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Sustainability Indicators for Building Modernization and Urban Renewal

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Abstract: *In Finland a large part of the building stock has reached the end of its design life and we have a concurrent demand for new housing in existing urban areas. We need replicable solutions for the renewal and infill development of our built environments. On European level, measures have been taken as to address current challenges. Finland is a bearer of responsibility with implemented national strategies for tackling climate change and building regulations for the energy performance of both new and existing buildings.*

Case examples highlight indicators like compactness, net land use, resource efficiency and an increased quality of life as characteristics of a sustainable development. Social regeneration and changed demographics can be key drivers for change. Sustainability assessments of best practice examples set benchmarks that can promote a clear set of sustainability measures for a wider stock of residential buildings and entire urban areas.

Refurbishment, sustainability indicators, Tes Energy Facade, urban renewal

1 Introduction

Finland has 2 836 000 dwellings [1], more than 570 000 of which are situated in concrete apartment buildings built in the late 1960´s or early 1970´s [2]. These have now reached the age of major renovations of building envelopes, water, heating and electricity supply systems. Energy efficiency is a growing concern: 84% of energy used in Finnish dwellings in 2008-2011 was used for heating, 29% of which was used in apartment buildings. [3] The regional perspective is climatic, based on long heating periods; urban, based on the volume of urban areas built between the 1960's and 1980's in the need of maintenance and repair; and industrial, with the need for replicable solutions for building repairs.

Our physical surroundings affect our quality of life. This was highlighted by the results of a survey of Finnish resident´s opinions on their neighborhood in 2010 published by Strandell and commissioned by the Ministry of the Environment. The survey targeted areas dominated by multistorey apartment buildings. The results show that Finnish housing areas can be perceived as insecure, unclean, having a lack of natural environments, a bad image and size of buildings, unsatisfactory yards, and a low overall rating of the living environment. [4] Listed indicators relate directly to the quality of life: there exists a social need for urban renewal. Can the needs be met in a sustainable and cost efficient way? What are the key indicators to address and evaluate?

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2 Sustainability Indicators for Urban Regeneration

2.1 European Perspective: Urban Challenges and Model Solutions

The challenges of European built environments are diverse and caused on one hand by urban decay and on the other by a continuous urbanization. In 2006, 75% of the Europeans lived in urban areas and it has been estimated that by 2020 the average will be 80%, and in some countries even above 90 %. Concurrently, the densification of our built environments has been defined as a common European target as to tackle the impacts of urban sprawl [5] i.e. an increased consumption of energy, land and soil, increased greenhouse gas emissions, air and noise pollution. An additional aim is to tackle the social polarization of suburbs.

The Finnish capital Helsinki provides one example of current challenges. Helsinki has grown at a speed comparable to south European cities like Porto, Portugal and Milan, Italy. When comparing low density areas, Helsinki is in a top position with close to 100% low density areas. [6] Helsinki represents typical fragmented Finnish urban structure and is one object for the application of current targets set by the Finnish Ministry of Environment: the compacting of Finnish cities, with the aim of integrating urban structures to decrease environmental impacts, improve the possibilities for efficient public transport and increase services. [7] Munich in Germany provides example of the opposite. It has been identified as an exemplary and desirable compact built environment. Even if the population has grown with 49% from 1955 to 1990, the town is defined as compact based on two indicators: built-up areas have grown slower than the population, and the share of continuous, dense residential areas add up to two thirds of all residential areas whereas only one third is defined as discontinuous. [8]

There have been efforts to redefine urban models driven by transport planners in response to urban sprawl. According to Transit-oriented development (TOD) models, the city is decentralized with alternative modes of mobility yet recomposed by walkable neighborhoods. Transportation needs to couple with decentralized water and sanitation systems and reduced car use, and promote a human scaled environment: compact, well-located, walkable and transit-served neighborhoods are critical to a sustainable future. In combination, TOD and green urbanism can deliver a powerful punch of energy self-sufficiency, zero-waste living, and sustainable mobility. [9] One example of such a development is Copenhagen, Denmark, that has developed in accordance with TOD since 1947. The linked town of Ørestad has been published as a successful development based on an assessment by Knowles in 2012, showing that e.g. car commuting has been exchanged for public transport. [10]

A different viewpoint is offered by the SmartCity - concept based on the use of smart grids and digital control systems coupled with information technology for real time energy management, transport systems and traffic management, water supplies, street lighting, high-tech manufacturing and data gathering. The aim is to reduce greenhouse gases and support energy efficient built environments by promoting the use of energy from renewable sources by scaling up innovation, heat and energy reuse, and retrofitting to “smart” houses. [11]

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2.2 European Strategies for a Sustainable Development of Built Environments

On the European level, strategic measures have been taken as to address current challenges of and develop our built environments with the aim of a sustainable future.

