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Chances for the upscaling of living-cost neutral renovations in the Netherlands

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Abstract. Many multi-owned condominiums need an energy renovation, but in practice the number of such renovations is low. Dutch policy emphasizes the need to search for cost-neutral renovation solutions. This study therefore examined how the number of living-cost neutral renovations of buildings owned by assemblies of homeowners in the Netherlands can be increased by means of an integrated unburdening offer that includes energy performance guarantees and supply chain integration. The study uses scientific literature, project experiences and in-depth interviews with experts to examine how policy, demand and supply currently play a role in the upscaling of living-cost neutral renovations. The study finds that customized guidance is needed for condominium associations to steer their maintenance decision processes towards deep renovations. Also chances are detected to link living cost neutrality with energy neutrality, while developing an integrated supply chain that takes into account full process guidance including the provision of performance guarantees. This is now already successfully implemented in a new non-profit service desk and a new process model will be tested in multiple regions.

1. Introduction

Condominiums are the most common residential building type in the EU: 42% of residential buildings in the EU are apartments, mostly in major cities. Similar to other residences, a large portion of the existing condominium stock was built before the introduction of thermal insulation standards, needs renovation in the near future, and gets renovated only at a slow pace [1,2]. In The Netherlands about 60% of the homes owned by condominium associations (CAs) was even built before the war [3].

Compared to the renovation of single-family owned dwellings or condominiums owned by a housing association, renovations of condominiums with multiple owners are hindered by slow adoption processes, as the investment decisions are made by owners represented in CAs, who usually gather only once a year. The renovation processes are slowed down by the needed guidance of inhabitants and complex decision-making is the rule [4]. Furthermore, there are concerns that the renovations might lead to higher total living costs [5]. On the other hand there might also be substantial reductions in energy costs, which could possibly reduce total living costs. Also, the volume and budget of condominium energy renovations make it interesting for suppliers to offer services for this target group. It thus makes sense to look into the opportunities of developing a construction supply chain offer for living-cost neutral condominium renovations.



2. Research approach

2.1. Context

This paper is an elaboration of the results of the MMIP-IEBB project 7.5 “Woonlasten-neutrale renovatie (WNR)”, which were previously presented in Dutch [6]. The project aimed for a practice consortium composed of Servicebureau WNR (a non-profit organization established during the project), DNA in de Bouw (an association of innovative contractors and service providers) and knowledge institutes KERN and TU Delft to stimulate supply chain innovation to develop the market penetration of energy renovation for CAs. The project emphasized the empowering of the enthusiasm of building owners and the upscaling of small-scale renovations with SME’s by means of open innovation, particularly to develop an offer for CAs.

2.2. Research question and approach

The research tried to answer the question: How can living-cost neutral renovations of buildings owned by condominium associations be upscaled?. The research investigated this question from three viewpoints - policy, demand and supply - to find synergies while creating policy recommendations, and investment strategies for seducing homeowners and companies’ innovation and supply chain integration.

2.3. Research method

This research was supported by literature study, desk research of European projects and results from semi-structured in-depth interviews developed in the IEA EBC Annex 75 “Cost-effective Building Renovation at District Level Combining Energy Efficiency and Renewables” [7]. The interviewees (see Table 1) were Dutch frontrunners experienced with the concept of living-cost neutral home renovations. The interviews took about 1,5 hours per person, were recorded and were analyzed to obtain a PESTLE/SWOT analysis. The results were coded according to the topics policy, business model and stakeholder dialogue to compare relevant data.

Code	Date	Type of organization	Position interviewee
I-1	03-11-2020	Supplier living-cost neutral renovation	Director
I-2	09-02-2021	Energy cooperative	President
I-3	22-02-2021	Province	Project leader local initiatives
I-4	16-12-2020	Municipality	Consultant energy
I-5	26-03-2021	Supplier integrated home renovation	Director
I-6	12-04-2021	Municipality	Strategy consultant policy
I-7	19-04-2021	Manager revolving fund	Consultant strategy and development

Table 1: Interviews done with Dutch stakeholders [6,7]

3. Research results

In the following sub sections the main results per viewpoint are discussed: policy, demand and supply.

