ACCELERATE PROSPERITY

GREEN CONSTRUCTION BRIEF (GCB)

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For the project "**Promotion of Startups in Pakistan**"
BMZ No. 2021 67 864

- Green Construction Market Analysis
- Identifying Business Opportunities
- Gauging Potential for Impact Investing

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1 EXECUTIVE SUMMARY

The Green Construction Brief (GCB) aims to support startups and small businesses in Pakistan by presenting a market analysis of the Green Construction (GC) and Green Construction Cleantech (GCC) markets. This analysis aims to help identify business opportunities and assess the potential for impact investing. The brief provides a comprehensive overview of the complex and fragmented construction sector to assist Accelerate Prosperity (AP) in navigating the industry in Pakistan.

Construction and Real Estate Sector Market Analysis

The construction and real estate sector in Pakistan is worth nearly USD 306.9 billion with a projected growth rate of 3.4% by 2025. The residential sector accounts for 75.8% of the market while commercial buildings make up 24.2%. The green construction market is influenced by the sector's market dynamics, such as growth rate and trends. Gaps in the residential and utilities sector present an opportunity for green construction. The residential sector has a shortage of 10 million units, while the utilities sector faces a 25% shortfall in electricity demand. 50.2% of electricity consumption is in the domestic sector, 14.7% in commercial/institutional, and 25.6% in industrial. There is a growing market for green construction measures to reduce energy consumption in households.

Green Construction (GC) Market Analysis

The green building floor area grew by 25.17% annually from 2014 to 2017 and 12.25% annually from 2017 to 2022. 52 buildings (mostly industrial) have been certified by the LEED rating system.[1] The expected growth in the next 5 years is estimated to be 16.47 million square feet, mostly in industrial buildings due to tax incentives. The expected worth of the green market in Pakistan is USD 11.39 billion by 2025, with residential buildings accounting for 86.4% and commercial buildings accounting for 13.6%. The leading trends in the green construction market in Pakistan include multi-unit residential, educational, and institutional new construction, net-zero buildings, controlling embodied carbon, demand for affordable energy efficiency solutions, and reconstruction of climate change-related disasters. Lower operating costs and higher building value are the leading triggers for green construction. The most relevant barriers are the fragile economy, high inflation rates, and rising property and material costs, making affordability and the high first cost of GC the leading constraints, followed by lack of awareness, lack of policies and regulations, and lack of trained professionals.

Green Construction Cleantech (GCC) Market Analysis

The green construction cleantech market is a part of the larger green construction market. Cleantech is a short term for “clean technology” companies that employ environmentally friendly practices with an aim to improve the environment. Construction cleantech refers to the integration of clean and sustainable technology into the construction industry. This includes the use of energy-efficient building materials, renewable energy sources, and smart building technology for reduced energy consumption and waste. The goal is to reduce the carbon footprint and environmental impact of construction while improving the comfort, safety, and sustainability of buildings.

A three-step classification mechanism was used for the market analysis of 78 businesses in the cleantech real estate sector. The businesses were classified based on their industry in the real estate sector, their second industry to identify overlap, and their theme. The study found that 35.9% of businesses were in the construction industry as they provide solutions that facilitate the construction and surveying of buildings. 61.5% were in the real estate software industry as they provide software-based solutions to make the management and operationalization of buildings easier and more efficient. The rest were in mortgage & lending, and search, buy & rent.

The overlap and theme analysis of the 78 businesses with a second industry revealed the following:

[1] LEED - Leadership in Energy and Environmental Design by the US Green Building Council.

Industry Overlap	Total of 78	Construction % of 78	Construction Themes	RE Software % of 78	Real Estate (RE) Software Themes
Clean energy	13%	4%	• 9.0% - Bio & circular construction materials • 5.1% - Geospatial technology services • 2.6% - Hardware – Energy Retrofits • 1.3% - Heating & geothermal • 1.3% - Marketplace for construction materials • 7.7% - Modular construction • 2.6% - Passive cooling • 2.6% - Supply chain services • 2.6% - Sustainable Cement • 1.3% - Virtual & augmented Reality	9%	• 3.8% - Cooling: efficient appliances. • 32.1% - Energy retrofits. • 6.4% - Facility management optimization. • 1.3% - Indoor health. • 1.3% - Manufacturing & robotics. • 7.7% - Residential Solar installation. • 7.7% - Smart meters. • 1.3% - Virtual & augmented reality.
Education	1%	0%		1%	
Energy efficiency	56%	18%		38%	
Health	1%	0%		1%	
Jobs Recruitment	1%	1%		0%	
None	9%	6%		0%	
Robotics	1%	0%		1%	
Waste	4%	4%		0%	
Water	13%	3%		10%	

Table 1 - Market Mapping: Summary of Findings

Most businesses (56%) have an overlap with the energy efficiency industry. 13% have an overlap with the clean energy industry and 13% with the water industry. 9% of the businesses have no overlap with any other industry.

In terms of the construction and real estate software industries, 18% businesses in the construction-energy efficiency overlap are in themes such as bio & circular construction materials and modular construction, while 38% businesses in the real estate software-energy efficiency overlap function in themes such as energy retrofit, facility management optimization, and smart meters. In the construction industry, most businesses are in themes such as bio & circular construction materials (EcoBricks/ Eco Enterprises), modular construction (Modulus Tech), and geospatial technology (VTOL Dynamics). In the software industry, most businesses are in energy retrofits (ezGeyser, Asani.io) and residential solar installation (Nizam energy).

Recommendations for AP Programming:

The green construction markets that demonstrate opportunities for businesses are the new multi-unit residential, new commercial, and utilities sub-sectors due to urban population growth and the energy crisis. Providing solutions for low-income housing and resilient solutions to climate change and disasters are potential markets.

Based on the analysis of the GC market, startups and SGBs have significant potential in the construction industry and real estate software industry. Within the construction industry, bio & circular construction materials and modular construction in the energy efficiency industry overlap and geospatial technology services without the overlap demonstrate investment potential. Within the real estate software industry overlap, the energy retrofit market in energy efficiency and water industries and residential solar installation in clean energy industry demonstrate investment potential. Themes that have potential as innovative, technology driven and disruptive solutions are supply chain services, building financing, sustainable cement, marketplace for construction materials, virtual and augmented reality, facility management optimization, virtual & augmented reality, cooling: efficient appliances, and manufacturing & robotics.

Recommendations for AP Investment and Business Development

<u>Financial</u>

- Early funding is needed due to high capital expenditures for physical product development and production. Debt financing may be suitable for the 2–3-year period.
- Equity investment is recommended for the growth phase (3-5 years) when the business model has proven successful.

- GCC businesses should prioritize financial self-sufficiency and focus on generating cashflows more than on seeking funding until they have market traction.

GC Market

- The construction and real estate software industries both have potential for impact investment, as they represent different aspects of green buildings (construction and operationalization).
- The real estate software industry is applied in both new construction and retrofit markets, while the construction industry is applied in the new construction market only.

Business Model

- X-as-a-Service business model: A trend in GCC, offering a solution that is a fusion of product and service with higher investment potential. Diversification to an end-to-end solution is recommended.
- Outsourcing: A growing trend towards streamlined management of outsourced aspects that has demonstrates investment potential.
- Market segmentation: An essential activity in the formation phase. It is recommended to diversify from residential to commercial and industrial in the growth stage.
- Customer awareness: Word-of-mouth drives organic growth more than advertisement.
- Income stream: Commission-based businesses should aim for a subscription-based model for a more sustained income stream.
- Impact: Environmental goals woven into the business model are important but financial self-sufficiency should be a priority. Impact key performance indicators (KPIs) will be realized in the growth phase and is not recommended as an aim in formation and validation phase.

Physical Products:

- Manufacturing location: The manufacturing location may limit customer reach due to the transport costs. Decentralizing manufacturing is an aim for businesses in the growth phase.
- Up-front cost: Businesses must aim for financial self-sufficiency due to the high up-front costs of research & development, manufacturing, and building prototypes.
- Prototypes and certification: Small prototype projects are necessary to validate product success and prove claims based on relevant KPIs. Businesses may be given support in construction, certification, and identification of KPIs.
- Import dependency and local manufacturing: Growth in businesses relying on imports may slow due to cost and economic constraints. Early investment in local manufacturing startups may have long-term benefits. Diversifying procurement and in-house manufacturing may reduce risk.
- Seasonal demand: Seasonal demand for products such as insulation and gas geyser retrofits may be mitigated through B2B partnerships and by focusing on new construction markets.

Recommendations for Ecosystem Development

- Entrepreneur training through workshops and hackathons to raise awareness and encourage participation and encouragement of social inclusion for women and youth-led businesses.
- Involvement of GC market stakeholders, technical experts, and startup ecosystem experts to provide support.
- Provision of systemic support in the form of early investment, grants, and funding for research and development.
- Establishment of COOP partnerships with institutions and other programs to facilitate knowledge sharing.

Recommendations for Further Research

Based on this brief, AP may conduct future research on specific industries and overlaps for a micro market analysis which could not be covered within the time scope of this brief.

2 INTRODUCTION

2.1 Background

2.1.1 Objective

The Green Construction Brief (GCB) aims to support startups and small businesses in Pakistan by presenting a market analysis of the Green Construction (GC) and Green Construction Cleantech (GCC) markets. This analysis is intended to help identify business opportunities and assess the potential for impact investing.

The GCB provides a comprehensive overview of the complex and fragmented construction sector, including the GC and GCC markets, to assist Accelerate Prosperity (AP) in navigating the industry in Pakistan. The brief includes recommendations for supporting the growth of entrepreneurs and businesses and making informed investment decisions in the green construction sector. These recommendations are based on research that considers the market size, growth trends, opportunities, and challenges.

2.1.2 Scope

The scope of the brief is the analysis of the Green Construction (GC) and Green Construction Cleantech (GCC) markets in Pakistan. It provides a market analysis that creates a link between the GC market and the GCC market within the context of the construction industry and real estate sector. The GCC market analysis defines and maps the construction cleantech ecosystem to provide AP with an overview of the market framework.

The study focuses on the geographical regions of Islamabad/Rawalpindi, Karachi, Gilgit Baltistan (GB), and Khyber Pakhtunkhwa (KPK).

2.1.3 Methodology

The methodology used in the Green Construction Brief (GCB) involved both secondary research and primary qualitative assessment to develop recommendations based on findings. Secondary research was conducted through a *literature review* (Annex G) of 60 reports and 20 articles on the macro GC and micro GCC scale. The desk research provided an overview of the global, regional, and local situation, market dynamics, trends, triggers, constraints, and information gaps.

Primary qualitative assessment included *key informant interviews (KII), market mapping* of GCC businesses, and *case studies*. 20 key informants were selected for interviews, including experts in the GCC ecosystem,[2] GCC entrepreneurs,[3] GC experts,[4] and GC impact investors (Interview notes of the KIIs' may be found in Annex F).[5] The market mapping of GCC businesses involved collecting information on 293 businesses related to sustainability, green building, climate action, and cleantech, and a cluster analysis was conducted on real estate related businesses to classify and map the GCC market.[6] Three businesses were selected for case studies out of a pool of 78 businesses based on founder interviews, desk research, and comparative analysis. A grading system was used in which scores were assigned based on sector, industry, and use of technology. Final selection was conducted through an assessment of desk research, business description, region, female-

[2] E.g., Project Directors of Pakistan's National Incubation Centers in Karachi, Islamabad, and Peshawar, Syed Ahmad Masud of Change Mechanics, and experts in cleantech such as Hammad Bashir of Global Cleantech Innovation Program (GCIP) by UNIDO, and Hira Wajahat of Cleantech Republic.

[3] E.g., Ansab Jahangir – founder of startup Asani.io, Yaqoob Khan – founder of SGB EcoBricks, Ashar – founder of startup EZ-geyzer, Nabeel – co-founder of startup Modulus Tech, etc.

[4] E.g., Architect Aqrab Rana (Founder and CEO of Pakistan Green Building Council- PGBC), Green Building Engineer Ainul Abedin, etc.

[5] E.g., Hasat Qureshi from Karandaaz and Ashar from GSMA.

[6] Other businesses in the set of 270 that were not part of the real estate sector belonged under sectors such as agriculture or energy or were part of industries such as waste management.

leadership, and founder interviews. The case studies were conducted to provide maximum learning for AP by covering a range of business types (detailed Case studies may be found in Annex E).

2.2 Market Brief

The following figure shows the hierarchical relationship between the three markets analyzed in this brief. The green construction (GC) market is a subset of Pakistan's construction industry and real estate sector market while the green construction cleantech market (GCC) is a small part of both.

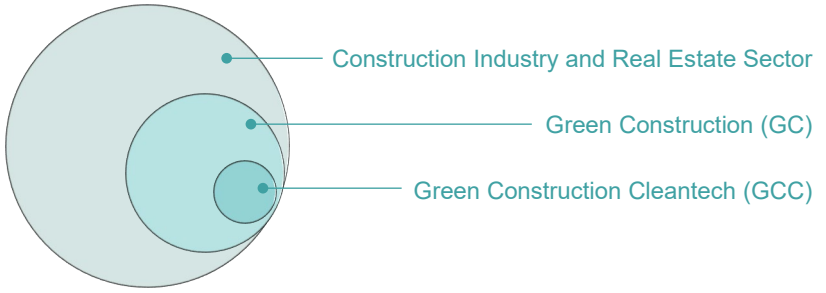

Figure 1 - Market Hierarchy

2.2.1 Green Construction (GC)

The Green Construction (GC) market analysis is conducted using a top-down approach by analyzing the construction industry market and the green building market.

Construction Industry and Real Estate Sector Market: The real estate sector includes developed or undeveloped land with sub-sectors such as residential development (single family detached or multi-unit), commercial development (transport, warehouse, institutional/ assembly, hotels and restaurants, healthcare, education, retail, and office), and industrial development.[7] The construction industry comprises of buildings (creation, renovation, repair, or extension of fixed assets), infrastructure (engineering construction such as roads, bridges, water and sewage system, or powerplants and dams), industries (factories or warehouses), and utilities (energy – electricity & gas – water, and waste treatment).[8]

Green Building: Globally, the term green construction is used synonymously with green building. "Green" construction or a "green" building, according to the World Green Building Council, is defined as "a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life."[9] Details of the parameters and metrics used to define green buildings and a green building glossary may be found in Annex A.

