

Soziale Nachhaltigkeit im bezahlbaren Wohnungsbau: Ein grüner Designansatz

Social Sustainability in Affordable House: A Green Design Approach

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Vorgelegt von:

Valeria Budean

Personenkennzeichen

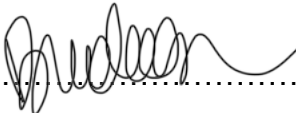
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Summary

This thesis looks into integrating principles for sustainable design and community engagement in affordable housing projects regarding their impacts on environmental, social justice, and economic feasibility dimensions. One of the research questions that this study wants to address as such is: How do principles of sustainable design and community engagement affect the social and environmental outcomes of affordable housing projects?

The study adopted a mixed-method approach: the quantitative analysis of environmental performance indicators was combined with qualitative assessments in terms of social well-being and community cohesion. Three case studies on Savonnerie Heymans in Brussels, Energy-Efficient Social Housing in Madrid, and Seestadt Aspern in Vienna served to outline how green design and community engagement find place within affordable housing and what has been the practical application and achieved outcomes.

The case studies demonstrate that sustainable design coupled with active community involvement enhance considerably in terms of environmental performance. Some of the key findings include:

- **Environmental Sustainability:** The projects showed a remarkable reduction in energy and carbon footprint. For example, these were distinguishable projects with reduced operational costs and improved indoor environmental quality, excluding all considerations of having efficient appliances, solar panels, and green roofs.
- **Social Integration:** Social integration and quality of life were enhanced, and the residents reported better levels of satisfaction because living conditions had improved and community cohesion was enhanced. The communal spaces and green areas were very important in improving social interaction and participation.
- **Economic Feasibility:** Higher development costs at the beginning were overcome by the long-term economic viability through reduced operating

expenses and increased resident satisfaction. Financial incentives and supportive policies played a very important role in mitigating upfront financial burdens associated with green design.

The findings show clearly that it is supportive policies and financial incentives that help overcome high initial costs related to green design. It also indicates that communal spaces and green areas are necessary for enhancing social sustainability. Some of the challenges, like specialized knowledge required by green construction and upfront costs, bring solutions along with them in the form of government subsidies, public funding, and phased development approaches.

This thesis concludes that it is possible and beneficial to have green design principles and community engagement considered in the development of affordable housing projects. Future developments should balance environmental, social, and economic goals to assure resilient, fair, and healthy urban communities. Aspects for future studies will include several parts of the world, long-term research, interdisciplinary strategies including policies and new technological ideas impressing on affordable housing be more feasible and sustainable.

This summary encapsulates key elements and findings of the thesis in putting before a comprehensive overview of research conducted on what would be the implications for the future of sustainable affordable housing.

Abstract

This thesis examines the integration of principles of sustainable design and community engagement in affordable housing projects in terms of their triple bottom line impacts with regard to environmental sustainability, social justice, and economic feasibility. Formulated more specifically, it sets the following research question: How does integrating sustainable design principles and community engagement affect the social and environmental results of affordable housing projects, and which lessons can be learned for their future development?

Case studies from Savonnerie Heymans in Brussels, Energy-Efficient Social Housing in Madrid, and Seestadt Aspern in Vienna demonstrate the when sustainable design goes hand in glove with active community involvement, the improvement in environmental performance for a project becomes practically very high. In most of these projects, reduced energy consumption and carbon footprints are core values. These values demonstrate improved social integration, higher quality of life, and long-term economic sustainability by way of reduced operational costs and better resident satisfaction.

Methodologically, it is a mixed-method study with buttoned-up quantitative analysis of the indicators' result on environment performance, coupled with qualitative assessments of social well-being and community cohesion. In this interdisciplinary approach, urban planning, environmental science, and urban design merge to form – within social theory – a contribution that can enable full knowledge of how aspects of green design and community engagement may be used in improving affordable housing.

The findings bring out clearly the supportive policies and financial incentives needed to overcome the first high costs associated with green design. They also put emphasis on communal spaces and green areas in enhancing social interaction and community participation, which are basic elements of social sustainability. This

paper concludes with recommendations for future affordable housing developments that balance environment, social, and economic goals toward resilient, equitable, and healthy urban communities.

List of Abbreviations

BEE	Building Energy Efficiency
BREAM	Building Research Establishment Environmental Assessment Method
CBA	Cost-benefit Analysis
IRR	Internal Rate of Return
LEED	Leadership in Energy and Environmental Design
NPV	Net Present Value
ROI	Return on Investments

Key Terms

Schlüsselbegriffe in Englisch	Schlüsselbegriffe in Deutsch
Affordable Housing	Bezahlbarer Wohnraum
Community Engagement	Bürgerbeteiligung
Economic Feasibility	Wirtschaftliche Machbarkeit
Social Sustainability	Soziale Nachhaltigkeit
Sustainable Design	Nachhaltiges Design

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1. Introduction: Setting the Stage for Sustainable Transformation

1.1 Understanding Social Sustainability in Housing

The global housing crisis is one of the critical challenges of the 21st century. Supposedly 80% of the cities around the world admit that they do not have affordable housing for the majority of their citizens – marking something that is not of geographical but, instead, economic dimensions.¹ The problem of non-affordable housing is connected to boosting social inequality, complicates economic development, and makes environmental problems more acute, thus stating that the chase for sustainable solutions is a must.

The urgency of this situation is further accentuated by the forecasts of two billion more people needing to be housed in the world during the next 75 years, driven primarily by natural growth combined with migration trends and thus would need to build 96,000 new affordable homes every day.² The proportion of the task is so difficult that it would require the application of new paradigms in the development of housing, first of all, through the prism of social sustainability and green design.

This, therefore, means that inclusion of green designing principles in the development of affordable housing is a way of dealing with environmental sustainability and also part of social well-being through the creation of an all-inclusive healthy and resilient community. This affordable-convention green building provides the convergence of both affordability and sustainability; it really is changing the paradigm from the usual mode of housing development that argues loudly for 'green' designs, which are environmentally responsible and accessible to all

¹ Sparrentak, Kim, Van: Access to decent and affordable housing for all. European Parliament 2021. In: https://www.europarl.europa.eu/doceo/document/A-9-2020-0247_EN.html (last accessed 11.03.2024)

² Smith, Sean: The world needs to build 2 billion new homes over the next 80 years. 2018. In: <https://www.weforum.org/agenda/2018/03/the-world-needs-to-build-more-than-two-billion-new-homes-over-the-next-80-years/> (last accessed 11.03.2024)

segments in society.³ This gives the background that sets a good platform in understanding how a green design approach can add substantially to mitigate the global affordable housing crisis with social sustainability.

1.2 The Evolution of Affordable Housing Policies and Practices

Nowadays, the standard practice policies for affordable housing have been considerably altered over the last century in most cities – for example, Vienna, where social housing has always been significant concern to the public. The Viennese model is long-term social commitment and quality-driven land allocation that sets examples of ways to target the housing shortage.

To this end, the IBA Wien 2022 project is but one of the numerous examples that solidify the reality of putting together social housing for the city of Vienna. It is all about social sustainability, urban planning, new social neighborhoods, new social qualities, and new social responsibility at the end.⁴ These themes guide the development of housing projects that are affordable, inclusive, environmentally sustainable, and socially cohesive.

What sustains the Vienna social housing policy is the municipal and nonprofit developers agree to rent controls and quality standards in the long run. This system effectively removes housing from markets in speculative real estate and guarantees reasonable and affordable rents under all market circumstances. Such strong regulation in this social policy is also secured by other stringent bindings to public finance, long-term low-interest loans, and land-use policies promoting affordable

³ Ahn, Yong Han/ Wamg, Yuhong/ Lee, Kang Hee/ Jeon, Myung Hwa: The greening of affordable housing through public and private partnership: Development of a model for green affordable housing. In: https://www.researchgate.net/publication/275939363_The_greening_of_affordable_housing_through_public_and_private_partnerships_Development_of_a_model_for_green_affordable_housing (last accessed 11.03.2024)

⁴ Hofstetter, Kurt/ Miessgang, Madlyn/ Pluch, Kerstin/ Scheuven, Rudolf et al.: Neues soziales Wohnen. Positionen zur IBA_Wien 2022. Berlin 2022. pp. 9-12, 14-18

housing.⁵

It is such a sharp contrast to most cities, where market-driven policies on housing mean that land is not affordable, led by high pricing of land and increased rent induced by investor activities. It would, however, be cheap enough to cater to the broad cross-section of its population by detaching the housing market from interest-bearing values by resulting in reasonable and stable charges on available resources to ensure that people are subjected to.

1.3 Green Design Principles in the Built Environment

Therefore, the incorporation of green design principles into affordable housing in the ultimate way in which environmental sustainability can be achieved in the enhancement of social well-being. In detail, green design strategies go all the way to the reduction of energy consumption and low carbon footprints, thereby creating healthful living environments from the use of sustainable materials and technologies.

Energy-efficient appliances, solar panels, green roofs, and water-saving fixtures - green design features bring about substantial energy use reduction leading to lower operation costs and improved indoor environmental quality in affordable housing projects for sustainability in the long term.⁶ This results in massive ecological gains in housing development, with other benefits such as reduced greenhouse gas emissions and enhanced biodiversity.

Case studies, such as the Savonnerie Heymans project in Brussels, evidence an effective green design for affordable housing with high transformation potential. These mesh the bioclimatic loggias, solar panels, recovery of rainwater, and the

⁵ Hofstetter, Kurt/ Miessgang, Madlyn/ Pluch, Kerstin/ Scheuven, Rudolf et al.: Neues soziales Wohnen. Positionen zur IBA_Wien 2022. Berlin 2022. pp. 23-28

⁶ Housing Market Developments in the Euro Area: Focus on Housing Affordability. Ed.: Publications Office of the European Union. Luxembourg 2022. In https://economy-finance.ec.europa.eu/system/files/2022-09/dp171_en.pdf (last accessed 29.05.2024) pp. 5-12

cogeneration heating system while maintaining the balance between the initial costs and the long-term benefits.⁷ Examples – such this one – prove how green design enhances environmental performance and social outcomes; it fosters healthier, more integrated communities.

Affordable housing projects at this intersection of green design and social sustainability work toward bringing affordability and environmental responsibility together. The paradigm shift from the traditional development of houses calls for an inclusive, resilient community capable of withstanding all challenges that may arise in the future, including those associated with urbanization and climate change.⁸

The following thesis on “Social Sustainability in Affordable Housing: A Green Design Approach” is about how principles of design for sustainability – which mean, among other things, a high degree of community engagement – can be done. This paper adopts a multi-disciplinary approach, embracing to be presented to policymakers, developers, and architects.