3.1. Policy

The European Commission [2] wants to halve the energy use in buildings in 2050 compared to 2005, hereby stimulating a higher renovation rate and more deep renovations. The Renovation Wave strategy [8] as core part of the European Green Deal, aims to build up an industrialized renovation sector and stimulate financial actors to transform existing buildings into nearly zero-energy buildings with a healthy indoor climate, to reach an annual renovation rate of 3%, to improve equal access to finance taking into account the affordability and the financial capacities of vulnerable households, and to gradually phase out the buildings with the worst energy performance labels. This implies a strengthening of energy renovation loans, energy performance contracts, reducing investment risks and providing integrated home renovation services including smart financing [1]. Policy development has to include

strategies for renovation of condominiums, taking into account supply chain integration, coupling of demand and supply, and smart processes that take into account the energy performance certification, building audits, renovation plans, ownership structures and possible supporting mechanisms [9].

The Netherlands subscribed to the EU goal for a carbon-free built environment in 2050, but policy strategies are still developing. In 2019 in the Netherlands, about 9% of all greenhouse gas emissions or about 70% of the total emissions in the built environment were still originating from the residences [10,11]. Meanwhile the development of energy renovations is too slow [10,12,13] and suffering from a lack of deep renovations [14]. While the current government emphasizes the need for one million new homes, about 7 million homes and 1 million buildings are still poorly insulated and heated with gas [15]. According to the Dutch climate law 1,5 million homes need to be handled by 2030 [11] and 200.000 homes should be able to disconnect from the gas supply [16].

To improve the situation Multi-annual Mission driven Innovation Programs (MMIP's) followed programs such as the Energy Leap/ "Energiesprong" [17], the Renovation Accelerator [18] for rented dwellings, the program Gas-free neighborhoods [19] and the Human Capital Agenda [20]. The MMIP's support the development of integrated renovation concepts, industrialization and digitization of renovation processes and the central positioning of building owners and users [16,21].

The Dutch Climate Council emphasizes the need for balancing monthly payments for a renovation loan with the advantages on the energy bill, possibly completed with customized support [15]. Particularly for social rented dwellings the average real saving on the energy costs should not be lower than the rise of the rent or service costs after renovation [22]. Loans of the National Heat Fund were also made available for CAs. This allows to obtain maximum €50.000 for a "Highly Energy-Efficient" renovation package and €65.000 for a "Zero-on-the-meter" package with a payback of 10 to 30 years (de Koning and Paradies in [23]).

Interviewees find that there are still many policies that could be strengthened, for example related to taxation, guarantees (I-1; I-3), innovation (I-3), hereditary tenure or change of ownership (I-3; I-5; I-7), equal access to financing (I-5; I-6; I-7) and process guidance (I-1; I-5; I-6), particularly addressing integrated home renovation services (I-5) and combinations of measures (I-2).

Local and regional authorities also could play an important role as in the Dutch context they are responsible for setting up plans for gas-free districts and regional energy strategies, which in turn might be coupled with renovation strategies. Many municipalities also already offer an energy advice desk, and experts recommend these should advance towards better reaching out to districts (I-2; I-4; I-6). Particularly there is a need to develop towards process guidance for groups of homeowners (I-1; I-2; I-5), local renovation hubs [24], integrated renovation offers including unbundling of financing and guarantees (I-6; I-7) and digital communication (I-2; I-6).

District approaches seem to be complex though, requiring intensive stakeholder dialogue and considerable means and competencies. Nowadays they seem to be too focused on heat grid development (I-3; I-4; I-6), even without requirements regarding supply temperature or use of renewable energy sources (I-6) or transparency of connection costs (I-1; I-3; I-5).

The Dutch government [25] asked the municipalities to look beyond the development of living-cost neutral approaches and to improve also the indoor comfort, the development of real estate value, the living and financial conditions of the inhabitants, and the livability of the districts. Interviewees commented it might be crucial to also facilitate groups of inhabitants or collective units (I-1; I-2; I-3; I-5), particularly bottom-up initiatives (I-3; I-5; I-6), while also engaging energy communities (I-6) or societal ESCo's (I-7) and supporting group buying initiatives (I-2).

