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ONE-STOP SHOP SOLUTIONS FOR RESIDENTIAL BUILDING ENERGY RENOVATION: BENEFITS AND CHALLENGES

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Abstract. *The Energy Union prioritizes energy efficiency to reduce pollution and reliance on imports. With 40% of Europe's energy consumed by buildings, upgrading existing structures is crucial for a clean energy transition, necessitating standardized, One-Stop-Shops (OSSs) for homeowner guidance and financing. OSSs solutions for energy efficiency measures in buildings are comprehensive programs or services that aim to streamline and simplify the process of improving buildings energy performance. This paper aims at analyzing the concept of OSSs as a key mechanism supporting enhanced energy efficiency in residential, business, and public buildings. The paper focuses on the key benefits and associated barriers and challenges of OSSs operation, so as to provide recommendation for accelerating building renovations towards a clean energy transition. The study underscores the importance of recognizing OSSs or analogous structures as facilitators for various stakeholders, including citizens, SMEs, and public authorities, to undertake projects related to the clean energy transition.*

Key words: *Clean Energy Transition, Sustainable Development, Decision Support, Energy Efficiency, Energy Renovation, One-Stop-Shops, Building Sector, Renovation Barriers*

JEL Classification: Q2, Q20, Q21, Q4, Q40, Q42, Q48

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1. INTRODUCTION

Within the Energy Union (EU), prioritizing energy efficiency stands as a key pillar aimed at reducing pollution, preserving domestic energy sources, and diminishing the EU's dependence on energy imports. Currently, buildings contribute to 40% of Europe's total energy consumption, with over 75% of the existing building stock falling short of current efficiency standards. While the EU and its Member States (MSs) have focused on new buildings through diverse policy instruments, such as standardization, informational campaigns, and market-based policies, it is crucial to recognize that the majority of the building stock in 2050 will consist of structures already in existence. Consequently, enhancing the efficiency of existing buildings has become a pressing necessity for facilitating a clean energy transition.

The residential sector represents nearly 75% of all buildings and 25% of Europe's total energy consumption mix (Pardalis et al., 2022). Improving the energy efficiency of residential buildings is therefore a key factor in achieving carbon neutrality by 2050. It is also estimated that approximately 75% of the building stock that will exist in 2050 has already been constructed (EC, 2019). This pursuit of energy sobriety must, therefore, imperatively manifest itself through the energy-efficient renovation of existing residential buildings. Despite this, depending on the year and the country, the annual renovation rate fluctuates within the range of 0.4% to 1.2%. At this pace, it would necessitate over a century to complete the renovation of the European housing stock (Filippidou & Jimenez Navarro, 2019).

Emphasized in both the "Renovation Wave" initiative of the European Green Deal and the REPowerEU Plan is the urgent requirement to augment the quantity of ambitious building renovations throughout the EU. Additionally, there is a crucial emphasis on seamlessly incorporating the transition to efficient, renewable-based heating and cooling as an integral component of these building renovations (Karakosta et al., 2023). Businesses play a pivotal role in driving the clean energy transition. Nevertheless, numerous homeowners, building owners, small businesses, and public authorities often lack the expertise and resources required to initiate, execute, and fund intricate and ambitious clean energy transition initiatives. Furthermore, project developers encounter substantial implementation costs due to the relatively modest scale of investments and the absence of comprehensive solutions. Additionally, these developers confront challenges in accessing suitable and appealing financing options within the market.

The process of constructing a new building or renovating an existing one is frequently a highly complex journey for homeowners. It demands a comprehensive understanding of technical and social diagnostics, engineering, financial structuring and provision, administrative and legal knowledge, as well as vigilant oversight of construction activities and quality assurance. The success of this endeavor relies on effective collaboration with various specialized service providers, whose identification and management can pose significant challenges (Pardalis et al., 2022). There is definitely a need to reduce the burden on homeowners and take on tasks for which homeowners are not well equipped, while also catalyze the evolution of market practices by developing integrated home renovation services. Therefore, the establishment of standardized one-stop shops, deployable swiftly at national, regional, or local levels, becomes imperative. These entities are designed to offer customized advice and financing solutions, guiding homeowners seamlessly through the preparation and implementation phases of their projects.