Conclusion

New and innovative ways must be thought of now to incorporate socially sustainable considerations in light of green design, with demand for housing rising worldwide. With example cases of Vienna’s model of social housing, more specifically case studies such as the Savonnerie Heymans project in Brussels, the Energy-Efficient Social Housing Residential Building in Madrid, and Seestadt Aspern in Vienna, this thesis brings in comprehensive elaboration of how the sustainable design potential is realized in solving housing deficits while promoting social inclusion and environmental responsibility. That participatory approach allowed affordable

⁷ Savonnerie Heymans/ MDW Architecture. Ed.: ArchDaily. In: <https://www.archdaily.com/220116/savonnerie-heymans-mdw-architecture> (last accessed 29.05.2024)

⁸ Sustainable and Affordable Housing. Spotlighting action from across the World Green Building Council network. Ed.: World Green Building Council. In https://worldgbc.org/wp-content/uploads/2023/05/C22.9056-WGBC_Affordable-Housing-Report_Master-2.pdf (last accessed 12.06.2024)

housing projects to embed practical responses guided by green design principles to the twin challenges of environmental sustainability and housing affordability has set pathways for more resilient and equitable urban communities.

2. Literature Review: Navigating the Landscape of Affordable Housing and Sustainability

This chapter, therefore, sets forth the literature on affordable housing and its relationship to sustainability, considering the aspects of social sustainability and green design. It further explores the policy development and where more research is required.

2.1 Social Sustainability and Green Design in Affordable Housing

Policymakers and urban planners have, for a long, kept affordable housing as one of the essential concerns; however, the infusion of social sustainability and green design into affordable housing has come about only in recent times.⁹

2.1.1 Understanding Social Sustainability

Social sustainability is defined as developing the community in an inclusive, fair, and crisis-resilient manner. One could speak of social sustainability in terms of social equity, community development, and quality of life. Concerning affordable housing, this means that the community development of residential developments positively impacts residents and the larger community.¹⁰

2.1.2 The Role of Green Design

Sustainable design, also known as green design, means designing buildings so that their environmental impacts are reduced. This reduction is achieved through energy efficiency, sustainable materials that minimize resource depletion, and improvement in the quality of the indoor environment. Green design in affordable housing will look

⁹ Housing affordability and sustainability in the EU. Analytic Report. Ed.: European Construction Sector Observatory. In: https://single-market-economy.ec.europa.eu/system/files/2021-02/ecso_ar_housing_affordability_2019_0.pdf (last accessed 06.07.2024) pp. 45-49

¹⁰ Akabogu, Denis Uche: Sustainable Housing for Social Equity: Fostering Community Well-being. In: <https://www.linkedin.com/pulse/sustainable-housing-social-equity-fostering-community-5obwf/> (last accessed 11.06.2024)

toward reducing the utility cost residents, lessening associated health outcome, and generally lowering the carbon footprint in housing development.¹¹

2.1.3 Integrating of Social Sustainability and Green Design

Social sustainability in affordable housing can be linked with green design for further outcomes. For instance, an energy-efficient building will lead to reduced costs of living- something critical for low-income families. Besides, the health-promoting materials and design will improve the physical and mental state of the occupants.

Studies have shown that green design principles incorporated into affordable housing projects make possible social sustainability through community engagement, healthy and safe living conditions, and the possibility of avoiding increasing burdens related to utility costs. But they also face their own set of challenges high upfront costs and a need for knowledge in green construction methods.¹²

For example, another study in social affordable housing related to LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method) green building certifications supports that the improved indoor environmental quality and reduced operation costs for residents contribute to the social sustainability.¹³

Another research project identified community participation in the process of design and planning as crucial factor: it can produce more socially sustainable outcomes. This can be justified by the fact that the voices of local people will be taken into

¹¹ Ziraldo, Katie: Green Architecture: What Is It and What Are Its Goals? In: <https://www.rocketmortgage.com/learn/green-architecture#:~:text=Green%20architecture%20is%20a%20philosophy,and%20energy%20sources%20in%20construction.> (last accessed 11.06.2024)

¹² Snood, Avneesh: Affordable housing and environmental sustainability: Building a greener future. In: <https://timesofindia.indiatimes.com/blogs/voices/affordable-housing-and-environmental-sustainability-building-a-greener-future/?source=app&frmapp=yes> (last accessed 11.06.2024)

¹³ Mazur, Lukasz/ Resler, Maria/ Koda/ Eugeniusz et al.: Energy saving and Green building Certification: Case Study of commercial buildings in Warsaw, Poland. In: <https://www.sciencedirect.com/science/article/abs/pii/S2213138823005131?via%3Dihub> (last accessed 11.06.2024)

consideration regarding their needs and preferences, which will influence acceptance and satisfaction levels with the housing development.

2.2 Policy Development and Gaps in Research

Effective policymaking is an inevitable process for promoting the integration of social sustainability and green design in affordable housing. This section traces the evolution of relevant policies and identifies gaps in current research.

2.2.1 Evolution of Affordable Housing

The affordable housing policies have evolved over the years to suit the needs of society better. The initial policies were majorly aimed to increasing the number of units for affordable housing. However, sustainability has recently been included in these policies.

For instance, in the United States, the LIHTC (Low-Income Housing Tax Credit) program promotes the integration of energy-efficient features into projects by developers.¹⁴ Similarly, there are number of directives laid down by the European Union to improve energy performance in buildings; hence, it impacts affordable housing indirectly.

2.2.2 Current Policy Landscape

Most of the policies being taken today towards sustainable, affordable housing are financial incentives, grants, and even technical assistance to developers that seek to reduce the level of barriers to the implementation of green design principles for

¹⁴ Manzi/ Tony, Lucas/ Karen, Lloyd-James/ Tony/ Allen, Judith: Social Sustainability in Urban Areas. Communities, Connectivity and the Urban Fabric. In: <http://ndl.ethernet.edu.et/bitstream/123456789/25994/1/59.pdf> (last accessed 11.06.2024) pp. 16-18, 49-61

affordable housing projects. However, this impact will always vary drastically among different regions or jurisdictions.¹⁵

2.2.3 Gaps in Research

Despite policy development, several gaps continue to exist in the research on affordable housing, social sustainability, and green design; for example:

Limited Longitudinal Studies: there is little or no long-term study concerning the impact of affordable housing green design on social sustainability. Most of the work done has focused on short-term impacts, hence not capturing all the benefits or even challenges of sustainable housing.¹⁶

Regional Variations: Most existing research has been concentrated in certain regions – essentially developed countries. Much more research needs to be undertaken across diverse geographical contexts to understand how differing climates, cultures, and economic conditions influence the implementation and outcomes associated with sustainable, affordable housing.¹⁷

Interdisciplinarity: Usually, research is conducted in siloed approaches related to architecture, urban planning, or social sciences. More studies from an interdisciplinary perspective are necessary and should accommodate these considerations in their development solutions.¹⁸

¹⁵ Designing Policies for Efficient, Inclusive and Sustainable Housing. Ed: OECD. In: <https://www.oecd-ilibrary.org/sites/8ec0f507-en/index.html?itemId=/content/component/8ec0f507-en> (last accessed 12.06.2024)

¹⁶ Zhao, Dong/ McCoy, Andrew P./ Agee, Philip/ Mo, Yunjeong et al.: Time effects of green buildings on energy use for low-income households: A longitudinal study in the United States. In: <https://www.sciencedirect.com/science/article/abs/pii/S2210670718301094> (last accessed 07.07.2024)

¹⁷ Sustainable and Affordable Housing. Spotlighting action from across the World Green Building Council network. Ed: World Green Building Council. In: https://worldgbc.org/wp-content/uploads/2023/05/WGBC_SAffordable-Housing-Report_FINAL.pdf (last accessed 12.06.2024)

¹⁸ Forrest, Ray/ Lee, James: Housing and Social Change. East-West Perspective 1st Edition. London: Routledge 2003. pp. 221-239

Policy Impact Analysis: More op-ed research to evaluate existing policies and identify best practices. For example: the gap effect of policy tools such as subsidies, tax credits and regulations on the adoption of green affordable housing can be detected.¹⁹

And also, these gaps are then vital to address as it allows the domain to progress in a manner affordable housing initiative invested into them contributes positively for social sustainability and meet environmental targets.

¹⁹ Carter, Kate/ Fortune, Chris: Sustainable development policy perceptions and practice in the UK social housing sector. In:
<https://www.tandfonline.com/doi/full/10.1080/01446190600922578?scroll=top&needAccess=true>
(last accessed 13.06.2024)

3. Crafting the Path: Methodological Approaches for Socially Sustainable Housing

This chapter details the methodological tool adopted in this chapter for addressing social citizens in affordable housing through a green design. It delineates the research plan and provides description related to data collection, methodology and ethical concern and limitations.

3.1 Research Design and Approach

This study used qualitative approach and triangulated data from varied sources in order to validate its findings. The research design is a mix of both qualitative and quantitative methods suited for providing the richness as well as comprehensiveness attention to the topic in question. The study utilizes a triangulation method which enhances the validity and reliability of this presents research.

3.1.1 Mixed-Methods Approach

Mix methods involve both qualitative and quantitative data collection and analyses. Because the field of affordable housing encompasses much and touch widely on several complex issue like social sustainability and green design, using too broad a lens can be misleading yet going to deep will not encapsulate an adequate breadth. Quantitative data provide the measurable evidence in this study, because these confirmatory enrolment patterns reflect a deeper understanding of which proportions residents are participating (qualitative).²⁰

3.1.2 Case Study Methodology

This research uses case study methodology. This research is limited to select affordable housing developments implemented with green design principles. By conducting case studies of the Tube projects and their outcomes, there were a

²⁰ Creswell, John W./ Plano Clark/ Vicki L.: Designing and Conducting Mixed Methods Research. Third Edition. Los Angeles: SAGE Publications 2017. pp. 55-76, 179-202

possibility to study both implementation and results in detail. Case studies are good at answering how and more why questions that allows one to see the marginal dimensions of situation (no clear quantitative measure).²¹ This work analyzes three case studies at different efforts for greening affordable housing developments: The Savonnerie Heymans Project, an older housing complex with implemented green design elements, and Energy-Efficient Social Housing Residential Building in Madrid, a newer sustainable housing complex in metropolitan area; and Seestadt Aspern, a large-scale green affordable housing project in Vienna, Austria.

3.2 Data Collection Methods

Data collection methods include surveys and document analysis. The rationale for the choice was to obtain extensive data that came from various sources that would then form the basis of the subsequent in-depth analysis.