Green Construction Market: Green construction encompasses the complete life cycle of a building and any aspect of the built environment represented by the construction industry and the real estate sector. As green buildings aim to reduce and eliminate carbon emissions in buildings, it also addresses the emissions and impact created during the cradle-to-grave stages of a building and all its components. This includes raw material extraction, material processing, manufacturing, transport and distribution, construction process and use, operationalization and maintenance, disassembly and reuse, and disposal.[10]

GC Market Analysis Constraints: Due to the nascent nature of Pakistan's GC market, international studies on green building do not include Pakistan in their GC analysis. Contextual data based on local studies on green buildings on the environmental and financial impact of GC is scarce in

[7] https://www.pacra.com/sector_research/PACRA%20Research%20-%20Real%20Estate%20-%20May21.pdf

[8] https://www.pacra.com/sector_research/Construction%20-%20PACRA%20Research%20-%20Mar'22_1648744436.pdf

[9] WHAT IS GREEN BUILDING? | WORLD GREEN BUILDING COUNCIL, https://www.worldgbc.org/what-green-building (last visited Oct 24, 2022)

[10] Green Building - Wikipedia, https://en.wikipedia.org/wiki/Green_building (last visited Oct 24, 2022).

Pakistan. While there is an increase in the covered area of green buildings, there is a lack of analysis of the building's impact to gather data such as reduction in carbon emissions in construction and operations, initial cost of green measures, and savings created over the first year and first decade. To counter this, a comparative analysis will be done using data from regional green building markets and their size and trends.

2.2.2 Green Construction Cleantech (GCC)

The Green Construction Cleantech (GCC) market analysis is conducted using a bottom-up approach by mapping the market landscape. The GCC market exists within the Green Construction (GC) market.

Cleantech: "Cleantech" is a short term developed by financiers for "clean technologies", a blanket term that may be used for companies and technologies that employ environmentally friendly practices and aim to improve the environment.[11]

Green Construction Cleantech Market: GCC is the term given to cleantech businesses that are linked to the GC market and the real estate sector. Analysis is carried out through a market mapping based on a three-step classification mechanism to classify businesses based on their industry in the real estate sector, their second industry to identify overlap, and their theme.

Green Construction Cleantech Market Constraints: The GCC market in Pakistan is in its nascent stage and information on it is scarce due to the lack of awareness of green building and green construction in the startup and SGB ecosystem.[12] The current incubator/ accelerator classification mechanism in Pakistan limits the scope of green building cleantech to construction material or material assembly product. This brief provides a comprehensive classification mechanism to bring the complete range of construction and real estate related cleantech under GCC. This unique mechanism will allow a more precise analysis of the GCC market and allow a better-quality assessment of the business potential and investment opportunities.

2.3 Framework of Green Construction Brief (GCB)

- Chapter on *Green Construction (GC) Market* Analysis: to present an analysis of the market size, expected growth, trends, influences, areas of opportunities, and constraints.
- Chapter on *Green Construction Cleantech (GC) Market* Analysis: to present an analysis of the sector, industry, and theme classifications through market mapping and cluster analysis, and key findings.
- Chapter on *Recommendations:* to present recommendations for AP's investment program, business development, ecosystem development, and scope for further study, based on the areas of opportunities and key findings from the GC and GCC market analysis.
- Chapter on briefs of the 3 case studies: Ghonsla, EcoBricks by Eco Enterprises, and ezGeyser (detailed case studies in Annex E).
- Annexes A-G in a separate document:
    - Annex A – Glossary of Definitions
    - Annex B – Glossary of Classifications
    - Annex C – Financial Metrics for Business KPI Evaluation
    - Annex D – List of Impact Investors, Accelerators, and Incubators
    - Annex E – Detailed Case Studies
    - Annex F – Interview Notes
    - Annex G – Literature Review

[11] CLEANTECH DEFINITION, https://www.investopedia.com/terms/c/cleantech.asp (last visited Oct 24, 2022)

[12] The Global Cleantech Initiative Program (GCIP) organized by UNIDO in Pakistan uses the following categories to classify their cleantech businesses: waste beneficiation, waste to energy, water efficiency, energy efficiency, renewable energy, and green building (findings from interview with Hammad Bashir of UNIDO).

3 GREEN CONTRUCTION (GC) MARKET

3.1 Introduction

This chapter presents a market analysis of the Green Construction (GC) market. As the GC market is part of the construction industry market, a brief market analysis of the construction industry has been presented in the beginning of the chapter to provide context for the green construction market analysis.

3.2 Construction Industry Market Size, Growth, and Trends in Pakistan

3.2.1 Market Size and Expected Growth by Construction Sub-Sector

The global construction market size is expected to grow from USD 13.57 trillion in 2021 to USD 15.17 trillion in 2022 at a compound annual growth rate (CAGR) [13] of 11.8%. It is further expected to reach USD 22.87 trillion in 2026 at a CAGR of 10.8%. The construction industry is comprised of the following construction sub-sectors: commercial, institutional, industrial, residential, infrastructure, and energy & utilities. While infrastructure projects (roads, dams, etc.) represent the largest market segment within the construction industry, they are not considered relevant to the GC market analysis in this brief.[14]

According to the IFC, the building and construction market in Pakistan is expected to grow by about 3.4% (CAGR) in five years by 2025. The market size is worth almost USD 306.9 billion (2018-2025) and is comprised of 75.8% residential buildings, worth USD 232.6 billion, and 24.2% commercial buildings, worth USD 74.3 billion.[15] [16]

Construction Market In Pakistan (2018-25)[17]		
Construction Sub-sector	**Size (USD Billions)**	**Growth (CAGR) %**
Education	19.2	4.6
Healthcare	2.3	2.25
Hotels & Restaurants	9.3	3.5
Institutional/ Assembly	10.8	5.25
Office	14.2	2.5
Retail	8.4	2
Transport	2.4	Above 6
Warehouse	7.7	16.3
Total Commercial	**74.3**	**3.5**
Multi-Unit-Residential	226.1	3.4
Single-Family-Detached	6.6	2
Total Residential	**232.6**	**3.25**
Grand Total	**306.9**	**3.4**

Table 2 - Construction Market in Pakistan

[13] Compound annual growth rate.

[14] The construction industry is not tracked as a separate industry in the Pakistan Economic Survey. There is no information on growth of construction sub-sectors such as residential, commercial, etc. Information on supporting industries such as the cement industry, steel industry, and brick may be used to track growth. 40 allied industries are connected to the construction industry through forwards and backward linkages. Most information on the construction industry in the Pakistan Economic Survey 2021-22 focuses on infrastructure development such as transport, highways, roads, e.g., China-Pakistan Economic Corridor (CPEC), dams, and ports.

[15] IFC, GREEN BUILDINGS MARKET INTELLIGENCE PAKISTAN COUNTRY PROFILE (2018)

[16] According to a report by Global Data, the construction market size in the year 2021 was USD 18.5 billion (https://www.globaldata.com/store/report/pakistan-construction-market-analysis/).

According to another report by MarketLine, the industry had total revenues in 2019 of USD 19.0 billion, representing a growth rate (CAGR) of 3.2% between 2015 and 2019. The non-residential segments of these revenues represent 68.9% of the industry's overall value at USD 13.1 billion (https://www.reportlinker.com/p03711616/Construction-in-Pakistan.html).

[17] IFC, Green Buildings Market Intelligence Pakistan Country Profile (2018)

Real estate property prices have been increasing in the last two decades. Investor interest has risen in real estate as it is considered a relatively safer investment option with steady cashflow streams. As per Pakistan's economic survey, the share of employment for the construction sector was 9.5 percent for the financial year 2021.

The sub-sector most relevant to GC in Pakistan are energy, housing, and water and sanitation and are analyzed below.[18]

3.2.1.1 Residential - Housing

Pakistan is the most rapidly urbanizing country in Asia and suffers from severe gaps in demand and supply of basic utilities and housing. Given that an average unit houses over six people means that nearly one-third of the population is without housing.[19] As the population has risen to 231.4 million and income levels have declined, soaring property prices have resulted in high demand for rental properties.

The estimated housing shortage in Pakistan is up to 10 million units, of which about 40 percent is in urban areas, amounting to about 3.4 million housing units. By 2023, 40 million people are expected to live in urban centers and towns in Pakistan and 50% by 2040. Over the next 20 years, the annual urban population is expected to increase by about 2.3 million per year and the gap is expected to continue to increase by roughly 350,000 units per year.[20]

Housing services in the form of housing development societies are under private ownership and widely fragmented.[21] The government has recently launched new housing projects,[22] The Federal Public Sector Development Program (PSDP) has appointed PKR 24 billion (USD 105.6 million) to housing which is 3% of the total allocation budget.[23]

Average residential property prices have increased from PKR 9,894 per square foot in 2016 to PKR 12,324 per square foot in 2021.

3.2.1.2 Utilities: Energy

Pakistan has one of the highest energy consumption levels – with 50% of the energy consumed in buildings – contributing to its total carbon emissions. Lighting alone consumes 15% of the total electricity generated. In 2021, the annual electricity consumption was 50.2% in the domestic sector, 14.7% in the commercial and government/ institutional sector, and 25.6% in the industrial sector.[24] This is mainly from heating, ventilation, and air-conditioning (HVAC) systems.[25] To reach the target set in Pakistan's NDCs, Pakistan aims to shift to 20% renewable energy by 2025 and 60% by 2030 and completely ban imported coal.[26]

According to National Electric Power Regulatory Authority's (NEPRA) 2020 yearly report, Pakistan's total installed power generation capacity at 38700 MW, of which 57% of energy comes from thermal (fossil fuels), 31% from hydro, 4% from renewable (wind, solar and bagasse) and 8% from nuclear.[27]

Pakistan is facing a severe energy shortage as the current electricity generation capacity is 21 gigawatts (GW) while the demand is approximately 28 GW, creating a shortfall of 7 GW or 25% of

[18] Waste beneficiation is not included in the market analysis as it is beyond the scope of construction. Only waste related to construction is assumed to be part of this study.

[19] https://neeca.gov.pk/SiteImage/Misc/files/NEECA%20Strategic%20Plan%202020-23%20Final%2028%20October%202020(1).pdf

[20] World Bank, Pakistan Housing Finance Project (2018)

[21] 800 registered and unregistered housing societies exist in the Islamabad territory.

[22] Such as the Naya Pakistan Housing Scheme

[23] https://www.pacra.com/sector_research/Construction%20-%20PACRA%20Research%20-%20Mar'22_1648744436.pdf

[24] Pakistan Economic Survey 2021-22

[25] IFC

[26] Government of Pakistan, Updated Nationally Determined Contributions 2021 (2021)

[27] In April 2022, electricity generated from re-gasified LNG fell 2% to 2,517 Gigawatt hours (GWh), hydroelectric generation fell by 7% to 2,404 GWh, coal-fired electricity fell 10% to 2,189 GWh, nuclear almost doubled to 2,251 GWh and fuel oil-based electricity climbed to 1,564 GWh from 1,48 GWh year on year, according to data from National Electric Power Regulatory Authority.

the total demand. [28] It is estimated that over 140 million people (22 million households) in Pakistan either have no access to grid electricity or face severe shortage. Load shedding durations have reached 10-12 hours in cities and 14-16 hours in rural areas primarily because power plants have reduced operations due to non-availability of natural gas and a decline in production of hydropower.[29]

As natural gas becomes scarce, the government has indicated a move towards creating policies to promote domestic renewable energy production to improve energy security. Under the new policy, due to be out in August 2022, 7-10 GW of residential solar systems would be deployed by the summer of 2023.[30]

3.2.1.3 Utilities: Water and Sanitation

Pakistan faces a two-tier problem of water scarcity, i.e., water quantity and quality. While water shortage is severe in Sindh, the majority of Khyber Pakhtunkhwa (KPK) and Punjab do not face extreme water shortage due to availability of surface and underground water which is then domestically boiled or filtered for use. Per capita surface water availability of 5,260 cubic meters per year in 1951 turned into around 1,000 cubic meters in 2016. This is likely to further drop to about 860 cubic meters by 2025. Surface water comprises glacial melt up to 41%, snowmelt up to 22% and rainfall 27%. The agricultural sector remains the major user of water (94% as per estimates) and major improvement is required in irrigation practices to reduce water wastage. Hence, urban water management has never taken precedence in Pakistan.[31]

Only 36% of the population of Pakistan has access to safe drinking water. Karachi and Islamabad are a few of the cities regularly cited for facing a water crisis. According to an estimate, 50% of Karachi's population doesn't have access to clean water. The heavily populated city requires 1.1 billion gallons per day, while the supply is only 550 million gallons. The situation becomes increasingly unsustainable as approximately 0.6 million people migrate to Karachi annually.[32]

Access to improved sanitation service was at 63.7% in 2015 and only 50% of the effluents were collected out of which only 10% were treated. It has been estimated that about 308 million cubic meters of municipal and 185 million cubic meters of industrial wastewater is generated annually, but only 3% was treated in 2006. As per official data in Pakistan, about 4.36 billion m3 (BCM) wastewater gets generated every year, of which 1.30 BCM is industrial wastewater, while 3.06 BCM is domestic water.

3.2.2 Trends: Climate Change, Disasters, and Reconstruction

Pakistan has been severely affected by climate change and is spending 5.8–7.6% of total federal expenditures on climate change (or about 11% combined on adaptation and mitigation), according to a multi-country study by United Nations Development Program (UNDP) in 2015. Overall, Pakistan's adaptation needs in 2016 were placed in the range of between USD 7–14 billion per annum to 2050. This estimated that 70% of this amount was primarily due to infrastructural costs.[33]

According to the National Disaster Risk Management Authority (NDMA), the 2022 flooding in Pakistan has caused catastrophic damage of approximately USD 18 billion.[34] While foreign aid is

[28] IFC

[29] According to reports, the country's public sector distribution companies (DISCOs) lost more than PKR. 2.8 billion or USD 12.2 million due to short recovery of bills in more than 430,000 cases of electricity theft during the fiscal year 2020-21 (FY21).

