A LANDSCAPE ANALYSIS OF SUSTAINABLE, GREEN, AND CIRCULAR HOUSING SOLUTIONS IN THE PHILIPPINES

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E4C Fellow:
Dean Ashton Plamenco, Philippines

This research is in collaboration with:
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Project Advisors and Collaborators: **Jessan Catre**, Terwilliger Center for Innovation in Shelter, Habitat for Humanity International (Philippines); **Jerick Axalan**, Market Systems and Entrepreneurship Specialist at Habitat for Humanity International (Philippines); **Juan Pablo Vargas**, Senior Advisor, Innovation, Entrepreneurship, and Markets Systems, Applied Innovation (Costa Rica); **Jennifer Oomen**, Director, Applied Innovation, Terwilliger Center for Innovation and Shelter (Netherlands)

E4C Program Management Team: **Mariela Machado**, Senior Program Manager; **Erin Peiffer**, Research Manager; **Marilynn Holguín Clover**, Program Coordinator; **Jonathan Kemp**, Program Specialist; **Carolina Rojas**, Program Associate

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Executive Summary

As underserved populations continue to be adversely impacted by the effects of climate change, there is the need for a more sustainable housing sector which offers adequate, affordable, and sustainable housing. In the Philippines, the housing backlog is expected to reach 22 million by 2040. While the National Climate Action Plan has cited green building as a key strategy to climate change adaptive housing, without an operational green building strategy, the transformation to more sustainable practices poses great challenges to the housing sector.

This study aimed to answer the question "*how might we make green housing more affordable and accessible for financial service providers, builders, and end-users*" in the Philippines. This was accomplished by 1.) defining and analyzing sustainable, green, and circular housing and construction concepts, 2.) mapping the housing value chain to identify stages, stakeholders, approaches, challenges and opportunities to greening the affordable housing value chain, and 3.) developing a Theory of Change to explain how a green and circular housing value chain can be achieved.

Through mapping the housing value chain, emerging themes, solutions and innovations, enabling interventions, and capabilities and preconditions were identified. One emerging theme is that the business case for green, while largely enabled by financing and policy, does not necessarily require newer construction technologies, they simply must allow for increased supply of housing units. Additionally, there is an opportunity to establish planning and design codes standards that are aligned to green principles. Some of the solutions and innovations identified across the value chain include passive design strategies and energy and water capture technologies; more efficient construction technologies to reduce resources, waste, and cost; and waste reuse models in material sourcing and production. Additionally, it was found that innovative financing and policy can be used to accelerate housing production by attracting homebuilders to venture into green housing development. Lastly, the Theory of Change developed through this study found that transforming the housing value chain to green unlocks necessary preconditions to ensure a functional housing value chain that can enable homebuilders to participate in the production of housing stock through green financing mechanisms, and at the same time provide green and resilient shelter for end-users.

From this study, key recommendations include 1.) reviewing and updating current building standards to incorporate green and resilient building, as well as the adoption of performance-based standards for housing to guide homebuilders to adopt the use of materials and methodologies that contribute to a greener housing construction value chain, 2.) land-use planning and implementation of development controls should enable efficient delivery of green housing development, and 3.) the government must step in to become both principal project sponsors and active regulators of housing projects to ensure affordability and timely delivery.

While the business case of green is demonstrated, the transition to greener affordable housing development in the Philippines must be backed by effective policy to further validate its business case and attract investments, ensuring a sustainable and productive housing sector for all.

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The Growing Need for Sustainable and Green Housing

In recent years, the world has witnessed a growing number of natural and anthropogenic[1] hazards affecting billions of lives each year driven by climate change and extreme weather events. Climate change has differing adverse impacts, especially in underserved populations, despite contributing less to global CO_2 emissions.[2] Climate-driven disasters brought not only serious risks to property and infrastructure but also caused internal displacement during the past decade, forcing an estimated 20 million people a year from their homes globally. In the Philippines, extreme weather events and natural disasters in the previous decade caused damages to infrastructure totaling USD 2 billion[3] while displacing 3.6 million people annually.[4] Those who lack access to resilient or secure housing are the most adversely affected as they often live in areas that are vulnerable to floods, hurricanes, cyclones, storm surges, mudslides, earthquakes and tsunamis.[5]

The construction sector accounts for the highest material consumption footprint, utilizing around 50% of the total material stock across the global economy[6] and 35% of the global final energy use in 2020. Meanwhile, CO_2 emissions temporarily fell 10% in 2020 due to a temporary decline in activity within the sector but is projected to pick up again to 40% with increasing economic activity.[7] In this light, there is a global movement of adopting green building principles to building control policies. Many countries, including the Philippines, have started to develop incentives and instruments around green and resilient building, as well as the uptake of circular economy[8] to achieve their built environment strategy. As people worldwide are increasingly subscribing to environmentally conscious practices, businesses are starting to identify new opportunities with the increasing demand for sustainable products and services. Additionally, governments are starting to develop action plans to shrink carbon footprints of economies with sustainability trends on net-zero, carbon-neutral, and regenerative goals.

Figure 1. Aerial photo of Pasig City, Quezon City, and the Pasig River[9]

[1] Originating from human activity
[2] World Meteorological Organization
[3] Philippine Statistics Authority, Damages due to Extreme Events and Disasters, 2020
[4] IDMC, 2011-2020 PH Internal Displacement Data, IDMC
[5] UN Disaster Risk Reduction, Global Assessment Report on Disaster Risk Reduction, 2019
[6] Lifecycle Initiative, SCP-HAT Global Report, Lifecycle Initiative 2020, 2020
[7] UNEP, 2021 Global Status Report for Building and Construction, 2021
[8] Republic of the Philippines, PH Nationally Determined Contribution as communicated to the UNFCCC, 2021
[9] Pixabay, Manila, Philippines, n.d.

A 'green' building reduces or eliminates negative impacts on the climate and natural environment through its design, construction or operation while preserving natural resources and improving quality of life.[10] Specifically in the Philippines, green building is the practice of adopting measures that promote resource management efficiency and site sustainability while minimizing the negative impact of buildings on human health and the environment. This practice complements conventional building design concerns around economy, durability, serviceability, and comfort.[11]

In the Philippines, the National Climate Action Plan has cited green building as a key strategy to climate change adaptive housing and land use development, promoting the proliferation of green cities and municipalities. The local built environment sector sees a significant opportunity to minimize adverse environmental impacts, primarily by reducing operational carbon emissions through increased energy efficiency and the use of low-impact materials. Although without an operational green building strategy, the transformation to sustainability poses a threat to the housing sector and may be unattractive to builders and buyers alike.

Sustainable housing today plays a crucial role in achieving inclusive development but has yet to become prominent in developing countries like the Philippines as it requires a new understanding to effectively address issues of slumification, urban divide, poverty, and climate change.[12] Local affordable housing programs often provide inadequate accommodations which are remote and offer little consideration to the occupants' way of life and livelihood. In some examples, rapid housing developments involve poor planning, amplifying environmental impacts and providing suboptimal societal benefit. In most developing cities, adequate and resilient housing remains a social burden that needs to be solved.[13]

Prior to the pandemic, the housing backlog in the Philippines was already 11.3 million in 2018, an estimate that includes the underserved segments. It is expected that by 2022, this will increase to 15 million and will hit 22 million by 2040. Of this, 3.1 million low-income Filipinos belong to the underserved segments called Owner Driven Construction (ODC) who build their homes incrementally over decades.[14] Over the last decade, the government allotment for the national housing sector stands at less than 2%. With the institutionalization of the new Department of Human Settlements and Urban Development, the government looks to push the harmonization of its urban development programs with the New Urban Agenda towards the realization of its "Ambisyon Natin 2040" (Our Ambition 2040) where *"Filipinos live in a prosperous, predominantly middle class society where no one is poor"*.

[10] World Green Building Council, What is a green building?, n.d.
[11] Philippine Green Building Code, Green Building Concept, 2015
[12] UN Chronicle, Addressing the Sustainable Urbanization Challenge, n.d.
[13] Almaden, C. R. C., & Navarro, K. D. (2016). The social cost of upgrading informal settlements in Butuan City, Philippines. *Journal of Urban Regeneration & Renewal*, *9*(3), 295-310
[14] Habitat for Humanity Terwilliger Center for Innovation in Shelter, Clearing the Housing Backlog: An Updated Supply and Demand Study on Unserved Owner-Driven Construction Segment in the Philippines, 2020

Figure 2. Housing Poverty in the Philippines[15]

The Objectives of the Study

A green and circular housing value chain mitigates ecological impacts and promotes sustainable development through a self-sustaining model of production and consumption. This is accomplished through environmentally-aware planning and design, and an enabling policy environment. In the Philippines, there is a need to align different approaches to sustainable building and to harmonize policy and financing mechanisms to enable the adoption of green and circular building technologies in the housing sector. With this, the study aims:

1. to define and analyze sustainable, green, and circular housing and construction concepts
2. to map the housing value chain to identify stages, stakeholders, approaches, challenges, and opportunities to greening the affordable housing value chain
3. to develop a Theory of Change which explains how a green and circular housing value chain could be achieved.

As seen in Figure 3, the research question was: *How might we make green housing more affordable and accessible for financial service providers, builders, and end-users?* The four sub-questions illustrated in the figure guided the approach to mapping and analyzing the housing landscape.

[15] Habitat for Humanity Great Britain, Housing Poverty in the Philippines, n.d.

