works. The cost of the investment is paid to the company through the energy savings that are generated.

Although the characteristics of each model are quite developed, they can be influenced by other factors that add or detract roles and responsibilities. The general model of OSSs guides homeowners through several or all stages of the renovation, enables the adoption of measures that improve the home's energy performance, and offers a renovated dwelling that meets the homeowner's needs [57]. Consequently, rather than developing the models in this section, we focus on an analysis of OSS implemented in Europe to understand their current situation by reviewing their starting point. In turn, in the following section, we carry out an analysis based on case studies.

Up to now, we can state that the introduction and development of OSS in Europe has gone as well as could be expected considering that the real participation in them and the time for their application to the project to which they belong (pilot or maintenance) is different. That is, they vary depending on the specific characteristics of each country or the action policies and the different ways of tackling each OSS by all agents involved (renovating agents, banks, and the country's policies).

One-Stop-Shops in Europe, Implementation, and Notable Aspects

The first reference to current residential OSSs is in a paper by Tommerup et al. [58]. Inspired by pioneering initiatives in Nordic countries, they suggested that the acceleration of renovation processes with sustainability criteria means promoting companies that supply "packages of integrated services that would include consultancy, contracting works, site

management, financing, putting into operation and maintenance" (page 4). Among these initial experiences, the following are notable:

- Sweden. In 2006, energy company Jämtkraft offered an integrated service that consisted of: (a) informing homeowners of dwellings with electric heaters of the benefits of connecting to a centralised biomass heating system; (b) removing electric heaters, installing radiators with their respective heat exchanger; (c) when applicable, extending the network to enable connection with the dwelling; and (d) managing a loan for up to 30 years with a competitive interest rate (APR 2.5% approximately). To achieve this, the energy company contracted two installation companies. To aggregate demand, it distributed explanatory leaflets that included testimonials and organised informative meetings with technical representatives and the financial entity.
- Finland. In 2009, ENRA was launched. This was a pilot programme designed to promote single-family home renovation. The OSS was comprised of a group of companies led by a specialist in renovation. The partners were manufacturers of doors, windows, ventilation systems, and insulation. In addition, there was a heat pump supplier and an energy auditor. The process began with a meeting with potential customers who were told about the possibilities of renovation. Awareness was raised about the environmental impacts and the improvement in comfort and air quality. Homeowners who were interested received a visit from a technician who carried out an energy audit, which culminated with a cost-benefit analysis of potential measures that were then prioritised by the interested party. If the customer wanted to adopt measures that were not offered by the OSS, they were sought in the market. Finally, the customer was free to contract the turnkey renovation, and was offered a flexible schedule for the works. This company ceased operations in 2011 due to financial problems with the parent company that were not related to the implementation of the OSS [14].
- Denmark. In 2009, Clean Tech emerged, led by the company Dong Energy and associated with a window manufacturer, a heat pump distributor, a producer of insulation, and a financial entity. Aimed at single-family homes heated with gasoil, the OSS set up a website complete with a cost-benefit calculator for a range of improvements and a single point of contact to obtain more information. When required, a technician sent by the OSS visited the home and explained the best improvements that could be made, accompanied by a quote. The OSS managed subsidies, licences, and loans. Finally, the works were carried out with an extended guarantee. In addition, the energy company counted the savings achieved as part of its obligations before the respective national energy agency that offered financial aid for the adoption of certain measures. In 2012, Clean Tech stopped operating and Dong Energy focused its management on its main activity, as the profits from the OSS did not meet the operating costs [53].

