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CLIMATE TECH

Investment Trends in India

A 2022 Retrospective

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Message from Impact Investors Council (IIC)

As policy and industry gear up with interventions aligned with India's ambition, Net-Zero ambitions, merit the coming up of solutions that enable decarbonisation of sectors in a scalable manner. This pathway to a decarbonised economy needs to be complemented by appropriate tech interventions. However, the pace of evolution of ecosystems and innovations to become commercially viable and deployable at scale hinges on their ability to attract finance. An increasing number of 'Climate Tech' startups have been coming up over the last few years to support research, innovation and investments in developing a climate focussed strategy. However the scale of this finance and ease of access of enterprises to investors needs to be at a much larger scale and in a manner that is commensurate with the enterprises' growth trajectory and larger industry trends.

The Impact Investors Council (IIC) has endeavoured to enhance the capacity of the investor ecosystem to actively participate in climate finance. Continuing in this direction, this report focuses on the emerging trends within the climate tech ecosystem and showcase relevant insights to help investors make informed decisions. As India works towards developing a taxonomy for investments focused on climate action, the report also aims to socialise the different emergent segments within climate tech to build a better understanding of less understood solutions.

The imminent risk of climate change and its all pervasive impact indicates the need for a holistic approach towards investments that can also drive ecosystem partnerships and a blend of different forms of capital. The pathway towards this would require the impetus of early-stage investments to startups who require financial and technical support to consolidate technologies and build the confidence of the industry to leverage such solutions. The participation of more equity capital towards strengthening this narrative will play a critical role in mainstreaming investment in climate tech.

This report tries to address often asked questions while understanding the climate tech space. These include - what solutions are attracting most investment, which emerging new spaces could become potential game changers, who are the new rung of capital providers adopting a climate approach and what are some of the macro enablers to watch out for, as India builds upon its decarbonisation strategy.

We hope this report addresses what you seek to know about this emergent space in India.

Girish Aivalli
Chief Executive Officer
Impact Investors Council

Foreword by SBICAPITAL Markets Ltd.

In August 2022, India updated its Nationally Determined Contribution (NDC) under the United Nations Framework Convention on Climate Change (UNFCCC). The revised NDC includes key targets announced at COP26 in 2021: a commitment to reduce emissions intensity by 45% below 2005 levels by 2030 and increase the share of non-fossil power capacity to 50% by the same year.

During India's G20 presidency summit, there was a clear emphasis on the importance of comprehensive climate action through 'disruptive innovation for climate action.' Thus, innovation is viewed as a significant driver for national and subnational decarbonization efforts. India, as a developing economy, presents significant opportunities for investors interested in climate-focused investment strategies.

These objectives reflect India's proactive stance on climate change, aligning with global net-zero emissions efforts by 2070. As India expands in EV, clean energy, waste management & circular economy, climate-smart agriculture innovation and other climate focused avenues, it is evident that equitable funding and robust support are essential for recognizing that real impact emerges at the nexus of innovation and scalability.

This report provides a comprehensive overview of India's dynamic climate tech innovation landscape, highlighting key trends, emerging ideas, and promising startups. Notably, the amount invested in this space has nearly doubled in 2022, where the growth momentum continues from the EV mobility sector, sustainable battery recycling, and charging platforms.

Waste management and the circular economy is another booming sub-sector, driven by the strict implementation of policies for plastic and e-wastes, initiatives like Swachh Bharat 2.0 and the GOBAR-Dhan scheme (2023-24), and effective adherence to EPR guidelines with the 'Producer pays' principle, fostering partnerships and collaborations across the value chain.

In the energy sector, there is a strong focus on Green Hydrogen, driven by policy incentives such as the National Green Hydrogen Mission 2023 and an increased push for innovation.

Neev Funds, managed by SBICap Ventures Limited invests in critical climate change sectors, including biofuels, agriculture, waste management, and energy. Our focus is on early-stage SME businesses in these fields who drive innovations in the climate change space.

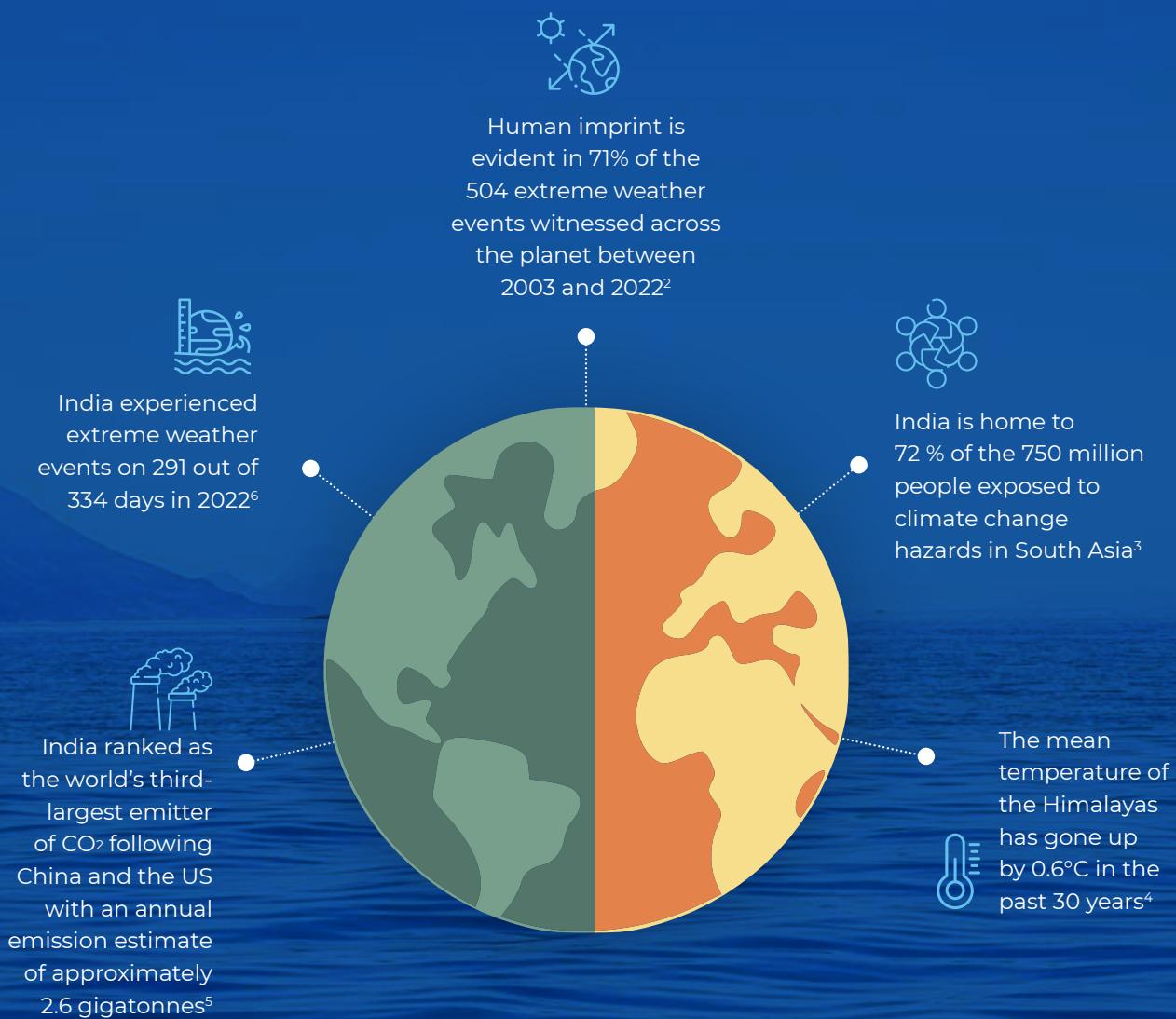
In partnership with IIC, this report aims to serve as an informative guide, aiming to facilitate stakeholder alignment with the necessary financial support required to promote innovation in addressing climate change.

Mr. Rajay Kumar Sinha,
MD & CEO SBICAPITAL Markets Ltd. and
Chairperson, SBICAP Ventures Ltd.

Introduction

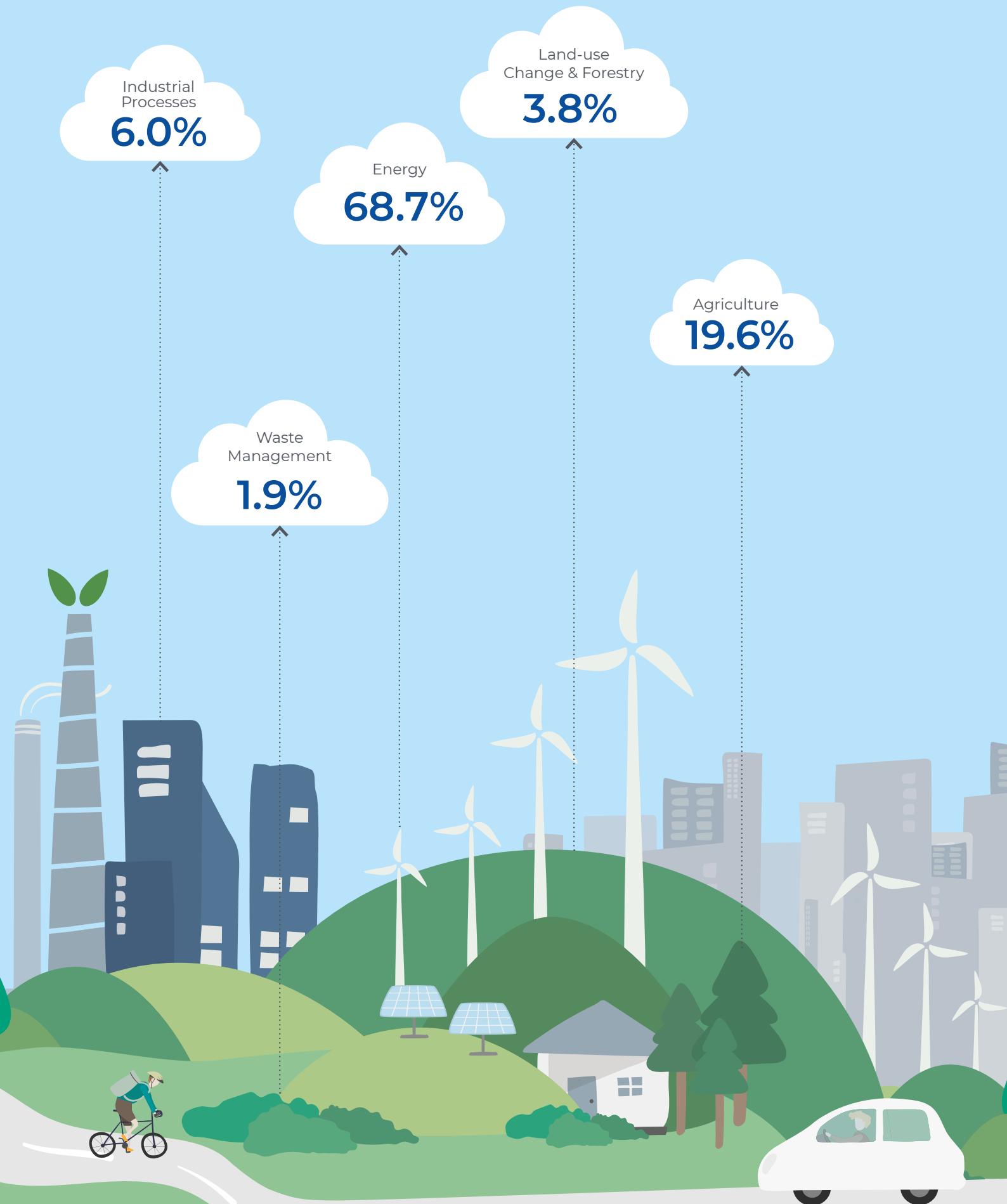
Since 1992, more than 24,000 people have died because of heat waves in India and the impacts are expected to worsen as heat waves become more frequent, intense and lethal due to the climate crisis¹. The global urgency to take climate action has never been stronger.

Figure 1.1: A snapshot of changing environmental patterns



Sector-wise Greenhouse Gas (GHG) emissions in India

The rise in average temperatures in the country can be attributed to the following sectors based on their relative contribution to greenhouse gas (GHG) emissions as summarized below⁷:



A report by the London based global think tank Overseas Development Institute, found that India may lose anywhere between 3–10% of its GDP annually by 2100, while its poverty rate may rise by 3.5% in 2040 due to climate change⁸

These statistics emphasise the urgency for climate action by policy intervention as well as resource mobilisation. The Government of India (GoI) has been introducing measures aimed at lowering the intensity of the climate crisis as well as committing to reducing CO₂ emissions by 50% by 2050 and achieving net-zero emissions by 2070⁹.

Figure 1.2 presents a snapshot of India's Long-term Low Emission Development Strategy put forward by the Ministry of Environment, Forest and Climate Change (MOEFCC), GoI, to outline the nation's commitment to low carbon emission.

Figure 1.2: Elements of India's Long-Term Low-Emission Development Strategy¹⁰



Sectoral Focus: On energy, industry, transport, buildings, agriculture, and waste management.

Mitigation Measures: To reduce GHG emissions, including promoting renewable energy, improving energy efficiency, adopting sustainable agricultural practices, implementing waste management strategies, and transitioning to low-emission transportation.

Adaptation and Resilience: Towards climate change adaptation and resilience measures to protect vulnerable communities, ecosystems, and infrastructure from the impacts of climate change.

Technology and Innovation: Importance of technology development, transfer, and deployment to support low-emission development, including the promotion of clean technologies and innovation.

International Collaboration and Financing: For international collaboration, cooperation, and financial support to effectively implement low-emission development actions and achieve climate goals.

Monitoring, Reporting, and Review: For measuring progress towards achieving the long-term low-emission development (LT-LEDS) goals, while ensuring transparency and accountability.

India has recently strengthened its climate change targets to align with global climate action goals and has submitted its first Nationally Determined Contributions (NDC) under the Paris Agreement in August 2022¹¹. The revised targets include a commitment to reduce the emissions intensity of GDP by at least 45% from 2005 levels and ensure that at least 50% of installed electricity generation

capacity by 2030 comes from non-fossil fuel sources¹². India's participation in the United Nations Framework Convention on Climate Change (UNFCCC) COP26 resulted in the announcement of a net-zero target by 2070 and endorsement of the Glasgow Breakthrough Agenda for accelerating the development and deployment of clean technologies¹³.

