



ASPEN NETWORK
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ENTREPRENEURS
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Building the Green Economy

Trends and Opportunities for Green
Entrepreneurship in **India**

March 2023



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ANDE is grateful to the many entrepreneurs and intermediary organizations who participated in interviews and answered surveys used to generate the insights in this report. A full list of participants is provided in Appendix A.



About ANDE

The Aspen Network of Development Entrepreneurs (ANDE) is a global network of organizations that propel entrepreneurship in developing economies. ANDE members provide critical financial, educational, and business support services to small and growing businesses (SGBs) based on the conviction that SGBs create jobs, stimulate long-term economic growth, and produce environmental and social benefits.

As the leading global voice of the SGB sector, ANDE believes that SGBs are a powerful, yet underleveraged tool in addressing social and environmental challenges. Since 2009, ANDE has grown into a trusted network of nearly 300 collaborative members that operate in nearly every developing economy. ANDE grows the body of knowledge, mobilizes resources, undertakes ecosystem support projects, and connects the institutions that support the small business entrepreneurs who build inclusive prosperity in the developing world. ANDE is part of the Aspen Institute, a global non-profit organization committed to realizing a free, just, and equitable society.

About the IKEA Foundation

This report was produced with support from the **IKEA Foundation**. The IKEA Foundation is a strategic philanthropy that focuses its grant making efforts on tackling the two biggest threats to children's futures: poverty and climate change. It currently grants more than €200 million per year to help improve family incomes and quality of life while protecting the planet from climate change. Since 2009, the IKEA Foundation has granted more than €1.5 billion to create a better future for children and their families. In 2021 the Board of the IKEA Foundation decided to make an additional €1 billion available over the next five years to accelerate the reduction of Greenhouse Gas emissions.

Learn more at: www.ikeafoundation.org or by following them on [LinkedIn](#) or [Twitter](#).

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DEFINITIONS AND ABBREVIATIONS

► DEFINITIONS AND STUDY SCOPE

Small and growing businesses (SGBs): This study focuses on growth stage opportunities in small business entrepreneurial activity, classified by ANDE as small and growing businesses (SGBs). SGBs are defined by ANDE as commercially viable businesses with five to 250 employees that have significant potential and ambition for growth. Typically, SGBs seek growth capital from US \$20,000 to \$2 million. SGBs differ from the more traditional characterization of small and medium-sized enterprises (SMEs) in two fundamental ways. First, SGBs are different from livelihood-sustaining micro and small businesses, which start small and are designed to stay that way. Second, unlike many medium-sized companies, SGBs often lack access to the financial and knowledge resources required for growth. While some literature and resources apply broadly to SMEs, ANDE focuses on SGBs when possible (such as in the primary data collection on entrepreneurs and intermediaries and in case studies).

Green entrepreneurship: This report follows the International Labour Organization (ILO) definition of the term green entrepreneurship. According to the ILO, green enterprises are those that address climate change and/or have a positive environmental value either through the process of delivering products/services (e.g., utilizing clean technologies) or by providing products or services in a green sector (e.g., waste management). As noted by the ILO, “usually, green entrepreneurs consider both aspects in their business models, creating additional decent employment through the use of more environmentally friendly processes, while reducing the overall environmental impact as a result of people or companies using the final product or service.”¹

► ABBREVIATIONS

ADB:	Asian Development Bank	IoT:	Internet of things
CO2:	Carbon dioxide	NAPCC:	National Action Plan on Climate Change
CSR:	Corporate social responsibility	NDC:	Nationally Determined Contribution
DFI:	Development finance institution	PPP:	Public-private partnership
EE:	Energy efficiency	R&D:	Research and development
EV:	Electric vehicle	SAPCC:	State Action Plans on Climate Change
FAO:	Food and Agriculture Organization of the United Nations	SGB:	Small and growing business
GDP:	Gross domestic product	SDG:	United Nations Sustainable Development Goal
GHG:	Greenhouse gas	SME:	Small and medium-sized enterprise
IFC:	International Finance Corporation	VC:	Venture capital

¹ International Labour Organization. [Green entrepreneurship: Creating green jobs through sustainable enterprise development.](#)



METHODOLOGY

The information shared in this report was gathered from three sources:

1 **Synthesis of existing literature and resources, such as research studies, policy documents, and online resources, which are cited as footnotes throughout the report.**

2 **Primary and secondary data collection from entrepreneurs and intermediaries, including:**

Entrepreneur data: To understand the state of green entrepreneurial activity in India, the authors selected a sample of 100 green enterprises that fit the SGB criteria. To identify enterprises, the authors searched publicly available sources, including Crunchbase and portfolios of accelerator and incubator programs, as well as pulling from Intellectap's internal database. Enterprises identified from these sources were narrowed down to only those that fit the SGB criteria, meaning they had a maximum of 250 employees and investment of no more than \$2 million. This sample is not meant to capture the full scale of entrepreneurial activity in India, particularly those enterprises in the informal sector, nor is it necessarily representative of all SGB activity in the country. Rather, this sample is meant to capture a sample of promising enterprises with a strong web presence and high levels of investor awareness in order to understand trends among SGBs that are achieving market traction and are candidates for scale.

Intermediary data: To gather data about the support services available to green entrepreneurs, ANDE utilized its Entrepreneurial Ecosystem Snapshot methodology, which includes gathering data on the work of organizations that support green enterprises (referred to as intermediaries) through either financial or non-financial support. The process includes a combination of primary surveying of intermediaries regarding their support services and perspectives on challenges and opportunities for green entrepreneurship and desk research to fill in information from non-respondents. Through this process, ANDE identified a total of 140 intermediaries in India, 54 via survey and 86 via desk research. The methodology is designed to capture all – or nearly all – entrepreneur support organizations and can therefore be understood as a census of all actors providing support specifically for green entrepreneurship in India at the time data collection was carried out (May to November 2022). The full set of insights gathered from the data is available [here](#).

2 **Interviews with stakeholders, including:**

Key stakeholder interviews: Using the convenience sampling method, primary interviews were conducted with 13 green entrepreneurs, four investors, and five additional sector stakeholders/experts. In addition, ANDE hosted three stakeholder convenings in September 2022, including two virtual sessions with key stakeholders across India and one in-person session in Guwahati in the state of Assam which focused on ecosystem actors in the Northeast region. The convenience sampling method does not guarantee the representativeness of a sample by design, and the sample relied on the target respondents' willingness to participate in interviews. However, the combination of one-on-one interviews and stakeholder conversations provided a rich amount of qualitative data for this report.

SGB case studies: Another round of interviews was conducted with five selected green entrepreneurs, one working in each sector group, using the purposeful sampling technique.² To meet the selection criteria, the entrepreneurs had to have achieved exemplary business growth in recent years while having a clear approach to gender equality and impact measurement and management (IMM). As the goal of the case studies is to exemplify successful business models, the selected SGBs are, by design, not representative of all SGBs in the ecosystem.

2 Palinkas, L. et al. 2015. [Purposeful sampling for qualitative data collection and analysis in mixed method implementation research](#). Administration and Policy in Mental Health and Mental Health Services.



INTRODUCTION

Climate change and environmental degradation pose a significant and urgent threat to economic growth, public health, and livelihoods around the world. Experts warn that failure to prioritize climate action will continue to put human welfare at significant risk over the next ten years³ and well beyond. Developing countries will bear the brunt of climate change economically, socially, and environmentally.⁴ According to research by SwissRe, natural catastrophes led to US \$190 billion in economic losses in 2020 alone.⁵ If no mitigation and adaptation action is taken, world GDP could shrink by 18% over the next 30 years⁶ which would widen existing socio-economic disparities within and among nations.⁷

In India, the impacts of climate change pose profound challenges to the country's economy and livelihoods. India has the second-largest population in the world (1.4 billion) and is currently, but not historically, the third-largest global emitter of CO₂.⁸ Research estimates that the Indian economy is 31% smaller than it would have been in the absence of global warming,⁹ and extreme weather events will continue to disrupt some of its largest market sectors, such as agriculture, water, and energy.

The IPCC Sixth Assessment Report Working Group-II predicts that by the end of the 21st century, India's average temperature will increase by 4.4°C over the 2005 average.¹⁰ The report identifies India as one of the countries that will be most "economically harmed" by climate change. It also states that rising sea levels and groundwater scarcity will have a direct impact on agricultural productivity, posing a huge threat to livelihoods, as nearly 55% of India's total workforce is engaged in agricultural and allied sector activities.¹¹

Large corporations are seen as the main emitters of greenhouse gases globally, yet it is estimated that over 80% of their emissions are derived from their value chains, where primarily small and medium-sized enterprises (SMEs) operate.¹² These are Scope 3 emissions, which refer to indirect emissions resulting across the supply chain.¹³ Scope 3 emissions are typically more difficult to both measure and address compared to Scope 1 (direct emissions from company operations) and Scope 2 (indirect emissions from energy bought by the company).¹⁴ SMEs, which make up approximately 40% of employment in India,¹⁵ are often integrated into corporate supply chains. Therefore, addressing their challenges will be critical to achieving India's de-carbonization targets – not only by improving their own environmental practices, but also by introducing new solutions to combat climate change and its effects.

3 World Economic Forum. 2021. [The Global Risks Report 2021: 16th Edition Insight Report](#).

4 Safanov, G. 2019. [Social Consequences of Climate Change: Building Climate Friendly and Resilient Communities via Transition from Planned to Market Economies](#). Friedrich Ebert Stiftung.

5 Bevere, L. and Weigel, A. 2021. [sigma 1/2021 - Natural catastrophes in 2020](#). SwissRe Institute.

6 "World economy set to lose up to 18% GDP from climate change if no action taken, reveals Swiss Re Institute's stress-test analysis." SwissRe Institute News Release. 22 April 2021.

7 Islam, S. N. and Winkel, J. 2017. [Climate Change and Social Inequality](#). United Nations Department of Economic and Social Affairs.

8 Center for Science and Environment. 2021. [On the Road to COP 26 Discussion Paper Series: India's Climate Change Strategy](#).

9 Diffenbaugh, N. and Burke, M. 2019. [Global warming has increased global economic inequality](#). Proceedings of the National Academy of Sciences of the United States of America (PNAS).

10 Intergovernmental Panel on Climate Change. 2022. [Climate Change 2022: Impacts, Adaptation, and Vulnerability: Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change](#).

11 Ministry of Agriculture and Farmers' Welfare. 2021. [Annual Report 2020-21](#).

12 Bové, A. and Swartz, S. "Starting at the source: Sustainability in supply chains." 11 November 2016. McKinsey Sustainability.

13 Ibid.

14 Read, S. "What Is the Difference between Scope 1, 2 and 3 Emissions, and What Are Companies Doing to Cut All Three?" 20 September 2022. World Economic Forum.

15 Goyal, M. "SMEs Employ Close to 40% of India's Workforce, but contribute only 17% to GDP." 9 June 2013. The Economic Times.



Green entrepreneurs introduce new technologies and solutions for delivering goods and services in ways that both avoid negative environmental impacts and that help communities adapt and become more resilient in the face of a changing environment. Not only are Indian SMEs potential contributors to climate change solutions, but their future sustainability depends on it. SMEs are especially affected by climate shocks, with increased sensitivity to resulting price fluctuations and supply shortages.¹⁶ Climate change intensifies pre-existing challenges for Indian SMEs such as resource strain and infrastructure related issues.¹⁷ It is imperative, therefore, that decision-makers support green entrepreneurs both for the climate and environmental protections they offer and to increase employment through the growth of sustainable industry.

Small and growing businesses (SGBs) are the primary focus of this report. They differ from the broader category of SMEs in that they have ambitions for growth yet often lack access to the financial and knowledge resources required to scale. Green SGBs, defined in detail in the Methodology section, have business models that pursue both environmental and economic goals. While countries grapple with the trade-offs between traditional and more inclusive and sustainable industrial development, green SGBs can provide solutions that drive employment and environmental protection simultaneously within the broader context of sustainable industrialization.

This report establishes a baseline understanding of the state of green entrepreneurship in India by assessing existing business models, the available financial and technical support for entrepreneurs, and key sectoral issues regarding the policy landscape and market opportunity. The purpose of the study is to inform decision-makers, such as policymakers, donors, investors, and business development service providers, of the primary trends, opportunities, and challenges in the green entrepreneurial ecosystem to help them with their planning and deployment of resources in the coming years.

Key questions explored in this report include:

- ✓ What are the characteristics of the existing green entrepreneurial ecosystem in India?
- ✓ Which sectors are most active and provide the greatest opportunity for additional growth?
- ✓ How many entrepreneurship service providers are supporting green entrepreneurs in India, what services do they provide, where are they based, and where are there gaps in support?
- ✓ What are the key opportunities, challenges, and recommendations for building the green entrepreneurial ecosystem in India based on insights from experts and stakeholders?

The report is divided into two parts. Part 1 provides a high-level review of green entrepreneurial activity in India, the support available to enterprises, and key challenges and opportunities. Part 2 provides deep dives by sector, reviewing common business models, relevant policies, and estimated market opportunity for green enterprises.

16 International Trade Centre. 2022. [From Climate Risk to Resilience Small Business in Value Chains](#).

17 Bollinger, K. et al. 2012. [Facing the Impacts of Climate Change: Indian MSMEs and Adaptation](#). GIZ and SIDBI.



PART 1: THE STATE OF GREEN ENTREPRENEURSHIP IN INDIA

Overview of Climate Risks and Government Response in India

Climate change places significant stress on India's biodiversity, food supply, water and energy security, and human health. Despite India holding 18% of the world's population, it only accounts for 4% of global water resources.¹⁸ Droughts and changing weather patterns are exacerbating this scarcity, with the average annual per capita water availability expected to decrease to 1,367m³ by 2031 from 1,545m³ in 2011.¹⁹ Research has shown that annual gross domestic product (GDP) in India drops 2–5% in drought years.²⁰ India witnessed unusually intense rainfall and storms during its monsoon season in 2022, when rainfall reached 108% of its long period average (LPA) and about four more cyclonic disturbances occurred than the average between 1971 and 2020.

These extreme weather events have significant repercussions for human health. A major heat wave in 2016 caused weeks of extreme temperatures (above 40°C) in northern India, leaving the population vulnerable to heat stroke and dehydration.²¹ UNICEF estimates that around 100,000 children under five years of age died because of diarrheal disease in 2016,²² an issue exacerbated by increased incidences of extreme rainfall, flooding, and rising temperatures.²³ Further, UNICEF estimated that India was the 7th-most affected country due to climate change-led weather events in 2019, both in terms of fatalities (2,267 people) and economic losses (US \$66 billion).²⁴ The widespread flooding and landslides in the state of Assam led to 700 deaths, and a further 900 deaths from lightning.²⁵

These climate change-induced challenges threaten the largest sectors of India's economy. Agriculture in India accounts for 55% of its employment,²⁶ and climate-sensitive rainfed agriculture accounts for 40% of national production. Due to increasing severity of droughts, the agriculture sector could experience losses of more than US \$7 billion annually by 2030.²⁷ This potential food scarcity would especially threaten the nearly 15% of India's population that was undernourished as of 2018.²⁸ Agricultural productivity challenges in India may also have adverse effects on global food supplies as the country imposes restrictions on the export of wheat and rice, produce that other countries

18 [World Water Day 2022: How India is addressing its water needs](#). 14 February 2023. World Bank.

19 [Per Capita Availability of Water](#). 2 March 2020. Ministry of Jal Shakti.

20 Gadgil, S. and Gadgil, S. 2006. [The Indian monsoon, GDP and agriculture](#). Economic and Political Weekly.

21 USAID. 2017. [Climate Risk Profile: India](#).

22 World Bank Group. 2021. [Climate Risk Country Profile: India](#).

23 Ibid.

24 [Climate Change and Environmental Sustainability](#). UNICEF.

25 International Displacement Monitoring Centre. 2022. [2022 Mid-Year Update](#).

26 Department of Agriculture, Cooperation & Farmers' Welfare. 2021. [Annual Report 2020-21](#).

27 USAID. 2017. [Climate Risk Profile: India](#).

28 World Bank Group. 2021. [Climate Risk Country Profile: India](#).



depend on to meet their own demands. At the same time, it is estimated that over 12 million people live on land at risk from rising sea levels, and nearly 171 million are dependent on at-risk coastal ecosystems.²⁹

India has been a central voice since the onset of global discussions on climate change, hosting one of the early United Nations conferences on Climate Change, the eighth session of the Conference of the Parties (COP) in Delhi in 2002. While currently being one of the largest emitters in the world as a country, historically India is not a leading emitter and its per capita emissions are relatively small. Therefore, India has been hesitant to bear the brunt of the economic responsibility for shifting toward a green economy given the relatively high per capita emissions for which high-income countries are responsible.³⁰

As time has progressed, the weight of scientific evidence of the impact of climate change and improved forecasting methodologies, particularly regarding the effects of droughts, monsoons, and glacial melt, have led the Indian government to adopt domestic policies to address both mitigation and adaptation needs. India formed an Expert Committee on Impact of Climate Change under the Ministry of Environment and Forests in 2007 to assess climate change impacts on key sectors and vulnerable regions of the country. In 2008 the National Action Plan on Climate Change (NAPCC) was developed, which created eight National Missions ranging from those dedicated to the adoption of solar energy, to sustainable agriculture, to strategic knowledge for climate change.³¹ Notably, it also focused on the complementary benefits of a green transition for both the environment and for the social wellbeing of its citizens. For example, it highlighted how the adoption of clean cooking practices could improve mitigation efforts and health for those in rural and impoverished settings and showed how renewable energy development could create new job opportunities. As an extension of the NAPCC, state governments were also directed to develop State Action Plans on Climate Change (SAPCC), which focused on climate change adaptation and resilience at the sub-national level. Over the years, some states have made more progress in developing plans than others. For example, Maharashtra formally adopted their SAPCC in 2017, and Odisha is in the process of finalizing a second version of its SAPCC.³²

India's updated Nationally Determined Contribution (NDC), its roadmap for climate action in conformance with the Paris Climate Agreement,³³ is ambitious. Its most notable goals include setting out to increase the cumulative proportion of non-fossil fuel-based energy to 50% by 2030, reduce emissions intensity by 45% by 2030 compared to 2005 levels, and create an additional carbon sink equivalent to 2.5–3 billion tonnes of CO₂ through increased forested area. To achieve these goals, the Ministry of New and Renewable Energy (MNRE) released numerous schemes and guidelines, with a focus on solar, off-shore wind, and small-hydro energy. Examples include the Solar Park Scheme, Validity Gap Funding (VGF) Scheme, Guidelines for Development of Onshore Wind Power Projects, and the Small Hydro Power Programme.³⁴ The National Programme on High Efficiency Solar PV Modules aims to reduce the renewable energy sector's dependence on imports by domestically manufacturing solar PV (Photovoltaic) modules.

Notably, India's NDC also emphasizes the country's commitment to increasing its ability to contribute to new climate technology innovations and investing in research and development (R&D).³⁵ India has played a leading role in

29 Ibid.

30 Dubash, N. et al. 2018. [India and Climate Change: Evolving Ideas and Increasing Policy Engagement](#). Annual Review of Environment and Resources.

31 Ministry of Environment, Forest and Climate Change. 2021. [National Action Plan on Climate Change \(NAPCC\): Frequently Asked Questions](#).

32 Dubash, N. 2019. [India in a Warming World: Integrating Climate Change and Development](#). Oxford University Press.

33 [United Nations Climate Change](#). United Nations Framework Convention on Climate Change. 8 March 2023.

34 [Ministry of New and Renewable Energy](#). Ministry of New and Renewable Energy. Accessed 8 March 2023.

35 Government of India. 2022. [India's Updated First Nationally Determined Contribution Under Paris Agreement \(2021-2030\)](#).



developing standards for assessing climate change impacts. In 2010, the government established the Indian Network for Climate Change Assessment (INCCA), with most of its research focusing on the topics of agriculture, water resources, ecosystems and biodiversity, and human health.³⁶ A National Ministry of Strategic Knowledge for Climate Change (NMSKCC) was created under the NAPCC, implemented by the Department of Science and Technology, to generate actionable knowledge of climate impacts and the potential of emerging climate technologies.

In January 2023, the government of India announced US \$2.3 billion to promote green hydrogen, under the National Green Hydrogen Mission. The mission aims to play a critical role in India's energy transition, particularly in the decarbonization of high carbon intensity sectors. The Mission will develop capabilities to produce at least 5 million metric tonnes (MMT) of green hydrogen annually by 2030, with the potential to reach 10 MMT per annum through growing export markets.³⁷

Overview of Green Entrepreneurial Activity in India

Enterprises can take climate action by realizing new solutions, developing technical innovations, creating and meeting consumer demand for sustainability, and changing habits and cultures.³⁸ Green entrepreneurs tackle climate change from multiple angles. For example, some mitigate its effects through carbon sequestration technologies. Others help communities adapt to its impacts through drought-resistant crop seeds or create more resilient industries through reducing reliance on price-volatile fossil fuels and shifting towards renewable energy. Green enterprises also contribute towards biodiversity and environmental conservation by participating in forest and landscape restoration activities, restoring depleted ecosystems, conserving water, preserving soil, and more.³⁹ Importantly, green enterprises can not only reduce negative environmental and health impacts through their products and services but also create sustainable employment and livelihood opportunities, particularly for marginalized groups, women, and youth.⁴⁰

Green entrepreneurial activity in India can be categorized into five sector groups: low-carbon energy, land and ocean management, transportation, water and waste management, and the built environment. Within each group, there are distinct sectors (listed in Table 1), which contain numerous business models and address different portions of the market. These sectors and associated business models are discussed in depth in Part 2.

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- 36 Dubash, N. et al. 2018. [India and Climate Change: Evolving Ideas and Increasing Policy Engagement](#). Annual Review of Environment and Resources.
- 37 Ministry of New and Renewable Energy. 2023. [National Green Hydrogen Mission](#).
- 38 T. Rafi. [How Entrepreneurs Could Shape The Climate Change Battle](#). 3 March 2021. Forbes.
- 39 Rohe-Frydrych, J. and Ebert, L. [Rethinking the role of business in conservation: Why small local enterprises are key to biodiversity and climate action](#). 28 February 2022. NextBillion.
- 40 International Training Centre of the International Labour Organization. 2016. [Greening Economies, Enterprises, and Jobs: The role of employers' organizations in the promotion of environmentally sustainable economies and enterprises](#).


Table 1: Green sector groups and sectors*

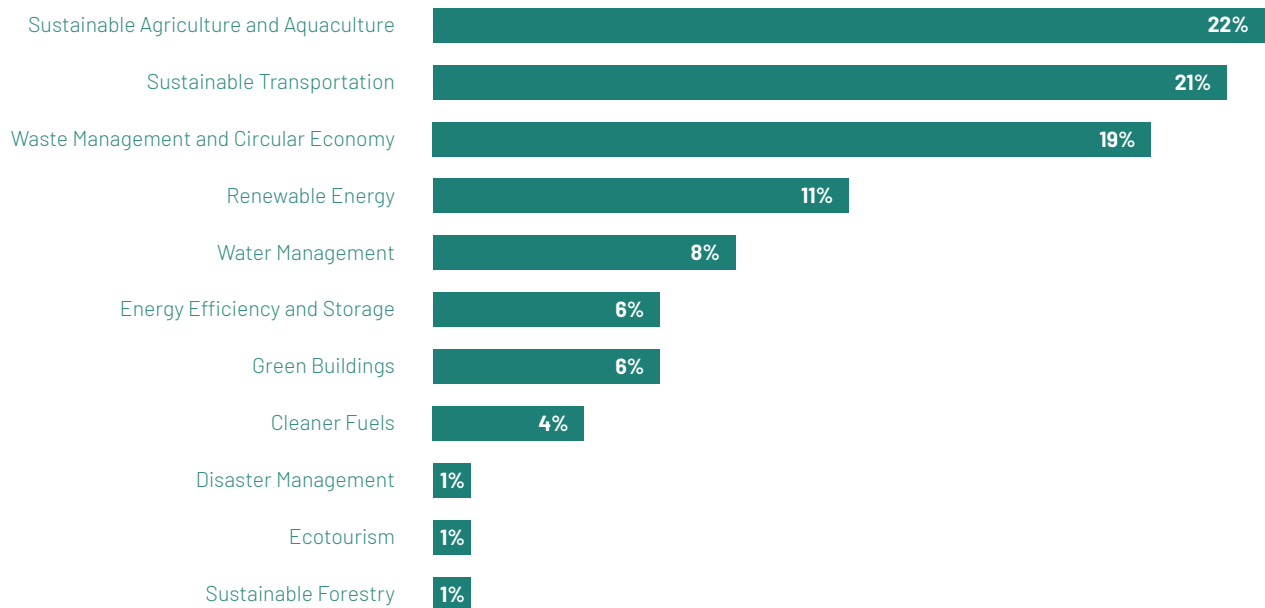
LOW-CARBON ENERGY	LAND AND OCEAN MANAGEMENT	TRANSPORTATION	WATER AND WASTE MANAGEMENT	BUILT ENVIRONMENT
Energy Efficiency and Storage	Sustainable Agriculture and Aquaculture (e.g. crop diversification and micro-irrigation)	Sustainable Transportation (e.g. electric vehicles, charging infrastructure)	Water Management (e.g. collection, treatment, and supply)	Green Buildings (e.g. retrofitting, new builds)
Renewable Energy (e.g. grid-tied renewables, off-grid renewables)	Sustainable Forestry (e.g. reforestation, carbon-sequestration, afforestation)		Waste Management and Circular Economy (e.g. solid waste, sewerage, post-use processes)	Disaster Management (e.g. developing monitoring and response systems)
Cleaner Fuels (e.g. biofuels, green hydrogen)	Eco-tourism (e.g. eco-lodging, eco-tours, agro-tourism)			

***Note:** Capital-intensive industries like rail, aviation, and pipeline transport are not listed as they are dominated by large corporations, and small business entrepreneurial opportunity in such industries is limited.

To examine the nature of green entrepreneurial activity in India, a sample of 100 green SGBs were identified through publicly available sources such as Crunchbase and portfolios of investors and accelerator programmes (see the Methodology section for more information on the sampling technique). Within the sample, referred to as “entrepreneur data” throughout the report, sustainable agriculture and aquaculture, sustainable transportation, and waste management enterprises were the most common. Notably, many green SGBs in the sample provide solutions with overlapping missions. Examples include [Oorja](#), which provides decentralized solar energy systems to farmers, [Tadpole](#), which retrofits gas-powered vehicles to be run fully on electric power, and [Krimanshi](#), which turns food residues and surplus into feed for livestock.



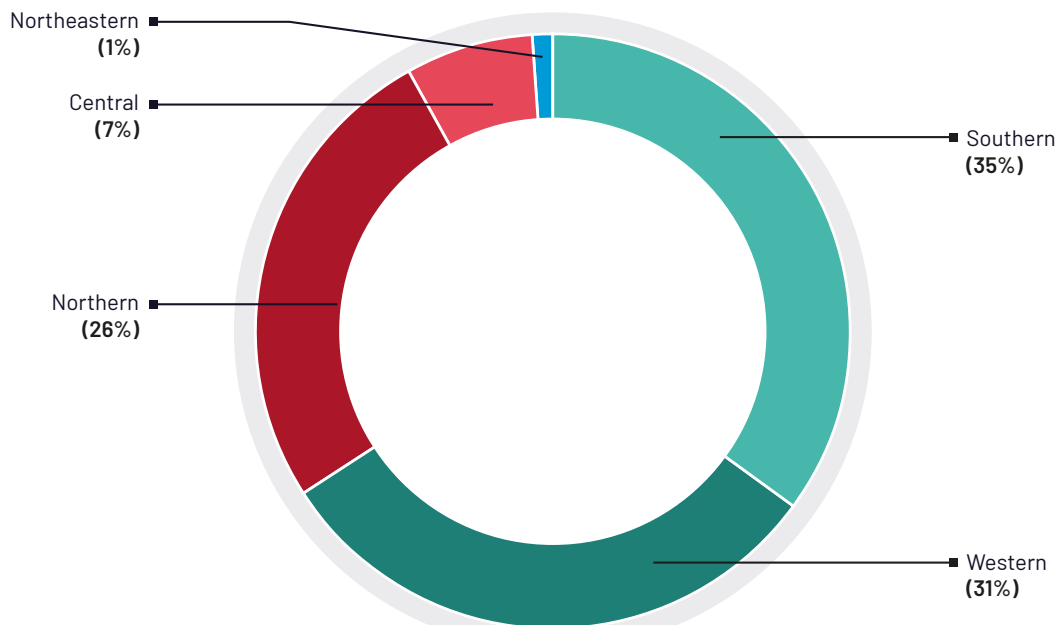
Figure 1: Sample green SGBs by sector



Source: Entrepreneur data (N=100)

The green SGBs identified in this sample are fairly evenly spread between the Southern, Western, and Northern regions of India (Figure 2). Very few were identified in the Central and Northeastern regions. This does not necessarily reflect a lack of small business activity, but rather less growth-oriented entrepreneurship that successfully attracts attention from investors and intermediaries like those in the sample of green SGBs assessed in this report.

Figure 2: Sample green SGBs by headquarters

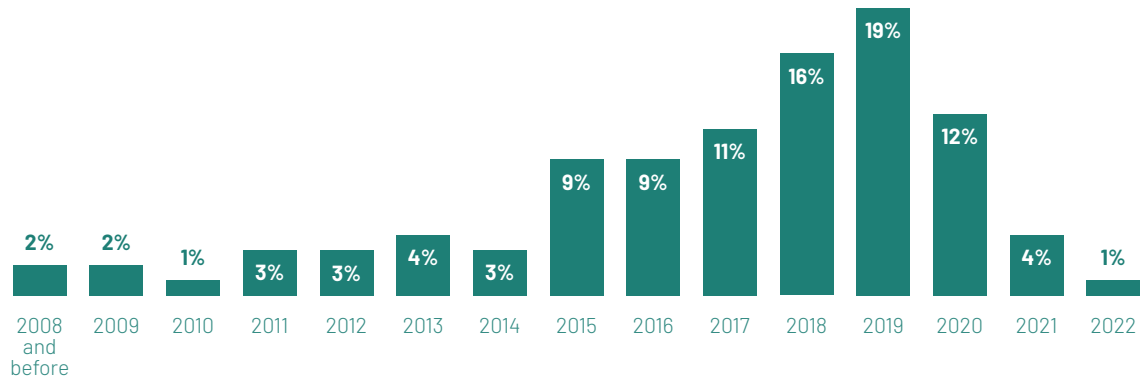


Source: Entrepreneur data (N=100)



Nearly all the green SGBs identified for the study were founded in the past decade, with a clear uptick in activity since 2015 (Figure 3).

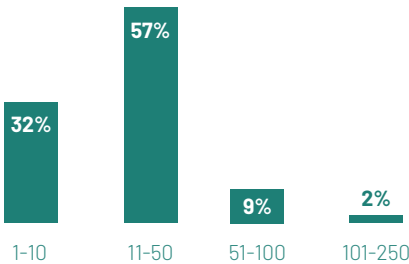
Figure 3: Founding year of sample green SGBs



Source: Entrepreneur data (N=100)

Though the definition of an SGB covers companies ranging from five to 250 employees, most companies are at the smaller end, with nearly all employing less than 50 staff (Figure 4).

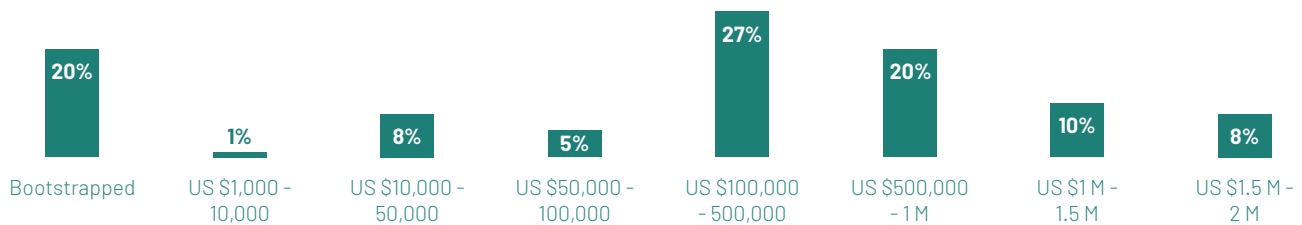
Figure 4: Number of employees of sample green SGBs



Source: Entrepreneur data (N=98)

Funding information was identified for 88 ventures in the sample. Of these, roughly 20% were bootstrapped, without any outside funding sources. Among those with funding information publicly available, most commonly it totals in the US \$100,000–1 million range. More than half have received some form of equity investment, often sourced from multiple investors.

Figure 5: Funding raised by sample green SGBs



Source: Entrepreneur data (N=88)



GREEN ENTREPRENEURSHIP AND GENDER EQUALITY

Women in developing economies are disproportionately affected by climate change and environmental degradation as they are largely dependent on natural resources for their livelihoods and are subject to social and economic inequalities such as limited access to finance and land ownership rights.⁴¹ However, women are not only threatened by climate change but are also change agents supporting climate action. As shown in the figure below, gender equality is essential to achieving many of the SDGs, including those directly tied to climate and environmental action.

GENDER EQUALITY AND OVERLAP WITH OTHER SDGS



Image adapted from: UN Women. 2018. **Why Gender Equality Matters Across All SDGs.**

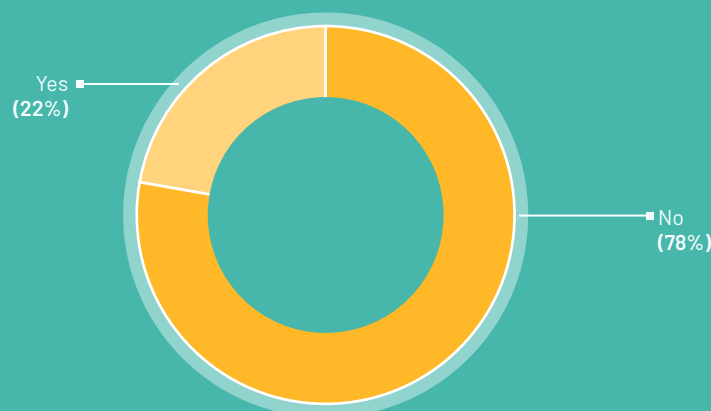
However, SGBs led by women face several barriers to scale. Within the sample of Indian green SGBs identified for this study, which captures businesses with a well-established web presence and traction in the ecosystem, only 10% have a woman founder or co-founder. This, at least in part, reflects gender imbalances present worldwide regarding access to finance. Women entrepreneurs attract a minority of global investments, having received only 2.3% of global VC funding in 2020.⁴² The concept of “gender lens investing” has been gaining momentum in terms of capital allocated across private and public finance providers. However, these efforts have a long way to go to close the gender finance gap, currently estimated at US \$285 billion worldwide.⁴³

In India, roughly 60% of support organizations surveyed as part of ANDE’s Ecosystem Snapshot process indicated that they target their green entrepreneurship support to women-led SGBs; however, this decreases to only 22% when looking at finance providers. An example of one such finance provider is Upaya Social Ventures, which targeted 60% of its new investments to women-led enterprises in 2022.

41 Vizaki, M. et al. 2021. *Ways to Gender-Smart Climate Finance: Financial Services*. 2X Climate Taskforce.
 42 Global Entrepreneurship Monitor. *Global Entrepreneurship Monitor Releases Ranking of Countries for Conditions to Start a Business*. Accessed 15 February 2023.
 43 IFC. 2017. *Investing in Women: New Evidence for the Business Case*.



PERCENTAGE OF INVESTORS IN INDIA THAT TARGET INVESTMENTS TO WOMEN-LED BUSINESSES



Source: Intermediary data (N=54)

For most women-led enterprises that do not have access to impact investors, structural barriers and cultural norms hold them back. For example, three years of business financial records and a minimum bank deposit in order to engage with financial institutions is a requirement that can pose a barrier, especially in a country like India where of the 77% of women that own a bank account, half of them use them in a limited manner or never at all.⁴⁴ Loans also require co-signers which may be more difficult for women to obtain. These issues are exacerbated by a lack of data on the financial and impact performance of gender-lens investing and a lack of broad uptake of gender inclusive practices within financial institutions.

Few SGBs in India have ensured their business activities and employment structures are gender inclusive. Some SGBs with this focus include **Bastar se Bazaar Tak**, a sustainable agriculture SGB that aims to provide employment opportunities to rural tribal youth and women through post-harvest management, value addition, and the marketing of processed non-timber forest products (NTFP).⁴⁵ **SMV Green Solutions** provides electric rickshaws fitted with cloud-based cameras and smartphones to ensure the safety of women drivers and passengers, and provides access to loans from financial institutions and occupational support (licences, insurance, training, and financial literacy) to women from low-income households.

The Indian government has made strong commitments to women's economic empowerment and gender equality through policies, legal frameworks, and direct interventions. The Ministry of Women and Child Welfare (MWCD) introduced the draft National Policy for Women in 2016, which directed micro-level policies to mainstream gender inclusion.⁴⁶ To address access to finance challenges, the government has also put in place numerous initiatives and incentives to address access to finance, such as the Start-up India programme designed to provide a range of support to innovative start-ups. Ten percent of the corpus fund is reserved for women-led start-ups. Additionally, the government of India's think tank, NITI Aayog, has launched the Women's Entrepreneurship Platform to help provide a supportive ecosystem to budding and existing women entrepreneurs across the country.⁴⁷

44 Indian Women Aren't Using Their Bank Accounts. This Is How and Why Women's World Banking Plans to Change That. Accessed 9 March 2023. Women's World Banking.

45 Upaya Social Ventures Announces Investments in Four Job-Creating Indian Companies. 20 January 2021. Upaya Social Ventures Press Release.

46 Government of India Ministry of Women and Child Development. 2016. *National Policy for Women (Draft)*.

47 *Moving the Needle: The Women Entrepreneurship Platform*. NITI Aayog. Accessed 9 March 2023.

