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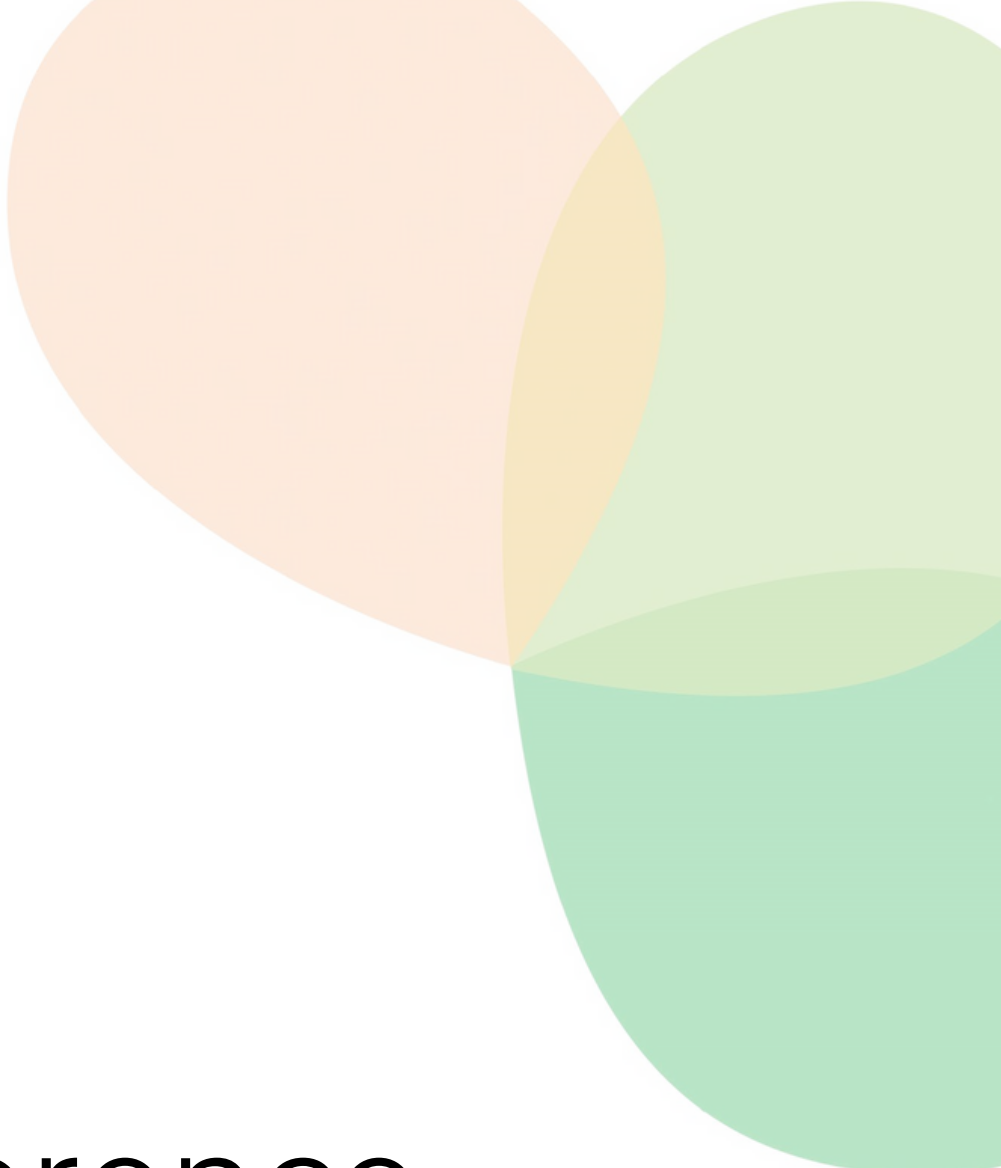
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OVERCOMING COMMUNICATION AND INFORMATION BARRIERS IN THE DUTCH ENERGY TRANSITION:

A Study on Online Sources of Energy-Efficient Retrofits in Homeowners' Associations