Over the past few decades, in response to national and European environmental challenges, cities have established ambitious targets as they drive the energy transition locally. Concerned by the well-being of their citizens, cities play a key role in bringing citizens on board to actively participate in the energy transition. They set up One-Stop-Shops (OSS) and integrated home renovation services to overcome a number of barriers that currently limit the deep renovation rate of private households and to foster the rate of energy efficiency improvements in the residential sector (Boza-Kiss et al., 2021).

An OSS for energy renovation is a centralized platform, either virtual or physical, that connects homeowners with comprehensive information and services necessary to implement ambitious global energy renovation projects. By offering essential services, such as project design, technical expertise, and access to financing options under one roof, an OSS bridges the gap between demand and supply in the renovation market, streamlining the process and fostering an increased rate of energy-efficient retrofits within a defined area.

This paper aims at analyzing the concept of OSSs as a key mechanism supporting enhanced energy efficiency in residential, business, and public buildings. OSS solutions for energy efficiency measures in buildings are comprehensive programs or services that aim to streamline and simplify the process of improving the energy performance of buildings. The paper focuses on the key benefits and associated barriers and challenges of OSSs operation, so as to provide recommendation for accelerating building renovations towards a clean energy transition. The study underscores the importance of recognizing OSSs or analogous structures as facilitators for various stakeholders, including citizens, SMEs, and public authorities, to undertake projects related to the clean energy transition.

Apart from this introductory section, the paper follows with a summary of the most related to buildings energy renovation in a view of energy transition European policies and the presentation of the concept of OSSs. The paper continues with an analysis of the main benefits and challenges for OSSs during the renovation process, highlights future research directions and ends with conclusions arisen from the study.

2. EU Policies Affecting Renovation

Renovating public and private buildings is an essential priority to meet our climate goals, according to the European Green Deal published in December 2019. To underline its importance, in 2020, the European Commission (EC) published a strategy entitled "A Renovation Wave for Europe – Greening our Buildings, Creating Jobs, Improving Lives" to boost renovation in the EU. The Renovation Wave aims to double the annual energy renovation rates at the EU level in 10 years from the strategy's launch.

Apart from the increase in renovation rates, the strategy aims to reduce greenhouse emissions and enhance the quality of life for people living in and using the buildings. The Renovation Wave identifies three focus areas: (a) tackling energy poverty and worst-performing buildings, (b) renovating public buildings and social infrastructure, and (c) decarbonizing heating and cooling.

The Renovation Wave initiative builds on the national Building Renovation Plans, the Energy Performance of Buildings Directive (EPBD) and the building-related aspects of each EU country's National Energy and Climate Plans (NECPs).

In December 2021, the EC proposed a revision to the Energy Performance of Buildings Directive (EPBD) and suggests strengthening the long-term renovation strategies towards 'Building renovation plans' to meet a minimum 55% EU reduction in greenhouse gas (GHG) emissions by 2030, now legally required under the 2021 European Climate Law (Maduta et al., 2023). This EPBD revision sets out how the EU can achieve a zero-emission and fully decarbonized building stock by 2050, mainly by increasing the renovation rate for the worst-performing buildings in each EU MS.

While the Energy Efficiency First principle was already embedded in the Regulation on Governance of the Energy Union and Climate Action (EU/2018/1999) and in the Energy Efficiency Directive (EED, EU/2018/2002), the revised directive (EU/2023/1791), published in the Official Journal on 20 September 2023, provides a stronger and wider legal basis for the application of the principle (EC, 2023a). This means that EU countries must consider EE in all relevant policies and significant investment decisions taken in the energy and non-energy sectors.

