Extract from SCIS policy paper: Upscaling urban residential retrofit for the EU’s low carbon future: challenges and opportunities

https://smartcities-infosystem.eu/sites/www.smartcities-infosystem.eu/files/document/scis_policy_paper_2_urban_residential_retrofit_web.pdf

1. THE CURRENT STATUS OF BUILDING RETROFIT: INSIGHTS FROM THE SMART CITY INFORMATION SYSTEM

1.1 IMPACT OF CURRENT PRACTICES

With respect to the EU climate and energy goals[1], a major challenge for EU cities lies within retrofitting the existing urban building stock. Hereby existing buildings represent a substantial potential for both (1) energy savings and (2) renewable energy production or intake.

Substantial energy savings can be realized when buildings that were initially not or poorly insulated undergo a deep retrofit. Savings of more than 80% of the end energy needed for combined space conditioning and domestic hot water production are feasible, at least in the moderate to colder climates of the EU[2]. If the remaining energy needs are subsequently filled in with renewable sources, the operational carbon emission reductions can reach 100%. In this case, the required level of building envelope retrofit leads however to important investment costs – for an average single family house the budget will quickly amount to over 50.000 Euro. Related payback times may equally mount to decades – 30 to 50 years is a common figure. Building owners may therefore turn to less ambitious renovation works. Not only will these result in proportionally smaller energy savings; a second round of investment in a deeper retrofit will often be delayed, complicated or even prevented.

Given the importance of energy renovation, many EU funded projects have a focus on (residential) building retrofit and experiment with new techniques and operational procedures, financing schemes, end user engagement strategies and governance process setups. These have led to a wealth of experiences and replicable successes that deserve to be maximally disseminated. The Smart City Information System (SCIS, *https://smartcities-infosystem.eu/*) follows up a group of 50 of these EU funded 'smart cities and communities (SCC)', 'low-carbon energy (LCE)' and 'energy-efficient buildings (EeB)' projects. Notably via its self-reporting tool, SCIS builds a view on the output of its projects in scope.

1 *https://ec.europa.eu/clima/policies/strategies/2030_en* and *https://ec.europa.eu/clima/policies/strategies/2050_en*

2 In southern areas of the EU, buildings may have no or very limited heating systems. In this case, retrofit and introduction of a standard heating system may increase energy use because the increased comfort is taken for granted. Reversely, the cooling load in these regions may be the dominant space conditioning factor. This however comes with an advantage, where the cooling energy demand is at its highest with sunny summer conditions and thus when PV-energy is directly available for cooling purposes. The relatively low heating (and cooling) demands and the availability of solar energy for cooling make building envelope retrofit a less critical issue in the South of the EU compared to the moderate and colder climates in the rest of the EU. The insights in this report mainly refer to situations with a dominant heating demand.

5. Whereas a residential building renovation rate and related primary energy savings of around 1% per year are common average figures for the EU[7], in order to reach the EU climate targets, these figures should increase. Given the current situation in the building sector, this leads not only to an **unprecedented investment challenge** but also to an increasing and even critical **capacity problem**;
6. In order to accommodate for the use of renewable energy sources and to allow for low temperature heating, the average depth of building retrofit must be increased. In the long term most buildings will thus have to undergo a deep retrofit[8]. This adds to all the previous challenges;
7. The **diversity** in residential buildings makes it difficult to revert to standardized and industrialized processes with a view on upscaled building retrofit programmes.

In this respect, retrofitting the existing building stock is substantially different from new construction and the rollout of renewable energy infrastructures.

All new buildings in the EU must comply with tightening EPBD requirements and shall be NZEB as of 2021, making new-build fully future-proofed with a view on the low carbon transition, while at the same time being in line with the market.

Meanwhile, many renewable energy sources have become financially competitive with their fossil counterparts. This applies to solar energy and recently also for wind energy at scale. Not surprisingly, investors have turned towards this emerging RE market. This results however in an asymmetrical market for the necessarily combined EE-RE efforts: globally, energy efficiency remains a sector in which investments continue to underperform – especially for buildings, the IEA concludes that *'[i]n the building sector, energy efficiency investment is falling far short of the significant growth needed to meet sustainability goals'*[9]. Energy-efficiency thus finds itself at the unpopular side of the market, while it continues to represent an enormous potential for energy and carbon savings.

Many of the challenges and problems associated with upscaled retrofit have been known for a long time but have not yet found the solutions that lead to a generalized breakthrough scenario.

7 This rate strongly depends on what is understood as 'building renovation'. In their extensive survey of both energy and non-energy renovations in the EU for the period 2012-2016, Navigant and Ipsos Belgium distinguish between different depths of energy retrofit. If residential renovations are set to achieve a minimum of 30% of primary energy savings, the EU average annual, floor area based retrofit rate for such performance level is 1,3%. Only 0,2% of the residential renovations lead to primary energy savings of more than 60% ('deep retrofit'). If one considers any kind of energy-related intervention, for example also replacing a boiler, the overall average intervention rate is 12,3%. However, the majority of the interventions considered from such perspective realise less than 3% savings. Navigant & Ipsos Belgium (2019), op. cit., p. 15-16. Currently all residential retrofits taken together lead to primary energy savings of 1% per year for the EU as a whole (Navigant & Ipsos Belgium 2019, p. 23).

8 Vandevyvere, H., Reynders, G. (2019), The trade-off between urban building stock retrofit, local renewable energy production and the roll-out of 4G district heating networks. Case study modelling for 9 urban districts in Flanders, Belgium, EnergyVille.

9 IEA World Energy Investment 2019, *https://www.iea.org/wei2019/overview/* and *https://www.iea.org/wei2019/end-use/*

1.3 ANALYSIS

Closer observation of the above-mentioned barriers helps to reveal structural factors of the replication and upscaling deficit for deep residential retrofit.

1. **Atomized owner structure and commonholds.** Regarding residential ownership structure, the situation differs from country to country. Individual home ownership is however dominant in the EU and varies from just more than 50% in Germany to up to nearly 100% in Romania with an EU average around 70%[10]. Some countries stand out with a substantial share of social (rental) housing like the Netherlands with a rate of 30%[11]. Regarding the dwelling typology, 42% of the EU housing stock are apartments with national shares varying to an even greater degree. All in all, individually owned homes and privately owned commonholds make up for a dominant share of the market, while they are at the same time the most difficult sectors for addressing collective and upscaled retrofit. Indeed, we observe that most progress in this field is currently made in contexts where there is an institutional owner (e.g. a housing corporation) professionally managing a large stock of dwellings. Moreover, in this case the concerned housing stock is often of a uniform shape, better allowing for an industrialized approach. A good example can be found with the Dutch Energiesprong[12] and its related initiatives like the REnnovates project[13].

10 *https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Housing_statistics%20#Tenure_status*

11 *http://www.housingeurope.eu/resource-1323/the-state-of-housing-in-the-eu-2019; https://themasites.pbl.nl/balansvandeleefomgeving/jaargang-2018/themas/verstedelijking-wonen/ontwikkeling-woningvoorraad*

12 *https://energiesprong.org/*

13 *https://rennovates.eu/*

For individual home or apartment owners, the situation is different. To cite one city coordinator in a FP7 smart city project[14], *'[t]he combination of high investment, construction hassle, many multifamily buildings, lack of knowledge and difficulty to find and trust good advisors/constructors and last but not least other things on their mind makes that many home owners are not doing these high-level retrofits. Although we all know something has to change, the urgency is not felt on an individual level for most of us.'*

For commonholds, the decision structure complicates setting up deep retrofit in such way that legal changes have sometimes to be implemented in order to afford for compliance with the national EPBD translations[15].

The situation where retrofit projects are most often set up on a building-by-building basis prevents that economies of scale can be realised.

2. For building owners in general, and for residential home owners in particular, **energy efficiency is not a primary concern**. Home owners are first of all confronted with competing investment priorities for the budget they have available, and short-term concerns will hereby often prevail[16]. When asked about motivations for (or the appreciation of) a retrofit, respondents may place the financial savings stemming from the reduced energy consumption somewhere between the first and the fifth position on the order of rank, while other aspects like increased comfort, enjoying a new kitchen or bathroom, and living in a healthier or a more beautiful home may be judged equally or even more important. Environmental concerns like reducing carbon emissions rarely take precedence, however. An additional difficulty for understanding the investment motivations is that available sources give diverging assessments of this aspect[17]. Furthermore, the lack of awareness plays a role in the poor attention for energy aspects[18] and may be linked to the spheres of concern that can be distinguished in the citizens' hierarchies of interests, see the SCIS policy paper on replication[19] and Figure 2. A last complicating factor is the **different target groups** with profiles and interests that differ on the basis of age, family composition, financial capacity and housing history[20]. Renters are, through the split incentive syndrome, an even harder target group to reach. Here, the preferred strategy will rather consist of convincing the building owner to invest in retrofit, and subsequently earn the investment back through higher renting revenues. Structural aspects of the renting market however prevent a simple one-to-one outcome in this context.