These innovative initiatives had a marked commercial nature. Due to the geographic context in which they emerged, they were mainly focused on the replacement of heating equipment in single-family homes. Mahapatra et al. [14] reported subsequent experiences in the same region. Notable for their singularity are the experiences led in Finland by two DIY chains: K-Rauta and Rautia. Their OSS models consist of a set of services offered through a single point of contact (the aforementioned companies associated with local contractors) under the same roof (their network of physical shops). The services that are provided included: energy audits, design, supply of materials, execution of works, and financing. In all these cases, the initiatives have a leading company that brings together a set of contractors specialised in the provision of services and specific products and prioritises those of an eminently local nature. This has a positive impact on the creation of wealth and employment. After these early days, projects emerged such as the "One-Stop-Shop Project" (OSSP), financed by energy and innovation agencies in countries—such as Norway, Denmark, Finland—and the Belgium region of Flanders, and focused on investigating the barriers to energy renovation and business models to overcome them.

The real impetus for the model came from the launch of the Winter Package (that is, Clean Energy for all Europeans) in 2016. The annex to that Communication established that the "The Commission will Encourage Member States to develop dedicated local or regional one-stop-shops for project developers, covering the whole customer journey from information, technical assistance, structuring and provision of financial support, to the monitoring of savings." To achieve this, structural funds from Horizon 2020 and the resources of ManagEnergy were made available for projects that promoted the exchange of good practices. One of the projects that emerged in this framework is Integrate Solutions for Ambitious Energy Refurbishment of Private Housing, INNOVATE [56]. This project promotes the establishment of OSSs in participating countries (Spain included), studies innovative initiatives beyond those in the north and, as a new feature, introduces solutions for multi-family homes. Through the identification of predefined packages of measures, the aim is to renovate 117 buildings with energy savings of at least 50%, mobilising 37.41 million euros of private investment. The REFURB project aims to construct a web tool that helps homes to understand the benefits and co-benefits of nearly zero energy buildings (nZEB) and construct a roadmap for the renovation of their dwellings in a gradual process over time with the assistance of an OSS. The COHERENO project [59] advances in a similar line. It is focused on reinforcing collaboration between companies to create innovative business models and enable single-family dwellings to achieve the nZEB paradigm. It draws up portfolios of accredited suppliers and improves the quality of services to increase the confidence of homes. In turn, EuroPACE analyses through pilot tests (including in Spain) the feasibility of adopting the PACE model that emerged 20 years ago in California.

In addition, due to its singularity and path, the two following initiatives should be explained that are still operating:

- Retrofit Works (RW), started in 2013 in the United Kingdom as part of the Green Deal. It is based on a cooperative of SMEs of contractors, local suppliers (including technicians) qualified in energy issues and social agents, and the energy consultancy Parity Projects (PP). Together, they have formed since 2017 an OSS in which PP carries out the energy audits and the design and the cooperative provides three quotes from its members to execute the works, which are monitored by PP. The process starts with a web tool provided by PP that households can use to find out about possible improvements and the required investment. Those who are interested contact PP and, depending on the scope of the works, one of the technical coordinators visits the home to carry out an onsite assessment. Then, the three proposals of RW cooperative members are sent and a service contract is signed with PP, which carries out the technical monitoring of the works with the selected RW contractor. The operating costs of PP are covered by commission paid by the contractors.
- OKTAVE, in France, is led by town and city councils and promoted by the agency for ecological transition ADEME and the Gran Este region. It brings together two financial companies, one of a social nature. The OSS provides a service that includes customised assistance on technical, financial, and administrative aspects under a model of a single point of contact. It draws up a financial plan that combines subsidies, tax credits, and zero interest loans for up to 15 years, and it seeks an ESCO to recover the investment with energy savings. Again, the contractors and suppliers are local and are trained by OKTAVE, which enables them to gain accreditation and form part of a register of qualified suppliers. The process starts with a free energy audit to assess the solutions and draw up a quote and an estimation of financing possibilities depending on income. It continues with the signing of a payment agreement for the provision of customised services, the search for suppliers and contractors in the register, and an analysis of the suitability of the technical and financial proposal. With the fees received, the management of subsidies (whose amount is paid in advance through a revolving fund), licences, and loans begins. The works are monitored, accepted, and put into operation. The OSS has a division specialised in joint tenancies with separate financing for shared and private areas.