Figure 1.3: India's Updated Nationally Determined Contributions (NDCs)



The GoI has also launched several schemes and programs across sectors such as water, agriculture, energy, mobility, waste management, and circular economy to enhance both adaptation and mitigation efforts (Table 1). The Press Information Bureau (PIB) reported in August, 2022 that these

measures have resulted in the decoupling of economic growth from GHG emissions, with significant reductions expected from initiatives like Indian Railways' net-zero target by 2030 and the widespread adoption of LED bulbs¹⁴.

Table 1.1: National Missions launched by the Government of India

National Mission	Year	Objective
National Green Hydrogen Mission	2023	Creating an enabling ecosystem for G-H2 deployment Achieving at least 5 MMT/annum G-H2 production capacity by 2030
National Hydrogen Mission	2021	Energy independence for India Decarbonisation of key sectors India as a global hub for production and supply of alternative fuel
National Mission for Sustainable Agriculture	2014	Enhancement of agricultural productivity through climate resilient farming practices
National Mission for a Green India	2014	Protection, restoration and enhancement of India's diminishing forest cover Response mechanism to climate change through adaptation and mitigation measures
National Water Mission	2011	Conservation of water Minimize water wastage Equitable distribution of water across and within States
National Mission for Enhanced Energy Efficiency	2011	Strengthened market for energy efficiency Conducive regulatory and policy regime Fostering innovation and technology advancement
National Mission on Sustainable Habitat	2010	Build resilience of cities to face impact of climate change
National Solar Mission	2010	India as a global leader in solar energy
National Mission for Sustaining Himalayan Ecosystems	2010	Scientific study for climate vulnerability assessment of the Himalayan ecosystem
National Mission on Strategic Knowledge for Climate Change	2008	Promotion of research, knowledge generation and capacity building relating to climate science

Source: Economic Survey 2022-23¹⁵

Figure 1.4: Union Budget 2023 - Accounting for Climate Action



Boost to Energy Transition

Allocation of ₹ 35,000 crores for energy transitions.



Ladakh's Renewable Energy Potential

Allocation of ₹ 20,700 crores for integrating 13 GW of renewable energy from Ladakh to boost economic development.



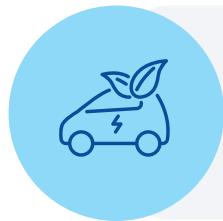
Green Hydrogen Mission

Promised outlay of ₹ 19,700 crores to facilitate India to be a leader in decarbonising industrial and transport sectors.



Battery Energy Storage Support

Viability gap funding for storage projects with capacity of 4,000 MWH addresses the need for battery storage in scaling up renewable energy utilisation.



Electric Vehicles

Removal of custom duties on components for lithium-ion batteries reduces EV cost. Allocation of ₹ 5172 crores towards its flagship program – FAME-II¹⁶.



Circular Economy

Allocation of ₹ 10,000 crore towards the GOBARdhan scheme to promote a circular economy by setting up 500 “waste-to-wealth” plants across the country¹⁷.



Other Positive Initiatives

Increases in budget allocations for PM-Awas Yojana and MISHTI have potential for climate-resilient housing and improving resilience against natural disasters.

Source: The Economic Budget 2023¹⁸

India's Leadership at the G20

As the host of the G20, India has emphasized the need for collective action on climate change, among other topical agendas. India has maintained its commitment to a **net-zero target by 2070** and as a part of the presidency, has hosted ministerial meetings on climate change. India has made "**disruptive innovation for climate action**" the focal point of its G20 presidency¹⁹ with a special focus on green development, climate finance and technological innovations supporting climate action.

India's G20 presidency presents an opportunity to bridge the divide between the global south and the global north²⁰. Climate finance remains a critical issue, with India needing substantial funds for its energy transition. Estimates suggest that at least **\$900 billion will be required for a just energy transition in India over the next 30 years**²¹. There is great potential for India to leverage increased climate finance flows from developed to developing countries at attractive rates of interest, if not as grants, to support its climate leadership goals.

The Technology-Finance Paradigm

Finance is an important component of India's climate action. To accomplish climate action goals, attempts are being made to mobilise private financing. Though the last few years have seen significant action by the public and private sector in this direction, for climate action targets to materialise, the availability of appropriate and affordable finance remains a constraint.

As extreme weather events in the country underscore the need for resilience-building measures, the need to fund enterprises working on innovation to combat the climate crisis becomes imperative. The need for the private sector to step in and help fund nascent enterprises combating climate change using cutting-edge technologies (referred to as climate tech enterprises) is extremely important to help bridge the gap between the demand and supply of funds. The climate tech startup ecosystem in India is positioned at the intersection of technology, offering potential solutions for both individuals and organisations. Climate tech encompasses a wide range of industries, including renewable energy, sustainable agriculture, waste management, and more, and fostering innovation across these sectors is vital for comprehensive climate action.

As the implications of climate change become more obvious, it is envisaged that innovation will play a significant role in facilitating national and subnational decarbonisation processes. Innovation to tackle climate change is currently underway in areas such as Clean Energy, Climate Smart Agriculture, Sustainable Mobility, Circular Economy, Low-Carbon Manufacturing, Sustainable Land and Water Management, and Carbon Capture, among others. In the Clean Energy space, while there is growth in solar and wind power generation, there are other sources, such as biofuels and geothermal energy, that are acting as a bridge toward clean energy²². Food production and animal husbandry is another space where startups have developed precision agriculture and smart farming that utilises less land and water²³. In the electric vehicle (EV) industry, home-grown startups are leading from the front as the adoption of two-wheeler electric vehicles is growing daily, especially in the last-mile delivery space, which has a rather significant carbon footprint²⁴. Funding these innovations is crucial for India to achieve its net zero targets and achieve the status of a Green Economy.

Recent breakthroughs present both the commercial and public sectors with a variety of technology driven mechanisms, ranging from low- or no-carbon solutions to mitigate GHG sources to carbon capture and storage innovations to address the implications of global warming.

Equity investments in climate tech enterprises in India over 2016–2021 stood at a **\$1 billion**, compared to approximately **\$15 billion in Europe, \$20 billion in China**, and almost **\$50 billion in the United States**²⁵. While the interest and investments towards climate linked innovation garners momentum, India is poised at a pivotal juncture to integrate technology and innovation with financial capital to achieve impact at scale.





Executive Summary: Climate Tech Investment Trends in India: A 2022 Retrospective



The climate tech startup space raised a cumulative ~\$2 billion across 279 deals between 2020 and 2022.

The climate tech startup ecosystem in India has experienced a profound evolution, marked by impressive growth and dynamic trends. From 2020 to 2022, the sector saw a surge in investment, totalling approximately \$2 billion across 279 deals. Notably, this period witnessed an astounding 126% increase in deal value and a remarkable 64% surge in deal volume from 2021 to 2022. This upswing can be attributed to the escalating recognition of climate change imperatives and a combined effort of impact and commercial investors towards climate focussed innovations.

Table 2.1: A Snapshot of the Climate Tech Sector

Climate Tech	2020	2021	2022
Deal Value (\$ mn)	169	561	1267
# of Deals	65	81	133

Source: Authors, 2023

This surge in activity can be attributed to the growing emphasis on climate change interventions and an investor shift towards a climate-focused lens.

Figure 2.1: Investment Value (\$ mn) (2020 - 2022)

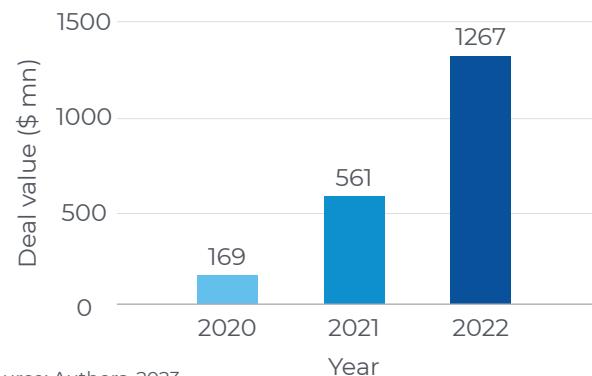
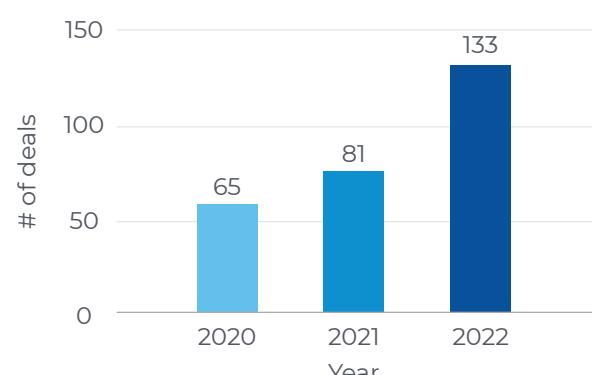
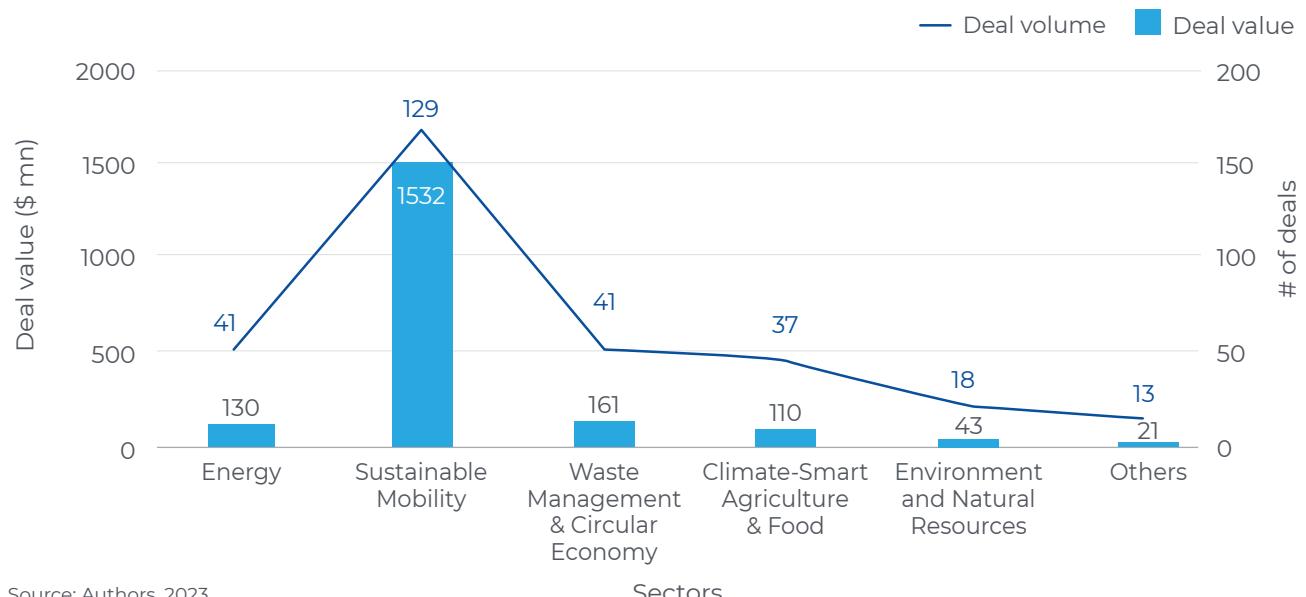


Figure 2.2: Investment Volume (2020 - 2022)



Sector Focus: Where Do We Stand?

Figure 2.3: Cumulative Investment Value (\$ mn) and Volume across Sub-Sectors (2020 - 2022)

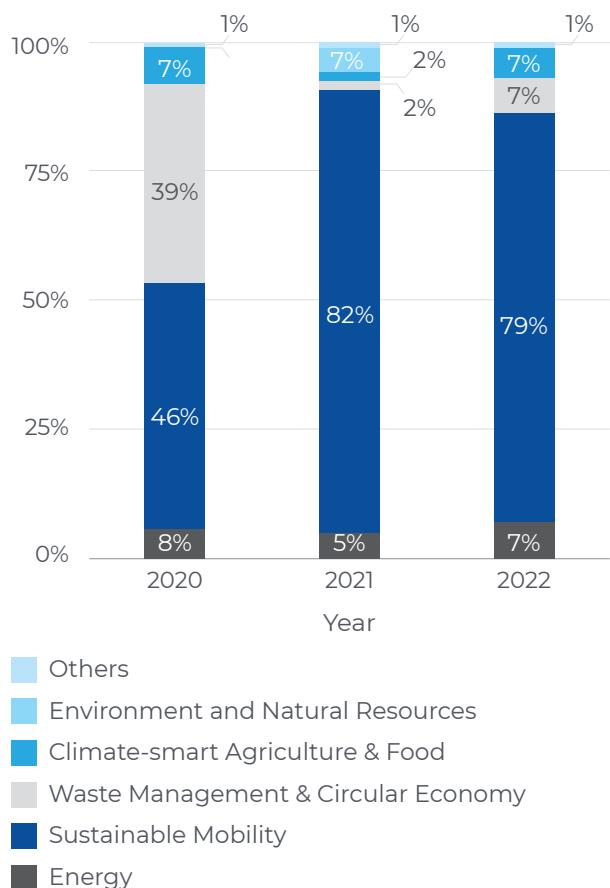


Source: Authors, 2023

Between 2020 and 2022, the sustainable mobility sub-sector raised **~\$ 1.5 billion** across **129 deals**, leading in terms of deal value as well as deal volume. In 2022 alone, the sub-sector raised **~\$ 1 billion** across **62 deals**.

The rise in climate tech investments can be majorly attributed to the increased participation of investors in the sustainable mobility sector over the past three years. Even without accounting for investments in electric vehicle (EV) original equipment manufacturers (OEMs), just by considering the capital-intensive nature of this industry, we can observe nearly half of the overall Climate Tech investments directed towards the sustainable mobility sector. This trend is propelled by the increasing funding towards enterprises involved in building the charging infrastructure and using EVs as a service.

Figure 2.4: Investment Value (\$ mn) across Sub-sectors (2020 - 2022)



Source: Authors, 2023

Stage-Wise Funding

Seed stage funding continued to lead, however each of the sub-sectors saw unique solutions as well as investor support by way of growth capital.