Overall, the literature and empirical research found that currently Dutch national policy still doesn't give or support a clear direction and adequate communication to target deep renovations including energy efficiency and renewable energy systems. In this context, policy development should target CAs by providing appropriate guidance processes for achieving integrated renovations.

3.2. Demand

Data show that the market for renovating buildings owned by CAs deserves attention. In 2015 in the Netherlands there were about 144.000 CAs related to about 1,2 million homes, a majority of which was privately owned [3]. About 45% of the CAs can be found in Dutch cities [4], with 30 to 50% concentrations within the four major cities [26]. About 75% of all CAs can be found in the provinces of Utrecht, South Holland and North Holland [3]. 40% of the CA owned buildings consists of maximum 2 living units, 40% has 3 to 10 living units and the rest has more than 10 living units [4]. Only about one third of the CAs is governed by one of the 550 management offices (communication Bouwkennis). The associated real estate values are relatively low and the household incomes relatively average [3].

There have been numerous studies about what drives or hinders individual homeowners in their renovation decision-making [27,28,29,30]. Results can be more promising when the decision processes are socially steered and influenced by influential people in the surroundings [31,32]. Important success factors are that the owners already detected a renovation need [33], that the whole customer renovation journey is guided [29,34] by trusted actors [35], who offer services beyond the first consultations [17,36,37]. Providing personalized access to financing plays a crucial role [28,38,39]. For owners also the rise of the real estate value after renovation plays a role [11,40,41]. For tenants the financial profit of energy production [11] might count. For building renovations decided by CAs the business case should be attractive and related to the multi-annual maintenance plan and the collective finances [4]. Literature shows that there are important legal and administrative hindrances when targeting multi-owned buildings. CAs can still be dormant or non-existent [3]. Ownership legislation could hinder reaching out to CAs [42]. For many CAs changing or establishing a deed of division is still too cumbersome [43]. A minimum reserve fund should be available, which is currently no obligation [26].

Interviewees recognize these observations and believe that a maximum exploitation of opportunities can lead to a larger acceptance of investing in more renovation measures beyond maintenance (I-1; I-5; I-7). CA administrators and managers are perceived as a primary influential target group that could also be better trained on administrative, maintenance and sustainable renovation matters (I-1). All interviewees found creative ways to communicate with and motivate homeowners, usually focusing on messages of increased comfort (I-1; I-4; I-5), energy cost savings (I-1; I-2; I-4) and smooth processes with energy performance guarantees after renovation (I-1; I-5). The needed coaching of energy renovations is emphasized (I-1; I-2; I-5; I-6), which needs the development of a sound business case (I-1; I-3), a collective approach to facilitate decision processes (I-1; I-2; I-5), and equal access for vulnerable households to financing (I-2; I-4; I-7).

Overall the research found that to upscale living-cost neutral renovations there is a need for customized CA support to arrange the whole renovation journey, including solving administrative and legal hurdles, detailed advice and training for the CA. Customized design, process management and financing solutions should be developed and coupled to performance guarantees and personal access to finance. Policy could support identification of CAs whose buildings are in need of renovation and direct to integrated home renovation service providers that specifically target process guidance of CAs.

3.3. Supply

The research identified a need for better supply chain integration to support living-cost neutral renovations. The renovation sector is highly fragmented and consists mainly of SME's with insufficient R&D means, knowledge and time [6,44]. Construction and installation companies are barely active in demand creation [45], and in the follow-up of the installations [46]. They are difficult to engage as they like to avoid risks compared to business as usual [47]. Zero-on-the-meter renovation concepts and installations as well as process guidance can still be improved [48].

Supply activating policy focuses mainly on standardization and cost efficiency by means of industrialization and digitization [16,21], but supply chain collaboration is key for supplying integrated home renovation services. Essential is the systemic collaboration with neutral trusted advisers [34,49] such as real estate professionals, financial actors (banks, ESCo's, insurance companies), authorities and non-profit organizations that can manage customer relationships [44,47]. Other key factors are the establishment of stable consortia and efficient team work [50,51], the integration of quality

assurance [47,52] for customer confidence [50], planning to maximize energy savings [53]; step-wise approaches for CAs [54], social marketing and efficient customer communication [23,55]. The financing arrangements need to be coupled to quality and energy performance ([1] Art. 33).