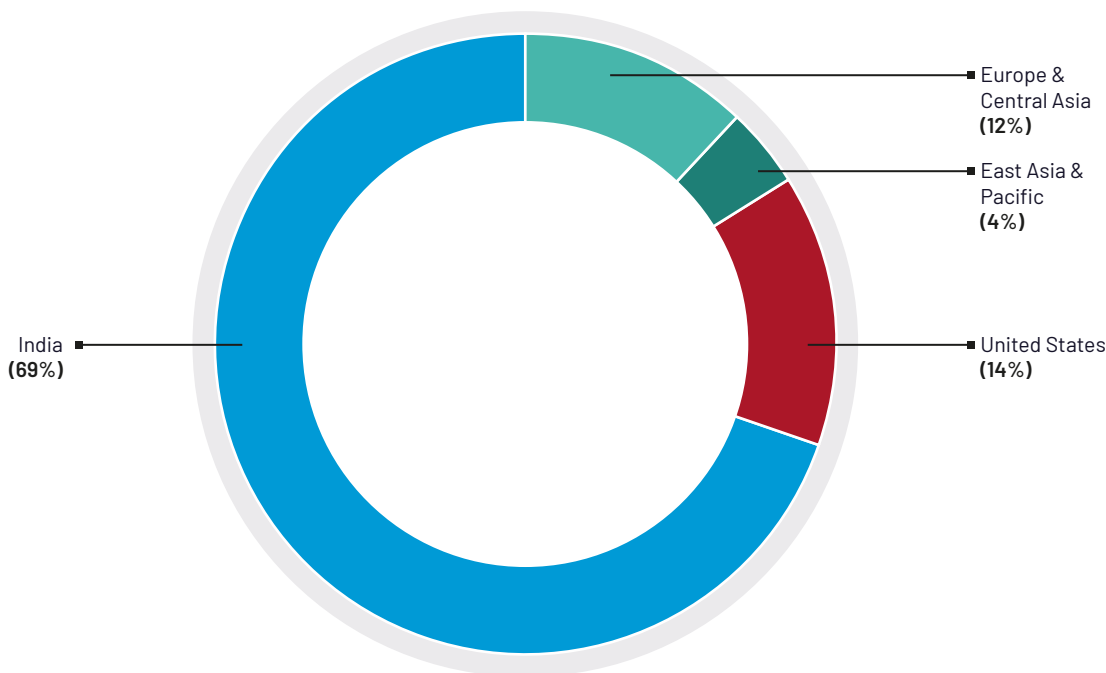


Support Available to Green Entrepreneurs

Using its Entrepreneurial Ecosystem Snapshot methodology, ANDE identified 140 organizations that offer programmes, initiatives, research, or investment targeted to green entrepreneurship in India (referred to as “intermediary data” throughout the report).⁴⁸ Though most of the organizations provide both financial and non-financial support, the percentage of those providing non-financial support is greater (78%).

The entrepreneurial ecosystem in India is dominated by local players, with almost 70% of the organizations being headquartered in the country (Figure 6). Most are fairly new to the green entrepreneurial ecosystem as well, with 90% having started focusing on the green economy in the last ten years.

Figure 6: Headquarters of organizations supporting green entrepreneurship in India



Source: Intermediary data (N=137)

Within India, support organizations commonly have offices in Northern, Western, and/or Southern India, with very few operating in the Eastern, Central, or Northeastern regions (Figure 7). This is similar to the breakdown of green SGB headquarters as displayed in Figure 3.

Based on feedback from stakeholder meetings, a lack of entrepreneurial activity and robust business models deter the development of local entrepreneur support organizations, which in turn limits new business development. Given the nascent stage of green entrepreneurship in those regions, grant funding and government subsidies are required to develop the ecosystem and encourage private investment.

⁴⁸ Saini, A. et al. 2023. *Entrepreneurial Ecosystem Snapshot: Green Entrepreneurship in India*. Aspen Network of Development Entrepreneurs.



Figure 7: Regions in which support organizations have offices

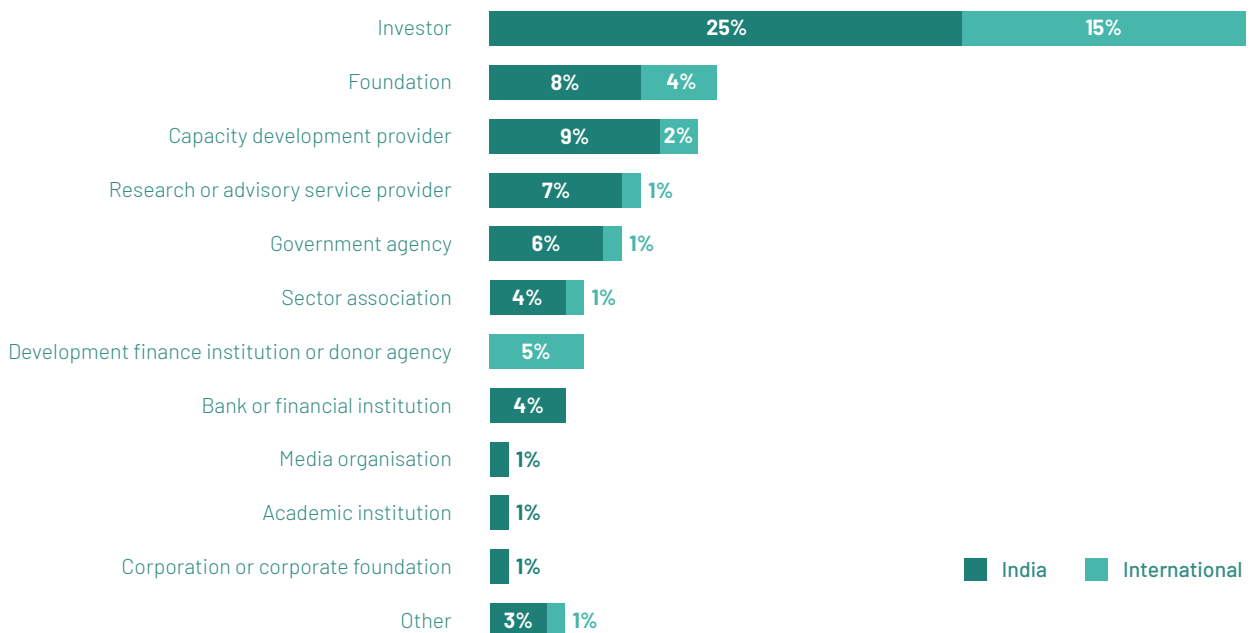


Source: Intermediary data (N=113)

Just under 40% of the identified support organizations exclusively focus on green entrepreneurship. [Climate Collective Foundation](#) is an example of a capacity development provider whose entire mission is aligned with supporting green ventures via acceleration programmes, funding platforms, impact metrics, research, and community activities. The remaining 60% do not limit their support solely to green businesses. An example of a generalist support organization is [Acumen](#), an impact investor which recently launched its Green Growth Accelerator for social entrepreneurs aiming to create decent jobs and positive environmental impact.

The most common types of organizations supporting green entrepreneurs in India are investors (Figure 8). This is a stark difference from snapshots of other developing economy ecosystems, in which capacity development providers are the most common type of support provider.⁴⁹

Figure 8: Support organization type by headquarters location



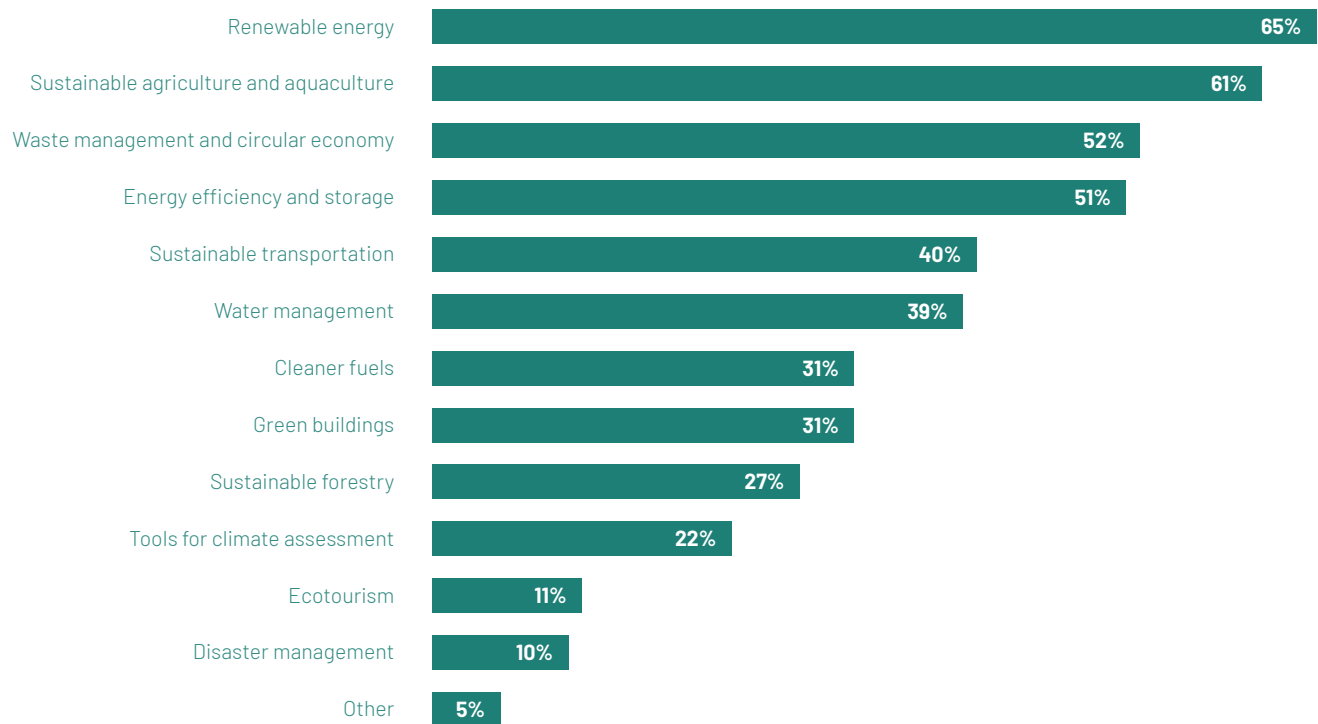
Source: Intermediary data (N=137)

49 See ANDE’s snapshots in different countries and regions at [Entrepreneurial Ecosystem Snapshots – Home](#).



Most support organizations direct their services to two or more green sectors, most commonly renewable energy, sustainable agriculture and aquaculture, and waste management. Similar to the rates of entrepreneurship by sector displayed in Figure 2, ecotourism and disaster management are not a significant focus for supporters of the green entrepreneurial ecosystem in India.

Figure 9: Percent of support organizations by target green sector

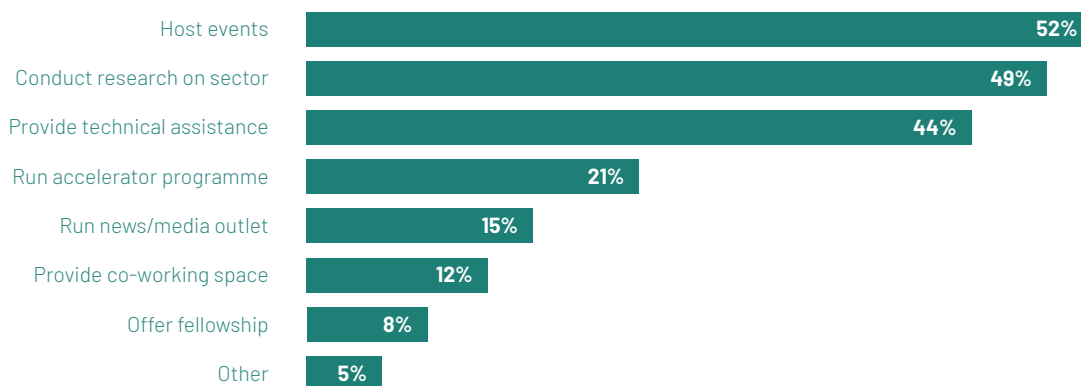


Source: Intermediary data (N=134; respondents could select more than one)

Non-financial support is most commonly delivered in the form of event hosting (52%), research on the sector (49%), and technical assistance (44%). Other non-financial support services, such as running news/media outlets, managing an incubator or providing a co-working space, running accelerator programs, and offering fellowships, are far less available in the ecosystem (Figure 10). Direct support providers such as accelerators and incubators focus most commonly on access to networks and business strategy and planning.



Figure 10: Percent of organizations by non-financial support type

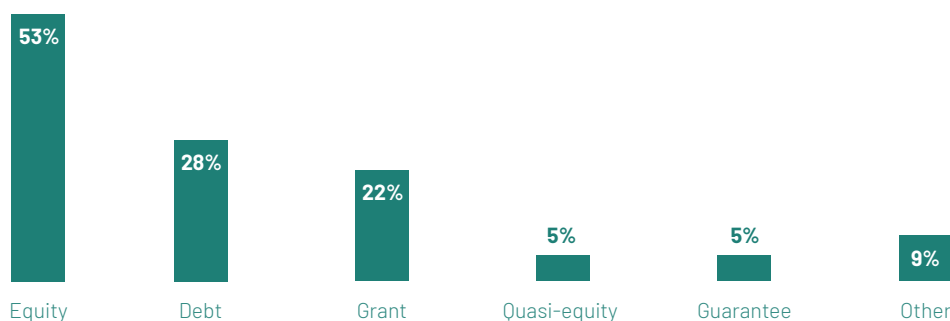


Source: Intermediary data (N=131; respondents could select more than one)

The intermediary data also shows the types of capacity development support services, market linkages, and investment linkages intermediaries provide. Most organizations that provide capacity development support help entrepreneurs expand their networks and partners (90%) and assist them in developing business strategies and plans (83%) rather than developing products or services, operations and technology, etc. Almost all organizations that support market linkages concentrate on helping entrepreneurs access new markets and customers (96%) instead of assisting them to access infrastructure and meet market standards (54%). Lastly, all support organizations that reported providing investment linkage support said they help entrepreneurs access investors rather than preparing them for pitches or granting access to information. Interviewed investors cited a lack of financial sophistication and accurate valuation among potential investees. At the same time, interviewed entrepreneurs noted the challenges in securing the financing they need. This challenge is not unique to India, and there are mechanisms to address this, e.g. through targeted matchmaking and increased investment readiness support from intermediaries.

Financial support providers most commonly provide equity financing to entrepreneurs, with under 10% of financiers offering quasi-equity or guarantees. While the prevalence of equity and debt finance are a positive sign for the ecosystem, grants are an essential resource for idea-stage companies that are still working out their business model and have not yet proven profitability.

Figure 11: Percentage of financial support providers by financial instruments offered



Source: Intermediary data (N=81; respondents could select more than one)

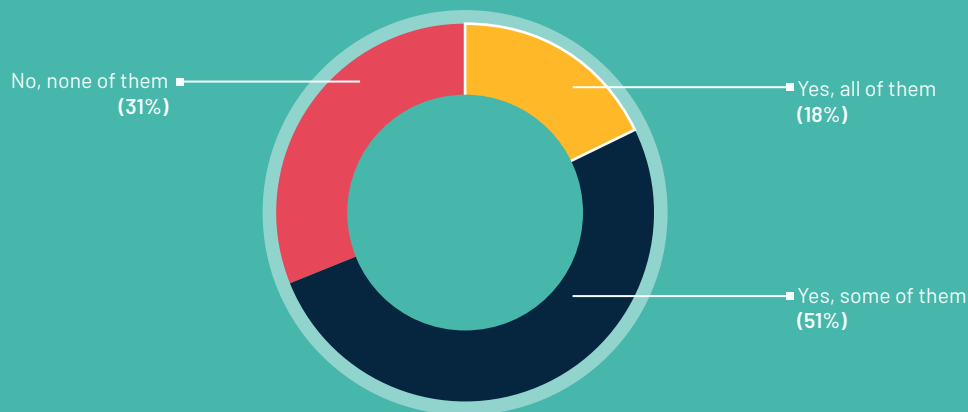


A CLOSER LOOK AT IMPACT MEASUREMENT

Measuring results and assessing outcomes directly or indirectly (through proxy indicators) helps enterprises to understand and communicate the social and environmental value they create through their products or services. The ability to demonstrate and measure impact not only improves internal decision-making but also makes companies more attractive to potential investors. However, enterprises across the board struggle to measure their impact. Those working on climate and environmental goals face a particular challenge due to the very technical nature of measurement in those fields. That is especially the case for those working in climate change adaptation and resilience, for which there are significantly fewer available measurement tools in comparison to mitigation.⁵⁰

When asked how many of their supported entrepreneurs measure their climate and/or environmental impact, surveyed support organizations (such as accelerators, investors, and technical assistance providers) reported that in most cases either some or all of their entrepreneurs do have some sort of impact measurement practice in place.

PROPORTION OF SUPPORTED ENTERPRISES THAT MEASURE CLIMATE/ENVIRONMENTAL IMPACT



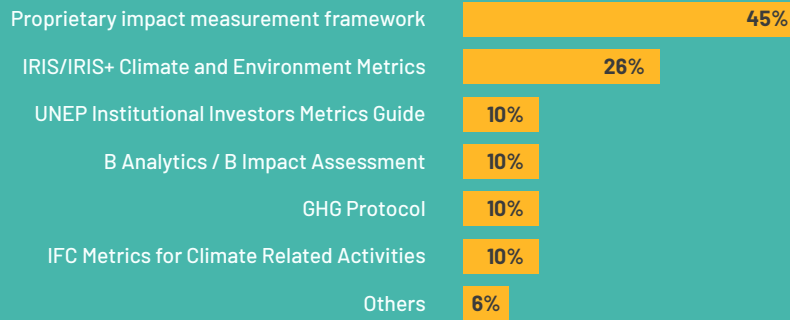
Source: Intermediary data (N=48)

The Indian entrepreneurs who measure their results and try to assess their impact most commonly use a proprietary framework created to fit their specific business model. Some interviewed entrepreneurs shared that they leverage research by prominent entities, while others conduct their own research to understand how their products contribute to climate goals. IRIS+ is the most commonly used standardized framework, while a smaller proportion use other frameworks from UNEP, B Analytics, etc. When asked how they measure their own organization's impact, support organizations reported a similar breakdown, preferring proprietary tools over other established frameworks.

50 Joshi, J. et al. 2022. *Measuring the Impact of Climate Small and Growing Businesses*. Aspen Network of Development Entrepreneurs.



IMPACT MEASUREMENT FRAMEWORKS USED BY ENTERPRISES



Source: Intermediary data (N=31; respondents could select more than one). Support organizations were asked which frameworks were most commonly used by supported enterprises.

When support organizations were asked about the challenges entrepreneurs face regarding impact measurement, the most common responses were a lack of organizational capacity or knowledge of best practices. This is reflected in research by Kiva, which found that globally, one in five social enterprises lack qualified staff to undertake impact measurement.⁵¹ Nearly 40% of surveyed support organizations in India also noted that cost is a major barrier, which is likely an even higher barrier for SGBs not actively receiving capacity development support. To address financial and personnel constraints, funders and investors can subsidize impact measurement efforts. For example, impact investors that require impact reporting can help cover costs for new technology, staff training, and database setup.

IMPACT MEASUREMENT CHALLENGES FACED BY ENTREPRENEURS



Source: Intermediary data (N=32; respondents could select up to three). Support organizations were asked what challenges their supported entrepreneurs face when measuring impact.

51 MacColl, S. Why social enterprises struggle to measure impact – and what impact investors can do about it. 8 August 2022. NextBillion.



Top Sectors by Market Opportunity and Level of Support

Table 3 compiles the information shared in Parts 1 and 2 of this report to compare the market opportunity and levels of funding, policy, and accelerator/incubator support for each green sector in India. This information is specific to ventures operating within the SGB segment, meaning they are typically formalized, already have at least five employees, and are seeking growth capital.

The methodology and data sources used and their respective limitations are as follows:

- **Market opportunity:** The market opportunity estimates are based on either an identified government set target or relevant SDG indicator to be achieved by 2030. The market opportunity covers the gap between 2022 (i.e. baseline) and 2030 (i.e. endline) and provides a cumulative figure for the period assuming a constant growth rate to reach 2030 targets. The advantage of this approach is that it allows for comparable figures across different sectors by applying a similar methodology without overly complicating the process. However, this exercise did not account for all possible factors that affect market potential (e.g. the different infrastructure required for each sector and incentives that affect consumer behaviour) and instead uses government-identified targets as proxies for possible growth. Importantly, these estimates do not necessarily reflect all private sector activity in a given sector but rather only the business segments in which SGBs are active. For instance, the installed capacity for wind energy in India ranks fourth highest in the world, but it was not considered for the market opportunity estimate in this report since SGBs do not actively engage in that sector. Details on how the market opportunity was calculated for each sector are provided in Appendix B.
- **Funding support:** The level of funding support was evaluated based on the availability of funding for each key area of business activity identified within each sector (as described in Part 2 of the report). Within each sector, the authors searched for four types of financiers: development finance institutions (DFIs), foundations, commercial banks, and private investors such as venture capitalists or impact investors.⁵² While not exhaustive, the funding support captures prominent financiers in the Indian green ecosystem for each category regardless of their funding or deal size. The high/medium/low classification was based on whether each type of financier provides funding to all (high), one or more (medium), or none of the identified key areas of a sector, and the overall classification depended on the average level of support provided by the four funder types.
- **Policy support:** Policy support was assessed based on the extent to which the government's strategies and policies aimed to promote the private sector, entrepreneurial, and SGB activities. The research team documented a fairly comprehensive list of policies and strategies relevant to the sector and then removed some from the list that have no bearing on business activity. It should be noted that this evaluation focused on formulated policies and strategies rather than on the degree to which they are effectively implemented. However, Part 2 indicates some gaps in the policies and strategies, such as whether they lack specific targets or plans to achieve their stated goals.

⁵² Agricultural banks, such as the National Bank for Agriculture and Rural Development (NABARD), perform as a refinance agency and channel their support through commercial banks. Hence, this research does not consider agricultural banks as an independent category and captures their activity instead along the scope of commercial banks' activities wherever possible.



- Accelerator/incubator support:** The level of accelerator/incubator support was based on the number of identified accelerators and incubators targeting each green sector in India. This information was pulled from the intermediary data collected for this report through ANDE's Entrepreneurial Ecosystem Snapshot methodology. This dataset is comprehensive of all major actors currently supporting green SGBs in India and should be seen as representative.

The market opportunity and levels of support were categorized as high, medium, or low for each sector relative to the other sectors.

Table 2: Definitions of categories used in the analysis

MARKET OPPORTUNITY	FUNDING SUPPORT	POLICY SUPPORT	ACCELERATOR/ INCUBATOR SUPPORT
SMALL (< US \$51 billion)	LOW (Financiers provide support to <i>none</i> of the key areas of business activity)	LOW (Policy/strategies promote entrepreneurial activity in <i>none</i> of the key areas of business activity)	LOW (< 11 accelerators/incubators work in sector)
MEDIUM (US \$51 – 200 billion)	MEDIUM (Financiers provide support to <i>some</i> key areas of business activity)	MEDIUM (Policy/strategies promote entrepreneurial activity in <i>some</i> key areas of business activity)	MEDIUM (11–19 accelerators/incubators work in sector)
LARGE (> US \$200 billion)	HIGH (Financiers provide support to <i>all</i> key areas of business activity)	HIGH (Policy/strategies promote entrepreneurial activity in <i>all</i> key areas of business activity)	HIGH (20+ accelerators/incubators work in sector)


Table 3: Overview of market opportunity size and support levels by sector

SECTOR	MARKET OPPORTUNITY	FUNDING SUPPORT	POLICY SUPPORT	ACCELERATOR/ INCUBATOR SUPPORT
Energy Efficiency & Storage	MEDIUM	LOW	LOW	MEDIUM
Renewable Energy	SMALL	HIGH	MEDIUM	HIGH
Cleaner Fuels	MEDIUM	LOW	LOW	MEDIUM
Sustainable Agriculture & Aquaculture	LARGE	HIGH	MEDIUM	HIGH
Sustainable Forestry	SMALL	LOW	LOW	MEDIUM
Ecotourism	N/A	LOW	LOW	LOW
Sustainable Transportation	SMALL	MEDIUM	HIGH	MEDIUM
Water Management	LARGE	MEDIUM	MEDIUM	MEDIUM
Waste Management & Circular Economy	LARGE	LOW	HIGH	HIGH
Green Buildings	LARGE	LOW	MEDIUM	MEDIUM
Disaster Management	N/A	LOW	LOW	LOW

Note: The market sizes for ecotourism and disaster management are not estimated due to lack of SGB activity.



Several conclusions can be drawn from compiling these various data sources. Some highlights include:

Some sectors already have significant market traction and are receiving broad levels of support from policy, funders, and capacity development providers.

- Sustainable agriculture and aquaculture** is an enormously important sector in India, with an estimated market opportunity between 2022 and 2030 of US \$434 billion. With about 55% of Indians engaging in the agriculture sector⁵³ and aquaculture providing livelihoods to more than 20 million fishers and fish farmers,⁵⁴ reduced crop and fish yields due to climate change pose a major threat to society and the economy in India. There is significant SGB activity in the sector, while the activity is concentrated around agriculture rather than aquaculture. The government has also launched several initiatives, such as the National Mission on Sustainable Agriculture (NMSA), to make agriculture and aquaculture more resilient to extreme climate events, although some of them do not provide direct support to entrepreneurs. The sector also receives significant financial support, especially from private investors like [Omnivore](#), [Agfunder](#), and [Nabventures](#). Omnivore typically invests US \$1 million to US \$1.5 million in seed-stage enterprises.⁵⁵ The sector also receives a significant amount of attention from capacity development providers, such as [Acumen's India Climate Resilient Agriculture Accelerator](#), which focuses on solutions that build the climate resilience of smallholder farmers, and [Villgro's Climate Smart Agriculture Program](#), which targets pilot-stage agriculture enterprises with innovative solutions to increase productivity while reducing inputs and wastage. However, in stakeholder feedback meetings, ecosystem actors pointed out that there are different levels of support for different business segments in the agriculture sector, and support organizations need to provide more targeted interventions to certain underserved regions and climates.
- Sustainable transportation** is a primary focus of India in its efforts to achieve net zero⁵⁶ by 2070 and offers a market opportunity of US \$29 billion between 2022–2030. The focus on 'green growth' as highlighted in the latest financial budget for the country also includes providing an impetus for green mobility.⁵⁷ Some of the initiatives that provide this boost include incentivising domestic EV manufacturing and exempting the materials required to produce lithium-ion batteries from custom duties.⁵⁸ During COP26, India committed to a target of 30% of all new private vehicle sales being electric by 2030. To help reach this goal, automotive manufacturers and oil companies have increased investments in the sector. For example, the Indian Oil Corporation plans to install EV charging facilities at 10,000 fuel stations over the next three years.⁵⁹ The Indian government has been implementing several other plans to expand the sustainable transportation sector, such as 100% foreign direct investment through the automatic route.⁶⁰ India's production-linked incentive scheme with an outlay of US \$3.5 billion for the automotive industry includes incentives of up to 18% to encourage domestic production of high-tech automotive parts. Further, it promotes the domestic manufacturing of EV batteries.⁶¹ While the funding and accelerator/incubator support for the SGBs in the sustainable transport sector are not as high as those for other sectors with market traction, SGB activities in this area are growing organically. Electric vehicles are appealing to more and more

53 Department of Agriculture, Cooperation & Farmers' Welfare. 2021. [Annual Report 2020-21](#).

54 [Cabinet Approves Pradhan Mantri Matsya Sampada Yojana for Boosting Fisheries Sector](#). 20 May 2020. Ministry of Fisheries, Animal Husbandry & Dairying.

55 Insight from primary discussion with Omnivore

56 [For a livable climate: Net-zero commitments must be backed by credible action](#). UN. Accessed 9 March 2023.

57 Government of India. [Budget 2023-24 Speech of Nirmala Sitharaman Minister of Finance. 2023](#).

58 Ibid.

59 [IndianOil to install EV charging facilities at 10,000 Fuel Stations](#). 3 November 2021. IndianOil.

60 [Nod for 100% FDI in auto sector](#). 7 March 2002. The Economic Times.

61 Saur, J. [Rising EV: The State Of EV Sector In India](#). 19 October 2022. Saur Energy International.



consumers as an alternative to internal combustion engine vehicles as petrol and diesel prices are considered by many to be too high.⁶²

- **Renewable energy** is being strongly pushed by the Indian government due to its commitments to net zero emissions by 2070 and meeting 50% of electricity demand from renewable energy sources by 2030.⁶³ While SGBs are not very active in other renewable energy sources (e.g., wind or hydropower), they play an important role in the provision of solar energy. For example, global market pioneers like [SELCO Solar Light Private Ltd.](#) have been active in India's off-grid solar sector for over 20 years. An increasing range of solar-based solutions have also been developed in recent years due to cost decreases in solar panels, other solar products and LED lights, improved battery technologies, and the increased attention paid to enabling regulatory environments by the Ministry of New and Renewable Energy (MNRE) and other bodies. These solar-based solutions include solar drip irrigation, solar home systems, solar for small businesses and health centres, and solar or hybrid mini-grids. SGBs in this sector focus on installing solar energy systems, like [Oorjan](#) which recently raised US \$450,000 from [Globeveestor](#),⁶⁴ or supporting other businesses by distributing or providing financing options, like [SundayGrids](#) and [Enray Solar](#). Although the Indian government has adopted an ambitious target, there are no specific provisions regarding how to engage the enterprises in the sector with the exception of supporting incubation centres across the country through the Jawaharlal Nehru National Solar Mission (JNNSM).⁶⁵ Solar-energy SGBs would benefit from supportive policies such as alternative financing schemes to reduce the burden of high upfront costs and incentives for manufacturing facilities.

Other sectors, on the other hand, have yet to receive enough support, especially given their growth potential based on the estimated market opportunity.

- **Waste management and circular economy** presents the second-highest market opportunity at US \$823 billion (after green buildings) among green sectors in India and provides enormous job creation potential. The government has taken steps to formalise the collection, segregation, and treatment process and aims to enhance involvement of the private sector at each stage. These measures have the potential to improve resource efficiency in the country by creating transparency in waste value-chains and aid the effective recovery and re-use of waste produced. The sector is experiencing a lot of entrepreneurial activity, with a mix of SGBs and larger enterprises and emerging business models in the waste-to-value and technology for waste business segments. For example, dry waste management enterprise [Nepra](#) has raised US \$18 million in series C funding. Examples of other prominent innovators include [Wastelink](#), which transforms food waste into animal feed and fertilizer, and [Canvaloop Fibre Pvt. Ltd.](#) which processes agricultural waste into textile fibers. While DFIs, private investors, foundations, and commercial banks all provide financing to the sector, most financing – except for that from private investors (e.g., [Aavishkaar Capital](#), [Ennovent Capital](#)) – is directed to projects run by the government instead of going directly to private enterprises. Given that many businesses in the waste management sector are informal, funds that are directed to the government do not reach a great number of businesses. Therefore, the sector needs substantially more financial support that directly supports ventures, and ecosystem stakeholders need to lend support to entrepreneurs to formalize their business so that they provide waste management services that meet environmental regulations and appeal to the private investors. This will also help SGBs with

62 Roy, R.D. 2022. [Our Aim Is To Expand Throughout the Country' - How India's Tadpole Projects Is Retrofitting Its Way To Success.](#) 2 June 2022. Auto Futures.

63 Birol, F. and Kant, A. 2022. [India's clean energy transition is rapidly underway, benefiting the entire world.](#) 10 January 2022. IEA.

64 Singh, A. [Rooftop Startup Oorjan Raises \\$450K Led by Globevestor.](#) 5 October 2017. VC Circle.

65 [Jawaharlal Nehru National Solar Mission.](#) IEA. Accessed 2 March 2023.



impactful innovations to reach the scale at which they can engage with municipal and state-level governments to provide waste management solutions.

- **Green buildings** also present a large market opportunity for entrepreneurial activity. However, policies aimed at the green buildings sector are heavily focused on larger enterprises. There are some positive developments in terms of increasing support for SGBs in this sector. For example, the Indian government is encouraging start-ups to submit state-of-the-art construction technologies for green buildings,⁶⁶ providing incubation and acceleration support to educational and research institutions like the Indian Institute of Technology (IIT) Madras, and regulating building codes and rating systems. The sector itself receives a high volume of funding, mostly driven by DFIs, but this is mostly directed to the government; direct funding channels to SGBs are not well established.
- **Water management:** The fact that India will face more extreme water stress caused by climate change presents a large market opportunity for growth in this sector. However, SGBs are not highly active in the water management space, and funding, policy, and accelerator/incubator support does not adequately target green entrepreneurship. For instance, the Indian government adopted policies to map available and stressed underground water resources, but the mapping activity does not involve private sector enterprises that could support this exercise. Government support is mainly directed to the private sector in the form of start-up challenges.

Other sectors covered, including the **energy efficiency and storage** and **cleaner fuels** sectors, have medium-size market opportunities but receive relatively lower levels of funding support compared to other sectors with similar or smaller market potential. Funding support in these sectors mostly comes from donor agencies.

66 [PMAY \(Urban\) - Progress](#). Ministry of Housing and Urban Affairs. Accessed 2 March 2023.



Key Challenges and Opportunities

ANDE surveyed 54 intermediaries active in supporting green entrepreneurship in India and interviewed entrepreneurs and other stakeholders to gather their perspectives on key challenges and opportunities in the coming years. Several common themes emerged, which are described below.

TOP CHALLENGES

CHALLENGE 1:

Limited access to finance

Nearly three-quarters of surveyed support organizations reported that limited access to finance or growth capital is the primary challenge facing green entrepreneurs in India.⁶⁷ However, the issue does not appear to be the lack of financial support providers, as the most common type of intermediary supporting green entrepreneurship in India are investors (see Figure 8). Rather this challenge reflects a mismatch in the type of capital available and the needs of many green entrepreneurs, as indicated by participants in stakeholder feedback meetings. This issue can be further broken down into several sub-challenges, including:

- **Limited familiarity with green business models:** Many financiers, including private investors and banks, exhibit a limited understanding of green business models, increasing the risk-aversion of potential investors in green entrepreneurship and the collateral requirements of banks. Stakeholders further shared that investors are more experienced in dealing with software companies that have a clear growth path and history of profitability. However, many green SGBs, particularly those addressing adaptation, require significant up-front investment and R&D resources to reach the point of profitability. Therefore, many service-oriented and hardware-based green SGBs have had a particularly challenging time securing funding.
- **Limited number of investment-ready business models.** The second-most commonly cited challenge was a limited number of green business models which are perceived as investment ready by financiers. Lack of scalability is often cited as the reason for green enterprises not being investment-ready, and the nascency of business models and innovation increases the risk perception in terms of bankability due to insufficient data backing return on investment. Stakeholders also noted that oftentimes enterprises circulate through incubators and accelerators as they have been able to refine their business models via their support and commercialize their innovations through access to their networks thereby successfully securing funding and support in multiple rounds. This points towards a need for ESOs to support enterprises providing innovative solutions which tackle climate challenges but do not have the expertise to develop investment-ready business models.
- **Mismatch between supply and demand for capital.** Participants in stakeholder meetings stressed that the primary issue with access to finance is not a lack of investors but rather a lack of available capital for green entrepreneurs in their earliest stages. Indeed, access to finance was cited as one of the main improvements in the ecosystem by the same set of surveyed stakeholders. This reflects the increasing number of financial support providers active in the green entrepreneurial ecosystem (about 70% provide some form of financial

67 Saini, A. et al. 2023. [Entrepreneurial Ecosystem Snapshot: Green Entrepreneurship in India](#). Aspen Network of Development Entrepreneurs.



support, a much higher proportion than in other ecosystems studied by ANDE) as well as the fact that most of this financial support is directed to early-stage or growth-stage businesses that have gained initial market traction or demonstrated steady growth, respectively. The intermediary data indicate that financial support providers most commonly provide financing in form of equity and ticket sizes ranging from US \$100,001 – \$500,000.⁶⁸ While these amounts work for entrepreneurs who have been able to reach the early or growth stages, they present a challenge for idea and startup-stage businesses that need smaller and more flexible forms of financing such as grants, quasi-equity, or guarantees.

CHALLENGE 2:

Limited collaboration between stakeholders and policymakers

Roughly one-third of surveyed support organizations reported that limited collaboration between stakeholders was a top challenge for green entrepreneurs in India. And while only 18% listed an unsupportive policy environment as a key challenge, interestingly nearly 50% of organizations cited this as an area where collaborative action could be impactful in terms of improving the enabling environment for green SGBs.⁶⁹ This is evidenced by the following challenges:

- The need for more policy considerations for green SGBs:** In stakeholder convenings, support organizations shared that existing policies do not adequately address the challenges that green businesses face, especially those in their earliest stages. Even those policies focused on the private sector are more informed regarding large corporations, leaving the unique challenges faced by green businesses unaddressed. Large corporations and small entrepreneurs face different challenges; hiring and retaining the right talent and paying levies to comply with government regulations can be more burdensome to earlier-stage ventures than to businesses operating at scale. Interviewed entrepreneurs expressed that there could be more support extended to the private sector, for example by reducing subsidies on products which are in direct competition with those of green SGBs or leaning more heavily on private enterprises for the provision of services where possible. In order to elicit government support that lessens the burdens for early-stage SGBs, stakeholders should work collaboratively to identify priority issue areas and voice these needs efficiently to the government to encourage an improved enabling policy environment.
- Lack of collaboration between stakeholders:** Green entrepreneurship has been catalyzed over the past decade in India. Given the number of entrepreneurs in the space and the number of initiatives, stakeholders are usually vying for the same set of verified, successful businesses to join their programmes, hindering potential for collaboration. In order to be able to address systemic gaps with respect to green entrepreneurship support, there is a need for stakeholders to collaborate strategically, bringing together their collective strengths towards greater impact, such as happened in the off-grid renewable energy sector with the establishment of the [Clean Energy Access Network](#) a decade ago.

68 Equity being the most common form of financing offered by support organizations does not mean that more SGBs are financed by equity deals than any other forms of financing. For instance, the number of loans provided by a given bank would typically exceed the number of equity deals made by an impact investor annually. Rather, this information indicates that there is a greater prevalence of organizations that offer equity as compared to organizations that offer other forms of financing in the Indian green entrepreneurial ecosystem.

69 Saini, A. et al. 2023. [Entrepreneurial Ecosystem Snapshot: Green Entrepreneurship in India](#). Aspen Network of Development Entrepreneurs.



CHALLENGE 3:

Lack of support for impact measurement and management (IMM)

As more financiers and donors seek to measure the environmental impact of their investments, the demand for quality IMM has increased. However, many green entrepreneurs do not have the human or financial resources to conduct quality IMM and need support to integrate IMM systems into their operations. Sub-challenges include:

- **Lack of expertise:** Entrepreneurs often lack the know-how to conduct IMM, and many support organizations also do not have in-house human resources and expertise to support entrepreneurs adequately in building out IMM systems. Stakeholders in India would benefit from training to equip them with relevant resources, frameworks, and methodologies.
- **Lack of finances:** A substantial number of support organizations indicated that the cost of IMM is an inhibiting factor. When it comes to paying for IMM expenses, most support organizations reported mobilizing the financial resources from their own pockets but also from entrepreneurs and donor organizations.⁷⁰
- **Lack of IMM tools for adaptation and resilience:** Measuring impact is especially challenging for climate change adaptation as most tools are designed for mitigation, for which there are common indicators and methodologies for measurement. Climate adaptation metrics also need to account for indicators that bear importance locally. It might be more helpful to have metrics that are agreed upon by local stakeholders in the ecosystem. Reconciling these contextual needs with the demand for cross-regional comparisons should be prioritized by experts and support providers moving forward.⁷¹

TOP OPPORTUNITIES

OPPORTUNITY 1:

An increasing number of financiers focused on green start-ups

While access to finance was reported as the most common challenge among stakeholders, it was also cited as a key area of improvement, and roughly 60% of support organizations identified access to finance as an area where collaborative action can make a meaningful impact. Support organizations can work together to identify sectors in which green entrepreneurs are presenting promising business models but are in need of greater investment and tailor financing to their needs. This will take effort to educate investors in which green business models have potential for profitability, what types of financing are the best fit in the early stages, and what return window and rates investors can expect.