[30] Energy Deficiency presents opportunities in the following energy sectors Solar Panels / Photovoltaic Panels, Dry Batteries, Inverters, Wind Farm Equipment (especially turbines), Biomass Boilers, Transmission Equipment, Distribution Equipment, Biogas Equipment, and Technical Consultancy.

[31] Despite recommendation of Pakistan Council of Research in Water Resources in National Water Policy 2018 to streamline Urban Water Management, not much has been done in this regard. Both the Environmental Protection Agency guidelines and National Water Policy require industrial units to have water treatment plants, however, the policy has not been implemented yet.

[32] Water mafia charge 10,000-12,000 PKR (USD 43-53) per 4,000-gallon water tanker. Transmission and distribution losses of 30-35 % are being experienced, some of this owing to the water mafia.

[33] GOVERNMENT OF PAKISTAN

[34] 33 million people have been displaced; 1.7 million houses damaged.

awaited, the government has rerouted USD 913.2 million from the PSDP budget towards rehabilitation and reconstruction in flood affected areas.[35]

3.3 Green Construction (GC) Market Size, Growth, and Trends in Pakistan and South Asia

3.3.1 Global Green Construction and Climate Market

In 2015, the Paris Agreement was put in place to counter the effects of climate change. Achieving the goals set in the Paris Agreement creates significant business and investment opportunities. Annual global investment in climate business solutions is over USD1 trillion and expected to grow. According to the IFC, the combined markets for renewable energy (USD 297 billion), energy storage (USD 2.5 billion), green buildings (USD 423 billion[36]), climate-smart urban transport (USD 288 billion), water recycling (USD 23 billion), and municipal waste management (USD 160 billion) are today worth more than USD 1.1 trillion. [37]

Globally, the building sector generates 28% of energy-related greenhouse-gas emissions and consumes more than 50% of electricity. By 2050, the built environment is expected to double. Most of this construction will occur in emerging markets, particularly in middle-income countries experiencing high population growth, rapid urbanization, and income growth.[38] The rapid growth in construction in these countries, along with the urgency of mitigating climate change, makes green construction an important solution.[39]

Green construction plays a pivotal role in spurring low-carbon economic growth and transition to clean energy. Globally, green building activity tends to double every three years. The current size of investments in green buildings is only a fraction of the investment opportunity.[40] According to the IFC, global investments in green buildings accounted for USD 423 billion of the USD 5 trillion spent on building construction and renovation in 2017. The green buildings sector represents a USD 24.7 trillion investment opportunity by 2030 across all emerging market cities. Most of this investment potential – USD 17.8 trillion – lies in East Asia Pacific and South Asia, where more than half of the world's urban population will live in 2030. The investment opportunity in residential construction, estimated at USD 15.7 trillion, represents 60% of the market.

3.3.2 Sustainable Development

Implementation of adaptation and mitigation measures to counter climate change has created a market for sustainable development in the GC industry and an opportunity for it to be a part of the climate resilience agenda. Adaptation measures in GC include the reconstruction of resilient buildings and infrastructure that are damaged due to disasters, the design of energy efficient buildings to adapt to the extreme climate, use of non-toxic and sustainable building materials, implementation of sustainable construction processes and transport of materials, and sustainable consumption and reuse of resources such as water. Mitigation measures include reduction in carbon emissions and greenhouse gases (GHGs) to reduce the effect of climate change.

3.3.3 Pakistan's Carbon Emissions

Pakistan's total emissions as per 2018 were 489.87 Metric Tons of Carbon Dioxide Equivalent ($MtCO_2e$), which is about 0.9% of the global carbon emissions.[41] As per Pakistan's Updated

[35] https://www.researchandmarkets.com/reports/5640151/pakistan-construction-market-size-trends.

[36] USD 388 billion in 2017.

[37] IFC, Creating Markets For Climate Business An IFC Climate Investment Opportunities REPORT (2017), www.ifc.org

[38] IFC, Green Buildings A Finance and Policy Blueprint For Emerging Markets (2019)

[39] IFC, Creating Markets for Climate Business An IFC Climate Investment Opportunities Report (2017), www.ifc.org

[40] IFC

[41] UNIDO, Evaluation of Carbon Emission Reduction of GCIP Projects - Creating a Better Future for Pakistan (2016)

Nationally Determined Contributions (NDCs') 2021, it has set a cumulative ambitious conditional target of overall 50% reduction of its projected emissions by 2030. The strategy to achieve this goal is the promotion of efficient energy consumption measures and renewable energy production.[42]

Emissions are measured in the form of energy use and direct emissions. Emissions related to the construction industry are found within the energy sector, therefore, power generation, transport fuel combustion, energy use in industrial, residential, and commercial buildings, emissions from air conditioning and refrigeration, brick manufacturing, etc., Emissions from Industrial processes and product use include cement and steel manufacturing.[43]

Sector	Sub-sector	Energy Use[44]	GHG emissions[45]
Energy	Industrial	37.1%	18% of total
	Residential	22.2%	24.87 $MtCO_2e$
	Manufacturing industries & construction	-	66.2 $MtCO_2e$
	Transport	31%	51.34 $MtCO_2e$

Table 3 - Emissions in Pakistan

3.3.4 Market Size and Expected Growth by Construction Sub-Sector

The green construction market in Pakistan is in its nascent stage and, according to the IFC, it will have a slow uptake in the next several years. Green building area has grown from 5,000 square feet of certified green building floor-area in 2014 to 7 million square feet in 2017 and 11.43 million square feet in 2022. 52 buildings have been certified by the LEED[46] rating system.[47] Most of these buildings are part of the industrial sector, such as factories and warehouses, due to the export subsidies given by governments in the form of tax relief.

The green building floor area grew approximately 25.17% per year from 2014-17 and 12.25% per year from 2017 to 2022. Based on the average growth rate from the period from 2017 to 2022 (12.52%), the expected growth in the next 5 years can be estimated as approximately 16.47 million square feet.[48]

As shown below, the green market is worth almost USD 11.39 billion with residential buildings accounting for USD 9.84 billion and commercial buildings accounting for USD 1.55 billion.[49]

	GC Market In Pakistan[50]	GC Market in South Asia
Construction Sub-sector	Size by Year 2025 (USD Billions)	Size by Year 2030[51] (USD Billions)
Education		41.2
Healthcare		13.5
Hotels & Restaurants		38.8
Institutional/ Assembly		17.3
Office		61.7
Retail		87.6
Transport		3.2
Warehouse		18.2

[42] GOVERNMENT OF PAKISTAN

[43] The cement sector accounts for 68.9% of total coal consumption by industries (https://neeca.gov.pk/SiteImage/Misc/files/NEECA%20Strategic%20Plan%202020-23%20Final%2028%20October%202020(1).pdf).

[44] Including fuels and electricity.

[45] https://neeca.gov.pk/SiteImage/Policy/Draft%20NEEC%20Policy%20PD%20Reviewed%20PRU%209122021.pdf

[46] Leadership in Energy and Environmental Design by the US Green Building Council.

[47] https://www.gbig.org/places/809

[48] It is to be noted that future growth may not necessarily follow the same trend as in the past and this estimate is only a prediction.

[49] IFC

[50] IFC, Green Buildings Market Intelligence Pakistan Country Profile (2018)

[51] IFC, Green Buildings A Finance And Policy Blueprint For Emerging Markets (2019)

Total Commercial	**1.55 (13.6%)**	**281.5 (16.0%)**
Multi-Unit-Residential		542.9
Single-Family-Detached		933.8
Total Residential	**9.84 (86.4%)**	**1,476.7 (84.9%)**
GC Total	**11.39**	**1,758.1**

Table 4 - Green Construction Market Size in Pakistan and South Asia

3.3.5 Market Size and Growth by Regional Comparison

A comparative analysis of the GC market sizes of the following South-Asian countries was performed: India, Bangladesh, Sri Lanka, and Nepal.

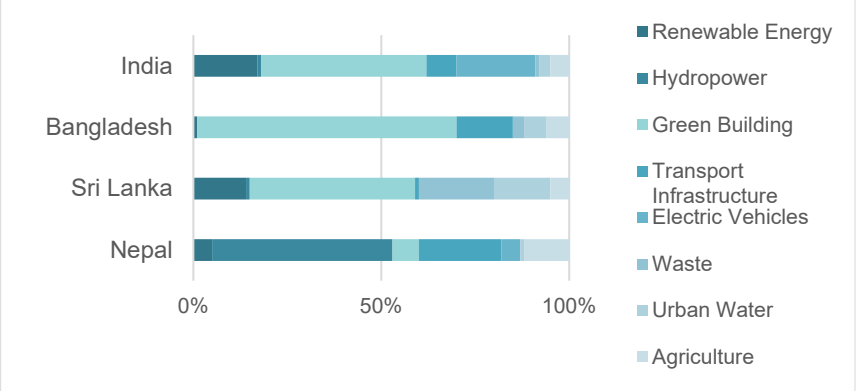

Figure 2 - Regional Climate Investment Market Size Comparison

By Regional Country[52]	GC Market Size by Year 2030[53] (USD Billions)	Total Residential by Year 2030 (USD Billions)	Total Commercial by Year 2030 (USD Billions)	GC Market % of total Climate Investment
India	1,400	1,250	228	46%
Bangladesh	118.8	100	18	70%
Pakistan (Year 2025)	11.39	9.84	1.55	-[54]
Sri Lanka	8.4	6.8	1.6	45%
Nepal	3.4	2.7	0.65	7%

Table 5 - Regional Green Construction Market Size Comparison

Bangladesh and Sri Lanka are the closest comparable countries based on indicators such as population, GDP, GDP growth, inflation, Ease of Doing Business ranking, and foreign direct investment (net inflows). But these indicators alone may not be used to create a comparative analysis of the size of the GC market. The indicators which may be more relevant are government laws, green policy and implementation, Nationally Determined Contributions (NDCs) and targets achieved, private sector engagement and investment, foreign direct investment, vulnerability to climate change, and economic growth.

The table below shows a comparison of the number of LEED certified building project types and their covered area followed by a comprehensive green construction market comparative analysis with Bangladesh and Sri Lanka.

	Bangladesh		Sri Lanka		Pakistan	
LEED Certifications	**Number**	**Area**	**Number**	**Area**	**Number**	**Area**
Total	210	53.57	70	7.53	52	11.43
Industrial & Manufact.	173	49.4	35	2.73	28	8.26
Office	26	2.67	10	0.95	15	2.12

[52] In descending order, largest to smallest GC market size.

[53] IFC, CLIMATE INVESTMENT OPPORTUNITIES IN SOUTH ASIA (2017), www.ifc.org2

[54] No information available.

Multifamily residential	-	0.14	3	1.90	2	0.75
Retail	-	0.29	3	0.17	2	0.043
Higher Education	-	-	2	0.048	1	0.05
Other	6	0.87	13	1.62	3	0.25
* Area in million square feet						

Table 6 - LEED Certified Buildings and Covered Area

3.3.5.1 Bangladesh

The construction market in Bangladesh is expected to reach USD 118.8 billion, 10 times larger than that of Pakistan. Most of this market will be in residential construction (84%), while the remaining 16% will be in commercial construction.

Bangladesh has more than 400 green buildings certified and registered, 214 of which are LEED certified and equal to a square foot area of 53.57 million (four times that of Pakistan's).[55] Like Pakistan, Bangladesh has a strong manufacturing sector, which is why almost 92% of its green building area is in the industrial and manufacturing project category and 5% in offices.

Through policies and regulations, the country is prioritizing energy conservation and the greening of its buildings. GC penetration in commercial buildings is expected to be 50% by 2030 as their NDCs'[56] specify a 2.5% emissions reduction in the commercial space, and 20% in the residential sector by 2030, as green benefits are better understood, and regulations are implemented.

3.3.5.2 Sri Lanka

The GC market in Sri Lanka will be worth USD 8.4 billion (almost two-third the size of Pakistan's) with residential construction at 81% and commercial at 19%.

Sri Lanka has 70 green buildings certified through international channels such as LEED, which amounts to approximately 7.53 million square feet (two-thirds the size of Pakistan's), and an effective local certification system. 36% of certified construction is in industrial and manufacturing, 25.2% in multifamily residential, and 21.5 in other project types.

Through implementation of policies and regulations, GC penetration into the commercial sector is projected at 40%, 50% in the hotel sector due to demands from the tourism industry, and 30% in the residential sector by 2030.

3.3.5.3 Pakistan

According to the IFC, the GC market is worth USD 11.39 billion with 86.4% residential construction and 13.6% commercial.

Pakistan has 52 LEED[57] certified buildings amounting to a total of 11.82 million square feet.[58] Following the manufacturing trend in Bangladesh, 72.2% of Pakistan's green area falls under industrial and manufacturing, 18.5% in offices (mostly financial institutions), and 6.5% in multi-unit residential. Like in Sri Lanka, demands from the growing tourism industry may encourage GC growth in hotels and supporting construction. Like Bangladesh and Sri Lanka, the primary owners of the certified buildings in Pakistan are corporations and investors.

Pakistan's NDCs make no mention of GC goals set for the construction industry and real estate sector besides recommending actions on green building codes and certification. A goal is set to shift energy production to 20% renewable energy by 2025 and 60% by 2030. For the building sector, the

[55] https://www.usgbc.org/resources/country-market-brief

[56] Nationally Determined Contributions.

[57] Leadership in Energy and Environmental Design by the US Green Building Council.

[58] https://www.gbig.org/places/809

National Energy Efficiency & Conservation Authority (NEECA) has set a goal to develop building energy management systems and use of low energy appliances.

3.3.5.4 Outcome

The above comparative analysis allows for an assessment of the growth, triggers, and constraints of GC. The growth of the GC market in Pakistan is driven by the industrial and manufacturing sector, where investors and corporations factor in the returns on investment (ROI) through export/ import tax subsidies for LEED certified facilities. The increase in certified industrial buildings creates a market for GC measures, services, products, and expertise, and the long-term benefits outweigh the high initial cost.