- BetterHome, in Denmark, offers predefined renovation packages for private homeowners. Through automated, customised services and a web application, the potential customer first informs the installers and preselects the measures. Then, the homeowner through direct contact with the technical team can adapt the package and the technical and financial terms to their specific needs. The OSS works with local craftspeople, who receive training and tools to guarantee quality services. BetterHome carries out the promotion, quality control, monitoring, and customer care. In 2016, it completed over 200 projects and it has gradually expanded [20].

A different scheme is that implemented in France by the Ile de France region, where the regional government organises the OSS. A new, semi-public company was established and an ESCO was developed to offer a complete value chain for renovation to homeowners [20].

In general, the services offered by OSSs can be grouped as follows:

- Raising awareness and encouraging demand through information on the benefits and co-benefits of specific interventions, depending on the type of dwelling. Some OSSs have created IT tools that can undertake approximate simulations and present potential solutions with an estimate of costs and benefits. This saves a lot of technicians' time because it identifies the real demand. This function is fundamental, particularly from the perspective of overcoming the aforementioned barriers caused by families' lack of knowledge and asymmetrical information, as explained previously.
- Technical assistance through an energy audit as a starting point to determine specific measures (that is packages) and their subsequent selection by households according to their needs, financial possibilities, and preferences; the implementation project (if applicable); the search for contractors; assistance in the selection of the proposed improvements depending on technical, economic and regulatory criteria; monitoring, quality control and acceptance of works; putting the works into operation and assessment of the energy performance after the intervention; and finally maintenance. Renovations generally follow a gradual model like a road map.
- Financial assistance, through the prescription of specific measures and assessment of the investment compared to the financial benefits; identification of sources of funding that complement the eventual savings; subsidies depending on the type of intervention and the socioeconomic characteristics of the households; and provision of information on tax credits. Financial entities can offer soft loans (with highly favourable conditions for the borrowers compared to the general conditions in the market) due to public guarantee funds that mitigate the risks. Insolvent households can benefit from recoverable funds if their conditions improve, or in cases of transfer of property.
- Management of applications for loans and subsidies; licenses for works and operation (as applicable); and execution of guarantees of works carried out before the contractors.
- Training of contractors, technicians and industrialists on new materials, equipment and procedures in relation to energy efficiency and with financial entities to improve the risk analysis. In many cases, this training is a requirement for contractors to form part of the portfolio of suppliers of the OSS. This can increase the quality of the works and, above all, the confidence of households.

Based on the above, it is clear that OSS not only foster demand for renovation, but also bring together a fragmented market of suppliers (technicians, suppliers, contractors, and financial entities) and real and induced customers. They bring together under one roof the experience and knowledge of technicians and industrialists on the one hand, and aggregate demand on the other. For this reason, they have been classified by Boza-Kiss and Bertoldi [20] as new, innovative business models from the perspective of offerings, and transparent, accessible instruments of support from the perspective of customers. The general model of OSS guides homeowners through several or all stages of the renovation. This enables the adoption of measures that improve the energy efficiency of the home at the same time as they provide a renovated dwelling that meets customers' needs [57].

5. Analysis and Discussion

As indicated previously, after filtering the cases that were detected initially, 34 OSSs were analysed. To a varying extent, six OSSs' experiences that are no longer operating were also examined. Although this will be discussed below, it should be noted that in general these OSSs closed down because they had functioned as pilot projects, in the context of a European project and from their foundation they had been established in this way. These five cases were not included in the database as there was insufficient information for their analysis.

Out of the OSSs analysed, and in addition to the relevant initial experiences of Nordic countries, operating OSSs are mainly located in the Netherlands (5), France (4), and the United Kingdom (4). Of these, four OSSs have been operating since 2009 (ProjectZero in Denmark, Ecofurb in England, KredEx in Estonia, and Bolig Enøk in Norway). These are the longest running OSSs after the two that have been in operation since 2005 (Huisdokter in Belgium and EERSF in Bulgaria). In addition, three OSSs are operating in Spain, although they were only founded recently (OSIR, Opengela, and HolaDomus (GarrotxaDomus)), to which we can add Save the Homes, which is running in Valencia and was therefore excluded from the analysis.