3. **Building envelope retrofit is an expensive operation**, dramatically increasing retrofit costs compared to the more affordable renewable energy technologies like PV, solar boilers and heat pumps. Cases in practice indicate a deep energy retrofit cost of a single family home of typically 40.000-70.000 Euro in the Netherlands and 50.000-80.000 Euro in Belgium with budgets over 100.000 Euro being common as well[21]. In France similar figures appear, e.g. for the EU supported OKTAVE programme, with representative cases displaying a retrofit cost of 70.000 over 140.000 and up to 220.000 Euro, of which the energy measures part respectively amounts to 50.000, 90.000 and 65.000 Euro[22]. The H2020 co-funded Superhomes retrofit scheme in Ireland indicates a range of 35.000-75.000 Euro[23]. For apartments, the deep retrofit cost will be lower due to smaller floor surfaces and a smaller share of exterior façades versus a higher share of party walls and floors. Deep retrofitting of different types of apartments in the FP7 smart city project City-zen (Amsterdam, Grenoble) shows a typical range of 20.000-65.000 Euro per apartment[24].

14 Citation captured for the My Smart City District Lunch Academy during EUSEW 2016, *http://www.cityfied.eu/news/press-releases/food-for-thought-with-the-mscd-lunch-academy.kl*

15 An example in Belgium: *https://www.gebouwbeheerder.be/renovatie-appartementsblokken-kluwen-stilaan-ontward/* versus *https://www.notaris.be/nieuws-pers/detail/vijf-belangrijke-nieuwigheden-voor-januari-2019*

16 E.g. Magallón, D. et al. (2019), Manual of Financing Mechanisms and Business Models for Energy Efficiency, BASE/UN Environment, p.8 - *https://www.buildup.eu/sites/default/files/content/manual-financing-mechanisms_25-06-19_web.pdf*

17 BPIE (2016), Scaling up deep energy renovation - unleashing the potential through innovation & industrialisation, pp. 24-25 - *http://i2-4c.eu/wp-content/uploads/2016/10/BPIE_i24c_deepretrofits.pdf* with reference to Energiesprong; BPIE (2016), with reference to Rasmumssen M.K. et al (2016), Healthy Homes Barometer 2016, Velux Group, for evidence: *https://www.velux.com/article/2016/europeans-on-healthy-living-the-healthy-homes-barometer-2016*, p.17, where well-being at home and energy efficiency are equally valued. This is also the case in an assessment by Superhomes in Ireland, see *https://www.slideshare.net/TippEnergy/superhomes-decarbonising-irish-homes-with-deep-retrofit* p. 8; and for OKTAVE, see OKTAVE: a one stop shop for houses deep renovation, Covenant of Mayors Investment Forum 2019, *https://ec.europa.eu/info/sites/info/files/4.1_oktave_gaspard.pdf*, p. 8. Further assessments are to be found e.g. in Heislberg, P. (2019), Barriers and potentials for renovation seen from the customer side and how these can be addressed by one-stop-shops, presentation at 'One-Stop Shops in the EU: current and future role in building renovation', Brussels, 13/03/2019, available at *https://e3p.jrc.ec.europa.eu/events/one-stop-shops-eu-current-and-future-role-building-renovation*.

18 Oktave Report 2014-2018, *https://www.oktave.fr/oktave/european-funding*, English version p. 6.; HousEEnvest project presentation at Covenant of Mayors Investment Forum 2019, p. 9; Magallón et al. (2019), p. 8.

19 Smart City Information System, Why may replication (not) be happening - Recommendations on EU R&I and regulatory policies, SCIS, 2018, *https://smartcities-infosystem.eu/library/publications*

20 Marketing research documented in Oktave (2018), p. 21.

21 Vandevyvere, H. (2018), Whole retrofit offers: projects & initiatives in Europe / Offres de rénovation globale : projets et initiatives en Europe, presentation, City-zen Days / Jeudis de l'ALEC, Grenoble, 01.02.2018.

22 Oktave (2018), p. 39.

23 *https://superhomes.ie/what-is-deep-retrofit/*

24 City-zen deliverables 5.1 Retrofitting of Amsterdam towards zero energy buildings and 6.2 Retrofitting of Grenoble social housing buildings, *http://www.cityzen-smartcity.eu/home/reporting/deliverables/*

For any type of building, total retrofit costs may shoot up because extensive interior refurbishment is taken on or because specific challenges must be addressed, like renovating heritage buildings or the need to remove asbestos.

Taking into consideration that energy cost savings of 1.000 to 2.000 Euro per year are a good performance for a single family home[25], one understands that the payback time quickly amounts to the order of several decades. Given the high costs of deep building retrofit, many building owners will revert to a less performant project or do the works in phases. This brings on a substantial risk of **suboptimal lock-in**, whereby the executed renovation works delay, complicate or even prevent later upgrades to a higher, fully futureproofed level of energy efficiency.

4. **Lack of (access to) appropriate financing** is a barrier systematically coming back in project reporting and studies[26]. First, there are indications that the financial sector is not sufficiently aware of the level of the challenge. For example, at the 2019 Covenant of Mayors Investment Forum, the European Mortgage Federation put forward a range of 10.000-20.000 Euro to be accorded in plus to home buyers when the latter want to proceed with retrofitting upon acquiring the home[27]. Higher amounts were judged as generating too much risk. Second, many building owners effectively lack the financial capacity to take on large additional mortgages. This implies that alternative financing schemes must be developed, but most efforts in this sense are still at the experimental stage. Third, from the public policy point of view, subsidizing and taxing may have to be reconsidered in order to better realize the related overall, societal goals and to guarantee a socially just transition through appropriate redistribution mechanisms. Public authorities should hereby fully account of the many secondary benefits that come with building retrofit operations. This holds amongst others for reduced health expenditures, reduced energy poverty and increased local economic activity. Vulnerable groups will profit most of the secondary benefits of energy retrofitting[28].