Source: Authors, 2023

Figure 2.5 : Stage-wise Investment Value (in \$ mn) (2020- 2022)

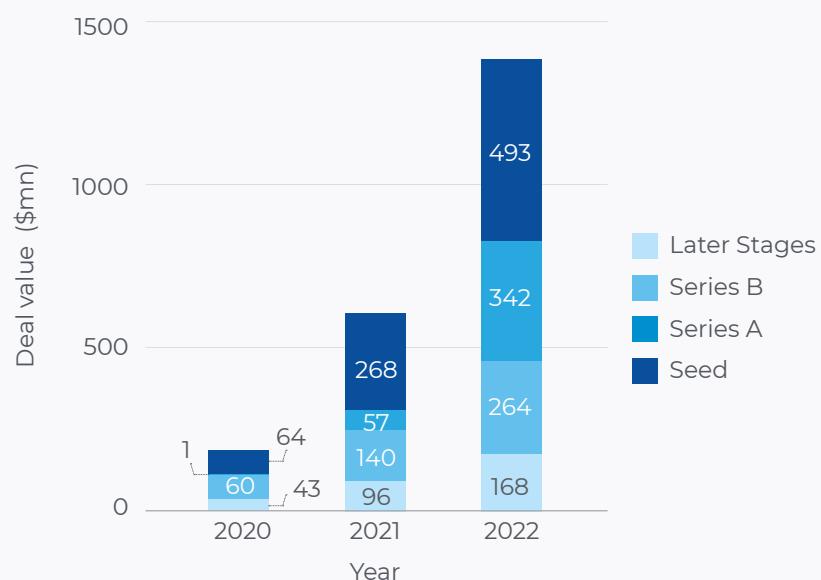
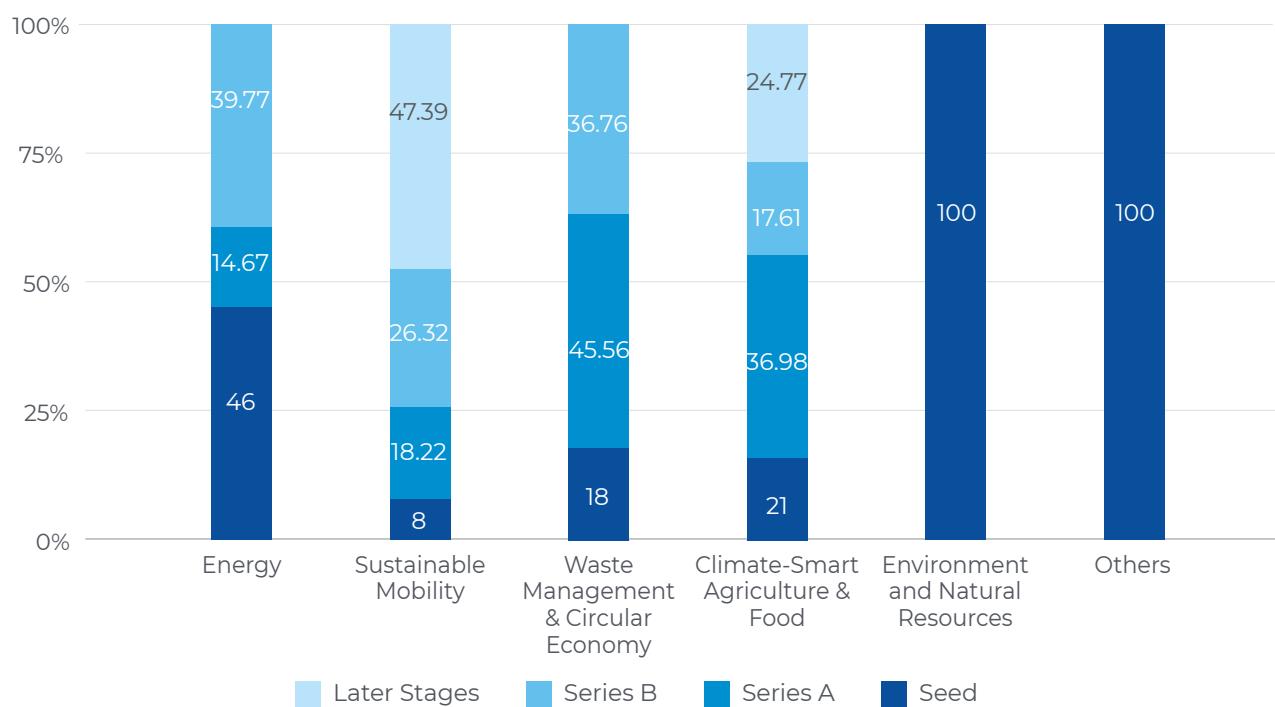


Figure 2.5.1: Stage-wise Investment Value (in %) across Sub-sectors in 2022



Source: Authors, 2023

Given the increasing number of technological innovations, most investments continue to take place in the early stages viz., Seed and Series A. Enterprises are increasingly coming up with innovations in product, business processes or business models that leverage technology to address value chain inefficiencies. We see notable

examples of early-stage innovations across sectors - right from electrolyser manufacturing (**NewTrace**) to green construction materials (**Zerund**) each addressing a unique sectoral challenge. The climate smart agriculture and food space has also seen an investment surge in alternative proteins as well as climate resilient

imperatives such as organic farming and precision agriculture. The mobility space too has been interestingly seeing early-stage investments towards consolidating the sectoral infrastructure, such as battery charging solutions even as newer Original Equipment Manufacturers (OEMs) continue to come up.

Growth capital is characterised by the mobility space given the increasing demand for EVs. However enterprises in other sectors, which demonstrate their growth potential either through breakthrough innovative technologies or ecosystem building models have also attracted investments.

Compared to previous years, **2022 has seen a notable increase in high ticket deals (>\$25 million)** on account of the surge in mobility transactions. Apart from large EV OEMs we have also seen other solutions in the space raising high ticket deals. For instance, **Battery Smart** with its battery swapping solutions and **Statiq** with its EV charging solutions have also raised funding > \$25 million. This is indicative of an increasing focus, currently, towards building the infrastructure requirements of the EV sector, which is drawing substantial investments.

High-ticket deals show growth while the majority investments remain <\$5 million

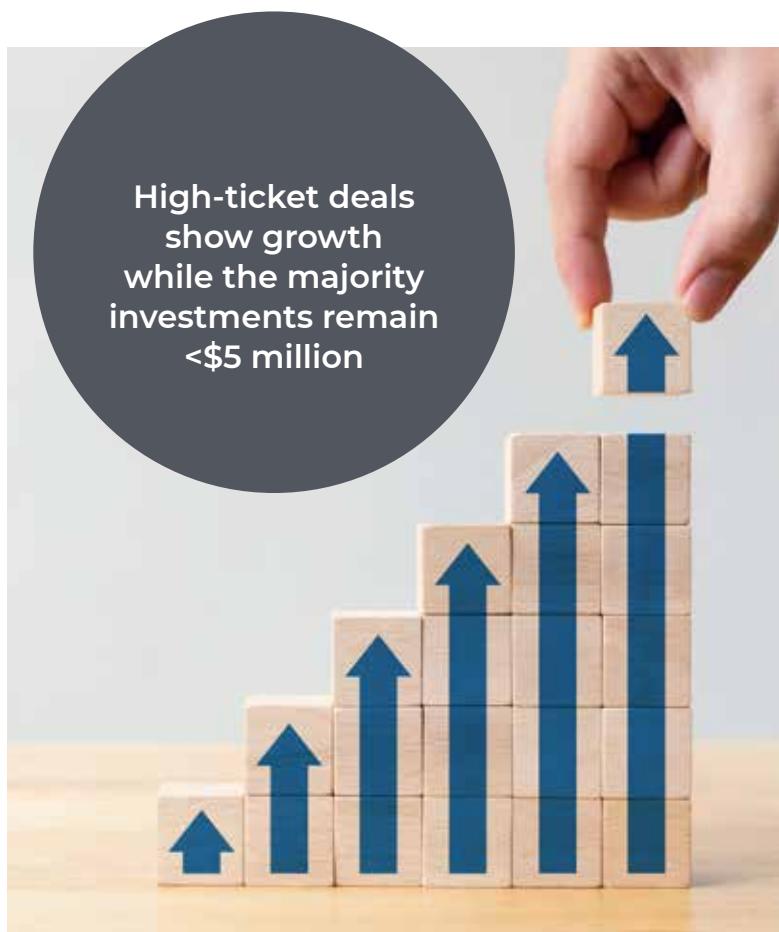
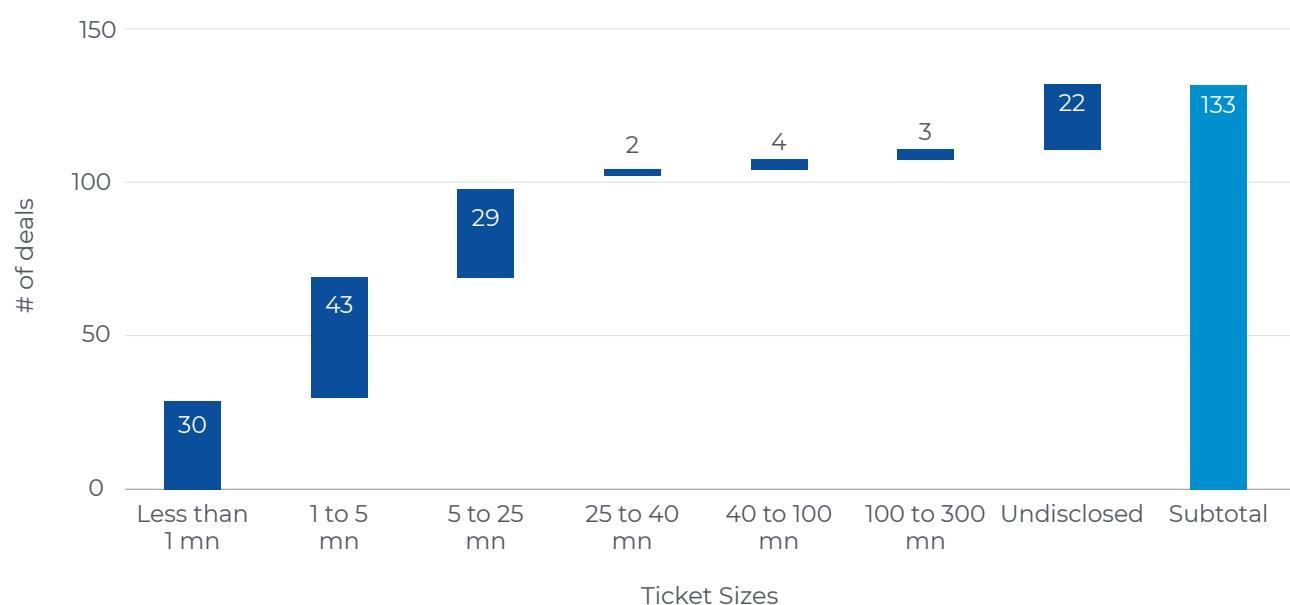


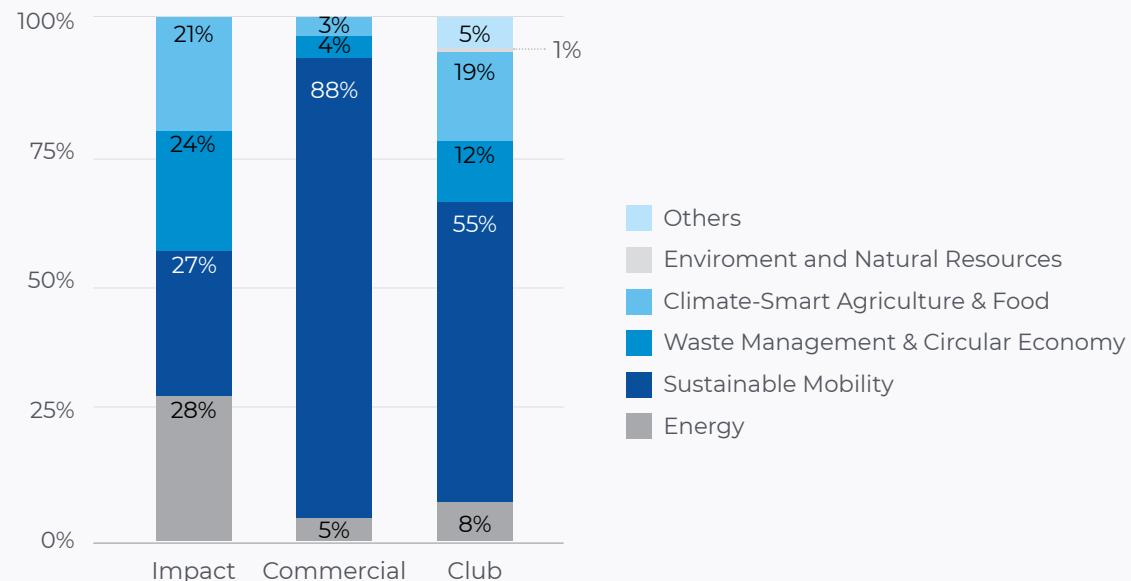
Figure 2.6: Ticket Sizes of Deals in 2022



Source: Authors, 2023

Sources of Capital

Figure 2.7: Investments (\$ mn) by Impact, Commercial & Club Investors across sub-sectors in 2022



Source: Authors, 2023

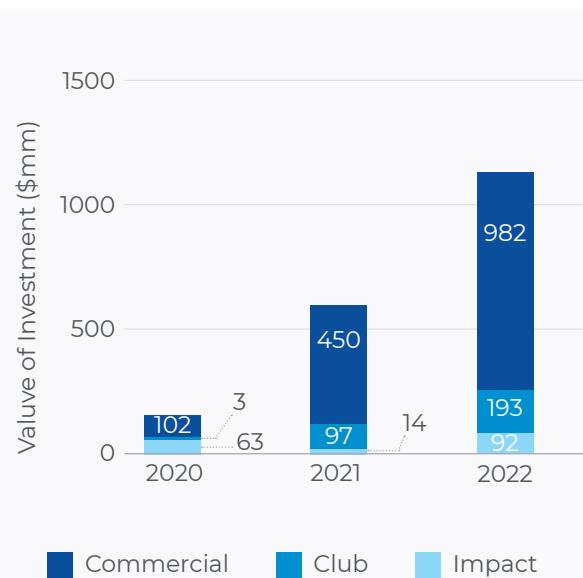
Investments by commercial investors saw a huge surge in 2022, once again propelled by the sustainable mobility space. Favourable government policies and incentives for EVs, coupled with a burgeoning middle class - have created a promising market for sustainable transportation options. Investors recognise the potential for substantial returns as the shift towards eco-friendly mobility gains momentum, aligning with global sustainability trends. However, it is interesting to see innovations in other sub-sectors as well feeling a rising push from commercial investors.