OPPORTUNITY 2:

Collaboration to improve policies for green enterprises

Currently there are multiple policies working in a fragmented manner to develop and improve the ecosystem at different levels. Central and state nodal agencies can work in coordination to implement these policies and programmes. This can be done by identifying government schemes and programmes with specific sector focus.

⁷⁰ A more detailed look at impact measurement among entrepreneurial ecosystem actors is available in ANDE's [Entrepreneurial Ecosystem Snapshot report](#) for India.

⁷¹ D. Bours, C. et al. 2014. [Guidance for M & E of Climate Change Interventions](#). SEA Change and UKCIP.



Also an implementation cell can be formed to oversee monitoring and implementation, mobilize resources, and ensure coordination among different government departments.

OPPORTUNITY 3:

Tailored capacity building support for green business models

While some challenges are universal across different green sectors, others are not. Green enterprises approach climate change mitigation, adaptation, and resilience challenges very differently, with some providing tech-enabled solutions and others offering service-oriented solutions that differ both in revenue model and target customer base. Enterprises with tech-based solutions grow their businesses more easily because investors are more familiar with these business models and their proprietary products provide unique solutions. For instance, [Indra Water](#) offers a large quantity water treatment system that covers various pollutants, using a technology distinguishable from existing products. In the waste management sector, SGBs compete with informal waste collectors who may not meet environmental standards but provide their services at a lower price and depend exclusively on this income to support their livelihood. More tailored support for specific sectors and business models by accelerators and incubators, combined with studies around how to incorporate existing informal players into more formal sector economy opportunities, could allow for improved peer-learning among entrepreneurs, more targeted advisory support, and better investment readiness for not yet proven business models.



THE PROMISE OF GREEN JOBS

The transition to a green economy presents enormous potential for job creation. The International Labour Organization (ILO) estimates that India has the potential to create over 50 million jobs by 2070 on its path toward net zero.⁷²

The ILO defines green jobs as “decent jobs that contribute to preserve or restore the environment, be they in traditional sectors such as manufacturing and construction, or in new, emerging green sectors such as renewable energy and energy efficiency.”⁷³ Based on the ILO’s global estimates, the water and solid waste management sectors have particularly high job creation potential due to their labour intensity and the highly informal nature of these sectors currently.⁷⁴

DEFINING A GREEN JOB



Source: International Labour Organization. **What is a green job?**

As India transitions to a green economy, the demands for both skilled and unskilled labour will continue to shift. Existing employees will need to learn new technologies, termed as “reskilling” or “upskilling”, whereas new job seekers will need technical skills and knowledge relevant to emerging green sectors. To address the shortages in skills, the government launched the Skill Council for Green Jobs in India, which provides an e-learning management system to Indian job seekers building new skills in green industries and technologies.⁷⁵

72 World Economic Forum and Kearney and Observer Research Foundation. 2021. *Mission 2070: A Green New Deal for a Net Zero India*.

73 “What is a green job?” 13 April 2016. International Labour Organization.

74 International Labour Organization. 2018. *Skills for Green Jobs in India*

75 Skill Council for Green Jobs. Accessed 15 February 2023.



Case Studies of Successful Green SGBs

This section presents case studies of five green SGBs in India that have established a sustainable business model in their respective sectors. The businesses were selected from the entrepreneur dataset described in the methodology section and then categorized into three groups depending on how many of the following conditions were met: 1) the presence of women in a founding team, 2) the number of women employees, 3) experience working with accelerators or incubators, 4) positive revenue growth trajectory over time, and 5) commitment to measuring their climate impact. The researchers prioritized the enterprises that met the most criteria (4+) first, and then moved on to those that satisfied fewer criteria. However, most of the enterprises featured in this section meet four or more of the mentioned conditions, meaning that they are likely to champion gender equality and impact measurement, work with ecosystem stakeholders, and have a successful record of growing their business. As the goal of the section is to show successful venture models, the selected SGBs are, by design, not representative of all SGBs in the ecosystem.

Each profile describes the selected company's business model, financial and non-financial support received, and key milestones in its growth journey. Specific challenges and solutions identified by the companies are described to inform sector stakeholders of the types of obstacles faced by green SGBs and provide examples of successful pathways toward growth. The information was gathered through interviews with company founders.

The recurring success factors observed throughout the case studies include:

- 1 Funding at the early stages of business development, whether it be via support from family or friends, grants from investors, or establishing a customer base.
- 2 Product innovation, which often benefited from having access to technologies at research institutions.
- 3 Technical support and financial assistance from accelerators/incubators.

Other success factors include marketing strategies that gain significant media attention, "celebrity" marketing that helps promote products, and the existence of clear government targets to expand the market in the sector.



SGB PROFILE:

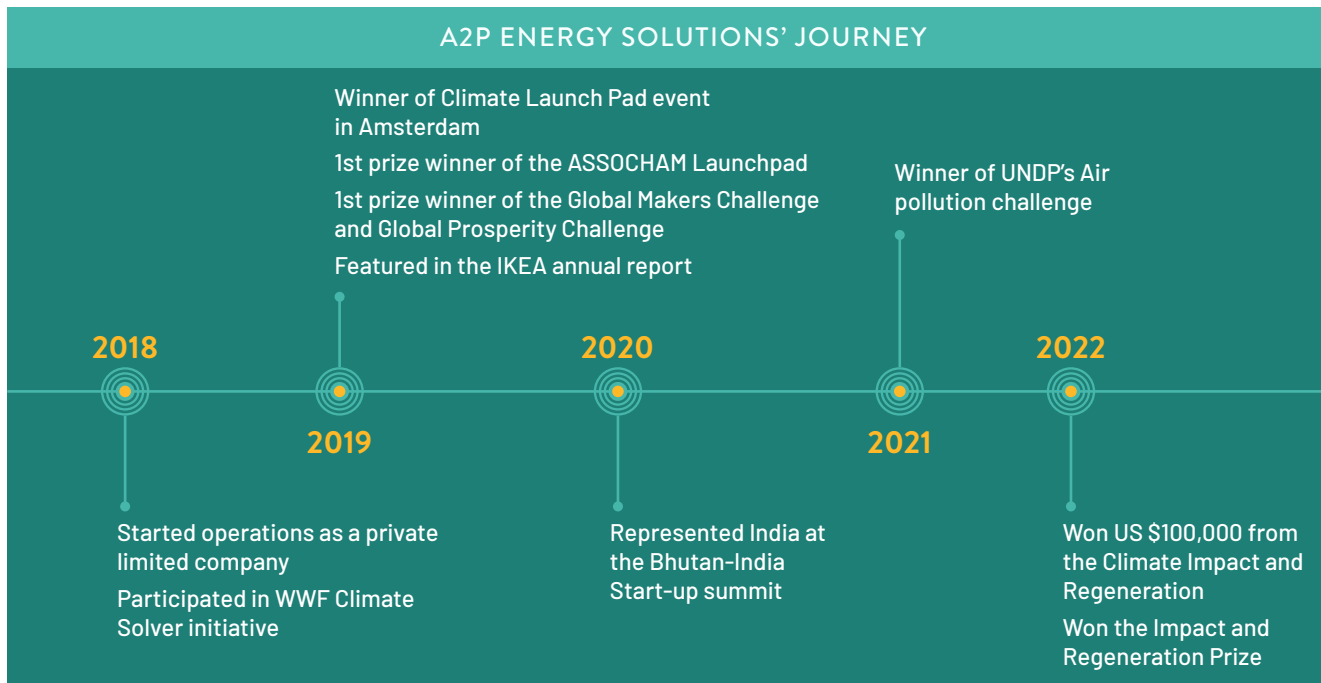
A2P Energy Solution

A2P Energy Solution contributes to resolving the open-field paddy straw burning problem by converting straw into useful energy products. The founders of A2P Energy Solution – Sukhmeet Singh and Dr Robert Berry – were inspired by their interactions with farmers about the significant business opportunity of using agricultural waste to manufacture cleaner fuels and founded their venture in 2018.



A2P Energy Solution uses crop waste, such as paddy straw, to manufacture cleaner fuels. The company uses technology to track waste biomass and then works with farmers to collect and buy the waste via farmer outreach and training on biomass management. The company sells paddy straw energy pellets, paddy straw briquettes, wood sawdust energy pellets, green coal pellets, and paddy straw.

A2P ENERGY SOLUTIONS' JOURNEY



A2P's journey has not been devoid of challenges and setbacks. Particular challenges pointed out by the founders included a lack of biofuel management experience, the high cost of operations, and a lack of funding. Incubation and acceleration support were invaluable for the founders to complement their insufficient prior management experience. The operation costs are high because no one single machine can process all different types of agri-waste. On the funding side, VC money has not been accessible to A2P as VCs prefer business models that offer early exits and high return profiles, while the break-even point on manufacturing plants is about five years. A2P was able to navigate through its early stage through grants and prize money.



Key success factors that have contributed to the growth of A2P Energy Solutions

SUCCESS FACTORS	DETAILS
Funding	<ul style="list-style-type: none"> ▶ Funding from Oglesby Charitable Trust at its initial stage helped set up a pilot scale manufacturing unit. ▶ Prize money from various challenges was used to scale up the manufacturing operations. ▶ After the manufacturing unit was established, product sales ensured consistent revenues and profitability, which were then used for scaling up, launching the green coal product, and R&D. Their current revenues as of 2022 are about US \$300,000.
Partnerships	<ul style="list-style-type: none"> ▶ Has been a part of several incubator programmes, including WWF India as a part of the Climate Solver initiative during its inception stage, which helped A2P access business advice and grant money. ▶ Has formed partnerships with key customers like Pepsico, IKEA, Unilever, and support organizations, including Cisco, World Wildlife Fund, and World Bank Group.
Favourable policies	<ul style="list-style-type: none"> ▶ The government mandated 5–10% blending of biomass pellets and briquettes with coal in thermal power plants,⁷⁶ which created a business opportunity for A2P.
Innovative Technology Platform	<ul style="list-style-type: none"> ▶ A2P leverages satellite imagery to identify crop-burning areas and connects various players (e.g., farmers, biofuel manufacturers, and buyers) in the value chain.

Every year, A2P energy replaces 12,000 tonnes of fossil fuels and prevents the emission of 36,000 kg of particulate matter. Each of A2P’s manufacturing facilities helps generate 15 permanent and 288 temporary employees per year. A2P Energy considers women an important focus group for greening impact, and currently 30% of their senior management staff are women.

76 Ramanathan, S. *Union Budget 2022-23: National biomass co-firing policy mooted by CSE in focus*. 1 February 2022. Down to Earth.

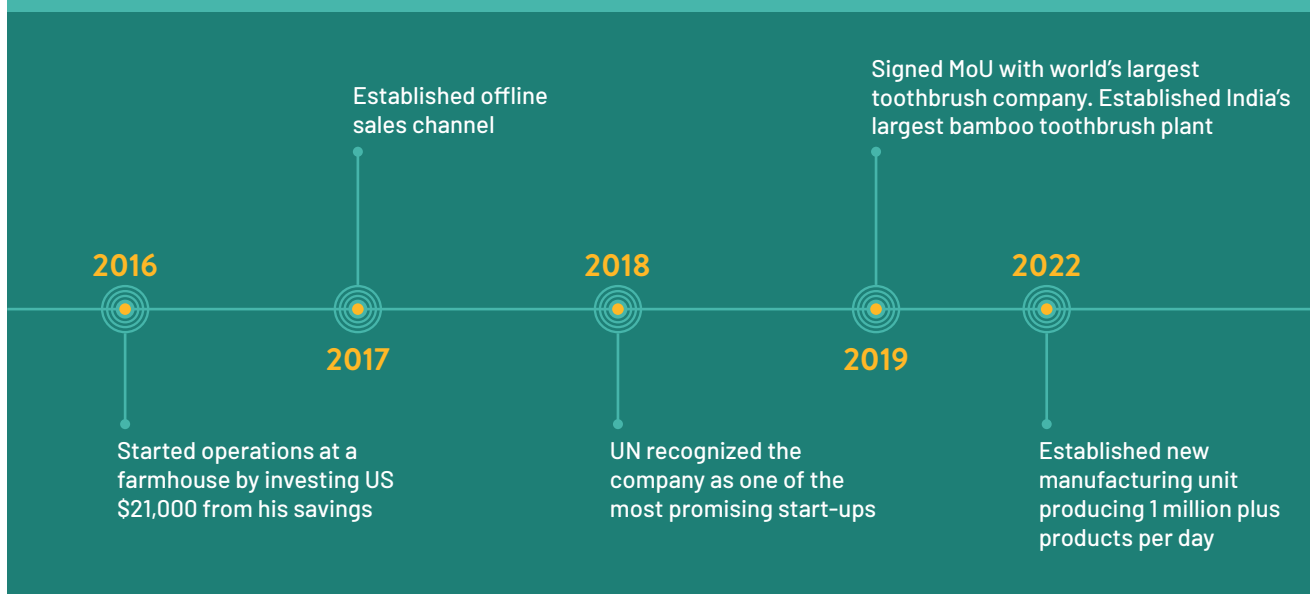


SGB PROFILE:
Bamboo India

Bamboo India makes innovative bamboo products that replace plastic products. In interacting with farmers, Yogesh Shinde – the founder of Bamboo India – realized that bamboo is an underutilized resource that can potentially be used in over 1,800 ways (e.g., food, a wood substitute, or for making buildings or handicrafts). Yogesh and his wife, Ashwini Shinde, launched Bamboo India in August 2016 at a farmhouse with ten farmers and an initial investment of US \$21,000. Over the past six years, this SGB has transformed itself into a fully integrated company, having control over different stages along the supply chain. At the time of inception, Bamboo India struggled to manufacture even 100 units of product a day, but now it produces over a million bamboo products daily. When the company started its operations, the products were manufactured manually. Now, the venture uses machinery that enables faster processing to manufacture its products.



BAMBOO INDIA'S JOURNEY



Bamboo India reported their struggles with the lack of patient capital and high competition despite the government's efforts to support start-ups through initiatives such as income tax exemption, intellectual property protection, and the Government e Marketplace (GeM) Startup Runway. Bamboo India also struggled to receive funding support from investors or commercial banks at the start-up stage as they did not have a traditional business model in India.⁷⁷ The company also had to forgo the funding worth US \$ 71,500 that they received from Shark Tank because the investor wanted returns within two years. With operations being both labour and capital-intensive, Bamboo India would have had to compromise on its core focus of sustainability and environment conservation to meet such aggressive

77 Chakraborty, R. 2017. *Not for the Income But the Outcome: Why Yogesh Shinde Quit His European Life to Start Bamboo India*. Yourstory.



targets. Lastly, their products compete directly with fast-moving consumer goods produced by companies such as Colgate and Oral B; Bamboo India's marketing budget is not as high as those of its competitors and expanding only on the basis of e-commerce has its limits. The enterprise also faces challenges with establishing effective distribution channels to reach customers across the nation.

Key success factors that have contributed to the growth of Bamboo India

SUCCESS FACTORS	DETAILS
Social Media Marketing	<ul style="list-style-type: none"> ▶ Social media platforms like Instagram and Facebook helped with targeted marketing and reaching the maximum number of customers.⁷⁸ The founder also credits social media for his TED talk invitation and the signing of an MoU with the world's largest bamboo products manufacturer.
Customer Support	<ul style="list-style-type: none"> ▶ Leverages "WhatsApp for Business" to provide customer care support. The platform is used to resolve customer pre-sales product queries, respond to customer complaints, and provide order delivery status. Having the customer support team respond to all queries helps build trust and enhance sales.
Product Innovation	<ul style="list-style-type: none"> ▶ With consistent efforts to reduce production costs, Bamboo India brought down the prices of its bamboo toothbrushes from US \$2.8 to US \$0.7. ▶ Taking customer feedback and suggestions, Bamboo India has introduced a variety of toothbrushes in the market.
Advertisement and Promotion	<ul style="list-style-type: none"> ▶ Bamboo India's work has been acknowledged by the prime minister of India, Narendra Modi. The United Nations recognised the enterprise as one of the promising start-ups in 2018, and celebrities from the film industry have also promoted the products pro-bono.
Support from Friends and Family	<ul style="list-style-type: none"> ▶ At the initial stage, the founders' friends and family pooled money to ensure the continuity of Bamboo India's business operations. ▶ The enterprise did not have enough capital to buy machinery to engrave, polish, and paint its products and relied, instead, on local workshops to give its products the finishing touch and make them market ready.

Bamboo India uses the entire bamboo plant while producing zero waste. While the enterprise produces around 500 kg of bamboo dust, it is collected with the dust collector, compressed, and turned into bamboo pellets. Bamboo leaves are used to make straws. As of 2021, the enterprise replaced more than 1.65 million kg of plastic waste. Bamboo India's social impacts are not confined to the environment, as it also provides employment to artisans in rural areas. Currently, it employs around 45 direct employees, 250 indirect employees, and more than 5,000 farmers and artisans. The enterprise also encourages women's active participation, and more than 70% of their staff are women.

78 The Better India. Agripreneur Uses Power of Social Media To Replace 16.5 Lakh Kg Plastic Waste with Bamboo ([Link](#))



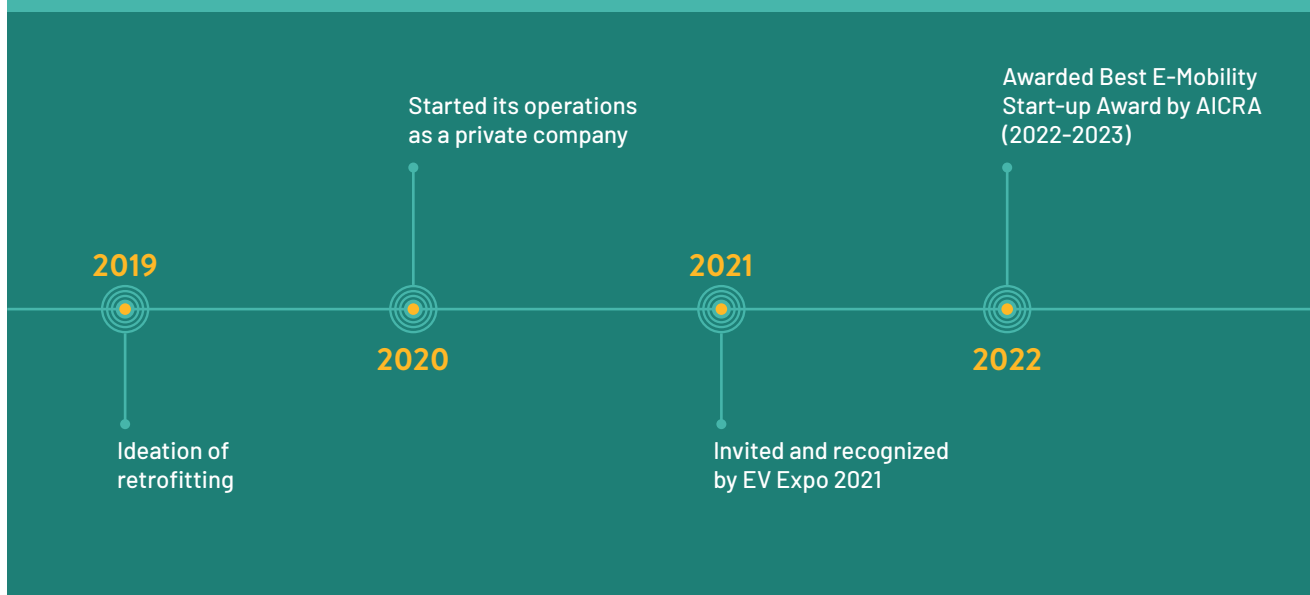
SGB PROFILE:

Tadpole

Tadpole provides affordable clean energy solutions, focusing on waste management and power efficiency at the same time, in line with their capability of “making electric vehicles without adding new vehicles on the roads.” Mr Jawaad Khan, the engineer who founded Tadpole, converted a Maruti 800 1998 model into an EV for his college project. Tadpole launched in 2020 as a privately held company. Over the past two years, the SGB has put itself onto a successful trajectory and is already earning approximately US \$1.8 million in annual revenues. The enterprise is self-funded and has just started talking with investors to scale up.



TADPOLE'S JOURNEY



Despite its rapid growth, Tadpole is facing a few challenges, including limitations in current market conditions, high operational costs, and gaps in the policy landscape. The current market conditions include the significant price disparity between EVs and internal combustion engine (ICE) vehicles⁷⁹ and insufficient charging infrastructure. Most start-ups in the EV space encounter high manufacturing and R&D expenses, supply restrictions related to the raw materials used in the battery packs (e.g., lithium, cobalt, nickel, and manganese), and poor production capacity, which all negatively impact operational costs. Lastly, the national government in India is leading the country towards electrifying mobility but needs to harmonize disparate state policies to standardize charging stations across the country and establish a dedicated department to help secure a supply chain of critical raw materials for EVs.

⁷⁹ Major roadblocks for India's electric vehicle market. 20 March 2022. Mint.



Key success factors that have contributed to the growth of Tadpole

SUCCESS FACTORS	DETAILS
Access to State-of-the-Art Machinery	▶ Tadpole launched its first vehicle as a project under Indian Institute of Technology Delhi (IIT Delhi) and Foundation for Innovation and Technology Transfer (FITT). This helped the company acquire state-of-the-art machinery for testing batteries and motors.
Advertisements in Print and Electronic Media	▶ Tadpole’s work has been publicized by major newspapers in India, such as Business Standard, Mint, and AajTak, which helped it gain more clients.
Elite Clientele	▶ The company’s technological innovations and publicity ultimately led to it having an elite list of clientele, including the Indian Army and prominent private players (e.g., Action Construction Equipment, Tenon group). It has also partnered with a coal mining company to convert heavy motor vehicles into EVs.

Tadpole contributes towards the National Electric Mobility Mission Plan (NEMMP) 2020 and the Faster Adoption and the Manufacturing of (Hybrid &) Electric Vehicles (FAME) scheme by turning vehicles that use gas into EVs. The company also contributes to the environment by planting trees under their green initiatives and runs educational initiatives like EVAC (Electric Vehicle Awareness Camp) and CSAC (Cyber Security Awareness Camp) which raise awareness about EVs and sustainability to students and stakeholders from the government and private sectors. Tadpole is also developing a new line of electric bikes, heavy duty vehicles, and earth movers. The venture is looking to hire 1,000 employees in the next three to five years and to make EVs into hydrogen vehicles.

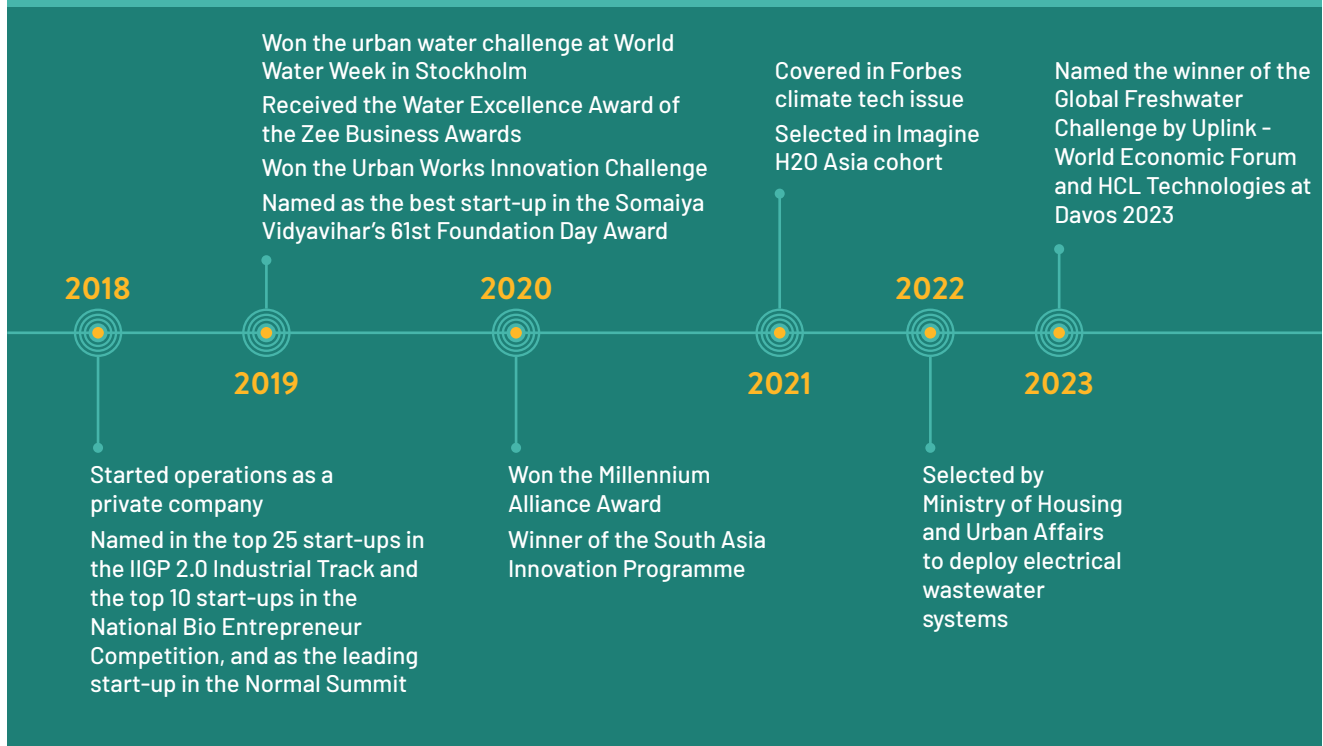


SGB PROFILE:
Indra Water

Indra Water provides economical water treatment systems for recycling domestic and industrial wastewater. Their product provides solutions to water scarcity and sustainability and is distinguishable from other chemically or biologically driven solutions that cannot handle large variations in pollutants. The idea for the venture started when its two founders, Amrit Om Nayak and Krupal Patel, were pursuing their postgraduate degrees at the University of Washington. They developed a small model to treat stormwater and subsequently made it reusable for landscaping and gardening.⁸⁰ They then conducted another pilot at a boiler plant. The duo founded Indra Water in 2018 after returning to India and have a team of 26 employees as of February 2023. They have successfully won several events and competitions, thus raising the company's profile in the waste and water space.



INDRA WATER'S JOURNEY



80 Mitter, S. [This biotech startup's wastewater treatment system can solve India's water crisis - here is how.](#) 20 November 2018. Your Story.



Despite their successes, Indra Water has faced their share of challenges due to gaps in policy, the complexities involved in working with public sector stakeholders, and the manufacturing issues related to scaling up. Firstly, the existing policies do not introduce incentives to mainstream the largely informal sector, and appropriate regulatory standards to certify or grade water treatment machinery to standardize treated water quality on intended reuse have not been put in place. The lack of adequate monitoring and quality control systems makes it difficult for clients to trust wastewater treatment products. Secondly, complexities involved in working with multiple public stakeholder entities leads to delays and increased turnaround times with project deployment. Lastly, Indra’s proprietary solution requires manufacturing unique reactors and power and reactor management system components. Producing proprietary solutions requires vendor trials and multiple process iterations to ensure consistent quality and low turnaround time, which adds another layer of complexity to scaling up the business.

Key success factors that have contributed to the growth of Indra Water

SUCCESS FACTORS	DETAILS
Funding	<ul style="list-style-type: none"> ▶ 40% of Indra water’s working capital requirement is used for research and growth-related activity, whereas the remaining 60% goes towards infrastructure, projects, inventory, and scaling-up activities, among others. ▶ About half of the working capital towards research and growth-related activities is funded by grants and soft loans. The rest is funded via equity infusion and sales. Between 2020 and 2021, Peak Sustainability Ventures, SINE ITT Bombay, RiiDL, and angel investors invested about US \$250,000 of equity in the company.⁸¹ Indra is on course to record more than US \$1million in sales in the 2022-2023 financial year to further fuel its growth trajectory.
Product Innovation	<ul style="list-style-type: none"> ▶ Indra Water’s reactor – a single integrated effluent treatment plant (ETP) module – has 60% fewer steps than traditional reactors, which helps Indra’s clients save 25% in capital expenditure (CapEx) and 40% in operating expenditure (OpEx). ▶ Modular design of the plant enables easy capacity upgrades and quick deployment. ▶ The novel structural reactors are quickly interchangeable and require minimal human expertise for maintenance.
Incubation Support	<ul style="list-style-type: none"> ▶ Incubator programmes, such as the SINE IIT Bombay, RiiDL, and Imagine H2O, were instrumental in helping the enterprise deploy and test solutions, explore new opportunities, access grants for deployment opportunities, and interact with industry experts who have helped the company in its R&D journey.

Indra Water’s products save 35% on life cycle costs and have zero chemicals. Their plants save more than 80% of space and generate at least 65% less solid sludge than other chemically or biologically driven solutions. The company has created 46 jobs (including direct and indirect jobs) and employs 20 people in its engineering and operations team, 15% of whom are women.

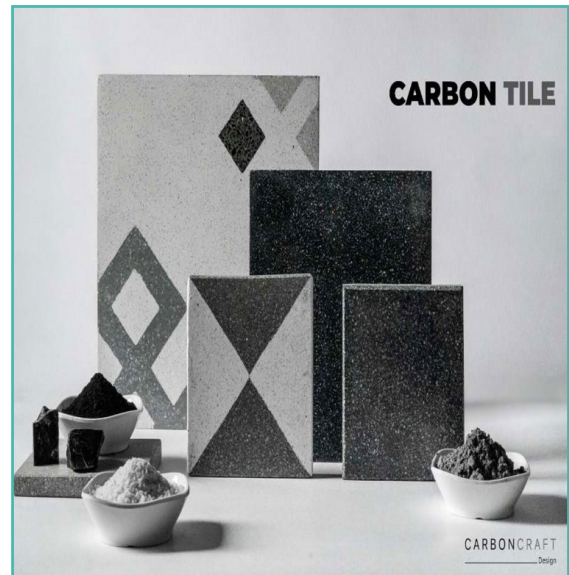
81 Routh, B. *Indra Water: Treating wastewater efficiently*. 26 May 2022. Forbes India.



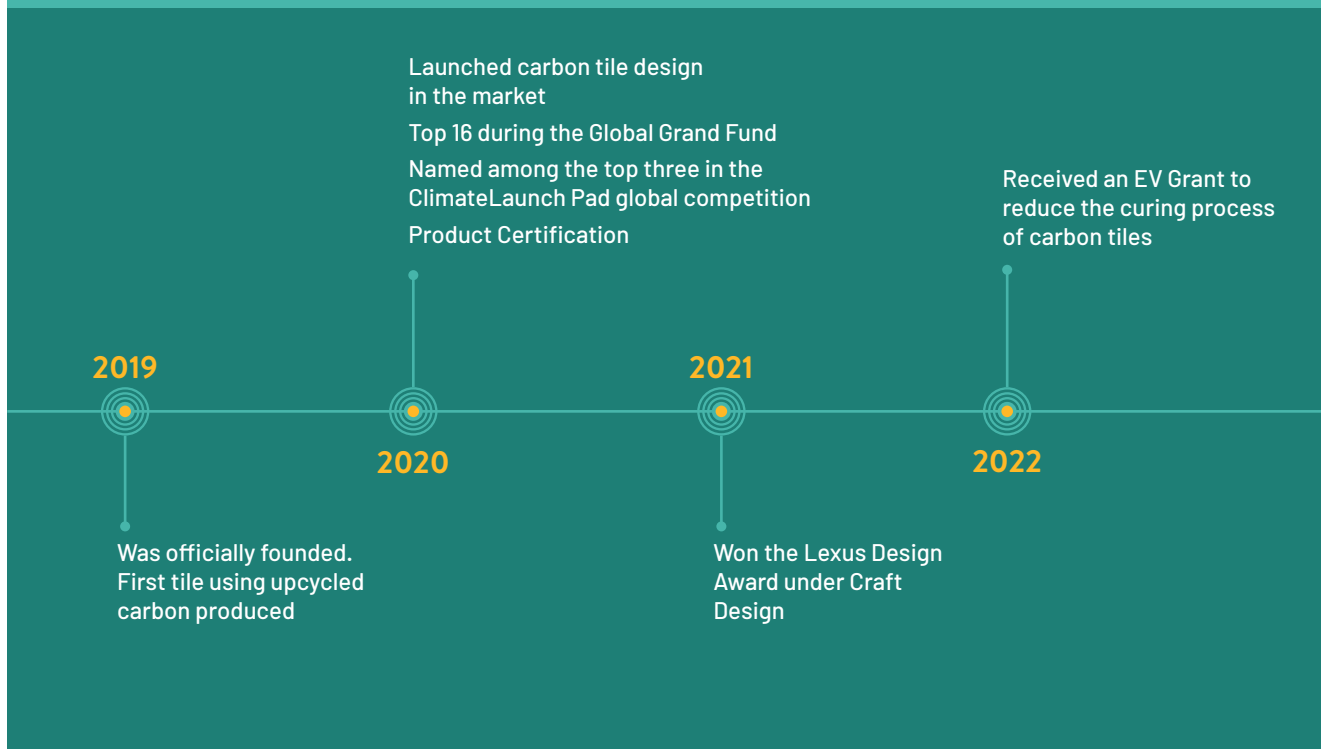
SGB PROFILE:
Carbon Craft

Carbon Craft is a Hubli⁸²-based design and material innovation start-up building architectural and interior products by converting carbon emissions into building materials. A significant number (70%) of their products are made of upcycled materials and use only 20% of the energy of mass-produced conventional tiles. The company aims to create carbon-negative homes and build a clean and healthy living experience.

Tejas Sidal, the founder of Carbon Craft, employed his background in architecture to build the first upcycled carbon tile in 2019. Then, Tejas added a design value that was lacking in the bricks to target a niche market and founded Carbon Craft in the same year.



CARBON CRAFT'S JOURNEY



Carbon Craft has been able to obtain external funding and have successfully won a competition, thus raising the company's profile in the green building space. They attribute their success to coming across with the right funding and networking opportunities. However, Carbon Craft's journey is not devoid of challenges and setbacks that are common to SGBs, which include the unavailability of funds, lack of regulations for the sector, and competition from

82 Hubli is a region in the state of Karnataka.



traditional tile makers in the market. While many start-ups take off in their initial stages with grant funding, the chances of grants coming in for the construction sector in India are slim. Additionally, India does not have an effective and comprehensive green building code that will provide credibility to a potential consumer base. Carbon Craft also competes with traditional business models in the construction sector that provide products at lower prices, such as Kajara and Somany, to name a few.

Key success factors that have contributed to the growth of Carbon Craft

SUCCESS FACTORS	DETAILS
Funding	▶ Received a grant from Emergent Ventures backed by Thiel Foundation to reduce the curing process for Carbon Craft tiles from 28 days to 6–8 hours.
Accelerator Support	▶ Has been part of five accelerator programmes (e.g., Climate-KIC Accelerator and Viridian Accelerator Centre), whereby it received support in terms of certification of products and grants in the various stages of the programmes.
High-profile clientele	▶ Customers of Carbon Craft include household names in architecture and fashion, such as Adidas (whose Mumbai store the company retrofitted in 2020).

Carbon Craft has a like-minded team of designers, architects, and engineers who are working towards innovating circular building products enabling every consumer to make an environment-conscious choice. Through the production of carbon tiles, the company intends to foster the circular economy in material supply and consumption, thus reducing carbon emissions in the air. The company has also developed a 3-stage process to upcycle recovered carbon black (rCB). Carbon Craft contributes to livelihoods by creating employment opportunities for craftspeople from rural areas of Tamil Nadu and Gujarat. The company also hires an equal percentage of men and women.



PART 2: SECTOR DEEP DIVES

Part 2 examines each green sector in detail to inform stakeholders of the support available to entrepreneurs and to identify the gaps preventing further growth. Each sector narrative aims to address the following questions:

- What are some examples of SGBs in each sector and business segment?
- What policies are in place to support entrepreneurial activities, and which policies exist in words but lag in action?
- What type of funding is available in each sector, and how big are the ticket sizes?

The sector narratives follow the structure described below:

- **Background and Business Segments:** Provides an overview of the sector globally, the India country context, a list of business segments in which SGBs are active, and examples of SGBs.
- **Policy Landscape:** Identifies national policies, strategies, and government initiatives that directly or indirectly support entrepreneurship. The policies are assessed on their likelihood to contribute to SGB growth and do not attempt to determine their effectiveness to date.
- **Funding Landscape:** Describes the funding landscape by identifying closed deals by four types of funders: DFIs, foundations, impact investors/private equity investors/venture capitalists, and commercial banks.
- **Estimated Market Opportunity (2022–2030):** Uses either a government-set target or relevant SDG indicator to estimate the gap between 2022 (i.e., baseline) and 2030 (i.e., endline) and provide a cumulative figure for the period assuming a constant growth rate to reach 2030 targets. This exercise did not account for all possible factors that affect market potential (e.g., the different infrastructure required for each sector and incentives that affect consumer behavior) and instead uses government-identified targets as proxies for possible growth to allow for comparison across sectors. Importantly, these estimates do not necessarily reflect all private sector activity in a given sector but rather only the business segments in which SGBs are active and for which a government target has been set. Details on how the market opportunity was calculated for each sector are provided in Appendix B.

Readers interested in the high-level overview of each sector can use the following links under the Sector Group column, and those who want to know more about the sector landscape in detail can go directly to the relevant sectors using the links under the sector column.