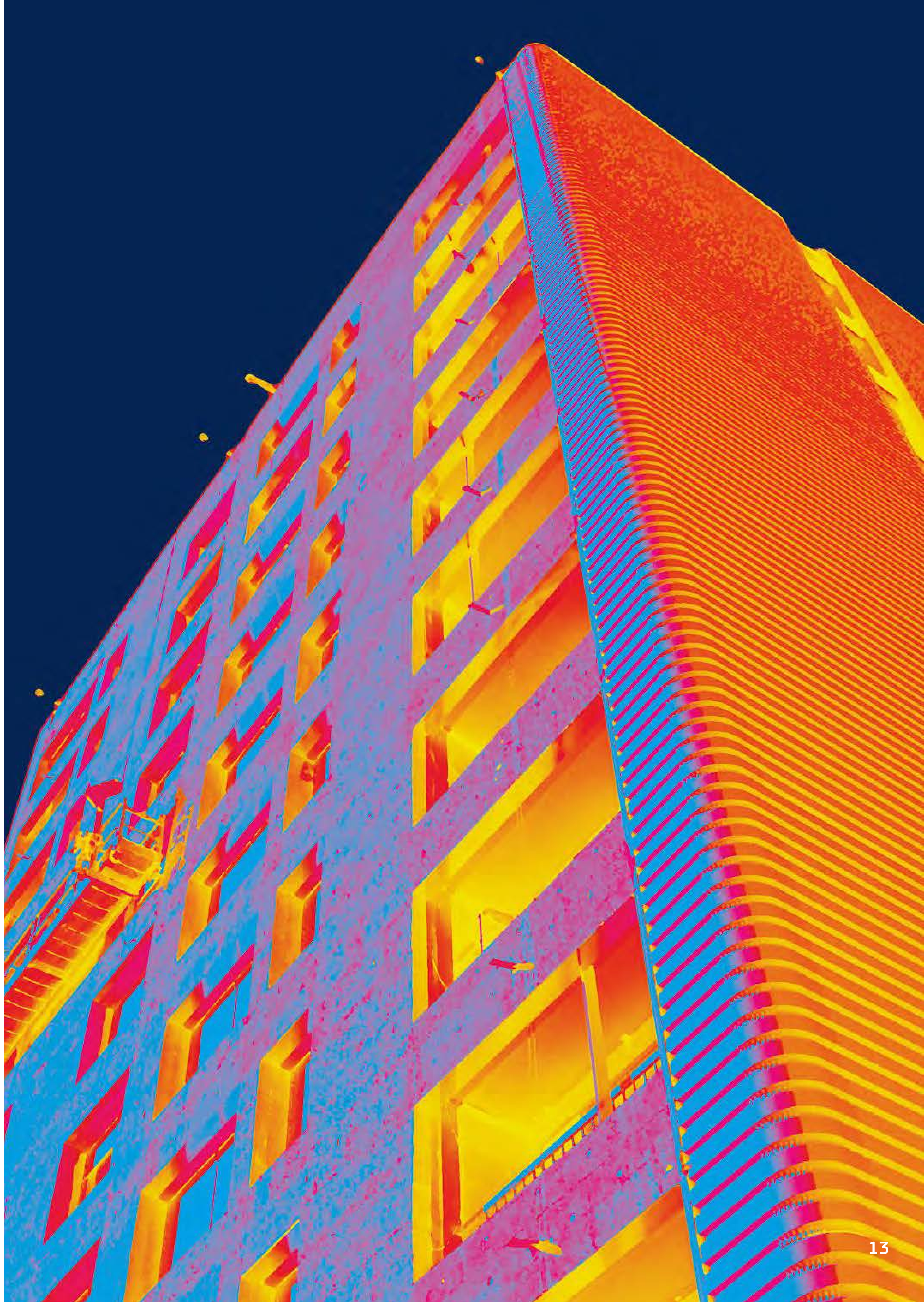
5. **A critical, quantitative and qualitative capacity shortage in the EU construction sector:** sampling the EU construction observatory's 2018 reports brings forward a systematic message: there is a critical lack of labour force in both numbers and skills. This is the case both in Western and Eastern Europe with only individual cases like Greece and Italy standing out from the trend. It may hereby be suspected that the transfer of construction labour force from the Eastern member states to their Western counterparts adds to the generalisation of the capacity problem throughout the EU. Regarding (energy) retrofit of the existing building stock, this challenge is often appearing as even more critical, especially in terms of required skills and competences. The aging construction work force is another problem across the EU and indicates a low attractivity for young people to step in. Because of supply shortage, housing prices are generally on the rise – if they do not soar out of control with observed increases of 10 to 15% in just two years (2015-2017). In this way, the access to affordable housing becomes a real pain point.

25 E.g. Superhomes assessment, *https://www.slideshare.net/TippEnergy/superhomes-decarbonising-irish-homes-with-deep-retrofit*, p. 14.

26 HousEEnvest (2019) p. 9; Oktave (2018) p. 6.; Magallón et al. (2019) p. 8.

27 European Mortgage Federation, Innovative Financing Solutions, Covenant of Mayors Investment Forum, 19.02.2019.

28 This has been extensively documented in OECD/IEA (2014), Capturing the Multiple Benefits of Energy Efficiency, IEA. The impact of secondary benefits can hardly be underestimated. The report states, for example, that '[w]hen quantified health and well-being impacts are included in assessments of energy efficiency retrofit programmes, the benefit-cost ratio can be as high as 4:1, with health benefits representing up to 75% of overall benefits.' (p. 97).



The insufficient availability of qualified contractors, and most notably installers, is echoed in other recent research[29].

The construction sector is furthermore hampered by low growth in productivity and fragmented value chains. Somehow linked to these problems of capacity, fragmentation and low productivity is the **high failure rate** in the construction sector, further jeopardizing its output and clients' confidence in building and installation contractors. Failures may occur as a consequence of bad work, but also through lack of communication, design errors, parties not honouring their contractual obligations, etc. High failure rates seem to be systematic and persistent in the construction sector, both in periods of low and high conjuncture. It may hereby be suspected that the widespread shortage of (qualitative) supply on the market enables contractors to at least partly transfer the cost of failure to their clients, thus making the sector to consider the situation as acceptable. It is difficult to supply a sharp overall figure for the EU, but **failure costs may well be averaging between 10 and 15% of the sector's turnover** with some country estimates going over 20%. Hereby reported costs may remain an underestimate of the real costs of error in the building sector[30], and it is unclear how much poor quality is accepted without further being accounted of.

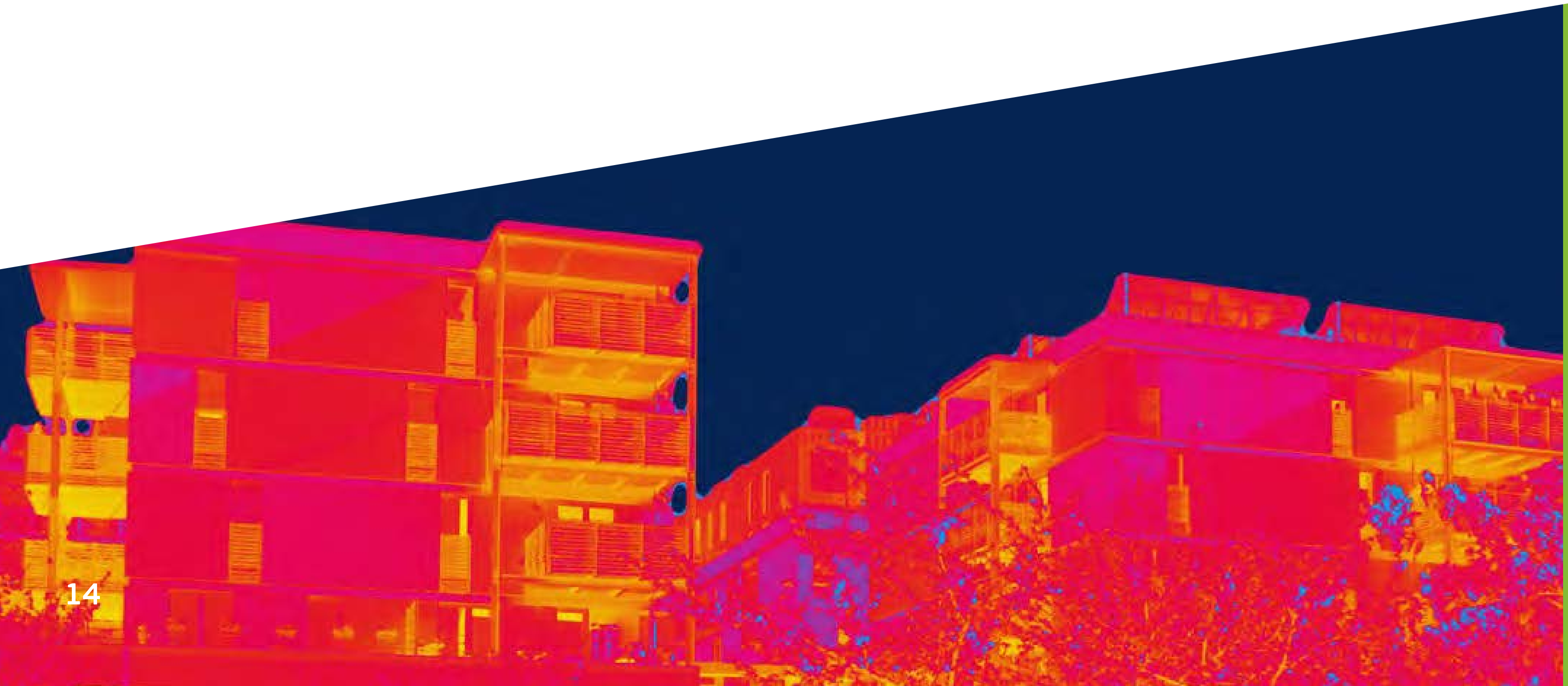
In addition, **errors in planning and execution may also lead to higher energy consumption** during the operation of the buildings. In the GrowSmarter project, it was estimated that energy consumption could go up with 10 to 20% due to such errors[31].