The climate-smart agriculture sector which saw muted investments from commercial investors in 2021 and 2020, saw innovative solutions in the food and agri segments supported by commercial investments. **Pixxel** with its satellite based technology to monitor soil and farm raised \$25 million from commercial investors.

The waste management space also saw an increased interest from commercial investors in end-to-end solutions such as **Recykal** as well as in innovative recycling and upcycling solutions such as **Phool.co** (upcycling bio waste) and **Metastable Materials** (battery recycling) and in green construction solutions such as **Zerund**.

In the energy sub-sector, early-stage energy optimisation solutions have been the subject of interest among commercial investors as well as enterprises presenting high potential for scale in the energy storage segment.

Figure 2.8: Amount of Capital Raised through Commercial, Impact and Club Deals (2020-22)



Source: Authors, 2023

Impact investors continue to support early-stage investments, especially solutions that present a high level of innovation. Apart from early-stage innovations, we also see the ticket size of investments by impact investors present a very visible increase in 2022. **Hygenco**, engaged in green hydrogen manufacturing, raised \$25 million in 2022 from **Neev Fund** while **ElectraEV**, which aims to improve the efficiency of EVs through its powertrain components, raised \$25 million from **GEF Capital's South Asia Growth Fund II**.

Circulate Capital with its sector-focussed strategy has emerged as a profound advocate of the waste management and circular economy space. The year-on-year increase in investments in this space has been greatly propelled by Circulate Capital's sector focussed strategy enabling greater support to emerging innovations. Other impact investors continue to support this space given its vast scope and increasing innovation in technology to process different forms of waste. More than 50% of the

investments in this domain over the last three years have come through Impact focussed investors. As India's urban landscape expands and economic growth accelerates, waste generation follows suit, necessitating innovative waste management solutions. Impact investors recognise the untapped potential of recycling, upcycling, and resource recovery – not only to address environmental challenges but also to unleash economic value.

It is also notable to mention that there is a consolidation of the value chain in every segment, as corporate investors step in to invest in startups vertically integrating their operations. Be it **Log9 materials** (battery manufacturer) investing in **Metastable Materials** (battery recycling) or a **Hero Motocorp** supporting EV OEMs, we can foresee how an integration within the value chain can eventually lead to more innovation as technologies become deployable at scale.

Apart from standalone investments from commercial and impact investors, in 2022 we noted increasing co-investments between commercial and impact investors through club deals. Such deals formed a major share of the investments in sectors with high gestation periods such as climate smart agriculture and food, as well as waste management and circular economy. As these club deals become more prevalent, the convergence of impact and commercial capital not only stands to strengthen financial support but also significantly magnify their practical impact on the ground.

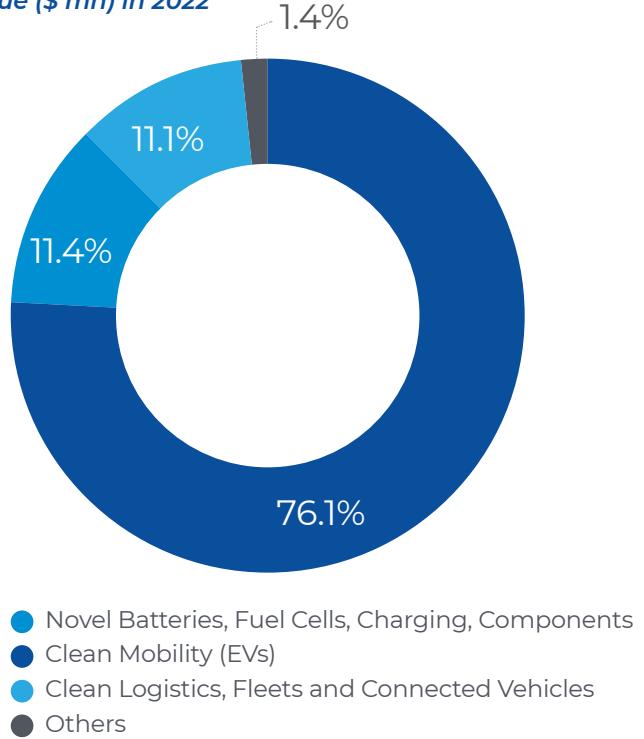


Sub-Sector Focus: Sustainable Mobility: Investment Thesis

As 57 startups raised ~ \$1 billion across 62 deals, the sub-sector dominated the climate tech landscape by generating 80% of the investment value.

This growth is attributed to increasing consumer awareness and proactive policy initiatives like the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) scheme. Looking ahead, sustainable mobility's future outlook is bright. EV OEMs with established distribution channels could turn to debt financing, wherein charging infrastructure development will likely attract growth capital, while asset-light models for consumers are set to remain in focus.

Figure 2.9: Sustainable Mobility - Investment Value (\$ mn) in 2022



Source: Authors, 2023



Figure 2.10: Sustainable Mobility - Investment Value (\$ mn) & Volume (2020 - 2022)

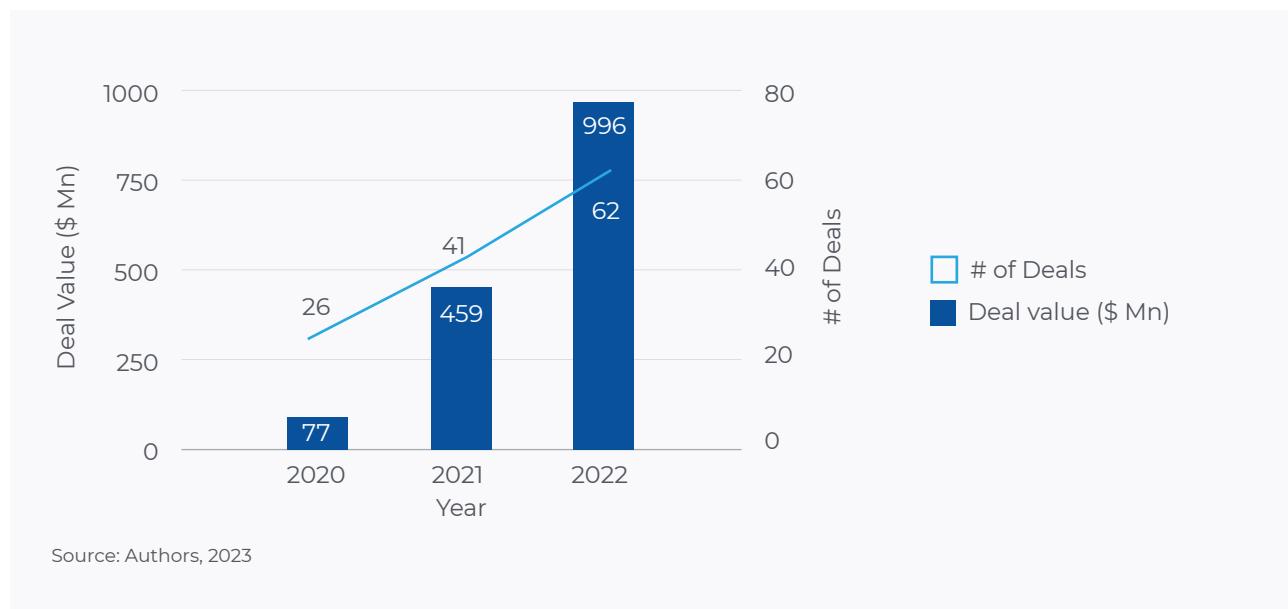


Table 2.2: Sustainable Mobility - Enterprises in Focus and Key Investment Details

2022 in Retrospect			
Enterprises in Focus		 ATHER	 OLA ELECTRIC
Business Trends	<ul style="list-style-type: none"> EV OEMs and supporting charging infrastructure emerge as pivotal themes Asset-light models including EV ride-hailing platforms and micro-mobility solutions gain traction Innovative business models like battery swapping emerge Strategic collaborations among startups emerge 		
Investment Trends		<ul style="list-style-type: none"> Commercial investors instrumental in driving significant investment volumes especially towards EV OEMs Established brands like Ola Electric and Ather Energy fetch substantial investments, especially in later-stage funding rounds. Impact investors seen participating in club deals to support early-stage enterprises Corporate investors like TVS Motor and Hero Motocorp invest in EV OEMs 	
Key Investors		 Hero	 TEMASEK  Edelweiss <small>ideas create. values protect.</small>  ADB Ventures

Source: Authors 2023

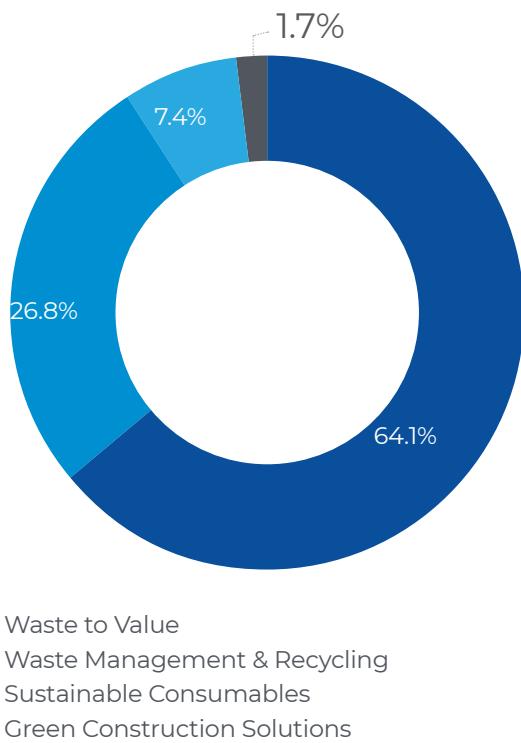
Sub-Sector Focus: Waste Management & Circular Economy: Investment Thesis



A remarkable surge in investment activity was seen in 2022 with 17 startups securing a total of \$83 million across 18 deals, marking an impressive eightfold increase in investment value over the previous year.

The sub-sector's future outlook is positive, driven by end-to-end waste solutions, battery recycling, and sustainable consumables, aligning economic viability with environmental responsibility. Sector-focused funds are expected to catalyse further growth and innovation in waste management and recycling.

Figure 2.11: Waste Management & Circular Economy - Investment Value (\$ mn) in 2022



Source: Authors, 2023



Figure 2.12: Waste Management & Circular Economy - Investment Value (\$ mn) & Volume (2020 - 2022)

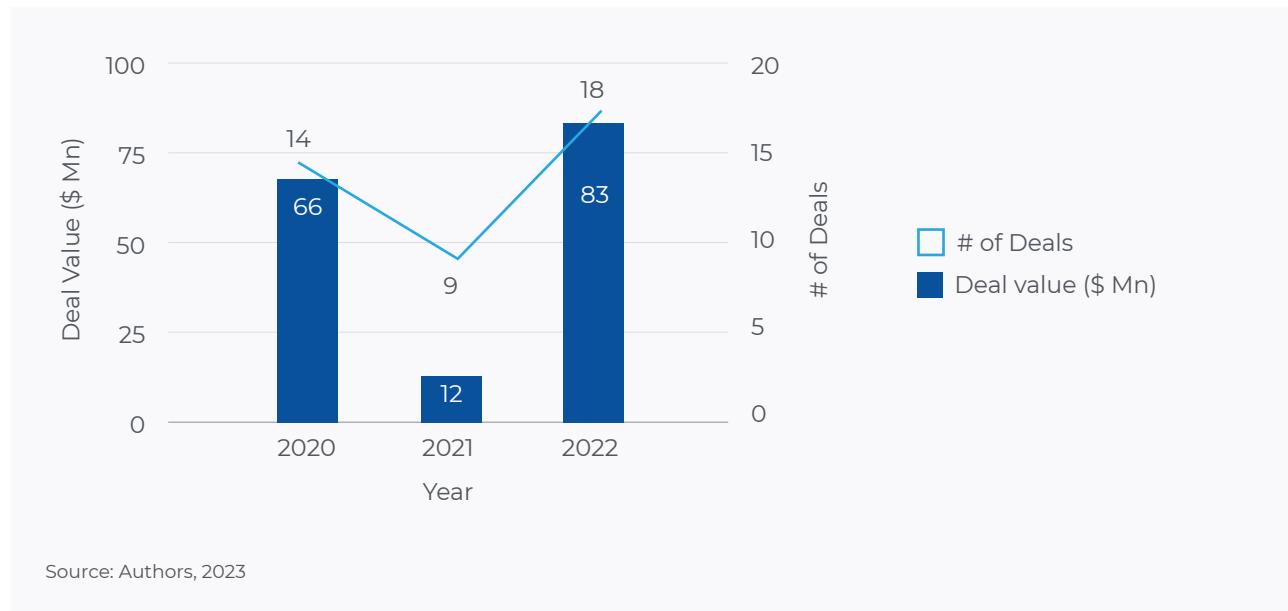


Table 2.3: Waste Management & Circular Economy - Enterprises in Focus and Key Investment Details

2022 in Retrospect	
Enterprises in Focus	  
Business Trends	<ul style="list-style-type: none"> Enterprises creating value out of waste gain momentum Innovations give rise to newer segments such as green construction materials and sustainable consumables Battery recycling steps up on the heels of a growing EV sector
Investment Trends	<ul style="list-style-type: none"> Commercial investors step in with high ticket deals Strategic investments observed as corporate investors invest across the value chain; such as Log9 Materials investments in a battery recycling startup Enterprises providing waste management solutions garner high ticket deals
Key Investors	  

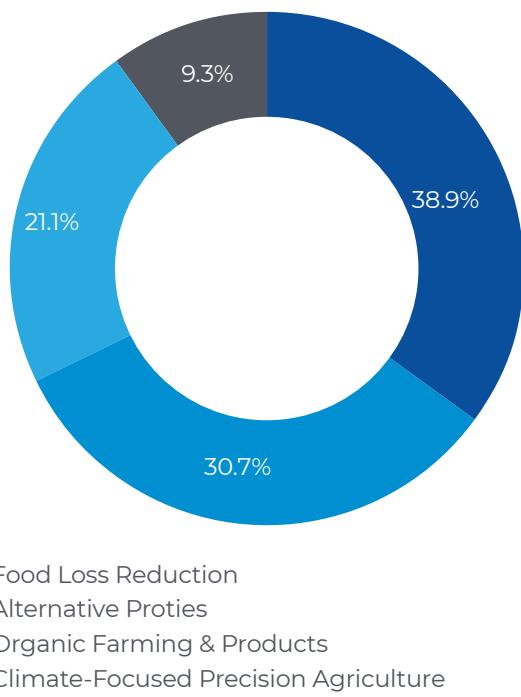
Source: Authors 2023

Sub-Sector Focus: Climate Smart Agriculture & Food: Investment Thesis

In India, Climate Smart Agriculture (CSA) is rapidly gaining momentum as a crucial sub-sector at the intersection of sustainable farming and climate change adaptation. In 2022, 18 CSA startups raised \$85 million across 22 deals.