The GC market in Pakistan is expected to grow in other sectors as well, due to an increase in political interest and awareness, especially after the impact of the 2022 floods caused by climate change and a renewed interest in implementing regulations. This growth is expected to follow the trajectory of Bangladesh and Sri Lanka, despite economic constraints.

3.3.6 Market Trends and Influences by Regional Comparison

Survey data on GC in Asia, China, and India assesses the leading trends and influences.[59] Based on this survey and the regional comparison indicators, the findings for India are most applicable to the local GC market.[60] The findings are presented below.

3.3.6.1 Increase in GC Activity by Project Type

As shown in the table below, due to population growth in urban areas, new high-rise residential and Communities/ Mixed-use development projects are expected to increase due to lack of space.

Project Types	India	China	Asia
New Commercial Construction			
New Institutional Construction			
Existing Building/ Retrofits			
New High-Rise Residential			
New Low-Rise Residential			
Communities/ Mixed-use Developments			
Commercial Interiors			

Table 7 - Regional Expected GC Activity by Project Type

3.3.6.2 Leading GC Triggers and Influences

The table below identifies the leading triggers and influences that affect the GC market through regional comparison. In India, the top triggers for new GC (in order of importance) are environmental regulations, need for healthier buildings (especially post COVID-19), lower operating costs, and higher building values. In Pakistan, as awareness of GC is similarly low in customers, client and customer demand may not be a leading trigger for GC. Financial triggers and policy/ regulations may be assumed to be the leading triggers, as is also evidenced by the comparison with the Bangladesh GC market.

Environmental	Market	Economic	Social	Policy
Reduces energy and water consumption	Market demand and transformation	Lower operating costs	Right thing to do	Environmental regulations
Lowers carbon emissions	Client demands	Higher building value	Healthier buildings and quality of life	Internal corporate commitment

[59] Dodge Data & Analytics, World Green Building Trends 2021: Smart Market Report, (2021)

[60] Bangladesh, Nepal, and Sri Lanka were surveyed but the report only includes results for India from the South-Asia region.

Improves indoor air quality		Supports the domestic economy	Increased worker productivity	
Protects natural resources		Job creation	Creates a sense of community	

Table 8 - Top GC Market Triggers and Influences

3.3.6.3 Leading GC Measures

The table below identifies the top GC measures through regional comparison. Top measures in India for the next five years are creation of Net-Zero and Net-Positive Buildings[61], Strategies to increase resilience[62], and Controlling embodied carbon.[63] [64] As Pakistan is severely affected by an energy crisis, the government and Pakistan's NDCs focus mainly on energy efficiency. Due to the recent floods, climate change has once again come to the forefront with a drive to create more resilient buildings. These measures create an opportunity for the mainstreaming of GC measures.

Top GC Measures[65]	India	China	Asia	Builders	Owners	Investors
Creation of Net-Zero/ Net-Positive Buildings						
Controlling Embodied Carbon						
Strategies to Increase Resilience						
Passive Building Design						
Prefabrication and Modular Construction						
Design for Disassembly and Recovery						

Table 9 - Top GC Measures

Builders, Owners, and Investors are considered the primary drivers of GC. The above results show their preference for GC measures which are based on the business case and investment returns of GC. The preference of owners and real estate developers in Pakistan may be assumed to follow the above results as the financial metrics of these measures are quantifiable, therefore proving a business case.

3.3.6.4 GC Products and Services

The below table identifies the leading GC products and services which vary across regions. In India, electrical products and waste management are leading, while thermal and moisture protection is not considered a top GC product. Pakistan may follow the same trends at a slower pace. For example, in Pakistan, building automation systems[66] are in their early stages, with small retrofit solutions such as smart lighting and energy regulation devices being more prevalent.

Top Green Products and Services	India	China	Asia
Waste Management			
Electrical			
Building Automation Systems			
Flooring			
Furnishings			
Mechanical			
Thermal and Moisture Protection			
Finishes			

Table 10 - Top GC Products and Services

[61] Net-Zero energy – where highly efficient buildings use only renewable energy.

[62] Especially due to climate change and to make GC hazard and disaster resistant.

[63] The entire carbon emissions associated with a building over its whole life from cradle to grave/cradle.

[64] See Annex A for glossary of definitions.

[65] Other measures not mentioned due to relevance are AI-Generative Design and Machine Learning to Improve Construction Process, AI-Generative Design and Machine Learning to Improve Design Process, Biophilic Design, Mass Timber, Design for Manufacturing and Assembly.

[66] Facility Management Optimization theme

The trend towards products and design to create healthier buildings and to improve the quality of life is increasing due to COVID-19. These trends are:

Building Design	Building Products
Upgrading HVAC[67] System to allow for fresher/ filtered air (mechanical)	Indoor air quality monitor
Overall focus on healthier buildings and occupant quality of life	Switch to No-touch bathroom fixtures.
Included operable windows (mechanical and automation)	Increased use of sensors and other IoT Technology (electrical).
Used more hard surfaces (finishes)	Selected furnishings with anti-bacterial coating

Table 11 - Trends in GC due to COVID-19

3.3.7 Key Stakeholders

The following are the institutional and industry stakeholders in the GC market.

Institutional GC Stakeholders	Industry GC Stakeholders
Government – Policy Makers	Investors
National Institutions	Owners
Councils[68]	Real estate developers
Foundations	Material Manufacturers & Vendors
International Organizations	Architects/ Designers
Government Utilities	Engineers
Corporations	Contractors/ Builders
Think Tanks	Specialists/ Consultants (Building performance, Energy Audits, Certification)

Table 12 - GC Stakeholders

3.4 Opportunities and Constraints: Key Findings

3.4.1 Opportunities

3.4.1.1 Industrial Sector

The growth of the GC market in Pakistan is driven by the industrial and manufacturing sector, where investors and corporations factor in the ROI through tax subsidies for LEED-certified facilities. This increase in certified industrial buildings creates a market for GC measures, services, and expertise, and the long-term benefits outweigh the high initial cost of implementation.

3.4.1.2 Construction Market Sub-sectors

In Pakistan, the residential sector represents 86.4% of the total GC market and consumes 50.2% of the total electricity generated. With growing population in urban areas and a housing shortage, there will be a need for significant construction, especially in the multi-unit residential building sector with an emphasis on affordable housing.

This presents a market opportunity for affordable GC measures to generate financial benefit and reduce electricity consumption through energy efficiency solutions. Real estate developers of housing societies are key players in this market. In the commercial construction sector, education and institutional buildings have the largest share with a high estimated growth rate, while warehouses have the highest growth rate. This presents a significant market for the implementation of large-scale GC measures.

[67] (Heating, Ventilation, and Airconditioning)

[68] Such as Pakistan Council for Architects and Town Planners (PCAT), Pakistan Engineering Council (PEC), etc.

3.4.1.3 Energy Efficiency

The energy crisis in Pakistan has driven the government to implement policies to improve energy efficiency in buildings. This includes regulating appliances, promoting the use of energy-saving lighting, and conducting energy audits. The increased accessibility of solar power systems for residential use also presents a significant opportunity for the implementation of energy-saving solutions, particularly in the growing construction sectors.

3.4.1.4 Climate Change and Disasters

The recent floods in Pakistan have heightened the focus on reconstruction, and international organizations are recommending that any reconstruction be resilient to the impacts of climate change. This creates an opportunity for GC as it provides solutions for building resiliency against future disasters.

3.4.1.5 New Construction vs. Retrofit/ Renovation

New buildings represent a larger GC investment potential as rapid growth in new construction is expected to cause the global building floor area to double by 2060, mostly in high population countries such as South Asia.

3.4.1.6 Key Stakeholders Driving GC

The key stakeholders in the GC market in Pakistan, including building owners, investors, real estate developers, and builders, are driven by the business case for GC. Their focus on the financial benefits of GC will drive the growth of the market in a sustainable direction.

3.4.2 Constraints

3.4.2.1 Leading GC Constraints

The following table shows the leading constraints influencing the GC market. The top GC barriers in India are lack of trained/ educated GC professionals, affordability, and high levels of corruption in the industry. In China, it is higher first costs, affordability, and inability to prove the business case.

Policy	Market	Economic	Social
Lack of political support	Lack of trained/ educated GC professionals	Higher first cost (perceived or actual)	Lack of public awareness of GC
Lack of policies, mandatory regulations, and implementation	Lack of market demand	Affordability	Lack of customer awareness of GC advantages
Lack of incentives (e.g., financial)	Lack of green materials and products	Unable to prove the business case of GC	Misconception that GC is for high-end projects only
	High levels of corruption in the industry		

Table 13 - Top GC Market Constraints

By comparative analysis it may be assumed that the weak economy, high inflation rates, and rising property and building material costs may make affordability and high first cost of GC the most relevant barriers in Pakistan. These may be followed by lack of public awareness, lack of trained professionals, and lack of policies and regulations. These constraints make it harder for the entry of any new GC measure and product into the market.

3.4.2.2 Limited Awareness and Knowledge

There is a limited awareness and understanding of GC practices, products, and services among key stakeholders, including owners, investors, contractors, and the public. Additionally, the market for GC measures and services is fragmented with limited knowledge and understanding of the key

suppliers and product offerings. This has resulted in a lack of confidence in GC and limited investment. To support the growth of GC, there needs to be increased awareness and education of the benefits of GC, including operational cost savings through energy saving measures, improved quality of life, and increased property value.

3.4.2.3 Construction Industry Dynamics

Construction work is unpredictable and is often subject to delays and prolonged deadlines, which can result in increased costs due to inflation, material shortage, and a lack of skilled labor. Additionally, construction is a capital-intensive industry that requires continuous financing, and poor cost estimation and construction management can significantly increase overall costs. Corruption and a lack of quality control, especially among builders and contractors, also hinder the progress of construction projects in Pakistan.

These factors pose constraints to the growth of the GC market in Pakistan as the construction industry needs to improve its dynamics for successful implementation of GC measures. The construction industry must focus on reducing delays and cost overruns, ensuring the availability of skilled labor and high-quality materials, implementing quality control measures, and reducing corruption. Additionally, uninterrupted financing is necessary for the successful implementation of GC measures in construction projects.

3.4.2.4 Macroeconomic and Industry

The macroeconomic and industry conditions can also have a significant impact on the GC market in Pakistan. Economic instability, currency devaluation, and high import taxes can make GC products more expensive and affect the growth of the market. The lack of local manufacturing ability and technological innovation, as well as the shortage of technical skills and expertise in the labor force, also pose challenges to the growth and development of the GC market.

4 GREEN CONSTRUCTION CLEANTECH (GCC) MARKET

4.1 Introduction

This chapter provides an overview of the global cleantech market before presenting a market analysis of cleantech related to the real estate and construction industry. It includes a comprehensive analysis of the Green Construction Cleantech (GCC) and its penetration into the Green Construction (GC) market.

4.1.1 Global Cleantech Market

This section highlights the lack of progress in achieving global climate targets as set in the Paris Agreement, despite countries making commitments in their Nationally Determined Contributions (NDCs). It emphasizes the crucial role of both small and large-scale solution providers in addressing the issue of climate change.

Cleantech is a short term for “clean technology” companies that employ environmentally friendly practices with an aim to improve the environment. According to the Cleantech Group, these solutions may range within the following areas:

Cleantech Areas[69]	Solutions
Energy & power	Renewables, decarbonization of home, commercial, and industrial energy use.
Resources & environment	Carbon capture & utilization, recycling and waste, and water and wastewater.
Transportation & logistics	Electrification of transport, supply chain and logistics, urban mobility, and smart cities.
Agriculture & food	Soil health, local food networks, indoor farming, and alternative protein.
Enabling technologies	Robotics, artificial intelligence and machine learning, data management & analytics.
Materials & chemicals	Bio-based plastics, material and chemical discovery, and composites.

Table 14 - Cleantech Market Areas

The five-macro sustainability and impact trends which are accelerating through entrepreneurship and innovation in the below six areas are resilience, circular economy, decarbonization, urbanization, and digitalization.[70]

The growth of the cleantech market is dependent on increased investment in the sector by businesses, financial institutions, cities, and countries. The shift of investor focus from fossil fuels to renewable energy and clean technology solutions is crucial to meet national climate action plans and reach the targets set in the Paris Agreement. However, the biggest challenge is to bring innovative cleantech solutions to market and make them cost-effective. To achieve this, collaboration between governments, investors, and accelerators is necessary to support solution providers and enable the scaling up of their business models. [71]

Evidence of cleantech innovation can be seen through early-stage private investment, high impact cleantech companies, environmental patents, and increase in cleantech imports and exports. Commercialization of cleantech can be measured through increase in renewable energy consumption, late-stage investment and exits, listing of cleantech companies and growth in cleantech employment. [72]

4.1.2 Green Construction Cleantech (GCC) Market

[69] The Global Cleantech Innovation Program (GCIP) by the United Nations Industrial Development Organization (UNIDO) is also aiming to evolve its cleantech technology classification from energy efficiency, renewable energy, waste beneficiation, water efficiency, green buildings, transportation, and advanced material and chemicals to more impact-focused categories such as energy systems, sustainable cities, healthy oceans and sustainable fisheries, food systems, and landscape restoration.

[70] CLEANTECH GROUP, GLOBAL CLEANTECH 100 (2021)

[71] CLEANTECH GROUP, THE GLOBAL CLEANTECH INNOVATION INDEX 2017 (2017)

[72] CLEANTECH GROUP, GLOBAL CLEANTECH 100 (2021)

The Green Construction Cleantech (GCC) market is a segment of the larger Green Construction (GC) market, which aims to integrate clean and sustainable technology into the construction industry. This includes the use of energy-efficient building materials, renewable energy sources, and smart building technology to reduce the carbon footprint and environmental impact of construction while improving the comfort, safety, and sustainability of buildings. GCC covers a range of areas, including the use of raw materials and resources, transport, green materials, digital technologies, renewable energies, and more, all aimed at making buildings energy and resource-efficient throughout their life cycle. The goal is to address the complete life cycle of a building and the built environment, including cities, to make them more sustainable and environmentally responsible.