6. **An industrialisation deficit:** compared to other industries, the construction sector stands out by functioning on a laborious project-by-project basis, and by operating through fragmented value chains. Although this is mostly due to the nature of the product – a building is not a consumption good like an appliance –, there is a lack of innovative capacity to be perceived in the sector as well. The capacity problem in terms of labour force also leads to contractors having their order books filled whether they innovate or not: the demand is there in any case. This further weakens the incentive to innovate. And finally, where industrialized production is envisaged, the diversity of the building stock still limits the possibilities of working at scale and speed.

29 Navigant & Ipsos Belgium (2019), op. cit.; Stroomversnelling (2019), Nul-op-de-Meter - Prijsontwikkeling 2015-2030, *https://energieling.stroomversnelling.nl/nul-op-de-meter/marktpartijen-over-kosten-nul-op-de-meter-renovaties-30-daling-is-haalbaar/*

30 A set of (mostly sectorial) sources was consulted, available through *https://www.this-magazin.de/artikel/tis_Wo-her_kommen_die_Fehlerkosten_am_Bau__1553527.html; https://qualiteconstruction.com/publication/rapport-de-lobservatoire-de-la-qualite-de-la-construction-edition-2019/; https://www.lesechos.fr/2003/05/logements-le-cout-des-malfacons-665636; https://cms.confederatiebouw.be/Jaarverslagen; https://insights.abnamro.nl/2019/04/faalkosten-in-de-bouw-lopen-jaarlijks-op-tot-miljarden-euros/; https://www.cmaanet.org/sites/default/files/2018-04/IMPACT%20OF%20REWORK%20ON%20CONSTRUCTION.pdf; https://www.ukconstructionmedia.co.uk/features/deconstructing-errors/; https://www.newcivilengineer.com/archive/billions-lost-through-construction-errors-each-year-23-06-2017/; https://www.taylorfrancis.com/books/e/9780429206528/chapters/10.1201/9780203859926-170; https://www.irbnet.de/daten/iconda/CIB5838.pdf.*

31 GrowSmarter, Technical Factsheet on Low Energy Districts, p. 9.



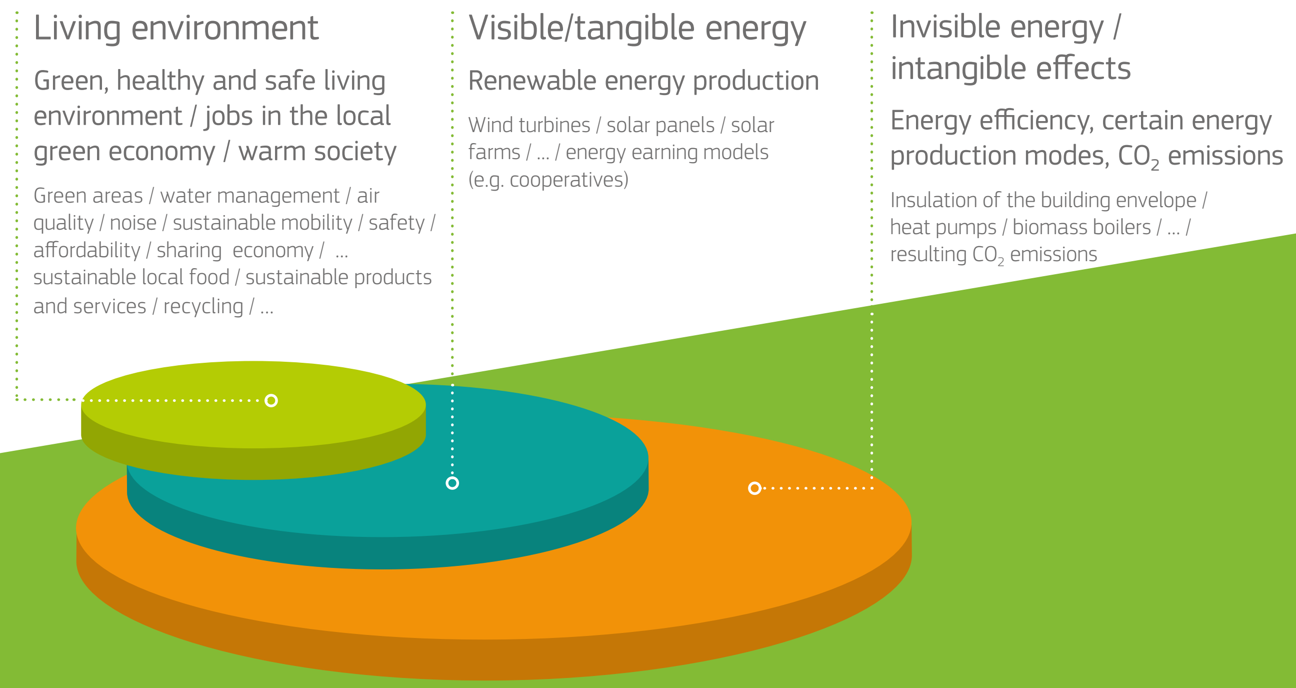


Figure 2: spheres of concern: citizens tend to pay more attention, and attach more value, to aspects that affect their living environment directly and sensibly. (Renewable and/or own) energy production may approach these central focus areas of attention, but energy use and carbon emissions are both invisible and not directly sensible, hence more difficult to incentivise.

Four major axes of intervention are discussed for their potential of bringing relief to the barriers inventoried higher.

2.1 MOTIVATING AND SUPPORTING THE BUILDING OWNER TOWARDS WELL-INFORMED RETROFIT

From project experiences and research, it emerges that **unburdening the building owner** is an essential strategy for increasing the uptake of building renovation. This includes several aspects among which:

- Providing **non-partial, neutral advice** regarding the best possible retrofit strategy for the building. This advice does not only identify the preferred technical solutions for both increasing energy efficiency and installing renewable energy production, but also their possible roll-out in time. If works cannot be done in one operation, phased interventions should indeed be foreseen, according to an appropriate **building roadmap**[32]. Such a building roadmap sheds full clarity on the building's future-proofing over time and must help to avoid that the building owner creates a suboptimal lock-in situation, whereby the executed works at one stage jeopardize further energy-related improvements at a later stage[33]. The advice may also account of the varying situation and needs of specific target groups (e.g. young families, empty nesters or owners of a multi-apartment dwelling[34]);
- Providing **support for acquiring the appropriate finance**. The financing method can differ from a traditional mortgage, as a series of alternative financing schemes have started to emerge on the market, see also further;
- Taking away **organisational burdens** from the building owner, like carrying out administrative procedures, prospecting subsidies, reviewing offers, selecting contractors, managing building site processes, controlling the quality of the works, following up on bills and the like;

32 In the Innovate project, this concept comes forward as the 'customer journey', guaranteeing that interventions are coherent and consistent with the long term future-proofing of the house (Covenant of Mayors Investment Forum, 2019, Parity Projects presentation). In Flanders, BE, the digital home passport (digitale woningpas) is set to become a roadmap for the building's futureproofing (*https://www.energiesparen.be/woningpas*).

33 One example of such lock-in occurs where windows are being replaced without considering a later external façade insulation package. In order to avoid thermal bridges, this package must connect to the windows in an appropriate form and thickness, reducing the net available window opening. The window frames must be designed for this smaller net opening.

34 See e.g. the segmentation exercise performed in REFURB, cf. Covenant of Mayors Investment Forum, 2019, REFURB presentation, with six identified high potential segments: young families, owners of houses in post war suburbs with detached houses, empty nesters, owners of terraced houses with a high energy bill, convinced energy savers and owners of multi-apartment dwellings.

- Assuring **non-partial quality control** by training, certifying and pooling contractors and subsequently performing quality controls of the executed works. This enhances the creation of an integrated value chain and responds to the construction sector's capacity challenges as discussed higher. Quality control procedures also help to assure that the predicted energy savings are feasible during the operational life of the building.

2.1.1 A PERFORMANT RETROFIT VEHICLE: THE ONE STOP SHOP

In optimal conditions, all these aspects can be taken care of through a ***one stop shop (OSS)***. One stop shops have meanwhile started to emerge in practice, and the concept is also advocated by the European Commission through the 'Smart financing for smart buildings' initiative and the latest update of the EPBD – Energy Performance of Buildings Directive 2018/844/EU. The EU Joint Research Centre (JRC) has studied the setup and produced a structured overview of case studies. JRC defines the OSS as follows: *'From a customer perspective, the integrated solution becomes a one-stop-shop (OSS) service in the building sector, when asset owners that would like to realize energy renovation of their buildings are aided in more than one/few steps in the process. An OSS service transforms a cumbersome and complex set of decision-making/actions by non-experts into a single entry, customer-friendly offer.'*[35]

The French OKTAVE scheme discussed higher represents a well-elaborated example of the OSS concept. It is conceived as a public-private ESCO and provides technical, financial and legal assistance. OKTAVE also trains local contractors and sets up contractor pools to enhance the supply side. It moreover supplies a cash advance on the available public subsidies, so that building owners with limited financial capacity have this budget available before the works, rather than after.