5.1. Nature and Initiative

As indicated, the OSS initiatives could be private, public, or mixed (public–private partnership, PPP). Priority was given to public initiatives (19 cases, 55.80%), two in collaboration with a cooperative and in two cases through a public–private partnership. Almost all these cases are in countries with low CO_2 emissions per capita, which may show a relationship between the efforts of these states to reduce their emissions overall and to encourage energy renovation of homes. In general, the public entities tend to be mainly town councils (strengthening the concept of proximity and local development), with the support of relevant regional or national energy agencies. In addition to public entities, members include manufacturers, contractors (industrialists and constructors), distributors, technicians, and financial entities, which are present in most of the initiatives. In contrast, only seven (20.59%) of the OSSs are exclusively private initiatives and a further three involved the participation of a PPP. This suggests that there are still insufficient incentives for private entities to take on the commitment of establishing an OSS, and highlights the risks entailed from a business perspective. This idea is reinforced further by considering that OSSs operate in countries with a wide range of GDP per capita. Therefore, it does not imply a lack of capacity of families to undertake energy renovation measures, but rather a lack of knowledge of incentives by technicians or a lack of willingness to launch these initiatives.

Almost half the OSSs have an all-inclusive operating model (the optimum model in which the OSS acts as the only point of contact and contracting that brings together of the services), 26% have a facilitating model (that basically offers information and contact with contractors), 24% a coordination model (that distributes the work between the contractors and carries out monitoring and acceptance of the works). Three percent had an ESCO model. These types of OSSs were still not representative because this model has only recently been introduced in Europe. It is interesting to observe the distribution and concentration of models by countries. In countries with a higher GDP, the most predominant models are all-inclusive and coordinated, possibly due to the fact that they facilitate the path for households during most of the process and homeowners are more likely to have available resources.

5.2. Financing for Their Operation

Most OSSs (32) have received public financing through various European programmes or projects, mainly to cover their operating costs. However, many OSSs charge homes for their services. A smaller proportion charge for contractors in the form of commissions. There is a greater presence of mixed financing in all-inclusive and coordination models.

Many of these OSSs started as pilot tests in the framework of European projects. Notably, OSSs that are no longer in operation generally shut down at the end of the project if they functioned as a pilot test and were no longer obtaining funding. This suggests that mechanisms of structural funding need to be generated so that these initiatives have economic feasibility that goes beyond the projects that finance them.

Almost 60% of the financing of renovation works is of a mixed type. A total of 26% of the works are financed exclusively by the owners (through all kinds of loans, in addition to their own capital). Finally, only 16% of the OSSs use public financing for their works. Regarding the financing of works in relation to the type of model, the ESCO type use private financing as they act as agencies that use energy savings to finance customers and, in this way, make their profit. If the existing types of financing are analysed, it can be seen that northern European countries have a mixed model of financing that should serve as an example for countries from other latitudes of Europe.

5.3. Communication Channels and Means

Regardless of the OSS model, the most frequently used channels to attract customers are the internet (websites) and mass media. Customer service offices also play a relevant role. The next most common means of communication is local meetings. However, local meetings were not used in ESCO models. The showroom option was only observed in all-inclusive and consultancy models and the 'door-to-door' method only in all-inclusive and coordination models, which were the models that offered most tools for attracting customers. This seems reasonable, as it is these two models that operate by majority and commit personal and economic resources to operate. Very varied forms of approaching potential clients were observed. However, one example of good practices is the case of the OSS Frederikshavn City Council (Denmark). What is interesting about this case is the incorporation of a 'mobile office', an information truck that is used during the launch of communication campaigns to raise citizens' awareness of energy renovation in towns and in the residential neighbourhoods of cities. This is complemented by postal distribution of information in a radius of 100 metres of the truck, indicating when the truck is available and explaining that people can visit it. The truck is often used during community events. Although there is no study analysing the impact of the use of this office, in practice it has been well-received by people as it represents an easy point of access.