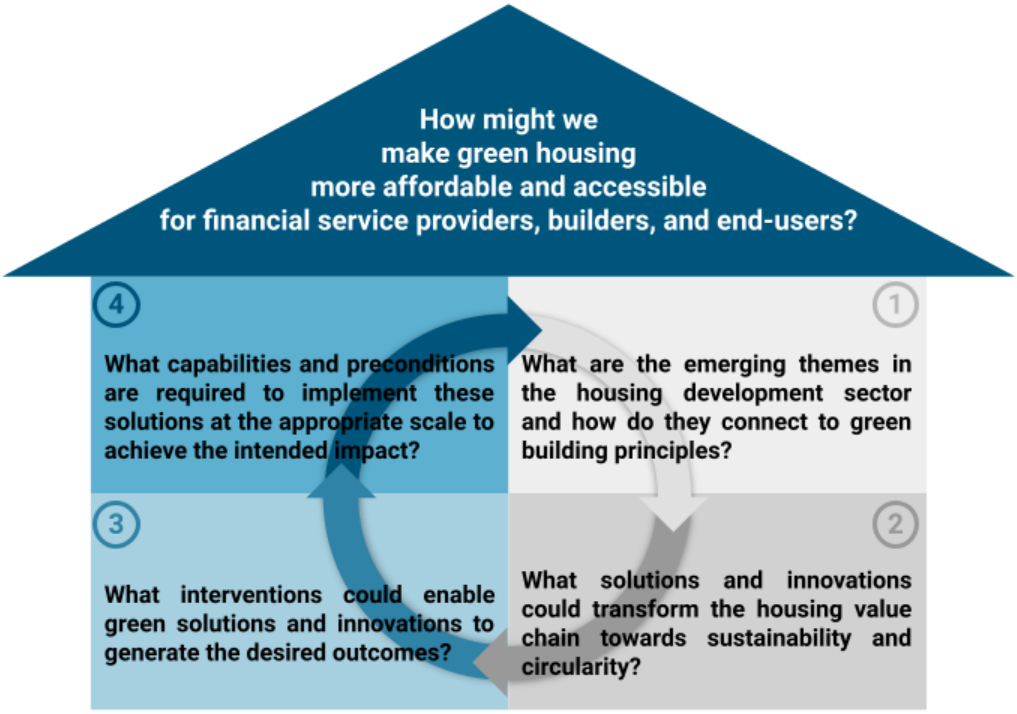

Figure 3. Research Questions

Methods

In this study, desk research and expert interviews were used to investigate emerging themes and sustainable, green, and circular housing and construction solutions in the Philippine housing value chain. Data analysis was used to assess enablers and to identify barriers and opportunities to greening the housing value chain. The results from each of the phases of the research were integrated with the key recommendations to develop a Theory of Change, as shown in Figure 4.

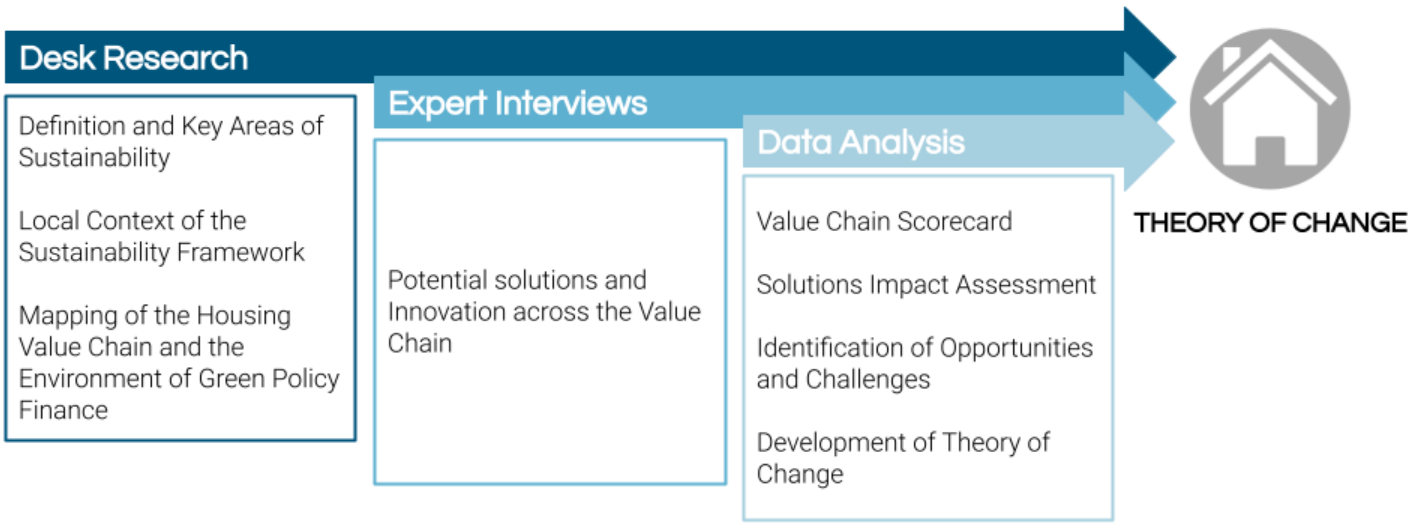

Figure 4. Research process

Desk Research

Sustainability concepts were identified from local and international frameworks such as UN-Habitat, Asian Development Bank, and Philippine Green Building Council. Additional sources of data such as case studies, market data, policy briefs, and key reports were used to assess the state of green housing in the Philippines. These sources were used to map the current housing value chain and to identify sustainable and circular solutions.

The housing value chain in the Philippines was mapped from the Planning & Design to End-of-life/Reuse stage. For each stage, processes, products, stakeholders, and interfaces were identified, as shown in Figure 5. Emerging trends such as housing demand and production were also studied to identify barriers and enablers to greening the housing sector.

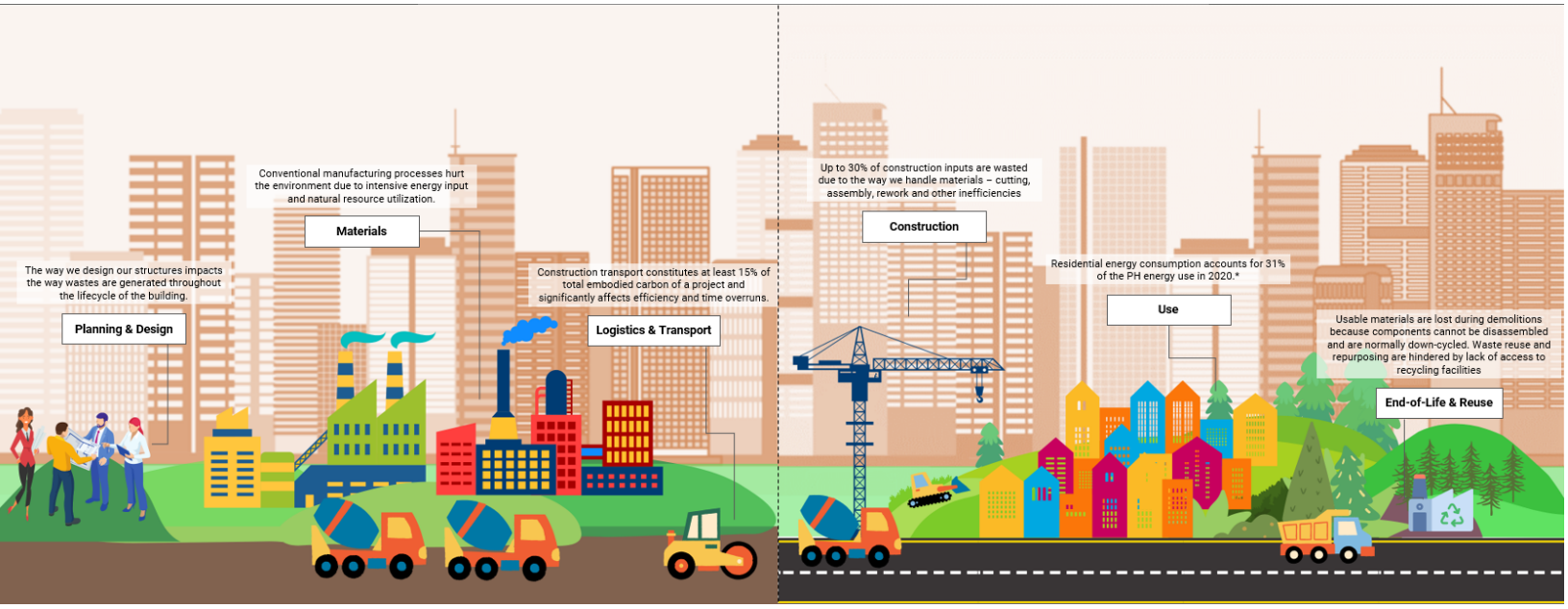

Figure 5. Stages of the Housing Value Chain

Expert Interviews

Expert interviews were also used to identify technological, policy, and financing opportunities that could transform the housing value chain to be more sustainable and productive. Thirteen interviews with stakeholders from different startups, contracting firms, construction material manufacturers/suppliers, recyclers, government institutions, housing developers, and academia were conducted to explore existing solutions, to assess the interaction between different stakeholders in the value chain, and to investigate the local policy and financing environment. These interviews aided in addressing any gaps found in the desk research phase.

Data Analysis

Data was synthesized from the desk research and interviews to map the housing value chain, identify key enablers and barriers, and identify opportunities to make the value chain more circular. Specific examples of different technological, financial, and policy innovations in the Philippines were prepared to illustrate how each of

the solutions identified across the value chain are operationalized and to reinforce the assessment on each of the stages along the housing value chain.