SECTOR GROUP	SECTOR
LOW-CARBON ENERGY	Energy Efficiency and Storage
	Renewable Energy
	Cleaner Fuels
LAND AND OCEAN MANAGEMENT	Sustainable Agriculture and Aquaculture
	Sustainable Forestry
	Ecotourism
TRANSPORTATION	Sustainable Transportation
WATER AND WASTE MANAGEMENT	Water Management
	Waste Management and Circular Economy
BUILT ENVIRONMENT	Green Buildings
	Disaster Management




Sector Group: Low-Carbon Energy


ENERGY EFFICIENCY AND STORAGE

KEY AREAS	BUSINESS SEGMENTS	MARKET OPPORTUNITY (2022-2030)
 Energy Efficiency (EE)	<ul style="list-style-type: none"> ✓ Energy audit service providers ✓ Energy efficient appliance providers ✓ Smart energy management providers 	US \$20.8 billion
 Energy Storage	<ul style="list-style-type: none"> ✓ Innovative battery technology manufacturers ✓ Battery recycling/re-use service providers 	US \$134.2 billion

RENEWABLE ENERGY

KEY AREAS	BUSINESS SEGMENTS	MARKET OPPORTUNITY (2022-2030)
 Solar Energy	<ul style="list-style-type: none"> ✓ Solar energy system providers ✓ Support service providers 	US \$29.3 billion

CLEANER FUELS

KEY AREAS	BUSINESS SEGMENTS	MARKET OPPORTUNITY (2022-2030)
 Biofuel	<ul style="list-style-type: none"> ✓ Biogas ✓ Bioethanol ✓ Biodiesel ✓ Briquettes and pellets 	US \$182.6 billion



Energy Efficiency and Storage

► BACKGROUND AND BUSINESS SEGMENTS

ENERGY EFFICIENCY (EE)

Background: Energy efficiency (EE) refers to processes that use a reduced amount of energy to provide products, services, or amenities. Improving energy efficiency is one of the most cost-effective and environmentally safe ways of achieving economic growth. At a global level, energy efficiency measures (from 2012 to 2017) helped lower greenhouse gas emissions by 12% to about 32.5 gigatonnes of CO₂ equivalent.⁸³ The International Energy Agency (IEA) estimates that adoption of energy efficiency as the first choice could lead to a US \$18 trillion economic increase globally by 2035.⁸⁴ In addition to reducing emissions, other benefits of energy efficiency mentioned by the IEA include employment creation, reduced pollution, industrial productivity, and improvements in human health.

Indian context: An increasing demand for energy and high volatility in prices of coal, gas, and oil pose a threat to India's energy security. To overcome this threat, the country has adopted a two-pronged approach (i.e., improving the energy intensity of the economy and enhancing the share of renewable energy in power generation). India's energy consumption, including primary energy sources (e.g., natural gas and renewable energy) and secondary energy sources (e.g., electricity), increased by 50% between 2007 and 2017⁸⁵ along with its population and GDP growth.⁸⁶ Should energy consumption in India continue on its current trajectory, a growing imbalance between supply and demand may develop. Increasing generation capacity often requires large investments and has a long gestation period, while enhancing energy efficiency provides an attractive solution for meeting the ever-rising demand for energy without sacrificing economic growth.

India adopted ambitious climate targets through its updated NDC at the Conference Of Parties (COP) 26, aiming to achieve 500 GW of non-fossil-fuel-based energy generation and reduce total projected carbon emissions by 1 billion tonnes by 2030.⁸⁷ Since 2010, energy efficiency improvements in India have abated 12% of additional energy use in 2018.⁸⁸ In 2018, a quarter of India's total energy use was regulated through energy efficiency mandates.⁸⁹

Business segments: The primary EE business segments among Indian SGBs include *energy audit service providers*, *energy efficient appliance providers*, and *smart energy management providers*.

83 [Emissions savings – Multiple Benefits of Energy Efficiency – Analysis](#). IEA. Accessed 30 September 2022.

84 IEA. 2013. [Capturing the Multiple Benefits of Energy Efficiency](#).

85 IEA. 2021. [E4 Country Profile: Energy Efficiency in India](#).

86 Ramakrishna, G. and Rena, R. 2013. [An Empirical Analysis of Energy Consumption and Economic Growth in India: Are They Causally Related?](#) *Studia Oeconomica*.

87 Modi, N. 2021. [National Statement by Prime Minister Shri Narendra Modi at COP26 Summit in Glasgow](#), PIB.

88 IEA. 2021. [E4 Country Profile: Energy Efficiency in India](#). Accessed Sept 14 2022.

89 Ibid.


Table 4: Business segment and examples of SGBs in energy efficiency

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Energy audit services	Measure electricity consumption and assess inefficiencies and leakages in energy systems.	<ul style="list-style-type: none"> ▶ PGS Energy Services ▶ SustLabs
Energy efficient appliance providers	Manufacture products and equipment that minimize energy consumption, such as LED lighting systems, waste heat recovery systems, and efficient cooling systems.	<ul style="list-style-type: none"> ▶ Promethean Energy ▶ Smart Joules
Smart energy management providers	Offer technologies and software that improve efficiency in energy consumption for buildings, industries, households, etc. as well as technology solutions for managing or monitoring real-time energy consumption, such as smart sensors, smart grids, energy-saving air conditioners, and washing machines.	<ul style="list-style-type: none"> ▶ Minion Labs ▶ Smart Joules

ENERGY STORAGE

Background: Energy storage refers to capturing the energy produced at a given point for later use to reduce imbalances between energy demand and energy production.⁹⁰ For instance, electricity storage devices help to optimize power consumption during peak load when demand is greatest. Pumped hydro, capacitors, accumulators, and compressed air energy are the most commonly used energy storage devices. There are also emerging energy storage technologies, such as battery energy storage systems (BESS), which store additional energy when price and/or demand is low and then release it back to the grid when price/demand is high. In 2020, global battery storage capacity additions rose to a record high of five gigawatts (GW), up by 50% compared to 2019.⁹¹ To meet the net zero by 2050 scenario, about 600 GW of battery storage capacity will need to be added by 2030 globally.⁹²

Lithium-ion batteries (LIBs) are one of the most prominent technologies in this field. Thanks to recent innovations that have reduced the cost of the technology (LIB prices fell by about 80% between 2010 and 2017),⁹³ it is expected to capture the majority of energy storage growth in markets across the globe by the next decade.⁹⁴ In particular, the LIB market is driven by expanding EV markets and related economies of scale in battery manufacturing.

Indian context: Growth in renewable energy and EV markets will propel the growth of the battery storage market. The two main technologies used for energy storage solutions are lead acid batteries (LAB) and lithium-ion batteries (LIB), with market sizes of about 456 GWh and 476 GWh in 2021, respectively.⁹⁵ The country presents a market growth prospect for LIBs and advanced chemistry cell (ACC) batteries.⁹⁶

The demand for energy storage is rapidly growing in India, and the government has launched programmes like The National Programme on Advanced Chemistry Cell (ACC) Battery Storage to establish manufacturing capability in the energy storage space. Currently, three companies (Reliance, Ola Electric Mobility, and Rajesh Exports Limited) are

90 NITI Aayog and Green Growth Equity Fund Technical Cooperation Facility. 2022. [Advanced Chemistry Cell Battery Reuse and Recycling Market in India](#).

91 [Grid-Scale Storage](#). 2022. IAE.

92 Ibid.

93 [Global Energy Storage](#). Deloitte. Accessed 9 March 2023.

94 [Grid-Scale Storage](#). 2022. IAE.

95 NITI Aayog and Green Growth Equity Fund Technical Cooperation Facility. 2022. [Advanced Chemistry Cell Battery Reuse and Recycling Market in India](#)

96 NITI Aayog. 2022. [Need for Advanced Chemistry Cell Storage in India](#).



under contract under the national programme;⁹⁷ all the contracted companies are larger than the SGB range, which reflects the state of the industry. SGBs in the energy storage space face challenges with regard to funding, although some private investors are supporting SGBs.

Business segments with SGB activities include *battery recycling/re-use service providers* and *innovative battery technology manufacturers*.

Table 5: Business segments and examples of SGBs in energy storage

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Battery re-use service providers	Help to reduce the number of batteries being disposed of as municipal solid waste by recycling or repurposing old batteries for reusable energy storage.	► Nunam
Innovative battery technology manufacturers	Offer technologies that are greener than the traditionally used lead acid and lithium-ion batteries. Examples of such technologies include zinc gel batteries, sodium-ion batteries etc.	► Offgrid Energy Labs

► POLICY LANDSCAPE

Although the battery manufacturing ecosystem in India remains at a nascent stage of development,⁹⁸ the policy landscape in India is favourable for the growth of entrepreneurial activity in the energy efficiency and storage sector. The government promotes the production of both energy efficient appliances and batteries within the country, which creates opportunities for business entities (including SGBs) that operate in this sector. For energy storage, there is expected growth in LIBs and other emerging advanced chemistry cells markets in India. However, a strong policy push for green energy technologies has created enormous potential for large-scale battery manufacturers instead of SGBs.

The government has taken four main initiatives under the National Mission for Enhanced Energy Efficiency, which it describes as follows:⁹⁹

- **“Perform Achieve and Trade Scheme (PAT)**, a market based mechanism to enhance the cost effectiveness in improving the Energy Efficiency in Energy Intensive industries through certification of energy saving which can be traded.”
- **“Market Transformation for Energy Efficiency (MTEE)** aims to accelerate the shift to energy-efficient appliances in designated sectors. The government launched two programmes under this scheme, namely Bachat Lamp Yojana and Super-Efficient Equipment Program (SEEP).”
- **“Energy Efficiency Financing Platform (EEFP)** aims to create mechanisms that would help finance energy efficiency programmes. The Government has signed MoUs with financial institutions to work together for the development of the energy efficiency market and for the identification of issues related to this market development.”
- **“Framework for Energy Efficient Economic Development (FEEED)** aims to develop fiscal instruments to promote

97 [Three Companies Signed Program Agreement under \(PLI\) Scheme for Advanced Chemistry Cell Storage in India](#). 29 July 2022. PIB.

98 NITI Aayog. 2022. [Need for Advanced Chemistry Cell Storage in India](#).

99 [National Mission for Enhanced Energy Efficiency](#). 10 August 2021. PIB.



energy efficiency. Under this initiative, two funds have been created viz. Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE) and Venture Capital Fund for Energy Efficiency (VCFEE).”

Table 6: Key policies and strategies for Indian energy efficiency and storage

POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
National Mission for Enhanced Energy Efficiency	Aims to strengthen the market for energy efficiency by creating a favourable regulatory and policy environment. Consisting of four main initiatives, one being the Market Transformation for Energy Efficiency (MTEE), which provides business-focused incentives and programmes to accelerate a shift to energy efficiency.	Has created opportunities for the growth of SGBs through its new programming initiatives, for example, SGBs involved in the energy efficient fans space.
National Programme on Advanced Chemistry Cell (ACC) Battery Storage	Aims to ensure greater domestic production of ACC batteries while also ensuring that the levelized cost of battery manufacturing in India is globally competitive.	To date, three companies have been allocated manufacturing tenders under this programme. ¹⁰⁰ All three are much larger than the SGB range.
Standards and Labelling Programme	Launched in 2006 by the Bureau of Energy Efficiency to provide consumers with informed choices about the energy saving, and thereby the cost saving, potential of the relevant marketed products.	This scheme has given impetus to manufacturers (including SGBs) to switch to such appliances through its cost saving incentives. The challenges faced by start-ups under this scheme are finance barriers and lack of resources for designing and testing appliances for these new products.
Unlocking National Energy Efficiency Potential (UNNATEE)	Lays a plain framework and implementation strategy to establish a clear linkage between energy demand scenarios and energy efficiency opportunities in order to conceptualize a comprehensive roadmap to address India’s environmental and climate change commitments. Such an exhaustive exercise is the first of its kind, clearly delineating the energy savings targets for each state in their respective sectors.	No specific provisions for private sector (including SGBs).

► FUNDING LANDSCAPE

The funding landscape of the EE and energy storage sector is dominated by DFIs, including the World Bank, GIZ, and the Japan International Cooperation Agency (JICA). Private sector engagement in the EE and storage space is limited and still in its nascent stages in India.

- **DFIs** support the sector. In 2018, The World Bank committed US \$600 million for the India Energy Efficiency Scale-up Program for a period of four years, which aims to scale up energy savings in residential and public sectors, strengthen the agency’s institutional capacity, and enhance its access to commercial financing. The implementing agency for this programme is the Energy Efficiency Services Limited (EESL). The GIZ is also promoting energy-

¹⁰⁰ [Three Companies Signed Program Agreement under \(PLI\) Scheme for Advanced Chemistry Cell Storage in India](#). 29 July 2022. PIB. The three companies were Reliance New Energy Limited, Ola Electric Mobility Private Limited, and Rajesh Exports Limited.



efficient cooling (EE-Cool) in India. This technical assistance programme will operate over a three-year period and will be implemented by the BEE. The Indian Government has come up with the India Cooling Action Plan (ICAP). The plan identifies necessary actions to take over a 20-year span that will result in access to sustainable cooling across the country.¹⁰¹ The ultimate goal of the programme is to reduce the direct and indirect GHG emissions caused by cooling systems. In 2017, KfW (on behalf of BMZ) signed a loan agreement worth US \$200 million with EESL to be invested in EE measures for private households, public buildings, street lights (LED technology), water supply systems, agriculture (pump replacement), and industry. EESL also provides non-financial support to help customers save energy. UNIDO, the Global Environment Facility (GEF), and the Bureau of Energy Efficiency (BEE) established the Facility for Low Carbon Technology Deployment. The facility aims to promote start-ups working in the low-carbon energy space including energy efficiency and energy storage. The project has a target to identify 120 innovations for technology validation and commercialize 40 innovations. Winners may receive funds up to US \$50,000 to take steps toward commercialization, including product validation and performance testing.

- **Impacting investing** is limited in the energy-efficiency space. The enterprises in this sector have not achieved scale and, hence, are not a great proposition for private investment.¹⁰² An exception is [Minion Labs](#), an SGB specializing in providing real-time insights into the energy consumption of electric appliances through its energy monitoring device, raised an undisclosed amount from Indian Angel Network.¹⁰³
- **Commercial banks** extend some support to the sector. For example, the State Bank of India (SBI) has signed a loan agreement with KfW of about US \$277 million to establish an energy-efficient housing programme in India, which aims to increase access to finance for both builders and buyers of energy-efficient residential buildings.¹⁰⁴
- **Foundations**, such as the MacArthur Foundation support research in the energy-efficiency space in India by tracking the progress of energy efficiency programs in India.¹⁰⁵

In contrast, investment in energy storage remains in a nascent stage. Energy storage is an upcoming business area in India, and the government is trying to expand manufacturing capacity in the area through its production linked incentive scheme. However, this key area faces challenges with regard to funding. DFIs are not currently very active in the battery storage space. Investors' lack of familiarity with technologies in this space is an impediment to their adoption. However, there are notable exceptions, such as the Asian Development Bank, which offers a technical assistance project to enhance adoption of EVs and grid integration of battery energy storage systems.¹⁰⁶ Some VC activity to support SGBs, albeit limited, is also witnessed. The limited track record of commercial deployment of such technologies dissuades investors from investing in them and related initiatives. Despite these challenges, there are some startups that have raised funding; for example, [Indi Energy](#) has raised seed funding (amount undisclosed) from investors such as the Mumbai Angels Network.

► MARKET OPPORTUNITY (2022 – 2030)

This report estimates a market opportunity for energy efficiency and storage of US \$108.9 billion between 2022 and

101 TERI SAS. 2020. [ReEnergize: Vasundhara Magazine Issue 4](#).

102 Insight from primary discussion with Greenfunder.

103 Avurpa, P. [Funding alert] [Indian Angel Network invests in Bengaluru-based startup MinionLabs](#). 27 February 2020. Your Story.

104 [SBI, KfW sign \\$277 mn agreement for energy-efficient housing programme](#). 16 December 2019. Business Standard.

105 [Shakti Sustainable Energy Foundation](#). MacArthur Foundation. Accessed 19 October 2022.

106 Asian Development Bank. 2021. [Promoting Clean Energy Usage through Enhanced Adoption of Electric Vehicles and Grid Integration of Battery Energy Storage Systems: Technical Assistance Report](#).



2030, composed of US \$20.8 billion from energy efficiency and US \$88.1 billion from energy storage. The methodology used to calculate the market opportunity leverages the government-set targets based approach on the assumption that government policies or strategies are key indicators of business activity in a sector. The market opportunity was calculated in terms of the fuel cost savings for the energy efficiency key area and battery packs to meet the battery storage demand for the energy storage key area. The market size for the energy storage key area does not include innovative technologies and battery re-use that have been identified as business segments, as their relevant targets do not exist because the market is still in its emerging stage.

Renewable Energy

► BACKGROUND AND BUSINESS SEGMENTS

Background: Renewable energy is defined as “energy derived from natural processes and replenished at a faster rate than it is consumed.”¹⁰⁷ According to the International Renewable Energy Agency, renewable energy sources include bioenergy, geothermal energy, hydropower, ocean energy, solar energy, and onshore and offshore wind energy.¹⁰⁸ Tides, waves, and currents can be harnessed for electricity generation, but the technologies are still in the research and development stage and are yet to witness commercial deployment.

Globally, there is a concerted effort to increase the share of renewable energy sources in the overall energy mix. According to IEA, the share of renewable energy sources in global electricity generation increased from 27% in 2019 to 29% in 2020.¹⁰⁹ The increase was mainly driven by a shift to solar photovoltaic (PV) and wind power, which increased from 8% to 9% between 2019 and 2020.¹¹⁰ However, as per IEA estimates, the share of renewable power in global electricity generation would have to increase to 60% by 2030 to meet the net zero emissions by 2050 scenario.¹¹¹ Electricity from renewable energy can potentially power 65% of the world’s total supply and decarbonize up to 90% of the power sector by 2030 and 2050, respectively.¹¹²

Indian Context: Electricity is India’s largest GHG-emitting sector, accounting for 34% of total emissions (including land use change and forestry) in 2016–17.¹¹³ Decreasing the GHG emissions by this sector is important to achieve the net zero by 2070 target adopted by the Indian government. Currently, electricity generation plants in India largely depend on coal as a fuel. In 2019–20, 72% of the total electricity generated in India came from coal-based plants.¹¹⁴ Thus, there is a strong policy push in favour of electricity generation from renewable sources in the country. Coal continues to account for the majority of Indian electricity supply.

In the last eight years, India’s renewable energy capacity has nearly doubled and solar energy increased 18-fold, making it one of the fastest-growing markets globally.¹¹⁵ As of July 2022, India has installed a wind power capacity

107 [About Renewable Energy](#). Government of Canada. Accessed 12 December 2022.

108 IRENA. 2019. [Renewable Energy and Jobs – Annual Review 2019](#).

109 IEA. 2021. [Renewables: Global Energy Review 2021](#).

110 IAE. 2020. [Renewables: Global Energy Review 2020](#).

111 Ibid.

112 [Renewable Energy - Powering a Safer Future | United Nations](#). United Nations. Accessed 11 October 2022.

113 NITI Aayog and Rocky Mountain Institute. 2020. [Towards a Clean Energy Economy: Post-Covid-19 Opportunities for India’s Energy and Mobility Sectors](#).

114 Ibid.

115 [India Has Achieved Its NDC Target with Total Non-fossil Based Installed Energy Capacity of 157.32 GW Which is 40.1% of the Total Installed Electricity Capacity](#). 28 December 2021. PIB.



of about 40,893 MW and solar power capacity of about 57,974 MW.¹¹⁶ Further, the Indian government has pledged to reach a non-fossil fuel energy capacity of 500 GW by 2030. The government aims to meet 50% of its energy requirements from renewable energy by 2030.¹¹⁷ As of December 2021, the total installed renewable energy capacity was 150.54 GW and solar power capacity was 48.55 GW.¹¹⁸

Overall, the industry, as it currently functions, is not very conducive to the growth of SGBs, and start-ups of much larger dimensions (higher than the SGB threshold) thrive in the sector. Smaller businesses do operate in segments such as rooftop solar services and support services. Hence, the following sections focus on solar energy.

SOLAR ENERGY

Indian Context: The state of energy access has improved significantly in India, with the achievement of 99.4% electrification. However, the country is yet to attain uninterrupted power supply in many areas, and many households still lack consistent access.¹¹⁹ The bottleneck now remains in providing uninterrupted and inexpensive power to the masses. With the population's growing appetite and need for energy, the market is shifting away from basic energy access products such as solar lanterns towards mini or microgrids. The primary reason behind this shift is to provide a more stable energy supply to the public now that the country has achieved universal access to electricity.

Business segments: The SGBs under the solar energy key area are involved in the provision of solar energy products and support services, categorized under business segments *solar energy system providers (RTS, mini-grids, etc.)* and *support service providers*. Business segments identified but excluded from the analysis due to a lack of SGB activities include solar consumer product providers (SHS, solar lanterns, etc.), solar component providers (solar photovoltaics, solar chips, etc.), and utility scale solar plants.

Table 7: Business segments and examples of SGBs in solar energy

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Solar energy system providers	Includes SGBs that assemble (and sometimes distribute) different components to create a functional system that generates electricity. SGBs in this segment may include system integrators, assemblers, engineering, procurement and construction (EPC) service providers, and mini-grid / micro-grid assemblers.	<ul style="list-style-type: none"> ▶ Oorjan ▶ Safearth
Support service providers	Includes SGBs that provide services that enable the uptake of solar power, including distributors, retailers, financiers of solar products as well as solar market places, cleaning services providers, etc.	<ul style="list-style-type: none"> ▶ Enray Solar ▶ Sunday Grids

► POLICY LANDSCAPE

The overall policy landscape for the renewable energy sector is favourable in India. The government has launched numerous schemes to the benefit of SGBs in this space. The government's policies focus more heavily on solar energy compared to other sources of renewable energy such as bioenergy, wind energy, and hydropower, among others.

116 MNRE || [Physical Progress](#). Ministry of New and Renewable Energy. Accessed 5 September 2022.

117 Modi, N. 2021. [National Statement by Prime Minister Shri Narendra Modi at COP26 Summit in Glasgow](#), PIB.

118 Ibid.

119 Mohammed, N. and Srivas, A. [Modi Announces 100% Electrification – But That Doesn't Mean Everyone Has Power](#). 29 April 2019. [The Wire](#). The government deems a village "electrified" if power cables from the grid reach a transformer in each village and 10% of its households, as well as public places such as schools and health centres, are connected.



However, the funding landscape is largely inclined towards large-scale businesses. These businesses are the ones that had taken off more than a decade ago when the industry started receiving government support. Most of the early movers are now high-growth enterprises.

Table 8: Key policies and strategies for Indian renewable energy

POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
Jawaharlal Nehru National Solar Mission (JNNSM)	Launched in 2010 as a part of the NAPCC with the aim of promoting electricity generation from solar power. It has been revised twice since its inception. The current target under this mission is to achieve 100 GW of solar power by 2022.	The mission creates a provision to support start-ups (including SGBs) and aims to partner with incubation centres that are being run in academic institutions across the country through mentoring, networking, and financial support. ¹²⁰
Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM)	Aims to provide energy and water security, de-dieselize the farm sector, and generate additional income for farmers by producing solar power. ¹²¹	This scheme creates opportunities for SGBs by promoting decentralized grid connected solar power plants but does not have any specific provisions to support SGBs.
Rooftop Solar programme Phase-II	Aims to accelerate the deployment of rooftop solar capacity, with a target installation capacity of 40 GW by 2022. The scheme provides for financial assistance for installations of up to 4 GW of solar rooftop capacity in the residential sector. It also provides incentives to distribution companies to promote incremental achievements over the previous year's progress. Further, it mandates the use of domestically manufactured solar cells and modules. This provision provides a push to solar cell and module manufacturing capacity in India. The government pays 30% of the benchmark cost of installing solar rooftop systems. This subsidy is intended to promote the uptake of rooftop solar in the country.	This scheme has created significant opportunities for SGBs that provide solar rooftop solutions, the mainstay of SGB activity within the solar electricity key area. However, SGBs operating in this space still face challenges regarding high upfront costs and the lack of: <ul style="list-style-type: none"> ▶ Awareness among consumers about the system ▶ Manufacturing facilities ▶ A skilled workforce for the provision of post-sale services ▶ Business models that are sustainable
Solar Parks Scheme	Under this scheme, the government promotes the setting up of large-scale solar electricity generation projects with the goal of achieving solar capacity of about 40 GW by 2022.	This scheme is not applicable to SGBs as business entities that are involved in large-scale solar power generation are larger than the SGB threshold.

▶ FUNDING LANDSCAPE

The renewable energy sector witnesses active participation from both the private and the public sectors. Venture capital funds, private equity funds, and private banks play a prominent role in the renewable energy space. Between January 2020 and March 2020, private equity-venture capital (PE-VC) companies spent US \$5.9 billion across 164

¹²⁰ Jawaharlal Nehru National Solar Mission. N.D. [Towards Building SOLAR INDIA](#). Accessed Oct 10 2022.

¹²¹ This scheme aims to create solar capacity of 30.8 GW with central financial support of about US \$4.2 billion. To provide further impetus to business activity under this key area, the Reserve Bank of India (RBI) has included these three components under priority sector lending guidelines. This step is helpful in creating and easing access to finance for initiatives under this scheme. About 5,000 MW capacity of small solar power plants under component-A, 360,000 standalone solar pumps under component-B and solarization of over 1 million grid connected pumps under the two variants of component-C have been allocated across India.



transactions in India.¹²² The growth in this sector is supported by domestic and global capital, both in the form of debt and equity.¹²³ As of 2018, about 32 VC and PE funds were active in this space.¹²⁴ Green bonds are also an important source of funding for renewable energy projects in India.¹²⁵ The total amount of green bonds issued between 2017 and 2021 is about US \$15 billion.¹²⁶ DFIs and foundations are also active in the solar sector. They have funded projects in rooftop solar, mini-grids, and utility-scale solar domains.

- **DFIs**, such as the World Bank, IFC, and British International Investment (BII) provide much of the funding for solar power. Through the State Bank of India, the World Bank has committed US \$165 million to finance the Rooftop Solar Program for the residential sector in 2022.¹²⁷ In 2019, the World Bank approved US \$150 million for the India-Innovation in Solar Power and Hybrid Technologies.¹²⁸ The project primarily focuses on demonstrating the operational and economic feasibility of utility-scale innovative renewable energy technologies and battery energy storage solutions. It also aims to build institutional capacity and support scaling technologies on a commercial basis.¹²⁹ In March 2021, the US Agency for International Development (USAID) and the US International Development Finance Corporation (DFC) deployed a US \$41 million loan guarantee programme to bolster Indian SME investments in renewable energy solutions, such as rooftop solar installation.¹³⁰
- **VCs and impact investors** are also active in the sector. In 2017, [Oorjan Cleantech Private Limited](#), a Mumbai-based rooftop solar platform, received seed funding worth US \$450,000 from Globeveestor.¹³¹ Ashv Finance provided approximately US \$120,000 to [Devidayal Solar Solutions Pvt. Ltd](#) to help them provide solar refrigerators to micro and small businesses.¹³²
- **National, state, and private banks** in India offer solar schemes.¹³³ Examples of banks financing solar include the State Bank of India (SBI), Bank of Maharashtra, Saraswat Bank, Canara Bank and the Central Bank of India. The banks provide debt finance to various types of solar projects.¹³⁴ In 2022, SBI in collaboration with Tata Power Solar System launched a dedicated centralized processing cell: Surya Shakti Cell.¹³⁵ The purpose of this step was to provide funding to SMEs involved in the installation of solar rooftops. The loan amount was capped at about US \$500,000 with up to ten years repayment.¹³⁶ As of March 2021, SBI has invested US \$4.26 billion for 752 renewable energy projects, including US \$2.48 billion for solar photovoltaic ground-mounted projects and about US \$249 million for rooftop solar projects.¹³⁷

122 Nagriya, S. [The contribution of VC funding towards renewable energy projects: a sneak peak - iPleaders](#). 16 May 2021. iPleaders.

123 Saboo, A. and Srivastava, S. 2022. [Renewable Energy Financing Landscape in India: The Journey So Far and the Need of the Hour](#). IEEFA.

124 Sarangi, G. [Green Energy Finance in India: Challenges and Solutions](#). ADB Institute.

125 [Winds of Change](#). India Exim Bank. Accessed 31 August 2022.

126 Rathore, M. 2022. [Volume of Green Bond Issuance in India from Financial Year 2017 to 2021](#). Statista.

127 [Additional Financing: Rooftop Solar Program for Residential sector](#) World Bank. Accessed 30 August, 2022.

128 [India: Innovation in Solar Power and Hybrid Technologies](#). World Bank. Accessed 30 August 2022.

129 Ibid.

130 [USAID and DFC Announce \\$41M Loan Guarantee Program to Finance Rooftop Solar](#). USAID. Accessed 30 August 2022.

131 Singh, A. [VC Circle, Rooftop Startup Oorjan Raises \\$450K Led by Globevestor](#). 5 October 2017. VC Circle.

132 CLEAN. 2021. [State of the Decentralized Renewable Energy Sector in India - Insights from CLEAN](#).

133 Chandra, N. 2021. [Rooftop Solar Loan in Delhi, India](#). Loom Solar. Accessed 30 August 2022.

134 First Green Consulting. [Different Financing Options in India for Solar Energy Projects Funding](#). First Green Consulting. Accessed 30 August 2022.

135 [SBI Launches Surya Shakti Cell; Partners with Tata for Solar Projects Financing](#). Mint. 31 January 2022.

136 [Surya Shakti - Solar Finance](#). SBI. Accessed 30 August 2022.

137 Nair, R. [SBI Has Provided Rs 319.28 billion in renewable energy project finance as of FY 2021](#). 9 July 2021. Mercom.



- **Foundations** such as the MacArthur Foundation, Rockefeller Foundation, and SELCO Foundation support the deployment of solar power in the country. The MacArthur Foundation has supported financial institutions that specialize in developing and scaling financing solutions for commercial solar rooftops, specifically targeting MSMEs.¹³⁸ SELCO Foundation has provided grants to [SNL Energy Solutions](#) to build a model village using solar technology, and Envo Renewable Energy Services Pvt. Ltd to offer temperature-controlled carts to daily vendors.¹³⁹

▶ MARKET OPPORTUNITY (2022 – 2030)

The market opportunity for the renewable energy sector – specifically rooftop solar (RTS) – in India between 2022 and 2033 is estimated to be **US \$29.3 billion**. The estimation focuses on RTS because the SGB activities in other business segments, including the solar industry outside of the RTS domain and other renewable energy industries, are limited.¹⁴⁰ The approach taken to approximate the market opportunity is based on the government-set targets for the business segment (i.e., 65.66 GW).

Cleaner Fuels

▶ BACKGROUND AND BUSINESS SEGMENTS

Background: There is no universally agreed upon definition of “clean” fuels, and the term cleaner fuels has different connotations as per different organizations. Synthesizing the definitions used by the World Health Organization (WHO), the United States Environmental Protection Agency (EPA), the United Nations Environment Program (UNEP), and the Union of Concerned Scientists, cleaner fuels can be defined as fuels that emit lower levels of greenhouse gases and pollutants relative to conventional gasoline and are derived from renewable energy sources. While nonrenewable energy sources, such as liquefied petroleum gas (LPG) and compressed natural gas (CNG), also fall under the category of cleaner fuels according to that definition, this report only focuses on those that are derived from renewable energy sources (e.g., biofuels).

Cleaner fuels contribute to climate change mitigation since they emit lower levels of greenhouse gases and pollutants. Biofuels help maintain the carbon cycle in the environment, both during production and when used. For example, biodiesel, a biofuel used for transportation, restores the natural atmospheric balance of carbon dioxide (CO₂). During production, the plant-based feedstocks used to make biofuels absorb CO₂ from the atmosphere. This recapture of CO₂ by the feedstocks offsets much of what is released when biofuels are used, thus closing the loop.¹⁴¹ Similarly, green hydrogen, which is made through the electrolysis of water using renewable electricity, emits only water vapour and warm air.

Indian Context: India is highly dependent on coal and crude oil for its primary energy supply¹⁴² and ranks as “the world’s third largest oil importing and consuming nation behind the US and China.”¹⁴³ The transport sector accounts for 10.2% of the country’s energy consumption,¹⁴⁴ and most of the energy in that sector is used in the form of diesel or petrol with some dependence on CNG.

138 [Financing Solar Power in India](#). 3 July 2019. MacArthur Foundation.

139 CLEAN. 2021. [State of the Decentralized Renewable Energy Sector in India – Insights from CLEAN](#).

140 Utility-scale solar plants and off-grid solutions are not included in the market opportunity assessment because SGBs do not actively engage in utility-scale solar plants and the off-grid solar market shows a declining trend in India.

141 U.S. Department of Energy. 1999. [Biofuels: A Solution for Climate Change](#).

142 MoSPI. 2021. [India Energy Statistics](#).

143 [India’s Oil Demand To Increase By 7.7% in 2022: OPEC](#). 17 August 2022. India Outlook.

144 Ibid.



India's net import of petroleum was 185 million tonnes (Mt) at a cost of US \$551 billion in 2020–21.¹⁴⁵ Its dependence on imported crude oil to meet domestic consumption and the fluctuating prices of global crude oil pose a serious threat to the country's energy security. The Indian government has a strong focus on becoming energy self-reliant by 2047 and, in 2023, approved the green hydrogen mission to achieve that goal.¹⁴⁶ Despite the government's efforts to promote biofuels and green hydrogen, this has not been sufficient to provide impetus to entrepreneurial activity in the sector; the policies have few provisions to promote entrepreneurial activity in the green hydrogen space. Therefore, this sector analysis narrows the research scope further down to biofuels, excluding green hydrogen.

BIOFUELS

Background: A biofuel is a liquid, solid, or gaseous fuel produced from biomass.¹⁴⁷ The various types of biofuels include biogas, biodiesel, bioethanol, briquettes, and pellets. Bioethanol is produced from sugarcane, maize, sugar beets, molasses, cassava, and wheat, among other feedstocks.¹⁴⁸ Biodiesel is produced from vegetable oils (soybean oil, palm oil, rapeseed oil, etc.), animal fats, or used cooking oil.¹⁴⁹ Briquettes and pellets are produced from organic materials such as rice husk, sawdust, bagasse, groundnut shells, and other agricultural waste.¹⁵⁰ Biogas is produced from the anaerobic decomposition of waste and can be used as fuel for cooking, heating, cooling, and power generation.¹⁵¹

Indian Context: In India, most biofuels are used for transportation.¹⁵² In 2020, the transport sector contributed about 13.5% of energy-related CO₂ emissions in India.¹⁵³ The government aims to reduce the carbon emissions from the transport sector by blending traditional fuels with biofuels. The current ethanol production capacity in India is about 6,840 million litres (4,260 million litres from molasses-based distilleries and 2,580 million litres from grain-based distilleries).¹⁵⁴ However, a lack of support from the government for developing sustainable supply chain standards and solutions, entrepreneurial support, and subsidies and incentives pose barriers to the production of biofuels.¹⁵⁵

Table 9: Business segments and examples of SGBs in biofuels

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Biodiesel providers	Produce biodiesel from various sources, such as oil seeds, used cooking oil, plastic waste, etc. Some also engage with other businesses to distribute the fuel.	<ul style="list-style-type: none"> ▶ BIOD energy ▶ GE Biofuels ▶ PureFuel Energy ▶ Uranus Oil

145 NITI Aayog. 2021. [Roadmap for ethanol blending in India 2020-25](#).

146 Ministry of Power notifies Green Hydrogen/ Green Ammonia Policy. 17 February 2022. PIB.

147 OECD/FAO. 2020. [OECD-FAO Agricultural Outlook 2020-2029](#). OECD Publishing, Paris/FAO, Rome.

148 NITI Aayog. 2021. [Roadmap for ethanol blending in India 2020-25](#).

149 Ministry of New & Renewable Energy. [National Policy on Biofuels](#). Accessed 12 October 2022.

150 World Bank. 2017. [Scalable Business Models for Alternative Biomass Cooking Fuels and Their Potential in Sub-Saharan Africa](#).

151 Ibid.

152 [Biofuels Explained](#). EIA. Accessed 9 March 2022.

153 New Climate Institute. 2020. [Decarbonising the Indian transport Sector Pathways and Policies](#).

154 Naren, V. 2022. [Spirited Manufacturing: Why Grain-based Distilleries Might Be the Answer to India's Rising Ethanol Demand](#). The Times of India.

155 Mohanty, M.K. [The Current Status and Key Challenges for Biofuel in India](#). Pro MFG Media. Accessed 9 March 2023.



BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Bioethanol providers	Produce bioethanol, most of them are sugar mills, traditional businesses (i.e., local manufacturers), and subsidiaries of well-established industrial units. The typical start-up cost of setting up a small ethanol plant is about US \$1.9 million. ¹⁵⁶ Currently, the landscape is dominated by established businesses , with not much SGB activities.	► Microbite
Bio-gas providers	Manufacture and supply biogas; the government is pushing compressed biogas (CBG) as a mainstream transport fuel.	► Vaayu-Mitra
Briquettes providers	Produce biofuels in the form of briquettes and pellets made from organic materials, such as rice husk, saw dust, bagasse, groundnut shells, and other agricultural waste materials.	► A2P Energy ► Biofuels Junction
Support services	Provide support services, such as engineering procurement and construction service providers, technology providers, and marketplaces for buying biofuels/biomass. Few SGBs are active in this space.	► Buyofuel

► POLICY LANDSCAPE

Policies on bioethanol and compressed biogas (CBG) are focused on providing demand stability which has enabled traditional businesses to participate in these segments, restricting entrepreneurial activity. There is also a push from the government for mainstreaming CBG and biodiesel as transport fuels. The blending targets for biodiesel and ethanol seek to promote the use of such fuels to lower the carbon emissions from the sector. However, the industry standard cost of building a CBG plant is about US \$8 million,¹⁵⁷ which is higher than the SGB range (i.e., US \$2 million) and explains the limited SGB activities in the scope. Another challenge the sector faces is the limited supply of feedstock. For instance, most of the biodiesel in India is produced from palm stearin which is imported. The government is trying to promote production of biodiesel from used cooking oil to replace palm stearin.¹⁵⁸

Table 10: Key policies and strategies for Indian biofuels

POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
Biodiesel Purchase Policy	Aims to provide guaranteed procurement of biodiesel by oil marketing companies (OMCs). There is a need to utilize different feedstocks for biodiesel production, which is largely dependent on imported palm stearin. The OMCs regularly float expressions of interest to encourage the production of biodiesel from used cooking oil.	This policy helps facilitate trade of biodiesel by easing norms for the sale and purchase of biodiesel, supporting SGBs in the cleaner fuels sector.
National Biofuels Policy	Launched in 2018 with an objective of providing regulatory impetus to targets for blending fuels used in the transportation sector. A target of 20% blending of ethanol in petrol is proposed by ethanol supply year (ESY) 2025–26. An indicative target of 5% blending of biodiesel in diesel /direct sale of biodiesel is proposed by 2030.	This policy does not create specific provisions for private sector participation (including SGBs). But it establishes a target for blending biofuels in traditional fuels, thereby generating market demand.