Interviewees acknowledged the specific complexities of condominium renovations and point to the need for processes that integrate specific incentives, guarantees and policies to support CA decision-making (I-1; I-2; I-3; I-5; I-7). They confirmed the importance of integrated offers (I-2; I-6; I-7) and the need to work closely together with CA administrators and managers (I-1; I-4; I-5; I-6), neutral advisors or architects (I-1; I-3; I-4; I-5; I-7), financing intermediaries that can cover market failures (I-1; I-3; I-5; I-7), municipalities (I-1; I-2; I-6), energy providers - particularly energy cooperatives (I-2; I-3; I-6) - , and specialized communication agents that can connect with various types of stakeholders (I-3; I-5; I-6). Also they pointed to a current lack of knowledge and training for contractors and installers (I-3; I-6), and lack of the guarantees these actors provide (I-5; I-7).

4. Discussion and outlook

The analysis results supported the establishment and development of a new Dutch non-profit organization “WNR”, that has a specific mission to support the upscaling of the market for living-cost neutral condominium renovations. As a service desk WNR now actively approaches CAs and supports energy renovation decision-making during CA assembly meetings, in view of progressing to offering a step-by-step integrated approach including feasibility studies, design plans, execution and quality assurance of condominium renovations [56]. As a unique customer value WNR offers a 30-year guarantee for the energy performance after renovation, aiming at about 90% energy reduction on building level after renovation. WNR will work together with a pool of advisors and contractors that will be trained and certified to offer living-cost neutral condominium renovations. WNR is supported by actors who already delivered successful condominium renovations using this framework [57]. WNR also progressed to working together with local authorities. Further strengthening of supply chain collaborations is planned in view of addressing the issues described previously. The model will now be tested in multiple regions in the framework of a LIFE-project.

5. Conclusion

This study aimed to determine opportunities for upscaling living-cost neutral renovations of condominiums owned by condominium associations (CAs). The research used literature and in-depth interviews with experts to determine policy, demand and supply chain development chances.

The upscaling of living-cost neutral renovations fits well within European and national policy, particularly when the goal is to combine energy neutrality with living cost neutrality. From a policy perspective it is important to also address a healthy indoor climate and equal access to financing for all members of a CA. European policy is in favour of more integration of advice, execution, financing and process guidance to unburden dwellers, and supports the development of integrated home renovation services and energy performance contracting. In the Netherlands this development is not yet in full view. While policy makers address individual homeowners and gas-free district approaches, the intermediate level of renovating buildings with multiple owners deserves specific further attention. Specifically CA administrators and managers require integrated process guidance towards deep renovation.

There is a huge potential in the Netherlands to renovate condominiums owned by CAs. There are various hurdles but also new opportunities to stimulate collective action and better management of condominiums. An appropriate offer for CAs that integrates performance guarantees and administrative and financing solutions could possibly seduce more CAs to start a deep renovation. Bundling of renovation demand could further stimulate upscaling and innovation of the supply chain.

The duration and the complexity of CA decision-making processes should not be underestimated. Customized solutions are needed to approach and consult CAs, taking into account possible legal barriers, administrative issues, detailed performance assessment, guarantee plans for CAs and service providers alike, and financial planning making use of reserve funds and multi-annual maintenance plans. In this sector a transformation is needed via open innovation and new supply chain partnerships that are

trained and certified for providing quality, energy performance guarantee based collaboration. WNR showed that these concerns and complexities can already be transformed into a viable business model.