The Philippine Green Building Code, Philippine Climate Change Action Plan, BERDE Green Building Rating Framework, Philippine National Development Plan, Philippine National Urban Development and Housing Framework and UN SHERPA were used as references to develop a framework in this study to assess value chain sustainability with regard to maturity level and potential for impact. Each value chain stage was assessed on sustainability based on the data collected using a three-level color map: **navy** (sustainable and functional), **blue** (partial function, transitioning to sustainability), and **gray** (weak function/dysfunctional).

The maturity criteria (Table 1) and the considerations for the impact assessment (Table 2) are presented below:

Table 1. Three-level maturity assessment

Three-Level Maturity Assessment	
Navy	Solution is currently implemented on a large scale with existing use cases and verified results
Blue	Solution is currently operational and observed in isolated cases
Gray	Solution is existing but not yet operational

Table 2. Sustainability considerations in the solutions impact assessment

Impact Assessment Considerations	
Economic	• Affordability • Support to the local economy • Lifecycle viability (use costs, maintenance, reuse)
Sociocultural	• Community health and safety and landscape preservation • Compatibility with the core needs of the community • Reproducibility, community development, and appropriation
Environmental	• Preservation of biodiversity and natural resources • Pollution reduction and climate change mitigation • Adaptation to natural environment and climate risks

The primary and secondary data sources were used to identify opportunities and challenges to greening the housing environment in the Philippines. The collective insights from the identified solutions, industry recommendations, and analysis contributed to the development of the Theory of Change.

Sustainable, Green, and Circular Housing

Defining Sustainability

Sustainability is a broad term with many definitions and applications. In this section, various terminologies for sustainability are discussed to provide a holistic view of sustainability as utilized throughout the rest of this report.

The practice of green building is central to sustainability in the built environment. Green building seeks to improve the efficiency of building performance through sound environmental and resource management standards throughout the building's lifecycle (resources, construction, operation, and maintenance) without significantly increasing the cost.[16] Environmental, economic, cultural, and social considerations form one of the bases of sustainability in the housing sector used in this report.

Figure 6. Four principles of sustainability in the housing sector

Housing should be planned, constructed, and used in a way that minimizes environmental impact and promotes environmental sustainability. This includes reducing the lifecycle carbon footprint throughout design, material supply, construction, use, maintenance, and demolition.[17] In its operation, environmental and energy performance should contribute to the reduction of energy poverty while improving the quality of life of its occupants. Adequate planning, design, and safe construction should ensure resilience of housing against natural and climate hazards, and rapid urban sprawl.

Housing, as a sector, significantly affects national economies and has tremendous potential to increase its productivity through increased efficiency and market reach. It must support sustainable economic growth while meeting people's needs. Locally, economic challenges related to housing could be addressed by enabling flexibility between buying and renting and by democratizing its information landscape, or making the data publicly available.

[16] Republic of the Philippines, Philippine Green Building Code, Chapter 1 Section 3, 2015
[17] Open Working Group for Sustainable Development Goals, 2014

Meanwhile, urbanization presents particular challenges for the Filipino culture and heritage as the process of migration to key cities brings the breadth of cultural diversity into centers for trade, education and development. In the Philippines, migrants and residents travel back and forth to their home provinces, participating in a process of cultural exchange. This cultural exchange is not just between regions but also across the global political economy including growth industries such as business process outsourcing,[18] leisure and tourism, and real estate development. In the local context of developing a cultural sustainability framework, the conservation of culture draws value not only for its role in the process of nation-building, but also in exploring its relationship with the environment.[19]

Housing development solutions should take into consideration questions on cultural identity, respect and value of heritage, preservation of the landscape, and emotional wellbeing of people by involving local communities in the development processes. Sustainable housing supported by state instruments should provide adequate, healthy, safe and affordable housing, including access to utilities and services, while promoting social inclusion, especially of marginalized and vulnerable groups. Community participation and universal design principles that increase usability and adaptability of housing can support inclusiveness and contextualization.

The term sustainability has been used to describe conserving environmental resources to meet both current and future human needs. Conventional sustainability recognizes that the uncontrolled extraction of natural resources is detrimental for the continuity of human existence.[20] This focus is highly human-centered and fundamentally aims to address the problem of continued economic growth while resources are limited.

The emerging field of regenerative design in the built environment evolves from the concepts and application of sustainability and suggests a more integrated approach to designing and constructing buildings.[21] It focuses on the development of settlements that complement and restore natural systems and processes and provide opportunities to cogenerate[22] for services (water, heating and cooling, electricity, etc.,). While regenerative design practices continuously evolve to cover a wide spectrum of sustainability concerns, it is becoming more and more compatible with the idea of dynamicity and adaptability in the designing of housing systems. Regenerative sustainability provides an opportunity to change the current linear model of building structures into models which transform wastes back into the value chain as productive inputs – turning linear into circular.

[18] World Bank Group, Philippine Urbanization Review, 2017
[19] Housing and Land Use Regulatory Board, Philippine National Urban Development and Housing Framework, 2017-2022
[20] Caradonna, J. L. (2014). *Sustainability: A history*. Oxford University Press.
[21] Orr, D. (1994). Earth in Mind Washington D. *DC: IslandPress*.
[22] Users/occupants are able to produce electricity, harvest water to complement supply (usual usage of water and electricity from concessionaires)

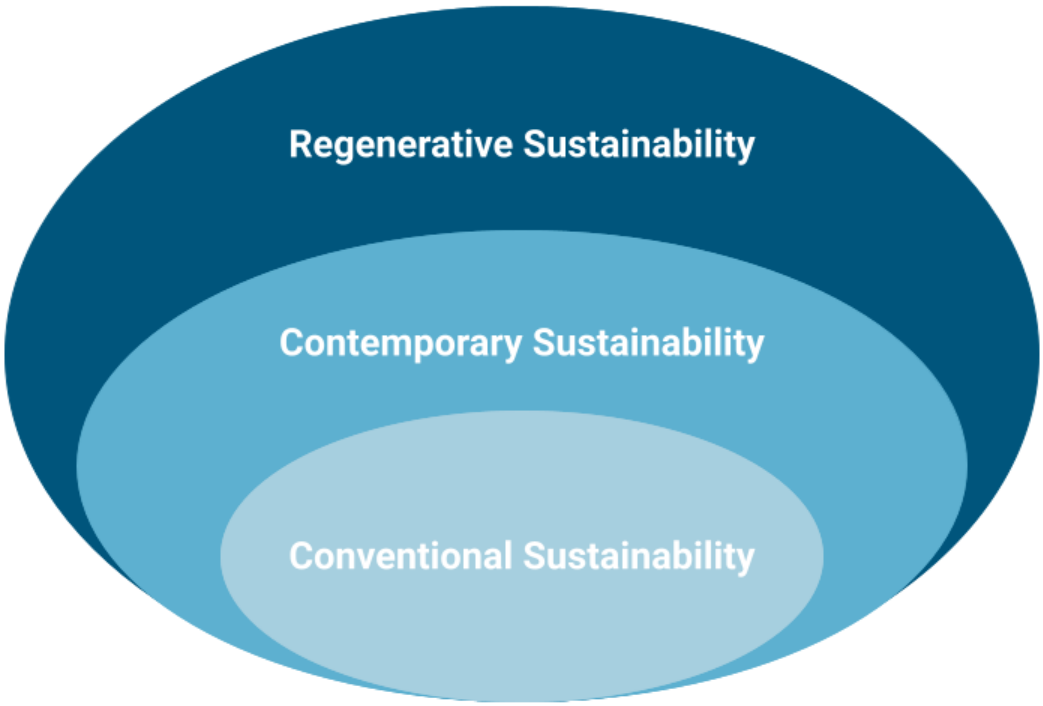

Figure 7. Conventional, contemporary, and regenerative sustainability

The concept of circularity focuses on a set of principles that offer an operational vision of concrete pathways to sustainable production and consumption (SCP) patterns and thus, to a sustainable economy.[23] While sustainability is more broadly related to people, the planet and the economy, circularity focuses specifically on resource cycles.[24] Circularity can be viewed as a potentially new sustainability paradigm where in this system, resource input and waste, emissions, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling.[25] For the context of analyzing local solutions, circular models under the following archetypes were considered:

- Value and resources recovery
- Circular design and production
- Optimal Use
- Circular support, facilitators and enablers, market places

[23] Ellen Macarthur Foundation, Towards a circular economy: Business rationale for an accelerated transition, 2015
[24] Versnellingshuis Nederland, Knowledge Map Circular Economy, n.d.
[25] Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The Circular Economy–A new sustainability paradigm?. *Journal of cleaner production*, *143*, 757-768.