¹⁵⁶ Ibid.

¹⁵⁷ Insight from primary interview with GreenFunder.

¹⁵⁸ [Bio Diesel](#). Ministry of Petroleum and Natural Gas. Accessed on 4 August 2022.



POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
Sustainable Alternative Towards Affordable Transportation (SATAT)	The primary scheme aimed at establishing an ecosystem for production of CBG from various waste/ biomass sources in the country. Launched in 2018, the scheme aims to set up CBG production plants and make CBG available in the market for use as a transport fuel. It targets production of 15 MMT of CBG from 5,000 plants by 2023. ¹⁵⁹	This scheme aims to promote entrepreneurship, but the minimum investment required to set up a plant under this scheme places business opportunities outside the SGB realm.

► FUNDING LANDSCAPE

The cleaner fuels sector has witnessed limited support from funders. This challenge is acute for SGBs in the sector as they require patient capital (the return horizon is usually in the range of 5–10 years or more). Financing from commercial banks is not easily accessible as banks are not familiar with the specific challenges of the sector, which include high research and development costs, requirement of financing for working capital, and demand uncertainty. Similarly, support is also largely unavailable from foundations, private investors, or DFIs. However, some notable developments are given below.

- **Private investors** provide limited support for this key area. However, some examples exist, such as Inflection Point Ventures, a 6,500+ strong members angel investing firm, which has invested about US \$194,000 in [Buyofuel](#), which operates an online marketplace for biofuels. In 2018, Finland-based energy company Fortum declared that it will invest 13.5 million euros in a biofuel joint-venture project with Numaligarh Refinery Limited (NRL) and Chemo Polis, based in the northeastern state of Assam,¹⁶⁰ which does not directly benefit start-ups but is expected to benefit businesses that engage in the biofuel supply chain by collecting raw materials and distributing the products.
- **DFI funding** is also currently not focused on this sector. IFC had invested in a sugar manufacturing unit (that also manufactures ethanol) in 2006 but that project is now closed.¹⁶¹ In December 2020, ADB funded a technical assistance (TA) project aiming to support India's development of biofuels through novel technological adoption and sustainable business structure. The assistance offered was worth US \$2.5 million.¹⁶²

► MARKET OPPORTUNITY (2022 – 2030)

The estimated market opportunity for cleaner fuels in India is US \$182.5 billion, composed of US \$163.4 billion for bioethanol and US \$19.2 billion for biodiesel based on the government-set target approach. The scope of market opportunity analysis only includes bioethanol and biodiesel, as green hydrogen in India is dominated by large-ticket businesses and corporates and there are no specific government targets for the production of biogas, briquettes, and pellets.

159 [Shri Dharmendra Pradhan presides over a slew of initiatives around Compressed Bio Gas to give filip to SATAT scheme.](#) 1 June 2021. PIB.






160 [Fortum invests €13.5 million in Indian biofuel project.](#) 3 May 2018. AA Energy. The exchange rate of euro to US dollars was 1 to 1.07 as of 16 February 16 2023.

161 IFC. 2007. [Bajaj Hindusthan Sugar Limited – Project Information Document.](#)

162 [ADB to Help Improve Advanced Biofuel Production in India.](#) 7 December 2020. ADB.




Sector Group: Land and Ocean Management

SUSTAINABLE AGRICULTURE AND AQUACULTURE		
KEY AREAS	BUSINESS SEGMENTS	MARKET OPPORTUNITY (2022-2030)
 <p>Pre-production and production</p>	<ul style="list-style-type: none"> ✓ Data-driven advisory services ✓ Green equipment providers ✓ Environmentally friendly input providers ✓ Innovative production services 	<p>US \$434 billion combining all key areas and business segments</p>
 <p>Post-production</p>	<ul style="list-style-type: none"> ✓ Green storage ✓ Processing equipment providers ✓ Testing and certification providers ✓ Green marketplaces 	
 <p>Sustainable livestock management</p>	<ul style="list-style-type: none"> ✓ Data-driven advisory services ✓ Green fodder providers ✓ Green equipment providers ✓ Livestock traceability technology ✓ Animal products marketplaces 	
 <p>Aquaculture</p>	<ul style="list-style-type: none"> ✓ Green equipment providers ✓ Fish marketplaces 	
 <p>Cross-cutting activity</p>	<ul style="list-style-type: none"> ✓ Farm to home 	



SUSTAINABLE FORESTRY		
KEY AREAS	BUSINESS SEGMENTS	MARKET OPPORTUNITY (2022-2030)
 Agroforestry	<ul style="list-style-type: none"> ✓ Tree seedling production and provision of tree management services ✓ Production of bamboo seedling and bamboo-based products 	<p>US \$16.9 million for bamboo-based agroforestry</p>
 Forest conservation	<ul style="list-style-type: none"> ✓ Tree seedling production and provision of tree management services ✓ Production of bamboo seedling and bamboo-based products ✓ Production and sale of sustainable wood forest products 	<p>No estimate</p>
 Non-timber forest products	<ul style="list-style-type: none"> ✓ Processing and sale of non-timber forest-based products 	<p>US \$826.7 million</p>

ECOTOURISM		
KEY AREAS	BUSINESS SEGMENTS	MARKET OPPORTUNITY (2022-2030)
 Ecotourism	<ul style="list-style-type: none"> ✓ Eco-lodging ✓ Eco-tours ✓ Agro-tourism ✓ Ecotourism marketplace 	<p>No estimate due to the lack of SGB activities in this sector</p>



Sustainable Agriculture and Aquaculture

► BACKGROUND AND BUSINESS SEGMENTS

Background: Sustainable agriculture refers to agricultural practices that meet the needs of present and future generations while ensuring profitability, environmental health, and social and economic equity.¹⁶³ Globally, the agricultural sector is the second largest contributor to climate change,¹⁶⁴ and new data from the Food and Agriculture Organization of the United Nations (FAO) reveal that the GHG produced by agrifood systems made up 31% of the global GHG emissions in 2020.¹⁶⁵ The leading emissions-generating activities in the sector are land conversion, such as clearing forests for farms; methane from livestock and rice production; and nitrous oxide from the use of synthetic fertilizers. The percentage contribution of GHG is expected to grow as the need for food continues to grow with the increasing population. From 1990 to 2010, global agricultural emissions grew by 8% and are expected to continue increasing by an estimated 15% by 2030, equivalent to seven billion tonnes each year.¹⁶⁶ Therefore, interventions that increase agricultural productivity and decrease emissions are urgently required to lower the carbon footprint of food production.

By 2030, the world will need to produce about 35% more food to feed its population.¹⁶⁷ However, as per current trends, the increase will only be about 20%. Climate change is decreasing agricultural yields thereby compromising the ability of future generations to meet their food needs. A growing population and decreasing yield are driving up the cost of food. This inflationary pressure is further augmenting hunger and malnutrition in various countries across the world. In 2020, 1 out of 10 people lacked regular access to adequate food,¹⁶⁸ and globally, one-third of the food produced is either lost or wasted.¹⁶⁹

According to the FAO, aquatic foods are being increasingly recognized as a critical piece of food security and nutrition due to their unique nutritional value that offers protein, omega-3 fatty acids, and micronutrients.¹⁷⁰ Aquatic foods provide about 17% of animal protein globally and account for over 50% in certain countries in Asia and Africa.¹⁷¹ Aquaculture production plays an important role in the global economy as well, as the US \$424 billion industry employs over 58 million people globally and produces at a rate that outpaces population growth.¹⁷²

Indian Context: Agriculture and adjacent sectors play a significant role in India's economy, accounting for a significant portion of the country's employment and GDP. With 700 million Indians living in rural areas, agriculture, forestry, fisheries, and biodiversity are central to these communities' livelihoods.¹⁷³

163 [Sustainable Development Goals | Food and Agriculture Organization of the United Nations](#), UN. Accessed 23 September 2022.

164 [New FAO analysis reveals carbon footprint of agri-food supply chain](#). 8 November 2021. UN.

165 [FAOSTAT](#). FAO. Accessed 23 September 2022.

166 Russell, S. [Everything You Need to Know About Agricultural Emissions | World Resources Institute](#). 29 May 2014. World Resources Institute.

167 Kray, H. A. [Farming for the Future: the Environmental Sustainability of Agriculture in a Changing World](#). World Bank Group. Accessed 19 September 2022.

168 [Goal 2 | Department of Economic and Social Affairs](#) UN. Accessed 19 September 2022.

169 [Food loss and waste must be reduced for greater food security and environmental sustainability](#). 29 September 2022. UN Environment Programme.

170 FAO. 2022. [The State of World Fisheries and Aquaculture – Towards Blue Transformation](#).

171 Ibid.

172 Ibid.

173 PwC. 2021. [Reaping the sustainable benefits of agricultural value chains](#).



Agriculture is responsible for about 17% of GHG emission in India.¹⁷⁴ About 74% of emissions from the agriculture sector are contributed by methane produced from rice cultivation and livestock, and the remaining 26% comes from nitrous oxide emitted from fertilizer.¹⁷⁵ The sector is the largest consumer of water in the country, accounting for more than 80% of total consumption.¹⁷⁶ India uses about 2–3 times more water to produce 1 tonne of food compared to other major economies (i.e., China, Brazil, and the U.S.).¹⁷⁷ Moreover, half of the arable land area of the country is under agricultural use, hence, sustainable use of water and land resources in agriculture is a key determinant of sustainable growth in India.

Fisheries and aquaculture provide livelihoods to 28 million in India.¹⁷⁸ Driven by its low cost and high nutritional value, the Indian fisheries sector has grown an average of 10% annually from 2014 to 2019, and production reached an all time high of 13.75 million metric tons during 2018.¹⁷⁹

According to the Ministry of Fisheries, Animal Husbandry & Dairying, climate change adaptation strategies include “developing cultivars tolerant to heat and salinity stresses and resistant to flood and drought, modifying crop management practices, improving water management, adopting new farm techniques such as resource conserving technologies (RCTs), crop diversification, improving pest management, better weather forecasts and crop insurance and harnessing the indigenous technical knowledge of farmers.”¹⁸⁰

In India, the government is promoting entrepreneurship (including SGBs) in the sector through various schemes and startup challenges. For example, the Initiative for Development of Entrepreneurs in Agriculture (IDEA)¹⁸¹ under the Ministry of Development of Northeastern Regions, intends to promote agri-business ventures in the Northeast and assist in establishing agri-business as a profitable venture.

PRE-PRODUCTION AND PRODUCTION

The pre-production stage refers to the preparatory stage before the sowing of seeds or before the agricultural production process begins. This stage involves processes such as tilling, plowing, and manuring and includes innovations in agricultural inputs, such as fertilizer or crop protection products.¹⁸² The use of innovative technologies that optimize the use of agricultural inputs, such as drone mapping, soil testing, etc. also falls under this key area. The pre-production stage also focuses on use of genetic resources to conserve and improve the quality and productivity of domesticated crops and livestock for the future.

Production refers to crop production and involves processes such as sowing, irrigation, weeding, harvesting, etc. In the production stage, farmers face many challenges, such as pests, disease, and severe or unpredictable weather.¹⁸³

174 NITI Aayog. 2019. [Transforming Agriculture for Challenges of 21st Century](#).

175 Ibid.

176 Ibid.

177 PRS Legislative Research. 2017. [State of Agriculture in India](#).

178 FICCI and PwC. 2022. [Championing the Blue Economy: Promoting Sustainable Growth of the Fisheries Sector in India](#).

179 [Cabinet approves Pradhan Mantri Matsya Sampada Yojana for boosting fisheries sector](#). 20 May 2020. PIB.

180 Gupta, A. and Pathak, H. 2016. [Climate Change and Agriculture in India](#). Government of India, New Delhi.

181 [Initiative for Development of Entrepreneurs in Agriculture \(IDEA\)](#). ,Startup India. Accessed 9 March 2023.

182 [Section 1 - Pre-Production](#). Farming First. Accessed 19 September 2022.

183 Ibid.


Table 11: Business segments and examples of SGBs in pre-production and production

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Data-driven advisory services	Refers to insights derived from data to improve the resource efficiency and productivity of agricultural production. This segment includes all kinds of advisory services about the weather, soil preparation, crop selection, use of fertilizers and inputs, etc.	<ul style="list-style-type: none"> ▶ AgSmartic ▶ Agtually ▶ Carnot Technologies ▶ Krishitantra
Environmentally friendly input providers	Providers of agricultural inputs that are organic and natural and reduce the negative impact of the agricultural production process on the environment. This segment includes SGBs that manufacture green inputs such as fertilizers, soil supplements, pesticides, weedicides, fungicides, etc.	<ul style="list-style-type: none"> ▶ Easykrishi
Green equipment providers	Providers of equipment or devices that use renewable energy or are energy efficient like solar pumps, solar tractors, soil testing equipment, and irrigation devices, among others.	<ul style="list-style-type: none"> ▶ Khethworks ▶ ThinkRaw
Innovative production services	Include agricultural practices that reduce the environmental impact of agricultural production, such as hydroponics, vertical farming, and organic farming, among many others. SGBs provide consulting services or promote such practices.	<ul style="list-style-type: none"> ▶ Acqua Farms ▶ Hydrilla

POST-PRODUCTION

Post-production processes refer to post-harvest processing operations as well as forward linkage for products, such as shelling, milling, packaging, storage, and transportation, and the steps taken to deliver food from the farmer to the consumer.¹⁸⁴ Post-harvest food loss is a major challenge across the developing world due to a lack of, or low quality, infrastructure, energy grids, and transport systems.¹⁸⁵

Green post-production processes involve using climate-friendly practices for the processing and storage of the harvest and enabling necessary market linkage with minimal food loss. Efficient processes also eliminate middlemen and improve farmer incomes.

Table 12: Business segments and examples of SGBs in post-production

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Green marketplaces	Online and offline marketplaces that deal in only organic and natural produce.	<ul style="list-style-type: none"> ▶ Brown Living ▶ Isayorganic
Green storage	Storage solutions that increase the life of agricultural produce while minimizing environmental impacts. This includes energy-efficient or renewable energy-based storage solutions, such as solar cold storage, and innovations that minimize food waste by extending the shelf life of produce.	<ul style="list-style-type: none"> ▶ ColdStar Logistics ▶ Ecozen Solutions ▶ Green Pod Labs

184 On farm postharvest and value addition | Sustainable Agricultural Mechanization. FAO. Accessed 22 September 2022.

185 Section 1 - Pre-Production. Farming First. Accessed 19 September 2022.



BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Processing equipment and service providers	SGBs provide products or services that enable the processing of agricultural produce on-farm. On-farm processing operations include threshing, shelling, drying, etc. SGBs in this segment provide post-harvest equipment that runs on renewable energy or is energy efficient.	► Oorja solutions
Testing and certification providers	SGBs that audit the quality of agricultural produce to determine its suitability for food standards, including those that provide a certification of authenticity of organic produce and are registered with the government. SGBs also leverage technology to provide quality assurance of fruits and vegetables.	► InfyU Labs

SUSTAINABLE LIVESTOCK MANAGEMENT

According to the World Bank, the various dimensions of sustainable livestock management include “balancing animal rations and sustainable sourcing of feeds, carbon sequestration in agricultural landscapes, energy-efficient technologies and renewable energy sources, animal health and welfare, better manure management, etc.”¹⁸⁶ Technological innovations such as data-driven feed management for increased yields and predictive disease management help to make livestock farming more sustainable and more resilient to climate change.

Table 13: Business segments and examples of SGBs in sustainable livestock management

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Animal product marketplaces	Online platforms that provide market linkage for animal products such as milk, meat, eggs, etc.	► Vilfresh
Data-driven advisory services	Provide advisory services and leverage data for insights to improve livestock management regarding the kinds of breeds, prediction of diseases, medical treatment, and the safety of animals.	► Statlogic
Green equipment Providers	Provide equipment that uses renewable energy or is energy efficient and is used in the livestock management value-chain (e.g., milk chillers).	► New Leaf Dynamic
Green fodder providers	Animal feed that has a lower environmental impact than traditional animal feed. SGBs under this segment provide silage services, animal supplements, etc.	► Cornext
Livestock traceability technology	Identification and tracking of animals to help control animal epidemics and ensure vaccination. SGBs under this business segment provides technologies such as radio-frequency identification (RFID), Internet of Things (IoT), and blockchain to improve the traceability of animals.	► Adis Technologies

AQUACULTURE

Aquaculture refers to the farming of aquatic organisms including fish, molluscs, crustaceans, and aquatic plants.¹⁸⁷ This key area includes the various dimensions of managing aquaculture, which the World Bank describe as “effective biosecurity and disease control systems; minimal antibiotic and pharmaceutical use; microbial sanitation; maintaining global standards for hygiene; efficient and humane harvest and transport; accountable

¹⁸⁶ [Moving Towards Sustainability: The Livestock Sector and the World Bank](#) World Bank. Accessed 19 September 2022.

¹⁸⁷ [Fisheries and Aquaculture - All Information Collections - Global Aquaculture Production](#). FAO. Accessed 22 September 2022.



record-keeping and traceability; profitability.”¹⁸⁸

Table 14: Business segments and examples of SGBs in aquaculture

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Automated fish management	SGBs that leverage automation and monitoring services to manage fish cultivation. For example, using technology to recycle and reuse water after mechanical and biological filtration and the removal of suspended matter and metabolites.	► Kravis Aqua
Fish marketplaces	Online marketplaces that connect customers to fish producers.	► LiveFish on Wheels
Green equipment Providers	Businesses that provide equipment that runs on renewable energy or is energy efficient and facilitates aquaculture, including drones that operate under water, solar fish dryers, etc.	► Eyerov

CROSS-CUTTING ACTIVITY

Cross-cutting activities cover the entire value chain of either sustainable agriculture or sustainable livestock management or aquaculture. The SGBs under the cross-cutting activity key area work across the entire agricultural value chain, beginning at the pre-production stage and ending at last-mile delivery to customers. Businesses under this key area provide support to farmers through advisory services, improved inputs (including genetically improved animals or fish), better post-harvest management techniques, and market linkage services. Initiatives under this key area introduce traceability in the value chain and improve farmer margins.

Table 15: Business segments and examples of SGBs in cross-cutting activities

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Farm-to-home	Farm-to-home or farm-to-fork refers to agricultural, animal, or fish products that reach the final consumer directly from the farm at which they were produced.	► Kisanwala ► Pepper Farms

► POLICY LANDSCAPE

The overall policy environment for sustainable agriculture is supportive. There is a specific emphasis on leveraging mechanization and technology to improve productivity in the sector. For example, the government aims to promote “Kisan Drones”, which are designed to inspect crops, digitize land records, and spray insecticides and nutrients. The programme will support start-ups’ application of this technology through various models, including drone-as-a-service, by providing the necessary skilling courses.¹⁸⁹ In addition, it will facilitate financial solutions leveraging public-private partnerships (PPPs). The government share in such thematic funds will be limited to 20%.¹⁹⁰

188 [Topics](#). World Bank. Accessed 22 September 2022.

189 [Budget 2022: Startups Will be Promoted to Facilitate ‘Drone Shakti’, vows Nirmala Sitharaman](#). 1 February 2022. First Post.

190 Parmer, B. 2022. [Govt Announces ‘Thematic Funds’ in Sunrise Sectors of Climate, Agri, Deeptech](#). VCCIRCLE.


Table 16: Key policies and strategies for Indian sustainable agriculture and aquaculture

POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
National Fisheries Policy	Provides a strategy to develop, harness, manage, regulate, capture, and breed fish in a responsible and sustainable manner. The policy serves as guidance for developing state specific policies and legislations.	This policy seeks to promote private sector participation (including SGBs), and it largely targets strategies for smaller-scale fisheries.
National Livestock Mission	Launched in 2014, this mission was restructured in 2021 to focus on employment generation, entrepreneurship development, and increases in per animal productivity in the livestock sector. It aims to increase the production of meat, eggs, goat milk, wool, and fodder. The key challenges that the policy seeks to address are lack of feed and fodder, low productivity, livestock health, and inadequate infrastructure for marketing, processing, and value addition.	The policy seeks to leverage PPP initiatives to enable farmers to have better access to credit, inputs, and marketing opportunities, which in turn supports farmer entrepreneurship (including at the SGB level).
National Mission on Sustainable Agriculture (NMSA)	<p>Aims to make agriculture more productive, sustainable, remunerative, and climate resilient. The mission was launched in 2014 and has undergone significant restructuring since then. Important components of this mission include:</p> <ul style="list-style-type: none"> ▶ Rainfed Area Development (RAD): promotes integrated farming systems involving mixed cropping practices. ▶ Soil Health Management (SHM): promotes location as well as crop specific sustainable soil health management. ▶ The Paramparagat Krishi Vikas Yojana (PMKVY): Aims to improve soil fertility through organic farming. The scheme promotes a cluster-based approach for value addition and provides market linkages to organic farmers. Under this scheme each farmer is given financial assistance of about US \$625 for three years to promote organic farming. ▶ Climate Change and Sustainable Agriculture: Monitoring, Modelling and Networking (CCSAMMN): Drives research and dissemination of knowledge to farmers about climate change and supports pilot projects in climate smart agriculture integrated farming systems. 	Under its Soil Health Monitoring component, this policy promotes the setting up of soil testing labs, agro-waste compost production units, and liquid/ carrier-based biofertilizer/biopesticide production units by private entrepreneurs. It also makes provisions for government capital assistance for a limited number of such facilities through the National Bank for Agriculture and Rural Development (NABARD).
Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyaan (PM-KUSUM)	Launched by the Ministry of New and Renewable Energy to promote the use of renewable energy in agricultural practices. It aims to add solar and other renewable capacity of 25,750 MW by 2022 with total central financial support of about US \$4.3 billion. Under the PM-KUSUM Scheme, 2 million farmers will be provided with subsidies for setting up stand-alone solar pumps and another 1.5 million farmers will be helped to solarize their grid-connected pump sets.	This scheme creates demand for solar pumps by <i>incentivising</i> farmers through subsidized solar pumps.



► FUNDING LANDSCAPE

In India, sustainable agriculture has gained significant interest and support from a range of funders.

- **Private investors** in India commonly support technology platforms as they are readily scalable, and investors are well-acquainted with the business model. The sector also witnesses participation from specialized impact investors focusing on agriculture and allied sectors like livestock, aquaculture, fisheries, horticulture, and semiculture, such as Omnivore, Agfunder, and Nabventures. Omnivore typically invests US \$1 million to US \$1.5 million in seed stage enterprises.¹⁹¹ The investments in this sector generally range from US \$10,000 to more than US \$200 million, depending upon the type and growth stage of the enterprise.
- **DFIs**, such as the World Bank and the Asian Development Bank, have funded state governments in India to support projects that enhance the climate resilience of agricultural systems, facilitate market access, and improve productivity, etc.
- **National regulatory bodies**, such as the National Bank for Agriculture and Rural Development (NABARD) and **international DFIs**, such as USAID, play a prominent role in the sector in terms of providing credit to farmers. In 2021, USAID and the U.S. International Development Finance Corporation (DFC) sponsored a credit guarantee scheme of about US \$55 million. The project aims to boost the post COVID-19 economic recovery by supporting key players in the agriculture sector, including farmers, agtech companies, and clean energy solution providers.¹⁹²
- **Foundations**, such as the Bill and Melinda Gates Foundation, Syngenta Foundation, and Grameen Foundation, support initiatives across the entire agricultural value-chain. However, their initiatives are not targeted towards SGBs but rather focus on the funding flows to farmers, farmer producer organizations, and state governments.
- **Commercial banks** support this sector. The government has established funds to support entrepreneurs, MSMEs, farmer producer organizations, and others operating in the agriculture and aquaculture space. These funds are operationalized by partnering with traditional banks to offer lower interest rates thereby supporting initiatives in these sectors.

PRE-PRODUCTION AND PRODUCTION

- **DFIs** like the World Bank have provided support. In 2020, the World Bank and the Government of Himachal Pradesh signed a US \$80 million loan agreement to increase agricultural productivity and improve water management practices in selected village councils in the state.¹⁹³
- **Impact investing** has been largely directed to businesses that provide data-driven advisory services. SGBs such as [Flybird Innovations](#) have raised funding from impact investors. Impact investor Caspian Debt, together with DFI Rabobank, launched a US \$2 million Rabo-Caspian Agtech Financing Fund in 2019.¹⁹⁴ The fund supports data-driven **agtech** companies offering farm productivity solutions through customized debt financing.

191 Insight from primary discussion with Omnivore.

192 [DFC and USAID Launches USD \\$55 Million Loan Financing Program As Part of COVID-19 Relief for Sustainable Agriculture Development in India](#). 23 September 2021. U.S. Embassy & Consulates in India.

193 [Project Signing - New World Bank Project to Benefit Over 400,000 Farming Households in Himachal Pradesh](#). 11 March 2020. World Bank.

194 [Rabobank and Caspian Launch \\$2 Million Debt Fund for India's Agtech Startups](#). 13 August 2019. Caspian



- The **Government of India** also seeks to improve agricultural infrastructure in the country. It has created a US \$4.2 billion fund for this purpose. The government has signed MoUs with several traditional banks to provide loans to agri-entrepreneurs. Thus, traditional banks cater to the pre-production, production, and post-production key areas, acting as agencies of the government.

POST-PRODUCTION

- **DFIs** that support this sector include the World Bank and Asian Development Bank (ADB). The projects funded by such organizations often cut across multiple components of the value chain, covering multiple key areas identified in this study. The ADB, with the Indian Government, deployed a US \$100 million loan to bolster agribusiness networks to increase farm incomes and reduce food loss in Maharashtra.¹⁹⁵
- **Impact investing** activity is often directed to SGBs that provide market linkages for agricultural produce or provide processing and quality assurance services. For example, [Oorja Solutions](#), which provides pay-per-use farming services like solar processing and solar drying, has raised US \$1 million in seed funding from Schneider Electric Energy Access Asia.¹⁹⁶
- To improve agricultural infrastructure in the country, the **Government of India** created a US \$4.2 billion Agriculture Infrastructure Fund (AIF).¹⁹⁷ Several commercial banks signed MoUs with National Bank for Agriculture & Rural Development (NABARD) to provide loans to agri-entrepreneurs through the fund.¹⁹⁸

SUSTAINABLE LIVESTOCK MANAGEMENT

- **DFIs** show support for sustainable livestock management in India. The Japan International Cooperation Agency (JICA) and the Government of India signed a loan agreement of about US \$113 million for the development of dairy infrastructure in the country. The project will be implemented from 2021 to 2025 in the states of Uttar Pradesh and Bihar. By developing the dairy infrastructure, the project will create market linkages for local produce and capacity building for relevant village and state-level institutions.¹⁹⁹
- **Impact investors** also extend support to this key area. For example, [Laymen Agro](#), an early-stage social enterprise based in Tamil Nadu that procures and delivers farm-fresh milk and vegetables to families in Coimbatore, raised US \$142,000 from Upaya Social Ventures and Sangam Ventures.²⁰⁰
- The **Government of India** launched the Animal Husbandry Infrastructure Development Fund (AHIDF) with a corpus of about US \$1.85 billion in 2020. This fund is meant to support entrepreneurs, MSMEs, farmer producer organizations, etc. It is meant as an interest subvention scheme to provide loans at lower interest rates. This scheme is being executed in partnership with traditional banks.

195 [ADB, India Sign \\$100 Million Loan for Agribusiness Development in Maharashtra | Asian Development Bank](#). 26 October 2021. ADB.

196 [Oorja secures \\$1 million in Seed funding to scale up pay-per-use farming services powered by clean energy](#). 11 October 2021. Oorja.

197 Government of India. [Scheme Guidelines for Central Sector Scheme of Financing Facility under 'Agriculture Infrastructure Fund](#). Department of Agriculture, Cooperation & Farmers' Welfare Ministry of Agriculture & Farmers' Welfare. Accessed 9 March 2023.

198 Ibid.

199 [JICA Supports First-of-its-Kind Dairy Production Improvement Project by signing an ODA Loan of INR 920 Crore | India](#) 18 April 2021. JICA.

200 [Agri start-up VilFresh gets ₹1.15-crore angel funding](#). 8 May 2019. The Hindu Business Line.



CROSS-CUTTING ACTIVITY

Initiatives under this key area receive funding from all investors as it covers all segments of the value chain as described above. For example, the Government of India, the Government of Maharashtra and the World Bank deployed a US \$210 million loan to “increase market access and productivity, and to build resilience of crops to recurrent floods or droughts in the Indian state of Maharashtra.”²⁰¹ This project supports the pre-production and production process as well as providing market linkages to the farmers.

- **Private investor** activity in this key area is also observed. For instance, [Pepper Farms](#) has raised US \$1 million in seed funding from Axilor Ventures.
- **Commercial banks**, as noted above, cater to the pre-production, production, and post-production themes, acting as agents of the government.

AQUACULTURE

Aquaculture key areas witness funding activity from DFIs. The World Bank has recently approved a US \$150 million project to augment the recovery of the fisheries sector post-COVID-19.²⁰² This key area also receives funding from private investors and impact investors. For example, [FreshR](#), an online marketplace for fish, raised US \$1.2 million from Axilor Ventures.

The government has created the Fisheries and Aquaculture Infrastructure Development Fund (FIDF) to promote farmers, cooperatives, and private enterprises in this sector. The fund was launched in 2018 with a corpus of about US \$928 million, and it will be operational for a five-year period. This fund is intended to provide loans to projects in the fisheries sector and offers interest subvention to commercial banks providing financial support to banks until outstanding loans and interests are fully paid off.

► MARKET OPPORTUNITY (2022 – 2030)

Using the SDG target-based methodology, the market opportunity for sustainable agriculture and aquaculture between 2022–2030 is estimated at **US \$433.7 billion**, covering all identified key areas. This translates to US \$48.2 on average each year. However, India’s agricultural investment has stagnated over the past few years. The investment in the sector was about US \$25 billion in 2013 and US \$27 billion in 2016, where the private sector’s share remained at 88% and 83% in respective years.²⁰³ Therefore, there is a significant gap in the sector to be filled each year.

201 [ADB, India Sign \\$100 Million Loan for Agribusiness Development in Maharashtra | Asian Development Bank](#). 26 October 2021. ADB.

202 [World Bank approves Rs 4,400-cr funding for three projects in India](#). 23 June 2022. Business Standard.

203 Government of India. [Scheme Guidelines for Central Sector Scheme of Financing Facility under ‘Agriculture Infrastructure Fund.’](#) Department of Agriculture, Cooperation & Farmers’ Welfare Ministry of Agriculture & Farmers’ Welfare. Government of India. Accessed 9 March 2023.



Sustainable Forestry

► BACKGROUND AND BUSINESS SEGMENTS

Background: The FAO describes sustainable forestry as a “dynamic and evolving concept, which aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations.”²⁰⁴ Sustainably-managed forests and trees contribute to the well-being of the planet by providing livelihoods, supplying clean air and water, and improving biodiversity. The FAO describes the important principles of sustainable forestry as:²⁰⁵

- **Environmental protection:** any forest practice needs to ensure that the ecological makeup of that forest is not tampered with at all costs.
- **Social well-being:** sustainable forestry must ensure that the interests of local communities are met either directly or indirectly.
- **Economic prosperity:** any sustainable forest practice should add economic value to the people as it conserves the environment.
- **Legal, policy, and institutional frameworks:** legal, policy, and institutional set-ups are necessary to support the aforementioned principles, focusing on participatory decision-making at all levels.

Sustainably managed forests improve the use of land, help reduce vulnerability to climate change, and advance both mitigation and adaptation objectives.²⁰⁶ As forests remove carbon from the atmosphere and store it, activities such as afforestation, reforestation, and avoided deforestation contribute to climate change mitigation.²⁰⁷ Forests naturally provide critical environmental services such as the prevention of soil erosion and maintaining productive climatic conditions. By sustainably managing these ecosystems, communities can diversify revenue sources and build local institutional capacity, ultimately improving social resilience.

Indian Context: The forestry sector in India is focused on forest conservation and community participation. As a consequence of the policy environment favouring conservation over production, the private sector’s role in forestry in India is limited to trees outside forests²⁰⁸ (TOF) for procuring raw material. Although the current government has aimed to promote private sector participation in the forestry landscape since 2018, such measures have continuously faced resistance from civil society and forest right groups as they pose threats to the rights of forest-dependent communities and may even contribute to environmental degradation.

204 [Natural Forest Management](#) FAO. Accessed 9 March 2023.

205 [What is sustainable forest management?](#) PEFC. Accessed 9 August 2022.

206 [Forests combat climate change.](#) World Bank. Accessed 19 October 2022.

207 [Forests and mitigation - Climate Change and Forests in the Congo Basin \(COBAM\).](#) CIFOR. Accessed 19 October 2022.

208 Generally, extensive tree wealth exists outside continuous forested areas in every country. Termed as “trees outside forests” (TOF), these are in the form of small woodlots and block plantations, trees along linear features, such as roads, canals bunds, etc. and scattered trees on farmlands, homesteads, community lands, and urban areas. Traditionally, these were not inventoried and little quantitative information existed about TOF. However, lately a lot of interest has been generated worldwide on TOF. Besides providing support to the rural economy, these trees are now a source of substantial forest produce in every country. MOEFCC. 2017. Field Manual on Assessment of Trees Outside Forests.



AGROFORESTRY

Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence.²⁰⁹ In India, agroforestry is covered under the category of trees outside forests (TOF).

Table 17: Business segments and examples of SGBs in agroforestry

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Bamboo-based Products	Bamboos can be used as a raw material for many industries such as biofuels, flooring, sustainable packaging, etc. Most entrepreneurs working in this space procure bamboo from channel partners who work directly with farmers.	► Bamboo India

Currently, India has only one forest certification scheme, and it is being implemented by a non-profit entity, the Network for Certification and Conservation of Forests (NCCF).²¹⁰ The NCCF has developed a certification standard for TOF; this standard is currently under review by the Programme for the Endorsement of Forest Certification (PEFC).²¹¹ This step will make it easier for private players in the sector to get their processes certified and bring more transparency to the sector.

NON-TIMBER FOREST PRODUCTS

Non-timber forest products (NTFPs) are any product or service other than timber that is produced in forests. This includes food products, medicinal plants, and materials such as bamboo and rattan.²¹² The estimated worth of NTFPs collected in India is about US \$2 trillion annually.²¹³ Most of this is collected by tribal communities living in and around forests. However, the economic benefits are not passed onto such communities.²¹⁴ NTFPs can also be cultivated outside of forests. The Indian government is promoting the cultivation of medicinal and aromatic plants (a type of NTFP) on farmlands. This will improve farmer incomes while also creating transparent value chains.

Table 18: Business segments and examples of SGBs in NTFPs

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Processing and sale of NTFPs	Social enterprises that work closely with forest communities and provide them with post-harvest management, processing and market linkages. Some enterprises are coming up in this segment, however, commercial activity is still limited.	► BastaR se Bazaar tak ► Jovaki Agro foods ► Last Forest

209 [Agroforestry](#). FAO. Accessed 9 August 2022.

210 [Forest-certification-scheme](#). NCCF. Accessed 9 August 2022.

211 [Indian Trees outside Forests certification standard - PEFC](#). PEFC. Accessed 9 August 2022.

212 [Forests and Non-timber Forest Products](#). CIFOR. Accessed 9 August 2022.

213 Aggarwal, M. and Ghosh, S. 2020. [India Urgently Needs to Streamline Multi-billion Rupees Worth NTFP Market](#). Mongabay. Accessed 9 August 2022.

214 Ibid.



FOREST CONSERVATION (ECOLOGICAL RESTORATION/ BIODIVERSITY CONSERVATION/AFFORESTATION)

Forest conservation or the enhancement of forest cover is a proactive measure taken to arrest and reverse the trend of forest decline and degradation.²¹⁵ Forest conservation in India primarily relates to the restoration of degraded forests. Enterprises in this key area work towards afforestation, forest creation, biodiversity conservation, etc. In India, private sector activity inside forests is highly regulated. In 2019, the forest advisory committee issued guidelines to allow tripartite agreements between NGOs, forest department, and corporates.

Bamboo cultivation on plantations is a form of agroforestry, but where it is collected from forests it is classified under NTFP. For the purposes of this study, it has been classified under agroforestry since most start-ups are sourcing bamboo from plantations.²¹⁶

► POLICY LANDSCAPE

The policy landscape on sustainable forestry in India supports various programs and missions. Forestry is a concurrent subject under the constitution, which means that both the central and state governments can legislate on this subject. This was done to increase the involvement of the state forest departments and local communities and to improve their participation in decision making processes.

Table 19: Key policies and strategies for Indian sustainable forestry

POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
National Bamboo Mission	Aims to promote the cultivation of bamboo. It amended Section 2(7) of the Indian Forest Act in 2017 to declassify bamboo as a “tree”, thus opening up its transit and felling permissions for non-forest lands. The mission was restructured in 2018 to emphasize bringing bamboo resources into the market value chain to reduce imports and improve livelihood and business opportunities.	The restructured mission provides a range of multi-pronged benefits for the private sector (including SGBs): availability of credit linked subsidy, assistance in processing and marketing of bamboo, skill development, etc.
Van Dhan Yojana	This scheme is a component of the Mechanism for Marketing of Minor Forest Produce (MFP). The main target of this scheme is to provide livelihood to tribal gatherers and to transform them into entrepreneurs.	This scheme supports farmers cooperatives and small SGBs through its provision of financial support to tribal communities through setting up locally-run groups.
Vriksh Ayush Mission	The main goal of this mission is to improve farmer income by promoting the cultivation of medicinal and aromatic plants. Medicinal and aromatic plants fall under the category of NTFPs. Under this scheme, the farmers/local communities are entitled for subsidized medicinal plant cultivation. The mission supports farmers throughout the value-chain. The government supports cultivation through subsidies, provides assistance with post-harvest management, and creates regional marketplaces to improve market linkages, etc.	This scheme promotes the cultivation and trade of medicinal plants and as such supports farmers cooperatives’ income generation.

215 [Forest Conservation As Well As the Enhancement of Forest Cover and the Roles of Forests in Meeting Basic Human Needs](#). IISD. Accessed 17 October 2022.

216 Tewari, S. et al. [Bamboo Based Agroforestry Systems](#). 9 March 2023.



► FUNDING LANDSCAPE

The funding landscape in the sustainable forestry sector is dominated by DFIs and foundations. Private sector participation in this sector is minimal in India and hence participation among private investors and commercial banks is also not very strong. The sector also witnesses active participation from NGOs and corporate social responsibility (CSR) initiatives.