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References

- [1] European Union Directive 2018/844 of the European Parliament and the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency - Text with EEA relevance - PE/4/2018/REV/1 <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0844&from=EN>
- [2] European Commission Recommendation 2019/786 of 8 May 2019 on building renovation (notified under document C(2019) 3352) Text with EEA relevance C/2019/3352 <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019H0786&from=GA>
- [3] CBS 2016 *Aantallen en kenmerken van Verenigingen van Eigenaren – een verkennend onderzoek* (Den Haag/Heerlen/Bonaire: Centraal Bureau voor de Statistiek) ISBN: 978-90-357-1828-9
- [4] Paradies G, Beekman L, Ooms M, de Koning N, Mulder G, van Baar M, Brester C, Cremers R, Schneijdenberg J and van Winden J 2017 *De Duurzame VvE* Rapportage eerste fase Topsector Energie - Samenwerking Topsector Energie en Maatschappij STEM TESE115014
- [5] Schilder F and van der Staak M 2020 *Woonlastenneutraal koopwoningen verduurzamen - Verkenning van de effecten van beleids- en financieringsinstrumenten* (Den Haag: Planbureau voor de Leefomgeving) report 4152 <https://www.pbl.nl/publicaties/woonlastenneutraal-koopwoningen-verduurzamen> consulted on 25/06/2021
- [6] Mlecnik E 2021 *WNR – Kansen voor de opschaling van Woonlasten-Neutraal Renoveren in Nederland* (Delft: TU Delft) <https://repository.tudelft.nl/islandora/object/uuid%3A4719444c-fd58-442e-b569-c087b23e7293>
- [7] Mlecnik E and Hidalgo-Betanzos J M 2022 *Policy instruments for cost-effective building renovation at district level combining energy efficiency & renewables (Annex 75)* (International Energy Agency) submitted for publication
- [8] European Commission Communication 2020 A Renovation Wave for Europe – greening our buildings, creating jobs, improving lives COM/2020/662 final <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0662&from=EN>
- [9] Changeworks, University of Maastricht and Energy Cities 2020 *Boosting energy retrofits in condominiums: Key policy recommendations for EU, national and regional policy makers* (report Interreg North-West Europe project ‘ACE-Retrofitting’) ISBN: 978-2-490384-18-1.
- [10] PBL 2020 *Klimaat- en energieverkenning 2020* (Den Haag: Planbureau voor de Leefomgeving)
- [11] Steenbekkers A, Fransman R, de Kluizenaar Y and Flore P 2021 *Woningverduurzaming: willen en kunnen betekent nog niet doen - Drijfveren en ervaren barrières bij woningeigenaren* (Den Haag: Sociaal en Cultureel Planbureau)
- [12] WRR 2016 *Klimaatbeleid voor de lange termijn: van vrijblijvend naar verankerd* (Den Haag: Wetenschappelijke Raad voor het Regeringsbeleid) WRR-Policy Brief 5,
- [13] SER 2018 *Voortgangsrapportage Energieakkoord 2018 en 5 jaar borging* (Den Haag: Sociaal-Economische Raad)
- [14] Filippidou N, Nieboer N and Visscher H 2019 Effectiveness of energy renovations: a reassessment based on actual consumption savings *Energy Efficiency* **12** (1), 19-35
- [15] Klimaatberaad 2019 *Klimaatakkoord*