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Keywords: Communication, Energy efficiency retrofits, Home-owners associations, information on energy transition

Abstract

This paper focuses on the information and communication challenges in the Dutch energy transition in the built environment, with a specific focus on energy-efficient retrofits (EER) in homeowners' associations (HOAs). The research surveyed the literature on barriers and drivers related to information and communication in EERs. It systematically investigated the information sources and communication channels provided by governmental and non-governmental institutions on financial subsidies, step-by-step guidelines, home evaluation tools, and participation guidelines. Lastly, the research categorised and evaluated the interfaces designed to deliver the information to the Dutch homeowners' associations. The research also explored the barriers and drivers related to trust issues in EERs as the correlation between trust and information and communication emerged as one of the most prominent factors affecting EERs' acceptance. The paper analysed the online information sources based on readability, credibility, and interactivity, focusing on accessibility and the ability to generate tailor-made suggestions. The analysis revealed that the online information sources are disorganised and dispersed. The online platforms rarely provide information on prior case studies and more on financial subsidies, guidelines, and EER benefits. Lastly, we discussed the main barriers and potential solutions for these challenges.

1. INTRODUCTION

The Dutch government set the climate goals of 95% mitigated emissions in 7 years and being gas-free in 27 years. Regarding these targets, the central government designs policies and funds for citizens to ease the financial burdens of renovating their houses for more energy efficiency. Energy-efficient renovations (EER) are complicated processes, and despite the financial aid from the local or central government, homeowners tend to postpone this process due to nuisance, information overload or social reasons. The Dutch government's targets for mitigating the emissions and gas-free heating transition deeply rely on renovating the existing building stock. Around 1.4 million houses need to improve their energy efficiency label to/above C in the next seven years, approximately 200,000 houses per year, which is very ambitious (RVO, 2022). Besides the financial, material, labour and management challenges, there are 143.000 homeowners' associations (HOAs, *Vereniging van Eigenaren (VvE) in Dutch*) in the Netherlands (de Statistiek, 2016), and these multi-family settlements, depending on the year they built, require 80% consent from the homeowners to be able to proceed in renovation processes.

The barriers in EER are diverse and challenging to overcome; on top of it, HOAs require more effort to apply EERs due to the challenges in group decision-making processes. The barriers in EER are related to financial barriers, process barriers, social barriers, and finally, information barriers (Prieto et al., 2023). However, information barriers play a fundamental role due to their effect on the acceptance and application of EER (Jia et al., 2021). Local authorities initiated one-stop shops (OSS) to cope with these challenges and aimed to go to citizens and talk to them in their neighbourhood and answer their specific questions. This approach worked well due to the personal relationship that citizens have with the authorities and their physical appearance (Kwon & Mlecnik, 2021). On the commercial side, the concept of OSS also helped citizens hire intermediaries in EER and discuss their renovation projects under Integrated Home Renovation Services (IHRS). One of the reasons behind the success of the IHRS is the ability of these intermediaries to curate and convey information about EER and deliver tailored guidelines to homeowners or associations (De Wilde & Spaargaren, 2019). The experts working at IHRS intermediaries provide the relevant topics and the experience they had to their customers. IHRS also eases the EER process due to their ability to offer packages that include all the services homeowners need during the EER, from auditing to the execution of the renovations. Moreover, these intermediaries also help citizens to apply for the related funding scheme and go through the entire process. Intermediaries' role in information delivery is crucial due to the complicated nature of EERs.

The importance of conveying relevant information to avoid 'information overload' is a fundamental factor in any field (Levy, 2008), as stated in EER research (De Wilde, 2019). In this manner, the IHRS intermediaries are crucial in EER. Yet, it is also stated that homeowners who aim to go through an EER process start with gathering information, generally from online sources (Arning et al., 2020); also, the initial phase is similar to the members of HOAs (Paradies et al., 2017). Even though they get information from IHRS businesses, these individuals verify the knowledge they got from the intermediaries by checking trustworthy official websites such as Milieu Centraal and Vereniging Eigen Huis (De Wilde, 2019, p. 19). The neutrality of these