4.2 Market Classifications

A three-step classification mechanism has been established for businesses that are linked to the GCC real estate sector. The businesses may be classified based on their industry in the real estate sector, their second industry to identify overlap, and their theme. This classification mechanism will allow the creation of a link between the GCC market and the GC and construction industry market trends.[73]

The following are the relevant sectors, industries, technology types, and themes (see glossary in Annex B).[74] Technology and impact tags may be applied to the businesses for detailed classification. An extensive list of these tags has been provided in Annex B.

Sectors	Industries
Real estate	
	Construction
	Real estate software
	Mortgage & lending
	Search, buy, and rent
	Real estate services
Energy	
	Clean Energy
	Energy Efficiency
	Energy Providers
	Waste Solutions
	Water
	Energy Storage
Education	Education
Health	Health
Transportation	
	Navigation and maps
	Logistics & delivery
Jobs recruitment	Jobs recruitment
Robotics	Robotics
Insurance	
	House & property

Technology Types	
Deeptech[75]	Mobile App
Artificial Intelligence	Big data
AI-Machine learning	Augmented Reality
AI-Computer vision	Virtual Reality
3D	Autonomous & Sensor Tech.
IoT-Internet of Things	Connected Device
Hardware	Recognition Tech.

Themes	
Manufacturing and robotics	Cooling: efficient appliances
Modular construction	Energy retrofits + Hardware
Supply chain service	Building financing
Passive cooling	Solar financing[76]
Marketplaces for construction materials	Smart glass windows
Bio & circular construction materials	3d printed architecture
Heating and geothermal	Wooden buildings
Sustainable cement	Waste to building material
Geospatial technology	Sustainability reporting in real estate
Virtual & Augmented reality	Cement + carbon capture
Facility management optimization	Third party certification
Residential solar installation	Sustainable steel
Indoor health	Sensor lights

[73] Please note that the classifications were filtered for the purpose of this brief. There are no specific sources (that were found) that focus only on green building or green construction cleantech. It should be noted that Dealroom.co classifies businesses under labels industries and sub-industries (Industries (such as real estate and energy) and sub industries (such as construction and energy efficiency)). To make the classification mechanism easier for the purpose of this Brief, the term "sector" is being used instead of "industries" while "industries" is being used for "sub-industries".

[74] https://knowledge.dealroom.co/knowledge/dictionary-taxonomy#industries

[75] https://dealroom.co/blog/2021-the-year-of-deep-tech

https://www.techworks.org.uk/about/what-is-deep-tech

[76] Solar financing initiatives are also providing the "service" of solar installation and so are categorized under service sub-industry (not mortgage & lending).

	Climate risk	Smart meters	Home energy storage

Table 15 - GCC Market Classifications

These GCC businesses may be classified based on their business model as per the following:

Client Focus	Business Model Type	Income Stream	Entrepreneurship Type
B2B (Business)	eCommerce & marketplace	Advertising	Innovative Ideas, Routes to Market, or Product
B2C (Consumer)	Manufacturing	Commission	Exceptional Growth, Growth Strategy, or Management
	SaaS	Subscription	Social Impact

Table 16 - GCC Business Model Classifications

4.3 Market Mapping

As the scope of the brief is GC related cleantech, only businesses with real estate as one of their sectors was shortlisted for analysis purposes. 78 out of the 293 businesses were found to have the real estate sector classification as one of their assigned sectors.[77] Following is the three-step classification for cluster analysis.

4.3.1 Sector Analysis

The following chart demonstrates the sector overlap analysis:

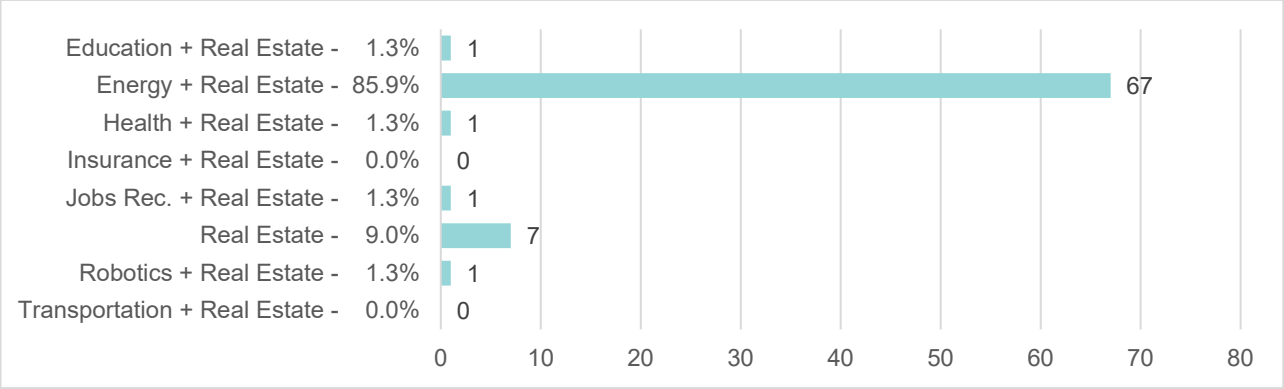

Figure 3 - Sector Analysis

The study finds that over 91.0% of the 78 GCC businesses analyzed were classified under more than one sector. These findings demonstrate that there is a significant market in Pakistan for GCC related to energy and are analyzed in more detail in the following sections. Insurance and transportation sector businesses in the real estate sector are not markets that GCC startups and SGBs have yet entered.[78]

4.3.2 Step 1: Industry Analysis – Industries within Real Estate Sector

The 78 businesses were classified based on their industry in the real estate sector to identify business function. The following is a definition of the five industries and their business types.

Industry	Definition of Business type
Construction	Solutions that facilitate the construction/ surveying of real estate properties. E.g., materials, GIS mapping service, prefabrication / modular construction.
Mortgage & Lending	Financial services specifically tailored towards the real estate market (may overlap with FinTech). E.g., green building financing initiative.

[77] Other businesses in the set of 270 that were not part of the real estate sector belonged under sectors such as agriculture or energy or were part of industries such as waste management.

[78] As far the study could find.

Real estate services	Businesses that do not fall under any of the other categories. For example, these could include tailored customer service and interior design solutions.
Real estate software	Software-based solutions to make the management and operationalization of buildings easier and more efficient. [79] E.g., Building energy performance management software, AR/VR for design walkthrough.
Search, Buy, & Rent	Platforms that facilitate the discovery, purchase, or rent of homes/ rooms. E.g., search platform for green certified buildings for buy or rent.

Table 17 - Industries of Real Estate Sector

The chart below shows the findings of the real estate industry analysis:

- 61.5% of the businesses function within the real estate software industry and focus on the management and operationalization of a building.
- 35.9% are part of the construction industry and focus mainly on the construction and surveying of buildings.
- 1.3% each in mortgage & lending and search, buy, and rent.
- No businesses in the real estate services industry (relevant to this study) were found and so it is excluded from further analysis.

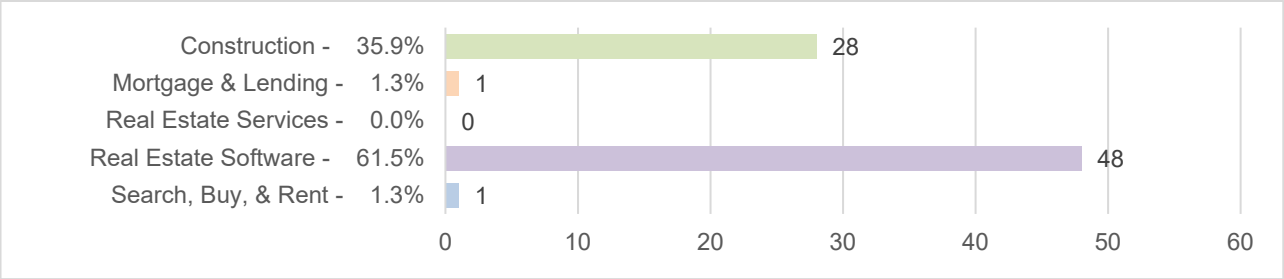

Figure 4 - Analysis of Businesses in Real Estate Sector Industries

4.3.3 Step 2: Industry Analysis – Second Industry Overlap

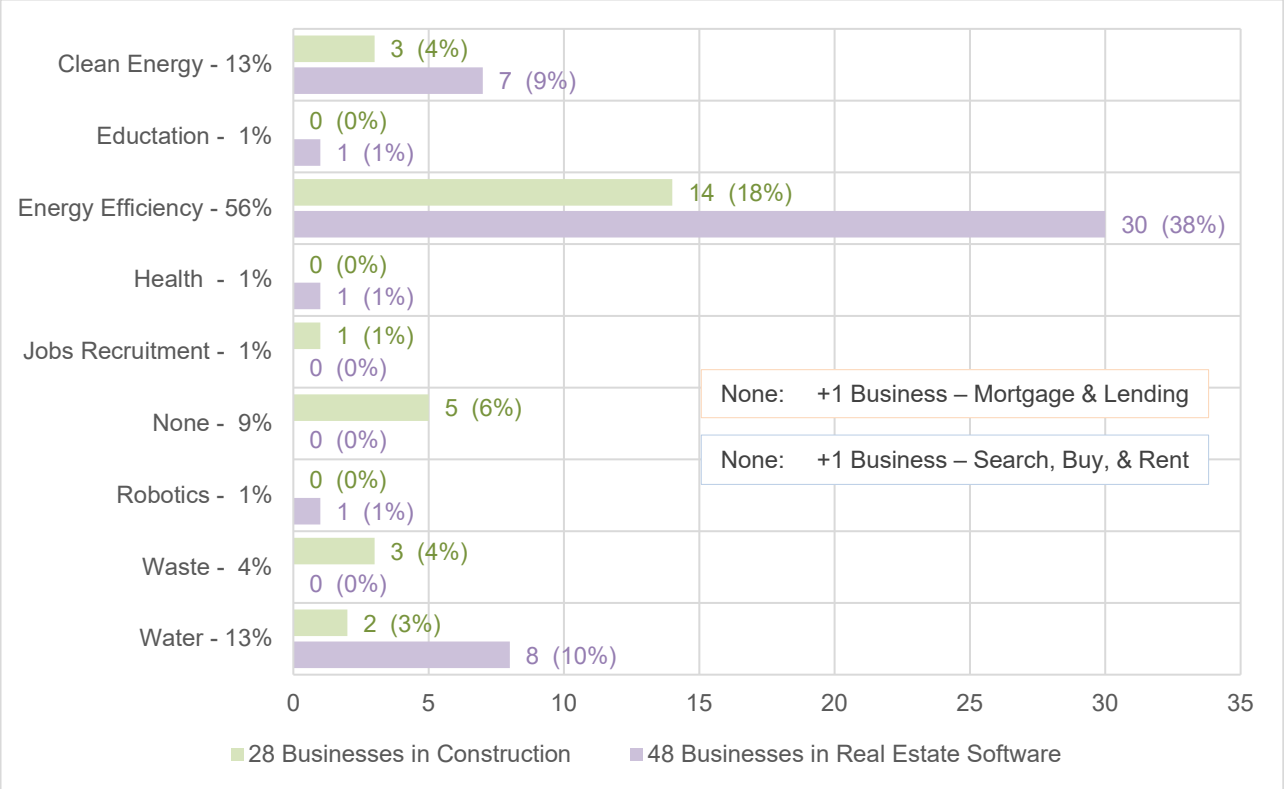

Figure 5 - Second Industry Overlap Analysis

[79] Full definition of real estate software: These startups provide a software-based solution to make the management and overview of facilities easier and more efficient such as companies that provide energy efficiency solutions for 'smart buildings' through software specifically designed for the real estate market.

As part of step 2, the businesses within the real estate industries are analyzed to identify their second industry to identify overlap. This chart above identifies the overlaps in which businesses are finding traction, not inundated, and not entering. [80]

Following are the findings from the analysis of the above chart:[81]

56% of businesses have an overlap with the energy efficiency industry. 13% have an overlap with the clean energy industry and 13% with the water industry. 9% of the businesses have no overlap with any other industry.

4.3.3.1 Construction Industry

- Compared to the software industry, fewer businesses exist in the construction industry.
- This may be due to the high capital cost and other constraints faced by businesses with a physical product and the difficulty in setting up manufacturing and entering the market.
- Most businesses overlap with the energy sector – clean energy, energy efficiency, waste, and water). 50% (14 of 28) construction businesses fall within energy efficiency overlap.
- Jobs recruitment is a business function that belongs only to the construction industry as it facilitates the construction process.
- No construction industry businesses overlap with education, health, and robotics industries.

4.3.3.2 Real Estate Software Industry

- Most businesses are part of the real estate software industry compared to the construction industry.
- This may be due to the ease of developing a software solution and product or device. Entry into the market for such solutions is easier, especially in the residential market.
- Most businesses overlap with industries from the energy sector (clean energy, energy efficiency, and water). 63% (30 of 48) businesses fall within energy efficiency overlap.
- 3 of 48 businesses in robotics, education, and health industry. This shows that these businesses are using innovative and disruptive digital technology to enter the niche markets
- As no businesses were found under the “none” category, it can be assumed that businesses in the real estate software industry always overlap with another sector and industry.

4.3.4 Step 3: Theme Analysis

Businesses under each real estate industry were assigned themes based on their function. The following graphic presents an analysis of the themes under each industry and second industry overlap. Following are the findings:

- While most themes fall under only one real estate industry, there are some like supply chain services (construction and search, buy, and rent) and virtual & augmented reality (construction and real estate software) that occur within more than one real estate industry.
- While sector and industry classifications rarely change, themes tend to change over time depending on current trends. Classification using sectors and industry should therefore be given priority.
- While the sector classification assesses using a top-down approach, the graphic may be used to classify businesses based on a bottom-up approach based on business description.
- Energy retrofit is different from hardware – energy retrofit in that the latter does not have a technological aspect. Such variation may be better assessed based upon the technology type classification. Most energy retrofit solutions will be based on connected devices, internet of things (IoT), and mobiles app.

[80] The labels on the left axis show the percentage out of the 78 businesses in these industries. The individual bar percentages are of construction (28) and real estate software (48) businesses in these industries.

[81] No businesses lie in the energy providers and energy storage overlap and will be removed from further analysis.