- <https://www.klimaataakkoord.nl/documenten/publicaties/2019/06/28/klimaataakkoord>
- [16] TKI Urban Energy 2019 Versnelling van energierenovaties in de gebouwde omgeving (MMIP 3) Meerjarig Missiegedreven Innovatieprogramma retrieved from <https://www.topsectorenergie.nl/> consulted on 25/06/2021
 - [17] Stutvoet E 2018 Energietransitie: omarm de complexiteit *A+BE Architecture and the Built Environment* **18** (TU Delft) ISBN 978-94-6366-070-9 <https://doi.org/10.7480/abe.2018.18>
 - [18] Renovatieversneller 2020 <https://derenovatieversneller.nl/> consulted on 25/06/2021
 - [19] Rijksoverheid, VNG, Interprovinciaal Overleg and Unie van Waterschappen 2020 Programma Aardgasvrije Wijken (PAW) <https://www.aardgasvrijewijken.nl/> consulted on 25/06/2021
 - [20] Visser S, Wagner M, de Graaf C, Heeres H, de Vreede O, Montenarie R, Boer K, Boutkan E, de Heus Y, Sieh M, Rozemeijer S and van Terwisga H 2019 Roadmap Human Capital Topsectoren 2020-2023, <https://www.topsectoren.nl/human-capital/documenten/kamerstukken/2019/november/12-11-19/roadmap-hc-topsectoren>
 - [21] TNO 2019 Programmabeschrijving IEBB Bijlage bij IEBB voorstel MMIP 3 Versnelling Energierenovaties in de gebouwde omgeving en MMIP 4 Duurzame warmte en koude in de gebouwde omgeving
 - [22] Aedes and Woonbond 2018 Sociaal Huurakkoord 2018 <https://www.aedes.nl/artikelen/klanten-en-wonen/huurbeleid/huurprijsbeleid/huurders-en-woningcorporaties-stemmen-in-met-nieuw-sociaal-huurakkoord.html> consulted on 25/06/2021
 - [23] van der Schoor T (Ed.) 2020 *Nul op de meter: hoe verder met energierenovatie?* Kenniscentrum Noordruimte Hanzehogeschool Groningen
 - [24] SaveTheHomes 2021 Horizon 2020 project <https://savethehomes.org/> consulted on 25/06/2021
 - [25] Ministerie van Binnenlandse Zaken en Koninkrijksrelaties 2020 Stand van zaken Klimaataakkoord Gebouwde Omgeving (Den Haag: DG Bestuur, Ruimte en Wonen) 2020-0000558548
 - [26] Ringelberg S 2019 VvE's zijn de vergeten startmotor van de Energietransitie <https://www.linkedin.com/pulse/vves-zijn-de-vergeten-startmotor-van-energietransitie-sven-ringelberg/?originalSubdomain=nl> consulted on 25/06/2021
 - [27] Lindenberg S and Steg L 2007 Normative, gain and hedonic goal-frames guiding environmental behavior *Journal of Social Issues* **63** 1 117-137
 - [28] Wilson C, Crane L and Chryssochoidis G 2015 Why do homeowners renovate energy efficiently? Contrasting perspectives and implications for policy *Energy Research & Social Science* **7** 12-22
 - [29] Ebrahimigharehbaghi S, Qian Q, Meijer F and Visscher H 2019 Unravelling Dutch homeowners' behavior towards energy efficiency renovations: What drives and hinders their decision-making? *Energy Policy* **129** 546-561
 - [30] Greer K, Wade J, Brocklehurst F, Morgan E and Killip G 2020 *International review of domestic retrofit supply chains (report BEIS 2021/023)* (UK Dept. for Business, Energy & Industrial Strategy)
 - [31] Schultz P, Nolan J and Cialdini R 2007 The constructive, destructive, and reconstructive power of social norms *Psychological Science* **18** 5 429-434
 - [32] Langley M, Bouman T and Steg L 2020 De waarden achter klimaatgedrag: Hoe persoonlijke waarden en waargenomen groepswaarden klimaatgedrag motiveren en versterken, *Mens en Maatschappij* **95** 3 175-196
 - [33] Schalkwijk M 2018 Energie besparen doe je nu (S26) Eindrapportage campagne-effectonderzoek (Amsterdam: Kantar)
 - [34] Mlecnik E, Straub A and Haavik T 2019 Collaborative business model development for home energy renovations *Energy Efficiency* **12** 1 123-138 <https://doi.org/10.1007/s12053-018-9663-3>
 - [35] Vringer K, van Middelkoop M and Hoogervorst N 2014 Energie besparen gaat niet vanzelf, evaluatie energiebesparingsbeleid voor de gebouwde omgeving (PBL policy study)
 - [36] Pettifor H, Wilson C and Chryssochoidis G 2015 The appeal of the green deal: Empirical evidence