platforms provides more trust to homeowners. So, the delivery of the information from a trusted party becomes crucial for any homeowner, especially homeowners who are in need of orientation, to come to a consensus to apply EER in HOAs. The differences between the members' level of knowledge in sustainable buildings, motivations for EERs and income level. From a social practice theory (SPT) point of view, Shove et al. argue that sustainable practices require materials, meanings given to the practice and competency to 'perform' the practices (Shove et al., 2012). However, to disseminate the practice, individuals need to perform the practice, share the meanings and let others join to spread the practice. The channels to disseminate knowledge, therefore the practice, is one of the fundamental parts of SPT. In the digital information age, the dissemination of practice via digital platforms is inevitable. In our case, this research aimed to explore the online sources published by governmental institutes and non-profit organisations to understand how these official institutions disseminate information based on the practice of EERs.

In this paper, we investigated the information and communication problems from the SPT perspective to understand how these practices are disseminated via governmental or non-profit organisations' websites and for which kind of audiences. Furthermore, we will analyse the contents of the websites accessible via popular search engines in the Netherlands on EER in HOA and the tools and representation methods used. Therefore, the research question is: *What kinds of information do governmental online sources disseminate on energy-efficient renovations in homeowners associations in the Netherlands, and how do the online sources convey information to various audiences?* This research aims to highlight the gap in scientific research on the accessible information online for citizens and the tools or representation methods used to convey information. The methodology of web-based content analysis is used in exploratory research for the preliminary research stage. The importance of the contribution of this paper is that the information published online for society on critical topics such as EERs in HOAs should also be investigated scientifically to exploit gaps and future potentials.

2. INFORMATION BARRIERS IN EER AND HOA

In the EU and the Netherlands, the construction industry is developing carbon-neutral, or positive, solutions to housing, yet the existing housing stock suffers from low energy efficiency. The European Commission (EC) and Netherlands Enterprise Agency (RVO) are funding research to understand the barriers and motivators for individual homeowners, housing corporations, HOAs, and social housing. There are various categorisations of barriers in the literature from the individual level to the institutional level, yet the information to apply EER is too complex for citizens, thus hindering action (De Vries, 2020). The information complexity includes financial instruments, building information, renovation technologies, and the renovation process (Jia et al., 2021), and the information on the EERs can be complicated for people who have no expertise in the field as well (De Wilde, 2019).

Regarding the HOAs, there are other barriers to group dynamics in decision-making (Paradies et al., 2017). Therefore, there are differences in the renovation phases between individual homeowners and HOA members, such as the orientation of the members and the voting process. However, the initial phase is similar to what Arning et al. described, getting informed and creating a motivation for EER. Although the decision-making dynamics are different, the

information needed is similar to an extent, except for participation and voting steps. Moreover, The amount of information to understand can be overwhelming for individuals (De Vries, 2020) The barriers in EERs are not the same at every stage of the EER process. There are early stages that encapsulate the awareness and information collection stages, followed by the stages of audits, planning, and concept designs (Arning et al., 2020; Prieto et al., 2023), which require homeowners, designers, and constructors to communicate (Jensen et al., 2013). In these stages, communication and coordination issues in EERs are among the most mentioned barriers in the literature (Prieto et al., 2023). The complexity of implementation of EERs (Ebrahimigharehbaghi et al., 2019), the administration of the process (Liu et al., 2020), or not being able to participate in the decision process due to lack of knowledge (Xue et al., 2022) are also major challenges for EERs.

The barriers mentioned above were also challenged by the EU, Dutch national and regional governments, municipalities, NGOs, and private entrepreneurs with new policies, subsidies, and communication channels. Moreover, the complicated process of EERs created a new opportunity for middle actors, called intermediaries, to help ease some of the barriers mentioned above. Intermediaries are bridges connecting different levels of actors where direct interaction is missing (Kivimaa et al., 2019). In the EER context, intermediaries are actors who help citizens unburden some of the complicated procedures of the EER process and gather reliable information (Arning et al., 2020; De Wilde & Spaargaren, 2019). It is not just the individuals these intermediaries influence but also other intermediaries and policy actors can be influenced by these binding middle actors (Janda & Parag, 2013). The research also points out that the lack of actors who help lead the EER process hampers decision-making (Laizane et al., 2016). The intermediaries help homeowners in the information-gathering phase by providing reliable information (Arning et al., 2020) and connections with the supply side of the process (De Wilde & Spaargaren, 2019). Decuypere points out the effect of intermediaries in EER decisions is important for the energy transition (Decuypere et al., 2022).