3.2.1 Surveys

For each selected affordable housing project, similarly-planned residents were surveyed to collect quantitative data on experiences of living in the projects and satisfaction as well as perceptions regarding sustainability/ green design features. The two types of questions, closed- and open-ended questions were employed in order to obtain a broader range of responses through the questionnaires. Topics covered in these problems:

- Housing conditions – to what extent are the housing of residents satisfied?
- Into which design benefits, that is energy savings and indoor air quality do green features contribute?
- Interactions partners integration in the household.
- What difference has living in the housing completed made to quality of life for residents?²²

²¹ Yin, Robert K.: Case Study Research and Applications: Design and Methods. 6th Edition. Los Angeles: SAGE Publications 2018. pp. 18-45

²² Fowler, Floyd Jackson: Survey Research Methods. 5th Edition. SAGE Publications 2014. pp. 23-47, 88-110

3.2.2 Document Analysis

Here, the focus is on looking at documents and interpretations of design in projects. Document analysis is used to support the data obtained through survey methods by contextualizing and verifying facts. Among the critical documents reviewed include:

- Environmental Impact Assessments
- Housing Development Proposal and Plans
- Policy Guidelines and Regulatory Frameworks Relevant to Sustainable Housing
- Post-Occupancy Evaluation Reports.²³

3.3 Data Analysis Techniques

Data analysis: Quantitative and qualitative techniques both were used to analyze the data for a more comprehensive examination.

3.3.1 Quantitative Analysis

The questionnaire base data were quantitatively analyzed statically. Descriptive statistics presented the data, whereas inferential statistics performed regression analysis on how variables (the effect of green design features in residents' satisfaction) interact with each other. Key martingale properties like:

- Means and standard deviations, as well as regression analysis of resident satisfaction scores
- Cross-tabulation to explore relationship between different survey variables
- Regression analysis is used to recognize important predictors of social sustainability outcomes.²⁴

²³ Bowen, Glenn A.: Documents Analysis as a Qualitative Research Method. Vol. 9(2). London: SAGE Publications 2009. pp. 27-40

²⁴ Field, Andy: Discovering Statistics Using IBM SPSS Statistics. 5th Edition. SAGE Publications 2018. pp. 101-132, 245-267

3.3.2 Qualitative Analysis

Open-ended survey questions and document analysis gave qualitative data that was analyzed using thematic analysis. Through coding data, it was possible to identify key themes and patterns that related to social sustainability and green design. Thematic analysis was manual and very sensitive in bringing out the true essence of information. Key process involved in the thematic analysis included:

- Open coding of data for identification of significant statements and concepts
- Development of themes and sub-themes through iterative review and refinement
- Interpretation of themes about research questions.²⁵

3.4 Ethical Considerations and Limitations

Ethical issues and limitations were also addressed to preserve the research process methods, validity of findings.

3.4.1 Ethics Design

As the research was non-participant and non-interview, there were little direct ethical implications beyond a respect for the source data as raw; responsibly conducted analysis. Ethical requirements concerning Essentia included:

- Ensuring transparency and consistency in reporting results produced from document review and surveys
- Properly quoting and giving credit to every source used in research
- Transparency: clear indication of the study's purpose and method.²⁶

²⁵ Nowell, Lorelli S./ Norris, Jill M./ White, Deborah E. et al.: Thematic Analysis: Striving to Meet the Trustworthiness Criteria. In: <https://journals.sagepub.com/doi/10.1177/1609406917733847> (last accessed 15.06.2024)

²⁶ Okorie, Gold Nmesoma/ Udeh, Chioma Ann/ Adaga, Ejuma Martha et al.: Ethical Considerations in Data Collection and Analysis: A Review: Investigating Ethical Practices and Challenges in Modern Data Collection and Analysis. Vol. 6(1). In: https://www.researchgate.net/publication/378789304_ETHICAL_CONSIDERATIONS_IN_DATA_COLLECTION_AND_ANALYSIS_A_REVIEW_INVESTIGATING_ETHICAL_PRACTICES_AND_CHALLENGES_IN_MODERN_DATA_COLLECTION_AND_ANALYSIS (last accessed 22.06.2024)

3.4.2 Limitations

This study had several limitations that were acknowledged:

- **Sample Size and Generalization:** The sample size for surveys was restricted due to case study focused nature of analysis which might not be representative of affordable housing projects on the whole. Thus, the results may not generalize to other populations.²⁷
- **Qualitative analysis is subjective:** Although efforts were made to minimize bias, the qualitative nature of content analysis carries subjectivity. To ensure the credibility of the data sources, a process called triangulation and peer debriefing was used.²⁸
- **Limited on Resources:** Limited by the scope of the research. Future longitudinal studies would enhance the knowledge on green design long-term effects in social sustainability based of the sample presented.²⁹

Improving the methodology, and expanding of research in this field will serve to inform appropriate policy decision-making for socially sustainable affordable housing.

²⁷ Flyvbjerg, Bent: Five Misunderstandings About Case-Study Research. Vol. 12(2). *Qualitative Inquiry* 2006. pp. 221-223

²⁸ Silverman, David: Doing Qualitative Research. In: https://www.miguelangelmartinez.net/IMG/pdf/2017_silverman_doing__qualitative_research_book.pdf (last accessed 22.06.2024) pp. 370-375

²⁹ Robson, Colin: *Real World Research: Resource for Social Scientists and Practitioner-Researchers*. 2nd Edition. Blackwell Publishing 2002. pp. 194-198

4 Greening the Horizon: Transformative Insights from Affordable Housing Projects

This chapter focuses on the process of in-depth analysis conducted, and describes it through two major case studies concerning affordable housing projects that have incorporated green design principles. It gives some useful perspectives on the implementation, impact, issues and solutions surrounding these projects.

4.1 Case Study Analysis Framework

For analyzing the case studies systematically, a framework with attention to following areas is applied:

- **Project Context:** Information relating to project, background information on the entire project
- **Green Design Elements:** Identifiable sustainable aspects implemented
- **Costs, savings and financial impact:** Analysis from economic perspective
- **Social Impact:** Benefits for the community and residents
- **Challenges and Solutions:** Issues during implementation, how were they addressed.

4.2 Case Study 1: Energy-Efficient Social Housing Residential Building in Madrid

Project Background

Location: San Fermin, Madrid, Spain

Architect: Guillermo Yanez

Size: 54 units

Target Demographic: Social housing for various income levels.³⁰

³⁰ Gonzalo, Roberto/ Habermann, Karl J.: Energieeffiziente Architektur. Grundlagen für Planung und Konstruktion. Publisher Birkhäuser 2006. pp. 74



Figure 1: Bird's eye view. The high building density of the area has an inner-city character

(Reference: https://issuu.com/tarekml/docs/architecture_et_efficacite_energetique [last accessed 24.06.2024] pp. 74)

Green Design Elements

Bioclimatic Design: This is a project with active and passive solar energy in unison with the surrounding landscape. Here consider systems that are active like the Photovoltaic and Solar heating panels. Passive elements are the massive third in tandem of south facing glazing and thermal mass materials. These techniques allow to gather and store solar energy so that artificial heating or cooling is used less.

Photovoltaic Panels: Alongside the rooftop, solar panels have been installed that help dramatically by way of producing power and lessen air conditioning consumption to preserve cost. Solar water heating, which helps therefore of greater efficiency from a renewable energy perspective.

Natural Ventilation: ventilation in this building is natural, because the window and vents are well placed to allow outside wind from one side to come in and go out on the other side, thus reducing on the use of fans to cool the building while at the same time maintaining the quality of the air.

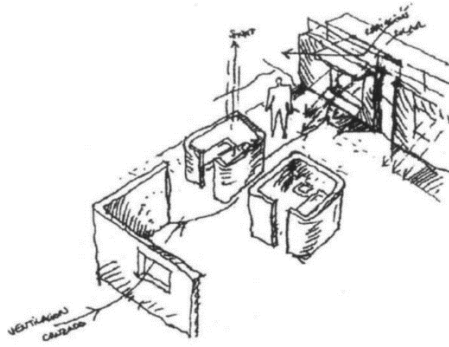


Figure 2: Schematic of cross ventilation

(Reference: https://issuu.com/tarekml/docs/architecture_et_efficacite_energetique [last accessed 24.06.2024] pp. 76)

Some of water-saving fixtures would consider the like of low flush toilets, low flow faucets, and shower heads; these would be fixtures that are built to use as minimal water as possible. Apart from this there is rainwater harvesting.³¹

Economic Analysis

Project Financing: The need, the subsidies of the EU, national and local funds earmarked for ecological and energy efficient projects.

Costs and Savings: Averaged more than 40% in energy conservation and approximately 50% reduction in CO₂ emissions against normal structures. Solar water heating system meets 70% of hot water needs and is counted to have an amortization span of 9.5 to 12.4 years.³²

Social Impact

Reduced Utility Bills: A major reduction of the energy bills for the residents.

Improved Indoor Climate: Improved housing standards through improved on ventilation and thermal insulation.

³¹ Gonzalo, Roberto/ Habermann, Karl J.: Energieeffiziente Architektur. Grundlagen für Planung und Konstruktion. Publisher Birkhäuser 2006. pp. 74-79

³² Madrid Social Housing SFSB. Ed.: European Investment Bank. In: <https://www.eib.org/en/projects/pipelines/all/20180337> (last accessed 04.07.2024)

Health Benefits: Natural materials applied and better quality of air enhances the health of people dwelling in those houses.

Challenges and Solutions

Initial Costs: Despite initial high costs of installation companies benefited from subsidies and incentives that was put in place.

Knowledge and Skills: Making sure that more members of the construction team had adequate knowledge of how green building should be done.³³

4.3 Case Study 2: Seestadt Aspern – Green Affordable Housing in Vienna

Project Background

Location: Vienna, Austria

Size: Approximately 2,600 housing units (entire development)

Target Demographic: Mixed-income residents, including families, singles, and elderly.³⁴

Green Design Elements

Energy-Efficient Buildings: Complies with passive house specifications such as insulation standards, such windows as low-emissive triple glazed window, and ventilation with high energy-efficient heat recovery systems respectively.

³³ Gonzalo, Roberto/ Habermann, Karl J.: Energieeffiziente Architektur. Grundlagen für Planung und Konstruktion. Publisher Birkenhäuser 2006. pp. 74-79

³⁴ Aspern – The Seaside Town in Vienna. Something for everyone. Ed.: City of Vienna. In: <https://socialhousing.wien/best-practice/planning-urban-development/seestadt-aspern> (last accessed 24.06.2022)

Renewable Energy Sources: Harnesses the use of solar to power light and perform heated water usage and geothermal for both heating and cooling.