The type of action to attract clients is also influenced by the area that is to be covered. For example, through workshops, conferences and training sessions for the population, ProjectZero aims to become the first decarbonised city before 2029 in Europe. This mass strategy is contrasted with others that have a smaller area of action, and therefore access to the public is only carried out through occasional channels of communication, including internet platforms, door-to-door visits, local meetings, showrooms, and offices. It is also important to include an online portal (e.g., EnergieSprong, HolaDomus, Oktave, among others), a network (suppliers, installers, etc.), and recently the use of social media (Facebook, Twitter).

5.4. Types of Improvements Offered

In the case of passive improvements, there is a tendency to propose more integrated improvements (insulation, ventilation, doors and windows, and sunshades), mainly in countries with economic resources that also have unfavourable atmospheric conditions, which drive the need to carry out energy renovations in dwellings. OSSs that operate in Spain have a predominance of thermal insulation measures, followed by renovations of doors and windows. Both interventions are fundamentally necessary due to the age of the Spanish building stock (mainly older than 1980), with building envelopes that do not provide insulation. In the case of blocks of flats, the main passive improvements (over 75%) are focused on the insulation (33 cases, 97.06%), types of doors and windows (29 cases, 85.29%), and ventilation (26 cases, 76.47%). In active improvements, there is a clear predominance (29 cases, 85.29%) of the incorporation of photovoltaic panels (mainly

in multi-family housing) and the incorporation of heat pumps (24 cases, 70.59%), followed by boilers and heat exchangers (with little representation). A wider range of measures are adopted in individual properties, but there is also a predominance of passive improvements (windows and doors, ventilation, insulation).

5.5. Services Provided

Of all the set of many possible services, the main ones that are offered are: energy audit (29 cases, 85.29%), prescription/project (25 cases, 73.53%), and search for providers (24 cases, 70.59%). Those that are least frequently offered are: acceptance of the works, putting into operation and improvements other than energy improvements. The fact that these other improvements do not receive specialised attention or financing does not mean that they are not included in the renovation.

5.6. Customer Target

It is not always easy to determine the target of the action. In some cases, the OSSs focus on a local office but act in different regions or internationally, particularly when they form part of a programme that involves many cities (e.g., Bolig Enøk, Energiesprong, FinEERGo, or Reinmarkt, among others).

Is important to highlight the OSS cases with a model addressed both single-and multi-family buildings market, as successful building renovation business models: EnergieSprong, HolaDomus (more than 430 households benefited, of which more than 100 assisted in the preparation of energy projects), Oktave, and BetterHome.

6. Conclusions

The analysis that was carried out revealed that, despite the difficulty in implementing OSSs and beyond the business model, they are efficient instruments that enable unification of the fragmented energy renovation market for dwellings, to a certain extent (e.g., BetterHome, more than 1300 projects executed from 2015 to 2018, in different building types, and with measures deployed, improving the energy performance savings between 30% and 70%, or Hola Domus, with more than 430 households benefited, Retrofit Works, with over 300 individual properties retrofitted from 2018, or EnergieSprong with more than 5000 homes retrofitted). Despite not being able to analyse results compared in scenarios with or without OSSs, it is important to indicate that results such as those described clearly show their potential as agents that generate change and improve the energy efficiency of homes, with the benefits of environmental friendliness and comfort, derived from interventions that improve the energy performance of homes and the living conditions of their inhabitants.