- **DFIs**, such as the World Bank, JICA, and USAID, provide funding for the sustainable forestry sector in India. However most of this funding is directed towards technical assistance projects, biodiversity conservation, and building climate resilience, etc. These programmes do not focus on supporting SGB activity in the sustainable forestry space. None of the SGBs that were identified in this sector are being supported by a DFI.
- **Commercial banks** are not supportive of enterprises in the sustainable forestry sector as they require collateral that SGBs in the sector typically cannot provide. As most of the government assistance schemes are executed through banks, the need for collateral restricts SGBs from benefiting from these schemes.
- **Foundations** are active in supporting the agroforestry and NTFP key areas. For example, the Balipara Foundation helps in the creation of food forests by planting trees that contribute towards extra income for communities. The Rainmatter Foundation also supports projects in this space through grants and equity funding. The LINK Fund, a philanthropic operational foundation which has a mandate to eradicate extreme poverty and mitigate the effects of climate change, also supports NTFP enterprises. The Tribal Cooperative Marketing Development Federation of India (TRIFED), a government agency, has partnered with the LINK fund to support value addition through technological intervention for efficiency in NTFPs and craft diversification, etc.
- **Private investors** are not active in the sustainable forestry space. Impact investor Upaya Social Ventures has invested in two NTFP social enterprises, both of which act as aggregators working with local or tribal gatherers that then supply the produce to other industries.

Afforestation activities are largely covered by **not-for-profit enterprises**. These initiatives are supported by CSR funds, foundations, or the government. The sector receives support from foundations, such as Rohini Nilekani Philanthropies, which funds initiatives for forest conservation, wildlife preservation and ecological research. Commercial activity in this space is limited.

An important source of funding for the sustainable forestry sector is **carbon finance**. Carbon credits developed through nature-based solutions that provide co-benefits (biodiversity conservation, livelihood generation, etc.) are in great demand in carbon markets.²¹⁷ Project developers are interested in forest-based projects to generate carbon credits. However, these developers are large-scale businesses, and this is not an avenue where SGBs have been active. One of the most prominent players in this space in India is EKI Energy Services, which last year achieved unicorn status²¹⁸ (valuation more than US \$1 billion).

217 Singh, S. 2022. [How India Can Benefit from Voluntary Carbon Markets](#). The Economic Times.

218 [The Indian Unicorn Landscape](#). Invest India. Accessed 9 August 2022.



▶ MARKET OPPORTUNITY (2022 – 2030)

Including both areas (NTFP and bamboo-based agroforestry) and using the government-set target approach, the **market potential for sustainable forestry is estimated at US \$843.6 million** between 2022–2030, which consists of US \$826.7 million for NTFP and US \$16.9 million for bamboo-based agroforestry. While India has adopted ambitious targets to create an additional carbon sink of 2.5–3 billion CO₂ equivalent by 2030,²¹⁹ most afforestation activity under various programmes and schemes of the government falls under the trees outside forests (TOF) category, whereas the private sector's activities are mostly observed in agroforestry like bamboo and NTFP.²²⁰

Ecotourism

▶ BACKGROUND AND BUSINESS SEGMENTS

Background: The International Ecotourism Society defines ecotourism as “responsible travel to natural areas that conserves the environment, sustains the well-being of local people, and involves interpretation and education.”²²¹

The commercial definition of ecotourism is loosely interpreted as nature-based tourism. However, nature-based tourism has two components: adventure tourism and ecotourism. Ecotourism includes elements of cultural tourism and rural tourism. The main purpose of ecotourism is the appreciation of nature whereas the main goal of adventure tourism is to experience physical exercise and challenging situations in nature.

Ecotourism contributes to climate mitigation by reducing GHG emissions by, for example, encouraging sustainable transportation and accommodation facilities that promote the use of renewable energy.²²² Ecotourism also utilizes mechanisms that reduce impacts on the environment and support biodiversity conservation.²²³

Indian Context: India's National Strategy on Sustainable Tourism defines ecotourism as tourism that takes full account of its current and future economic, social, and environmental impacts, addressing the needs of visitors, the industry, the environment, and host communities.²²⁴ It identifies ecotourism and adventure tourism as two primary activities to expand sustainable tourism.

The government's focus is on promoting ecotourism projects at a state level. It seeks to promote businesses, such as tour operators and accommodation providers, and provides a mechanism for onboarding private players (including SGBs) for the execution of ecotourism development projects.

Business Segments: The SGB activity in the ecotourism sector are *agro-tourism*, *eco-lodging*, *eco-tours*, and *ecotourism marketplace*.

219 Ministry of Environment, Forest and Climate Change, Government of India. 2015. [India's Intended Nationally Determined Contributions: Towards Climate Justice](#).

220 In June 2022, the Government came out with a regulation that allows private activity inside forest areas without the prior consent of the local community. This regulation is facing staunch opposition and is in violation of certain provisions of the Forest Rights Act. This regulation is seen as a body blow to India's environmental protection laws. The growth of private enterprises in this space is still questionable. Hence market opportunity is not estimated for the restoration of degraded forests.

221 [TIES Overview: What is Ecotourism?](#) The International Ecotourism Society. Accessed 9 March 2023.

222 [Transforming Tourism for Climate Action](#). UNWTO. Accessed 19 October 2022.

223 Simpson, M.C., et al. 2008. [Climate Change Adaptation and Mitigation in the Tourism Sector: Frameworks, Tools and Practices](#). UNEP, University of Oxford, UNWTO, WMO.

224 Ministry of Tourism. 2021. [National Strategy and roadmap for sustainable tourism in India](#).


Table 20: Business segments and examples of SGBs in ecotourism

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Agro-tourism	Agro- tourism combines tourism with sustainable agricultural practices. It involves recreation in the agricultural environment and may include an opportunity to help with farming tasks during the visit. The activities involve direct contact with domestic animals, plants and animal products, and the products of processing ²²⁵ within the framework of sustainable tourism.	<ul style="list-style-type: none"> ▶ Farmguru ▶ Meyome Resort ▶ Spring Valley Farm
Eco-lodging	SGBs that operate eco-conscious hotels, homestays, retreats, etc. As per the sustainable tourism criteria, accommodation providers need to ensure that the design and construction of their buildings and infrastructure follow principles of sustainability, which prescribe the use of responsible and eco-friendly products for building materials, capital goods, food, and consumables. ²²⁶	<ul style="list-style-type: none"> ▶ Siddharth Village
Eco-tours	Tour operators that specialize in leading clients on tours to learn about an area's natural and cultural history while preserving its environment. The tour operators have to abide by the sustainable tourism criteria. Operators incorporate methods that decrease the stress visitors exert on the environment, for example, cycling or hiking through parks. ²²⁷	<ul style="list-style-type: none"> ▶ Blive ▶ Grand Himalayan Expedition
Ecotourism marketplace	SGBs that serve as aggregators of service providers in the ecotourism space. The enterprises on these platforms identify as eco-lodging or eco-tour operators.	<ul style="list-style-type: none"> ▶ Igloopupa ▶ Seek Sherpa

▶ POLICY LANDSCAPE

The policy landscape of ecotourism is still evolving in India. The government has taken several initiatives to promote ecotourism in the country and has recognised ecotourism as a focus industry in the Himalayan states of Jammu and Kashmir, Himachal Pradesh, Sikkim, and Uttarakhand.²²⁸ The government has provided financial assistance for the development of ecotourism projects in various Indian states. For example, the Ministry of Tourism has sanctioned about US \$319,000 for an ecotourism project in the Morni-Pinjore Hills and Sultanpur National Park in the state of Haryana.

The government is focusing on turning India into a global tourism hub. The Ministry of Tourism was allocated about US \$292 million in the Union Budget 2022, which is 18.4% higher than the allocation in the previous year.²²⁹ The pandemic severely affected the tourism sector as a whole. The emergency loan assistance scheme, formulated to support MSMEs in the tourism sector, was extended to March 2023.

225 Sznajder, M. et al. 2009. *Agritourism*. CABI.

226 *Sustainable Tourism for India: Criteria and Indicators Applicable to Accommodation Sector and Tour Operators*. Ministry of Tourism, Government of India.

227 *Ecotourism Operator*. Environmental Careers Organization Canada. Accessed 9 March 2023.

228 *Ecotourism: A Model To Reboot Tourism*. IBEF. Accessed 18 October 2022.

229 PTI. 2022. *Budget 2022: Tourism Sector Gets Rs 2400 Crore; Some Relief for Hospitality Sector*. Financial Express.


Table 21: Key policies and strategies for Indian ecotourism

POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
Guidelines for Sustainable Ecotourism	These guidelines, from the Ministry of Environment, Forests and Climate Change, are voluntary in nature and apply to tour operators, accommodation, and beaches, backwaters, lakes, and rivers. The guidelines recognise that tourism in India is primarily driven by the private sector. They promote ecotourism inside forests and allow construction of non-permanent structures inside protected zones, which was not permissible until 2021.	These guidelines provide directions for tour operators and accommodation providers to promote sustainable tourism practices. They promote entrepreneurship among local communities through the development and sale of sustainable products based on each area's nature, history, and culture (including food and drink, crafts, performance arts, and agricultural products).
National Strategy for Sustainable Tourism	<p>Identifies ecotourism and adventure tourism as the two main components of sustainable tourism. It focuses on capacity building (at the state level) of entrepreneurs and local communities.</p> <p>There is a strong focus on creating an inclusive mechanism by involving all stakeholders, building campaigns, and developing entrepreneurship in the country. Each state in India has its own ecotourism policy, which lists specific measures being taken in that state and the activities that would be included under the definition of ecotourism for that state. This ensures that diverse avenues of sustainable tourism are developed across the country.</p>	The strategy seeks to promote entrepreneurship (including SGBs) amongst local communities through state governments. The state governments will identify the capacity needs of local communities. This includes training to perform specialized roles such as tourist guides, natural science interpreters, patrol partners for protection work, entrepreneurs for small-scale homestead-based hospitality industry, and small business operators.
National Strategy on Ecotourism	Formulated to position India as a preferred destination for ecotourism globally. It seeks to develop an enabling ecosystem for the growth of ecotourism in the country and create synergies amongst the central and state governments, local communities, conservation NGOs, and the private sector for the development of ecotourism in the country.	This strategy seeks to promote industry players (including SGBs), such as tour operators and accommodation providers. It provides a mechanism for onboarding private players (including SGBs) for the execution of ecotourism development projects.
Swadesh Darshan Scheme	<p>This scheme promotes the creation of ecotourism circuits within states with funding support from the central government. It also recognises the role of entrepreneurs in the tourism space.</p> <p>This scheme is envisioned to synergise with other schemes, such as Swachh Bharat Abhiyan, Skill India, and Make in India, with the aim of positioning the tourism sector as a major engine for job creation and building synergies with other sectors.</p>	This scheme seeks to promote private sector participation (including SGBs) and public-private participation for the development of tourism circuits.



► FUNDING LANDSCAPE

Funding in the ecotourism space is in a nascent stage in India, with **most support coming from DFIs and the government** directed towards infrastructure and technical assistance projects rather than private sector enterprises. There is limited support from private investors, and no support from commercial banks or foundations was observed.

The World Bank supported the UP Pro Poor Tourism Development Project in Uttar Pradesh.²³⁰ The project, worth US \$40 million,²³¹ seeks to re-orient tourism in a more inclusive manner so that it contributes to the physical and economic development of local residents and entrepreneurs, such as rickshaw drivers, local artisans, and street vendors. The project is expected to enhance the linkage of local communities with the tourism value chain and improve living conditions for some of the state's poorest residents by providing access to better infrastructure services.

In 2021, the Government of India received a loan of US \$79 million from the New Development Bank²³² for Meghalaya Ecotourism Infrastructure Development. The focus of this project is to develop ecotourism hubs, create basic tourist accommodation, and improve accessibility and connectivity. Technical assistance projects are also supported by organizations such as USAID. The Forest – PLUS 2.0 programme by USAID aims to promote community-based ecotourism by enhancing ecological and socio-economic sustainability.²³³

230 [UP Pro Poor Tourism Development Project](#). UP Tourism. Accessed 13 August 2022.





231 [India Signs Loan Agreement with the World Bank for USD 40 Million for 'U.P. Pro-Poor Tourism Development Project'](#). 28 December 2017. PIB.

232 NDB. 2021. [Meghalaya Ecotourism Infrastructure Development Project](#).

233 USAID. 2019. [Forest-PLUS 2.0: forest for water and prosperity](#).



Sector Group: Transportation

SUSTAINABLE TRANSPORTATION		
KEY AREAS	BUSINESS SEGMENTS	MARKET OPPORTUNITY (2022-2030)
 <p>Electric vehicles and enabling infrastructure</p>	<ul style="list-style-type: none"> ✓ EV providers ✓ EV equipment providers ✓ Retrofitting providers ✓ Battery swapping service providers ✓ Charging service providers 	<p>US \$29 billion</p> <p>covering the EV and enabling infrastructure business segment (the other segments lack a national target and were therefore not included in the estimate).</p>
 <p>Mobile services</p>	<ul style="list-style-type: none"> ✓ Micro-mobility solutions ✓ Ride hailing solutions ✓ Ride sharing solutions 	
 <p>Non-motorized transport (NMT)</p>	<ul style="list-style-type: none"> ✓ Bicycle providers ✓ Bicycle equipment providers 	
 <p>Technology and software</p>	<ul style="list-style-type: none"> ✓ Parking solutions ✓ Traffic monitoring solutions 	



Sustainable Transportation

► BACKGROUND AND BUSINESS SEGMENTS

Background: Sustainable transportation refers to the provision of services and related infrastructure to enable the movement of people and goods from one location to another and, at the same time, ensure safety, resilience, efficiency, and protection of the environment through the reduction of fuel consumption and GHG emissions.²³⁴ The key elements of sustainable transportation include:²³⁵

- **Being green** – decreasing GHG emissions and noise pollution.
- **Universal access** – connecting all people, including women and marginalized communities.
- **Safety** – drastically reducing fatalities, injuries, and crashes.
- **Efficiency** – optimizing the predictability, reliability, and cost-effectiveness of mobility.

The transport sector has the highest reliance on fossil fuels of all sectors and is a major contributor to CO₂ emissions. The sector accounted for about 37% of CO₂ emissions globally in 2021, and its contribution is anticipated to grow even more as transport demand in developing economies increases.²³⁶ As of 2020, the global share of CO₂ emissions from each transport segment was as follows: road transport (78%), shipping (11%), aviation (8%), and rail (3%).²³⁷ As there are limited SGB activities in rail, aviation, and pipeline transport, this sector narrative focuses on road transport.

Globally, there is a push for the adoption of electric vehicles (EVs), one form of sustainable transport, and the EV market recorded steady growth between 2010 and 2020.²³⁸ Global sales of EVs reached a record high in 2021, with about 120,000 being sold weekly.²³⁹ The supportive regulatory framework in countries around the world is one of the main factors contributing to increased adoption of EVs. By 2020, at least 20 countries had banned the sale of conventional cars or mandated the sale of zero-emission vehicles.²⁴⁰

Sustainable transportation systems are beneficial for the environment as they promote the shift to alternative energy, fuel efficiency, and electrification.²⁴¹ Alternative modes of mobility reduce demand for fossil-fuel transportation or replace it altogether, contributing to reduced fossil fuel consumption and hence climate change mitigation. Sustainable transportation has a direct impact on human health and well-being as well due to a reduction in air pollution, improved safety, reduced number of deaths or injuries from transport accidents, and job creation.²⁴² Sustainable transportation increases the mobility of low-income populations and thereby contributes to their increased access to basic resources such as water, food, and healthcare.²⁴³ Other benefits include improved access

234 United Nations. 2021. [Sustainable Transport, Sustainable Development: Interagency report for second Global Sustainable Transport Conference](#).

235 Sustainable Mobility for All. 2017. [Global Mobility Report- Tracking Sector Performance](#).

236 [Transport: Improving the sustainability of passenger and freight transport](#). IEA. Accessed 6 October 2022.

237 [Distribution of carbon dioxide emissions produced by the transportation sector worldwide in 2020, by subsector](#). Statista. Accessed 9 March 2023.

238 IEA. 2021. [Global EV Outlook 2021: Accelerating ambitions despite the pandemic](#).

239 [Transport: Improving the sustainability of passenger and freight transport](#). IEA. Accessed 6 October 2022.

240 Ibid.

241 [Sector Summary: Transportation](#). Project Drawdown. Accessed 6 October 2022.

242 Holl, S. et al. 2021. [The Case for Impact Investment in Sustainable Mobility in Developing Countries](#). Shell Foundation.

243 Ibid.



to important services such as education, the integration of markets and economies, the enhancement of rural-urban linkages, and facilitation of international trade.²⁴⁴

Indian Context: As of 2022, India's automotive industry market ranked fifth in the world in its size and is projected to rise to third by 2030.²⁴⁵ The transport sector is a significant consumer of energy in India, accounting for about 50% of India's oil consumption.²⁴⁶ In 2020, the sector used around 19% of the energy consumed in the country²⁴⁷ and generated 13.5% of India's CO2 emissions.²⁴⁸ Thus, decarbonizing the transport sector is an important step towards realizing India's target of net zero by 2070.

As per the Indian Energy Storage Alliance, the Indian EV storage market is expected to grow at a compound annual growth rate (CAGR) of 36% up to 2026.²⁴⁹ As of August 2022, there were a total of about 1.3 million EVs on Indian roads, this number is expected to grow to 45–50 million by 2030.²⁵⁰

Sustainable transport places emphasis on the use of EVs and non-motorised transport. Transitioning to sustainable transport also involves city planning, improved infrastructure, and increased use of public transport services. In India, these activities fall under the government's domain, whereas the private sector is largely involved in the provision of vehicles and mobility services.

The four key areas for SGB activity are as follows: *electric vehicles and enabling infrastructure, mobility services, technology and software-based solutions, and non-motorised transport (NMT).*

ELECTRIC VEHICLES AND ENABLING INFRASTRUCTURE

EVs are vehicles that use electricity as their primary source of energy. EVs convert electrical energy into kinetic energy by an induction motor to propel themselves. Since EVs run on electricity, they need a supporting infrastructure that enables smooth functioning. Charging stations and battery swapping services facilitate large-scale adoption of EVs and are referred to as enabling infrastructure. For the purposes of this report, the term EV will include two-wheelers, three-wheelers, e-rickshaw, electric boats, and any other modes of electric transport being used in India.

EVs are an important part of the government's strategy for decarbonizing the transport sector. The government is promoting original equipment manufacturers, battery service providers, and charging infrastructure providers as they are integral to the adoption of EVs.

244 United Nations. 2021. [Interagency report for second Global Sustainable Transport Conference](#).

245 Bhardwaj, N. 2022. [Electric Vehicle Industry in India: Why Foreign Investors Should Pay Attention](#). India Briefing.

246 Ibid.

247 Kamboj, P. et al. 2022. [India Transport Energy Outlook](#). New Delhi: Council on Energy, Environment and Water.

248 CEEW. 2020. [Decarbonising the Indian Transport Sector Pathways and Policies](#).

249 Bhardwaj, N. 2022. [Electric Vehicle Industry in India: Why Foreign Investors Should Pay Attention](#). India Briefing.

250 Strategic Investment Research Unit (SIRU). [The Electric Vehicle \(EV\) Sector in India to Boost Both the Economy and the Environment](#). Invest India.


Table 22: Business segments and examples of SGBs in EVs and enabling infrastructure

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Battery swapping service providers	A battery swapping station allows EVs to exchange a discharged battery pack for a charged one as an alternative to plugging the vehicle into a charging station. This business segment covers SGBs that provide such services.	<ul style="list-style-type: none"> ▶ Battery Pool ▶ Racenergy
Charging service providers	Charging stations are a set of power electronics, usually wall or pedestal mounted, that safely supply regulated power from the grid to vehicles' batteries.	<ul style="list-style-type: none"> ▶ BrightBlu ▶ Kazm ▶ Tirex Transmission
EV equipment providers	Manufacturers and importers of EV equipment, such as electric traction motors, power inverters, charge ports, and onboard chargers.	<ul style="list-style-type: none"> ▶ Revoh
EV providers	Includes SGBs that produce EVs, which encompasses manufacturers, assemblers, or importers of EVs and encompasses EVs of all kinds, such as two-wheelers, three-wheelers, boats, etc.	<ul style="list-style-type: none"> ▶ Ebik ▶ Indeanta ▶ Massive mobility ▶ Raptee Energy ▶ Revamp Moto ▶ SMV Green Solutions
Retrofitting provider	Retrofitting services refer to conversion of internal combustion engine vehicles into EVs. This business segment covers SGBs that provide products and services that facilitate the retrofitting of vehicles.	<ul style="list-style-type: none"> ▶ Tadpole ▶ Starya Mobility

MOBILITY SERVICES

Mobility services include services such as ride-sharing, ride-hailing, mass transit, and micro-mobility.²⁵¹ The enterprises under this key area provide mobility services using EVs or other types of vehicles. Mobility services minimize individual passenger trips and encourage the mass movement of people, contributing to reductions in traffic congestion and GHG emissions. Business segments in this key area include *micro-mobility solutions*, *ride-hailing solutions*, *ride-sharing solutions*, and *mass transit solutions*. However, few SGBs in India provide mass transit solutions.

Table 23: Business segments and examples of SGBs in mobility services

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Micro-mobility solutions	Used for providing travelling services for short distances to one or two passengers at a time. They usually enable passengers to cover the first or last mile of a journey. Electric bicycles and electric scooters are among the most popular choices in micro-mobility as they are easy to use and act as an alternative to public transport.	<ul style="list-style-type: none"> ▶ Torq Electric ▶ Flo Mobility ▶ Hala Mobility ▶ MyByk
Ride-hailing solutions	Includes taxi-like solutions based on mobile applications.	<ul style="list-style-type: none"> ▶ Drife Technologies ▶ Malbork Technologies

²⁵¹ Holl, S. et al. 2021. *The Case for Impact Investment in Sustainable Mobility in Developing Countries*. Shell Foundation.



BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Ride-sharing solutions	A type of transportation where a group of passengers shares the same vehicle (car, motorcycle, bicycle, etc.).	<ul style="list-style-type: none"> ▶ MyRideMate ▶ Orahi

TECHNOLOGY AND SOFTWARE

This section looks at how technology and software can be used to improve the environmental impacts of transport. Greening is achieved by leveraging technology to manage traffic, thereby reducing congestion, preventing accidents, and making road transport safer and greener. Further, technology is also used for improving security by managing parking spaces. This key area includes enterprises that leverage technology and software to ensure efficiency in the transport sector. Business segments identified under the technology and software key area include *parking solutions* and *traffic monitoring solutions*.

Table 24: Business segments and examples of SGBs in technology and software

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Parking solutions	Includes SGBs that provide on-demand parking discovery. SGBs leverage technology to help corporations and employers manage parking while also helping drivers find parking spots.	▶ Parking Rhino
Traffic monitoring solutions	Includes SGBs that use technology to provide traffic coordination solutions to improve the safety and reliability of road transport systems. This business segment covers SGBs that leverage technology to monitor vehicles on-road for red light violations, speed violations, and automated number plate recognition, etc.	▶ Vehant Technologies

NON-MOTORIZED TRANSPORT

Non-motorized transport (NMT) includes walking, cycling, and using other modes of transport, such as rickshaws. This key area consists of developing infrastructure to facilitate NMT and the provision of bicycles. Infrastructure to facilitate NMT includes the creation of pedestrian-friendly roads and separate lanes for bicycles, etc. Responsibility for the planning and development of such infrastructure lies with the government, and private sector participation is limited to manufacturing bicycles.

In India, the bicycle manufacturing industry is dominated by businesses larger than SGBs, such as Hero, Avon, etc. As of 2019, the top four manufacturers captured about 85% of the market share.²⁵² One example of an SGB in this space is [Cyclop](#), an online marketplace for buying bicycles and other related equipment such as wheel parts, pedals etc. However, no other SGBs in bicycle manufacturing were identified for this study.

▶ POLICY LANDSCAPE

The policy landscape for sustainable transportation in India is conducive for the private sector (including SGBs). The government is making a strong push to support EVs and the creation of the enabling infrastructure that they require. For example, the government has launched several incentives and schemes to boost demand for EVs and motivate manufacturers to invest in R&D for EVs and their related infrastructure.

252 UNIDO. 2019. [Technical Report – The Indian Bicycle Sector](#).


Table 25: Key policies and strategies for Indian sustainable transportation

POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
Battery swapping policy (<i>still in draft form</i>)	Aims to standardize battery configuration across EVs. The policy promotes the use of EVs in services such as deliveries, intercity transportation etc.	The policy will benefit manufacturers as it will ensure the easy availability of machinery spare parts. This will also help battery manufacturers leverage economies of scale and lower battery production costs.
Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME)	Initially launched in 2015 to reduce the use of diesel- and petrol-powered vehicles in the country. Its primary focus is to popularize the use of EVs by bringing down costs. The scheme creates demand incentives by leading to an upfront reduced purchase price at the dealer level. FAME II will also provide demand incentives, charging infrastructure incentives, and administrative expenditure. The scheme will be implemented beginning 2024 and has a total budget allocation of US \$1.2 billion for its second phase. ²⁵³	This scheme promotes private enterprises (including SGBs) involved in manufacturing EVs.
Green Urban Mobility	Aims to provide impetus to green and clean urban mobility projects. The scheme has an outlay of about US \$367 million for implementing projects which will be selected through the Green Urban Mobility Challenge. It aims to reduce pollution levels through changes in travelling practices, the improvement of urban mobility infrastructure and services such as pedestrian/ cycling pathways, last-mile connectivity, enhanced information technology applications, and innovations in the implementation and financing of urban mobility projects.	While no specific provisions have been created for increasing SGB participation, those in cities with populations over 1 million have the opportunity to engage in PPPs.
National Electric Mobility Mission Plan	This policy aims to achieve national fuel security by promoting hybrid and electric vehicles in the country; the primary method of achieving this goal is by promoting EVs through fiscal and monetary incentives.	While this plan makes no specific provision for SGBs, its demand-side incentives and the PPP opportunities it creates may support SGBs.
National Mission on Transformative Mobility and Storage	The primary objective of this mission is to drive clean, connected, shared, sustainable, and holistic mobility initiatives.	This mission will continue for five years (until 2024) and promote domestic manufacturing across the EV value-chain.
Production Linked Incentive Scheme for Automotive Sector	Aims to enhance India's manufacturing capabilities for advanced automotive products with a budgetary outlay of about US \$3.2 billion. It promotes investments in the automotive manufacturing value chain. Its prime objectives include overcoming cost disabilities, creating economies of scale, and building a robust supply chain. This scheme is a sales value linked scheme. To be eligible under this scheme auto manufacturers need a minimum revenue of about US \$1.2 billion and auto components manufacturers need US \$60 million revenue.	This scheme promotes private enterprises involved in manufacturing EVs. However this scheme is not applicable to SGBs given the revenue requirements.

253 Mishra, R.D. and Baruah, R. 2022. [Under 20% Spent on Centre's EV Scheme](#). Mint.



► FUNDING LANDSCAPE

Different types of financiers are active in different key areas within sustainable transportation. While private investments are found across a range of business segments, DFIs mostly focus on mobility services and work with the government on infrastructure projects to improve public transport and connectivity and facilitate NMT. The EV industry has witnessed the emergence of funds, such as the Micelio Fund and EV2 Ventures, that provide seed stage capital to SGBs and smaller enterprises that provide charging infrastructure and support battery swapping.

There are some challenges associated with availability of finance for EVs as well. Since the EV space is relatively new, the product-market fit is still evolving. Due to the risks associated with EVs, financing from banks and financial institutions is not very readily available.

ELECTRIC VEHICLES AND ENABLING INFRASTRUCTURE

This key area attracts funding from a range of funders.

- **DFIs** support this key area. For example, the NITI Aayog is leading the establishment of a US \$1 billion fund, which will be backed by the World Bank and the Small Industries Development Bank of India (SIDBI).
- **VCs and impact investors** actively invest in EVs in India. Capital A partners, Eversource Ventures, and Incofin are some of the prominent investors in this space, with mainstream VCs typically investing something in the range of US \$3 million to US \$10 million.²⁵⁴ SGBs are mostly found in the enabling infrastructure space and are typically funded by angels such as Indian Angels Network and by family offices such as Credence Family Office. Deal sizes from angels range from US \$10,000 to about US \$1 billion, depending upon the nature and growth stage of the enterprise.
- **Commercial banks** such as Axis Bank and Yes Bank have partnered with EV manufacturers to provide reasonable electro-magnetic interference (EMI) on electric cars. However, retail lending to individuals and enterprises for financing EVs has not grown due to low customer awareness.²⁵⁵ EV-related loans also carry considerably higher interest rates than diesel or petrol vehicles due to their perceived greater financing risk.²⁵⁶
- **Foundations**, such as the Shell Foundation and Shakti Sustainable Energy Foundation have supported the EV ecosystem through technical assistance and funding support. For example, Shell Foundation has provided an undisclosed amount of funding to consumer lending platform RevFin in partnership with EV fleet operator SmartE. The capital will be utilized for offering loans to electric three-wheelers operating on SmartE's platform in the state of Uttar Pradesh.²⁵⁷

MOBILITY SERVICES

This key area receives funding from DFIs, private investors, and non-bank financial companies (NBFCs).

- **DFIs**, such as the World Bank, support projects to improve urban mobility by improving public transport. For example, the World Bank has loaned US \$150 million for the implementation of the Chennai City Partnership:

254 Primary research insight.

255 Gupta, N. 2022. [An Overview of EV Financing in India](#). EVreporter.

256 Laemel, R. and Kulkarni, I. 2021. [How to Make Finance Cheaper, More Accessible for EVs in India](#). RMI India.

257 Ghosh, D. 2021. [Shell Foundation Funds Revfin and SmartE Project to Push EVs in Tier-II Cities](#). Tech Circle.



Sustainable Urban Services Program. The programme will enable mobility services in Chennai, focusing on providing safe transportation for all citizens but with a specific emphasis on women's safety.²⁵⁸

- **Private investors** are also active in funding SGBs in mobility services. For example, [Hala Mobility](#) raised US \$1 million from Magnifiq Securities. The start-up's electric ride-sharing platform targets last mile connectivity issues and has a mission to provide an affordable solution that reduces pollution and congestion. Similarly, public bicycle-sharing start-up [MYBYK](#) raised US \$1 million in pre-Series A funding from Avon Cycles and other investors.²⁵⁹
- **Non-bank financial companies (NBFCs)** provide support for mobility initiatives. For example, Alt Mobility offers a low-cost debt financing solution for the electrification of commercial fleet, which was mobilized through its commercial fleet leasing platform.²⁶⁰

TECHNOLOGY AND SOFTWARE

This key area primarily receives funding from impact investors and angels and not so much from DFIs, foundations, or commercial banks. [ParkMate](#), an SGB providing smart parking solutions, has raised undisclosed funding through EvolveX, a global accelerator programme.²⁶¹ [Vehant Technologies](#), which manufactures physical security, surveillance, and traffic monitoring systems, has raised about US \$61,000 from an angel investor.

► MARKET OPPORTUNITY (2022 – 2030)

The three key areas under sustainable transportation are EVs and enabling infrastructure, mobility services, and technology and software. However, a government target only exists for EVs and enabling infrastructure but not for the remaining two key areas. Hence, the market opportunity for the sustainable transportation sector concentrates only on EVs and their supporting infrastructure using the government target-based approach and **calculates the market opportunity at US \$29 billion between 2020 – 2030**. Among the EVs, the market opportunity specifically focuses on electric two-wheelers (e.g., e-scooters and e-bikes) and three-wheelers (e.g., electric auto-rickshaws), which are where most SGBs are active.²⁶²

258 [New World Bank Project to Support Southern Indian City of Chennai Deliver Better Services to its People](#). World Bank. Accessed 5 October 2022.

259 Sangwang, S. 2021. [\[Funding Alert\] Bicycle-sharing Startup MYBYK Raises \\$1M from Avon Cycles, Others](#). Yourstory.




260 [ALT Mobility Launches New Financing Solution with NBFCs to Electrify Commercial Fleets](#). 11 August 2022. The Economic Times.



261 [Smart Parking Startup ParkMate Raises Seed Funding](#). 19 September 2022. The Startup Lab.

262 Other vehicle segments, such as passenger cars and commercial vehicles, typically require an initial investment that is higher than the SGB limit in India.



Sector Group: Water and Waste Management

WATER MANAGEMENT		
KEY AREAS	BUSINESS SEGMENTS	MARKET OPPORTUNITY (2022-2030)
 Water conservation and restoration	<ul style="list-style-type: none"> ✓ Water harvesting ✓ Efficient water usage ✓ Borehole/water well drilling services 	N/A no specific SDG targets or government targets related to water conservation and restoration
 Purification and distribution	<ul style="list-style-type: none"> ✓ Water treatment and supply ✓ Water automatic teller machine (ATM) operators 	US \$768.7 billion
 Technology for water	<ul style="list-style-type: none"> ✓ Smart water management ✓ Air to water technologies 	N/A no specific SDG targets or government targets related to technology for water

WASTE MANAGEMENT AND CIRCULAR ECONOMY		
KEY AREAS	BUSINESS SEGMENTS	MARKET OPPORTUNITY (2022-2030)
 Sustainable waste services	<ul style="list-style-type: none"> ✓ Integrated solid waste management services ✓ Wastewater services ✓ Plastic waste services ✓ E-waste services ✓ Textile waste services ✓ Waste to Value 	US \$823.2 billion covering US \$801 billion for sanitation and US \$22.2 billion for solid waste management.
 Support services	<ul style="list-style-type: none"> ✓ Technology for waste services ✓ Sustainable packaging providers ✓ Waste equipment providers ✓ Infrastructure providers 	



Water Management

► BACKGROUND AND BUSINESS SEGMENTS

Background: Water management refers to the utilization of water to meet current ecological, social, and economic needs without compromising the ability to meet future requirements.²⁶³ Nearly 40% of the world's population lives in water-scarce areas, and the World Bank estimates nearly 1.8 billion people will be living in absolute water scarcity by 2025.²⁶⁴ Therefore, investment in water management is essential to address the problem of water scarcity. Water management also plays an important role in maintaining biodiversity and ecosystem services in addition to achieving economic goals.²⁶⁵

Water management contributes to climate adaptation by building resilience, protecting health, and saving lives.²⁶⁶ Rainwater is a critical piece of water management in regions with uneven rainfall as it builds resilience and creates water reserves that steady the supply over time. Water management also contributes to climate change mitigation by protecting ecosystems and reducing carbon emissions from water and sanitation transportation and treatment.²⁶⁷ Peatlands (terrestrial wetland ecosystems) store at least twice as much carbon as all of earth's forests.²⁶⁸

Indian Context: India is among the 17 most water stressed countries in the world.²⁶⁹ As of 2019, almost 600 million people in India faced extreme water stress – a situation where agriculture, industries, and municipalities withdraw more than 80% of their available supply.²⁷⁰ It is estimated that by 2030, India will face a 50% shortfall in water supply,²⁷¹ equating to hundreds of millions of people facing severe water scarcity. This will eventually result in about a 6% loss in the country's GDP by 2050.²⁷² As of 2022, India has about 18% of the world's population and only 4% of its water resources, and groundwater depletion has become a growing concern.²⁷³ Thus, there is a dire need to manage water resources and improve water use efficiency in the country. NITI Aayog, the Indian government's leading policy think tank, has developed a Composite Water Management Index (CWMI) to enable effective water management in the country. The government encourages private sector participation in water management space through CSR activity.

WATER CONSERVATION AND RESTORATION

Generally, water conservation and restoration entails the “minimization of loss or waste [and] the preservation, care and protection of water resources as well as efficient and effective use of water.”²⁷⁴ Water is an important input in various sectors such as agriculture, energy production, and industry. The various methods of water conservation and restoration include rainwater harvesting and storage, water recycling and reuse, storing water in dams, and artificial recharging of aquifers.²⁷⁵

263 [Water Resources Management: Sector Results Profile](#). World Bank. Accessed 25 August 2022.

264 [Water Resources Management](#). World Bank. Accessed 25 August 2022.

265 [Water and the Green Economy](#). United Nations Department of Economic and Social Affairs (UNDESA). Accessed 9 March 2023.

266 [United Nations – Water and Climate Change](#)

267 Ibid.

268 Ibid.

269 Hofste, R., et al. 2019. [17 Countries, Home to One-Quarter of the World's Population, Face Extremely High Water Stress](#). WRI.

270 Ibid.

271 [4 Ways to Scale up Finance for India's Water Sector](#). 26 May 2021. World Economic Forum.

272 NITI Aayog. 2019. [Composite Water Management Index](#).

273 [How is India addressing its water needs?](#) World Bank. Accessed 24 August 2022.

274 Water Services Regulatory Board. 2009. [Water Conservation and Water Demand Management Guidelines](#).

275 Ibid.



This key area focuses on water conservation and restoration of water resources. Businesses engaged in rain water harvesting, groundwater restoration, source sustainability, and source augmentation are covered under this key area, which leads to the following three business segments: *borehole/water well drilling services*, *efficient water use*, and *water harvesting*.

Table 26: Business segments and examples of SGBs in water conservation and restoration

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Borehole/water well drilling services	Includes SGBs involved in groundwater exploration, such as those that drill boreholes and protected dug wells.	<ul style="list-style-type: none"> ▶ Krishna Borewells ▶ Shree Sairam Borewells
Efficient water usage	Includes SGBs that manufacture devices to improve water use efficiency.	▶ EarthFokus
Water harvesting	Includes SGBs involved in rainwater harvesting and storage and that develop rainwater harvesting systems.	▶ Neerain

WATER PURIFICATION AND DISTRIBUTION

As of 2021, approximately 48% of rural households and 28% of urban households in India do not have access to an improved or safe drinking water source.²⁷⁶ The government has launched various programmes to provide piped water to all households in the country. Water purification is the process of removing contaminants (chemical contaminants, biological contaminants, solids, or gases) from water.²⁷⁷ The practice of selling or distributing water is often combined with purification, as seen in community water purification systems and water ATMs.

The two business segments with SGB activities in India, therefore, are *water treatment and supply* and *water ATM operators*.

Table 27: Business segments and examples of SGBs in water purification and distribution

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Water ATM operators	Includes SGBs that set up low-cost water ATMs which supply purified water at low costs to communities and institutions.	▶ Hydrotech Solutions
Water treatment and supply	Includes SGBs that provide purification equipment or supply purified water.	<ul style="list-style-type: none"> ▶ Drink Prime ▶ Oceo Water

TECHNOLOGY FOR WATER

The use of smart water management technologies such as IoT, blockchain, and artificial intelligence (AI) helps to identify, analyze, and understand patterns of water use.²⁷⁸ IoT-based technology is used in the agriculture sector to optimize the usage of water for irrigation (avoiding over/under irrigation) and detect any leakages.²⁷⁹ Smart metering devices are used in the domestic and industrial sectors to monitor water consumption levels and detect any

276 Khambete. A. 2021. [Everything You Want to Know about Drinking Water](#). India Water Portal.

277 Popescu R., et al. 2017. [Nanostructured Membranes for the Microbiological Purification of Drinking Water, Chapter 12](#). In: Grumezescu, A. (ed) [Water Purification, Nanotechnology in the Agri-Food Industry](#), vol 9. Elsevier, United States.