Green Spaces: Large parks, squares, and gardens combined with residential neighborhoods or situated in the immediate vicinities of the latter.

Water Management: These are forms of ways through which rainwater is accommodated for instance rainwater harvesting systems through green roofs.³⁵

Economic Analysis

Project Financing: Supplemented by public and private capital, with government support from Austria and from EU grants.³⁶

Costs and Savings: The initial costs of construction were relatively higher, mainly because of the incorporation of new technologies, despite this the cost of operating the homes is relatively lower than the other customary homes and therefore the value for the residents and the Municipality is high in the long run. The use of the intervention is thus justified on the grounds of obesity prevention and the associated monetary savings such as utility bills and maintenance expenses.³⁷

³⁵ Facts + Figures about aspern Seestadt. Ed.: Die Seestadt Wiens. In: https://www.aspern-seestadt.at/jart/prj3/aspern/data/downloads/181004_aspern_Seestadt_Facts_Figures_EN.pdf (last accessed 26.06.2024)

³⁶ Fact Sheet Siemens & Smart City Research (ASCR). The only research project of its kind in Europe, based in Vienna. Ed.: Siemens. In: <https://assets.new.siemens.com/siemens/assets/api/uuid:677e4451-fe97-49b3-aa9f-519370a8ccac/Fact-sheet-Siemens-ASCR-EN.pdf> (last accessed 24.06.2022)

³⁷ Aspern Smart City Research. Energy Research shaping the future energy. Ed.: ASCR Aspern Smart City Research GmbH & Co KG. In: https://www.ascr.at/wp-content/uploads/2017/11/ASCR_Folder_2017_ENG_OK_low.compressed.pdf (last accessed 24.06.2024)

Social Impact

Community Cohesion: Seestadt Aspern is built in such a way that people interact; there are common areas, garden areas as well as other local facilities which enhance togetherness.

Health and Well-Being: Employment of non-hazardous materials and availability of sufficient afforestation beneficially impact the residents' health.

Economic Opportunities: The development comprises and different commercial areas that enhance business to a certain level thus addressing the economic sustainability.³⁸

4.4 Comparative Analysis of the Case Studies

Environmental Impact

The energy-efficient social housing residential building, in Madrid and Seestadt Aspern in Vienna successfully reduced energy consumption and CO₂ emissions. In Madrid they installed panels and solar water heating leading to a 40% decrease in energy usage and cutting CO₂ emissions in half compared to buildings.³⁹ Similarly, Seestadt Aspern adopted house standards and renewable energy sources resulting in a drop, in greenhouse gas emissions. These achievements highlight the importance of incorporating eco design principles into housing projects.⁴⁰

³⁸ Neues Soziales Wohnen. Positionen zur IBA_Wien 2022. Ed.: IBA_Wien 2022 und future.lab. Berlin: Jovis Verlag 2020. pp. 236-240

³⁹ The Role of Solar Panel Installation in Madrid: Transition to Renewable Energy Sources. Ed.: Keiken. In: <https://www.keiken-engineering.com/news/the-role-of-solar-panel-installation-in-madrid> (last accessed 26.06.2022)

⁴⁰ Facts + Figures about aspern Seestadt. Ed.: Die Seestadt Wiens. In: https://www.aspern-seestadt.at/jart/prj3/aspern/data/downloads/181004_aspern_Seestadt_Facts_Figures_EN.pdf (last accessed 26.06.2024)

Economic Feasibility

While the total initial investment required by both schemes was high, numerous funding methods took into account the economic feasibility of the schemes. In the scheme of Madrid, EU subsidies and national financing helped to put upfront the initial costs, many of which would have eventually become long-term money savers.⁴¹ Seestadt Aspern also entailed many of the economic features as it was mainly public and privately financed. Thanks to cutting-edge technologies, operational costs were significantly lowered and hence translated into long-term savings for the residents and the municipality.⁴² Savings in utility bills and maintenance costs from both projects resulted in a positive return on investment.

Social Benefits

The living conditions of the residents of both projects were drastically improved, utility costs decreased, and the residents were more engaged with the community. In Madrid, natural ventilation, in conjunction with green roofs, was utilized to improve the indoor climate and air quality; therefore, the health impacts of the residents were also improved.⁴³ Seestadt Aspern social interaction was created through public spaces and services that gave unified community feel. The two projects were green-designed and socially sustainable, with elements beneficial in creating healthier and more resilient communities.⁴⁴

Challenges and Mitigations

Both projects were associated with very high initial costs. However, both challenges were mitigated by public funding, subsidies, and phased development. The Madrid

⁴¹ Madrid Social Housing SFSB. Ed.: European Investment Bank. In: <https://www.eib.org/en/projects/pipelines/all/20180337> (last accessed 04.07.2024)

⁴² Aspern Smart City. Final Report. Ed.: ASCR 2023. In: <https://www.ascr.at/wp-content/uploads/2024/05/AB-ascr-190x260mm-2023-en-RZ-web-1.pdf> (last accessed 26.06.2024)

⁴³ Gonzalo, Roberto/ Habermann, Karl J.: *Energieeffiziente Architektur. Grundlagen für Planung und Konstruktion*. Publisher Birkenhäuser 2006. pp. 74-79

⁴⁴ Facts + Figures about aspern Seestadt. Ed.: Die Seestadt Wiens. In: https://www.aspern-seestadt.at/jart/prj3/aspern/data/downloads/181004_aspern_Seestadt_Facts_Figures_EN.pdf (last accessed 26.06.2024)

project relied on EU subsidies and local incentives to bridge the gap in upfront costs.⁴⁵ Seestadt Aspern, on the other hand, benefited from strategic funding from public sector and co-funding from the private sector to cope with its investment.⁴⁶ Another challenge was that of the need for expert knowledge of green technologies. Both projects have responded to this by hiring and employing trained professionals who are well versed and skilled so as not to complicate the delivery process of green design features.⁴⁷

⁴⁵ Madrid Social Housing SFSB. Ed.: European Investment Bank. In: <https://www.eib.org/en/projects/pipelines/all/20180337> (last accessed 04.07.2024)

⁴⁶ Fact Sheet Siemens & Smart City Research (ASCR). The only research project of its kind in Europe, based in Vienna. Ed.: Siemens. In: <https://assets.new.siemens.com/siemens/assets/api/uuid:677e4451-fe97-49b3-aa9f-519370a8ccac/Fact-sheet-Siemens-ASCR-EN.pdf> (last accessed 24.06.2022)

⁴⁷ Green Jobs & Skills Challenges and Opportunities for Energy Agencies. Ed.: European Energy Network. In: https://enr-network.org/wp-content/uploads/EnR_Green-Jobs-Report.pdf (last accessed 04.07.2024) pp.14-15

5 Economic Viability of Green in Affordable Housing

The elements of cost, investment and financing associated with the implementation of green design elements in affordable housing is explained in this chapter. Besides, it analyses the cost-benefit approach as well as advantages and disadvantages of BEE from an economic perspective and use real life case scenario to discuss how the policy in question can be effectively implemented as well as some of the associated financial implications.

5.1 Cost-Benefit Analysis of Green Design Features

Green design features are of great importance in promoting the achievement of environmental sustainability and reduction in operating costs associated with providing affordable housing. Some of included elements in the green features include energy-efficient appliances, which help in consumption of minimum electricity; the presence of solar panel in the quest for renewable solar energy; green roofing to help insulation and hence minimize storms water; and water-saving fixtures that help consumption of minimal water. Even if the level of the such features adds value to save the level, the true assessment of such comprises the understanding of changed initial costs, both for financial metrics as well as non-financial metrics such as wider impacts on environmental and social issue.⁴⁸

5.1.1 Methodology

The cost- benefit analysis (CBA) entails a systematic process:

1. Selection of Green Features: In affordable housing sector Europe, pertinent green design features that could be selected include energy-efficient appliances, use of solar panels, green roofs, and water-saving fixtures.

⁴⁸ Proença, Lucio/ Ghisi, Enedir: Assessment of Potable Water Savings in Office Buildings Considering Embodied Energy. In: Water Resources Management. Vol. 27(2). Springer 2013. pp. 581-599

2. Time Horizon: It is the period of years taken into consideration during the evaluation; normally 20-30 years. It includes the entire economic, environmental, and social impacts.⁴⁹
3. Economic Metrics: on that note, the payback period, net present value (NPV), and internal rate of return (IRR) all support economic viability inherent in economic metrics. Such kinds of metrics are the of information of how concomitantly the project will achieve some money benefit over period.⁵⁰

5.1.2 Analysis

Upfront Costs

Energy-Efficient Appliances: Includes the premium over standard appliances plus installation. Typical European grants for energy-efficient appliances – subtracted from the net costs.⁵¹

Solar Panels: High upfront costs, but there are incentives with some European governments and feeding tariffs.⁵²

Green Roofs: The high level of diversity in this sector is highly dependent on the structure of the building and even complexity related to the design.⁵³

⁴⁹The Green Book. Central Government Guidance on Appraisal and Evaluation. Ed.: HM Treasury/ Government Finance Function. In: https://assets.publishing.service.gov.uk/media/623d99f5e90e075f14254676/Green_Book_2022.pdf (last accessed 17.03.2024) pp. 24

⁵⁰ Gallant, Chris: Net Present Value vs. Internal Rate of Return. In: <https://www.investopedia.com/ask/answers/05/npv-irr.asp> (last accessed 18.03.2024)

⁵¹ Kow, Jia Liang: Do Energy Efficient Appliances Make Financial Sense? In: <https://getsolar.ai/blog/energy-efficient-appliances/> (last accessed 18.03.2024)

⁵² De Rooij, Dricus: Solar incentives: why invest in solar energy? In: <https://sinovoltaics.com/learning-center/consumers/solar-incentives/> (last accessed 18.03.2024)

⁵³ Theodosiou, Theodoros: Green Roofs in Buildings: Thermal and Environmental Behaviour. In: https://www.researchgate.net/publication/233461448_Green_Roofs_in_Buildings_Thermal_and_Environmental_Behaviour (last accessed 18.03.2024)

Water-Saving Fixtures: Relatively low investment, with costs mainly associated with purchase and installation.⁵⁴

Operational Saving

In every feature, savings are quantified across the analysis period- from reduced energy bills to savings on water, to lower maintenance costs. Of importance will be the necessity of such a state as the UK to boast specific European data, e.g., of accurate energy prices and water rates.⁵⁵

Environmental and Social Benefits

In light of the above-discussed economic viability, it could only mislead readers for other palettes of gains not to be put on the table for discussion, in particular those related to mitigation of greenhouse gases, restoration on biodiversity (e.g. through green roofs) improvement of indoor air quality, or overall health of the inhabitants. These contributions to the value of the property are deemed as indirect benefits of healthy living conditions.⁵⁶

5.1.3 Conclusion

Such analysis demonstrates the most green design features have higher upfront costs and will result in significant long-term savings as well as environmental benefits. More concretely, solar panels demonstrate the highest economic return, together with energy-efficient appliances. For the view of being designed, such consideration has to be tailored to the local climate, regulation, and availability of incentives that would eventually determine the implement ability of such features.