Another example grouping a series of 11 OSS in in different member states is the Innovate project[36].

An OSS setup may come with specific additional benefits. First, more trust and confidence from the demand side can be obtained if the OSS is (co-)managed by public entities, in particular local or regional authorities (e.g. Innovate).

Second, impartial quality assurance is equally of high value for building owners, financiers and insurance companies alike (e.g. OKTAVE, HousEEnvest). One Innovate demonstrator has a *retrofit coordinator* as 'custodian of the truth' – a hint to the lack of confidence that generally hampers the standard renovation market. Certifications may support such quality assurance, like the *NOM keur (Zero on the Meter certificate)* developed by Stroomversnelling in the Netherlands[37].

Third, bundling of projects and contractors, as well as pooling of the associated risks, can generate a stronger business case, with better rates for financing.

And last, a well-designed OSS can overcome a major shortcoming of (commercial) ESCOs, being the short investment horizon. It is indeed improbable that purely private ESCOs could be a preferred one stop shop vehicle for realizing upscaled retrofit ambitions since their service offering will always be based on a positive business case with typical payback times for realized investments limited to 10-15 years. This would favour the unwanted lock-in effect. Moreover, ESCOs find it difficult to penetrate the residential market[38].

35 Boza-Kiss, B. & Bertoldi, P. (2018), One-stop-shops for energy renovations of buildings - Case studies, JRC Science for Policy Report, p. 4.

36 *http://www.financingbuildingrenovation.eu/*

37 *https://nomkeur.nl/over-nom-keur/*

38 See e.g. "ESCOs for residential buildings: market situation in the European Union and policy recommendations", available at *https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2013/5a-cutting-the-energy-use-of-buildings-projects-and-technologies/escos-for-residential-buildings-market-situation-in-the-european-union-and-policy-recommendations/*

Some other schemes come close to the OSS concept, like the European Energy Efficiency Fund with its combined financing and technical assistance; the HouseEEnvest project, a public-private collaboration for increasing EE in multifamily dwellings by providing financial and technical support; the BE-REEL project with building passports/renovation advice, professionals training, certifying and collective retrofit demonstrators; and the REFURB project with its 'compelling offer'.

A further, more complex development of the concept could consist of setting up a special purpose vehicle that also manages interventions like urban restructuring or densification through demolition and reconstruction. A variant of this concept consists of 'topping up' existing buildings with a new floor while retrofitting them, so that the entire real estate operation (energy retrofit plus supplementary dwelling units) provides for an attractive business case. The H2020 supported project Abracadabra has researched such setup, widening it to 'add-ons' or *'high quality volumetric additions'* that can be attached to any side of the retrofitted building[39].

2.2 THE IMPORTANCE OF A GUIDING FRAMEWORK FOR URBAN RETROFIT: CITY ENERGY VISION AND LOCAL AREA ROADMAPS VERSUS BUILDING ROADMAPS

The optimal technology choices for a building depend on its location. If the building is situated in an area with a (sustainable) district heating and cooling (DHC) network or where such network will be rolled out in the predictable future, the optimal choices differ from an area where no district heating and cooling system is present or being planned. It is thus important that local authorities provide for **area roadmaps, and in particular for heat and cold zoning plans**, so that an optimal tuning between building functions and district energy infrastructures (or between building roadmaps and area roadmaps) can be achieved[40]. Moreover, the desired retrofit level of individual buildings is also dependent of the presence of a district heating and cooling system, and especially of its temperature regime. For example, poorly insulated buildings can hardly be serviced by low temperature district heating networks while the latter will increasingly become the norm with an increasing uptake of renewable and sustainable heat sources. Reversely, when high temperature sustainable heat is available through a DHC system, buildings can first connect to this system in order to operate in a sustainable way on a short timeframe. The building envelope retrofit can then be performed at later stages or only to a limited degree (for example in heritage areas where the possibilities to insulate the building are limited). Staged retrofit can go well together with progressive lower temperatures in the DHC system as more renewable sources become integrated into the latter.

39 A project fact sheet explains: 'Adding usable space through building extensions increases the real estate value of an existing property and is a way to finance the renovation of the whole building, making it more affordable to building owners. The idea behind it all is that volumetric additions, e.g. rooftop extensions, aside or façade additions, as well as an entirely new building, could be sold or rented out and thus reduce the initial investment allocated for the renovation.' *http://www.abracadabra-project.eu/wp-content/uploads/2019/01/ABRA-Fact-sheet.pdf*. See further *http://www.abracadabra-project.eu/case-studies/*

40 Strict and recent examples hereof are the obligation for municipalities in the Netherlands to develop a Heat Transition Vision by 2021 and in Flanders, Belgium, to develop municipal heat zoning plans by 2025. Similar instances are the Scottish initiative *http://www.districtheatingscotland.com/* or the long-standing tradition of Denmark with regard to energy and heat zoning planning, see e.g. *https://ens.dk/sites/ens.dk/files/Globalcooperation/regulation_and_planning_of_district_heating_in_denmark.pdf*

2.3 TAPPING INTO ALTERNATIVE FINANCING MECHANISMS

Building renovation, and most notably building envelope retrofit, requires a substantial, long term investment with correspondingly long payback times. Classical loans and mortgages are designed for this type of investment but may not bring the appropriate solution in many cases where retrofit is desirable.

Second, there is **a need to evolve from a building-by-building approach to larger schemes, both for reasons of upscaling the renovation effort and for creating the possibility of upscaled, de-risked financing mechanisms to operate**.

In this sense several existing or emerging financing methods can be identified.

In the realm of **bank solutions and funding schemes** these are, amongst others:

- **Dedicated funding through promotional banks, development banks, green investment banks:** these banks operate in areas where classical banks do not (usually) invest, by overcoming specific barriers or market failures that cause the problem. These failures can be, for example, unapplied external costs, uncertainty over future policies, asymmetric information or risk aversion.

  In Germany, KfW (originally Kreditanstalt für Wiederaufbau) is a public investment bank with a special legal status that allows to issue, for example, soft loans (see also further). KfW has a longstanding tradition of financing sustainability measures such as energy retrofit of buildings and is able to achieve high leverage factors (up to a factor 20 of private to public investments triggered)[41]. In the case of retrofit, KfW smartly increases the financial support according to the level of energy savings achieved, thus stimulating investors to raise their ambitions.

  KredEx is a similar and highly relevant example in Estonia. In particular, KredEx set up a revolving fund issuing soft loans for increased energy efficiency in multifamily apartment buildings[42].

  The common characteristics of these banks are their public ownership, a specific societal mission, a special legal status and the ability to finance 'difficult' projects through their non-profit character and special operating conditions, in particular by providing low interest rates and specific guarantees.

- **Dedicated credit lines (soft loans)**: public bodies offer the dedicated financing scheme at interesting conditions; ideally, they can refinance it one on one with private bank loans. Banks may however require too stringent guarantees from the public body. This in turn could be addressed by including **guarantee funds** in the operation. Soft loans may accommodate for long payback periods and their potential could be maximized by combining them with a one stop shop set up by the same public body that is issuing the soft loans. Soft loans may also well be combined with grants/subsidies, further easing the investment for the building owner. In the latter case, they may be regarded as a leveraging instrument, but practice seems to indicate that the leverage factor typically remains under 10[43].

  The public guarantee is essential in helping to de-risk the scheme. An additional advantage will be that public authorities guaranteeing such bonds will restrain from causing regulatory instability and hence, more financial risks, as they have now all the reasons to limit the latter.

  A relevant example of soft loans provided for EE investments comes with the Nationaal Energiebespaarfonds Nederland[44].