The updated EED prominently features OSS as a key mechanism supporting enhanced EE in residential, business, and public buildings (EC, 2023b). The document underscores the importance of recognizing OSSs or analogous structures as facilitators for various stakeholders, including citizens, SMEs, and public authorities, to undertake projects related to the clean energy transition. OSSs play a crucial role in providing substantial support, particularly benefiting vulnerable customers by offering dependable information on EE improvements (Agrawal et al. 2023). As outlined in the document, this support encompasses technical, administrative, and financial advice, along with facilitating necessary administrative procedures, accessing financial markets, and providing guidance on legal frameworks, including public procurement rules and EU taxonomy. EED's Article 22 emphasizes the need for a supportive framework, advocating for the establishment of OSS or similar mechanisms to provide technical, administrative, and financial assistance for energy efficiency, covering areas such as energy checks, building renovations, and the adoption of renewable energy for final customers, especially households (affected by energy poverty and on worst performing buildings), SMEs, and microenterprises. The EED document also mentions that dedicated OSS facilities should give information on qualified EE professionals, collect typology-aggregated data from EE projects, share experiences and make them publicly available, and connect potential projects with market players, particularly smaller-scale, local projects.

OSSs are also mentioned as suggestions in the revision of the Energy Performance of Buildings Directive (EPBD), specifically in Art 15 and 15a "The EPBD revised documents mention that (a) financial incentives for renovations shall target, as a priority, vulnerable households, people affected by energy poverty and people living in social housing; (b) MS shall address the risks of eviction through renovation, (c) a delegated act shall encourage financial actors to provide for more green mortgages and loans, (d) OSS for renovations shall provide independent and free advice on building renovations". It becomes evident that there's a general lack of attractive and accessible financing packages available for the building sector and that one-stop shops to act as independent, transparent, and accessible tools are required to inform and assist in this effort, offering packaged solutions for joint planning, permitting, financing, and contracting to overcome the barriers for uptake (Karakosta & Papapostolou, 2023; Maduta et al., 2023).

Thus, the revised Energy Performance of Buildings Directive highlights the key role of local governments in the set up and operation of home renovation services. The European Parliament

has proposed to establish at least one One-Stop-Shop per region and in any event per 45,000 inhabitants, with a harmonized approach to be implemented in MS. This highlights the necessity to accelerate the implementation of OSSs and integrated home renovation services systems.

Summing up the analysis of current support policies related to OSSs and the needs on the ground, it should be mentioned that OSSs should be considered as a key mechanism of housing renovations in line with the EU environmental transition, while public and financial incentives should encourage efficient renovation. Thus, there is a need to facilitate the organization of networked one-stop shops, ensuring also their efficiency and sustainability.

3. THE CONCEPT OF A ONE-STOP-SHOP

Homeowners can face an overwhelmingly challenging journey when renovating their homes. It requires technical and social diagnosis, engineering, structuring and provision of finance, administrative and legal knowledge, monitoring of works, and quality assurance. It depends on the smooth collaboration with several specialized service providers, who may be challenging to identify and deal with. Thus, there is definitely a need to reduce the burden on homeowners and take on tasks for which homeowners are not well equipped, while also catalyze the evolution of market practices by developing integrated home renovation services.

The One-Stop-Shop (OSS) concept is basically defined as integrated home renovation services and is both a business and customer engagement model for applying innovative financing models (Bagaini et al., 2022). OSSs aim to bring together into one place all the technical and economic assistance customers need when undergoing an energy renovation (Bertoldi et al., 2021). Increasing customer access to information, incentives, financing, and quality contractors, OSS often involves coordination between stakeholders such as utilities, ESCOs, financial institutions, contractors and installers, OEMs, local governments, and community organizations (Kleanthis et al., 2022). Thus, OSSs are virtual and/or physical places where homeowners can find all information and services they need to implement an energy renovation project.