278 Gupta, A. et al. 2020. [Smart Water Technology for Efficient Water Resource Management: A Review](#). Energies.

279 Kamienski, C. et al. 2019. [Smart Water Management Platform: IoT-Based Precision Irrigation for Agriculture](#). Sensors.



leakages in the distribution system.²⁸⁰ As such, smart water management technologies lead to better water resource management by minimizing water wastage and ensuring efficiency in water use. Technologies are also used for water harvesting. For example, atmospheric water generator technology is used to convert air into water, which helps to increase water availability.

This key area includes businesses that leverage digital technologies to monitor the use of water and harvest water, including *air to water technologies* and *smart water management*.

Table 28: Business segments and examples of SGBs in technology for water

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Air-to-water technologies	Includes SGBs that use technology to harvest water by converting humidity in the air into water.	<ul style="list-style-type: none"> ▶ Akvo ▶ Uravu labs
Smart water management	This business segment includes enterprises that use technology for water management, such as manufacturers of smart meters, software providers, etc.	<ul style="list-style-type: none"> ▶ Kritsnam technology ▶ WEGoT

► POLICY LANDSCAPE

Water management in India is led by the government. Hence, policies target municipalities and other government departments that are in charge of implementing various programmes and schemes. For example, the Groundwater Management and Regulation Scheme to map the available resources and identify stressed resources, etc. This mapping activity is essentially undertaken by the government, with some potential for businesses collaboration to execute the task. Other policies encourage the private sector's participation in the water management sector by promoting CSR activities. In response, large corporations are transforming their supply chains by working with socially responsible SGBs and SMEs. The government is also supporting activity in this area under AMRUT 2.0 (see Table 29), which is designed to empower start-ups in the water and used-water sector with technological innovation. Similarly, skill development and employment generation measures under the Jal Jeevan Mission may create opportunities for SGB activity.

280 Gupta, A. et al. 2020. *Smart Water Technology for Efficient Water Resource Management: A Review*. Energies.


Table 29: Key policies and strategies for Indian water management

POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGBS
Atal Bhujal Yojana	A central government scheme with a total outlay of about US \$751 million to be implemented over a period of 5 years (2020–21 to 2024–25). Half of this amount is loaned by the World Bank and the other half is contributed by the central government. It seeks to incentivize states to implement groundwater management practices and provide support to women, marginalized farmers, populations affected by floods and droughts, etc.	This scheme seeks to improve community participation in water management and does not focus on private sector participation.
Atal Mission for Rejuvenation and Urban Transformation 2.0 (AMRUT 2.0)	Launched in 2021 for five years, this mission is designed to provide universal coverage of water supply through functional taps to all households in the country and coverage of sewerage/septage management in 500 cities. ²⁸¹ It promotes a circular economy of water through the development of a City Water Balance Plan (CWBP) for each city focusing on recycling/reuse of treated sewage, rejuvenation of water bodies, and water conservation.	Under this scheme, the government has launched a start-up competition to encourage start-ups that provide innovative technology and business solutions to address challenges in the urban water sector in India. The winners will be awarded US \$25,000 to scale up their solutions.
Ground Water Management and Regulation Scheme (GWM& R)	Implemented in 2007–08 with an aim of providing scientific inputs for the sustainable management of groundwater resources in the country. It is a Central Sector Scheme dealing exclusively with groundwater. The National Aquifer Mapping and Management (NAQUIM) programme was initiated in 2012 as a part of the scheme. The aim is to delineate and characterize the aquifers and develop plans for sustainable groundwater management in the country.	This scheme is implemented through the Central Ground Water Board and does not specifically address the engagement of the private sector.
Jal-jeevan Mission	The broad objectives of the mission are to provide Functional Household Tap Connection (FHTC) to every rural household. It aims to achieve end-to-end management of water from source sustainability to greywater recycling. It includes skill development and employment generation: skilling and capacity building of local people to maintain water supply structures.	This scheme promotes leveraging technology to improve transparency and accountability. While central government-focused, there are opportunities for private sector participation in ensuring quality of water supply as laid out in the Mission. ²⁸²
National Water Mission	The aim of the National Water Mission is to ensure integrated water resource management by conserving water, minimizing wastage, and ensuring more equitable distribution across and within states.	This policy aims to promote businesses in micro-irrigation, water positive technologies, and desalination technologies among others. Under this mission the government seeks to increase private sector participation through the CSR activities of larger corporations and nonprofits. There are not any direct policy impacts on SGBs, but SGB can benefit indirectly as large corporations transform their supply chains.

281 Basic civic amenities are provided under the [Atal Mission for Rejuvenation and Urban Transformation \(AMRUT\) 2.0](#), 22 December 2022.

282 [Private sector engagement for scaling up small water enterprises](#), 15 July 2022. Safe Water Network.



POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGBS
National Water Policy	Addresses the need for a comprehensive law, making water management more climate resilient in India, and conservation of river corridors, water bodies, etc. A draft policy has been created; however, it has not yet been adopted. This draft policy seeks to provide a coherent structure and clearly link water policy to policies in other sectors.	The current policy talks about increasing private sector engagement through PPPs. At present, limited SGB presence is seen with PPPs and SGBs are largely working in collaboration with municipalities.
Water Technology Initiative	Aims to strengthen R&D capacity and the capability to develop research-based solutions for existing and emerging water challenges facing the country in the areas of water quality, quantity, reuse, and recycling. This scheme promotes research, development and the capacity building of professionals working in the water management sector. The department supports the ecosystem through research, bilateral partnerships, etc.	This promotes research and development for emerging technologies in the water management sector, such as desalination of water, sustainable water treatment and reuse technologies, etc. This scheme does not directly contribute towards market creation for SGBs working in these emerging technologies.

► FUNDING LANDSCAPE

In India, the public sector plays a lead role in water management. Water supply is managed at a municipal level. Private players are contracted by municipalities either to set up the required infrastructure or maintain the infrastructure setup or a combination of both. In larger cities municipal corporations service millions of people; direct contracting with municipalities tends to be the domain of larger corporations. The role of SGBs in this sector is either in acting as sub-contractors to large corporations or in engaging with the municipalities in smaller towns to set up decentralized infrastructure. Overall funding in the sector is dominated by DFIs. The focus of this funding is on water conservation and restoration, although some funding is also directed towards infrastructure projects to facilitate water purification and distribution.

No significant activity by commercial banks was identified for any of the key areas below. SGBs can access debt financing by commercial banks under the normal working capital or term loan facilities. However, to access such lending facilities, SGBs need to pledge collateral and the repayment mechanisms are not structured to meet the fund flow characteristics of the sector.

WATER CONSERVATION AND RESTORATION

The funding landscape for water conservation and restoration is heavily dependent on **public sources of capital** since most of the initiatives in this space are either infrastructure oriented or non-revenue generating. In addition to government funding, DFIs such as JICA, the World Bank, and ADB are actively supporting the setting up of large-scale infrastructure projects.

Initiatives under this key area are also funded through the **CSR programmes** of corporations focused on promoting sustainable water stewardship. For example, Hindustan Unilever contributes towards conservation and restoration activities through its CSR programmes. The work of these programmes focuses on encouraging water conservation measures, community-based governance of local water resources, and optimized use of water.



WATER PURIFICATION AND DISTRIBUTION

The funding landscape for water purification and distribution is reasonably diversified since interventions in this area can be at a large urban body level or at a local community level. At the large urban body level, initiatives under this key area witness support from **DFIs** and **private foundations**. For instance, the Urban Water Supply Modernization Program of the state of Karnataka received funding of US \$150 million from the World Bank. This project aims to provide continuous piped water to inhabitants in three cities of Karnataka. The government has also launched a start-up challenge under AMRUT 2.0 to promote start-ups in the water and wastewater sector. The winning start-ups will be awarded about US \$25,000 to scale their solutions.

VCs such as Aavishkaar Capital and Advantage Ventures have invested in social enterprises such as [Waterlife](#) and [Piramal Sarvajal](#), which operate in the water purification and distribution-based business segments.

Projects under the key area have also attracted **CSR funding** from corporations such as PepsiCo²⁸³ and Standard Chartered-Piramal.²⁸⁴ These corporations endeavour to build a positive value chain by working with other socially responsible enterprises and ultimately enhancing water security and improving access by setting up decentralized drinking water solutions.

TECHNOLOGY FOR WATER

The government of India recognises the important role that technology can play in improving water management and seeks to promote technological solutions in the water management space by actively supporting start-ups. Recently, the government (under the Department of Science and Technology) provided financial support of about US \$41,000 to [Kritsnam Technology](#).²⁸⁵ Kritsnam technology provides data-driven solutions to use freshwater sustainably for industrial, commercial, agriculture and drinking purposes.

Some VC activity was also witnessed in this sector. For example, [Uravu Labs](#) raised funding in seed/ pre-seed rounds, [Akvo](#) raised an undisclosed amount from Schokland Funds, and [Kritsnam Technologies](#) raised seed funds from GenNext Ventures in 2019 and eleven different angel investors in 2022.

► MARKET OPPORTUNITY (2022 – 2030)

While the key areas with high potential for SGB contribution and growth are water conservation and restoration, purification and distribution, and technology for water, there are no specific SDG targets or government targets related to technology for water or water conservation and restoration key areas. Hence, the market opportunity estimate pertains only to water distribution and purification. The estimated **market opportunity is US \$768.7 billion** to achieve universal access to water by 2030. In the budget 2022–23, the government has allocated about US \$7.5 billion to provide tapped water to about 38 million households (about 182.4 million individuals). However, there is a significant gap between the amount allocated by the government and the amount required to cater to the entire population. This creates opportunities for private businesses to participate in this sector.

283 [World Water Day 2021 – Top CSR Projects in India](#). The CSR Journal. Accessed 24 August 2022.

284 [Standard Chartered and Primal Sarvajal's Commitment to Provide Access to Safe Drinking Water](#). CSR Times. Accessed 25 August 2022.

285 [Govt Announces Rs 3.29-cr Financial Support to Startup Firm Kritsnam Technologies](#). The Print. Accessed 24 August 2022.



Waste Management and Circular Economy

► BACKGROUND AND BUSINESS SEGMENTS

Background: The World Bank estimates that 2.01 billion tonnes of municipal solid waste are generated globally every year, and at least one third of it is not managed appropriately in an environmentally safe fashion.²⁸⁶ The indiscriminate disposal of waste creates serious health, safety, and environmental consequences and contributes to pollution and global climate change through methane generation.²⁸⁷

The adoption of sustainable waste management practices plays a critical role in the transition to a green economy. Waste management is the effective control of the generation, storage, treatment, recycling, reuse, transportation, recovery, and disposal of waste.²⁸⁸ Reducing waste mitigates climate change as waste is a major source of GHG emissions. Landfills are the third-largest anthropogenic source of methane, “accounting for approximately 11% of estimated global methane emissions, equivalent to nearly 800 megatons of carbon dioxide equivalent per year.”²⁸⁹ Waste incineration is also detrimental for the climate, emitting 2.5 times more CO₂ to generate the same amount of electricity as a coal power plant.²⁹⁰ Conversely, recycling reduces energy consumption as a product made from recycled materials requires less energy than a product from new materials.²⁹¹

In addition, measures to reduce farm waste and redistribute edible food can help address hunger and malnutrition. Wet waste (organic biodegradable waste) can be converted into compost, biogas, and clean, renewable, and affordable energy. Moreover, efficient waste management services can be a powerful catalyst for economic growth by creating new jobs.²⁹²

Indian Context: Waste generation is expected to grow to an alarming level as India’s population continues to rise.²⁹³ Urban India generates 50 million metric tonnes (MT) of municipal solid waste per year, which comprises 51% organic waste, 17% recyclables, 11% hazardous, and 21% inert waste.²⁹⁴ At current rates, this is expected to reach 125 million MT per year by 2031.²⁹⁵ The rapidly growing urban population also poses a new challenge to treating wastewater and sanitation systems.²⁹⁶ Most Indian villages do not have any waste management infrastructure, and the lack of formal infrastructure leads 90% of the villages to depend on informal waste collectors.²⁹⁷

The waste management sector in India has been traditionally dominated by the informal sector, with on-ground execution being carried out by marginalized waste picker communities.²⁹⁸ The informal sector refers to either individuals, families, or private enterprises whose activities are not licensed or taxed by and reported or registered

286 [What A Waste 2.0: A Global Snapshot of Solid Waste Management to 2050](#). The World Bank. Accessed 24 January 2023.

287 Ibid.

288 [Chemicals and Waste](#). UN Department of Economics and Social Affairs. Accessed 24 January 2023.

289 [Landfill Methane: Reducing Emissions, Advancing Recovery and Use Opportunities](#). Global Methane Initiative. Accessed January 24 2023.

290 [Trash Incineration and Climate Change: Debunking EPA Misinformation](#). Energy Justice. Accessed January 24 2023.

291 U.S. Energy Information Administration. [Recycling and the environment explained](#). Accessed 20 September 2022.

292 [What A Waste 2.0: A Global Snapshot of Solid Waste Management to 2050](#). The World Bank. Accessed 24 January 2023.

293 [Waste Management in India – Statistics & Facts](#). Statista. Accessed 24 January 2023.

294 [Solid Waste](#). India Waterportal. Accessed 24 January 2023.

295 [Effective Waste Management for Sustainable Future](#). 8 February 2023. Confederation of Indian Industry.

296 [Circular Economy in Municipal Solid and Liquid Waste](#). 17 May 2022. Ministry of Housing and Urban Affairs, Government of India.

297 Pandey, K. 2022. [Most Indian Villages Do Not Have Any Waste Management Infrastructure: Study](#). Down To Earth.

298 [Indian Firm’s Digital Solution for Urban Waste Pickers](#). 29 July 2021. The UN Specialized Agency for ICTs.



to governmental authorities. The informal waste management providers often provide waste collection services, and they play an important role in reducing the cost of treatment and disposal of waste.²⁹⁹ About one percent of India's population is estimated to engage in waste management informally.³⁰⁰ How prevalent the informal sector is relative to the formal sector in the country is yet to be known. However, one study estimates that only one-third of the total e-waste - one business segment of waste management - in India is processed by formal recyclers, while the rest is either not recycled or handled by informal recyclers.³⁰¹

However, over the past few years, the government has placed great emphasis on improving waste management services in the country and has taken steps to formalize the collection, segregation, and treatment process. While municipal bodies at a city/town level deliver waste management services, the government outsources waste management functions to private players on a contractual basis via public-private partnerships (PPPs). With the aim of enhancing the involvement of the private sector at each stage of the process, the government has organized several start-up competitions to support technology development and the commercial deployment of innovations in this space. These measures have the potential to improve resource efficiency in the country by creating transparency in waste value-chains and aiding the effective recovery/re-use of waste produced; the adoption of a circular economy in India will result in yearly benefits of US \$624 billion by 2050 and a 44% reduction in GHG emissions.³⁰²

This report identified two key areas within the waste management sector in India: *sustainable waste services* and *support services*. The sustainable waste services key area covers primary activities in the waste management value chain, and support services include the secondary activities necessary to support the primary activities.

SUSTAINABLE WASTE SERVICES

The sustainable waste services key area deals with various activities across the waste management value chain, including waste collection, sorting, material recovery, recycling, disposal, etc. The business segments with SGB activities under the sustainable waste services key area include *e-waste services*, *integrated solid waste services*, *plastic waste services*, *textile waste services*, *waste-to-value services*, and *wastewater services*. Business segments identified but not listed here include *biomedical and hazardous waste services*, where either business activities are rare or multinational companies beyond the scope of the SGB range are active.

299 Singh, R. 2022. [Solid Waste Management: Why Integrating Informal Sector Is A Must](#). DownToEarth.

300 Sengupta, D. et al. 2022. [Circular Economy and Household E-Waste Management in India: Integration of Formal and Informal Sectors](#). Minerals Engineering, Vol. 184

301 Ibid.

302 Kumar, R. 2022. [What Is Circular Economy and Why Is It Important for India?](#) The Economic Times.


Table 30: Business segments and examples of SGBs in sustainable waste services

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
E-waste services	SGBs involved in the collection, transportation, and disposal of e-waste (e.g. electrical and electronic equipment, batteries) catering to households, municipalities, businesses, or commercial establishments. They also provide extended producer responsibility (EPR) ³⁰³ services to clients.	<ul style="list-style-type: none"> ▶ Binbag ▶ NamoeWaste
Integrated solid waste management services	Collect, transport, segregate, recycle, treat, and dispose of different types of solid waste, including highly decomposable objects (e.g. food), bulky items (e.g. tree branches or old appliances), and slowly compostable items (e.g. paper, glass, or metal objects).	<ul style="list-style-type: none"> ▶ Sahas Zero Waste ▶ Recircle
Plastic waste services	Collect, transport, recycle, and dispose of plastic waste, serving households, municipalities, businesses, or commercial establishments.	<ul style="list-style-type: none"> ▶ Ashaya Recyclers Private Limited ▶ Banyan Nation
Textile waste services	Involved in collecting, transporting, sorting, recycling, treating, and disposing of textile waste, including fashion and textile industry waste created during production, consumer use, and disposal.	<ul style="list-style-type: none"> ▶ EcoDhaga ▶ Rimaged
Waste to value³⁰⁴	Convert waste into useful resources, such as new or improved products (e.g. energy, organic fertilizers, clothing, building materials). This segment includes SGBs working in waste-to-energy, waste-to-fuel, waste-to-compost, waste-to-building materials, waste-to-textile, etc., using various technologies and innovations.	<ul style="list-style-type: none"> ▶ Paterson Energy ▶ Wastelink
Wastewater services	SGBs that collect, treat, and dispose of wastewater for municipalities, businesses, or commercial establishments.	<ul style="list-style-type: none"> ▶ Grace Green Infra Pvt. Ltd. ▶ Indra Water

SUPPORT SERVICES

The business segments under this key area were identified by studying the various support services required to complement the primary activities in the waste value chain. Business segments with SGB activities in this key area include *infrastructure providers*, *sustainable packaging*, *technology for waste*, and *waste equipment providers*.

Table 31: Business segments and examples of SGBs in support services

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Infrastructure providers	SGBs that set up, operate, and maintain effluent treatment plants (ETPs), sewage treatment plants (STPs), and material recovery facilities (MRFs), etc.	<ul style="list-style-type: none"> ▶ Ganesh Enviro
Sustainable packaging	SGBs that provide biodegradable or no packaging solutions, thereby reducing non-biodegradable waste.	<ul style="list-style-type: none"> ▶ Refillable ▶ Zeroplast labs

303 [Extended Producer Responsibility](#). OECD. Accessed 9 March 2023.

304 The terms were adopted from MoHUA. 2017. [Waste to Wealth: A Ready Reckoner for Selection of Technologies for Management of Municipal Waste](#).



BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Technology for waste	Leverage technology to increase efficiency in waste management processes such as aggregators of waste collectors, SGBs providing IoT bins and AI and ML-enabled segregators, etc.	<ul style="list-style-type: none"> ▶ Bintix ▶ Infinite Cercle (Cercle X) ▶ Wastefull Insights
Waste equipment providers	Provide the equipment required for delivering waste management services. SGBs in this business segment manufacture support equipment such as modified collector trucks, conveyor belts, equipment for purification of air, water treatment equipment, etc.	<ul style="list-style-type: none"> ▶ TrashCon ▶ Vivesty Green Recyclers

► POLICY LANDSCAPE

The overall policy landscape in the waste management sector in India is favourable. The government has launched several national priority missions to improve the state of waste management (both rural and urban) and access to sanitation, launched several action plans and start-up competitions, and encouraged PPP models.

Despite the positive steps taken by the government, there is a need to increase transparency in waste value chains to encourage private investment in the sector. Due to the informal nature of waste management operations, the sector remains unattractive to investors. Furthermore, while the government encourages PPPs, the informal nature of many service providers' businesses hinders them from working with municipal corporations. Lastly, working with municipal corporations is difficult for start-ups due to operational inefficiencies such as lags in payment schedules and cancellation of tenders. Thus, SGB activity is not very vibrant despite the strong policy push.

Table 32: Key policies and strategies for Indian waste management and circular economy

POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
Atal Mission For Rejuvenation And Urban Transformation 2.0	Will be implemented over a period of five years (2021-26) with the goal of increasing water-use efficiency across all sectors and ensuring sustainable withdrawals and supply of freshwater. The current mission obligates PPPs for cities with populations over one million. In those cities, a minimum of 10% of the total fund allocation at the city level needs to be committed to PPP projects.	The Technology Sub-Mission (TSM) will encourage start-up ideas and private entrepreneurship by commissioning them into pilot projects. The government has also launched the AMRUT 2.0 start-up challenge to encourage start-ups working in water management and sanitation space. The winners of this competition will receive awards of US \$25,000.
Batteries Management Rules, 2022	Replaces the 2001 rules and delineates the roles and responsibilities of different stakeholders, such as manufacturers, importers, dealers, etc. to ensure the sound management of battery waste. The rules require a computerized system for tracking the sale, distribution, collection, and transport of batteries. They also create provisions for EPR for producers and importers of batteries.	These rules promote the setting up of new industries and entrepreneurship in the collection and recycling/refurbishment of waste batteries.



POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
Biomedical Waste Rules	Largely deal with the packaging, handling, and treatment of biomedical waste and include strict monitoring and compliance procedure for entities involved in the transport, handling, and treatment of biomedical waste.	They do not specify the involvement of the private sector (including SGBs), however SGBs handling biomedical waste must abide by these rules.
Construction and Demolition Waste	Provide a framework of definitions, roles, and responsibilities for various stakeholders such as waste generators, local authorities, various government authorities, etc. They also provide guidelines on the segregation, handling, and disposal of construction and demolition waste.	The rules mention that the local authorities may partner with private players to discharge some of the functions of the local bodies, which creates opportunities for SGBs.
Electronic Waste Rules, 2016	Provide a framework of definitions, roles, and responsibilities for various stakeholders, such as manufacturers, producers, and dealers of plastic waste. These rules also provide for EPR for any producer of electrical or electronic equipment.	Requires the producer of electrical or electronic equipment to create proper channels for the management of e-waste, which creates opportunities for the private sector (including SGBs).
Hazardous Waste Management Rules, 2016	Provide the legislation on the management of hazardous and other wastes. ³⁰⁵ The rules lay out the roles and responsibilities of various stakeholders, the requisite permissions to operate in the hazardous waste management space, guidelines for the export and import, treatment storage, disposal, packaging, labelling, and transport of such waste.	This provides for the participation of the private sector after obtaining approval from the government authority.
Municipal Solid Waste Management (SWM) Rules, 2016	Lays the foundation for municipal solid waste management practices. It promotes the use of different technologies for processing waste.	The rules also provide for the engagement of the private sector in the waste processing and treatment stage.
National Action Plan on Municipal Solid Waste Management	This guiding document for states prepares an action plan for managing solid waste at a city/town level. The plan emphasizes the following hierarchy for waste management: 1) waste prevention or minimization, 2) waste utilization, 3) waste recycling, 4) waste processing, 5) waste-to-energy, and 6) landfilling. The plan presents a cluster-based approach for waste processing and disposal to discourage the mushrooming of small facilities which are difficult to monitor.	The plan calls for engagement between the public and private sectors in waste processing and treatment. SGBs can work with municipalities on a contractual basis.

³⁰⁵ Wastewater and exhaust gases, wastes arising out of the operation from ships beyond five kilometers of the relevant baseline, radioactive wastes, bio-medical wastes, etc. are some of the wastes considered as hazardous wastes under these rules.



POLICY/STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
Plastic Waste Rules, 2018	Provide guidelines for the manufacturing and recycling of plastic bags and multi-layered packaging and created extended producer responsibility (EPR) for producers, importers, and brand owners of plastic waste. According to these rules, producers, importers, and brand owners are required to submit an EPR plan to the State Pollution Control Board detailing their strategy to manage and implement plastic waste.	This provision has created opportunities for SGBs like Recircle , who partner with producers, importers, and brand owners of plastic waste to execute their EPR obligations.
Swachha Bharat Mission-Grameen 2.0	Launched in 2014, with phase II approved in 2020 with the aim of eliminating open defecation in the country. The second phase will be implemented between 2020 and 2025 and includes the following targets: universal access to toilets, effective management of solid waste by 80% of households and all public places, and reducing litter and stagnated water and plastic waste in villages.	The mission supports private sector engagement via cost-sharing, cost recovery, and revenue generation models.
Swachh Bharat Mission-Urban 2.0	Launched in 2021 as the second phase of the Swachha Bharat Mission (SBM) to be executed from 2021 to 2026. The mission aims for 1) garbage-free urban India focusing on the management of construction and demolition waste and plastic waste, 2) a system for managing untreated fecal sludge or used water, and 3) behavioural change of citizens.	This encourages local, innovative, cost-effective solutions and business models by small-scale entrepreneurs and start-ups in solid waste and sanitation management via investment in R&D and technologies.
Waste to Wealth Mission	Aims to identify, develop, and deploy technologies to treat waste to generate energy, recycle materials, and extract resources of value.	This mission supports SGBs that require support for technological development.

► FUNDING LANDSCAPE

VCs, DFIs, and foundations play a significant role in funding the waste management sector in India. Identified DFIs and foundations provide funding to improve sanitation and public health. VCs have invested in start-ups working across various segments of the waste value-chain, and impact investors have supported social enterprises such as [Saahas Zero Waste](#) operating in the collection, segregation, treatment, and disposal of solid waste. Commercial investors have invested in capital expenditure (CapEx)-heavy models which can meet the return expectations of commercial investors.

As the formal waste management sector is evolving, funders and investors need to introduce innovative financial instruments such as outcome-based payments, impact bonds, guarantees, and patient working capital debt to support small businesses to scale up and achieve sustainability. Such innovative financing instruments will help SGBs sustain longer return horizons and meet their working capital needs.³⁰⁶

306 Primary research insight from Intellectap interviews.



SUSTAINABLE WASTE SERVICES

- **DFIs and the government** are mainly responsible for funding sustainable waste services. The funding is largely directed towards projects that aim to improve sewage treatment and solid waste management. For example, the World Bank approved US \$105 million to strengthen solid waste management systems in Kerala in 2021 by establishing integrated systems that include a balance of decentralized and centralized waste management interventions.³⁰⁷
- **Private investors**, particularly VCs, have been active in supporting plastic waste management businesses. This focus is driven by the significant awareness and policy push toward eradicating plastic waste. Emerging markets like India present high return prospects in the plastic waste management space.³⁰⁸ VCs and impact investors that fund initiatives under this key area include Aavishkaar Capital, Circulate Capital Ocean Fund, Asha Impact, and Ennovent Capital, amongst others. **NEPRA** raised its seed round of US \$0.9 million from Aavishkaar Capital in 2013³⁰⁹ and raised round C funding of US \$18 million from Aavishkaar Capital and Circulate Capital in 2020.³¹⁰ **Ishitva Robotics Systems** raised pre-series A rounds from Inflection Point Ventures.³¹¹ Ennovent Capital, an impact investor that provides funding in the WASH sector,³¹² invested an undisclosed amount in **Hasiru Dala Innovations**, a waste management SGB based in Bengaluru.³¹³ In 2016, Green Artha invested US \$800,000 in a waste recycling company, **Banyan Nation**.³¹⁴ The Circulate Capital Ocean Fund (CCOF) raised US \$39 million to develop the largest investment portfolio focused on reducing or eliminating ocean plastic waste in India in 2020.³¹⁵ Integra Capital also invested in **Waste Link**, a business that transforms surplus or rejected food that would otherwise be wasted into nutritious animal feed.³¹⁶
- **Commercial banks** are also funding the waste management sector. For example, IDBI Bank developed a framework to determine the eligibility criteria for green projects for its Green Bond Portfolio.³¹⁷ In 2015, IDBI raised about US \$350 million from green bonds. This fund has been utilized in different sectors, such as clean energy and waste management. Within the waste management sector, the capital will be utilized for financing investments in integrated waste minimization, collection, management, transportation, disposal, re-use, recycling, and waste-to-energy power plants,³¹⁸ where SGBs play a significant role in the collecting and transporting process.
- **Foundations** are also lending active support to the sector through the government. Sanitation is one of the five priorities of Bill and Melinda Gates Foundation in India. The foundation supported sanitation and fecal sludge management initiatives in the country and supported the Ministry of Housing and Urban Affairs through a US \$150,000 technical assistance project on urban sanitation and fecal sludge management in 2019.³¹⁹

307 [World Bank Approves \\$105 Million Project to Strengthen Solid Waste Management Systems in Kerala, India](#). The World Bank. Accessed on 24 January 2023.

308 Circulate Capital. 2021. [Financing Plastic Action in Emerging Markets Addressing Barriers to Investment](#).

309 Information from VCC Edge Database.

310 Roy, D. 2020. [Waste Management Firm Nepra Raises Series C Funding From Aavishkaar, Circulate Capital](#). VCCIRCLE.

311 [What A Waste 2.0: A Global Snapshot of Solid Waste Management to 2050](#). The World Bank. Accessed 24 January 2023.

312 [Transforming Waste Management, and Waste-Pickers' Prospects, in Bengaluru](#). Ennovent. Accessed 24 January 2023.

313 Sarika, S. [Impact Investor Ennovent Backs Waste Management Startup Hasiru Dala](#). VCCIRCLE. Accessed January 24, 2023.

314 Ganguly, P. [Plastic Recycling Startup Banyan Nation Raises Funds from Artha](#). 2 March 2016. The Economic Times.

315 Kaplan, R. [Investing to Transform India's Recycling and Circular Economy Value Chain](#). Circulate Capital. Accessed 24 January 2023.

316 [Wastelink](#). Wastelink. Accessed 29 August 2022.

317 IDBI Bank. N.d. [IDBI Bank Limited Green Bond Framework](#). Accessed 24 January 2023.

318 Ibid.

319 [WASH Institute](#). Bill and Melinda Gates Foundation. Accessed 24 January 2023.



SUPPORT SERVICES

The support services key area witnesses support mainly from VCs and not much from DFIs, commercial banks, or foundations. [Bintix](#), which provides a technology platform for waste collection, has raised about US \$750,000 over multiple rounds.³²⁰ In 2021, Imperial Tobacco Company of India Ltd. (ITC) partnered with Invest India under the ITC Sustainability Innovation Challenge in an effort to support start-ups working on sustainable packaging and smart waste management solutions.


► MARKET OPPORTUNITY (2022 – 2030)



Since there are two main categories of waste (solid and liquid waste), the market opportunity is estimated for solid waste and sanitation services separately. Using the SDG target approach, **the market potential for sanitation and solid waste management is projected to be US \$801 billion and US \$22.2 billion, respectively, totaling US \$823.2 billion.** The government has allocated about US \$903 million to provide sanitation services in rural areas in its budget for 2022-23, but there is a significant gap between the amount allocated by the government and the amount required to cater to the entire population.

320 [Bintix](#). Crunchbase. Accessed 24 January 2023.



Sector Group: Built Environment

GREEN BUILDINGS		
KEY AREA	BUSINESS SEGMENT	MARKET OPPORTUNITY (2022-2030)
 <p>Green construction</p>	<ul style="list-style-type: none"> ✓ Green construction materials providers ✓ Green building construction ✓ Green building consultancy ✓ Support service providers 	<p>US \$1.04 trillion</p>

DISASTER MANAGEMENT		
KEY AREA	BUSINESS SEGMENT	MARKET OPPORTUNITY (2022-2030)
 <p>Disaster preparedness</p>	<ul style="list-style-type: none"> ✓ Predictive analytics and AI 	<p>No estimate</p> <p>due to the lack of SGB activities in this sector.</p>
 <p>Disaster response</p>	<ul style="list-style-type: none"> ✓ Drone technology ✓ Satellite-based technology 	



Green Buildings

► BACKGROUND AND BUSINESS SEGMENTS

Background: A “green” building is 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.³²¹ According to the World Green Building Council (WGBC), features of green buildings include “the efficient usage of energy, water, and other resources, the use of renewable energy, measures to reduce pollution and waste and to enable recycling, good indoor environmental air quality, the use of non-toxic, ethical, and sustainable materials, the consideration of the environment and the quality of life of occupants in design, construction and operation, and the design enabling adaptation to a changing environment.”³²²

The GHG emissions from the buildings and construction sectors need to be completely decarbonized by 2050 to meet the Paris Agreement goals.³²³ In 2021, buildings accounted for 40% of global energy consumption and 33% of GHG emissions.³²⁴ Green buildings help in climate mitigation by reducing emissions and improving resource efficiency, but they also play an important role in climate adaptation. Green building increases the resilience of buildings and reduces their vulnerability to extreme weather events.³²⁵ Measures such as bio-climatic design, dry proofing, drainage, green roofs, and efficient heating and cooling systems help buildings adapt to climate change.³²⁶ Green buildings also offer several other benefits, such as reduced construction and operating costs, higher occupancy rates, and job creation.³²⁷ Moreover, people who work in green offices or live in green homes experience improved health and well-being.³²⁸

Indian context: The construction sector accounts for 8% of GDP in India and employs 12% of the total workforce.³²⁹ The transition to green buildings began in the early 2000s. According to the Indian Green Building Council, the green built-up area in the country was about 20,000 square feet in 2003 but increased to about 7.5 billion square feet in 2020 thanks to the contributions of all stakeholders in the ecosystem, including architects, developers, product manufacturers, corporations, governments, academia, and nodal agencies.³³⁰

The government is a major stakeholder in the sector, and it mobilizes finance from DFIs to fund its initiatives. The funding is directed towards government projects or directly to builders and customers through commercial banks. Key challenges include knowledge gaps, lack of enforcement or implementation, cost-based barriers, and limited technological advancements.

The green buildings sector has two key areas – green construction and retrofitted building – but this section focuses on green construction only. Retrofitting existing buildings refers to improving the efficiency of energy or water usage by replacing fittings and appliances; these are covered under the energy efficiency and storage and water management sectors, respectively.

321 [Green Buildings: A Finance and Policy Blueprint](#). The World Bank. Accessed on January 23, 2023.

322 Ibid.

323 [UNEP. 2021. 2021 Global Status Report For Buildings And Construction](#).

324 [Tricoire, J. Why Buildings Are the Foundation of an Energy-efficient Future](#). 22 February 2021. World Economic Forum.

325 [Thacker, S. et al. 2021. Infrastructure for Climate Action](#). UNOPS.

326 Ibid.

327 [What Is a Sustainable Built Environment?](#) World Green Building Council. Accessed 21 February 2023.

328 Ibid.

329 [Ministry of Housing and Urban Affairs, Government of India. 2021. National Mission on Sustainable Habitat 2021-2030](#).

330 [Kumar, V. 2020. With 7.60 Billion Sq Ft of Green Buildings, India Among the Top 5 Globally](#). 6 August 2020. The Hindu Business Line.



GREEN CONSTRUCTION

Green construction refers to the use of eco-friendly construction materials, efficient building design, and sustainable construction processes to reduce the environmental impact of the built environment.³³¹ The Indian government is promoting green construction through the Sustainable Habitat Mission and the Pradhan Mantri Awas Yojana (Urban) Mission. The green construction key area includes SGBs that provide products and services that reduce the carbon footprint and improve the resource efficiency of the building sector.

The business segments with SGB activities under the green construction key area in India include *green building construction*, *green building consultancy*, *green construction materials providers*, and *support service providers*.

Table 33: Business segments and examples of SGBs in green construction

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Green building construction	Includes SGBs that provide structures that are designed, built, renovated, operated, or reused in a resource efficient manner. Businesses in this segment provide modular homes through product and process innovation.	▶ Tvasta Construction
Green building consultancy	Includes SGBs that offer consultancy services for the design and construction of buildings that are more energy efficient, well-ventilated, and have maximum natural light.	▶ Architude
Green construction material providers	Includes SGBs that manufacture eco-friendly construction materials, such as bricks, green cement, insulators, bio-panels made from agri-waste, fly ash brick, carbon tiles, etc.	▶ Stawrcture
Support service providers	Includes SGBs that support the green building ecosystem indirectly by connecting sellers and buyers of green construction materials.	▶ Econaur

► POLICY LANDSCAPE

The policy landscape in India is favourable for the green buildings sector. The government is promoting eco-friendly designs, green construction materials, and efficient management of buildings to reduce the environmental impact of the building sector.

331 United States Environmental Protection Agency. [Green building](#). Accessed 23 January 2023.


Table 34: Key policies and strategies for Indian green buildings

POLICY / STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
National Mission on Sustainable Habitat	Aims at (1) promoting low-carbon urban growth towards reducing GHG emissions intensity for achieving India's NDC, and (2) building the resilience of cities to climate change impacts. The mission covers five broad thematic areas (i.e., energy and green building, urban planning, green cover and biodiversity, mobility and air quality, water management, and waste management), not specifically focusing on green buildings. The mission will be implemented between 2021 and 2030.	The mission does not specifically promote private sector activity but supports the sector as a whole.
Pradhan Mantri Awas Yojana (PMAY)-Urban	Aims to provide housing for all. The Technology Sub-Mission (TSM) under the scheme was set up to facilitate the adoption of modern, innovative, and green technologies and building materials for faster and higher quality construction of houses. ³³² TSM will also assist states and cities in deploying disaster-resistant and environment-friendly technologies. ³³³ Under the TSM, the government also launched a Global Housing Technology Challenge – India (GHTC-India), which aims to identify and mainstream globally the best available proven construction technologies that are rapid, sustainable, green, and disaster resilient.	This supports entrepreneurs (including SGBs) to develop innovative materials and technologies that promote green buildings and resilient infrastructure.
Eco-Niwas Samhita	This energy-conservation building code for the residential sector promotes energy efficiency in the design and construction of homes, apartments, and townships. The Eco Niwas Samhita 2018 (Part-I: Building Envelope) prescribes minimum standards for building envelope designs and the Eco Niwas Samhita 2021 (Code Compliance and Part-II: Electromechanically and Renewable Energy Systems) provides compliance approaches and minimum energy performance requirements for building services, indoor electrical end-use, and renewable energy systems.	Ensuring compliance with these codes and regulations indirectly supports private players (including SGBs) by generating builders' and building owners' demand for green buildings.
Energy Conservation Building Code	Sets minimum energy standards for commercial buildings having a connected load of 100kW or contract demand of 120 kilo volt ampere (kVA) and above, although state governments have the flexibility to modify the code to suit local or regional needs. The major challenges in the implementation of this code are a lack of awareness about it among governmental departments, lack of inter-departmental coordination among government bodies (e.g., the Ministry of Power and Ministry of Urban Development), and lack of technical knowledge and support. ³³⁴	

332 Government of India. [Technology Sub-Mission](#). Accessed 23 January 2023.

333 Ministry of Housing and Urban Affairs. [Technology Sub-Mission under PMAY-U Facilitates Adoption of Modern, Innovative and Green Technologies and Building Material for Faster and Quality Construction of Houses](#). Accessed 23 January 2023.