⁵⁴ Garcia, N., Miranda: Life-Cycle Cost Analysis of Efficient Water Fixtures and Electric Appliances Used to Minimize Water Energy Consumption in Homes in the U.S. Edinburgh: The University of Texas Rio Grande Valley, Faculty of Civil Engineering. Theses and Dissertations 2021. pp. 43-51

⁵⁵ Colita, James: Incorporating Sustainable Practices in Affordable Housing Developments. In: <https://www.linkedin.com/pulse/incorporating-sustainable-practices-affordable-housing-colita-james> (last accessed 18.03.2024)

⁵⁶ Snood, Avneesh: Affordable housing and environmental sustainability: Building a greener future. In: <https://timesofindia.indiatimes.com/blogs/voices/affordable-housing-and-environmental-sustainability-building-a-greener-future/?source=app&frmapp=yes> (last accessed 11.06.2024)

Future research needs to refine this analysis with real-world data emerging from developing technologies and landscapes of policies.

5.2 Economic Impact of Green Design on Affordable Housing

In fact, such integration of green design in affordable housing projects represents an approach that is transformational far into economic implications. Beyond near-term environmental benefits and operational efficiencies, it holds the promise of redefining affordability in new ways that contribute both to property value enhancements and furthering the case for economic resilience. The next section reviews the broader economic effects that relate to embedding sustainability practices within affordable housing, including the following: reduced operating costs, enhanced property values, and ensuring long-term affordability.⁵⁷

5.2.1 Operating Costs and Affordability

Low operating costs include energy-efficient appliances, solar panel and improved insulation, among others, that reduce the consumption of energy. This translates to lower utility bills for the developer and, respectively, further promises the affordability of the housing units in the long run for the residents.⁵⁸

Enhanced property values

Properties with the incorporated green design elements often experience enhanced values. This is because the property will be much desirable by a segment of

⁵⁷ Bradshaw, William/ Connelly, Edward F./ Cook, Madeline et al.: The Costs and Benefits of Green Affordable Housing. In: <https://www.newecology.org/wp-content/uploads/2017/08/The-Costs-Benefits-of-Green-Affordable-Housing.pdf> (last accessed 18.03.2024) pp. 15-17.

⁵⁸ Williams, Rashad: Energy Efficiency Home Improvement Credit: Transforming Your Home and Saving Money. In: <https://www.linkedin.com/pulse/energy-efficiency-home-improvement-credit-your-saving-williams-> (last accessed (04.07.2024)

consumers who are increasing, with an aspect of being environmentally friendly and ready to pay for more sustainable better living choices.⁵⁹

Implications

The reduced operational costs and increased desirability are other factors that could make developers increase the rents and sale prices, but at the same time this should not compromise the affordability of the properties. This creates a good situation in that the environmental footprint is lessened, and the economic returns are high.⁶⁰

Defining Affordable Housing

Affordable housing is what a low- or moderate-income household using a reasonably small proportion of gross income can afford. It typically implies that not more than 30% of gross income is spent on housing, with all its attendant costs, so adequate money remains for other critical needs in life. On the other hand, affordable housing does not bring enormous financial burdens that immensely reduce or limit the capacity of its residents to afford other introductory material and services.⁶¹

Challenges in Maintaining Affordability with Green Design

Although green design tended to increase a project's upfront costs, inherently, there was no contradiction between green design and social sustainability of affordable housing. This meant making the right balance of trade-offs between initial investments pitted against future savings and benefits. Through such more

⁵⁹ Laroche, Michel/ Bergeron, Jasmin/ Barbaro-Forleo, Guido: Targeting consumers who are willing to pay more for environmentally friendly products. In: <https://www.emerald.com/insight/content/doi/10.1108/EUM000000006155/full/html> (last accessed 06.07.2024)

⁶⁰ Brady, Catriona/ Burrows, Victoria/ Al-Musa, Ahmad et al.: Beyond the Business Case. Why You Can't Afford Not to Invest in A Sustainable Built Environment. In: <https://worldgbc.org/beyond-the-business-case/> (last accessed 20.03.2024)

⁶¹ Rosenfeld, Orna: Interpreting the term "affordable housing" in the Housing Partnership. In: https://ec.europa.eu/futurium/en/system/files/ged/briefing_note_2017_interpreting_the_term_affordable_housing_-_march_2017.pdf (last accessed 08.07.2024) pp. 7-10

innovative financing mechanisms bracketed with government incentives and application of cost-effective technologies, the higher upfront costs in green design would diminish, thus supportive of, rather than opposed to, affordability.⁶²

5.2.2 Financing and Incentives

Government Incentives

There are countless government programs that are offering grants, low-interest loan and tax credits to be able to integrate green features in affordable housing.⁶³ The lowers financial barriers at the onset and makes it economically viable for the developers to go project green.

Private Financing

The value of sustainable buildings is being seen more and more by private financial institutions and, in the light of his fact, very favorable financing conditions for green developments are being offered. This trend is fueled by a reduce profile of risk that is related to energy-efficient building and the potential to realize returns that are above average.⁶⁴

Growing Demand

A change in pattern is evident from market trends regarding the growing demand for houses with sustainable or green features. Mainly, this change has been guided by a rise in the level of awareness among consumers around the environment and

⁶² Cowan, Kathy Moore: "Green, Affordable" Housing: A Contradiction in Terms? In: <https://www.stlouisfed.org/publications/bridges/summer-2008/green-affordable-housing-a-contradiction-in-terms> (last accessed 08.07.2024)

⁶³ Combination of financial instruments and grants. Ed: European Commission. Place of Publication: Brussels 2021. In: https://www.fi-compass.eu/sites/default/files/publications/Combination%20of%20financial%20instruments%20and%20grants_1.pdf (last accessed 09.07.2024)

⁶⁴ Parsad, Ananthakrishnan/ Loukoianova, Elena/ Xiaochen Feng, Alan/ Oman William: Staff Climate Notes. In: Mobilizing Private Climate Financing in Emerging Market and Developing. 2022. Issue 007. pp. 8-11

aspiration from healthier living environment⁶⁵. Economic viability arising from the increasing demand for green building practices, which is market-driven, underscores the viability of green affordable housing. This new trend forces developers or those positioned into such trends to contribute to environmental sustainability, which means competitive markets.⁶⁶

Conclusion

The nature of the economic impact of integrating green design into affordable housing goes beyond each of their respective scopes to provide a very comprehensive strategy toward the dual challenges that environmental sustainability and housing affordability pose. The first of these taken together – reduced operating costs, enhanced property values, leveraging of financial incentives – contribute to the economic appeal of green design. The way forward is to create an enabling environment through encouragement of developers and policymakers for the adoption of the green design principle. Affordable housing should be economically, environmentally, and socially viable.

5.3 Case-Study: Economic Analysis of Green Affordable Housing

Affordable housing projects, when integrated with such green design, not only help the environment but also help in economic sustainability and improved living quality. The book analyses a collection of case studies of affordable housing projects integrated with Green; dominant in and around Europe, their stories of success.

⁶⁵ The Rise of Sustainable and Energy-Efficient Home: Building for a Greener Future. Ed.: Shivoham Group. In: <https://www.linkedin.com/pulse/rise-sustainable-energy-efficient-homes-building-greener-llsge> (last accessed 20.03.2024)

⁶⁶ Dmytriyeva, Kateryna: Building the future: The rose of Green Real Estate. In: <https://www.cim.io/blog/the-rise-of-green-real-estate>. (last accessed 20.03.2024)

The geographical diversity of these case studies is supposed to be sufficient for a wide spectrum of climate zones and numerous urban contexts.⁶⁷ Equally important will be the range of green features applied and their respective scope, so that a wide set of environmental strategies has been taken into account to ensure a solid basis for conducted comparison.

5.3.1. The Savonnerie Heymans Project: A Model for Sustainable Social Housing in Brussels

Location: Brussels, Belgium

Size: 42 units

Target Demographic: Diverse, including families and singles across various income levels

Green Features: Bioclimatic loggias, solar panels, rainwater harvesting, and a cogeneration heating system, incorporate modern sustainability within the preservation with historical features and balance upfront costs against long-term benefits.⁶⁸

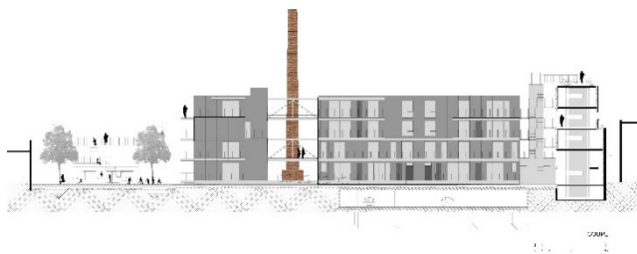


Figure 3: Elevation. MDW Architecture

(Reference: <https://www.archdaily.com/220116/savonnerie-heymans-mdw-architecture> [last accessed 20.03.2024])

⁶⁷ Dong, Junyan/ Zheng, Bomin/ Fu, Yupi/ Li, Kechao: Study on Interior space Optimization of Green Affordable Housing in Cold Region. Changchun, Jilin Province: In: https://www.researchgate.net/publication/341073299_Study_on_Interior_Space_Optimization_of_Green_Affordable_Housing_in_Cold_Region (last accessed 21.03.2024) pp. 1-4

⁶⁸ Savonnerie Heymans/ MDW Architecture. ArchDaily. In: <https://www.archdaily.com/220116/savonnerie-heymans-mdw-architecture> (last accessed 29.05.2024)

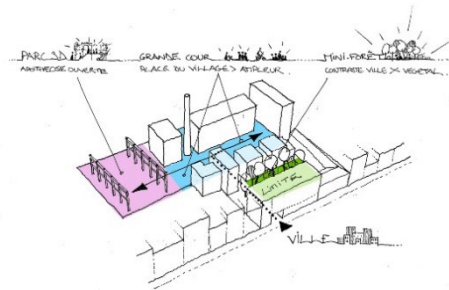


Figure 4: Drawing 02. MDW Architecture

(Reference: <https://www.archdaily.com/220116/savonnerie-heyman-mdw-architecture> [last accessed 20.03.2024])