The future outlook is promising, demonstrating great potential for climate smart solutions to provide not just technological capacity to farmers but also empower the agri ecosystem and value chain actors with climate and farm level data insights relevant for decision making - a possible game changer for financial institutions in extending agri-finance. As consumer awareness grows, alternative proteins could emerge as the next big wave in climate smart foods.

Figure 2.13: Climate Smart Agriculture & Food - Investment Value (\$ mn) in 2022



Source: Authors, 2023



Figure 2.14: Climate Smart Agriculture & Food - Investment Value (\$ mn) & Volume (2020 - 2022)

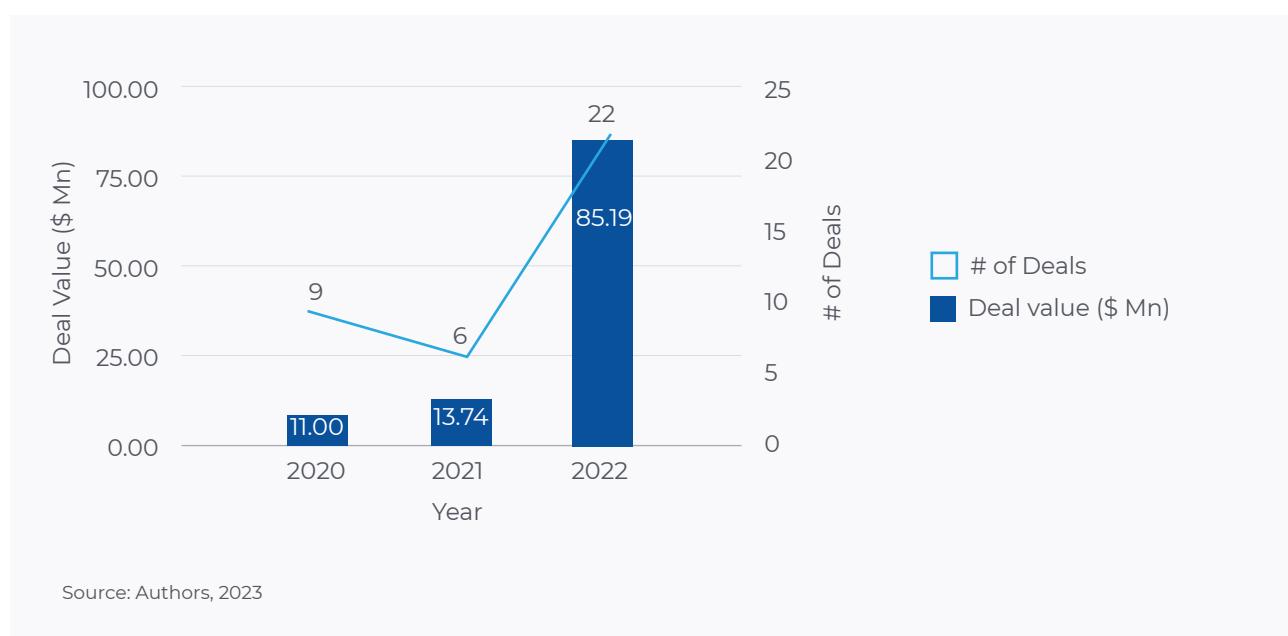


Table 2.4: Climate Smart Agriculture & Food - Enterprises in Focus and Key Investment Details

2022 in Retrospect	
Enterprises in Focus	   
Business Trends	<ul style="list-style-type: none"> Alternative protein sees a major surge as domestic investors support foodtech Climate resilient solutions building farmer incomes seen as a major draw Alternative farming methods such as Hydroponics gain traction Precision agriculture and organic farming raise high tickets (>\$5 mn) AI backed data driven solutions fetch high investment value Business models expand scope from the farmer to B2B solutions
Investment Trends	<ul style="list-style-type: none"> High-value investments carried out through club deals Impact investors support deep tech in alternative proteins Holistic farming solutions also supported by impact investors
Key Investors	   

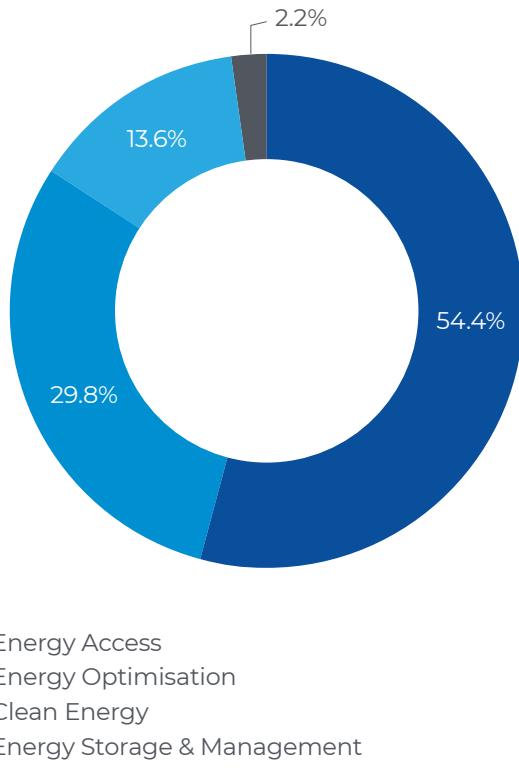
Source: Authors 2023

Sub-Sector Focus: Energy: Investment Thesis

Between 2020 and 2022, the Indian Renewable Energy (RE) space underwent a remarkable transformation, attracting approximately \$129 million in investments across 41 deals, with \$87 million worth of investments in 2022 alone.

As India's bid for energy independence receives policy impetus, the ecosystem of RE solutions is on a growth trajectory. Right from energy production and storage to energy efficiency and access to the last mile, solutions are leveraging technology to support India's clean energy transition. Battery Energy Storage Systems (BESS) are set to gain growth capital for scalable solutions in India's growing renewables landscape. Commercial investors step in with large ticket deals even as impact capital flows to early-stage innovative models.

Figure 2.15: Energy - Investment Value (\$ mn) in 2022



Source: Authors 2023



Figure 2.16: Energy - Investment Value (\$ mn) & Volume (2020 - 2022)

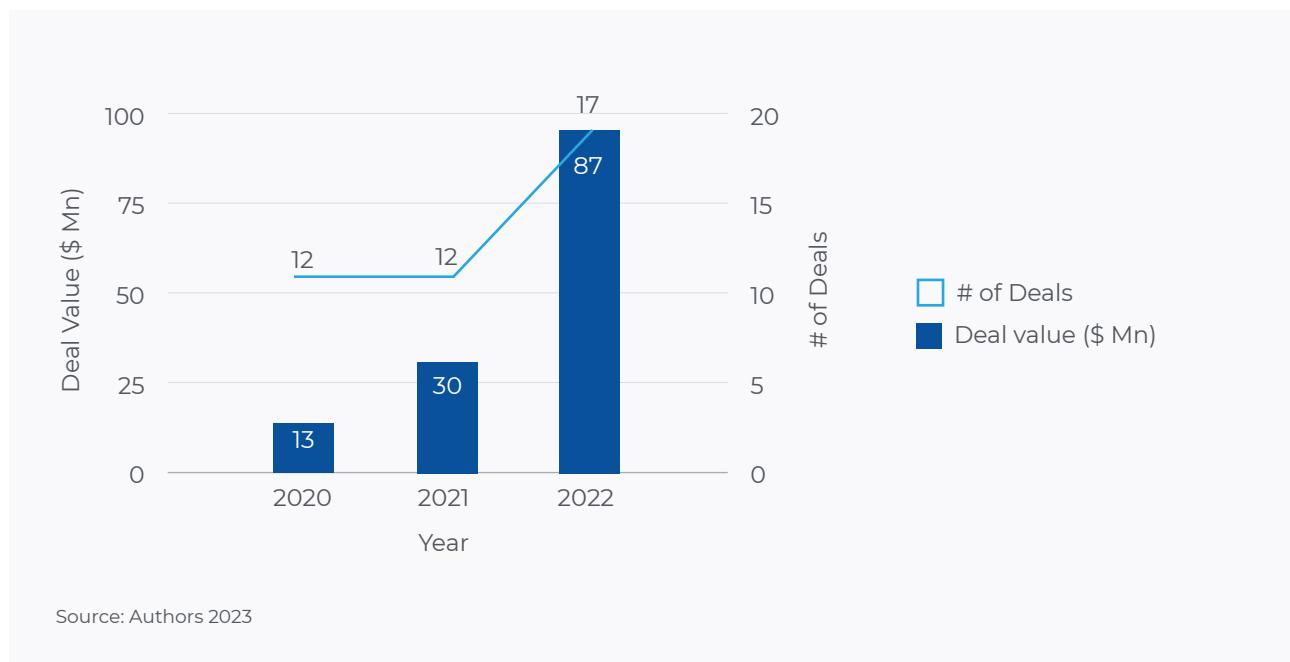


Table 2.5: Energy - Enterprises in Focus and Key Investment Details

2022 in Retrospect	
Enterprises in Focus	 HYGENCO  newtrace  REPOS <i>Fuelling Possibilities >></i>
Business Trends	<ul style="list-style-type: none"> Green hydrogen under spotlight with technologies enhancing production and improving efficiency Innovative business models enable access to 'green' fuel Energy storage in focus as EVs and RE projects abound Data analytics and monitoring systems come up to build efficiency in operations
Investment Trends	<ul style="list-style-type: none"> Impact lens transitions as commercial investors back Innovations Series B investments for energy storage solutions on a growth path Impact investments towards new age technologies in early stages
Key Investors	  

Source: Authors 2023

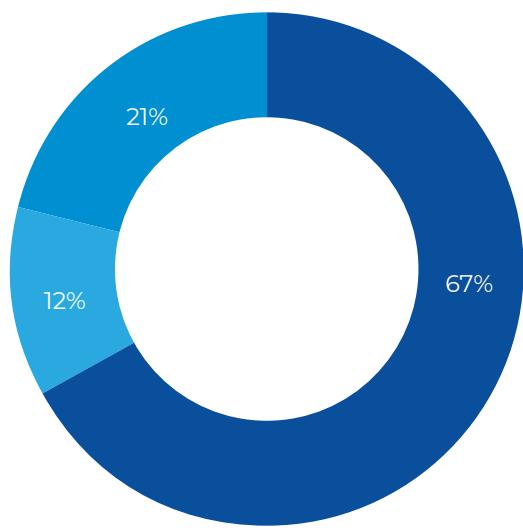
Sub-Sector Focus: Environment & Natural Resources: Investment Thesis



Still in its infancy, this space has seen a decline in investment volumes and value in 2022, mainly on account of a very high-ticket deal in 2021, that did not get similar traction in the subsequent year. As the narrative around climate adaptation gains momentum, deep-tech solutions addressing air and water purification show promise.

As technological innovations need time to stabilise, the road ahead merits increased focus from impact investors.

Figure 2.17: Environment & Natural Resources - Investment Value (\$ mn) in 2022



- Air Pollution and Ambient Environment
- Clean Water
- Water Management and Conservation

Source: Authors 2023



Figure 2.18: Environment & Natural Resources - Investment Value (\$ mn) & Volume (2020 - 2022)

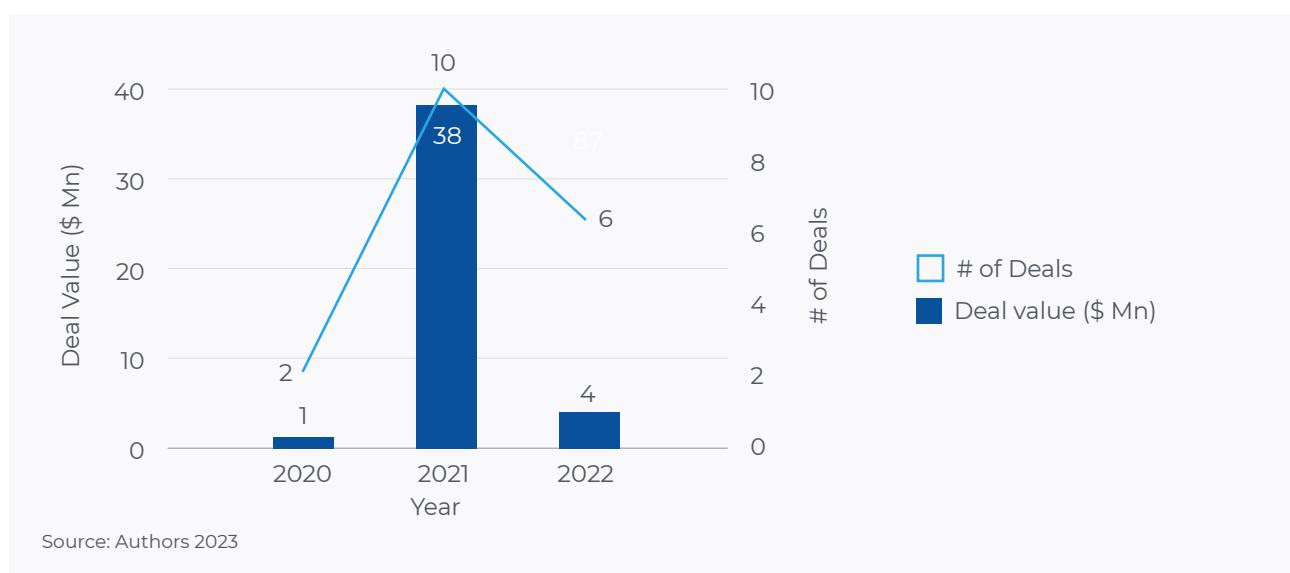
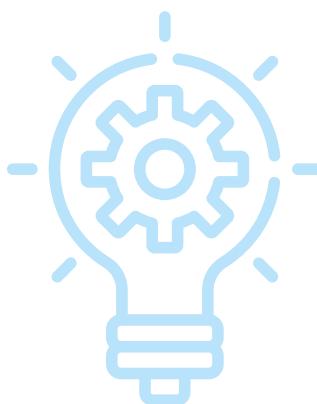


Table 2.6: Environment & Natural Resources - Enterprises in Focus and Key Investment Details

2022 in Retrospect	
Enterprises in Focus	 
Business Trends	<ul style="list-style-type: none"> • Deep technology innovations • Solutions with a B2B focus attract investor attention • Sector linkage gets established as water wastage is addressed with water circularity
Investment Trends	<ul style="list-style-type: none"> • Most solutions in early stages with seed stage funding being in focus • Commercial and club investments seen in a space having direct climate impact
Key Investors	  

Source: Authors 2023



New Age Innovations

It is interesting to witness increasing early-stage activity in new-age startups developing innovative digital solutions to aid businesses with a greater understanding of green solutions.