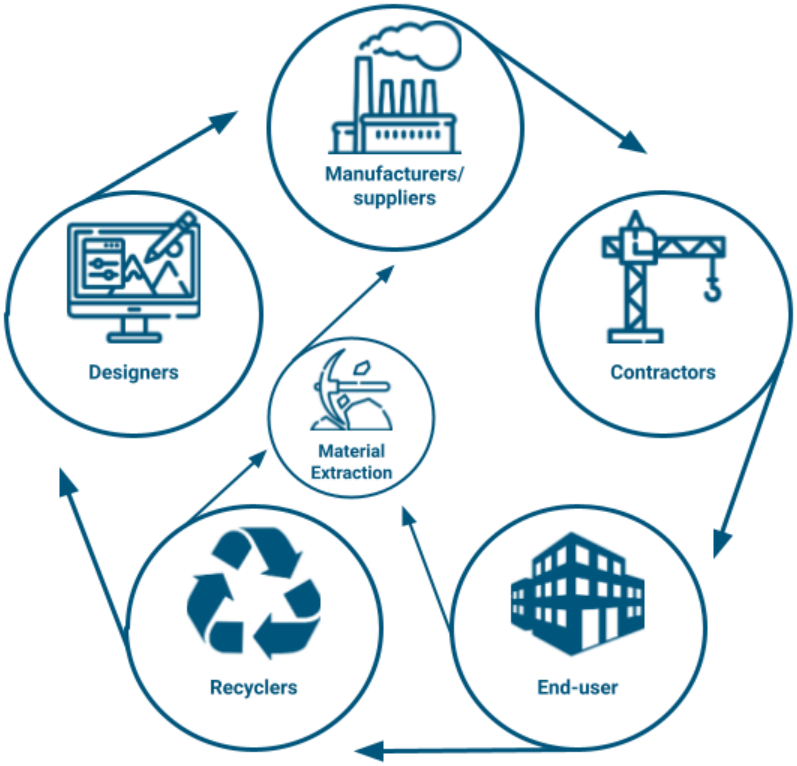

Figure 8. Housing construction value chain circularity

Furthermore, the definition of sustainability used in identifying solutions and innovations in this research focuses mainly on the environmental (green) context and definitions and result areas from UN-Habitat SHERPA, the Philippine Green Building Code, BERDE Program to develop an applicable framework to assess the potential impact of green solutions identified in the Philippine affordable housing market. The criteria for green solutions are presented in Table 3 below:

Table 3. Assessment Criteria for Identified Green Solutions

Preservation of Natural Resources	Preservation of biodiversity and avoiding the depletion of natural resources
Reduction of Carbon Emissions	Reduction of CO2 emissions and local pollution
Climate Adaptability	Adaptation to the environment including disaster risks
Effective Use of Land & Ecology	Effective site selection, reducing negative impact of construction and operations to the local ecology
Energy Efficiency	Reducing and managing excessive use of energy in its lifecycle
Water Conservation	Efficient use of water and wastewater and decreasing demand for water supply
Use of Low-Impact Materials	Usage of recycled or low-carbon materials and materials requiring low-energy inputs during production
Wellbeing & Resilience	Promotion of productivity, comfort, and occupant health
Economic Opportunity	Support to local businesses and promotion of livelihood

Approaches to Built Environment Sustainability in the Philippines

Various approaches to housing were identified in local development frameworks, building guidelines, and climate adaptation strategies. Figure 9 shows how these paradigms relate to sustainability.

Green - eliminates of negative impacts, and creation of positive impacts, on our climate and natural environment. (World Green Building Council).

Resilient - ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner. (UN DRR)

Inclusive - promote and sustain human prosperity and well being in an economy of permanence and to manifest complex adaptive systems (Du Plessis, 2012)

Figure 9. Green, resilient, and inclusive approaches within the sustainability framework

Green approaches to housing in the Philippines are usually exhibited with the use of low-impact materials and/or the adoption of passive and bioclimatic design principles.[26] Low-impact materials are those building materials that require less energy input to manufacture such as bamboo and timber.
In recent years, there have been developments in the production of concrete, steel, and aggregates that enables these materials to be manufactured with significantly lower carbon footprints using alternative and recycled inputs, cogeneration and new processing technologies. Below are some examples of green, resilient, and inclusive approaches to housing in the Philippines.

Cubo Modular[27]

Modular Technology

- Engineered bamboo technology
- Polycarbonate windows and canopy for high impact resistance
- Highly-customizable due to modular assembly and off-site fabrication
- Flexible financing options

Holcim EcoPlanet[28]

Low Carbon Cement Product

- 30% lower embodied carbon than conventional concrete
- Uses low-emission raw materials and recycled construction and demolition wastes
- Production uses alternative fuels to further decarbonize upstream processes

[26] A significant portion of energy use in the conventional modern house is used to create a thermally comfortable, functional environment for the occupants. Houses that are passively designed take advantage of natural climate, material properties and the basic laws of physics to maintain thermal comfort. Passive design can be used to improve comfort by passively heating or cooling and providing daylight. (Green Building Interventions for Social Housing, UN-Habitat)
[27] Cubo Modular, Sarangani Suite, n.d.
[28] The Philippine Star, Holcim rolls out green cement, 2021

National development frameworks and climate action plans align with the Philippine National Building Code in promoting resilience of infrastructure and social services against the effects of climate change. In fact, this is a priority agenda in the Philippine Development Plan[29] citing the urgency to address the growing need for adequate housing in well-planned communities. Resilience is a long-term concept that covers the full disaster continuum and includes aspects of positive transformation that enhances the ability of future generations to meet their needs.[30]

Climate Change Resilient Pilot House[31]

EDGE Certified Project

- Two-story row house for the urban environment
- 72 square meters of usable space
- Safe shelter during floods and typhoon
- High thermal comfort due to higher floor to ceiling height and optimal openings

Cement Bamboo Frame Technology[32]

AITECH Certified Project

- Prefabricated engineered bamboo system designed to be load-bearing members
- Designed to be earthquake resistant
- Minimum service life of 25

[29] Housing and Land Use Regulatory Board, Philippine National Urban Development and Housing Framework, Chapter 12, 2017-2022
[30] Harvard Humanitarian Initiative, Perceptions of Disaster Resilience and Preparedness in the Philippines, 2018
[31] Edge Buildings, Climate Change Resilient Pilot Office, n.d.
[32] Facebook, Base Bahay Foundation, 2017

In the Philippines, scaling up of low-income and pro-poor housing are causing shifts to more inclusive and integrated community development, providing livelihood opportunities to its beneficiaries. This is seen to address the challenges of relocation in semi urban and rural areas such as being disconnected from the local economy and basic social services. Development of inclusive and accessible housing projects enables good 'social mix'[33] and sustainable land use, thus promoting the overall well-being of its occupants.

Agriya Project[34]

Agricultural Residential Metropolis

- Mixed-use development: agricultural, residential and agri-tourism promoting livelihood and local development.
- Sources produce from local farmers in a farm-to-community model.
- Homebuyers are provided with backyard farming kits
- Facilities for livestock and aquaculture

SEE Development Project[35]

Integrated Housing and Community Development

- Participatory design process with the community
- Community develops products with local producers to create eco-friendly building products made from upcycled plastic wastes
- Designer-supplier-end-user participation model for housing development

[33] Definition from the Philippine National Urban Development and Housing Framework
[34] Damosa Land, Why Investing in 'Agropolis' Makes Sense, 2021
[35] Expert Interview and shared presentation materials, 2021

Meanwhile, the emergence of new paradigms are guided and enabled by the local green building and housing policy environment which include various operational terms to achieve national sustainability targets. Table 4 presents these operational terms and their characteristics aligned to the key result areas of sustainability.

Table 4. Sustainability terms found in PH Policy and Financing Environment

Terms	Characteristics and Definitions
Integrated Neighborhoods and Ecosystems	Housing and auxiliary services and needs of occupants are adequately satisfied. Physical infrastructure of housing and location ensure compliance to DRRM and CCA requirements. Management of critical resources such as upland, coastal, ancestral domains, and biodiversity areas.
Community-Driven Development	Involves the beneficiary in the entire development process to increase occupancy rates and ensure inclusive access to services and benefits.
Preventive Resettlements	Ensure safety of families living in danger areas and enable recovery of urban resources such as estuaries, landfills, waterways and easements and public spaces.
Human-Scale and Walkability	Incorporate human scaled proportions and design in local neighborhood planning ensuring necessary infrastructure and services are within walking distance.
Compact Development	Promotion of efficient neighborhood densities at all scales of urban planning to maintain balance between urban demand and resource availability to address urban sprawl.
Alternative Tenure	Rights-based instruments offer a less costly approach to providing secure tenure to segments of society unable to secure freehold titles, particularly the urban poor (ADB Philippine Urban Assessment).
Water and Energy-Sensitive Urban Planning and Design	Incorporates urban water cycle, including stormwater, groundwater and wastewater management into the design to minimize environmental degradation and ensures energy conservation especially during its operation.
Disaster Resilience	Enable infrastructure to withstand or recover from most natural disasters, protecting the occupants from danger in the occurrence of such events.
Green Jobs	Ensure a shift to a low carbon development and adapt to the effects of climate change including jobs that reduce the environmental impact of enterprises and economic sectors, ultimately to levels that are sustainable through high efficiency strategies, techniques and technologies and minimization or elimination of all forms of wastes and pollution.
Sustainable Cities and Municipalities	A city/town designed in consideration of environmental impact and protection of ecosystems, efficient in use of land, energy, water and food (i.e., eco-efficient), minimizing waste outputs, and creating sustainable jobs to achieve the smallest possible ecological footprint, reduction of its overall contribution to climate change, and building resilient communities and ecosystems.

Mapping the Housing Value Chain

Stages and Stakeholders

In this section, trends, enablers, and barriers of green and circular technologies adopted across different stages in the value chain are discussed. Additionally, key stakeholders and interfaces are mapped to provide an overview of the green housing landscape and to aid in identifying experts to interview. The stages are broken down into 1.) planning and design, 2.) materials and transport, 3.) construction, 4.) use and occupancy, and 5.) end-of life and/or reuse.