Economic Analysis

Project Financing

Source of Finance: Financing of the Savonnerie Heymans took on the character of a mix between European Union supports, national housing programs, and earmarked sustainable development initiatives at the city level.⁶⁹

Costs and Savings

Savonnerie Heymans, Brussels: Green investments led to reduce energy use, with initial costs offset by the anticipated decrease in long-term operational expenses for residents.⁷⁰

⁶⁹ Financing Energy Efficiency in Buildings. Ed.: European Commission/ Financing Renovations. Brussels 2020. In: https://commission.europa.eu/funding-tenders/find-funding/funding-management-mode/2014-2020-european-structural-and-investment-funds_en (last accessed 04.07.2024)

⁷⁰ Foster, Behany, Martha: Building good practice. Savonnerie Heymans – Bruxelles, Belgium. 2018. In: <https://docplayer.net/53155773-Building-good-practice-savonnerie-heyman-bruxelles-belgium.html> (last accessed 06.07.2024)

Performance Metrics Return on Investment (ROI)

The sustainable focus anticipates an ROI between 5-10%, thanks to energy savings and heritage value.⁷¹

Resident Impact

Residents are expected to see utility bill reduction of 20-25% due to the energy-efficiency measures. With additional health benefits from the use of natural materials possibly reducing healthcare expenses by an estimated 10%.⁷²

Comparative Analysis

The economic analysis of Savonnerie Heymans project validates the fiscal prudence of incorporating green design in affordable housing. Key economic insights include leveraging a of financing sources, selecting green technologies with quick payback periods, and emphasizing designs that enhance both environmental sustainability and resident well-being.⁷³

Conclusion

The Savonnerie Heymans project exemplifies how green design can be harmoniously integrated into affordable housing. By combining innovative energy-saving measures with the conservation of historic elements and provision of communal spaces, it stands as a compelling model for sustainable urban living. The case study underscores the potential economic benefits of integrating green design

⁷¹ Davis, Marc: How to Find Your Return on Investment (ROI) in Real Estate. In: <https://www.investopedia.com/articles/basics/11/calculate-roi-real-estate-investments.asp> (last accessed 04.07.2024)

⁷² Galooli: The Energy Efficiency Formula: How to Calculate Energy Efficiency. In: <https://galooli.com/blog/calculate-energy-efficiency/> (last accessed 04.07.2024)

⁷³ Almansour, Maram, Dr.: Achieving Sustainable Development: The Integration of Economic Growth, Social Well-being, and Environmental Protection. In: <https://www.linkedin.com/pulse/achieving-sustainable-development-integration-growth-social-lpybf> (last accessed 25.03.2024)

principles into affordable housing, demonstrating the environmental sustainability and social welfare can be mutually reinforcing.

6 Findings and Analysis

This chapter interprets the findings of the case studies and synthesizes some lessons from various examples of green affordable housing. It will show reflection on the research questions and provide an overall answer to them based on the empirical data and the theoretical frameworks discussed above in the thesis.

6.1 Analysis of Case Study Findings

The project of Savonnerie Heymans in Brussels is an illustrative example of how principles of green design have been utilized toward integrating social sustainability with affordable housing. The parameters through which the results attained in this case study were analyzed are economic viability, social impact, and environmental benefits.

Economic Viability

Economic analysis for the Savonnerie Heymans project shows that it is economically sensible to combine green design elements in affordable housing.

Upfront Costs and Financing

There were some pretty sizeable upfront project costs deriving from diversified mix of funding resources, with principal financing drawn from European Union supports, national housing programs, and local sustainable development initiatives.⁷⁴ This diversified the financing approach to lessen the financial burden on any one entity.

Operational Savings

This was achieved by designing energy-efficient measures, including bioclimatic loggias, solar panels, and heating system based on cogeneration. The outcome of this system resulted a drastic reduction of energy consumption, whereby residents

⁷⁴ Financing Energy Efficiency in Buildings. Ed.: European Commission/ Financing Renovations. Brussels 2020. In: https://commission.europa.eu/funding-tenders/find-funding/funding-management-mode/2014-2020-european-structural-and-investment-funds_en (last accessed 09.07.2024)

who would typically pay 20-25% paid-in utility bills saw a massive decrease in energy consumption that translated to long-term financial savings.⁷⁵

Return on Investments (ROI)

A much more conservative ROI expectation of the project is anywhere between 5 to 10% which would come from the cash conserved or saved upon the energy used, plus the succeeding heritage value restored to elements through conservation.⁷⁶

Social Impact

The project contributed significantly towards social sustainability by way of improving living conditions and setting up instruments for community participation:

- **Better Living Environment:** By using natural materials and providing good ventilation, it helped create a healthy indoor environment that could cut down, by an estimate, 10%⁷⁷ in healthcare expenses.
- **Community Engagement:** It featured communal spaces that would enhance social interactions and community cohesion, critical in social sustainability.

Environmental Benefits

- **Reduction in CO₂ Emissions:** The project has resulted in the reduction of carbon emissions to considerable extent, which is indeed hooked with broader environmental goals.⁷⁸

⁷⁵ Williams, Rashad: Energy Efficiency Home Improvement Credit: Transforming Your Home and Saving Money. In: <https://www.linkedin.com/pulse/energy-efficiency-home-improvement-credit-your-saving-williams-> (last accessed (04.07.2024))

⁷⁶ Davis, Marc: How to Find Your Return on Investment (ROI) in Real Estate. In: <https://www.investopedia.com/articles/basics/11/calculate-roi-real-estate-investments.asp> (last accessed 04.07.2024)

⁷⁷ Galooli: The Energy Efficiency Formula: How to Calculate Energy Efficiency. In: <https://galooli.com/blog/calculate-energy-efficiency/> (last accessed 04.07.2024)

⁷⁸ Progress on climate action. Ed.: European Union. In: https://climate.ec.europa.eu/eu-action/climate-strategies-targets/progress-climate-action_en (last accessed 09.07.2024)

- Biodiversity and Urban Greening: This was given more significant input in terms of urban biodiversity by introducing green roofs and rainwater harvesting systems and improved maintenance of stormwater.⁷⁹

Reflection on Research Questions

Main Research Question: The case study confirms that green design elements can be effectively put into low-cost housing to increase social sustainability by finding a balance between the initial investment and long-term economic benefits, social values, and environmental values.

Sub-Questions:

Economic Implications: Through the project, it was demonstrated the high upfront costs are offset by long-term savings, though considering methods to make green affordable housing economically viable.

Impact on Affordability: Affordability will not be affected much because operational cost savings from green design help in maintaining affordability.

Green Design and Social Sustainability: The value of green design in enhancing social sustainability was one clear outcome – it favored improved living conditions and community engagement.

Necessary Policies and Incentives: Results point to the fact that financial incentives and multiple sources of funding act as one the promoters of green affordable housing.

⁷⁹ Mihalakakou, Giouli/ Souliotis, Manolis/ Papadaki Maria et al.: Green roofs as a nature-based solution for improving urban sustainability: Progress and perspectives. In: <https://www.sciencedirect.com/science/article/pii/S1364032123001624> (last accessed 09.07.2024)

6.2 Comparative Analysis and Synthesis

The comparison must be drawn beyond the context of the Savonnerie Heymans project and its wider implications with similar green affordable housing initiatives such that made in the Energy-Efficient Social Housing Residential Building in Madrid and Seestadt Aspern in Vienna.

Economic Viability

- **Initial Investments and Financing:** The projects were all about surpassing high upfront costs but succeeded in pulling diversified funding sources, including government incentives and private financing, that would offset these costs.⁸⁰
- **Operational Savings:** Large utility bill savings were reaped through energy-efficient technologies that went to prove the point that green design can pay off big dividends over time.⁸¹

Social Impact

- **Improved Living Conditions:** According to residents of the case study dwellings, there was enhanced indoor air quality and healthier living conditions generally. This thus goes to support the idea that green design enhances social sustainability.⁸²

⁸⁰ Madrid Social Housing SFSB. Ed.: European Investment Bank. In: <https://www.eib.org/en/projects/pipelines/all/20180337> (last accessed 04.07.2024)

⁸¹ Garcia, N., Miranda: Life-Cycle Cost Analysis of Efficient Water Fixtures and Electric Appliances Used to Minimize Water Energy Consumption in Homes in the U.S. Edinburgh: The University of Texas Rio Grande Valley, Faculty of Civil Engineering. Theses and Dissertations 2021. pp. 43-51

⁸² Mihalakakou, Giouli/ Souliotis, Manolis/ Papadaki Maria et al.: Green roofs as a nature-based solution for improving urban sustainability: Progress and perspectives. In: <https://www.sciencedirect.com/science/article/pii/S1364032123001624> (last accessed 09.07.2024)

- Community Engagement: Communal spaces and green areas were fundamental in promoting social interactions and bringing about community cohesion.⁸³

Environmental Benefits

- Reduction in Carbon Emissions: Every project reported had significant reductions in carbon emissions; hence, this was an assurance of environmental benefit from green design when applied to affordable housing.⁸⁴
- Urban Greening: Improvements in urban biodiversity and better storm water management are realized through such means as green roofs, urban gardens, and efficient water management systems.⁸⁵

Challenges and Mitigations

- Initial Investment: High upfront costs were among the most prevalent. Mixing public and private funding, along with incentivization by the government, had its part in getting past this.⁸⁶
- Technical Expertise: All of these would involve advanced green technologies, whose implementation would call for skilled professionals. In its wake, consequent training and hiring of experienced staff became a necessary step to get the projects executed successfully.⁸⁷

⁸³ Gonzalo, Roberto/ Habermann, Karl J.: Energieeffiziente Architektur. Grundlagen für Planung und Konstruktion. Publisher Birkhäuser 2006. pp. 74-79

⁸⁴ Progress on climate action. Ed.: European Union. In: https://climate.ec.europa.eu/eu-action/climate-strategies-targets/progress-climate-action_en (last accessed 09.07.2024)

⁸⁵ Mihalakakou, Giouli/ Souliotis, Manolis/ Papadaki Maria et al.: Green roofs as a nature-based solution for improving urban sustainability: Progress and perspectives. In: <https://www.sciencedirect.com/science/article/pii/S1364032123001624> (last accessed 09.07.2024)

⁸⁶ Madrid Social Housing SFSB. Ed.: European Investment Bank. In: <https://www.eib.org/en/projects/pipelines/all/20180337> (last accessed 04.07.2024)

⁸⁷ Green Jobs & Skills Challenges and Opportunities for Energy Agencies. Ed.: European Energy Network. In: https://enr-network.org/wp-content/uploads/EnR_Green-Jobs-Report.pdf (last accessed 04.07.2024) pp.14-15

Synthesis and Reflection

The comparative analysis examines lessons learned from the Savonnerie Heymans project on the economic feasibility and social sustainability of integrating green design in low-cost housing. Key lessons learnt:

It is a question of balancing the cost against benefits: Even though there are more significant upfront costs with green design, long-term economic, social, and environmental benefits offset such costs. The need to balance these aspects comprises the heart of the sustainability of affordable housing projects.