In order OSSs to be efficient and fulfill their objectives, they need to cover the following services, ideally, ‘under one roof’:

- Active engagement of homeowners requires strategic approaches, such as market segmentation, customized communication, and effective marketing tools. Targeting specific groups like young families, elderly individuals, and low-income households is essential to connect with them at the right moment, delivering tailored messages for maximum impact.
- Energy renovation and financial plans should be custom-designed to achieve deep renovation, whether executed in a single phase or through a gradual, step-by-step approach. The pace of implementation can be adapted based on the financial resources available to each homeowner.
- Managing the renovation process on behalf of homeowners.
- Securing extended and affordable financing, particularly for low- and middle-income families, the elderly, and other vulnerable groups who lack access to alternative financing methods, despite the substantial energy savings that could cover the costs.
- Ensuring guarantee of results and ongoing evaluation, including the assessment of work quality and, ideally, monitoring of energy savings post-renovation.

In general, most OSS models entail significant multi-stakeholder cooperation, with models leveraging digital tools offering the potential to streamline and accelerate customer enrollment, program coordination, and retrofit package design and evaluation, while helping to reduce program set-up and operational costs (Bagaini et al., 2022; Pardalis et al., 2021). In particular, an OSS supported by digital tools can streamline customer enrolment and provide suggested renovation plans with estimates of the costs and energy savings based on information about the current building and the needs, objectives, and resources of the building owner. This approach relies on the quality of the information provided as well as information on the local building stock to support the initial design and planning of the renovation.

Furthermore, organizational structures and operational specifics of OSSs can be classified into six main categories (Bertoldi et al., 2021):

- Government-driven OSS: Programs primarily influenced by national, regional, or local government initiatives, often motivated by climate, energy, or social targets.
- Industry driven OSS: Initiatives led by manufacturers or installers seeking to expand their business footprint or enhance customer support.
- ESCO based OSS: OSSs leveraging Energy Service Companies (ESCOs) that extend and reposition their value-added solution components.
- Facilitator OSS: OSSs led by consultants evolving their original customer-centric businesses, broadening the scope of services to reach a wider customer base.
- Cooperative type OSS: Initiatives primarily focused on societal benefits, extending beyond just energy or cost savings.
- Store OSS: Large stores or warehouses offering a platform for customers to explore technologies and products, providing a personal contact option for tailored advice and immediate assistance.

In this context, it is important to note that the necessity for standardized tools, capable of amplifying investments based on stakeholders' perceptions, has received positive evaluations from various services within the EC. This need is being addressed through different approaches, one of which involves the implementation of Sustainable Energy Investment Forums (SEIFs). Launched by the EC in 2017, this initiative is funded by the H2020 scheme and overseen by the European Climate, Infrastructure, and Environment Executive Agency (CINEA). To date, more than 68 events have been organized across 25 MS under this initiative. The primary objective is to facilitate dialogue among relevant stakeholders to stimulate private-sector investments in sustainable energy, ultimately improving access to finance for energy efficiency projects.

There are funded projects under the Horizon 2020 and LIFE Programme that are working towards the enhancement of the investments of energy efficiency projects at regional level, using the results of the SEIFs. Such an example is the H2020 project SMAFIN, which set up the prosperous ground to connect smart financing with energy efficient projects in four Balkan countries (Bulgaria, Croatia, Greece and Romania) and to create a complete roundtable discussion methodology. Similarly, the LIFE project SMAFIN Expanded, which is a continuation of SMAFIN project, supports smart financing implementation for energy renovation of existing private and/or public buildings, investments in SMEs and the tertiary sector in five countries (Bulgaria, Croatia, Greece, Romania, and Slovenia). Furthermore, the ENERGATE project, an initiative under the LIFE programme, serves as a platform that connects homeowners, energy service providers, and financial institutions, streamlining the process for energy efficiency projects

through a transparent marketplace. Of course, these projects are just two examples among many other EC funded initiatives dealing with different aspects of energy efficiency. The scope is to build on the available outcomes derived from related recent EU projects and find a way to further enhance them. Thus, the idea laying beneath these initiatives is to provide tools, methodologies and structures so as to reduce complexity, simplify decision making and propose integrated services for clean energy transition (Karakosta et al., 2023).