One of the effects of intermediaries in EERs is their ability to create trust. Arning et al.'s findings show that homeowners' trust in the intermediaries during information navigation and decision-making better facilitates EERs (Arning et al., 2020). Several scholars state that social interactions and the person who delivers the message play an important role in the acceptance of EER (De Vries, 2020; Ebrahimigharehbaghi et al., 2019). The social influence of individuals or neighbours is an essential factor in EER, and therefore, it is important to look at the interactions between trusted parties, such as governmental organisations and individuals from the social environment. Although it depends on public trust in governmental organisations, the reliability and credibility of the information is one of the critical factors that make the information search phase difficult (Jia et al., 2021). Dutch homeowners feel the need to check the credibility of information if the source is not coming from an unbiased non-profit organisation or a neighbour (De Wilde, 2019). This also points out that online information sources have a role in informing homeowners in times of doubt.

The in-person interaction is more impactful, yet the need for local online websites is vital in community engagement. Kwon and Mlecnik also argue that even the offline consultancy for EERs is effective, it requires higher budgets, and since local administrations have more trust in

the digital content they share, using web-based technologies to inform homeowners has considerable potential (Kwon & Mlecnik, 2021). It is evident that information delivery and communication play a pivotal role in EERs. However, the research on Dutch online resources in the energy transition literature is limited. Despite research on the barriers and underlying reasons for these barriers, there are 1.4 million homes with an energy label below ‘C’ to renovate in the Netherlands (RVO, 2022). Even though the number of houses undergoing energy renovations increases every year in the Netherlands, the percentages for medium and deep renovation rates stand at 0.8% and 0.1%, respectively (European Commission. Directorate General for Energy. et al., 2019). The number of experts, the required budgets, and the number of renovations needed to reach the goals of Klimaat Akkoord seem problematic. Therefore, this paper tried to investigate the online governmental information sources accessed via popular search engines and analysed the content based on the format of the information, the types of information, the targeted audience and the date of publication to understand the distribution of information on EERs for the HOA members.

3. METHODOLOGY

The methodology used in this research aimed to understand the information conveyed by governmental, non-profit and commercial institutions from the user’s perspective, in our case, the homeowners in HOAs. Therefore, web-based content analysis has investigated the knowledge shared online by these institutions. Web-based content analysis is unobtrusive yet unstructured as well (I. Kim & Kuljis, 2010). The method has been applied in sustainability research to investigate the sustainability measures in hotels (Hsieh, 2012), university organisations (Hasim et al., 2018), and campuses (A. A. Kim et al., 2018). In this study, the aim is not to analyse the content of specific institutions but the content homeowners can access on EER in HOAs. The internet content accessed by individuals was investigated via popular search engines regarding public health awareness (Buchbinder & Bourne, 2018). In this paper, we acquired the website URLs using keywords through search engines rather than the institutions. Search engine data collection has its limitations due to the dynamic nature of page ranking algorithms; however, it is helpful to find practice-based content using specific keywords (Falco & Kleinhans, 2018).

The methodology for analysing the data focuses on the information types found essential in EER (Jia et al., 2021). The type of information can stimulate the homeowners to engage, yet the amount of information is a criterion. The textual explanations written for experts and scientific purposes differ from the general audience, and to be able to achieve inclusive information communication, we compared the word counts on the website to understand how the audience is a factor in word counts. Following the word counts, it is important to incorporate other types of knowledge representations, and for that reason, we also analysed the usage of other representational techniques, illustration, visualisation and videos, Table 1. Lastly, we analysed whether interactive tools have been implemented in the webpages to directly interact with the audience and what kind of audience has been targeted in these websites.