- **Local or regional dedicated public schemes and funds:** the principle is the same as for dedicated banks, but these are (conglomerates) of local and/or regional authorities that set up a scheme for dedicated financing, eventually with the inclusion of a guarantee fund. They will hereby revert to proper financiers where needed. The set-up may deliver extended services and even function as a complete one stop shop. An example of the latter is Picardie Pass Rénovation[45]. **Grouping green loans or bonds into an aggregated portfolio** could be a variant of this approach. In a similar way, risks and transaction costs can be reduced and economies of scale may be exploited. One example is the very successful Swedish Kommuninvest Green Bond initiative for local authorities[46]. Single cities can equally work out soft loan schemes or they can alternatively be created at the national level[47].

- **EU support funds**: The EU has developed several financial and/or process related support mechanisms through, amongst others, the European Structural & Investment Funds (ESIF), the European Fund for Strategic Investments (EFSI), the Private Finance for Energy Efficiency (PF4EE) and the European Energy Efficiency Fund (EEEF).

Besides this, alternative financing solutions exist. Some of the most relevant instances are:

- **Energy performance contracting and ESCOs**: whereas the principle of an ESCO (energy services company) or the related EPC (energy performance contracting) is straightforward and attractive, **a major shortcoming of current (private) ESCO/EPC schemes** is that these only support investments that pay themselves back over a maximum of 10 to 15 years, see also the discussion of the one stop shop concept.

- **On-tax financing and on-bill programmes**[48]: in the case of on-tax financing, the repayment of the investment in building related measures (both EE and RE) happens trough an additional property tax bill, and thus goes via the (local) authorities. The public character of the scheme reduces risks and enhances trust building.

  The EuroPACE project is set up to experiment with this principle; the mechanism is already more common in the US[49]. EuroPACE projects are funded through the issuance of bonds. The annual repayments shall not exceed the yield of EE or RE measures. An EuroPACE scheme is moreover intended to stay with the property and not with the original building owner in case of sale (as does the property tax). However, this project envisages project times of up to 20 years which must be considered as a handicap in many cases (namely, for interventions with payback times of more than 20 years).

41 See e.g. *https://www.i4ce.org/wp-core/wp-content/uploads/2015/10/14-09_kfw_case_study.pdf* p. 2.

42 *http://citynvest.eu/content/kredex-revolving-fund-energy-efficiency-apartment-buildings*

43 EEFIG (Energy Efficiency Financial Institutions Group) (2014), Energy Efficiency – the first fuel for the EU Economy - How to drive new finance for energy efficiency investments, *http://www.eefig.eu/index.php/the-eefig-report*, p. 25.

44 *https://www.energiebespaarlening.nl/*

45 *www.pass-renovation.picardie.fr/*

46 *https://kommuninvest.se/en/funding-and-funding-need/greenbonds/*

47 A documented series of cities working out soft loan schemes can be found in Cicmanova, J. et al. (2017), Financing the energy renovation of residential buildings through soft loans and third-party investment schemes, Infinite Solutions Guidebook, Energy Cities, *https://energy-cities.eu/wp-content/uploads/2019/01/PUBLI_infinite_solutions_guidebook_softloans_2017_en.pdf.* The publication refers to Riga (LV), Parma (IT), Frederikshavn (DK), Delft (NL), Bordeaux Metropole (FR), Hauts-de-France Region (FR) and Centre-Loire Valley Region (FR). Soft loan financing schemes can also be developed at the national level. Cited examples are in France, Lithuania, Estonia, Slovakia and Germany.

48 Main source: Smart Energy Europe (2018), Scalable Innovative Financing for Smart Buildings, *https://www.smarten.eu/wp-content/uploads/2018/10/Smart-Financing_final_with-date-1.pdf*

49 Klimovich, K., Puig MacLean, E. (2018), EUROPACE, presentation, CoM Investment Forum, 21.02.2018.

On-bill programmes work following the same principle but in this case the finance supplier is paid back through a surplus on a utility bill, currently the energy bill. The finance supplier may be the utility itself or a private lender. This leads to two variants: one where the money comes from a (semi-)public body and is provided with very low interest rates, and one where private third parties supply the finance. In the latter case, the interest rate will still be lower than the typical market loan rates as the security of the scheme is enhanced by the link to the utility bill. This method is applied in the US since the 1990s.

On-billing has been suggested as one solution to overcome the split incentive syndrome in the residential rental market[50].

Loans or mortgages attached to the building can be considered as a variant of the on-bill or on-tax schemes. The advantage is that the owner does not carry a financial charge for a building that is no more his or hers, thus providing for additional flexibility on the housing market.

Special purpose vehicles may be set up with a wider scope of investing in EE and/or RE, housing, energy infrastructures or other projects with a societal goal, thus going beyond the mere financing aspect. Two examples in the fields of energy, climate and sustainability are presented below:

- **Climate funds, revolving funds:** important drivers for setting up a climate fund are (1) to group and de-risk investments through the set-up of a structured and neutrally controlled pool of resources (societal rather than commercial objective, professional risk management, mixed shareholdership open to professional investors as well as local enterprises and citizens); and (2) in this way, to allow for the financing of unprofitable yet socially important projects by redistributing the yields of profitable projects within the same pool of resources. The second aspect is thus instrumental in securing a socially just transition.
- **Public-private partnerships** (PPPs) are a proven concept for mobilising both public and private capital for investments of public or mixed public-private interest. A PPP must realize its win-win goal in order to be effective. An interesting example of a climate-dedicated PPP is ProjectZero in Sonderborg, Denmark[51]. Its set-up is as represented in Figure 3.

50 Technum (2015), Financiering Lokale Klimaatplannen - Draaiboek, report commissioned by the Flemish Government - department LNE, *https://archief-algemeen.omgeving.vlaanderen.be/xmlui/handle/acd/229990*, p. 45-46.

51 *http://www.projectzero.dk*

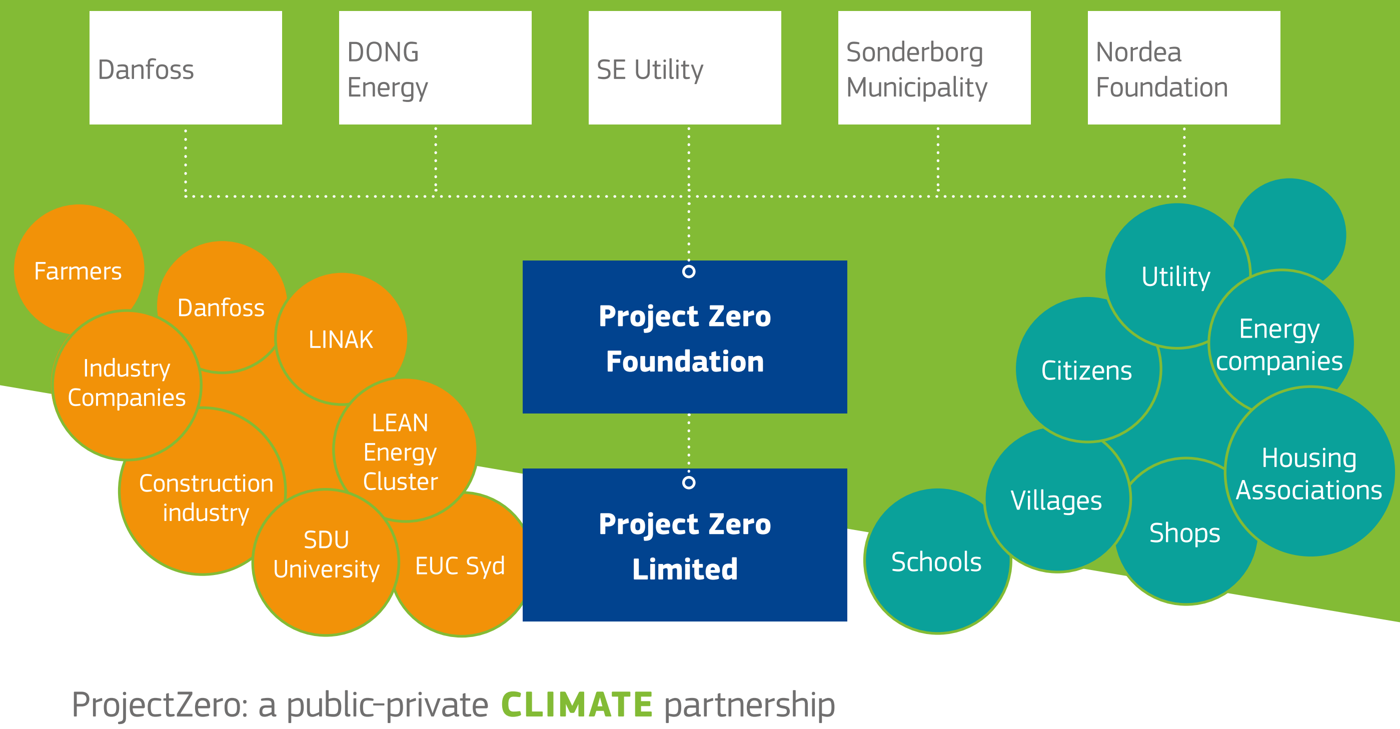


Figure 3: functional structure of ProjectZero in Sonderborg, Denmark. Scheme taken from Peter Rathje, ProjectZero - a full scale Living Lab for Green Energy and Climate solutions, presentation given at the IEE REQUEST Closing Event, 05/08/2012, Stockholm.