4. OSS Benefits and Challenges During the Renovation Process

In general, OSSs potential benefits are clear, since they can provide opportunities for utilities to cooperate with a cross sector of expert stakeholders from local municipalities, community groups, or trade associations to offer customer-centric building decarbonization services which fully advise and support customers. Furthermore, OSSs that leverage digital tools and a team of quality contractors could offer the potential to reduce operational costs, and to minimize the complexity of customer enrollment, management, and retrofit design at scale (Pardalis et al., 2021). Over time, effective digital tools can help to streamline retrofit designs and estimates of energy savings.

The research conducted among initiatives related to OSSs emerged some key benefits for OSSs (Figure 1). One-Stop Shops for home renovation operate within local contexts, possessing an in-depth understanding of the local market, clients, and conditions. These entities engage in an interactive relationship with clients, guiding them through incremental renovation steps and monitoring completed projects. By informing, motivating, and providing comprehensive support from inception to completion, OSSs play a pivotal role in expediting building refurbishments. Additionally, they empower interested but undecided energy users or asset owners to actualize energy-efficient investments and other sustainable projects. One of their key functions is to facilitate access to financing, occasionally offering favorable rates and potentially enhancing the overall energy performance of renovations through a holistic approach. Importantly, in certain instances, OSSs extend their services to reach vulnerable populations, such as tenants in social housing.

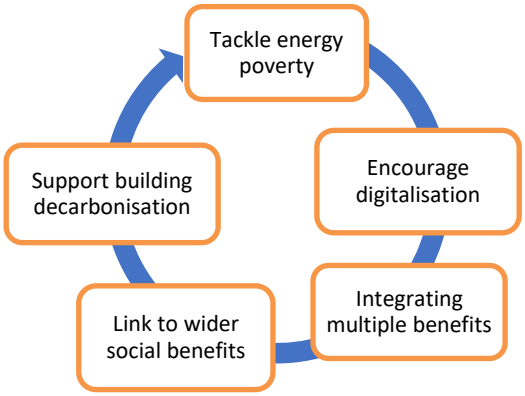

Fig. 1 Key benefits of the One Stop Shops Solution

OSSs role is to advise, support and implement renovation services, by operating as a single coordinator and providing a single point of contact for customers (Bertoldi et al., 2021). In this way, the customer offloads technical and economic responsibilities and risks. OSSs cover upfront costs with various financial mechanisms (including on-bill) and maximize lifetime of existing building technologies to lower and disperse investments. OSSs also include performance guarantees, automated enrollment and design process, while digital tools can enable streamlining of processes by tracking customer satisfaction throughout retrofit journey.

This research has highlighted several potential challenges concerning the operation of OSSs that should be considered carefully when designing building decarbonization programs for specific regions, customers, and building segments. These include economic, information and decision making challenges (Figure 2). Indicatively, there are organizational challenges, and although the fact that these initiatives require high investment costs, the benefits from renovation actions are delayed (Pardalis et al., 2021). Furthermore, there is an unknown quality of work and a lack of trust related to such activities, while also incorrect beliefs about the future benefits of an energy efficiency renovation exist. Since the volume of data to be analyzed from an OSS is huge, there is a risk of imperfect information-processing capacity and also a high transaction cost of searching for information.