For the content analysis, we conducted two kinds of approaches. Initially, we checked the existence of textual, visual, and interactive tools: text language, illustrations, visualisations, step-by-step guidance, tailored advice, and chatbot. In the second part, we coded the content

on websites based on information types: benefits of EERs, information on finance, technology, processes, and buildings, and reviews of citizens or finished projects. The content is analysed from the translated versions of the texts or translated versions of the video content. The texts were coded as they included any information on the types above. The content is coded based on information regarding:

- The benefits of energy savings applications or renovations,
- The financial tools to get a loan or subsidy, or information about ‘Euro’ currency as a cost or a gain
- The technologies to implement during EER or introduce techniques to apply EER,
- The EER process, such as steps to initiate the EER or the possible step that gives knowledge about the EER process,
- The existing building stock or related to the existing building,
- Finished projects or citizen reviews based on a previous EER experience

4. DATA COLLECTION

The dataset is collected by manually selecting all the textual information from the website via an incognito browser (Google Chrome and Microsoft Edge). The research aimed to find out the content users’ access via popular search engines in the Netherlands using “**vve energiezuinige renovatie**” (*HOA energy-efficient renovation*) keywords, which can be seen in Figure 1. Therefore, we collected the URLs of the search results only from the first page of the search engines. Google Search, Bing Search and Startpagina.nl were used to conduct the search. All the browsers were used in ‘incognito’ mode, and the connection was done via the TU Delft network. This information is important for the repeatability of the research due to the varying results based on the location where the search is done by the search engines. The sponsored or advertised results were excluded as they do not reflect the page ranking algorithms.

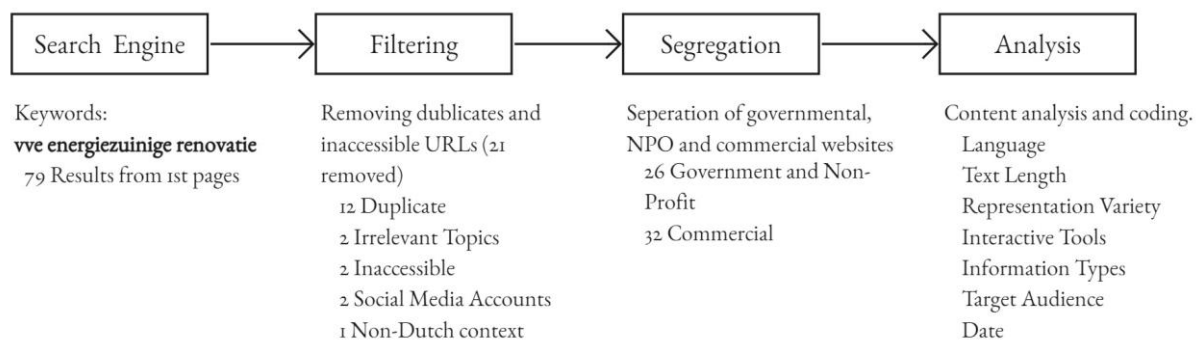


Figure 1: Data collection and filtering chart.

Each URL is aggregated in a .xls table via the URL (Appendix I). Every page is scraped in its original language, which is primarily Dutch; for later documentation, every webpage is printed as a PDF for later comparison if needed. All the websites have been scraped by the ‘select all’ action, which selects all the selectable elements in the webpage and then pasted into a word counter (Microsoft Word) for textual content length, and the word count is done in the original language of the websites. Following the PDF documentation and word count, the contents were translated into English via ‘Google Translate’ or ‘Microsoft Translate’ on the web browsers Google Chrome and Microsoft Bing, respectively.

We reached 79 webpages via the first pages of search engines; 21 of the URLs were discarded due to being duplicates, social media links, inaccessibility, or irrelevancy to the Dutch EER in the HOA context. Out of 58 pages after the filtering, only 26 belonged to governmental or non-profit institutions. The research also analysed commercial websites (32 web pages) to be able to compare the tools used in information delivery; however, due to the marketing incentives that may affect the investigation, their content was analysed.