Independent from the opportunities that alternative funds and financing provide, the JRC opinions that financial institutions *'could and should intervene through provision of risk guarantees priced against the real as opposed to the perceived risk profile'* of energy efficiency investments in buildings. *'Initially, guarantees would encourage banks to explore default risk beyond their current conservative horizons with respect to energy efficiency lending. The banks would then gain from the reduced risks, and in the long run this should lead to a greater willingness to lend to energy efficiency and more favourable lending terms, stimulating greater demand for loans without the need for guarantees*[52,53].

52 Zancanella, P., Bertoldi, P., Boza-Kiss, B. (2018), Energy efficiency, the value of buildings and the payment default risk, JRC, p. 34.

53 About the generally wrong perception of the risk profile of EE measures, see also Ehrhardt-Martinez, K., Laitner, J.A. (2008), The Size of the U.S. Energy Efficiency Market: Generating a More Complete Picture, *https://www.aceee.org/sites/default/files/publications/researchreports/E083.pdf*, p. 29.

2.4 STANDARDIZING THE UNSTANDARDIZED

Regarding the roll-out of innovative technology solutions (or combinations of solutions), a **double challenge** can be identified:

- Deploying the **4th industrial revolution for the building (retrofit) industry** through digitalisation, automation and prefabrication which concerns mainly the individual building level; and
- Deploying **community/district energy infrastructures** that allow groups of (retrofitted) buildings to generate, use, store and exchange energy (heat, cold and electricity) which concerns mainly the district/community level. This aspect is related to the development of Local Energy Communities (LECs), Positive Energy Districts (PEDs) and the peer-to-peer electricity market.

Smart industrialization of the retrofit process implies reverting to customized industrial production in order to evolve from the artisanal project-by-project approach characteristic of the current building sector towards a maximum of factory-prepared and (semi-)automated output. This includes quality standard metrics, pre-defined retrofit project approaches, efficient coordination of participating home construction contractors and measurement and verification of energy savings. These process standards are often produced as a by-product by the public(-private) OSS vehicles, based on the field experience gained through the latter's project portfolios.

An example of this approach is demonstrated through the REnnovates project[54]. A new, prefabricated skin is placed around existing houses in 3 working days, while the residents continue to occupy their home. The new skin includes PV panels for onsite renewable energy production, allowing the homes to reach a Net Zero Energy standard. A technical module with a heat pump, domestic hot water production and storage, HVAC provisions, a PV converter and a battery for electricity storage is added as an external, stand-alone component and connected to each house. Through a smart grid setup, the building also exchanges electricity with a district battery, thus providing flexibility services to the community.

Figure 4: REnnovates concept, situation before and after deep retrofit. Composite image based on REnnovates materials, https://rennovates.eu/.

54 https://rennovates.eu/ Rennovates contributes to the Dutch Stroomversnelling programme, https://stroomversnelling.nl/

3. POLICY RECOMMENDATIONS: SUPPORTING INCENTIVES FROM THE LOCAL TO THE EU LEVEL

Retrofitting existing buildings is not an obligation. Requirements related to the energy performance of an existing building will only apply, e.g. when a building undergoes major works that need a building permit or when it is rented out. By contrast there are, at the level of the EU EPBD directive, currently no obligations to retrofit a building when it is sold. The EPBD does however recommend such, pointing to 'trigger points' in the life cycle of the building, where an energy retrofit has more chances of being executed at affordable cost and in the best practical circumstances. Member states should in general *'stimulate cost-effective deep renovation of buildings, including staged deep renovation'* through appropriate strategies, action plans and support mechanisms (Art. 2a).

From the policy point of view, and given the slow current renovation rate of the existing building stock, this implies that (deeply) retrofitting the stock to prepare it for the 2050 energy and climate goals will much depend on **stimulus**.

This implies that actions at different policy levels (local, regional, member state and EU) are recommended to (1) eliminate as much as possible the barriers identified under section 1.2 and section 1.3 and (2) support all contributing factors of the solution pathways discussed under section 2. This holds in particular for **institutional and regulatory barriers** on the one hand (for example regulation forbidding to increase the social housing rent proportionally to the operational savings realized after a retrofit) and **institutional and regulatory facilitation** on the other hand (for example, creating the legally favourable context for the implementation of local energy communities and peer-to-peer energy trading), see also the previous policy paper 'Why may replication (not) be happening?'.

From the above analysis it has become obvious that **local and regional authorities can play a pivotal role** in facilitating and upscaling the retrofit effort.

3.1 GENERAL EU POLICY OUTLOOK

The adoption of a **European Green Deal** by the new European Commission, taking up function as of November 2019, promises a favourable policy context for addressing the EU building stock retrofit challenge. Hereby a housing renovation programme will be *'one of the flagships'* of the upcoming Green Deal, according to an Euractiv press report[55]. The report continues to precise that *'[f]unding from the European Investment Bank (EIB), which recently overhauled its energy lending policy, could also be mobilised* to ensure residents don't have to find tens of thousands of euros upfront – which they simply don't have, (as Vice-President of the EC) *Timmermans suggested.'*

In line with this, it could be recommended to align the 'best of class' in developing the One Stop Shop concept or other integrated value chains in the retrofit sector with structural funding (EIB, EEEF, ESIF, EFSI, PF4EE…) in order to inject finance where it is best spent. This would mean that such innovative setups can evolve from '*niche*', as labelled by the JRC in 2018, to mainstream practice.

3.2 REGULATION DERIVING FROM THE EPBD AND THE EU ENERGY MARKET RULES

Output from SCC Lighthouse Project Group workshops has made clear that *'policy makers could adjust regulations to facilitate permitting for energy retrofitting and to allow and promote energy exchange between buildings.'* **It is 'suggested to apply regulations related to building properties on the building level and energy supply regulations on a community level.'**[56] From the combined GrowSmarter-Remourban-Triangulum end conference (Brussels, 8 October 2019) it was recommended to *'reconfirm that national taxes and regulations support and do not restrain the production of local sustainable energy from photovoltaics, wind, biogas and encourage uptake of excess heat'*[57]. SmartEnCity advises further to *'set up requirements to facilitate the connection to the district heating or establishing conditions on the* (retrofit) *funding which make connection a pre-requisite'*[58] i.e. making sure that enough individual buildings connect to the local, collective district energy systems in order to make the latter feasible and profitable. It continues with advising to *'take a more holistic approach to urban retrofitting not solely focusing on the energy frame of the single building, but the overall energy consumption of cities and districts and the most cost-effective way to bring down energy consumption/or obtain RES supply'*. **This may go against the unbundling and choice of energy provider principles that have been embedded in the EU energy market rules, implying that the latter may have to be revised**, see also the corresponding analysis in the previous policy paper 'Why may replication (not) be happening?'.

In addition to the current barriers for rolling out real P2P electricity trading, the **data privacy regulation** is often mentioned as another factor complicating the effective development of district energy management systems (DEMSs), virtual power plants (VPPs) and the like. A similar reflection holds for the energy consumption data of individual buildings, where the privacy rules complicate the assessment and the communication of building performances and, up to a certain level, the effective roll-out of collective actions.

In the context of the EPBD, it is hereby important that effective **area measures** are not hindered by restrictive building measures that have been conceived from a too narrow, single building perspective. It is therefore recommended that both **mutually coherent building roadmaps and area roadmaps, in particular heat zoning plans**, are developed throughout the member states. For their part, consistent building roadmaps shall also help to **avoid sub-optimal lock-ins** when gradually retrofitting buildings to a future-proofed standard.

In the domain of Positive Energy Districts (PEDs), it will be rewarding to put a strong focus **on retrofit PEDs – PEDs developed within the existing urban tissue**. They present in fact many more challenges than PEDs newly developed in green-fields or reconstructed brownfields.