In 2002 a roadmap was adopted for the development of the environmental policy-making in the EU during 2002-2012, the 6th Environment Action Programme. Four priority areas were identified: climate change, nature and biodiversity, environment and health, natural resources and waste [12]. It included a call for a Thematic Strategy on the Urban Environment with the objective of contributing to a better quality of life and with the emphasis on developing integrated urban areas, healthy living environments and a sustainable urban development. The strategy was adopted in 2006. [13] In 2011 the Roadmap to a Resource Efficient Europe followed that included two milestones directly relating to a sustainable urban development: (B)by 2020, EU policies are to take into account their direct and indirect impact on land use in the EU and globally, and the aim should be for no net land take by 2050. The roadmap includes targets concerning single buildings as well: (B)by 2020 the renovation and construction of buildings and infrastructure will be made to high resource efficiency levels. The Life-cycle approach will be widely applied; all new buildings will be nearly zero-energy and highly material efficient and policies for renovating the existing building stock will be in place so that it is cost-efficiently refurbished at a rate of 2% per year. 70% of non-hazardous construction and demolition waste will be recycled. [14] Economic and environmental issues have been tackled in the strategies through fostering the development of a green economy, energy and resource efficiency. The 7th Environment Action Programme entitled “Living well, within the limits of our planet” entered into force in January 2014 and guides European environment policy until 2020. [15] The emphasis is still on environmental aspects of sustainability. However, social aspects are noted in the targets as well. For example, “(T) the 7th EAP reflects the Union’s commitment to transforming itself into an inclusive green economy that secures growth and development, safeguards human health and well-being, provides decent jobs, reduces inequalities and invests in, and preserves biodiversity, including the ecosystem services it provides (natural capital), for its intrinsic value and for its essential contribution to human well-being and economic prosperity” [16].

In this context, Finland is a global actor and bearer of responsibility. A national Climate and Energy Strategy was compiled in November 2008. In 2009 the Finnish Government adopted the Foresight Report on Long-term Climate and Energy Policy, including the target of reducing greenhouse gas emissions by at least 80% by 2050, as compared to 1990 levels. [17] With regard to single buildings, building regulations applicable to new buildings with the emphasis on overall energy performance of a building came into force in June 2012 [18]. The Finnish statutory regulation on the improvement of energy efficiency of buildings undergoing renovation and alteration works applies to all building renovation works requiring a building permit since 01.09.2013 [19]. The aim is a decrease of the total energy consumption of buildings in Finland with 25 % and carbon dioxide emissions with 45% by 2050. Suggested means include systematic real estate upkeep. [20]

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2.3 Case Studies

Single demonstration projects and urban scale pilots represent examples for the scalability and replication potential of sustainability strategies and implementations aiming at urban regeneration. Current aims for building works and resource efficiency in construction reflect ongoing developments in the field of sustainability, where a holistic approach is applied to projects and processes.

One example of large scale regeneration of an existing area is provided by the social housing demonstration in Roosendaal, the Netherlands realized in 2010-2011. The project included the refurbishment of in total 246 row house homes, 70 of which were renovated to passive house standard, and the addition of 100 new homes. [21] The demonstrated repair works comprised a retrofitting with timber facade and roof elements, triple glazed windows, the addition of ventilation units with heat recovery, a condensing gas boiler and solar thermal collectors. The energy efficiency targets included an 80% reduction in heating energy demand, a 50% reduction in hot water demand, and a 70% decrease in overall building related energy use. The building process utilized industrial prefabrication and assembly work was realized on site during one working day per apartment and with all building works done within a period of two weeks [22]. The alteration works were efficient, but a demanding part of the process was the preparation and implementation phases with the facing of habitants of various cultural and social background. The focus was on improving the quality of living and decrease costs for upkeep: not only for the building owner but for residents as well. [23]