These solutions indicate the increasing level of innovation towards bringing climate

solutions closer to the user base and enabling businesses to become receptive to 'green' practices.

Some notable examples include **Terra.do** (online climate school), **Climes** (carbon credit purchase platform) and **Varaha** (full stack platform facilitating projects for carbon trading).

Approach and Methodology

This report is a ground-up study of equity investments, between 2020 and 2022, of Indian innovation-focused climate tech startups.

The key terms that are crucial for understanding the methodology and approach used in this study are explained below, while other key definitions are captured subsequently in the appendix.

Key Terms

Climate tech startups: For-profit enterprises that use technology to create climate impact through climate mitigation and/or adaptation technologies.

Climate Mitigation: Actions and strategies undertaken to reduce or prevent the emission of GHGs into the atmosphere, thereby mitigating or minimising the negative impacts of climate change²⁶.

In the context of this report, it refers to technological solutions that reduce the impact

of climate change on the sub-sector under consideration.

Climate Adaptation: Climate adaptation refers to the process of adjusting and preparing systems, communities, and ecosystems to cope with and respond to the impacts of climate change²⁷.

In the context of the report, it refers to technological solutions that preempt and mitigate the impact of climate change on the sub-sector under consideration by adopting practices and solutions that help brace for the changing climate scenario.

Early-stage: Startups that have raised early rounds of external equity, typically ranging from seed capital to Series B between 2020 and 2022 (for the purposes of this report).

Innovation: Technology-led solutions to climate-related problems that leverage technology to introduce a product, process or business model which is unconventional in its approach. These innovations may include:

Product innovation 	Creating new products or disruptively better versions of existing products that can help significantly reduce adverse effects on climate in terms of emissions or assimilation of harmful substances and/or help better adapt and become resilient to adverse climate change effects.	Example: NewTrace leverages technology to manufacture 'membraneless' electrolyzers that aims to address the largest challenge of the green hydrogen sector - high production cost.
Process Innovation 	Creating new, efficient and significantly better processes that improve productivity in manufacturing, product use or service delivery to help reduce resource use and wastage.	Example: Akshayakalpa, an organic milk brand has also extended its model to build a 'hub-and-spoke' model for production and distribution of farm produce. It is working to not just organise the dairy industry but also empower farmers to adopt climate resilient farming practices and gain access to markets to build their income. It is building a holistic process for farming in India, that increases both - income as well as climate resilience of the Indian farming community.

Business Model Innovation 	<p>Finding a more efficient yet scalable way to run a business, via new revenue streams, optimising cost structures or better managing risk.</p>	Example: BluSmart Mobility who offers EVs as a service has been leveraging the low operating costs of EVs to offer better mobility services.
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Approach and Methodology

For the purpose of this study, we collected data from IIC's internal deal-flow analysis and desktop research.

1. Quantitative data analysis

The analysis of investment flows presented in this report is based on a database of **347 climate tech equity transactions** between January 1, 2020, and June 30, 2023, in India (i.e. enterprises who are either incorporated or have a presence in the country).

- This database was compiled at the 'enterprise' level along with related relevant information such as the nature of funding received (stage of funding), quantum of funding, profile of investors (impact, commercial or club) and a mapping of the broader sub-sector and segment that the enterprise pertains to
- The quantitative data was used to draw insights on the overall investment trends in the climate tech space and across its sub-segments.

Inclusion criteria

The following factors were applied by the team at IIC to select the enterprises -

- For-profit enterprises who leverage the power of technology to conserve and effectively manage waste, water, food or other elements causing environmental challenges.
- For-profit enterprises who focus on reducing GHG emissions through their process and/or product innovations.

- For-profit enterprises with a sustainability lens, i.e., positive environmental impact stated as one of their core objectives with an intentionality of climate impact, built into their business models.

All enterprises had to meet at least one of the above conditions to be included in our database.

Exclusion criteria

The following exclusion criteria were applied for the data analysis presented in this report:

This report excludes large-scale energy infrastructure enterprises (such as utility-scale RE, and rooftop solar businesses) and other already well-funded organisations. While the climate impact of these organisations is beyond question, these business models are well-established and stable, and thus more suited for commercial pools of capital such as private equity or project debt, rather than early-stage venture capital. The report does not assess other climate-related organisations (civil society institutions, grass-roots organisations, policy groups) unless they are within the ambit of the for-profit startup ecosystem

- The report excludes startups that are not early stage and are not "innovative" (definition in table above)
- At present, this report does not focus on some of the areas under the broader lens of "green finance" - which includes large projects under afforestation, grasslands, croplands, etc.
- Finally, this study is limited to startups in India.

2. Desktop Research

Reports that the team referred for this study have been included in the reference section.

- Explanation of taxonomy used in sub-sectors and their categories
- Methodology for classifying a deal as climate tech and impact

Classifying Climate Tech Startups

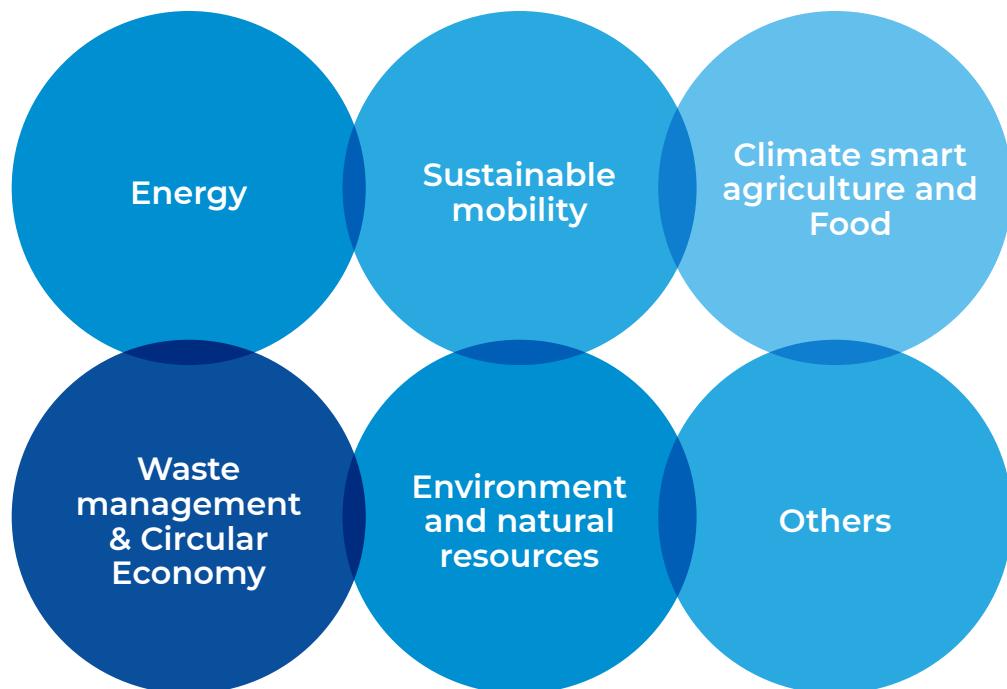
The climate space is cross-cutting, varied and encompasses many different themes. It can be classified into different sub-sectors from multiple perspectives.

One approach is to classify climate tech startups based on the space they operate in, such as energy, agriculture and land use, built environment, mobility and transport, heavy industry, GHG capture and storage, or climate and earth data capture. Alternatively, climate tech innovations are also often classified through the lens of mitigation, adaptation and resilience, depending on the type of outcome they primarily expect to gain.

The primary approach taken towards classifying a climate tech startup as an impact enterprise revolves around the enterprise's intent to either adapt or mitigate the effects of climate change; and in assessing the kind of impact it has been able to create. Consider enterprises leveraging technology to collect climate data for monitoring crop health or manufacturing agri-inputs that can help enhance the farmers' yield (e.g., Pixxel). One could even consider those enterprises that help generate clean energy by either modifying the existing processes (e.g., Hygenco) or by bringing in new innovations altogether (e.g., NewTrace). The ultimate aim is to be able to create a noticeable impact in an affordable manner enabling widespread adoption of solutions and ensuring these solutions reach the last-mile.

Consequently, for the purposes of this study and deriving from the practices as mentioned above, we have chosen to follow a classification for India-focused climate tech startups that fit well with stakeholder needs, prevalent markets, as well as global climate goals and GHG emission reduction imperatives that are increasingly becoming a core focus among all stakeholders.

Six Climate Sub-Sectors



Startups that have emerged with an innovative solution and yet do not fall squarely under any of the five sub-sectors defined above have been classified as 'Others'.

Taxonomy

Sub-Sector	Impact Imperatives	Sub-Segments
Energy 	<ul style="list-style-type: none"> Clean energy generation, solutions that produce sustainable sources of energy Lowered carbon emissions through improved energy storage and management, Energy Efficiency and/ or optimised energy use across sectors for energy use/loss reduction. Increased energy access for off grid, rural use for improved productivity, incomes, livelihoods, health impact, etc. 	<ul style="list-style-type: none"> Energy Access Energy Optimisation Energy Storage & Management Clean Energy/ Sustainable Fuel
Sustainable Mobility 	<ul style="list-style-type: none"> Low carbon mobility solutions for people and goods Improved supply chains, components for sustainable mobility/ clean vehicles. Increased access to people and goods through service offerings leveraging clean mobility 	<ul style="list-style-type: none"> Clean Mobility (EVs) Clean Heavy Transport Novel Batteries, Fuel Cells, Charging, Components Clean Logistics, Fleets, Connected Vehicles.
Climate Smart Agriculture, Food and Land Use 	<ul style="list-style-type: none"> Restore the ecosystem, soil or environment for sustainable agriculture & food – through practices, processes, inputs, etc. Minimise food loss Resource conservation with yield optimisation Develop and produce alternate / sustainable food products 	<ul style="list-style-type: none"> Organic Farming & Agri Products Eco-Friendly Agri-inputs Food Loss reduction Alternative Proteins Climate-Focused Precision Agriculture
Environment and Natural Resources 	<ul style="list-style-type: none"> Control or reduce pollution in air and ambient environment Reduce water use and wastage Improve access to clean water Capture GHGs, store and/or convert to value-added products 	<ul style="list-style-type: none"> Clean Water Air Pollution & Ambient Environment Carbon Capture, Utilisation or Storage Water Management and Conservation

Sub-Sector	Impact Imperatives	Sub-Segments
Waste Management and Circular Economy 	<ul style="list-style-type: none"> Divert waste from landfills, oceans and environment towards value-added products Develop new/ advanced materials that are biodegradable/ circular in nature Waste management facilities maximising material recovery, reusing, recycling, and upcycling Material recovery from demolition sites and reverse logistics solutions 	<ul style="list-style-type: none"> Waste to Value Waste Management & Recycling Sustainable Consumables Green Construction Materials
Others 	Products and services that support an enabling environment to mitigate and manage carbon emissions - this includes carbon measurement and trading platforms as well as solutions that help industries to lower carbon footprint by supporting climate friendly projects	<ul style="list-style-type: none"> Advanced/ new materials IoT, Data Analytics, Software Climate fintech Marketplaces for climate and sustainability focused products

*One of the sub segments under the 'Environment & Natural Resources' space considered for the previous report, was that of 'Forestry & Climate Friendly Land Use'. For the purpose of this report, we have excluded it from the classification. This is on account of the nature of projects that involve large scale public finance and the absence of startups working in this space. Any related technological solutions that have an impact on forestry and climate friendly land use have been classified under 'Others'.



The background of the image is a dark, slightly blurred photograph of a renewable energy facility. It features several wind turbines with white blades and a large array of solar panels in the foreground, all set against a backdrop of green fields and a clear sky.

Overview of Climate Tech Investments: Notable Observations

1. An 'Ecosystem' approach:

Climate tech evolves from bespoke solutions to an ecosystem enabler

Solutions seen coming up across the value chain in each sub-sector, thus enabling a scalable and sustainable growth of the ecosystem. Right from charging solutions in the EV space to AI driven battery optimisation, we see solutions addressing intrinsic challenges of each sub-sector and building ecosystem partnerships, enabling a digitisation towards India's green transformation.

2. Building social impact along with climate action:

The far reaching impact of climate tech

While technological interventions are directed towards climate resilient solutions, they are also enabling a positive social shift especially towards vulnerable populations. As **Recyckal's** technology connects waste pickers to waste buyers and Frontier Markets brings clean energy to rural communities, we see livelihood building and climate resilience go hand in hand, as an inclusive pathway enabled by technology.

3. Impact areas widen:

The multi-pronged approach of technology

Solutions that have attracted investor attention and demonstrate potential for scale also indicate the ability of their interventions to find application across impact areas including health, agriculture and industry in addition to climate. This demonstrates the potential for scale and commercialisation of climate tech.

Pixel: Actionable climate insights using satellite imagery	Cygni Energy: Battery energy storage
Areas of application: Agriculture, Urban planning, Energy	Areas of application: Electric Vehicles, Rooftop solar solutions

4. Upsurge in EV OEMs:

The emergence of a new sector

While the 'sustainable mobility' space started off with two-wheeler (2W) and three-wheeler (3W) OEMs, we observe this space emerging into its own driven by technological advancements, policy push, increasing consumer demand and a huge inflow of private capital. **Ather Energy, Ola Electric, and Euler Motors** have become key players in India's sustainable mobility space. They have attracted significant investments across all stages, with some securing deals exceeding \$50 million.