3.3 POLICY INCENTIVES AT THE MEMBER STATE LEVEL

Policies within the member states should address the retrofit challenge through properly designed **redistribution mechanisms**, assuring that fragile target groups are on board, and by fully incorporating **secondary benefit accounting**, such as reduced social expenditures stemming from better housing conditions. Once the diverse societal benefits of deeply retrofitting the existing building stock have been considered, the 'business model' for deep retrofit can be assessed from a correct verification basis. Hereby the benefit for society will be more than the sum of the profits of the individual business cases, as win-win situations will occur.

The combined GrowSmarter-Remourban-Triangulum policy paper recommends allowing local authorities to set **higher requirements than national energy-related regulations**, e.g. regarding retrofit ambition levels[59]. This principle might be extended to the domain of LECs and peer-to-peer trading of energy. In this way, a positive and upward competition between cities can also be enhanced.

SCC Projects ask furthermore for a **stable or predictable legal and institutional environment** with *'stable incentives and programmes for deep retrofit'*. As such, Remourban recommends a *'National Government*

55 'Housing renovation plan will be 'flagship' of European Green Deal', Euractiv, 25.11.2019, *https://www.euractiv.com/section/energy-environment/news/housing-renovation-plan-will-be-flagship-of-european-green-deal/*

56 *https://smartcities-infosystem.eu/low-energy-retrofitting*

57 Garcia-Fuentes, M.A. et al. (2019), Policy paper - From dream to reality: sharing experiences from leading European Smart Cities, *https://www.triangulum-project.eu/wp-content/uploads/2019/10/JointPolicyPaper_GrowSmarter-Remourban-an-Triangulum.pdf*, p.3.

58 Stendorf Sørensen, S. et al. (2016), Review of regulatory gaps and recommendations to facilitate city transformation processes (project deliverable 2.1), SmartEnCity, *https://smartencity.eu/media/smartencity_d2.1_review_of_regulatory_gaps_and_recommendations_to_facilitate_city_trasformation_processes_v1.0_1.pdf*, p. 32.

59 Garcia-Fuentes, M.A. et al. (2019), op. cit., p. 3.

Policy that is constant and does not lead to "boom and bust" pricing around external retrofitting and also does not focus on the cheapest options – such as insulation in isolation of other interventions.'[60] SmartEnCity advises that (energy supply) '*support schemes should have a long continuity in order to promote trust of investors.*'[61]

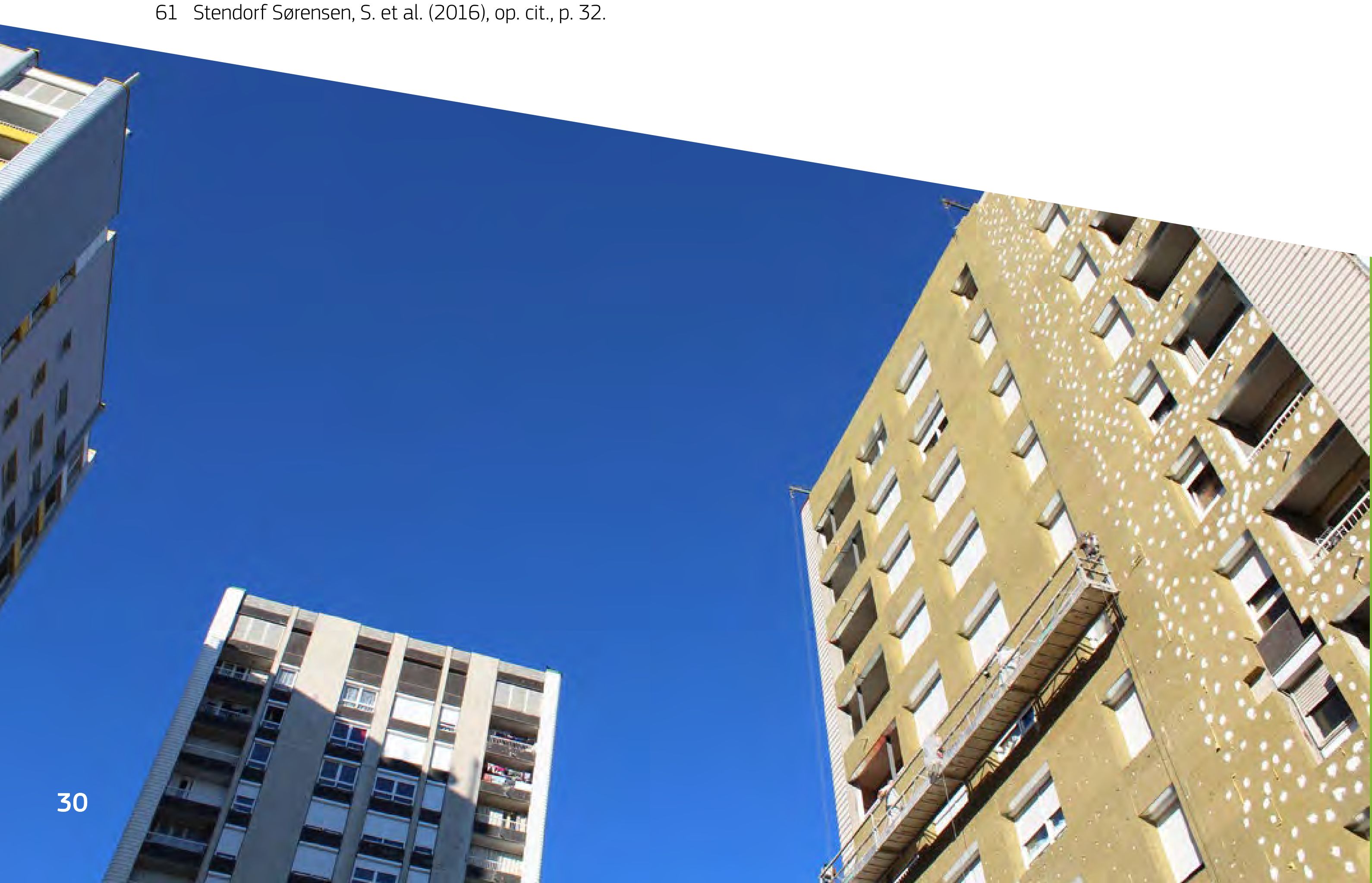
The previous policy paper already indicated that the market needs additional price signals to evolve in a sustainable direction. Green tax shifts, and implementing **carbon taxing** in particular, are hailed as effective measures to reach this goal.

3.4 A NEW MOMENTUM FOR THE CONSTRUCTION SECTOR

The capacity problem in the construction sector demands specialist intervention. From the above analysis, it may be clear that, apart from preparing the sector for *Industry 4.0*, it is necessary to make it attractive for young and highly skilled professionals. Indirectly, this also implies that professional education shall be enhanced in order to respond to the major challenges ahead. This demands a concerted effort from actors in the construction industry (e.g. industry federations) and the education system. It is however beyond SCIS' competences to advise on the details of such concerted action.

60 Remourban (2016), Report and policy recommendations on the optimization of the regulatory framework (project deliverable D1.14), *https://smartcities-infosystem.eu/sites/default/files/remourban_report_and_policy_recommendations_on_the_optimization_of_the_regulatory_framework.pdf*, p. 66.

61 Stendorf Sørensen, S. et al. (2016), op. cit., p. 32.



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GLOSSARY / LIST OF ACRONYMS

BPIE	Buildings Performance Institute Europe
DEMS	district energy management system
DHC	district heating and cooling
EE	energy-efficiency
EeB	energy-efficient buildings
EPBD	Energy Performance of Buildings Directive
EPC	energy performance contracting
ESCO	energy services company
EU	European Union
EUSEW	European Sustainable Energy Week
FP7	EU 7th Framework Programme
HVAC	heating, ventilation, air conditioning and cooling
H2020	Horizon 2020
ICT	information and communication technology
IEA	International Energy Agency
JRC	EU Joint Research Centre
LCE	low-carbon energy
LEC	local energy community
NZEB	near-zero energy building
OSS	one stop shop
PED	positive energy district
PPP	public private partnership
P2P	peer to peer
PV	photovoltaic
R&I	research and innovation
RE	renewable energy
SCC	smart cities and communities
SCIS	Smart Cities and Communities Information System
SRT	self-reporting tool
VPP	virtual power plant