5. RESULTS AND DISCUSSION

The results show that the websites lack interactive tools and representation methods other than textual explanations. Regarding the analysed webpages, textual explanation is the essential element, yet the lengths of the texts do not vary greatly based on the webpage format, see Table 1. The important factor to point out is that the word count changes drastically if the information is conveyed via a PDF document; in that case, the word count goes from 5,000 to 18,000. These PDFs are mostly reports; therefore, they tend to have larger text bodies and can be addressed to other audiences. Due to this huge difference in numbers, we excluded these in the word count numbers. The use of other information representations is not very common, such as illustrations, visualisation, and videos. Even though sharing a video created by another official entity can easily be embedded on the website. The usage of a chatbot, tailored guidance, or step-by-step (SbS) guidance is low. Chatbots are not implemented in any governmental web pages, and only 10% of commercial websites implemented this innovative technology.

	Average Word Count (no PDF)	Textual Explanation	Illustration	Visualization	Video Explanation	Chatbot	Tailored Guidance	Step-by-Step Guidance	Benefits	Fin. Info	Tech. Info	Process Info	Building Info
Governmental and NPO (26)	653 words	100%	19%	12%	4%	0%	0%	23%	62%	69%	46%	42%	19%
Commercial (32)	718 words	100%	10%	13%	3%	10%	0%	3%	55%	45%	52%	13%	26%

Table 1: Web-based content analysis comparison of governmental and commercial webpages.

The number of examples from previous projects and citizen reviews was mentioned in only 12% of the government or non-profit organisation websites, although the effectiveness of familiarity or social influence was argued in the literature for several years. The customer reviews in commercial websites are not analysed in due to the possible marketing incentives. The websites were all in Dutch language, and even though several have English as a language option, the content accessed was not specifically posted in multiple languages; the language options were designed to link to the home page of the website in English and not the content in the first link. Moreover, the target audience of the websites was mainly HOA members, 85%, yet experts were 4%, and non-specified content was 12%. Even though the homeowners have been addressed in the websites, the information about collective decision-making and its challenges were only mentioned in 38% of the websites. The HOAs in the Netherlands have different legal frameworks based on the year they are built, and this is identified as one of the

legal barriers to EER in HOAs (Siewers, 2022). Despite the research, there is a lack of this legal knowledge. The need for interactive tools to curate the knowledge of homeowners can be seen.

The analysis showed that dates provided on the websites and only 12% of the web pages were from 2023, dates between 2022 and 2023 were 15%, and pages before 2022 were 15%. Unfortunately, 58% of the web pages did not provide any dates. This is also important due to the changing deadlines for applying certain subsidies from the Dutch government, especially for HOAs. The Dutch government's site provides two dates, one for publication and another for the update.

Warmtefonds.nl's 'Frequently Asked Questions' (FAQ) page, which inherits an extensive FAQ section with a search engine embedded in the FAQ section, is one of the most comprehensive web pages amongst the URLs. However, due to the methodology for the word count of webpages, Warmtefonds's page is not high; the page design is based on expandable questions and answers, where 72 questions and their answers are provided just for the HOAs. The concept of an in-house search engine helps the knowledge base to be more accessible towards personal queries, yet if the query does not match directly with the intended answer, then the result section may be empty. Therefore, it is practical to consider intelligent systems that can correct misspellings and match synonyms in the knowledge base. This is an important aspect of websites if they look for engagement from the user.

Intelligent systems are needed to widen the targeted audience. All the websites analysed in this paper were originally in Dutch; this may be a result of the search keywords in search engines, yet there were rarely multilingual options, and these options were not related to the content. It is unsurprising to see all the content in Dutch, yet the Netherlands have many residents who are not competent enough to understand the content about EER in HOA. There are text translation tools we use to analyse the content, yet the accuracy of these tools is not verified, and regulations and legislation should not be misunderstood, especially where a process such as EER in HOA has many to consider.