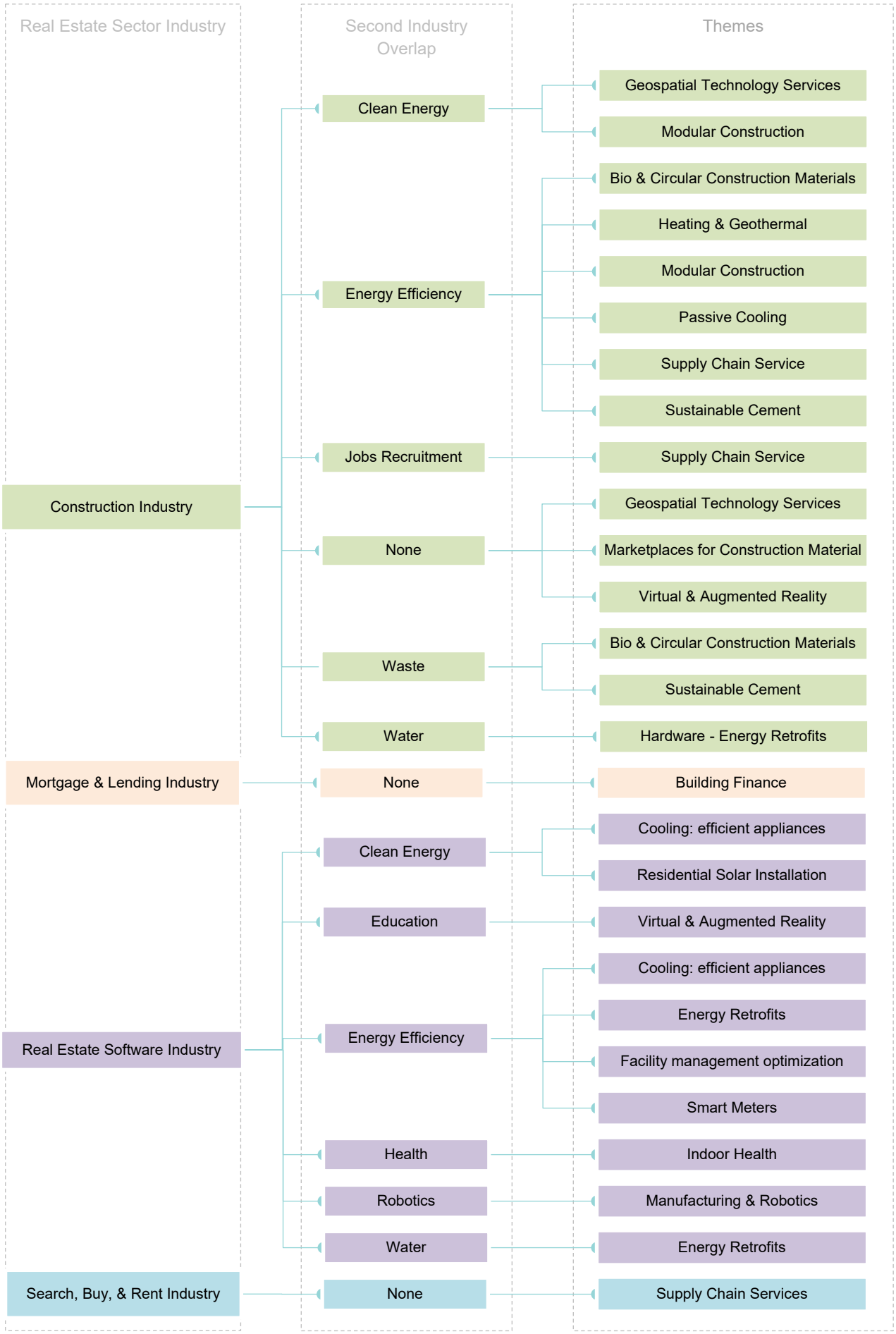

Figure 6 - Three-step Classification Findings

The chart below shows which themes the 78 businesses in the construction and real estate software industry are functioning under. The theme under mortgage and lending is building finance (startup: trellis) and under search, buy, and rent is supply chain services (business: zameen.com).

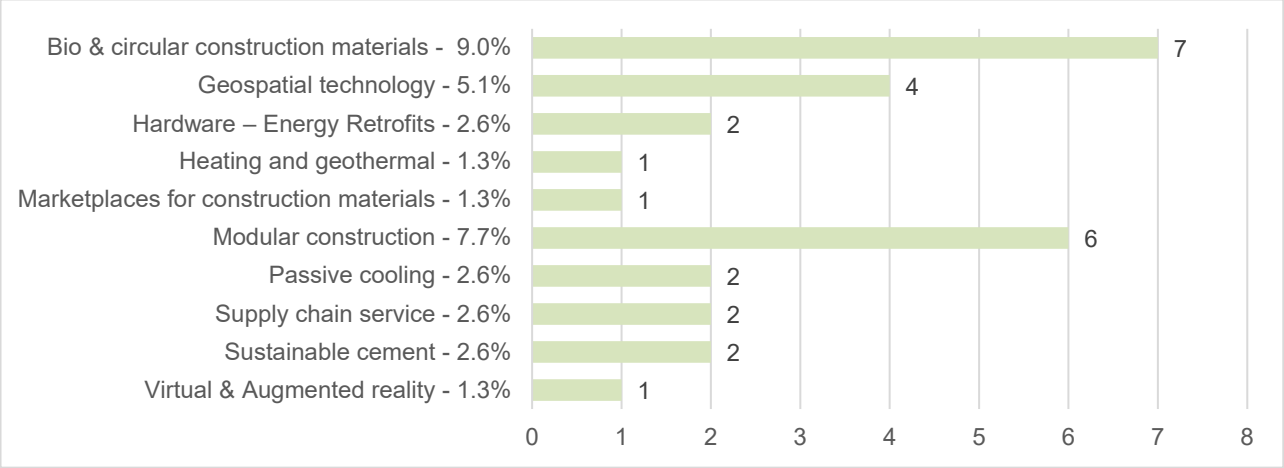

Figure 7 - Construction Industry Theme Analysis

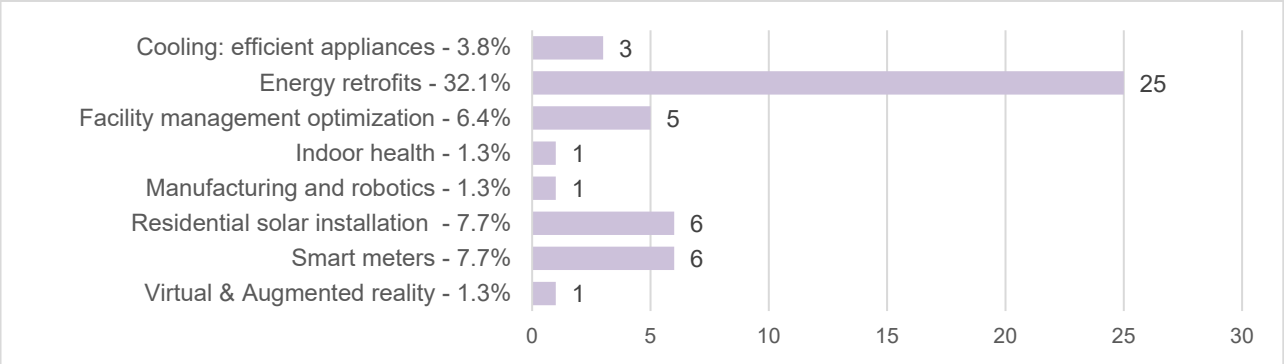

Figure 8 - Real Estate Software Industry Theme Analysis

18% businesses in the construction-energy efficiency overlap are in themes such as bio & circular construction materials and modular construction, while 38% businesses in the real estate software-energy efficiency overlap function in themes such as energy retrofit, facility management optimization, and smart meters. In the construction industry, most businesses are in themes such as bio & circular construction materials (EcoBricks/ Eco Enterprises), modular construction (Modulus Tech), and geospatial technology (VTOL Dynamics). In the software industry, most businesses are in energy retrofits (ezGeyser, Asani.io) and residential solar installation (Nizam energy).

No businesses in the following themes were found by the study: smart glass windows, 3D printed architecture, wooden buildings, sustainability reporting in real estate, cement + carbon capture, third party certifications, sustainable steel, sensor lights, and home energy storage.

4.3.5 Analysis: Active, Female-led, SGB

The following table shows a detailed analysis of businesses by real estate industries based on if they are active, founded by females, and if they are small and growing businesses (SGBs).[82] The findings are as follows:

- Though there are fewer construction businesses compared to real estate software, the former has a higher percentage of active businesses at 79%.
- Clean energy businesses have a low chance of failure in the market. This may be due to policies in solar energy that support such businesses.

[82] This table is based on best available knowledge.

- 61.3% of businesses in energy efficiency are active.
- Only 25% of water businesses in real estate software are active.
- Most SGBs in real estate software are in clean energy – solar installation.
- Most SGBS in construction are in energy efficiency in materials and modular construction.
- Most female-led businesses are in the energy efficiency businesses.

	Total	Active	Female	SGB
Real Estate Sector Total	**78**	**52**	**12**	**13**
		66.7%	**15.4%**	**16.7%**

Second Industry	Total	Active	Female	SGB
Real Estate Software Industry				
Clean Energy	7	7	0	5
Education	1	1	0	0
Energy Efficiency	30	16	5	2
Health	1	1	1	0
Robotics	1	1	0	0
Water	8	2	2	0
Industry Stats	48	28	8	7
		58.3%	16.6%	14.5%
Construction Industry				
Clean Energy	3	2	1	0
Energy Efficiency	14	11	2	3
Jobs Rec.	1	1	0	0
None	5	4	1	1
Waste	3	2	0	1
Water	2	2	0	0
Industry Stats	28	22	4	5
		79%	14%	18%
Mortgage & Lending				
None	1	1	0	0
Search, Buy, & Rent				
None	1	1	0	1

Table 18 - Cluster Analysis

4.4 Opportunities: Key Findings

The following are the key findings for opportunities in real estate industries and themes:

Real estate software industry and Themes:

- Most software related businesses are in the energy sector within themes like energy retrofit, facility management optimization, and smart meter products with a digital aspect. The primary business function is in energy, health, education, or robotics sector, while the real estate sector is their customer market.
- *Energy retrofits and Facility Management Optimization:* Two scales of the same solution, the latter is a holistic solution that embraces the management of a building's complete system through IoT sensors and control through reverse feedback of systems like HVAC, air quality monitoring, lighting, and window control to increase efficiency and to reduce operational costs. As these need to be custom designed and installed using a complex electrical system, they are only applicable to new construction. The former is usually limited to a single type of solution such as energy load management or reduction in energy consumption through IoT building

hardware and software. These retrofits may be installed as add-on devices and do not require extensive renovation in the building.[83] Energy retrofit business example are ezGeyser for gas (selected for case study), Asani.io for water, and IoTSol for electricity.

- *Smart meters and energy retrofits:* These devices and software solutions aid in energy and load management and load demand prediction and distribution. These solutions may have private, commercial, and institutional applications, especially in utility grids.
- *Manufacturing*: Companies may provide solutions for automation of the manufacturing of construction materials through digital technology to increase efficient production and reduce waste (startup Zambeel) and present an investment opportunity as an innovative solution.
- *Solar installation*: Solar installation is the most reliable investment in the current GC market for SGBs. These SGBs are integrating new technologies such as connected devices and mobile apps. The demand for an alternative to grid energy makes this a growing market. Providing solar services to regions outside of urban areas may be a challenge due to transport and supply costs and availability of expertise, but the market demand for small affordable solar solutions that provide energy for necessities may have market potential. Single-panel portable solar kits are becoming a norm in rural areas. Business e.g., Nizam energy and Sky Electric.

Construction Industry and Themes:

- Most businesses are in energy efficiency, including construction materials and technologies.
- *Modular construction*: these businesses produce high performance assembly products, steel/ cement composite panels, and insulated concrete forms. These companies may also have specialized packaging, transport, assembly, installation technology, and fabrication mechanism. An example of such a business is the startup Modulus Tech and EPS Solutions.
- *Bio and circular construction materials*: Materials that have a low impact on the environment and create benefits such as energy efficiency. These include businesses with solutions for bricks (SGB: EcoBricks by Eco Enterprises (selected for case study)), insulation (startup: Hempco/ Rasai Thermal),[84] sustainable cement, and sustainable steel. There may be potential in material made from waste, especially construction waste (e.g., from demolition or during construction), but this is as yet an unexplored market. The SGB, Opendoor Design Workshop, is exploring options for road pavers made from recycled material.
- *Geospatial technology*: Businesses providing innovative construction surveying solutions that use drone and big data technologies are creating a market niche. Large industrial and residential developers are provided quick solutions for surveys that normally take months. These businesses create impact by expediting a process and reducing its normal energy usage. Business examples are the SGB: VTOL Dynamics and the startup Seerab Maps.
- *Supply chain and Marketplace for construction materials*: GCC in the former is a difficult market to enter as a business will need a steady supply source, network of suppliers/ sellers/ transporters, warehouses in strategic locations to reduce transport costs, and a strong management system (startup: Ghonsla (selected for case study)). Comparatively, the latter is a digital platform that facilitates supply and does not require its own on-ground network (startup: Zaraye).

Potential themes:

- Themes such as facility management, supply chain, marketplace for materials, and geospatial technology services have business potential as new, disruptive, and innovative solutions.
- While no businesses were found by the study in some themes, the following still represent significant opportunity as rising trends: smart glass windows, 3D printed architecture, sustainability reporting in real estate, third party certifications, sustainable steel, sensor lights, and home energy storage.

[83] Learning and definitions from the following cleantech whitepaper were analyzed for relevance to the context of Pakistan: https://sustain.ubc.ca/sites/default/files/2021-030_BC%20Construction%20Cleantech_Sun.pdf

[84] E.g., natural insulation such as wool, hemp, and straw.

5 RECOMMENDATIONS

5.1 AP Programming: Green Construction (GC) Market

The following table identifies the GC markets discussed in chapter 3 that have a large market size and steady growth. Businesses that focus on these markets have more investment potential.