Policy Support: Incentives and supportive policies from the government are essential in popularizing the green design of low-cost housing. More drafting and improvement of such policies by policymakers are needed, which will best facilitate sustainable development.

Holistic Approach: Any green affordable housing project calls for a holistic approach to economic, social, and environmental factors. This will ensure developments are not only made more affordable while being sustainable but also enhance the quality of life for residents.

Conclusion

The comparison and case study analysis of the Savonnerie Heymans project, among other initiatives similar to this one, constitutes solid evidence that green design can be effectively integrated into low-cost housing as a way of promoting social sustainability. Findings underpin the notion that through a balanced approach, it is possible to create a diversity in funding, supportive policies, and commitment to long-term benefits that enable the application of green design in affordable housing. Contextualized outreach green design presentation of funds challenges and opportunities places affordable housing as one of the cornerstones for urban development.

7 Discussion

This chapter thus looks at the implications of the findings from previous chapters about their significance in the broad contextual framework of affordable housing and green design. It also brings into light some limitations of the study and suggests further research.

7.1 Implications of Findings

Some critical implications from the findings of case studies in green affordable housing projects, particularly that concerning Savonnerie Heymans, are:

Economic Viability and Sustainability

A case such as Savonnerie Heymans, an affordable housing project with green design features, proves that the initial costs may be high but very noticeably have long-term economic benefits. Reductions in operational costs due to energy efficiency and sustainable technologies are so dramatic that it would point out that a project of this nature can attain economic sustainability.⁸⁸ These findings confirm the argument that investing in green design is both responsible from an environmental perspective and a financially sound investment decision.

- Long-term Savings: from reduced energy and water use and operational savings constitute the direct economic benefits of green design. Such savings, in the long run, therefore, democratize housing, offsetting any upfront investment.⁸⁹

⁸⁸ Foster, Behany, Martha: Building good practice. Savonnerie Heymans – Bruxelles, Belgium. 2018. In: <https://docplayer.net/53155773-Building-good-practice-savonnerie-heymans-bruxelles-belgium.html> (last accessed 06.07.2024)

⁸⁹ Levy, Barak: Sustainable savings: The financial benefits of operating a green building. In: <https://wint.ai/blog/green-buildings-cost-less/> (last accessed 09.07.2024)

- **Increased Property Values:** The improved appeal of those properties with green features increases their property values for the developers and residents.⁹⁰

Social Sustainability and Community Impact

These types of projects show that green design has contributed, to a large extent, to social sustainability by improving living conditions and promoting community involvement.

- **Health Benefits:** Improving indoor air quality and implementing non-toxic materials result in increased health for the occupants.⁹¹
- **Community Cohesion:** Communal spaces and green areas allow social interaction that is essential to cohesion of the community. This is highly relevant socially to the well-being of residents.⁹²

Environmental Benefits

Environmental advantages, in terms of CO₂ reduction and urban biodiversity increase, could result from integrating green design into low-cost housing.

- **Carbon Footprint Reduction:** Huge projects, like Savonnerie Heymans, are linked to a high reduction in carbon emissions and hence respond to global concerns about sustainability.⁹³

⁹⁰ Laroche, Michel/ Bergeron, Jasmin/ Barbaro-Forleo, Guido: Targeting consumers who are willing to pay more for environmentally friendly products. In: <https://www.emerald.com/insight/content/doi/10.1108/EUM000000006155/full/html> (last accessed 06.07.2024)

⁹¹ Allen, G. Joseph/ MacNaughton, Piers/ Laurent, Jose Guillermo Cedeno et al.: Green Building and Health. In: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4513229/> (last accesses 06.07.2024)

⁹² Social interaction, inclusion and community cohesion. Ed.: Forest Research. In: https://cdn.forestresearch.gov.uk/2022/02/urgp_evidence_note_011_social_interaction_inclusion_and_community_cohesion.pdf (las accessed 09.07.2024)

⁹³ Progress on climate action. Ed.: European Union. In: https://climate.ec.europa.eu/eu-action/climate-strategies-targets/progress-climate-action_en (last accessed 09.07.2024)

- Urban Greening: Some of associated features include green roofs, rainwater harvesting, and others that help to secure urban biodiversity and efficient stormwater management.⁹⁴

Policy and Regulatory Implications

The findings bring out the supportive policies and financial incentives that are required to diffuse green design in low-cost housing.

- Government Incentives: Only those policies that include grants, low-interest loans, and tax credits raise the likelihood of overcoming higher first costs associated with green design.⁹⁵
- Regulatory Support: A full set of regulations that require or encourage green practices in building design will foster large-scale adoption of green design principles in the affordable housing stock.⁹⁶

7.2 Limitations of Study

While valuable in its contribution, this study has the following limitations:

Sample Size and Generalizability

This research is informed by a limited number of case studies and hence gives narrow representation of the widest range of affordable housing projects worldwide. Since this publication is based on those case studies, findings cannot be generalized for all contexts.

⁹⁴ Green Roofs Copenhagen. Ed.: The Technical and Environmental Administration in City of Copenhagen. In: https://en.klimatilpasning.dk/media/704006/1017_sJ43Q6DDyY.pdf (last accessed 06.07.2024)

⁹⁵ Combination of financial instruments and grants. Ed: European Commission. Place of Publication: Brussels 2021. In: https://www.fi-compass.eu/sites/default/files/publications/Combination%20of%20financial%20instruments%20and%20grants_1.pdf (last accessed 09.07.2024)

⁹⁶ Housing affordability and sustainability in the EU. Analytic Report. Ed.: European Construction Sector Observatory. In: https://single-market-economy.ec.europa.eu/system/files/2021-02/ecso_ar_housing_affordability_2019_0.pdf (last accessed 06.07.2024) pp. 64-69

- Regional Bias: Most of the case studies come from experiences in Europe, and policies or funding mechanisms vary significantly among regions.⁹⁷
- Limited Longitudinal Data: The study lacks the long-term data of economic and social impacts of green design in affordable housing, therefore, very hard to assess whether benefits and challenges are full-blown or change over time.⁹⁸

Methodological Constraints

The issue is that the reliance upon qualitative data and, therefore, the subjective nature of thematic analysis may be biased.

- Subjectivity: Qualitative data analysis can be subjective and may thus affect the results.⁹⁹
- Data Availability: It was not easy to get the detail of financial and performance data from some project, which is limitation of analysis comprehensiveness.¹⁰⁰

⁹⁷ Cohesion in Europe towards 2050. Eighth report on economic, social and territorial cohesion.

Ed.: European Commission. In:

https://ec.europa.eu/regional_policy/sources/reports/cohesion8/8cr.pdf (last accessed 07.07.2024)
pp. 267- 292

⁹⁸ Zhao, Dong/ McCoy, Andrew P./ Agee, Philip/ Mo, Yunjeong et al.: Time effects of green buildings on energy use for low-income households: A longitudinal study in the United States. In: <https://www.sciencedirect.com/science/article/abs/pii/S2210670718301094> (last accessed 07.07.2024)

⁹⁹ Bumbuc, Ștefania: About Subjectivity in Qualitative Data Interpretation. In:

https://www.researchgate.net/publication/305760585_About_Subjectivity_in_Qualitative_Data_Interpretation (last accessed 07.07.2024)

¹⁰⁰ Subrahmanyam, Avanidhar: Big data in finance: Evidence and challenges. In:

<https://www.sciencedirect.com/science/article/pii/S2214845019302650> (07.07.2024)

7.3 Suggestions for Future Research

Still, to build on the findings of this research and address the limitation of the current study, future studies have to make sure to include the following:

Expand Geographical Scope

Future studies need to have more diverse geographical locations to help untangle how such differing contexts influence both the focus of implementation and outcomes in green design within affordable housing.

- **Global Case Studies:** The case studies should include developing countries and regions that hold varying climates and economic conditions so that generalization of findings is enhanced.¹⁰¹

Longitudinal Studies

Long-term researches are likely to give meaningful insights into the lasting impacts that shall result from green design in affordable housing.

- **Impact assessment:** Economic, social, and environmental over long periods should be assessed through longitudinal research from which all the benefits and challenges can be realistically captured.¹⁰²

Interdisciplinary Approaches

It will add to their analysis by incorporating an interdisciplinary, multifaceted approach that brings together perspective of architecture, urban planning, social sciences, and economics.

¹⁰¹ Going Green: A Handbook of Sustainable Housing Practices in Developing Countries. Ed.: United Nations Human Settlements Programme: Nairobi 2012. In: <https://unhabitat.org/sites/default/files/download-manager-files/Going%20Green.pdf> (last accessed 07.07.2024)

¹⁰² Caruana, Edward Joseph/ Roman, Marius/ Hernandez-Sanchez, Jules et al.: Longitudinal Studies. In: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4669300/> (last accessed 07.07.2024)

- Holistic Analysis: Future research should be on holistic frameworks in which many factors that influence affordable housing sustainability interact.¹⁰³

Policy Impact Evaluation

The effectiveness of the existing policies and incentives shall be evaluated to identify best practices and any scope for improvement.

- Comparative Policy Analysis: Several policy frameworks need to be compared through research in order to learn which of them turns out to be most effective in promoting green design in affordable housing.¹⁰⁴

Technological Innovations

It can become an innovative solution for investigating new and emerging technologies that help to integrate green design in low-cost housing.