The lack of interactivity or personalisation is a serious problem. However, the lack of exemplary projects and citizen reviews is a missing part of content generation. The research also suggests that the customer reviews on EER may help other citizens to understand how other citizens had their processes, yet also points out how this development would be financially burdening small and medium local authorities (Kwon & Mlecnik, 2021). Therefore, the knowledge base created in the governmental webpages should consider disseminating citizen reviews via their trusted platforms without marketing concerns. Moreover, since the search engines give priority to the paid links on their web pages, this can be an opportunity for governmental websites to promote their official pages. The implementation of customer reviews on governmental websites can also trigger social influence among citizens and raise interest in EERs.

6. CONCLUSIONS

This research aimed to explore the information conveyed online on EER in HOAs based on the barriers related to information overload and reliability by many researchers. The Dutch government is supporting the energy transition in the built environment with different funding schemes for various types of housing, and there are many websites to convey this information

to citizens looking for information. This research investigated what kinds of information is disseminated about EER in HOA by governmental organisations in the Netherlands. The findings highlight several aspects of how information is presented and disseminated through governmental or NPO websites, and the results offer insights into the information homeowners find about EER in HOAs with a specific scope. The dissemination of the information is mainly via web pages. There are comprehensive websites that try to cover all the topics needed, yet it is not easy to navigate to find the required information on demand.

From the perspective of SPT (Shove et al., 2012), the practices can only be disseminated and embraced if there are material, aligned meanings between individuals and the competencies when they are performed. The performance of the practice is essential for the local community to accept the practice. Therefore, the lack of past practices, experience or reviews can hinder the social influence and acceptance of EERs due to the absence of visible performance. The potential of local administrations can be amplified if the reviews are presented via their websites (Kwon & Mlecnik, 2021). SPT points out that the locality matters due to the shared context, such as social connections, and the information curated and generated for the local context is relevant to the people. Here, we must point out that Kwon & Mlecnik also point out that Dutch local administrations have challenges in designing modular websites that have the potential to grow with modules. This scalability problem is crucial when the Netherlands aims to renovate millions of houses.

The lack of intelligent agents, such as civil servants or chatbots, that help individuals find related information in a language they can understand can be an initial step for EER in HOAs to cope with the information overload. Even though technologies like chatbots are applied in the public sector (Makasi et al., 2022), the governmental webpages investigated in this paper still need to implement such technologies. The information delivery with intelligent systems is also becoming context-specific. Chatbots such as ClimateBert are being tailored for specific uses to convey information about complex documents like the IPCC Report 2022, with around 600 pages (Vaghefi et al., 2023). The information can be interactively extracted with dialogue with the chatbot from a comprehensive document, which, in our case, the reports, legal documents and other technical information can be a source for interactive information gathering.

On the other hand, intelligent agents are not the only technique to ease the information challenges; the representation techniques seem to be lacking. Although the benefits that videos, illustrations, or visualisations can provide in communication, these representation modes are not discussed in this paper and require further assessment of the impacts of these different modes. The language barriers in information communication may also be eased with the use of varying knowledge representations, increasing inclusiveness.

This research aimed to understand the online information search phase of EER in HOA using standard search engines and evaluate the governmental content that citizens access. The paper also investigated the tools, representation methods, target audience and information types these websites convey and compared several features between governmental and commercial web pages. The investigations found that the information on webpages is not easy to navigate or not personalised to curate information based on the needs of the individuals. Furthermore, the

information on the websites has the potential to contain old information and a scalable method to check the viability of the information found missing. This exploratory study is a preliminary study for the AI-supported information organisation and communication in EER in HOA; therefore, the results reveal a need for more comprehensive research on the homeowners' perspective on accessing information using the internet, either with semi-structured interviews and user data from trusted websites. Although the existing intermediaries in the EER ecosystem play a crucial role, digital platforms can support the acceptance of EERs in HOAs by providing interactive and tailored information based on the context of the homeowners. Future research related to this research will focus on organising the information associated with EER in HOAs and applying a conversational AI method (chatbot) to engage with the citizens based on their questions. After all, this paper pointed out that interactive agents can be a part of the energy transition process where the knowledge can be disseminated considering the context of the individuals.