Type	Details
Industrial Sector	The increase in certified industrial buildings creates a market for GC measures, services, and expertise, and the long-term benefits outweigh the high initial cost of implementation. Due to the scale of the projects, this market is suitable for businesses at the growth stage after formation and validation.
Residential Sector	The residential sector is the easiest market to enter due to the small scale and range of customer demands. This sector represents 86.4% (USD 9.84 billion) of the total green construction (GC) market creating a market opportunity for affordable GCC measures that can generate financial benefit and help create impact by reducing electricity consumption. 95% of this market is multi-unit residential construction
Utilities Sector	There is a shortage of 25% of total electricity demand and overall gas shortage which causes frequent load shedding. 50% of total electricity generated is consumed by the residential sector. In Karachi, only 50% of the water demand is fulfilled. These factors create an opportunity for affordable GCC energy saving solutions.
Urban Population Growth	Most GC market growth will be in new commercial construction, new institutional, and high-rise and low-rise residential due to population growth in urban areas (based on regional comparison of GC market trends). GCC
Bottom of the Pyramid (BoP)	Providing solutions for the demands of the low-income housing market which has a shortage of 10 million residential units. As this is a gap that the government is keen to fill, it creates a potential for businesses providing solutions for quick and resilient solutions.
Climate Change and Disasters	Floods 2022 - International funding agencies recommend sustainable and resilient reconstruction. This creates an opportunity for GC measures, especially in housing reconstruction.
Key Stakeholders	Investors, owners, real estate developers, and builders are the primary drivers for the growth of the GC market. Real estate developers will allow access to a larger market and customer base in residential housing societies which also have commercial development.

Table 19 - Recommendation for GC Market

5.2 AP Programming: Green Construction Cleantech (GCC)

5.2.1 Selection of Startups and SGBs

Businesses can undergo preliminary evaluation by categorizing them based on the criteria outlined in Chapter 4.2 of this brief. Once the business' sector, industry, and theme have been established, they can be evaluated further to determine their client focus, business model type, income stream, and entrepreneurship type.[85] Based on these classifications and business model types, the businesses can be categorized as either startups or small and growing businesses (SGBs). The following are the definitions of startups and SGBs which will serve as the basis for the evaluation.

5.2.1.1 Startups

A startup is a team of entrepreneurial talent developing new innovations, in identifiable and investable form, with ambition to grow fast by using a scalable business model to create maximum impact.[86] It is not a smaller version of a big company, but an organization formed to search for a repeatable and scalable business model. The growth of a startup is not measured only by traditional metrics such as revenue or profit, but by key performance indicators (KPIs) such as market share, number of active users, etc. even with a free product or service.

[85] And technology tags and impact tags – list given in Annex B.

[86] https://www.startupcommons.org/what-is-a-startup.html

The following are the Startup Development Phases:[87]

Phase	Period	Input	Output
Formation	1-2 years	Ideas and Talent	Problem and Solution fit Vision and Founder fit
Validation	2-3 years	Product and Founders	Product and Market fit Founder Team
Growth	3-5 years	Business and Organization	Business Model and Market Fit Organization Growth

Table 20 - Startup Development Phases

5.2.1.2 Small and Growing Businesses (SGBs)

According to the website andeglobal.org, small and growing businesses (SGBs) are defined as commercially viable businesses with five to 250 employees that have significant potential, and ambition, for growth. Typically, SGBs seek growth capital from $20,000 to $2 million.[88]

5.2.1.3 Selection

Selection of businesses may be based on the following criteria:

Type	Details
Potential for Social Impact	Solutions that have a tangible and scalable impact.
Innovative Solution	Solutions that address a critical problem and pain point.
Demonstrated Commitment	Entrepreneur stake and development stage of minimum viable product (MVP).
Business feasibility	Market segmentation, value proposition, product launch stage.
Scalability	Demand for solution, application to other markets.
Team	Team dedication and skill, skill gaps, expertise outsourced.

Table 21 - Selection Criteria

5.2.2 Investment Opportunities for Startups & SGBs

The table below shows the markets in which startups and SGBs have demonstrated potential based on the findings from the GCC market mapping and analysis. Once businesses have been evaluated, the following table may be used to identify the businesses that fall under the recommended markets (sectors, industries, themes) with investment potential.

Market	Startups	SGBs
Construction Market	• Businesses at the 2–3-year mark that are focusing on niche residential markets to find their footing and validating idea. • Businesses at the 3-year mark that are working to grow their solution towards the industrial and commercial market scale.	• Businesses at the 5–10-year mark that have a strong market niche in residential, commercial, and industrial sector.
GC Market	New Construction Utilities - Retrofit (small scale)	New construction Utilities – Retrofit (large scale)
	• Potential to find innovative solutions for, and create sustainable impact in, both the new construction and the utilities – retrofit market. • More potential for growth in new construction due to the larger new construction market, however, entry into the market is more difficult. • More potential for innovation and disruption in utilities – retrofit, however, growth is slower.	• More potential for growth in the new construction market. • Less potential for innovation as the market is resistant to change. • Potential to adopt an existing and validated innovation. • Success in utilities – retrofit type is only seen in clean energy – solar initiatives.
Sectors	Energy	Energy

[87] https://www.startupcommons.org/startup-development-phases.html

[88] https://www.andeglobal.org/why-sgbs/

	Health Education Robotics Jobs Recruitment	
Real Estate Industry	Construction Real Estate Software Mortgage & lending Search, buy, and rent	Construction Real Estate Software
Energy Industry	Energy Efficiency Water Waste	Energy Efficiency Clean Energy
Themes	Bio & Circular Construction Material Building Financing Energy Retrofits Facility Management Optimization Geospatial Technologies Hardware – Energy Retrofits Indoor Health Manufacturing & Robotics Marketplace for Construction Materials Modular Construction Smart Meters Supply Chain Service Sustainable Cement Virtual and Augmented Reality	Bio & Circular Construction Material Geospatial Technologies Modular Construction Residential Solar Installation
Business Type	• Innovative. • Technology driven. • Disruptive. • Impact driven but sounds business plan. • 2-3 year since formation. • Sound business idea but needing to validate idea through protype construction or receive certification. • New idea that can carve its own market niche. • Using a less common technology, such as artificial intelligence, big data, geospatial technology. • Innovative product and service combination. • Innovative product, supply, and installation combination.	• Tried and tested idea (perhaps in a regional country) being replicated in the local market. • Technology is already validated in international or regional market. • Manufacturing machinery available for import or easy to locally manufacture. • New market niche or marketing and growth strategy. • Provision of value-added service. • Product, supply, and installation combination.

Table 22 - Recommendation for Investment Opportunities

5.2.3 KPIs for Business Case

The following is a list of key performance indicators (KPIs) that AP may use to evaluate businesses. Businesses may be advised on the use of these KPIs to strengthen their business case for investment consideration. Annex C further identifies detailed financial metrics for the evaluation of business KPIs.

Type	Financial Benefits KPIs	Social and Environmental Impact KPIs
Real Estate	Asset value increases. Higher sale price and rental rates Higher occupancy rates. Slower depreciation. Corporate image/ brand value increase.	Increase in use of green construction measures. Increase in awareness. Increase in market demand and customers. Decrease in cost and increase in availability of green products and materials. Protection of natural resources.
Energy	Lower operating costs due to energy savings. Lower maintenance cost. Reduced dependence on grid energy.	Reduction in carbon emissions. Decrease in energy consumption. Increase in renewable energy production. Decentralization of supply. Recycling and reuse of waste.
Health	Increased productivity.	Increase in occupant health and well-being. Creation of a sense of community.

5.2.4 Next Steps in AP Programming

The following recommendations will allow AP to grow its green construction program and portfolio based on the investment opportunities for startups & SGBs:

Type	Detail
Startups	
Identify businesses with potential at the early stage	Early-stage support (2–3-year period) support may be given to help business with idea development and how to seek validation.
	This may be done through workshops and hackathons to develop a list of businesses in the markets specified in table 21.
	Data may be gathered on the businesses to track their progress, growth, revenue generation, etc.
Provide support in the validation phase to nurture and build a strong relationship based on mentorship program	AP to build a support community of experts who may advise entrepreneurs and businesses on market segmentation, prototype manufacturing and construction, material sourcing, import laws, supply chain, and certification. Experts from the SGB group may be brought in for sharing their experience on the ground.
	Small grants may be considered for specific purposes such as building a prototype. This may be viewed as a long-term investment. Provide an incentive to the business that AP may be willing to invest in their venture in the future if certain KPIs (identified in table 22.) are met (parameters may be further defined for qualification).
	This will allow AP to take the role of a mentor to the business and will help reduce the gap between businesses and AP to create a mutually beneficial relationship of knowledge sharing that will help AP to keep adding to its repository of knowledge. The data gathered from these "partner" businesses may be used in data analytics to reveal patterns, trends, and further insights to support investment decisions.
Invest in businesses that successfully cross the validation phase (3-year and above)	AP will already have a good relationship history built on mutual trust and support. This will help reduce the strain on businesses to prove their business model from scratch and reduce AP's risk as they have nurtured the business and have helped provide a strong growth foundation.
	Investment decisions may be based on data and analytics derived from the information gathered from the list of businesses. AP will be able to make estimates on the market potential of the product and solution and compare it to the business's claims.
	In the case of products like energy retrofit type devices, the investment will be directed towards unit production (import and assembly).
Investment Range (based on learnings from qualitative research, interviews, and case studies)	**Investment range for startups in the growth phase (3-5-years) is estimated to be about USD 250,000 - 2 million.**
	Energy Retrofits • EzGeyser, an energy retrofit business in Pakistan (Islamabad), was looking for an investment of USD 250,000 to produce 5,000 units in 2021. For the 2022-23 fundraising round, they are looking to raise USD 1 - 1.5 million to produce 25,000 units in the next year.[89] • WEGoT, a smart meter device for real time water management in India, has raised USD 3.5 million to date (2022).[90]
	Facility management optimization • Sensorflow, a building energy management company in Singapore raised USD 2.7 million in 2021 to expand their operations.[91] • Resync, an AI driven intelligent energy cloud platform for smart building business (founded in 2017) in Singapore raised Pre-seed: USD 50,000 (2018 - 1 investor), Seed: USD 700,000 (2019 - 3 investors), and Series-A: USD 2.2 million (2021 - 1 investor).[92]
	Modular and prefabrication • Tvasta, a business in India that builds 3d printed low-cost homes, raised USD 500,000 approximately.[93]
	Marketplace for construction services (E-commerce) • Brick&Bolt, a marketplace for construction services with value-addition in India (founded 2017) raised Pre-seed: USD 500,000 (2018), Seed: USD 1.5 million (2019 - 1 investor),

[89] Annex E – Case studies

[90] https://greenfeels.in/blogs/eco-friendly/eco-friendly-tech-startups-in-india

[91] https://enablestartup.com/blog/green-tech-startups-opportunities/

[92] https://www.crunchbase.com/organization/resync

[93] https://www.entrepreneur.com/en-in/finance/construction-startup-tvasta-raises-funding-to-build-3d/392543

	Seed: USD 1.5 million (2020 - 4 investors), Series-A: USD 2 million (2020 - 1 investor), and Series-A: USD 4.8 million (2023 - 2 investors).[94]
	Bio & circualar construction material • Zerund, a lightweight waste plastic brick construction material business, raised approximately USD 1 million in 2022.[95]
SGBS	
Identify businesses with potential	Launch and widely advertise green construction workshops and fairs to target established businesses that match a certain parameter, e.g., businesses in bio and circular construction materials, 3-5 years age.
	Identify businesses that are unique, well established, balancing impact and financial sustainability, and looking to grow and diversify their manufacturing and operations.
	Make a list of potential businesses and entrepreneurs who fit the AP parameters as defined in table 21.
Provide support in scaling up of business in the form of engagement and networking program	Create strong relationships with the businesses by providing support to help them reach AP investment standard based on the KPIs identified in table 22.
	Support may be provided by guiding them on growth strategy and by connecting them to other experts in the group and field to create a support community.
	This relationship must be built on mutual respect as the business is already well established and is seeking a partner to grow as a team, not an investor to whom they must prove themselves and their worth.
Invest in businesses	AP may gauge the investment potential of these businesses through these relationship building events and eventually identify a short list of potentials.
	A dialogue may be held with these select few where the potential and strategy for growth, what each side brings to the table, and mutual benefit may be discussed.
	In the case of products such as construction materials, this investment will primarily be directed towards scaling-up by setting up manufacturing facilities in new locations.
Investment Range (based on learnings from qualitative research, interviews, and case studies)	**Investment range for SGBs in the growth phase (3-5-years) is estimated to be about USD 1 million - 5 million.**[96]
	Supply chain • Ghonsla, an insulation material and installation supply chain business in Northern Pakistan, received a grant of USD 100,000 in 2012 at business formation phase.[97]
	Residential solar installation and smart meter in clean energy • ZunRoof, a clean energy business in India specializing in residential solar installation with a heavy technological aspect, has raised USD 3 million is its series A round in 2020. It has previously raised USD 1 million in pre-series A (2019). They have raised USD 4.7 million to date (2022).[98] • Smart Joules, a data driven energy optimization business in India raised USD 4.9 million in Series A round (2021).[99]
	Bio & Circular construction material • Build up Nepal, a compressed stabilized earth brick business in Nepal which focuses on low-cost housing, impact, and working with development partners, has raised USD 1 million.[100]

Table 24 - Programming Recommendations

The overarching strategy that AP must employ for green construction is to build a knowledge bank. This may be a live database of businesses which will be constantly updated. It must include their business classification and details, growth, revenue generation, market, valuation, funding, or grants received, and any other relevant statistics. Further details may include constraints, innovations, and the use of technologies. Analytics of this database will allow AP to have meaningful insights through trends and pattern recognition to allow more informed decision making.

5.3 Strategy for AP Investment and Business Development

[94] https://www.crunchbase.com/organization/brick-bolt/company_financials

[95] https://app.dealroom.co/companies/zerund

[96] Based on learnings from qualitative research, interviews, and case studies: ZunRoof, a clean energy business in India specializing in residential solar installation with a heavy technological aspect, has raised USD 3 million is its series A round in 2020. It has previously raised USD 1 million is pre-series A in 2019.