In the Philippines, sustainability is almost always associated with minimizing environmental impacts which is perceived to be an additional investment. Currently, the government has not yet implemented mandatory regulations requiring sustainable business practices such as investment in net-zero production, energy retrofits, and capacity building towards more environmentally-conscious building practices, although incentives exist. Generally, the housing value chain in the Philippines is developing towards green with respect to the *planning and design* stage with the development of sustainable design principles and green project financing frameworks. As for *material and transport, construction, and use* stages, the value chain is ripe for transformation but gaps on green transition strategies and technology investments will need to be addressed by policy innovations. Lastly, the *end-of-life/reuse* stage was assessed to be weakly functioning with major opportunities for circularity seen in models such as recovery, reuse, reverse logistics. This analysis presented here is summarized in the housing value chain scorecard (Table 10).

Planning and Design

Sustainable design seeks to reduce negative impacts on the environment, and the health and comfort of building occupants, thereby improving building performance. The basic objectives are to reduce consumption of non-renewable resources, minimize waste, and create healthy, productive environments.[36] The way buildings use energy and generate wastes are determined as early as the planning and design stage. In this stage, designing structures that both require less natural resources and generate minimal waste could potentially cut up to 38% materials and energy input[37] compared to conventional design practices.

[36] US General Services Administration, Design Excellence Program, 2014
[37] International Finance Corporation, In the Philippines, A Blueprint for Low-Income Homes Goes Green, 2018

Table 5. System actors in the planning and development stage

Processes	Products	People	Interfaces/Constraints
Sustainable (net zero) Regenerative (net positive) Affordable (low-cost) Adaptive (flexible)	New constructions Fit-outs	Government Building Officials Planners Design Professionals End-users	Design codes Rule of thumb Site and use Local ordinances Resilience Lifecycle cost Maintenance planning End-users

In the Philippines, there is an increasing use cases of passive or bioclimatic design[38] which is the practice of designing buildings based on the local climate to minimize the need for artificial lighting and ventilation. In the affordable housing sector, examples are seen in housing products that are built using lighter yet sturdy materials such as bamboo, light timber, and lightweight concrete for the building shell designed to ensure thermal comfort of its occupants. In addition, housing projects are now being sited based on local topographical and meteorological features, vegetation, and cover as builders and developers attempt to introduce greener environments for their adaptable housing products. Also, there is an uptake for affordable housing units designed to be constructed efficiently, such as off-site prefabrication and modular housing assembly which cuts construction time by at least 40%.[39]

Planning for green local housing developments are enabled by existing development frameworks[40] that provide guidelines and metrics to ensure site suitability and adaptability while minimizing ecological impacts. In addition, there is a renewed call to pass the National Land Use Act to harmonize sector-specific land use policies. This would also institutionalize land use planning by providing for a national land-use authority to classify safe and secure land for settlement development. Meanwhile, voluntary green certification frameworks provide rating and review systems for green housing products which are currently being adopted by local shelter agencies in qualifying housing development projects for alternative financing.

Affordability is seen to be a major barrier in implementing green housing projects due to the perception that adopting green building frameworks (e.g., Leadership in Energy and Environmental Design (LEED) and BERDE) causes a moderate increase in costs of design and construction from materials, design, documentation, and monitoring requirements.[41] On the demand side, green certifications provide a premium to property value which makes it more attractive to investors but could cause higher upfront costs for buyers. For the supply side, the

[38] R. Wimmer, Adapting Zero Carbon Houses For Tropical Climates: Passive Cooling Design In The Philippines, 2014
[39] Interview with anonymous expert who is a construction developer, February 2022
[40] National Housing Authority, Guidelines for Site Selection, Site Sustainability, and Site Planning of NHA Housing Development Projects, 2015
[41] E. Aurellado, The Greening of the Project Management Cycle in the Construction Industry, Survey on LEED Practice, 2015.

additional upfront costs perceived by affordable housing developers without access to green financing are incompatible with traditional construction financing schemes.

Materials and Transport

In recent years, the National Climate Change Commission has prepared its National Climate Action Plan towards developing its own Nationally Determined Contributions. One key result area is related to the promotion of green and sustainable construction practices. Generally, the movement towards a sustainable construction value chain is driven by the private sector where they report that the switch to greener alternatives to construction materials translates to 10-20% more upfront costs.[42]

Research and development of green materials need to align with prescribed performance standards but currently, there are no available standards that are adopted on a national level. The local green building code provides prescriptive requirements but mostly focuses on occupant health and well-being. Voluntary green certifications set requirements for reduced energy use and waste production during production and use. Housing projects situated in remote areas neglect Scope 2 emissions ("indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling")[43] due to transport and hauling of materials as there is no current benchmark in establishing its footprint in the local setting. The local challenge of transport sustainability requires investment on infrastructure that mitigates economic losses due to congestion and, at the same time, promotes alternative and efficient transport modes.

Locally, developers of housing projects are safeguarded by provisions on price escalation, especially in irregular supply and pricing shocks. Currently, the delivery of green housing projects are estimated to incur more upfront costs due to supply constraints. Despite this, the adoption of green material and procurement standards is expected to relax such constraints by enabling increased production levels and by providing frameworks for suppliers to qualify for green financing.

[42] E. Aurellado, The Greening of the Project Management Cycle in the Construction Industry, Survey on LEED Practice, 2015.
[43] US Environmental Protection Agency, EPA Center for Corporate Climate Leadership, n.d.

Table 6. System actors in the Materials and Transport stage

Processes	Products	People	Interfaces/Constraints
Sourcing Processing Distribution	Cement Mineral-based (clay & ceramic, glass) Wood (timber, bamboo) Polymeric/Plastic Metal-Based Composites	Manufacturers Recyclers Retailers Inspectors Specifiers End-users	Material standards Industry requirements Rules of thumb Local codes Supply dynamics Environmental commitments Price fluctuations Innovations Product and market development

Construction

Green building starts with the understanding that the built environment can have profound effects, both positive and negative, on the natural environment as well as people who inhabit buildings every day. Green building is an effort to amplify the positive and mitigate the negative impacts of these effects throughout the entire lifecycle of a building.[44]

Housing adaptability is the capacity of a building to effectively accommodate the evolving demands of its context, thus maximizing value through its lifecycle.[45] The dynamic and flexible nature of housing construction is compatible with solutions promoting regenerative sustainability as observed in the owner-driven construction market as well as retrofitting and incremental building practices. Additive manufacturing techniques such as prefabricated homes and modular homes[46] are being scaled efficiently as digitalization unlocks applications in the local construction industry. Labor and process automation drives higher efficiency and productivity in housing construction. Meanwhile, supply chain issues in the midst of the pandemic caused construction material prices to rise as the local price index saw a 34-month high at 2.1% in 2021.[47] As alternatives to traditional construction, locally available materials such as bamboo and timber are utilized to offset the use of steel as reinforcing and framing material. Development of design and construction guides using vernacular materials and building environment design are currently being adopted.

[44] World Green Building Council, About Green Building, n.d.
[45] Schmidt III, R., Eguchi, T., Austin, S., & Gibb, A. (2010). What is the meaning of adaptability in the building industry. *Open and Sustainable Building*, 233-42.
[46] In the examples of Cubo Modular, Vazbuilt, and Modular Homes PH
[47] Philippine Statistics Authority, Price Indices, 2021

Table 7. System actors in the Construction stage

Processes	Products	People	Interfaces/Constraints
Site clearing Excavation Foundation Framing (concrete, steel, wood) Roofing Services	Building Phased/incremental construction Retrofit	Building Officials Neighborhood Builders Design Professionals	Design codes Rules of thumb Pollution Local ordinances Cost Constructability Wastes End-users

Constructing green housing products is perceived as costly not just by builders but also prospective homebuyers because of the 'green premium', or how green homes and buildings are marketed to buyers and lessors. Studies on the value of the 'green premium' in green real estate have shown that green certifications yield a rent premium of 6.0% and a sales premium of 7.6%.[48] In the affordable housing market, the current local price ceiling for socialized and economic housing only provides for small adjustments for homebuilders to invest in technology and design upgrades for green because the reference prices set for such construction are based on traditional housing design and construction. Lastly, slow adoption rates of newer and more efficient construction technologies hamper the cheaper and faster delivery of housing projects.

While there is an existing design manual for affordable housing projects, construction is approached from many different directions. There is an opportunity to identify performance standards and measurement methods with respect to resource usage, energy use, and ecological impact during construction. It is at this stage that the local ecology is actually modified, at the same time affecting the level of local pollution. Thus, providing a framework to measure its impact will enable the identification of labor and financing mechanisms aligned with the push towards the development of green jobs and sustainable finance. Locally, there are existing regulations providing tax incentives and abatement for businesses that promote jobs that contribute to the preservation of the environment.[49]

Use and Occupancy

Sustainable housing is associated with being a place of community, sustainability, safety and comfort, as well as a place that incorporates aesthetically pleasing features. The motivation for residents moving into a low-carbon development (LCD) is to have housing stability, live the life they want, including performing sustainable practices

[48] Dalton, B., & Fuerst, F. (2018). The 'green value' proposition in real estate. *Routledge handbook of sustainable real estate*, 177.
[49] Republic of the Philippines, Republic Act No. 10771, 2016

and enjoy the attractive design of the LCD. Experiences of living in an LCD include unexpected design influences on daily practices and an appreciation of the community atmosphere created.[50]

Housing use and occupancy is the stage at which the largest potential for savings can be realized over years of operation considering cogeneration and efficient use. Recent advances in energy and water storage technologies has enabled solar photovoltaic and rainwater harvesting systems to be cascaded to residential applications in a cost-effective manner. Examples in the affordable housing sector demonstrate at least 20% energy savings in a home installed with solar panels that provide 1200 W of electrical power.[51]

Table 8. System actors in the Use and Occupancy stage

Processes	Products	People	Interfaces/Constraints
Occupancy	Home repair	Homeowners	Design codes
Leases	Home alteration	Hardwares	Local ordinances
Changes in occupancy	Structural retrofit	Building Officials	Cost
Home deterioration	Services retrofit	Neighborhood	Constructability
	Wastes	Builders	Disaster risks
		Design Professionals	

Rental housing is seen as a vital component of the housing stock in the Philippines especially in its major cities where rentals are absorbing the urban population that is growing due to migration and natural increase. Vertical housing programs[52] promoting affordability, efficient land use, and building management are ripe for applications towards energy conservation, as well as cost-effective maintenance and property management. Energy and water savings are realized with installations of renewable energy devices and water harvesting systems to complement demand from occupant use. Also, energy efficient home devices are becoming more and more accessible to low income households enabling lower operating costs within a dwelling.