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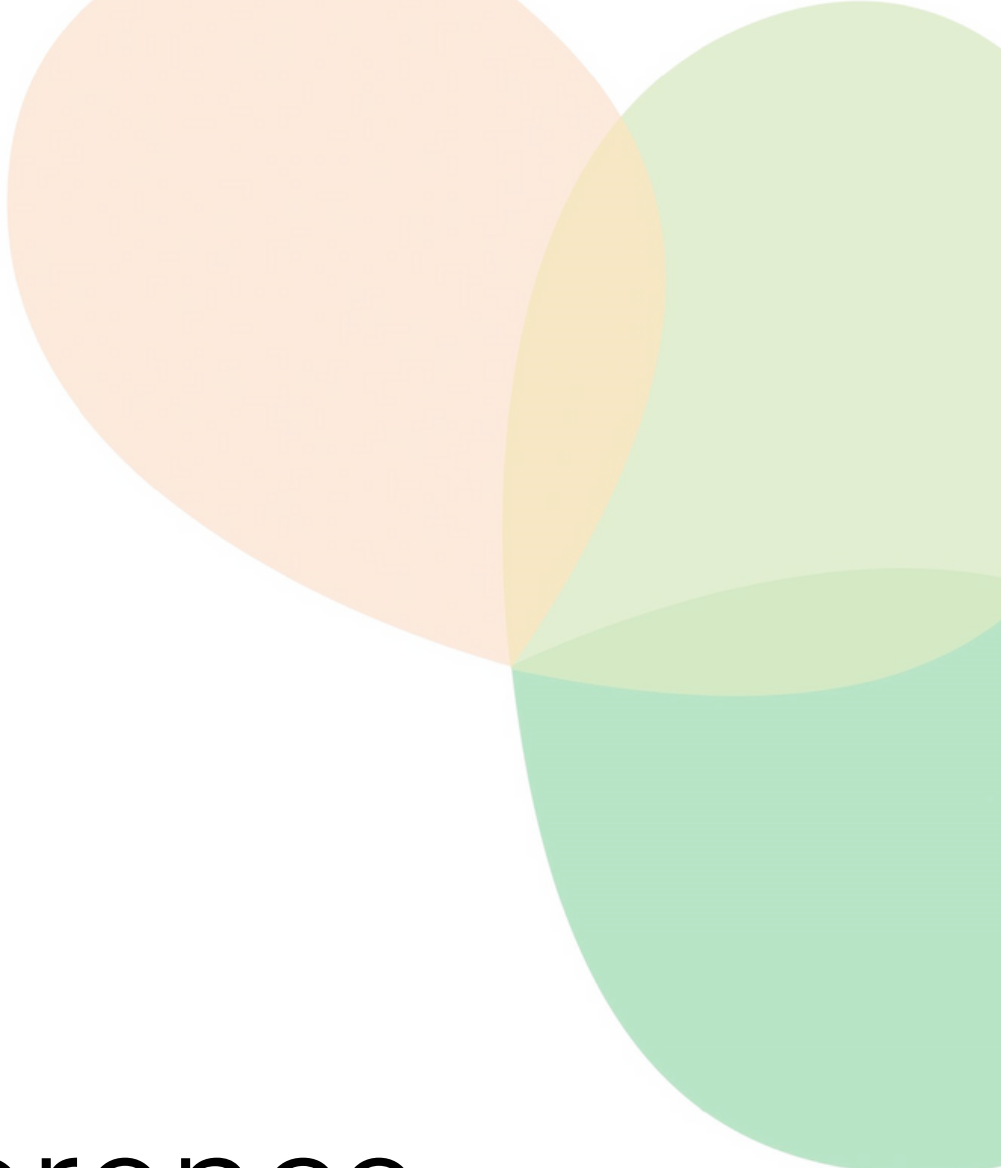
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11. APPENDIX

It can be accessed via the link below after the proceedings:

https://github.com/cemalkoraybingol/Behave2023_Paper_Appendix/blob/main/Behave2023_appendix.xlsx



Conference Proceedings

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