[97] Annex E – Case study.

[98] https://greenfeels.in/blogs/eco-friendly/eco-friendly-tech-startups-in-india

[99] https://angel.co/company/smart-joules-3/people

[100] https://thebpp.com.au/partnership/build-up-nepal-scaling-the-production-of-affordable-safe-and-eco-friendly-bricks/

The following table provides recommendations on AP's investment strategy and the corresponding recommendations on business capacity development and mitigation measures.

Type	AP Investment	Business Development
Financial		
Early Funding due to High CAPEX	• Most businesses have a physical product requiring manufacturing. It is costly to conduct research, build and test prototypes, and to set up production plants. • GCC businesses need early funding during the 2–3-year mark or risk failure due to high capital cost.	• GCC Businesses may be encouraged towards debt financing in the 2–3-year period. Awareness of debt financing in GCC entrepreneurs must be raised, including its benefits. • Training may be given in method to provide collateral by demonstrating customer commitments and projected earnings when there are no physical assets.
Equity Investment in GCC	• Equity investment in GCC is recommended in the growth phase, which is the 3–5-year period, when the business model has successfully crossed the validation phase. • The GCC business model does not support equity investment in the business and validation phase as investors require several years of good customer trajectory and impact which the business does not have during its initial phase.	• VC funding is only provided to 0.1% of businesses. • Financial self-sufficiency is to be given priority. Businesses should focus on generating cashflows from core business and not only on seeking funding till they have sufficient traction in the market.
GC Market		
Construction vs. Real Estate Software Industry	• Impact Investment potential in both as they represent different aspects of green buildings – construction & operationalization.	• Application of Real Estate Software business is in new construction and retrofit market. • Application of Construction business is in new construction market.
Business Model		
Trend Towards X-as-a-Service Business Model	• Most GCC businesses offer a solution that is a fusion of a product and service and has higher investment potential. • This may be because these businesses are providing an end-to-end solution and ease of use to the customer by managing production, marketing, delivery, and installation, therefore creating a higher chance of success, and ensuring customer satisfaction.	• Businesses are recommended to diversify their operations to an end-to-end solution. • For the real estate software industry, the service may be in the form of Software-as-a-Service (SaaS) digital platform merged with a retrofit device or a construction process. For e.g., IoT (Internet of Things), sensors, and devices for increasing energy efficiency in houses merged with a mobile app. • For the construction industry, it may be the merging of installation or supply chain service for construction material and technology. For e.g., energy efficient construction panels combined with a service for unique installation mechanism and transport strategy.
Outsourcing	• Businesses that have successfully created a system of outsourcing have more investment potential. • The core business will be the streamlined management of the outsourced aspects.	• Multiple business partners and outsourcing some aspects of the business is a growing trend. Such as outsourcing installation of devices, marketing, or development of digital software. • Successful businesses and entrepreneurs focus on management, training, and quality control while outsourcing the rest.
Market Segmentation	• Businesses must be evaluated based on their market segmentation and growth plans. • Investment is recommended in businesses that can diversify their customer market in the growth phase, e.g., shift from residential (which is easier to enter) to commercial/ industrial/ infrastructure.	• GCC businesses may focus on market segmentation during their formation and validation phase to correctly find and validate their customer market niche. • Market segmentation may evolve from residential market (as it is easier to enter) to commercial/ industrial during the growth stage.

Customer Dynamics		• Customer awareness and resistance to change – GCC businesses report organic growth in their customer base through word-of-mouth, requiring little advertising.
Income Stream	• Investment in commission-based real estate software businesses will always be dependent on the number of new devices they manufacture and customers they find. • Globally, subscription-based businesses have a more sustained income stream. However, it is not a commonly used model in Pakistan GCC.	• Real estate software businesses should aim to grow their commission-based income stream to subscription-based services. • Subscription based will also allow more opportunity for data collection to analyze customer demands.
Impact investment and self-sufficient businesses	• Impact Investment is a necessity to counter the effects of climate change. • However, impact is insufficient as the parameter upon which investment decisions may be based.	• Impact is insufficient as the primary aim of a business. Financial self-sufficiency is to be given priority. • If consideration for impact is part of the original business idea, the results (as impact KPIs) will be realized in the growth phase. • A business may not become sustainable[101] if it focuses only on creating impact and measuring success by level of impact created during the formation and validation phase.
Physical Products		
Manufacturing location	• Manufacturing location for construction materials limits customer reach due to transport costs.	• Businesses may aim to decentralize manufacturing in the growth stage.
Up-front cost	• Up-front cost of physical products (R&D and manufacturing) limits businesses.	• Businesses must aim to become financially self-sufficient during the formation and validation phase.
Prototypes and certification	• Investors should identify businesses in their growth phase that have already built a construction/ product protype as part of their validation phase. • Proof of claim must be identified based on the correct key performance indicators (KPIs) and relevant local and international certifications.	• Small prototype projects in the validation phase are necessary to prove product and idea success. • These prototypes must be tested and certified to validate claims based on relevant KPIs. • Businesses may be given support in identifying the correct KPIs for their product, in constructing/ manufacturing a prototype, and in seeking and receiving certification from relevant local and international bodies.
Import dependency and local manufacturing	• IoT sensors and most retrofit devices/ components are imported, creating uncertainty due to the economic situation, and causing growth limitations. • Investment in businesses which rely on imports will see slow growth due to import constraints. • Investment in such businesses at the growth stage will be beneficial to scale import product quantity. • Investors may consider early investment (2–3-year period) in startups in manufacturing. This may be seen as a long-term plan to promote local manufacturing and create benefits for all businesses that may use locally manufactured sensors, IoT devices, and other components.	• Businesses should create a strategy for imports to reduce risk. Diversifying procurement to multiple suppliers manages the risk of any one supplier failing to make a delivery. • Businesses may aim to develop in-house manufacturing capabilities to reduce import dependency. • COOPs between manufacturing startups may be considered so that local manufacturing capabilities may be developed.
Seasonal demand	• Applicable to materials such as insulation and gas geyser energy retrofits. • Regional comparison: insulation is not considered one of the top green	• Seasonal demand may be mitigated through B2B partnerships. Such as gas energy retrofit businesses may partner with geyser manufacturers.

[101] Sustainability is reached when the 3 “Ps” are taken into consideration, people, planet, and profit. Therefore, the social, environmental, and financial factors.

	construction measures in India. This trend may be assumed to be applicable to Pakistan as well as the benefits of insulation are not well known or researched in the local context. • As gas is facing a shortage, gas geyser energy retrofits are in demand as gas has become expensive and is needed for cooking. Therefore, while the retrofit device has a seasonal demand, other factors affect its demand.	• Seasonal demand of insulation may be mitigated by focusing on the new construction market instead of the retrofit market. Customers may be made aware of the benefits of integrating insulation (or other energy efficient products) into their buildings at the construction stage.

Table 25 - Recommendations for AP Investment and Business Development

5.4 Recommendations for Ecosystem development

Training in GCC may be given to entrepreneurs through workshops and hackathons. This will help raise awareness and encourage more entrepreneurs towards GCC initiatives. GC market stakeholders (owners, developers, and investors), technical experts (architects, engineers, and consultants), and startup ecosystem experts (cleantech experts and successful entrepreneurs) may be requested to provide support in these workshops.

Systemic support may be provided in the form of early investment, or provision of grants and funding for research and development. COOP partnership with institutions and other programs will help connect the islands of success and encourage knowledge sharing. A detailed list of impact investors, accelerators, and incubators has been provided in Annex D.

Social Inclusion for women and youths led businesses may be encouraged through hackathons for women and youth led initiatives.

5.5 Recommendation for Further Research – Micro Analysis

The Green Construction Brief (GCB) provides a comprehensive overview of the complex and fragmented construction sector, including the GC and GCC markets, to assist Accelerate Prosperity (AP) in navigating the industry in Pakistan. This includes a brief on the construction and green construction markets, a classification mechanism based on industries, industry overlaps, and themes, and recommendations on the market investment potential and business development strategy.

Based on this brief, AP may conduct future research on specific industries and overlaps for a micro market analysis which falls beyond the time scope of this brief.

This may include, for example, a micro analysis on:

- Businesses within the energy efficiency and real estate software industry overlap which will only cover themes such as energy retrofits, facility management, and smart meters.
- Businesses within the energy efficiency and construction industry overlap which will only cover the bio & circular construction materials or modular construction theme.
- Businesses which exist purely within the real estate sector (no overlap with other sectors), and which include multiple real estate industries such as construction, mortgage & lending, and search, buy, and rent.
- Businesses in the digitally innovative and disruptive themes like geospatial services, virtual & augmented reality, marketplace for construction materials.

The micro analysis may allow a deeper dive into the list of businesses to assess active companies, revenues, growth, number of employees, and market share. This will include engaging with the companies to understand specific challenges and opportunities for growth and profitability. As data on existing businesses is not readily available, analysis using regional comparison may be conducted to draw market parallels.

As the market is evolving quickly, the market trends and list of businesses will need to be regularly updated to record new entrants, new themes, and track activity and growth. A database may be developed to track growth, investment, and revenue generation.

6 CASE STUDY BRIEFS

GHONSLA

Brief	
Founder	**Zehra Ali (Female-led Business)**
Location	**Lahore, Chitral, and Gilgit Baltistan**
Product	**Insulation solutions**
Primary Industry	**Real Estate**
Primary Sub-industry	**Construction & Service**
Secondary Industry	**Energy**
Secondary Sub-industry	**Energy Efficiency**
Theme	**Supply Chain Service**
Technology Type	**-**
Type	**Innovative Route to Market, Exceptional Growth Strategy Management, Social Impact**
Impact Tag	**Industry, Innovation, And Infrastructure #9 Sustainable Cities and Communities #11**
Business Stage	**SGB**
Brief	**Ghonsla provided insulation solutions in the colder regions of Northern Pakistan (GB and KPK). The variety of affordable energy efficient insulation solutions are highly effective in reducing transference of heat in buildings to make them more sustainable. An innovative route to market business type creating significant social impact. (Ghonsla Pvt. Ltd. dissolved in 2018 and Ghonsla Construction Pvt. Ltd. Was founded by the Ghonsla regional manager)**
Impact	
Sustainable Impact	Energy conservation: Created 30% reduction in energy consumption. Forest preservation: 1-2 tons of wood saved per household per year. Ghonsla Construction has saved at least 5000 trees in Gilgit and Chitral. GHG Emissions Reduction: Reduction in wood burning which creates 2.5 times the emissions created from coal or gas. Recycled Products: Use of recycled products in manufacturing. Paper waste and plastic PET bottles are utilized in Ghonsla insulation. 400 tons of material recycled.
Economic Impact	Jobs Created by Ghonsla Construction: 100 employed, 1000 on contract. 2,400 working hours created. Cost savings: Increase in savings spent on purchase of wood or time spent collecting wood for heat.
Social Impact	2500 customers live in comfort and have been made aware of the benefits of insulation.
Impact	200,000 square feet insulated. Improves sound insulation as well. 500 houses and buildings completed.

Table 26 - Case Study Brief: Ghonsla

ECO ENTERPRISES

Brief	
Founder	**Yaqoob Khan**
Location	**Islamabad**
Product	**EcoBricks - Compressed Stabilized Earth Blocks and Interlocking Blocks**
Primary Industry	**Real Estate**
Primary Sub-industry	**Real Estate Construction**
Secondary Industry	**Energy**
Secondary Sub-industry	**Energy Efficiency**

Theme	**Bio & Circular Construction Material**
Technology Type	**-**
Type	**Innovative Product**
Impact Tag	**Industry, Innovation, And Infrastructure #9**
Business Stage	**SGB**
Brief	**Dry stacking block manufacturing business that provides ready-to-use high-quality, cost-effective, Eco-friendly indestructible construction blocks.**
Impact	
Sustainable Impact	Carbon Emissions: 75% reduction Water saving: Product absorbs 12% water, whereas burnt clay brick absorbs 20% of its volume.
Economic Impact	
Social Impact	Working for the flood-affected population
Impact	Labor and Time Cost: Saves 33% of the total labor time and 74% construction time. Can be built 6-8 times faster than regular brick wall. Wastage: Less than 1% wastage due to excellent delivery mechanism and quality control. Construction Cost: 15% reduction in grey structure cost. 34% cheaper than regular brick.
Product features	The product is bullet proof and blast resistant – armor piercing grade. Provides sound insulation. Earthquake resistant Brick is made of a special mix with numerous ingredients including cement.

Table 27 - Case Study Brief: Eco Enterprises

EZGEYSER

ezGeyser
بچت | سہولت

Brief	
Founder	**Ashar Bazeb Saeed (Youth-led Business)**
Location	**Islamabad**
Product	**Smart device for gas efficiency**
Primary Industry	**Energy**
Primary Sub-industry	**Energy Efficiency**
Secondary Industry	**Real Estate**
Secondary Sub-industry	**Real Estate Service**
Theme	**Energy Retrofits**
Technology Type	**IoT, Mobile App, Hardware**
Type	**Innovative Product**
Impact Tag	**Industry, Innovation, And Infrastructure #9** **Sustainable Consumption and Production #12**
Business Stage	**Startup – 3-year mark - Founded 2020**
Brief	**ezGeyser is a smart device that is integrated with a customer's gas water heating geyser. The device allows the customer to remotely operate and schedule the geyser using a mobile app.**
Impact	
Sustainable Impact	Efficient production and consumption by making energy consumption more efficient. Reduction in domestic gas bills by up to 60% and reduction in domestic gas wastage by up to 30%
Economic Impact	Potential to save over PKR 224 billion ($1 Billion) in LNG import by reducing gas consumption.
Social Impact	Provide convenience and savings to the customers.
Impact	100 units in 2021 in Islamabad for pilot testing. 25,000 customers to date.
Product features	Allows scheduling and smart controls. Provides a real-time consumption analysis to the end user
Product Cost	EzGeyser: Rs 18000/unit ($ 80/ unit) Installation: Rs 1500/unit ($ 7/ unit)
Awards	ezGeyser got a merit award at the PASHA ICT Awards 2022 in the IoT category.

Table 28 - Case Study Brief: ezGeyser