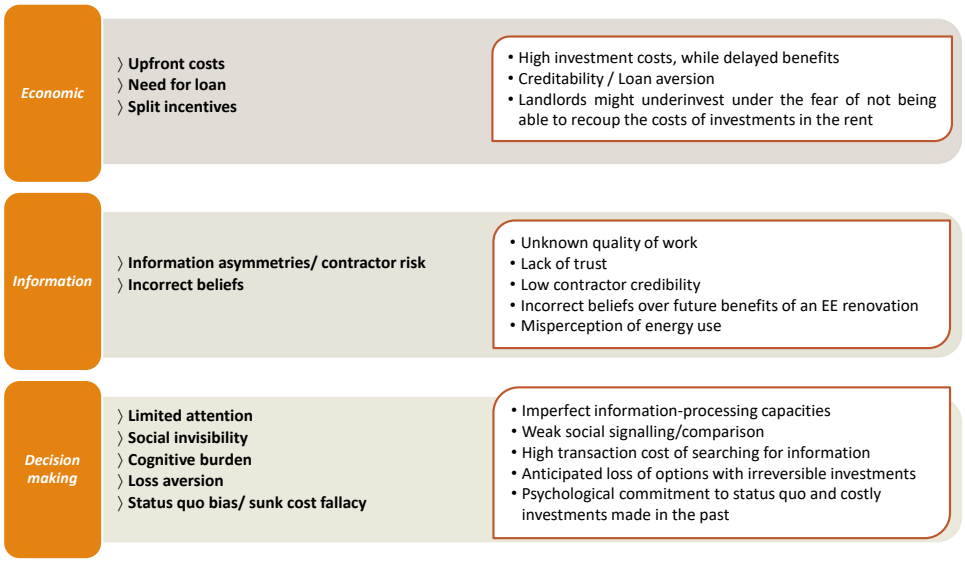

Fig. 2 Challenges of One Stop Shops Operation

A major challenge regarding the OSSs operation is the fact that substantial cooperation amongst several stakeholders required to be set up and managed. OSSs require targeting a limited segmentation of building stock to standardize solutions. OSSs are usually more suited to homeowners or landlords willing to invest over a period of time, making it hard to reach renters directly. Furthermore, reliable data on the existing building stock, and of the specific building required for accurate energy savings estimates, and of course they require a team with strong technical knowledge to optimize retrofit designs and plans.

In the following table a comparison between OSSs benefits and challenges in different stages of a renovation project is outlined. Furthermore, prioritizing challenges during the renovation process helps in identifying key areas that need immediate attention to ensure successful project outcomes. Thus, to prioritize the challenges and benefits mentioned in Table 1, a scale of 1 to 5, with 1 representing the least challenging and 5 representing the most challenging aspect during the renovation process for OSSs was used. A prioritasation of benefits was also conducted using the same scale.

Table 1 One Stop Shops benefits and challenges during the renovation process

Activity	Benefits		Challenges	
		Rank		Rank
Information	▪ Raising homeowners' awareness ▪ Raising public awareness of the benefits of energy efficient buildings	3	▪ Largest audience, messages not specifically tailored ▪ Greater impact if linked to follow-up services	2
Detection	Selection of companies	4	▪ Identify homeowners most likely to perform work (e.g. house buyers)	3
Simplified diagnosis & recommendations	▪ Key elements for 1st decision (go / no-go)	3	But excludes going into design details	1
Project design	▪ Detailed design and operational support ▪ Tipping point between the "advice" and the "support" (and "implementation") models ▪ Materialised by a service contract?	5	Engage in market activities, incurring professional liability	4
Renovation/ Supervision	▪ Assistance ▪ Delegation ▪ General Contractor (tipping point)	5	Services positioned either on the homeowners' side or on the builders' side (diverging interests)	5
Lack of market maturity (especially for low energy renovations)	Building homeowners' trust is key	5	▪ High risk of poor workmanship ▪ Building homeowners' trust is key	5
Quality assurance	Should cover all services provided, from initial contact to after-sales	4	Intrinsic performance or savings guarantee?	3

In summary, the most pressing challenges for OSSs during the renovation process are those related to renovation/supervision and lack of market maturity, followed by project design and quality assurance. Addressing these challenges effectively will be crucial for the success of OSSs in supporting sustainable building renovations. OSSs can capitalize on the benefits of an immature market by offering specialized services and focusing on building trust with homeowners.

5. Future Research Directions

Further research directions could include a close study of management of all information gathered for OSSs operation so as to provide lessons learnt, implications and recommendations per country, but also for Europe as a whole.

More specifically, some concrete examples of OSS implementation could be further studied in detail and thus reflect how these services can be expanded and replicated, and what key conditions are needed to make them sustainable in the long-term.