- Technological Improvement: Research is called for on how technological progress innovations can bring down costs and increase the sustainability of affordable housing projects.¹⁰⁵

Conclusion

This research work certainly provides evidence of integrating green design principles into affordable housing with great potential to attain social sustainability. It is not without its challenges, however – it has issue on growth grounds, most especially the serious concerns over initial costs. The long-term economic, social,

¹⁰³ Evaluation Perspectives. Holistic evaluation of housing projects and the 2030 Agenda for Sustainable Development: Some lessons from the field. Ed.: Council of Europe Development Bank. In: https://coebank.org/media/documents/EPS_Holistic_evaluation_housing_2021.pdf (last accessed 07.07.2024)

¹⁰⁴ Howlett, Michael/ Mukherjee Ishani: The Contribution of Comparative Policy Analysis to Policy Design: Articulating Principles of Effectiveness and Clarifying Design Spaces. In: https://ink.library.smu.edu.sg/cgi/viewcontent.cgi?article=3762&context=soss_research (last accessed (07.07.2024)

¹⁰⁵ Alvear, Alexandra: How can innovation and technology solve the housing deficit? In: <https://www.linkedin.com/pulse/how-can-innovation-technology-solve-housing-deficit-alexandra-alvear-y0dee/> (last accessed 07.07.2024)

and environmental benefits certainly outweigh the costs and hence shall induce strong justification for adopting green design. In other words, further research in this area of promising confluence of affordability and sustainability will be required in future research so that useful insights are to be brought out towards policymakers, developers, and the communities who want to chart a course toward building a more sustainable and equitable future.

8 Conclusion

8.1 Summary of Findings

The research was conducted at the junction of social sustainability and green design in the affordable housing context. The detailed analysis and case studies have resulted in a number of critical findings:

Economic Viability and Sustainability

- **Initial Costs and Long-Term Savings:** Green design is expensive to incorporate in affordable housing. However, these costs are dwarfed over time by the savings in both energy and water use, in operational efficiency, and through property appreciation.¹⁰⁶
- **Funding Mechanism:** Diverse sources of funding will involve governmental policies through grants or incentives and private investors or financiers themselves, which will possibly be a solution to existing financial constraints brought about by green design.¹⁰⁷

Social Sustainability and Community Impact

- **Improved Living Conditions:** Green design assures that there is an improvement in the levels of living of the residents. It provides good quality halls for fresh air in the house, natural lightening, and materials not containing toxins, which further help improve the health outcomes of the residents.¹⁰⁸

¹⁰⁶ Levy, Barak: Sustainable savings: The financial benefits of operating a green building. In: <https://wint.ai/blog/green-buildings-cost-less/> (last accessed 09.07.2024)

¹⁰⁷ Financing Energy Efficiency in Buildings. Ed.: European Commission/ Financing Renovations. Brussels 2020. In: https://commission.europa.eu/funding-tenders/find-funding/funding-management-mode/2014-2020-european-structural-and-investment-funds_en (last accessed 09.07.2024)

¹⁰⁸ Mihalakakou, Giouli/ Souliotis, Manolis/ Papadaki Maria et al.: Green roofs as a nature-based solution for improving urban sustainability: Progress and perspectives. In: <https://www.sciencedirect.com/science/article/pii/S1364032123001624> (last accessed 09.07.2024)

- Community Cohesion: Inclusion of communal spaces and green areas induces social interaction as well as community participation in social activities, highly needed for social sustainability.¹⁰⁹

Environmental Benefits

- Reduction in Carbon Footprint: Green Design in affordable housing leads to deep physical reductions in carbon emissions toward broader environmental sustainability goals.¹¹⁰
- Urban Greening and Biodiversity: Features such as rainwater harvesting systems and green roofs, which provide biodiversity and have the ability to support urban areas under storm conditions.¹¹¹

Policy and Regulatory Implications

- Supportive Policies: Governmental policies and incentives are very essential in seeing the universal application of green design principles in low-cost housing. Regulatory frameworks mandating or encouraging sustainable practice are called for in order to guarantee long-term success.¹¹²

¹⁰⁹ Social interaction, inclusion and community cohesion. Ed.: Forest Research. In: https://cdn.forestresearch.gov.uk/2022/02/urgp_evidence_note_011_social_interaction_inclusion_and_community_cohesion.pdf (last accessed 09.07.2024)

¹¹⁰ Progress on climate action. Ed.: European Union. In: https://climate.ec.europa.eu/eu-action/climate-strategies-targets/progress-climate-action_en (last accessed 09.07.2024)

¹¹¹ Mihalakakou, Giouli/ Souliotis, Manolis/ Papadaki Maria et al.: Green roofs as a nature-based solution for improving urban sustainability: Progress and perspectives. In: <https://www.sciencedirect.com/science/article/pii/S1364032123001624> (last accessed 09.07.2024)

¹¹² Combination of financial instruments and grants. Ed: European Commission. Place of Publication: Brussels 2021. In: https://www.fi-compass.eu/sites/default/files/publications/Combination%20of%20financial%20instruments%20and%20grants_1.pdf (last accessed 09.07.2024)

8.2 Contributions of the Study

This research makes a number of contributions to the subject area of sustainable housing:

Theoretical Contributions

- The interdisciplinary approach followed by this thesis weaves together streams of thoughts from architecture, urban planning, social science, and economics to give a comprehensive framework of understanding at the juncture of social sustainability and green design within the context of low-cost housing.¹¹³

Empirical Contributions

- **Case Studies:** The empirical evidence that drives home the benefits and challenges of green design in affordable housing is drawn from case studies on Savonnerie Heymans, Energy-Efficient Social Housing in Madrid, and Seestadt Aspern.¹¹⁴

Policy Contributions

- **Policy Recommendation:** Key findings underscore supportive policies and financial incentives as very important in promoting green design in affordable

¹¹³ Garcia, Jose Luis Miralles: Contributions to a theoretical framework for sustainable urban development: Some conclusions of the Spanish case. In: https://www.researchgate.net/publication/271438425_Contributions_to_a_theoretical_framework_for_sustainable_urban_development_Some_conclusions_of_the_Spanish_case (last accessed 09.07.2024)

¹¹⁴ Housing for All – An Exploratory Review of Social Housing Models in Vienna. Ed.: BC Housing's Research Centre. In: <https://viennahouse.ca/wp-content/uploads/2022/01/vienna-house-housing-for-all.pdf> (last accessed 09.07.2024) pp. 6-10

housing. Recommendations to policymakers are grants, low-interest loans, tax credits, or other means of off-setting the upfront costs.¹¹⁵

Practical Contributions

- Practice Guidelines: Following good practice emerging from the examination, this research provides practical guidelines by which green design elements can be effectively combined with affordable housing projects by developers and architects – namely, with an emphasis on community engagement and interdisciplinary approaches.¹¹⁶

8.3 Final Thoughts

Green design in affordable housing is not only integrative but also imperative to social sustainability. That is because high upfront costs coupled with placing specialist knowledge requirements run these against the long-run economic, social, and environmental benefits. Within the context of world rapidly urbanizing and increasing in its needs for affordable housing, sustainable design practices will definitely have to form the basic set of competencies for resilient, equitable. And healthy communities.

Future Directions:

- Expand Geographical Scope: Future research need to sample different geographical locations that would further explain how varying contexts are

¹¹⁵ Combination of financial instruments and grants. Ed: European Commission. Place of Publication: Brussels 2021. In: https://www.fi-compass.eu/sites/default/files/publications/Combination%20of%20financial%20instruments%20and%20grants_1.pdf (last accessed 09.07.2024)

¹¹⁶ Green Building. Interventions for Social Housing. Ed.: United Nations Human Settlements Programme: Nairobi 2015. In: https://www.mypsup.org/library_files/downloads/Green%20Building%20Interventions%20for%20Social%20Housing.pdf (last accessed 09.07.2024) pp. 49-70

influencing the implementation and outcomes of green design in low-cost housing.

- **Longitudinal Studies:** These require long-term research in order to capture lasting impacts of the green design, affecting economic, social, and environmental outcomes.
- **Interdisciplinary Research:** Future research should embody the adoption of the interdisciplinary approach, which shall help integrate perspectives from different fields to enhance holistic understanding with regard to Sustainable Affordable Housing.
- **Policy Impact Evaluation:** The existing policies and incentives will be evaluated for their effectiveness in view of the best practice and identifying scope for improvement.
- **Technological Innovations:** Researching new and emerging technologies is likely to reduce the cost and increase the feasibility of green affordable housing projects.

In conclusion, this research presents its implication for new possibility toward the integration of green design principles in affordable housing; it leads to success in the components of social sustainability. Further, the findings would help research and practical implementation targeted toward the better, sustainable, and equitable future for urban communities.

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Erklärung zur Nutzung von generativen KI-Tools¹¹⁷

Titel der Arbeit Social Sustainability in Affordable Housing: A Green Design Approach
 Abgabedatum 15.07.2024

1. Verantwortungsvoller Umgang mit KI-Tools

Bestätigen Sie die folgenden Aussagen.

Aussagen zum verantwortungsvollen Umgang mit KI-Tools	Bestätigung: Ja
Ich bin/wir sind über die Möglichkeiten und Grenzen der von mir/uns verwendeten generativen KI-Tools informiert.	<input checked="" type="checkbox"/>
Ich/wir habe(n) mich/uns vergewissert, dass die von den KI-Tools gelieferten Ergebnisse korrekt sind, oder dass ich/wir sie korrigiert habe(n).	<input checked="" type="checkbox"/>
Ich/wir erkenne(n) an, dass die Verantwortung für die Arbeit bei dem/den Autor(en) liegt, nicht bei den KI-Tools oder einer anderen Person.	<input checked="" type="checkbox"/>

2. Detaillierte Tätigkeiten, für die KI-Tools genutzt wurden

Geben Sie an, welches KI-Tool Sie in welchem Umfang für welche Tätigkeit genutzt haben.

Aktivität	Beschreibung	Verwendete KI-Tools (falls zutreffend) ¹¹⁸
Gliederungsentwurf	<ul style="list-style-type: none"> – Unterstützung bei der Erstellung eines ersten Gliederungsentwurf – Diskussion möglicher Kapitel und Abschnitte basierend auf der Recherche 	ChatGPT
Übersetzen von Text	<ul style="list-style-type: none"> – Übersetzung de von den IBA_Wien 2022 und future.lab verfassten Text 	ChatGPT
Generierung des Textes	<ul style="list-style-type: none"> – Generierung des Titels der Bachelorarbeit: „Social Sustainability in Affordable Housing: A Green Design Approach“ 	ChatGPT

¹¹⁷ Universität Hohenheim. Kognition: Erklärung zur Nutzung von generativen KI-Tools in Hochschulprüfungen.” https://digital.uni-hohenheim.de/fileadmin/einrichtungen/digital/KOGNITION_Generative_KI_Erklaerung.docx abgerufen am 14.12.2023.

3. **Unterschrift(en) des / der Autor:in / Autor:innen**

	Autor:in Nachname, Vorname(n)	Matrikulationsnummer	Datum	Unterschrift
1	Budean Valeria	01546154	15.07.2024	