The OSS integrates home renovation processes in a single point of contact for customers, which saves time, effort and energy that would otherwise be used to approach different companies. This is clearly beneficial for families and for the technical and financial agents who could take advantage of OSSs for contacts with customers. This is without doubt in the same line as the proposals of Purvis et al. [27] regarding the many benefits in starting up OSSs and the fact that they would have positive effects for all society and for private entities, overall, in the way to solve the existing barriers for the energy renovation of houses.

In addition, the importance of substantially renovating building stock was corroborated, through a process that involves homeowners and the construction sector. Other participants in this process are public administrations, as they have the powers required to define and apply energy efficiency policies for buildings. However, it was also shown that on some occasions, due to budget limitations, the costs of renovating the residential building stock cannot be covered.

As presented above, the nature of the OSSs under study is diverse but most are public initiatives. Only seven (20.59%) are exclusively private initiatives, which suggests that there are still not enough incentives for private entities to make a commitment to

establishing an OSS, with the business risks that this implies. This could also be related to the conclusions of Rosenow et al. [34] in the sense that, as this is not a very mature market and its implementation requires high levels of investment, private entities are discouraged from starting this task.

It is also important to highlight that, among partners, there are public entities, manufacturers, contractors (industrialists and builders), distributors, technicians, and finance companies that are present in most of the initiatives.

The responsibility of the relevant authorities in promoting energy renovation and mitigating its environmental and social consequences is unavoidable. However, it is no less certain that their presence in OSSs, if these are financed using public funds, could lead to difficulties.

As shown, the 'all-inclusive' model is used in almost half of the OSSs studied, followed by coordination. Offering an all-inclusive service requires an additional effort but enables manufacturers and service providers to meet customers' specific needs, which may range from solutions for owners of single-family homes to multi-family housing. In any case, the OSSs in Spain correspond to the 'facilitation' model. This is understandable if we consider the leading role of the public administrations that promote them.

Financing seems to be the main barrier to renovation and to the operation of OSSs, as it is based on a financing model that is strongly supported by public resources from European, regional, and local funds. For this reason, the need for post-project structural operational funds is clear.

Many project promoters continue to find it hard to cover the initial costs of their projects and lack access to attractive financing products that are suitable for the market. This market failure is due mainly to a lack of understanding of the risks, the many benefits, and the profitability of investments in sustainable energy, particularly energy efficiency, by finance companies and investors.

The coverage of the OSSs should be expanded, teaching from the academy and the dissemination of comprehensive models from the public sphere (governments and municipalities) in matters such as energy efficiency. In this sense, considering the relevance of the online platforms of some OSSs (EnergieSprong, HolaDomus, Oktave, among others), the creation of interaction platforms between administrations and interested entities seems essential to promote the dissemination of the OSS model, as well as dissemination structures that OSSs can use to explain the importance of the model to potential users and possible actions.

Collaborative work is essential for the functioning of the OSS. Consortia between advisers, suppliers, financial institutions, and others must be adequately linked to offer comprehensive and quality services to users. These tasks and stakeholders are not clearly evident in many of the OSS websites and can confuse users who do not understand the topics to access energy renewal services that are the subject of respective professionals or technicians in the field.

Certain recurring obstacles to implementation have been detected: the budget restrictions of local administrations, a lack of long-term structural funding at a reasonable cost, long periods required to approve financing, high transaction costs due to small individual investments, rather unattractive financial profitability, little reliability of repayments, lack of knowledge by banks, energy improvements that are not always translated into an increase in rental fees or value of the properties, and benefits that are not correctly monetised.

To sum up, regardless of the difficulties of OSSs and those that have shut down, it seems that they are an agent that will be a determining factor in achieving the energy targets proposed by Europe, in conjunction with the climate emergency.

In this work, it has not been possible to carry out a global quantitative analysis of the results in all the existing OSSs, mainly due to their diversity and lack of unified information, but perhaps a future line of analysis in this regard may be to obtain the final reports on

implemented projects, obtain a global view of these issues, and consider a total number of renovated dwellings and the total amount of investment, among other factors.

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