Furthermore, a methodology could be also build up focusing on streamlining the complex renovation process, offering a comprehensive one-stop solution for homeowners. This approach should involve multiple stakeholders in the value chain, fostering collaboration and communication to deliver tailored, customer-centric renovation services. This methodology would enable OSSs to adapt to evolving market trends and provide homeowners with a seamless, holistic renovation experience.

In summary, the future of integrated home renovation services will likely be shaped by advancements in technology, a focus on sustainability, and an increased emphasis on customer experience and personalization. One-stop shops that adapt to these trends and offer comprehensive, innovative solutions are likely to thrive in the evolving market.

6. Conclusion

The European building market tends to follow a top-down and supply-driven approach, leading to a mismatch between the products available and the needs and affordability of end-users. One Stop Shops have the potential to act as intermediaries, bridging the gap between users and the construction supply side. Consequently, they can enhance the real renovation rate by guiding potential clients through the final stages of decision-making.

In this context, this study analyzed the concept of OSSs as a key mechanism supporting enhanced energy efficiency in residential buildings and provided the related key benefits, the associated barriers, as well as challenges of the implementation of this innovative mechanism and recommendations.

The key benefit of OSS services is the ability to provide a single point of contact and make it easier for marginalized and disadvantaged communities to access the finance and expertise required to plan, coordinate, and implement a cost-effective home energy renovation.

Going through some conclusions resulted from this study, it could be highlighted that upscaling deep renovation will not happen without comprehensive home renovation services. In this context, OSSs role is considered vital and crucial in transforming the EU related policy into tangible renovation schemes on the ground. OSSs could facilitate building decarbonization also through digitalization and supporting tools integrating multiple benefits. Furthermore, OSSs could play an essential role in ensuring that renovations schemes are made accessible for the vulnerable, linking to wider social benefits, such as tackling energy poverty.

One-Stop Shops should be considered as originators of housing renovations in line with European environmental and clean energy transition. However, public incentives, such as financial incentives, regulatory support, or educational initiatives to increase awareness and engagement, as well as standardization and certification, should encourage efficient renovation, overcome challenges related to the OSSs implementation, improve their

efficiency and assure sustainability of their operation. The analysis resulted that the way forward are OSSs with trust, efficiency and standardization at the core.

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REŠENJA NA JEDNOM MESTU ZA ENERGETSKO RENOVIRANJE REZIDENCIJALNIH ZGRADA: KORISTI I IZAZOVI

Energetska zajednica daje prioritet energetskoj efikasnosti kako bi se smanjilo zagadjenje i oslanjanje na uvoz. Kako 40% energije u Evropi troše zgrade, osavremenjivanje postojećih struktura je od ključne važnosti za čistu energetsku tranziciju. Za to su neophodna standardizovana rešenja na jednom mestu (One Stop Shops - OSSs) za pomoć i finansiranje vlasnika objekata. OSS rešenja za mere energetske efikasnosti u zgradama su sveobuhvatni programi ili servisi koji imaju za cilj da racionalizuju i pojednostave process poboljšanja energetske efikasnosti zgrada. Ovaj rad ima za cilj da analizira koncept OSS kao ključnog mehanizma u podršci energetskoj efikasnosti u rezidencijalnim, poslovnim i javnim zgradama. Rad se fokusira na ključne benefite i prepreke i izazove rada OSS, kako bi dao predloge za ubrzavanje renoviranja zgrada ka čistoj energetskoj tranziciji Rad podvlači važnost prepoznavanja OSS ili sličnih strukltura kao facilitatora za različite stejkholdere, uključujući gradjanstvo, mala i srednja šreduzeća i lokalnu samoupravu, da preduzmu projekte vezane za tranziciju ka čistoj energiji.

Ključne reči: *Čista energetska tranzicija, Održivi razvoj, Podrška donošenju odluka, Energetska efikasnost, Energetsko renoviranje, One-stop shops, Gradjevinski sektor, Prepreke u renoviranju*