On a community level the technological driven approach to sustainability should be balanced by a social approach. The Finnish context provides another example. In Finland, there is a significant volume of urban areas from between the 1960's and 1980's [24] in which a large part of the building stock has reached the end of its design life. Fulfilling the requirements for energy efficiency and repairs will require additional material effort with higher embodied impacts. The effort will be higher than the gains of urban mining, and the cost of financing the process cannot be carried by the residents alone. Due to the speed and scale at which these areas were built, the demographics of the areas are fairly homogenous, and social needs are consistent. Typical in Finland is the need to improve safety and accessibility with lifts added to residential buildings, and to rework and reprogram dilapidated shopping centers which no longer meet current retail needs or the service needs of an ageing population. [25] Out of the economic framework is how local municipalities can reduce growing health care and frail care costs, by subsidizing the investment cost for home renovations. If the location of the area has potential for infill and a demand for expansion, then the investments can be better distributed so long as the land ownership, property legalities and the public planning process can be resolved. In this context, social sustainability is also an economic challenge. The City of Kouvola is one Finnish example of a town that has developed a 2030 - strategy for the infill development of central areas aiming at improving the quality of the environment, increasing the amount of available housing for families and increasing services. The plan for infill includes both new building and the addition of storeys to existing buildings. [26]

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For institutional owners a wish for social regeneration can be a key driver for investments. Where the demographics of a residential area have become skewed, or a target market for residential building requires radical changes, the owner is prepared to invest in redefining the profile of the end users and buildings. One example of a target market driven retrofit process is the refurbishment site in Oulu, Finland realized in 2012-2013 as a demonstration in project E2ReBuild. The building is one of five student apartment buildings in a housing corporation completed in 1985. The aim was for a comprehensive refurbishment of both indoor spaces and the building envelope implementing TES Energy Façade. The target was for energy efficiency at passive house level and modernized flats that would attract today´s students with families. [27] The main driver for the retrofit was the change in markets: modern students no longer enjoy living in single apartments. Instead, apartments were changed into modern, energy efficient and smart student family homes including upgraded outdoor facilities.

In some cases of social housing, the resident population has no alternative but to remain in the area that is being upgraded. The owners need to sell the residents the benefits of energy efficiency and sustainability, in order to trade off the increased rental costs with the perceived benefits. A careful cost effective energy renovation may be limited to the reuse of heating and installation of building automation, which has a realistic payback period. This is typical of an engineering approach to energy cost optimization, but requires tradeoffs with the residents, for example kitchen and bathroom renovations, for the disturbances to be accepted by tenants.

3 Discussion, Conclusion and Acknowledgements

3.1 Discussion and Conclusion

Key sustainability indicators with regard to building modernization and urban scale renewal rely firmly on all the three aspects of environmental, economic and social sustainability.

National strategies, research and implementations on the scale of demonstration sites support the European commitments to a low-carbon economy, a resource efficient future, a smart, sustainable and inclusive growth with regard to urban renewal. On single building level the aims are inforced through requirements for energy performance of both new buildings and buildings undergoing major renovations [28]. A striving for urban densification, renewal and social well-being can be identified. On strategy level, these are key indicators.

A sustainable land use and management is at the center of current aims for European urban environments and the discussed cases also suggest indicators like compactness and net land use as characteristics of a sustainable urban development. Land use becomes critical in regions like the Alpines where areas available for permanent settlement are limited [29].

Resource efficiency is a strategic goal and economic target for the construction sector including new building, refurbishments and urban structures. In realized demonstrations the focus has been on replicability and reducing the environmental impacts of repairs through the use of life cycle based products, such as TES Energy Facade. Sustainability assessments of best practice examples set benchmarks that can be used to promote a set of sustainability measures for a wider stock of residential buildings and entire urban areas.

Economics are decisive for the investor. Retrofit methods such as TES Energy Façade may anticipate future requirements for environmental considerations but there are no mechanisms to receive compensation for reducing greenhouse gases associated with the material flows of retrofits. Neither are the economic benefits of energy efficiency reflected in short term investments, and property values do not reflect their life cycle costs. The economic incentive for deep refurbishment, infill development and the regeneration of built areas has to be found in increased income resulting from e.g. a raised standard of living, increased let area or savings in upkeep costs. Based on selected cases a need for social regeneration and changed demographics might also be key drivers for investments and indicators for change. An increased quality of life is a desirable future and benefits all on both building and urban scale.

3.2 Acknowledgements

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