- for the influence of energy efficiency policy on renovating homeowners *Energy Policy* **79** 161-176
- [37] Cattaneo C 2019 Internal and external barriers to energy efficiency: which role for policy interventions? *Energy Efficiency* **12** 1293–1311
- [38] Schorel J and Opstelten I 2018 Objectgebonden financiering van verdergaande energiebesparende maatregelen (bij grondgebonden woningen) (Den Haag: Stroomversnelling)
- [39] Bos J, Verberk M and Warnaar M 2020 Kunnen woningeigenaren energie-investeringen betalen? (Den Haag: NIBUD)
- [40] Aydin E, Brounen D and Kok N 2020 The Capitalization of Energy Efficiency: Evidence from the Housing Market *Journal of Urban Economics* **117** 103243
- [41] Centraal Planbureau 2020 Kansrijk Woonbeleid - Update 2020 (Den Haag: CPB)
- [42] Weatherall D, McCarthy F and Bright S 2018 Property law as a barrier to energy upgrades in multi-owned properties: insights from a study of England and Scotland *Energy Efficiency* **11** 1641-1655
- [43] Siewers C and Luijk-Van Veldhuizen A 2018 Kleine VVE's (report Stichting VVE-Belang)
- [44] Mlecnik E and Artola I 2015 *Realisatie van BEN renovaties van eengezinswoningen in Vlaanderen: hindernissen en kansen voor bedrijven* (Antwerpen: Passiefhuis-Platform vzw & Brussels: Vlaams Energieagentschap)
<https://energiesparen.login.kanooh.be/sites/default/files/atoms/files/aanbodzijde.pdf>
- [45] Rijksdienst voor Ondernemend Nederland 2014 *Blok voor Blok: de bevindingen, Grootchalige energiebesparing in de bestaande woningbouw* (Den Haag: RVO)
<https://www.rijksoverheid.nl/documenten/rapporten/2014/06/23/evaluatierapportage-blok-voor-blok>
- [46] Gram-Hanssen K and Susse G 2018 Energy performance gaps: promises, people, practices *Building Research & Information* **48** 1 <https://doi.org/tudelft.idm.oclc.org/10.1080/09613218.2017.1356127>
- [47] Brocklehurst F, Morgan E, Greer K, Wade J, and Killip G 2021 Domestic retrofit supply chain initiatives and business innovations: an international review *Buildings and Cities* **2** 1 533–549, <http://doi.org/10.5334/bc.95>
- [48] Leidelmeijer K, Borsboom W, van Vliet M, Jacobs P, Cozijnsen E and de Jong P 2017 Opschaling nul op de meter, waardevolle lessen die je niet moet missen *VV+ mgz.* 12/2017 26-35
- [49] Tjørring L and Gausset Q 2016 Energy Renovation Models in Private Households in Denmark In Hoff J and Gausset Q (Eds.), *Community Governance and Citizen Driven Initiatives in Climate Change Mitigation* (London: Routledge) 89-10
- [50] COHERENO 2016 *Collaboration for housing nZEB renovation* Intelligent Energy Europe project 2012–2016 final report (Delft: TU Delft)
- [51] Grasset H and Scoditti E 2019 *EE renovation market mechanisms, trends and barriers* STUNNING Project report D4.1 Horizon 2020 grant agreement No 768287
- [52] RGS NL 2016 Kwaliteit in Balans Normenboek 2016 <https://www.rgsnl.nl/publicaties/kwaliteit-in-balans-normenboek-2016/> consulted on 25/06/2021
- [53] Schulze Darup B 2019 Kostengünstiger und zukunftsfähiger Geschosswohnungsbau im Quartier *Projektbericht Deutsche Bundesstiftung Umwelt* AZ 33119/01-25 (DBU)
- [54] Energy.nl 2021 Zet je VvE op Groen: concrete stappen naar vergaande verduurzaming <https://energy.nl/zet-je-vve-op-groen/> consulted on 25/06/2021
- [55] Rutten M 2015 Van Maken naar Raken, een gezonde organisatie door de klant centraal te stellen in de bouw-, installatie- en vastgoedsector *Constructief* ISBN 9789081583831
- [56] Goossen C-P and Rose C 2020 Appartementengebouwen woonlastenneutraal renoveren, Gids voor de Vereniging van Eigenaars (Stichting WNR)
- [57] Goossen C-P 2019 New Finance model for apartments to approaches neutral living expenses before and after the EnerPHit renovation *23rd Int. Passive House Conf.* Gaobeidian China