As EVs transition to being a mainstream choice for Indian consumers, OEMs are seen integrating value chains with supporting infrastructural solutions and ecosystem partnerships - thereby emerging as a separate space by themselves shaping the future of transportation in India.

EV OEMs have additionally spurred the emergence of innovative models like **Vidyut** and **Three Wheels United**, expanding EV financing to lower-income segments. Vidyut lowers upfront expenses by providing pay-per-use battery options, while Three Wheels United leverages technology for lending, enabling low-income customers to own EVs, allowing for widespread adoption and further increasing the segments' customer base.



5. Cross-sectoral linkages:

Impact of climate deepens intersection between sub-sectors

While the classification of enterprises into different sub-sectors has been based on their focal area of impact, we observe that solutions are not relegated to a single line of impact but have cross sectoral linkages.



GPS Renewables (Generating green energy from organic waste) :
Clean Energy
Waste Management



Ecozen: Tech driven agri solutions including solar powered cold storage
Climate smart agriculture
Clean Energy



Ace Green Recycling (recycling platform providing sustainable, end-of-life solutions for batteries)
Waste Management
Energy Storage

6. Moving the needle on climate adaptation: *Technology as an enabler*

While the majority of investments have been towards climate mitigation, we see technology holding great potential to catalyse investors towards funding adaptation efforts. As cold storage solutions like **Ecozen** help farmers reduce food wastage and adapt to the changing climate we also see water management being handled by Boson Whitewater even as water scarcity becomes a looming risk.

A focussed investment approach would go a long way in furthering the scale and impact of such innovations.

7. The case for carbon trading: *Innovations pave the way*

Even as policy works to develop the Indian carbon market, we see technology paving the way for a greater understanding, transparency and ecosystem building for players to engage in carbon trading.

Climes with its carbon trading platform and **Sangti** that helps measure carbon emissions are setting the pathway for organisations to transition to a climate sensitive and sustainable approach for a robust carbon trading economy.



Sub-Sectors in Climate Tech



Sustainable Mobility

The automobile industry in India plays a pivotal role in driving the country's economy, making up approximately 49% of India's manufacturing GDP and 7.5% of its overall GDP.²⁸ Given the size and scale of this sector, it remains one of the largest contributors to GHG emissions, at approximately 10% of India's total GHG emissions in 2022²⁹. This has necessitated the transition of the transport sector to a low-carbon pathway and the GoI has been actively promoting the transition to EVs through incentives and subsidies. As a result, the EV sector in India is witnessing increasing adoption.

The current penetration of EVs in the Indian automobile market is only 1%³⁰. However, considering the existing economies of scale and policy incentives, the domestic EV market is projected to grow at a CAGR of 49% between 2022 and 2030, with annual sales of EVs expected to reach one crore units³¹.

Electric 2W (e2W) and 3W (e3W) segments show promise

India's automobile market is predominantly driven by 2Ws, with 80% of internal combustion engine

(ICE) sales originating from this segment.³² Given India's price-conscious market and its economic viability, it is highly probable that the growth of EVs will be spearheaded by light electric vehicles. Notably, e2Ws and e3Ws, including e-rickshaws which are decarbonising India's transport sector and constituted 92% of the total EVs registered in the country in 2022³³.

Low plug points: Electrification infrastructure

Rising fuel prices, government incentives to achieve 30% of car sales and a projection of 70% of commercial vehicles and 80% of 2W and 3W sales to become electric by 2030 are fuelling India's EV growth³⁴.

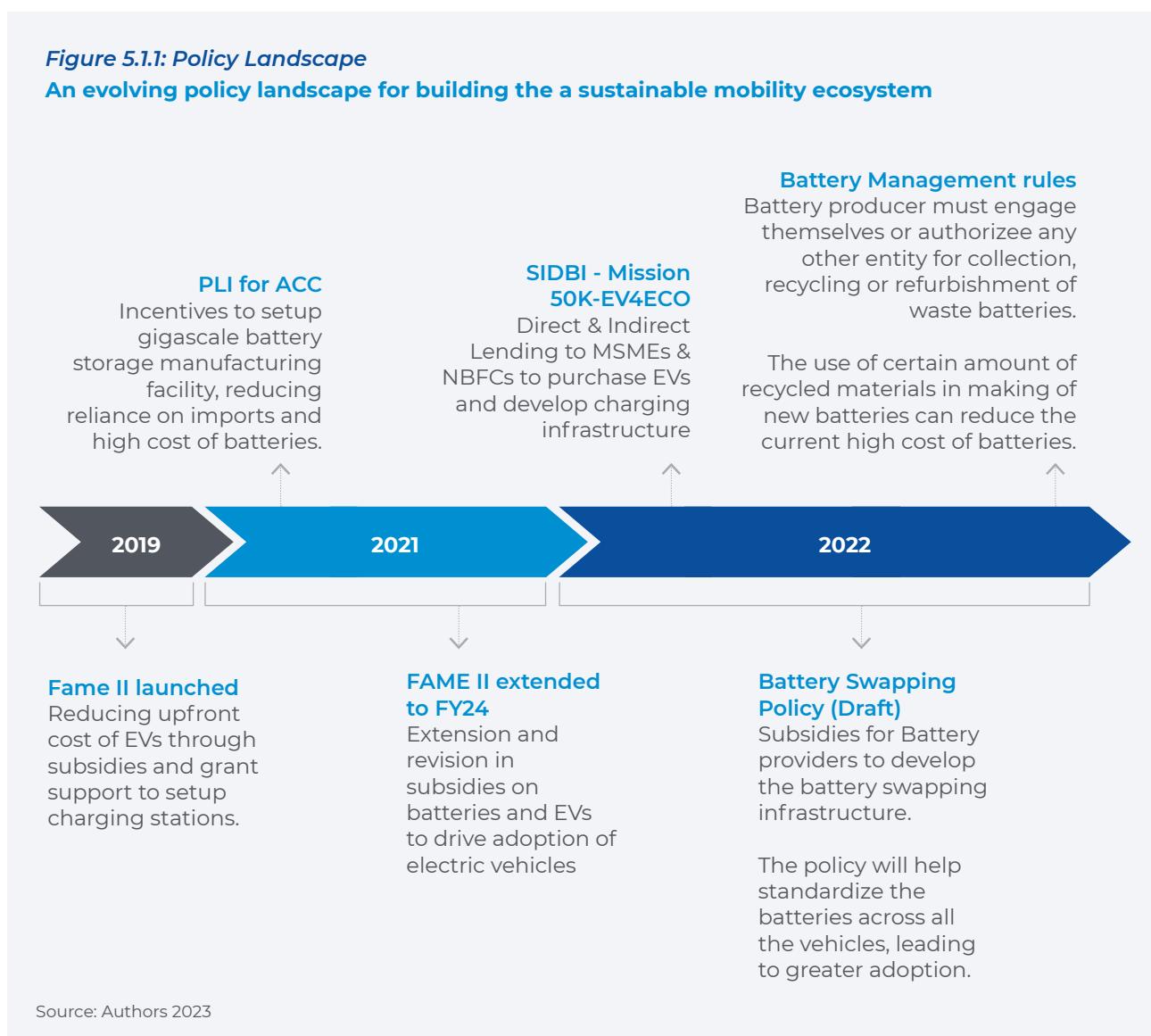
India needs 20.5 lakh EV chargers by 2030 to complement the surge in EV adoption³⁵. To complement the growth and ensure a smooth transition from ICE vehicles to EVs, it is crucial to establish a robust charging infrastructure. Currently, we have a single public charging station available for every 393 vehicles in the country,³⁶ signifying the growing need for investments in such solutions to bridge the existing gap.

Innovative technology and a conducive policy framework can reduce the upfront costs of EVs

Lithium, known for its unique properties, plays a crucial role in lithium-ion batteries, making it an ideal choice for energy storage. While India relies heavily on imported lithium, efforts are on to develop a domestically self-sufficient ecosystem. Battery recycling technologies can play a pivotal role by enabling access to lithium reserves and reducing input costs without compromising the efficiency of EVs.

Figure 5.1.1: Policy Landscape

An evolving policy landscape for building the a sustainable mobility ecosystem



Source: Authors 2023

Subsidies reducing the up-front cost of EVs under the FAME initiative are the major demand-side incentives to facilitate the acquisition of EVs. However over the last one year, there have been multiple developments and challenges in the FAME initiative. The recent developments on certain EV OEMs not complying with the guidelines that call for localised production, has resulted in the government halting subsidies under FAME for non-compliant OEMs. In addition, the reduction in subsidy for e2Ws to 15% from the

previous 40% is set to make the EVs pricier, denting demand.³⁷ Although this situation may have posed concerns in the short-term, it is important to note that subsidies were never meant to be a long-term solution. The overall growth of the EV market in the coming years can be driven by global trends, increasing consumer awareness and interest, their lower operating costs of EVs along with improvement and access to charging infrastructure.

The transition towards electrification: Business models in focus

Investors are seen backing EV OEMs who are actively working on electric alternatives to internal combustion engines. Additionally, they are backing enterprises that offer EVs as a service and startups that focus on building the charging

infrastructure and battery ecosystem in India. In line with the evolving and growing nature of the sector, we observe that the sustainable mobility segment can be segmented into different brackets:

Clean Mobility (EV OEMs)

This segment spans e-bicycles, e2Ws, e3Ws finding application across passenger commuting, goods delivery and logistics.

Clean Logistics, Fleets and Connected Vehicles

EV logistics operate as a service to different B2B and D2C industries. These asset-light models the end consumers are seen attracting increasing investor attention.

Fleet and connected Vehicles

Focus on providing small and lightweight e2Ws for both B2B and B2C through lease/rental models.

Novel Batteries, Fuel Cells, Charging, Components

Unique charging and battery management solutions, alternative chemistries for batteries and developing custom vehicle components reflect the next wave of tech innovations in this space.

For the purposes of our study, we have included battery recycling startups under the 'Waste Management & Circular Economy' sub-sector, acknowledging their process innovation of converting battery waste into valuable metals as part of circular economy.



Investment Thesis: Mobility holds the lion's share of investments in climate tech

In 2022, 57 sustainable mobility startups raised ~ \$1 billion across 62 deals. The sustainable mobility space continues to dominate with ~80% of the overall climate tech investment values and ~50% by deal volume in India.

Figure 5.1.2: Investment Value (\$ mn) across Sub-segments (2020 - 2022)

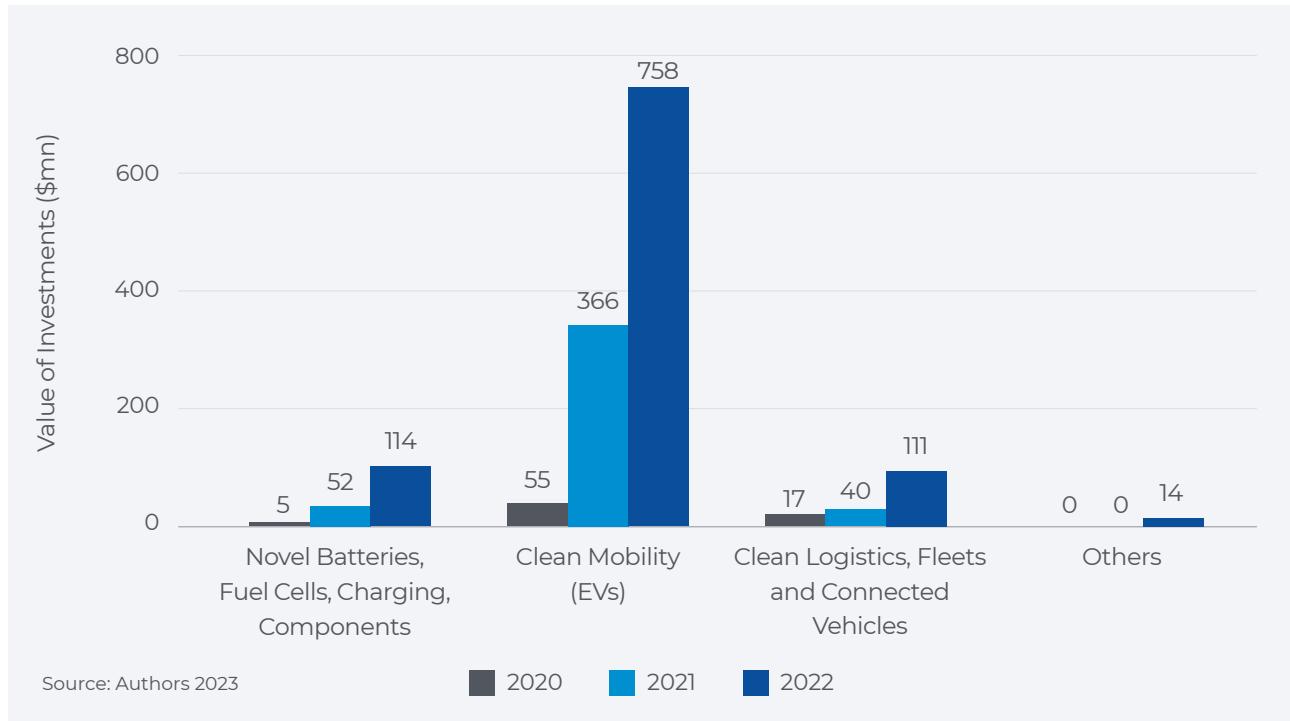


Figure 5.1.3: Investment Volume across Sub-segments (2020 - 2022)