Meanwhile, to accommodate the capacity of low-income households to afford local housing, models of incremental and phased construction must be developed. There is a perceived opportunity to scale prefabricated and modular housing to aid in the transition from transient to semi-permanent housing to permanent housing. In its current state, retrofit, alteration, and modification in the affordable housing segment is reported to be significantly more costly than reconstruction due to relatively small units compared to the same modifications in large developments. Still, providing access to home improvement financing, as well as introducing incremental housing products, can ensure efficient use of building resources and affordability when appropriate neighborhood development planning is considered. On the other hand, closing the gap from the supply side requires making market data available to the public to enable access to various housing products. This allows for more households to access housing options and to improve operational performance.

[50] Breadsell, J. K., Byrne, J. J., & Morrison, G. M. (2019). Pre-and post-occupancy evaluation of resident motivations for and experiences of establishing a home in a low-carbon development. *Sustainability*, *11*(14), 3970.
[51] Via Verde, Imperial Homes Corporation Case Study
[52] Tondominium, City of Manila Case Study

End of Life and/or Reuse

Considering sustainable construction, as defined by the Brundtland Commission (1987), the built environment constitutes one of the main supports of economic development, but it also has the potential for significant impacts on resources (land, materials, energy, water, human/social capital) and on the living and working environment.[53] The construction industry must ensure that the creation and responsible maintenance of a healthy built environment is based on resource efficient and ecological principles. National regulatory frameworks on waste management, especially on solid waste management, plastic wastes, and pollution, are existing but lack operational mechanisms. This is reflected in low recycling rates, especially of low-value plastics.[54]

Locally, waste material reuse and recycling business models thrive as social enterprises that partner with local businesses to divert wastes to microscale facilities. Waste products such as plastics and fibers are upcycled to eco-friendly construction materials such as framing materials[55] and building blocks.[56] These enterprises also provide services that certify plastic waste credits to manufacturers. This is currently an attractive option for businesses to compensate for plastic waste generation down the value chain. In construction, debris and demolition waste are being cycled back into the production of recycled concrete aggregates to reduce the need to source natural aggregates.

A major barrier to recovering materials is the absence of an integrated solid waste management program which makes the incremental cost of recovery way higher than just procuring new raw inputs. Effective operations and management of local material recovery facilities must be integrated with collection and landfilling activities to economize recovery costs with respect to the potential value of products to be upcycled. Currently, there is no large-scale demonstration of an effective waste reuse and recycling program. The effort is further challenged by the globalization of construction material suppliers bringing in cheaper construction material imports.

Table 9. System actors in the End-of-Life and Reuse stage

Processes	Products	People	Interfaces/Constraints
Demolition Recovery Hauling and Transport Reuse	Recycled aggregates Refurbished materials Low-impact construction materials Fillers	Homeowners Recyclers Local government Homebuilders	Local waste management programs Access to recovery facilities Abatement/Demolition Control

[53] del Río Merino, M., Izquierdo Gracia, P., & Weis Azevedo, I. S. (2010). Sustainable construction: construction and demolition waste reconsidered. *Waste management & research*, *28*(2), 118-129.
[54] Iya Gozum, How eco-design can shape a greener future for the planet and the next generation, 2020
[55] Eco-lumber, The Plastic Flamingo Case Study
[56] EcoPlas, Green Ants Builders, Inc Case Study

Table 10. Value Chain Scorecard

	Planning & Design	Materials & Transport	Construction	Use & Occupancy	End-of-Life/ Reuse
Trends	• Passive (bioclimatic) design • Adaptive and eco-efficient land use planning • Design for construction and operational efficiency	• Low-impact materials • Vernacular materials • Lack of examples of sustainable construction logistics.	• Prefabrication and Modularization • Labor and process automation • Vernacular construction	• Energy and resilience retrofitting • Rainwater and greywater systems • Rental housing • Alternative ownership models	• Scalable models of demolition waste reuse • Micro-factories • Conversion of occupancy types • Wastes to construction materials (agricultural and plastic wastes)
Barriers	• Higher upfront costs of building green which are incompatible to traditional construction financing schemes. • Implementing certifiable green projects are perceived to extend the design processes.	• No existing performance standards for green materials • Material production require intensive amounts of energy. • Volatility of construction material prices	• Perceptions of homebuilders and end-users on green construction • Cost premium on green • Local price ceilings on affordable housing • Information and technology gap on green construction practices. • Exiting of players in the housing market	• Access to home improvement financing • Incremental costs of energy and resilience retrofitting	• Low utilization of local recycling facilities • Lack of local recycling strategies • Inefficient material recovery programs
Enablers	• Incentives for green building that could attract investments and financing • Securing land safe for housing development • Stable demand for affordable housing	• Performance-based guidelines or standards on green materials • Investment on industrial transport infrastructure • Price escalation safeguards • Supply chain innovations decentralizing material production and supply	• Green financing mechanisms • Upskilling of the labor force by local technical vocational centers • Accreditation framework for green jobs in construction • Standards for Incremental/Phased Construction	• Increasing supply of housing loans from the government • Increasing access to smart and energy efficient home products • Democratization of housing market data • Guidelines for energy and resilience retrofit	• Legislations on recycling and solid waste management • Construction waste management planning

Solutions and Innovations Identified across the Value Chain

Figure 10 presents the technological solutions and policy and financing enablers identified across the value chain that lead to a greener affordable housing environment. In the case of the Philippines, interventions during the planning and design stage as well as the adoption of more eco-friendly materials impact the housing value chain sustainability significantly. Meanwhile, isolated examples of green technologies adopted in the construction, use, and end-of-life reuse were found.

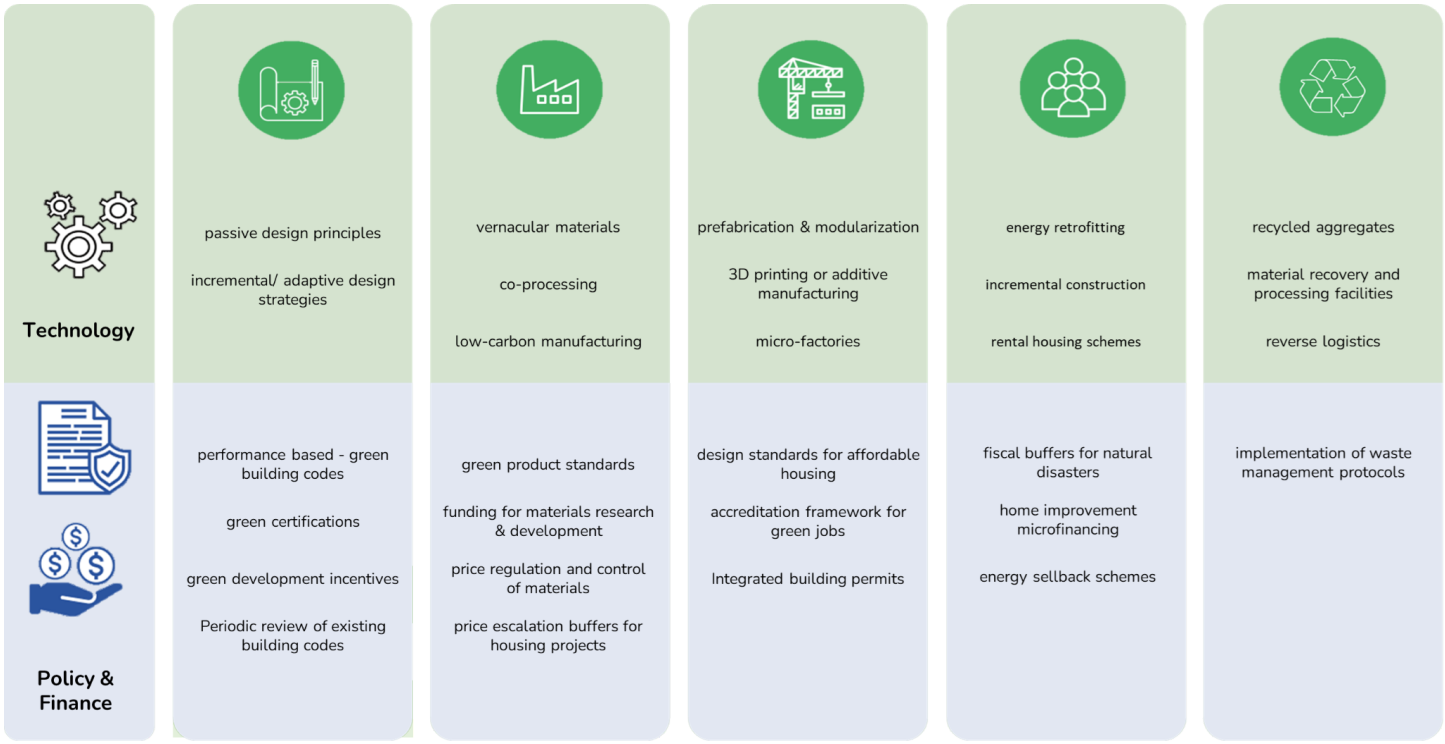

Figure 10. Technological solutions (green) across the value chain and policy and financing enablers (blue)