334 Alliance for an Energy Efficient Economy. 2017. [Roadmap to Fast Track Adoption and Implementation of Energy Conservation Building Code \(ECBC\) at the Urban and Local Level](#).



POLICY / STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
Excellence in Design for Greater Efficiencies (EDGE)	A global green building certification system focused on making buildings more resource efficient. It certifies both residential and commercial buildings, either new or refurbished.	
Leadership in Energy & Environmental Design (LEED -India)	An internationally recognized certification system for green buildings. This certification is voluntary in nature and is provided by the Indian Green Buildings Council (IGBC) which is a division of the Confederation of Indian Industry that works closely with the government to promote a sustainable built environment.	
The Green Rating for Integrated Habitat Assessment (GRIHA)	A voluntary national rating system for green buildings. The GRIHA rating system was developed by The Energy and Resources Institute (TERI), a research institution that works in the field of energy, environment, and sustainable development, and was later adopted by the Ministry of New and Renewable Energy.	

► FUNDING LANDSCAPE

The government of India is a major stakeholder in the green buildings sector, and it mobilizes funds for its various initiatives through DFIs. The funding is either directed towards government projects or builders and customers via commercial banks. The sector faces challenges in attracting private capital due to long-term payback time, high interest rates, and high initial costs.³³⁵ Green bonds financed by municipalities, corporations, and institutional investors are mostly directed to the renewable energy sector instead of the green buildings sector.³³⁶

- **DFIs** provide a high volume of funding for the green buildings sector. The ADB and IIFL Home Finance Limited signed a US \$68 million loan to improve the financial access of women with lower incomes to affordable green housing in India.³³⁷ However, the construction material industry is capital intensive, and grants are not readily available for businesses.
- **Private investment** is limited in this sector and mostly focused on technological solutions to support green buildings, such as 3D printing. Despite insufficient funding, [Strawcture Eco](#) raised seed funding of about US \$375,000 from multiple accelerators, including Social Alpha, Villgro, and Brigade REAP.³³⁸ Deep tech start-up, [Tvasta Construction](#) also raised seed funding of about US \$ 411,000 from ADB ventures and Hestia Partners.³³⁹
- **Commercial banks** (e.g., HDFC Bank, SBI, IIFL) play an important role by deploying funding received from multilateral and bilateral institutions. They act as intermediaries between DFIs and builders and buyers who require funding support. For example, Aavas Financiers received funds from the UK-IFC Market Accelerator for

³³⁵ [Greening The Building Sector: A Huge Investment Opportunity](#). auctusESG. Accessed 23 January 2023.

³³⁶ Menes, R. 2018. [Financing the Future of Green Buildings: A Conversation with Prashant Kapoor](#). GBCI.

³³⁷ [ADB Signs \\$68 Million Loan with IIFL Home Finance to Boost Women's Access to Affordable Green House in India](#). 21 February 2022. Asian Development Bank.

³³⁸ Bardhan, S. [Strawcture Eco Raises \\$375,000 In Seed Funding Round Led By Social Alpha, Villgro Innovations Foundations and Brigade REAP](#). 3 March 2022. Entrepreneur India.

³³⁹ Kandavel, S. [Deep Tech Startup Tvasta Raises Seed Funding from International Investors](#). 22 October 2021. The Hindu.



Green Construction (MAGC) programme, a partnership between IFC and the United Kingdom, and financed housing loans to customers belonging to low- and middle-income segments in semi-urban and rural areas.³⁴⁰ Banks also channel funding to the sector through green bonds. Between 2018 and 2020, the State Bank of India issued three green bonds totalling US \$800 million committed to building low carbon buildings.³⁴¹

- **Foundations** have supported efforts to build affordable housing. For example, the Selco Foundation funded Habitat for Humanity to build energy efficient homes for lower income communities.³⁴² Although not many foundations were identified, the partnership between Selco Foundation and Habitat for Humanity provides support to all identified business segments.

► ESTIMATED MARKET OPPORTUNITY (2022 - 2030)

This market opportunity analysis for the green building sector was based on the government-set target approach. The estimated **market opportunity of the green building sector is US \$1.04 trillion**. The Indian Green Building Council (IGBC) aims for 10 billion square feet of green building footprint in India by 2022.³⁴³ As India has achieved most of its target and only 0.73 billion square meters were left to be met between 2018 (last data available) and the target, a CAGR of 14% is required to fill the gap. Assuming that green buildings in India will continue growing at the target speed, the green building footprint target for 2030 is expected to reach 2.37 billion square meters.

Disaster Management

► BACKGROUND AND BUSINESS SEGMENTS

Background: The United Nations Office for Disaster Risk Reduction (UNDRR) defines a disaster as a “serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability, and capacity, leading to one or more of the following: human, material, economic and environmental losses, and impacts.”³⁴⁴ Global warming and changing weather patterns result in climate catastrophes across the world. According to the latest data, losses from natural catastrophes in 2020 rose to US \$210 billion globally from US \$166 billion in 2019.³⁴⁵ Proactively taking action by building disaster management into a country’s development plan can mitigate the impacts of disasters in the future.³⁴⁶ Thus, planning and preparing for disaster, especially considering climate risks, is becoming increasingly important for climate adaptation and resilience.

Indian Context: India’s states and territories have some of the highest disaster rates in the world, being extremely vulnerable to cyclones, earthquakes, landslides, floods, and droughts.³⁴⁷ Climate change and environmental degradation have exacerbated these disasters, both in intensity and frequency. In a single drought period in 2015–16, approximately 330 million people across ten states, including 37 million children under age five, were significantly impacted.³⁴⁸

340 [IFC, Aavas Financiers to Help Catalyze Affordable Green Housing Finance for Low-income Borrowers in India](#). 2 December 2020. IFC.

341 [Edge](#). 2020. [India Green Building Market Maturity Snapshot 2020](#).

342 [Habitat India and Selco Foundation Build Energy Efficient Homes](#). Habitat for Humanity India. Accessed 23 January 2023.

343 [Contributing to the National Agenda with Green Buildings](#). 28 October 2021. Confederation of Indian Industry.

344 UNDRR. 2022. [Global Assessment Report on Disaster Risk Reduction](#).

345 [Disaster Risk Management](#). 22 May 2022. The World Bank.

346 Ibid.

347 [Child Centered Risk Informed Preparedness for a Resilient India](#). UNICEF. Accessed 19 January 2023.

348 Ibid.



Disaster management falls under the ambit of government activities, and the sector in India is undergoing a paradigm shift due to the government moving from response and relief to a prevention-mitigation and preparedness-centric approach.³⁴⁹ The rationale behind this shift was that adequate mitigation and disaster risk reduction measures could prevent hazards from becoming major disasters.³⁵⁰ In this stream of effort, the Indian government places great emphasis on leveraging technology to manage disasters. Artificial intelligence and machine learning-based predictive analysis, drones, and augmented reality and virtual reality-based training simulators are some of the advanced technologies in use.³⁵¹

The government is the primary customer of businesses operating in the sector.³⁵² This comes with its own challenges, such as cumbersome procedures and delays in payments. Moreover, funding in this sector is limited for entrepreneurs. While DFIs offer the most funding to the sector, the funding goes to the government.³⁵³ Therefore, entrepreneurial and SGB activities in the sector are limited. Many enterprises in the scope provide disaster management-related services, not as their primary service but as one of many. For example, [Cortex Construction Solutions](#) provides a free app to check the earthquake resistance of buildings, though this is not the enterprise's main offering.

This section is organized into the following five major areas of operational activities in the disaster management sector:³⁵⁴

- **Prevention and mitigation:** avoiding, lessening, or limiting the adverse impacts of hazards and related disasters.³⁵⁵
- **Preparedness:** developing knowledge and capacities to anticipate, respond to, and recover from the impacts of likely, imminent, or current hazard events or conditions.³⁵⁶
- **Response:** providing emergency services during or immediately after a disaster.
- **Recovery:** encompassing the three overlapping phases of emergency relief, rehabilitation, and reconstruction.
- **Rehabilitation:** providing temporary public utilities and housing.

DISASTER PREPAREDNESS

Disaster preparedness includes the knowledge and capacities developed by governments, professional response and recovery organizations, communities, and individuals to effectively anticipate, respond to, and recover from the impacts of likely, imminent, or current hazard events or conditions.³⁵⁷

349 Ministry of Home Affairs, Government of India. [National Institute of Disaster Management](#). Accessed 19 January 2023.

350 National Disaster Management Authority, Ministry of Home Affairs, Government of India. 2019. [National Disaster Management Plan](#).

351 [Technology and Innovation at the Core of Disaster Management](#). 20 January 2022. Invest India.

352 Insight from primary discussions with Greenfunder and Skymet Weather.

353 Intellectap. 2020. [Promoting Disaster Risk Resilience Technologies And Innovations In India](#).

354 The broad framework of areas of operational activities is borrowed from the National Institute of Disaster Management report by the government of India. However, key areas of prevention and mitigation – two separate categories in the source – are combined in our analysis as the line between prevention and mitigation is blurry.

355 UNISDR. 2009. [UNISDR Terminology on Disaster Risk Reduction](#).

356 Ibid.

357 Ibid.


Table 35: Business segments and examples of SGBs in disaster preparedness

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Predictive analytics and AI	The use of environmental and climate data to predict future disasters. AI and satellite imagery are used for identifying damaged infrastructures, flooded areas, and road obstructions. Machine learning is widely used for hazard and vulnerability mapping. SGBs provide consulting services to the government and insurance providers. Due to increasing climate risks, agricultural production and agri-insurance companies are leveraging predictive technologies to assess risks on crop insurance. ³⁵⁸	▶ Aapah Solutions

DISASTER RESPONSE

Disaster response refers to the provision of emergency services and public assistance during or immediately after a disaster to save lives, reduce health impacts, ensure public safety, and meet the basic subsistence needs of the people affected.³⁵⁹

Table 36: Business segments and examples of SGBs in disaster response

BUSINESS SEGMENT	DESCRIPTION	EXAMPLES OF SGBS
Drone technology	Drones enable remote sensing, which allows for monitoring geophysical structures and showcasing live pictures/footage of disaster-affected sites to mitigate the impact of disasters and support relief measures. SGBs covered under this business segment are engaged in the manufacturing of drones.	▶ Cesta Enterprise
Satellite-based technology	Includes SGBs that use satellites for geospatial images to detect, monitor, and assess disasters. SGBs in this business segment offer satellite-based imagery services and connect stranded people with rescue teams using satellite-based mobile applications.	▶ Fork It ▶ H W Design labs

▶ POLICY LANDSCAPE

India promotes an enabling environment for entrepreneurial activity in disaster management. National programmes, such as Startup India and the Atal Innovation Mission, offer entrepreneurs technical assistance and resources to support growth and success. The National Disaster Management Authority is the leading body for managing disasters in the country. It is headed by the prime minister and is responsible for developing plans and guidelines in response to such events.

An important challenge faced by entrepreneurs is the lack of linkages with disaster management authorities.³⁶⁰ Entrepreneurs have limited information on government agencies' priorities and requirements regarding disaster management technology usage.³⁶¹ Further, operating in disaster management requires several permits and approvals from the government, which makes it difficult for SGBs to operate in this space.

³⁵⁸ Primary research insight.

³⁵⁹ Ibid.

³⁶⁰ Intellectap. 2020. [Promoting Disaster Risk Resilience Technologies And Innovations In India](#).

³⁶¹ Primary research insight.


Table 37: Key policies and strategies for Indian disaster management

POLICY/ STRATEGY	AIM	SUPPORT AND GAPS FOR SGB ACTIVITY
Disaster Management Act, 2005	The overarching regulation for disaster management which provides the blueprint for the institutional, legal, financial, and coordination mechanisms at the national, state, district, and local levels. The Act promotes scientific and evidence-based principles of disaster preparedness and response.	No direct impact on entrepreneurs.
National Disaster Management Policy, 2009	<p>Establishes the institutional and techno-legal frameworks for disaster preparedness and response with the government at the centre while also seeking to integrate stakeholders (e.g., communities) in planning processes. The policy directs the formulation of a disaster response plan, lays out the standard operating procedures, and defines the roles of different government bodies at the time of disaster.</p> <p>The policy aims to establish early warning and forecasting systems via risk assessment and vulnerability mapping. It also promotes the use of information and communication technology (ICT), strengthening emergency response operation centers, and training simulations and mass drills.</p>	No direct impact on entrepreneurs including SGBs

► FUNDING LANDSCAPE

Multilateral and bilateral organizations, such as the World Bank, UNICEF, and WHO, are highly active in the disaster management sector and provide both technical and financial assistance. However, the majority of their funding flows into the government for implementing disaster management projects rather than supporting private enterprise. VCs also provide financial support to pre- and post-disaster projects and companies. While several foundations like Reliance Foundation and Wipro Foundation support the disaster management sector, they do not lend financial support to entrepreneurs. Commercial banks are also not active actors in the landscape.

- **DFIs** are the most prominent funders of disaster mitigation and response. The World Bank has a US \$2 billion portfolio focused on disaster recovery reconstruction, disaster preparedness, and mitigation projects by accelerating new technology development.³⁶² In 2021, the World Bank approved a US \$125 million programme to support Kerala's disaster preparedness measures.³⁶³ The World Bank has also been supporting the Government of Uttarakhand since 2014 to restore housing and rural connectivity through the Uttarakhand Disaster Recovery Project and provided additional funding of US \$ 96 million in 2019 to the state government.
- **VC funding** for disaster management largely focuses on drone-based technology companies (e.g., [Enercomp Solutions](#)). Large corporations (e.g., Reliance Infosys) have also been investing in this technology and buying out start-ups. Yet, start-ups that have received investment or were targeted for a buy-out are out of the SGB range, with ticket sizes higher than US \$2 million. Predictive analytics-based companies also captured the interest of private investors. For instance, [Blue-sky Analytics](#) – an SGB that leverages environmental datasets to predict disasters such as floods and forest fires – raised US \$1.2 million from BEENEXT Emerging Asia and Rainmatter Capital.

³⁶² Intellectap. 2020. [Promoting Disaster Risk Resilience Technologies And Innovations In India](#).

³⁶³ [World Bank Approves \\$125 Million Program to Support Green and Resilient Kerala](#). 24 June 2021. The World Bank.



APPENDIX A: INTERVIEWEES AND STAKEHOLDER MEETING PARTICIPANTS

INTERVIEWEES	
Investors	Aavishkaar Capital Climake Emergent Ventures Green Funder Incofin Investment Management Omnivore Ventures Sangam Ventures Upaya Social Ventures
Accelerators/incubators	Technoserve
Enterprises	Aquaconnect A2P Energy Bamboo India Bastar se Bazaar Tak Carbon Craft Carbon Masters Ehands Energy Frontier Markets GreenPod Labs Indra Water Punjab Renewable Energy Systems Private Ltd. (PRESPL) Skymet Weather Services Pvt. Ltd. Tadpole Waste Link ZeroCircle



STAKEHOLDER MEETING PARTICIPANTS	
Academic Institutions	Guwahati University IIBM IIMCIP
Capacity Development Providers	BioNEST IASST CIIE.CO Climake Climate Collective Toilet Board Coalition Village Capital
Corporates	Mahindra Group
Enterprises	Techno Village
Foundations	AIC Selco Foundation Enviu Green Artha Rainmatter Foundation Shakti Foundation Shell Foundation SwitchON WWF India
Industry Associations	AVPN
Investors	Acumen Asha Impact Caspian Debt cKers Finance Entelechy Fund Grameen Capital India Indusland Bank Omnivore SAGANA Tata Capital Theia Ventures UC Inclusive Credit Villgro
Microfinance Institutions	Rashtriya Grameen Vikas Nidhi SaDhan
Nonbank Financial Institutions	Ananya Finance NABSAMRUDDHI Finance Limited
Research or Advisory Service Providers	AIC-SMU Technology Business Incubation Foundation Global Business Inroads Grameen Sahara Grassroots Global LetsEndorse Sundaram Climate Institute WRI India



APPENDIX B: DETAILED METHODOLOGY FOR MARKET OPPORTUNITY ESTIMATES

► ENERGY EFFICIENCY AND STORAGE

The fuel cost savings used for estimating the market opportunity within energy efficiency was derived from the projected energy consumption that the Indian government released. The Unlocking National Energy Efficiency Potential (UNNATEE) report showcases projected energy consumption when currently implemented programmes continue (876.8 MTOE) and projected energy consumption when India meets the target energy efficiency as per current policies (789.9 MTOE).³⁶⁴ The difference between the two scenarios was used to estimate the market opportunity. The first step starts with calculating the CAGR (i.e., the rate at which the energy capacity needs to increase each year to reach the energy consumption levels) required to achieve the two scenarios. As the baseline energy consumption in India in 2021 is 585.1 MTOE that leads to a CAGR of 4.6% for 876.8 MTOE and 3.4% for 789.9 MTOE.³⁶⁵ In other words, the CAGR enabled the projection of energy consumption from 2022 to 2030 for both scenarios. The difference between the two scenarios from 2022 to 2030 leads to energy consumption savings each year. Then, additional energy consumption savings to be achieved was calculated by subtracting the energy consumption savings of one year from the energy consumption savings of the following year. Then, multiplying the additional energy savings to be made from 2022 to 2030 by the price of MTOE of energy as published by the Bureau of Energy Efficiency (i.e., US \$239.23)³⁶⁶ produced the market opportunity of US \$20.79 billion by summing the annual market size from 2022 to 2030.

While the Indian government has not specified an energy storage target, NITI Aayog – the government’s public policy think tank – has estimated the demand for battery storage to be 78.32 GWh by 2026 and 260 GWh by 2030 if other climate targets are met.^{367 368} As there are two different targets to be met, the analysis calculated two different growth rates for 2022–2026 and 2026–2030,³⁶⁹ with the growth rate for 2022–2026 being 49% using the 2022 figure as a baseline, and the corresponding rate for 2026–2030 being 35% using the 2026 figure as the baseline. Then, the average cost of battery packs between 2022 and 2030 (US \$97.22 per Kwh) was adopted instead of the current cost that is estimated by the World Bank³⁷⁰ as the cost of battery packs is rapidly declining. Multiplying the unit cost of battery packs with the annual energy storage demand produced a projected annual market opportunity from 2022 to 2030 and adding these together produced an estimated market opportunity for the period of US \$88.13 billion.³⁷¹

364 BEE. 2019. [Unlocking National Energy Efficiency Potential \(UNNATEE\)](#).

365 Bureau of Energy Efficiency. 2019. [Roadmap of Sustainable and Holistic Approach to National Energy Efficiency](#).

366 Tripathi, A. 2021. [Ministry of Power notifies price of one metric tonne of oil equivalent applicable for Designated Consumer of Second Cycle of Perform, Achieve, and Trade \(PAT\) Scheme](#). Bureau of Energy Efficiency.

367 NITI Aayog. 2022. [Need for Advanced Chemistry Cell Energy Storage in India](#).

368 Other factors affecting the target include the growth in renewable energy installations and consumer electronics and the speed of transitioning to electric vehicles, to name a few that will constrain the coal capacity as per the current policy momentum. Furthermore, the estimated target accounts for the expected slowdown in demand owing to COVID-19.

369 NITI Aayog. 2022. [Need for Advanced Chemistry Cell Energy Storage in India](#).

370 World Bank. 2020. [Economic Analysis of Battery Energy Storage Systems](#).

371 The market opportunity is based on the current battery pack cost as of 2022 without accounting for the rapidly reducing price of battery packs.



► RENEWABLE ENERGY

Based on the government target for non-fossil fuel energy and the current percentage contribution targets of non-fossil fuel energy, the target capacity to be achieved by RTS (Rooftop solar) by 2030 is estimated to be 65.66 GW. This analysis assumed that 400 GW out of 500 GW – the target installed electricity capacity from a non-fossil fuel source by 2030³⁷² – will be produced by renewable energy sources such as solar, wind, biomass, and small hydropower, while the remaining 100 GW will be met by nuclear energy. This target leaves a gap of 287 GW as the current installed capacity in this scenario stays at 113 GW. With solar energy's current target contribution to renewable energy standing at 57%,^{373 374} 164 GW out of 287 GW would be powered by solar energy. Going further down, the government target sets RTS to contribute 40% of the installed capacity of solar energy,³⁷⁵ which leads to the 65.66 GW estimate above.

With the target identified, the next step was to calculate the CAGR, pull the cost of installing RTS, and sum the annual market size up to derive the market opportunity from 2022 to 2030. The installed RTS capacity in India as of December 2021 remained at 11 GW,³⁷⁶ which gives us a CAGR of 22%, i.e., the rate at which the RTS capacity will need to grow each year to achieve the 2030 target. The average cost of installing an RTS released by the government is US \$535.59.³⁷⁷ Using the baseline capacity and CAGR, the annual capacity to be achieved was inferred and the projected annual market opportunities in US dollars was calculated. The sum of annual market opportunities from 2022 to 2030 reaches US \$29.27 billion.

► CLEANER FUELS

The market opportunity for **bioethanol** was estimated by taking the following steps. The demand for ethanol in 2025 is estimated to be 13.5 billion liters by the NITI Aayog.³⁷⁸ In 2021, the ethanol production remained at 7.07 billion litres. The production value in 2022 and the target value in 2025 led to a CAGR of 18%, which was then assumed to remain constant till 2030. Then, the estimated production of bioethanol was multiplied by the cost (i.e., US \$1.05 per litre), which was borrowed from the International Council on Clean Transport (ICCT).^{379 380} By multiplying each year's estimated bioethanol production and the cost and summing them all up, the market opportunity for bioethanol was estimated to be US \$163.38 billion.

The estimated opportunity for **biodiesel** followed similar steps. The Indian government released a plan to blend biodiesel with diesel by 2030. The expected diesel demand in 2030 is about 169 billion litres. As 5% of it needs to be blended with biodiesel, the target production level of biodiesel leads to 8.45 billion litres. The analysis assumed that

372 [Government Lays Roadmap for Transition to Green Energy](#). 24 March 2022. PIB.

373 Kumar, A. 2021. [Standing Committee Report Summary: Action Plan for Achievement of 175 GW Renewable Energy Target](#). PRS India.

374 This approach assumes that India's reliance on solar energy vis-à-vis other renewable energy sources will remain the same as the target breakdown set for 2022.

375 [A Target of Installing 175 GW of Renewable Energy Capacity by the Year 2022 Has Been Set](#). 19 July 2018. PIB.

376 Garg, V. et al. 2022. [Rooftop Solar Lagging: Why India Will Miss Its 2022 Solar Target](#). Institute for Energy Economics and Financial Analysis.

377 The government released the costs of RTS by six brackets of the install capacity. The average cost of US \$535.59 is derived by averaging out the six figures and converting Indian rupees into US dollars with a conversion rate of 1:0.013.

378 NITI Aayog. 2021. [Roadmap for Ethanol Blending in India 2020-25](#).

379 Zhou, Y. et al.. 2021. [Techno-economic Analysis of Cellulosic Ethanol in India Using Agricultural Residues](#). The International Council on Clean Transportation.

380 This cost is the average of the levelized cost of producing bioethanol in facilities of 36.5 million litres and 70 million litres each year. This cost includes the capital cost and the operational cost for bioethanol production.



the biodiesel produced in 2021 remained at 1.06 billion litres.^{381 382} The unit cost of producing one litre of biodiesel is estimated to be US \$0.70, according to IRENA.^{383 384} Lastly, the total market size from 2022 to 2030 was calculated by multiplying the estimated production of biodiesel and the cost and summing all annual market opportunities up, which resulted in US \$19.17 billion.

► SUSTAINABLE AGRICULTURE AND AQUACULTURE

The calculated market opportunity of this sector represents the investment required to achieve SDG 2 (ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture), specifically Targets 2.4 and 2.5 that focus on *sustainable* agriculture and aquaculture,³⁸⁵ taking the average cost per capita to achieve the goal and the population growth in India into account. The SDG target-based methodology assumed that monetary inputs lead to better SDG outcomes and was used for the sustainable agriculture and aquaculture sector because there are no quantifiable national targets in India.

The cost of sustainable agriculture and aquaculture was obtained from the [Brookings Institution's Building the SDG Economy 2019 report](#).³⁸⁶ The cost estimated also relates to Targets 2.4 and 2.5. The cost estimated per capita to achieve SDG2 for India is US \$32.99.³⁸⁷ The components used in the calculation of the cost per capita included improving³⁸⁸ 1) primary agriculture and natural resources (e.g., soil, fish stock, forest resources), 2) agro-processing operations, 3) institutional frameworks, and 4) research, development, and extension.

Finally, the cost estimate per capita coupled with annual population projections (up to 2030) in India³⁸⁹ enables the calculation of annual investments in sustainable agriculture and aquaculture. India's population was projected to be 1.40 billion in 2021 and 1.51 billion in 2030.³⁹⁰ These population projections multiplied by the unit cost calculated above produced a total estimated spending of US \$46.10 billion in the sector in 2021 and US \$49.91 billion in 2030. With these two figures, this analysis derives CAGR, the annual investment needed, and the overall market opportunity between 2022 and 2030 by summing up the annual investments leading to US \$433.75 billion.

381 The amount refers to the biodiesel procured by public sector oil marketing companies (OMCs) in 2019–2020, and this is the latest data available on the website of the Ministry of Petroleum and Natural Gas (MoPNG). The analysis assumes that the OMCs are procuring the entire volume of biodiesel being produced in the country.

382 [Bio Diesel](#). Ministry of Petroleum and Natural Gas, Government of India. Accessed 9 March 2023.

383 The cost estimate can be found from the following link: [Total Advanced Biodiesel Production Cost Ranges by Technology for Biomass](#). IRENA. Accessed 9 March 2023.

384 This cost also includes both the capital cost and the operational cost of producing biodiesel in 2012 USD/litre diesel equivalent terms.

385 Target 2.4 regards ensuring sustainable food production systems and implementing resilient agricultural practices that increase productivity and production, help maintain ecosystems, strengthen capacity for adaptation to climate change, extreme weather, drought, flooding, and other disasters, and progressively improve land and soil quality. Target 2.5 is to maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional, and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed.

386 Kharas, H. and McArthur, J. 2019. [Building the SDG economy: Needs, spending, and financing for universal achievement of the Sustainable Development Goals](#). Brookings Institution.

387 The dataset for the report "Building the SDG Economy" is used here and can be downloaded from this [link](#).

388 Kharas, H. and McArthur, J. 2019. [Building the SDG economy: Needs, spending, and financing for universal achievement of the Sustainable Development Goals](#) Brookings Institution.

389 The population projections are obtained from [United Nations World Population Prospects 2022](#).

390 Data used here are from [United Nations World Population Prospects - Rural population](#) and [United Nations World Population Prospects - Urban population](#).



► SUSTAINABLE FORESTRY

The first step to estimate the market opportunity in this area was to identify the government target for sustainable forestry and the identified key areas. The national target for forest conservation is to create an additional sink of 2.5–3 billion tons of CO₂ equivalent by 2030.³⁹¹ Based on the projected forest carbon in 2021 (i.e., 30.44 billion tonnes of CO₂ eq) and in 2030 (i.e., 32.52 billion tonnes of CO₂ eq), the carbon sink gap to be met was estimated to be 2.18 billion tonnes of CO₂ equivalent.³⁹² Then, the analysis focused on 5.5% of the carbon sink gap (5% by NTFP and 0.5% by bamboo-based agroforestry) because 50% of the carbon sink gap would be met through restoration of degraded forests, which is led by the government and non-profit organization, and the remaining 44.5% will be met by wood-based industry. The wood-based industry in India is unorganized and not well regulated, which feeds into the rise of “sustainable wood” enterprises such as wood-based industries whose positive environmental impacts are questionable. The carbon sequestration targets for the NTFP and bamboo-based industry were, then, converted into the size of additional land (in hectares) requiring the planting of NTFP trees (0.11 million hectares) and bamboos (0.88 million hectares) by considering the carbon sequestered by one hectare of NTFP and bamboo. These additional lands with trees were then added up with the current areas under NTFP (i.e., 0.06 million hectares)³⁹³ and bamboo trees (i.e., 0.12 million hectares)³⁹⁴ to derive the target in 2030 (i.e., 0.94 million hectares for NTFP and 0.23 million hectares for bamboo). The CAGR driven from the current and target values for NTFP and bamboo-based agroforestry were 36% and 7%, respectively.

Lastly, the average costs per hectare were identified from various sources and multiplied by the unit cost of the land that needs to be covered with NTFP and bamboo trees annually. The average per hectare cost of cultivation of NTFPs was estimated to be about US \$935.28 with the government subsidy.³⁹⁵ The per hectare cost of bamboo-based agroforestry was estimated to be US \$155.^{396 397} Multiplying the cost and required land led to the projected annual market opportunity from 2022 to 2030 and summing up the market size for the period led to US \$826.73 million for NTFP and US \$16.92 million for bamboo-based agroforestry.

► SUSTAINABLE TRANSPORTATION

The Indian government aims to realize EV sales penetration for 80% of two and three-wheelers by 2030,³⁹⁸ and the number of electric two-wheelers and three-wheelers to be sold in 2030 were estimated based on previous sales data from 2016–2022 for such vehicles.^{399 400} The number of two-wheelers sold in 2030 is anticipated to be 13.2 million, and three-wheelers come in at 0.4 million. As 80% of the total vehicle sales is expected to be met by EVs, the target for electric two-wheelers turns out to be 10.6 million and for electric three-wheelers 0.3 million.

391 Forest Survey of India, Ministry of Environment, Forest & Climate Change, Government of India. 2019. [India's Nationally Determined Contribution of Creating an Additional Carbon Sink of 2.5 to 3 billion Tonnes of co2 eq through Additional Forest & Tree Cover: Possibilities, Scale and Costs for Formulating Strategy.](#)

392 Ibid.

393 [Promotion of Herbal Cultivation in the Country.](#) 9 March 2021. PIB.

394 [Ministry of Agriculture and Farmer Welfare. N.d. Restructured National Bamboo Mission.](#) Accessed 9 March 2023.

395 [Concept Note for Vriksh Ayush.](#) 2020. Ministry of Ayush.

396 Dev, I. et al. 2020. [Bamboo-based Agroforestry System \(Dendrocalamus strictus + Sesame-chickpea\) for Enhancing Productivity in Semi-arid Tropics of Central India.](#) Agroforest Systems.

397 This is the cost of bamboo cultivation for a period of seven years.

398 [NITI Aayog & RMI Release Technical Analysis of FAME II Scheme.](#) 5 April 2019. PIB..

399 [Automobile Domestic Sales Trends.](#) Society of Indian Automobile Manufacturers. Accessed 9 March 2023.

400 The CAGR between 2016 and 2019 came out to be 5.63 % for three-wheelers and -0.25 % for two-wheelers. Sales data from 2021 was used as the baseline to project the sales up to 2030 along with the above-mentioned CAGR.



The next step involved calculating the CAGR between 2022 and 2030 using the current sales of electric two-wheelers (i.e., 0.2 million)⁴⁰¹ and three-wheelers (i.e., 0.2 million).^{402 403} The current sales and target sales of the electric vehicles enabled the derivation of the CAGRs required to achieve the target sales in 2030 for two-wheelers (9%) and three-wheelers (60%). The average costs of electric two-wheelers and three-wheelers were calculated by identifying key models of two and three-wheelers and averaging out their current prices, which led to US \$2,309 for three-wheelers and US \$845 for two-wheelers. Multiplying the annual sales and cost and summing them all up produced a market opportunity of US \$746.92 million for three-wheelers and US \$23.70 billion for two-wheelers.

► WATER MANAGEMENT

The identified target for water management is universal access to water by 2030. The indicator of the performance for the target is the percentage of the population using at least basic drinking water services and safely managed water services (indicator 6.1.1 SDG 6).^{404 405} As of 2020, 90.49% of the Indian population had access to at least basic drinking water services.⁴⁰⁶ Since this is the latest available data, the percentage of the population with access to at least basic drinking water services was assumed to remain the same in 2021.

The last few steps were to identify the unit costs of providing basic and improved water services in India, estimate the annual spending using the unit cost and the number of the population, and aggregate all up to derive the market opportunity from 2022 to 2030. The data used for [this World Bank report](#) estimated the annual costs per capita to be US \$32.8 for the rural population and US \$107 for the urban population.⁴⁰⁷ Then, the unit cost was multiplied by the number of people living in rural and urban areas in India for the years 2021 (baseline) and 2030 (endline) to calculate the investment needed in the respective years (US \$74.69 billion in 2021 and US \$94.69 billion in 2030).⁴⁰⁸ The baseline and endline investment levels provided a CAGR of 2.7%. Then, the annual market opportunity from 2022 to 2030 was calculated using the CAGR and the sum of the overall market opportunity for the nine years is **US \$768.68 billion**.

► WASTE MANAGEMENT AND CIRCULAR ECONOMY

First of all, targets, current levels, and unit costs were identified. The SDG targets relevant to the greening of the waste management sector are indicator 6.2.1 under SDG 6 (the percentage of the population using safely managed sanitation services)⁴⁰⁹ for the sanitation key area and indicator 12.5.1 under SDG 12 (national recycling rate in terms of tonnes of material recycled).⁴¹⁰ India's SDG targets used for this analysis are 61.4% of the population having access to safely managed sanitation services for the sanitation key area and a 28% recycling rate for the solid waste key area. These targets were set based on the performance level of selected countries (i.e., Lao PDR for the sanitation

401 [India's Electric Vehicle Sales Trend for 2021](#). 11 January 2022. EVreporter.

402 Ibid.

403 The total number of electric three-wheelers was obtained by adding the vehicles sold under different categories.

404 [Population Using at Least Basic Drinking Water Services \(%\)](#). WHO. Accessed 9 March 2023.

405 Ibid.

406 [Sustainable Development Report](#). Cambridge University Press. Accessed 9 March 2023.

407 The annual costs per capita for India's rural and urban population were obtained from the World Bank's report, which estimates the costs of meeting the 2030 SDG targets on drinking water, sanitation, and hygiene. The annual costs per capita include the costs for capital investment, programme delivery, operations, and major capital maintenance to sustain the life span of the infrastructure created.

408 The population data was obtained from [United Nations World Population Prospects 2022](#). Accessed 9 March 2023.

409 [Percentage of the population using safely managed sanitation services, including a hand-washing facility with soap and water \(SDG 6.2.1\)](#). [Percentage of Population Using Safely Managed Sanitation Services Including a Hand-washing Facility with Soap and Water \(SDG 6.2.1\)](#). WHO. Accessed 9 March 2023.

410 [SDG Indicator Metadata](#). N/A. United Nations Statistics Division (UNSD)/ United Nations Environment Programme (UNEP). Accessed 9 March 2023.



key area and the Philippines for the solid waste key area) that have a similar level of GDP to India but have a higher achievement rate in the relevant SDG. The next step was to identify the current state of India; in 2022, 45.9% of the Indian population overall has access to safely managed sanitation services,⁴¹¹ and 5% of the waste generated is recycled in India.^{412 413} Then, the associated unit costs were obtained from the World Bank's data. In India, the annual cost of providing sanitation and hygiene service to each individual in rural areas is US \$153.15 and in urban areas it is US \$86.85.⁴¹⁴ The total average cost of waste collection, transfer, and recycling per tonne in India is US \$76.5, which consists of waste collection and transfer and recycling costs.^{415 416} This cost also takes the projected recycling rate.

With the input numbers, the next step was to calculate the total spending in 2021 (the baseline, assuming 46% coverage for sanitation and 5% recycling rate for solid waste) and 2030 (the endline, assuming 61% coverage for sanitation and 28% of recycling rate for solid waste), calculate the CAGR, derive annual market size based on the CAGR, and sum it all up for both the sanitation and solid waste key areas. The total spending was obtained by multiplying the population number from United National Population Database⁴¹⁷ and the unit costs identified above. Using the 2021 and 2030 total spending, our analysis calculated the CAGR for the sanitation and solid waste key area and annual market opportunity using the CAGR. The sum of the annual market opportunity from 2021 to 2030 is US \$800.99 billion for safely managed sanitation services and US \$22.19 billion for a national recycling rate of 28%.

► GREEN BUILDINGS

The unit cost of construction of a green building is estimated to be US \$634.75 per square meter. First of all, the cost of a conventional building was calculated. While the information on the cost of green buildings in India is not readily available, the cost of conventional buildings in India is available, and the cost of green buildings relative to the cost of conventional buildings is available in other countries. The World Green Building Council estimates that for many certified green buildings globally, the costs of construction are between 0% and 4% higher than that of conventional buildings.⁴¹⁸ Considering that green building is still a new concept in India, it is reasonable to assume that the average construction costs of a green building are 4% higher than that of a conventional building.⁴¹⁹ The weighted average cost of a conventional building in India is US \$610.33 per square metre, which is driven by the cost of four different types of buildings (i.e., hotels, residential, office and retail, and commercial buildings) and each building type's share to the total building stock share.⁴²⁰ The costs of each building type were obtained from the Turner and Townsend International Construction Market Survey 2021 Report.⁴²¹ The unit cost of construction takes into consideration labour, materials, and plant costs. Lastly, the annual green building stock multiplied by the unit cost provides the annual market opportunity, and aggregating the estimates from 2022 and 2030 gives a total estimate of US \$1.04 trillion.

411 This figure is from [the global data on Water Supply, Sanitation and Hygiene \(WASH\)](#). Accessed 9 March 2023.

412 Kaza, S. et al. 2018. [What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050](#). World Bank.

413 The annual costs per capita entail the costs for capital investment, program delivery, operations, and major capital maintenance to sustain the life span of the infrastructure created.

414 Hutton, G. and Varughese, M. 2016. [The Costs of Meeting the 2030 Sustainable Development Goal Targets on Drinking Water, Sanitation, and Hygiene](#). Water and Sanitation Program: World Bank.

415 The waste management costs entail the costs of collecting, transferring, and recycling waste.

416 Kaza, S. et al. 2018. [What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050](#). World Bank.

417 India's urban and rural populations are obtained from the [UN Population Division Data Portal](#).

418 World Green Building Council. 2013. [Business Case for Green Buildings: A review of the Costs and Benefits for Developers, Investors and Occupants](#).

419 Ibid.

420 Turner & Townsend. 2021. [International Construction Market Survey Report](#).

421 Ibid.



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