One example that illustrates how policy and finance enable technology is Via Verde Homes who utilize passive design and cogeneration principles[57] through structurally efficient and lightweight materials and the installation of solar panels to provide household power, making it the country's first grid-connected, solar-powered community of low-cost homes. Investments such as these are enabled by the availability of financing schemes such as the BALAI BERDE Program[58], which makes use of green certification frameworks like Excellend in Design for Greater Efficiencies (EDGE).[59]

Case Studies

Thirteen case studies were identified and summarized in Table 11 to illustrate how each of the solutions identified across the value chain are operationalized and to reinforce the assessment on each of the stages

[57] Via Verde Homes Project by the Imperial Homes Corporation
[58] Excellence in Design for Greater Efficiencies (EDGE), BALAI BERDE and EDGE: Scaling Up Green Housing in the Philippines, 2021
[59] Excellence in Design for Greater Efficiencies, What is Edge?, n.d.

along the housing value chain. In the table, green cells indicate the green assessment criteria (of sustainability) each case study addresses.

Table 11. Green Assessment of Case Studies

	Efficient Use of Natural Resources	Reduced Carbon Emissions	Climate Adaptability	Use of Land & Ecology	Energy Efficiency	Water Conservation	Use of Low-Impact Materials	Wellbeing & Resilience	Promotion of Sustainable Transport	Economic Opportunity
Agricultural City (Damosa Land Corporation)	■	■	■	■				■	■	■
EcoPlanet (Holcim Philippines)	■	■			■		■			
Cement Bamboo Frame Technology (Base Bahay Foundation)	■	■	■				■	■		■
Via Verde Homes (Imperial Homes Corporation)		■	■		■			■		■
Ecoplas Bricks (Green Antz Builders Inc)	■	■					■			■
Engineered Bamboo Homes (Cubo Modular)	■	■	■				■			
Weida Rainsaver Tank (Weida Philippines)						■				
Climate Change Resilient Pilot House (Bicol State College of Applied Science and Technology)	■		■		■		■	■		
Tondominium I (City of Manila)			■	■				■		■
Ecolumber (The Plastic Flamingo)	■	■	■				■	■		
Connovate High Performance Concrete (Connovate Philippines)	■	■	■					■		
Green Home (Greenovate Corporation)	■	■	■				■	■		
BluHomes (Aztala Corporation)	■		■	■	■	■	■			

BluHomes by Aztala Corporation, a local real estate development company, is an example of one of the case studies. They are an eco-friendly housing project certified by EDGE[60] that promotes efficient use of resources including energy and water. Each housing unit has a native and endangered tree planted in its front lot to accommodate local shade. The exterior walls are painted with reflective coating while the roof is provided with insulation and solar panels to augment energy use for LED lighting. Water-efficient plumbing fixtures are also installed in its plumbing system to reduce water consumption.

[60] Excellence in Design for Greater Efficiencies, BluHomes Gakakan, n.d.

Impact Assessment of Solutions

Identified solutions and their level of operational maturity in the Philippine context and their assessed impact on sustainability considerations are shown below in Table 12. Maturity and impact assessments based on economic, sociocultural and environmental sustainability considerations (previously shown in Table 3), where **navy** (sustainable and functional), **blue** (partial function, transitioning to sustainability), and **gray** (weak function/dysfunctional) assess how much each solution enables the achievement of these considerations.

As an example, the green maturity score for sustainable materials illustrates the increasing number of use cases of sustainable materials in the Philippines enabled by the adoption of green building standards and the support for the production of locally available and low-impact materials. At the same time, the assessed impact on economic sustainability is high because it addresses all three considerations under the economic criterion in Table 2.

Table 12. Solutions Maturity and Impact Assessment

Solution	Maturity	Impact		
		Economic	Sociocultural	Environmental
Sustainable materials		High	Low	High
Green Building Standards		Low	High	High
Integration of "Design for Environment" to curricula		Mid	High	High
Design standards for socialized and economic housing		High	High	Mid
Capacity building of the general labor workforce		Low	High	High
Mechanisms to improve compliance to balanced housing		Mid	High	Low
Implementation of building codes and standards		Low	High	Mid
Effective legal environment for efficient project delivery		High	Low	Mid
Incentives for green materials/process inputs		High	Low	Mid
National housing roadmap		Mid	High	Mid
Housing microcredit		High	High	Low
Sustainable finance framework for banks and financial institutions		Mid	High	High
Financing schemes to enable LCH and EH developers		High	Low	Low
Revenue models for housing projects		High	Low	Low

Challenges and Opportunities to Greening the Affordable Housing Value Chain

Based on the desk research, interviews with stakeholders, case studies, and the analysis of the solutions, the challenges and opportunities to greening the housing environment in the Philippines are discussed below.

Harmonizing National Building Frameworks

Presidential Decree No. 1096 (PD 1096), also known as the National Building Code of the Philippines (NBCP) and its Implementing Rules and Regulations (IRR) prescribe the minimum standards and requirements to regulate buildings and structures. With the objective to incorporate Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) in building regulations, stakeholders suggested including disaster risk reduction and management in the policy declaration of the Act. It was cited that differences in the requirements of local governments make it difficult for developers to comply with local ordinances. Moreover, there is an opportunity to empower the local government units by providing for the creation of local ordinances which are more stringent than what the building code requires. Stakeholders also noted that the NBCP does not provide for its periodic review. There should be a mechanism for periodic review to update the minimum requirements and guidelines for buildings and structures while taking into consideration new innovations and construction techniques.

With the existence of the Philippine Green Building Code and other applicable laws to housing, especially for the social and economic housing segments, provisions for energy efficiency and use of low-impact materials must be introduced to guide the direction of the construction of new buildings and housing stock. As the local manufacturing and finance sectors are gearing towards climate-smart, environment-friendly, and globally-competitive industries, green building standards must be in place to enable the transition of these sectors as buildings are major investments in these industries.

Green Alternative Building Materials

Good building practices are a combination of well-planned design and well-executed construction. It was seen, however, that the NBCP gives more emphasis on design and provides less on how structures should be constructed. It is usually estimated that at least 20% of total construction resources are wasted due to poor workmanship and issues with design and constructability. Locally, waste management protocols are required in applying for Environmental Compliance Certificates, but this is only required for large developments. Waste management protocols could be found useful in even smaller developments, but it may be costly to implement.

Meanwhile, for construction materials, there is no integrated regulatory framework which provides the criteria for material selection. At present, multiple local and international standards are used to guide the use and application of construction materials. In some cases where there are no local standards for a particular material, international standards are used which may not be optimal for local conditions and usually results in additional compliance costs. Furthermore, the current laws on materials mostly provide for fire-resistance and health. In order to enable development and adoption of alternative and sustainable materials, a unified approach for materials selection providing criteria for strength, durability, and sustainability must be developed.

Incremental and Owner-Driven Construction (of Simple Structures)

Currently, there is no framework or guidelines to regulate and ensure the stability and serviceability of housing structures that are initiated and built by owners. While the national building code classifies buildings according to

use or occupancy, it also categorizes structures with mixed occupancies according to use or occupancy with the most restrictive requirements.

There is a gap in knowledge and best building practices in the Owner-Driven Construction (ODC) segment. If ODC is to augment housing supply, it should be in accordance with the principles of resilient and climate-smart building. As there are no existing guidelines on Owner Driven Construction promulgated by the national government, the challenge is to develop guidelines for simple structures considering varying risks with respect to geography, location, and frequency of occurrence of multiple natural hazards. In a senate bill[61] filed to amend the current national building code, a peer review system of Special Structures was proposed that could provide a framework for simple structures and others that are exempted from the existing code. Aside from structural concerns, stakeholders also noted that building use or typology, building material (i.e., glass and glazing), adherence to green technology, building maintenance, and the image of public buildings must also be considered in the peer review.

Permitting Process and Standard Costs for Socialized and Economic Housing Projects

While there is a regulatory framework provided by BP 220[62] for the approval procedures for the planning and design of subdivision and buildings, the implementation of such projects are impeded by the lengthy processing of various kinds of permits, clearances and applicable local development controls. This has resulted in low throughput rates of housing projects in the case of Expert A[63] where building permits for each of the identical housing units in subdivision projects are processed individually. There is an isolated use case of an Integrated Building Permit to streamline the approval process, thus reducing the time to mobilize resources to project completion. As material prices are relatively volatile, reducing delays mitigates risks due to cost escalation which usually discourages developers working on tight price ceilings in the affordable housing sector. Periodic review of standards and price references must be based on the expense profiles of previous projects, thus establishing a data-driven approach to such reviews that will help the regulatory authorities to set realistic and achievable benchmarks for developers to be attracted to invest in greener technologies to build housing projects.

Smart Property Management enabling Efficient Operation and Maintenance

In the Philippines, housing projects to address urban sprawl are met by challenges of inadequate planning for livelihood and future climate risks. As these projects are usually situated in less prime locations, maintenance for such investments are not being followed through. In recent years, the local government has been able to provide quality homes while putting a premium on establishing safe and resilient housing communities to empower the marginalized beneficiaries with their own houses at low cost. Realizing that shelter is a right while ownership is an option,[64] unlocking different tenure modes provides opportunities for investments in operations and maintenance. Management schemes for housing complexes and vertical housing projects could soon be realized given validated use cases utilizing smart property management tools in commercial real estate. This is seen to solve problems of housing quality deterioration over the years and cost-savings in water and energy operations.[65] Currently, there is also a lack of information for owners who need to voluntarily retrofit their homes as the current state of practice of structural inspection and retrofit is isolated.

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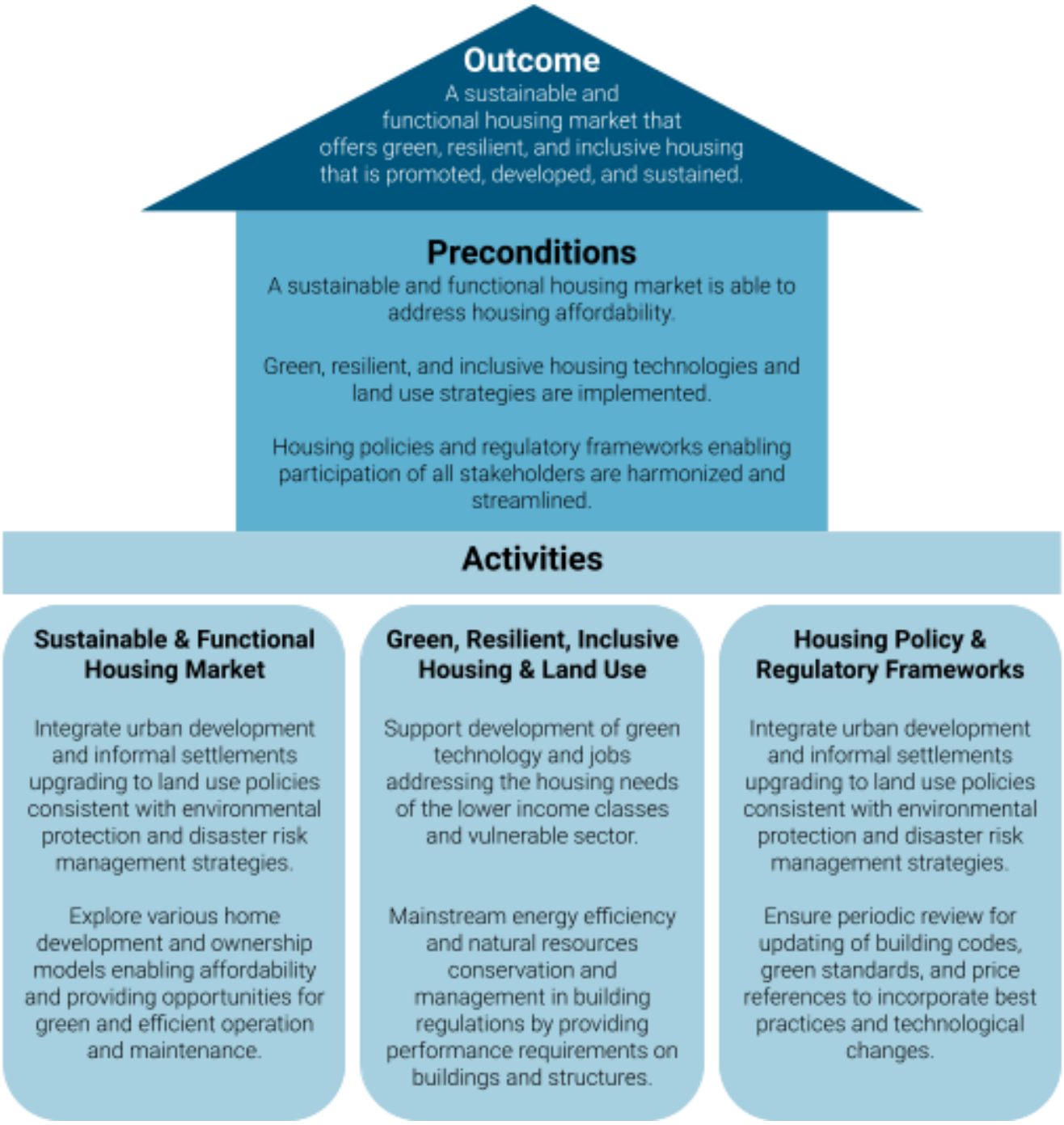
[61] Business World, Consolidated House bill to upgrade building code hurdles TWG, 2020
[62] Housing and Land Use Regulatory Board, Batas Pambansa Bilang 220 for Socialized and Economic Housing Projects, 2008
[63] Anonymous subdivision and housing developer
[64] Lade Jean Kabagani, No substandard housing project under Duterte admin: DHSUD, 2022
[65] Manila Bulletin, Property Managers Can Generate Energy Savings, 2013

Theory of Change: Greening the Housing Value Chain

From the research completed, a Theory of Change to explain how a green and circular housing value chain can be established was developed including activities, preconditions, and the ultimate outcome.



Conclusion

There is a growing need for a more sustainable housing sector which offers adequate, affordable, and sustainable housing. This study aimed to answer the question "*how might we make green housing more affordable and accessible for financial service providers, builders, and end-users?*", specifically looking at the Philippines context. This was accomplished by 1.) defining and analyzing sustainable, green, and circular housing and construction concepts, 2.) mapping the housing value chain to identify stages, stakeholders, approaches, opportunities, and challenges to greening the affordable housing value chain, and 3.) developing a Theory of Change to explain how a green and circular housing value chain can be achieved.

For this study, sustainable, green and circular housing and construction were found to have the potential to drive sustainable development and poverty reduction. Due to regulatory and operational challenges and constant realignment of environmental priorities, sustainability in housing is multifaceted and thus closing the housing gap is a dynamic process of balancing stakeholders and market forces.

Through mapping the housing value chain, emerging themes, solutions and innovations, enabling interventions, and capabilities and preconditions were identified. One emerging theme is that the business case for green, while largely enabled by financing and policy, does not necessarily require newer construction technologies. Technology solutions that allow increased supply of housing units need not be novel, considering how the construction technology in the affordable housing sector is regulated in terms of production costs. Additionally, there is a huge opportunity to align green principles in establishing planning and design codes standards to guide and control how housing units are constructed and to complement programs that incentivize building green. It is high time to develop performance-based design and construction standards for a green and more resilient incremental and owner-driven construction sector that is seen to augment at least half of the affordable housing deficit.

Solutions and innovations identified across the value chain include passive design strategies and energy and water capture technologies enable housing units to decrease the demand while at the same time generate and/or recover energy and water for later use prove effective in reducing operational costs. Housing units are being built more efficiently with construction technologies that require less materials yet yield less wastes, bringing down costs and the demand for natural resources. Additionally, waste reuse models in material sourcing and production are adopted as plastic wastes are being incorporated into building materials. While this reduces the amount of wastes that end up in landfills and into water streams, effects of the degradation of such materials must be studied.

With regard to enabling interventions, financing and policy innovations can accelerate housing production by attracting homebuilders to venture into green housing development. Financing programs for green housing projects are currently being offered to cater both homebuilders, to construct housing units, and for homebuyers, to provide flexible and affordable payment options for their new homes. Sustainable financing principles and the framework for green jobs is seen to cascade to the construction sector at a lower rate as technological adoption in the sector has proved to be historically challenging.

The Theory of Change developed through this study found that transforming the housing value chain to green unlocks necessary preconditions to ensure a functional housing value chain that can enable homebuilders to

participate in the production of housing stock through green financing mechanisms, and at the same time provide green and resilient shelter for end-users. The development of frameworks and policies, and to measure and operationalize jobs that contribute to greening the environment, will further ensure a sustainable and more productive housing market. The immediate activities outlined in the Theory of Change proposes a way to transition a housing value chain to a more sustainable and functional housing value chain, aligned with the Habitat for Humanity vision that families and communities could build stability and self-reliance, and could be at peace knowing that their homes are strong, safe, and adequate.

From this study, several key recommendations were identified. First, current building standards should be reviewed and updated to incorporate green and resilient building. Performance-based standards should also be adopted to guide homebuilders to adopt the use of materials and methodologies that contribute to a greener housing construction value chain. Second, land-use planning and implementation of development controls must enable efficient delivery of green housing development. Identification and securing appropriate sites where passive and eco-friendly design strategies are feasible will maximize the benefit of building green as this does not solely depend just by constructing green – green housing project delivery entails planning, designing, and constructing for greater efficiencies, operational savings, and reuse. Third, participation and commitment of different stakeholders must be safeguarded by the institutions. The difference between how buyers and homebuilders define affordable housing is causing challenges in matching the purchasing power of buyers and business prospects of builders at the current price points for Socialized, Economic, and Low Cost Housing. The government must step in to become both principal project sponsors and active regulators of housing projects to ensure affordability and timely delivery.

While the business case of green is demonstrated, the transition to greener affordable housing development in the Philippines must be backed by effective policy to further validate its business case and attract investments, ensuring a sustainable and productive housing sector for all.

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