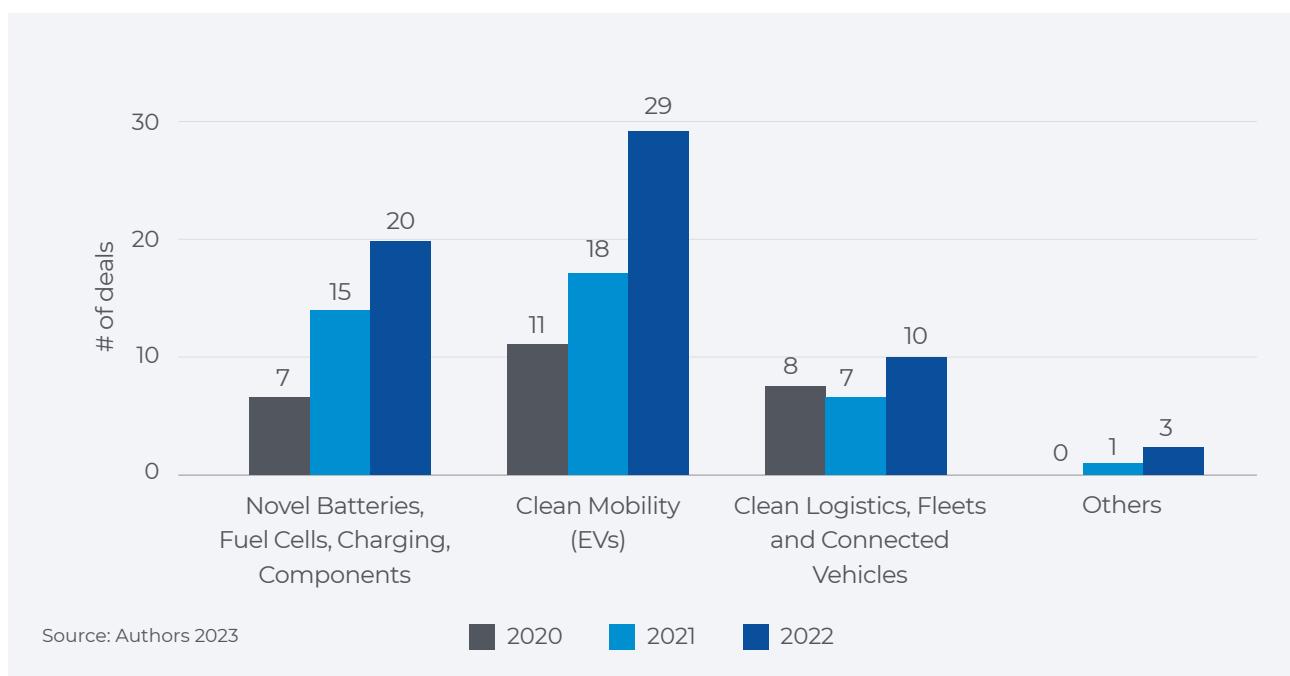
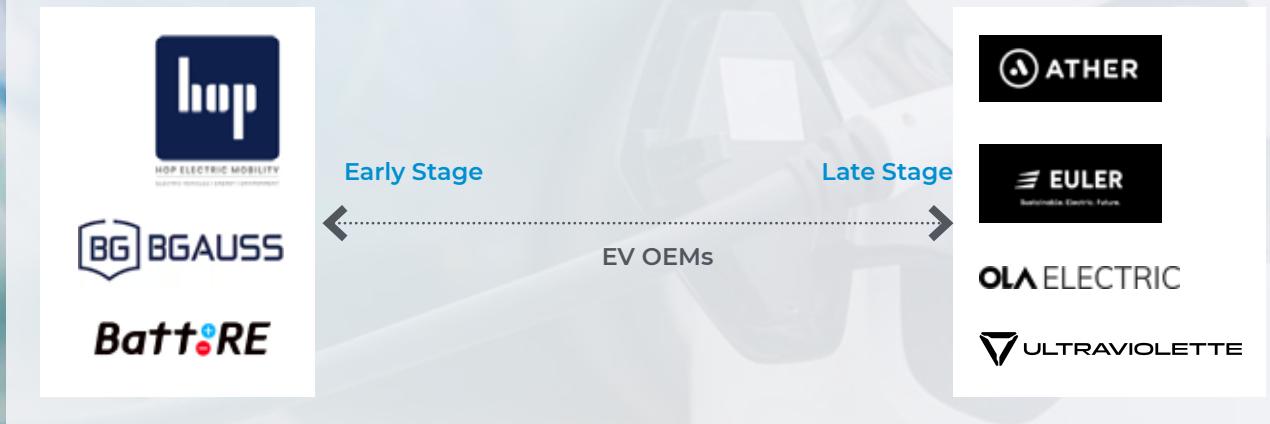


Figure 5.1.4: Categorization of EV OEMs as early-stage and late-stage enterprises



Almost 50% of the investment volumes in the sub-sector are driven by EV OEMs such as Ather Energy, Ola Electric and Euler Motors garnering investments across early, growth and later stages.

Over the past three years, there has been a notable surge in the development of e2Ws and e3Ws by OEMs. In 2022, this segment attracted investments totalling to ~ **\$760 million** across **29 deals** at different stages, including early, growth, and late-stage capital. **Late-stage equity investments are towards EV OEMs such as Ather Energy and Ola Electric who have built well-established brand across geographies.** ICE vehicles manufacturers such as TVS Motors, Hero Motocorp and certain commercial investors such as Blume Ventures, Edelweiss and Qualcomm Ventures have been funding the expansion of EV OEMs like Ather Energy, Euler Motors, Ola Electric and Ultraviolette Automotive.

Micro-Mobility: Segment with Increasing Focus

We witness asset-light models such as **EV ride-hailing platforms, shared and micro-mobility solutions growing in parallel.** Ride-hailing platforms like Blu Smart Mobility, Evera Cabs, and Malbork Technologies have secured early-stage funding in 2022. Unlike conventional ride-hailing platforms where the fleet is owned by the fleet partners, new-age EV ride-hailing models are distinctive. EV platforms like **BluSmart** own the fleet and pay drivers a fixed amount per hour. This approach, coupled with lower EV operating costs, ensures affordable fares, no cancellations, and high customer satisfaction, leading to higher consumer adoption.

A notable example of B2B collaborations in 2023 to transition to clean mobility

zomato **ZYPP**

Charging Infrastructure: Area of importance

Range anxiety among users is considered one of the major barriers to EV adoption. To address these barriers and foster the growth of the EV ecosystem, it is imperative to develop an extensive charging infrastructure. **In 2022, the charging infrastructure segment attracted ~\$110 million across 20 investment deals.** However, over the last three years, enterprises developing charging infrastructure have attracted investor interest only in the early stages, signalling the need for growth capital to develop charging infrastructure at scale.

Moreover, alongside traditional EV chargers, battery-swapping technology has the potential to facilitate the mass adoption of EVs. Some of the battery-swapping solutions that received early-stage equity funding include **BatterySmart**, **Clean Electric**, **eChargeup**, **Esmito** and **RACEnergy**.

Capitalising on the demand for quick charging for e-rickshaws and e-scooters utilised by last-mile delivery agents, these battery swapping network operators are forming partnerships with local businesses like small garages and mom-and-pop shops to rapidly establish swap stations without the need for commissioning new real estate. This emerging business model is an opportunity for investors.

Interesting investment trends:

Considering the capital-intensive nature of the industry, we have witnessed a growth in investment volumes exceeding \$5 million over the past two years. Back in 2020, most deals exceeding this threshold were primarily focused on EV OEMs, the increasing demand for infrastructure development has led to a shift. In 2022, we saw startups focusing on building charging infrastructure, rapid charging EV batteries, and offering EVs as a service to raise funding in this bracket. This surge in sector-wide investments has resulted in the **average deal value increasing fivefold, rising from \$3.5 million in 2020 to \$18.4 million in 2022.**

In alignment with trends in other sectors, over **60% of deal volumes in the sustainable mobility sector are from seed stage enterprises.** However it is worth noting that on account of the growing EV revolution, we are witnessing an increasing number of early-stage EV OEMs raise seed capital as well. These OEMs are entering the market to capitalise on the burgeoning opportunities, alongside established OEMs with well-established distribution channels.

Meeting India's projected market penetration of electric vehicles (EVs) by 2030 faces a major roadblock from the lack of easily accessible, well-distributed, and universally applicable charging infrastructure, especially in tier-II and III cities. To change the perception and promote the adoption of EVs across all sectors, it is crucial to focus on technological innovations that facilitate rapid charging and universal battery swapping.

Electric Vehicle Charging

Figure 5.1.5: Number of Deals across Different Ticket Sizes (2020 - 2022)

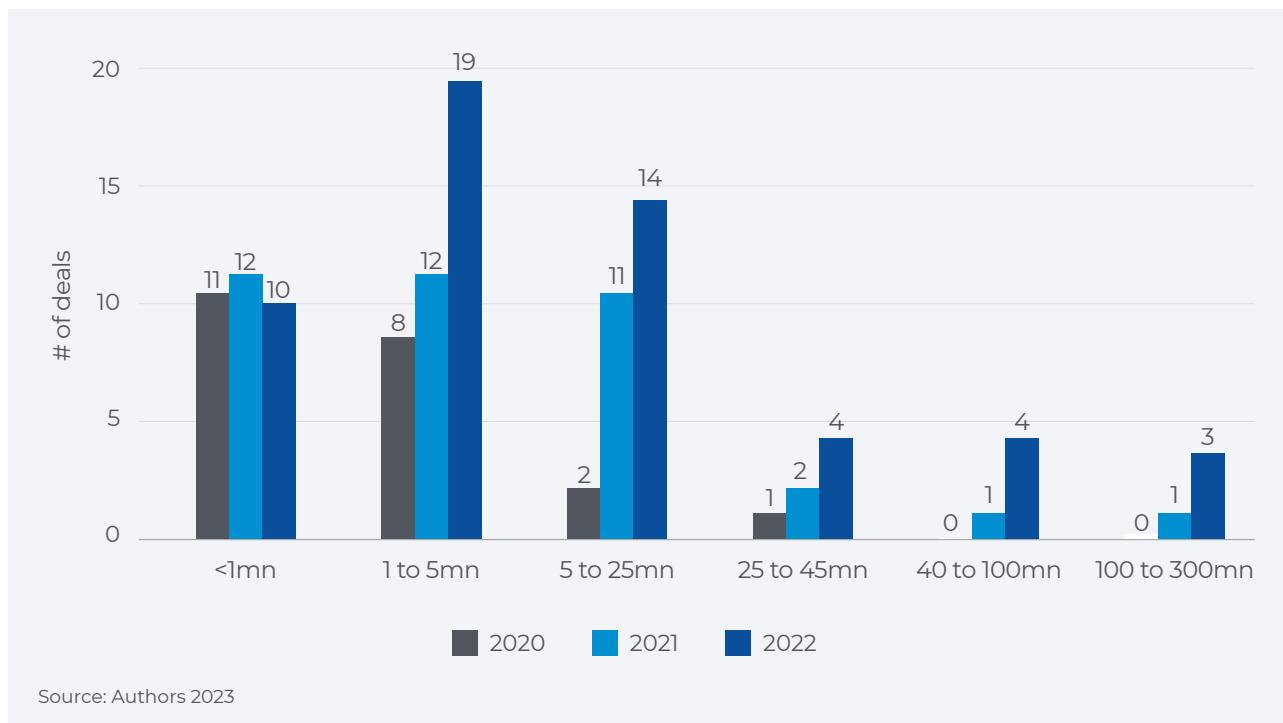


Figure 5.1.6: Stage-wise Contribution to Deal Flow (2020 - 2022)

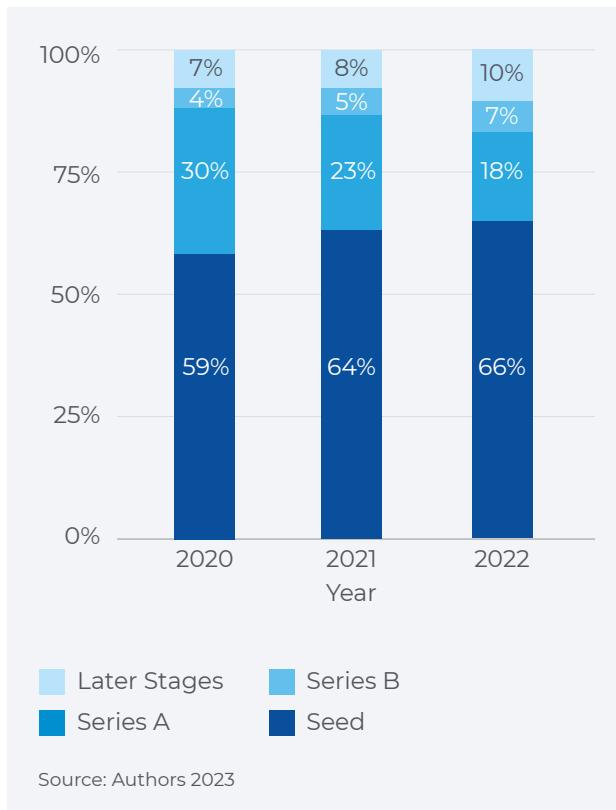
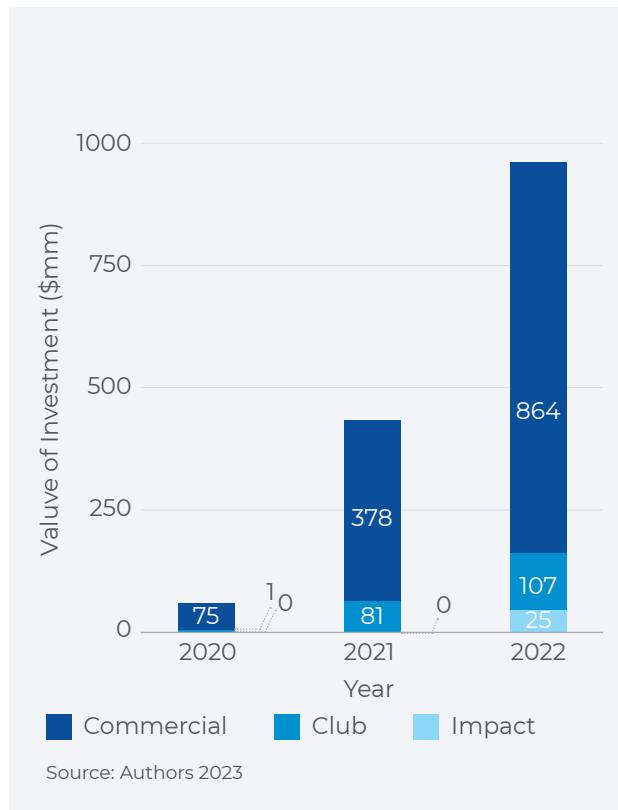


Figure 5.1.7: Investments (\$ mn) by Commercial, Impact, and Club Investors (2020 - 2022)



During the past three years, commercial investors have played a dominant role in driving investment volumes and deal flows in the sector. The significant increase in investment volumes in 2022 can be largely attributed to investors like **IIFL, Edelweiss, and Caladium Investment** supporting the development and expansion of EV OEMs such as **Ather Energy, Greaves Electric Mobility, and Ola Electric**, particularly through high-ticket deals. These investments are seen across stages.

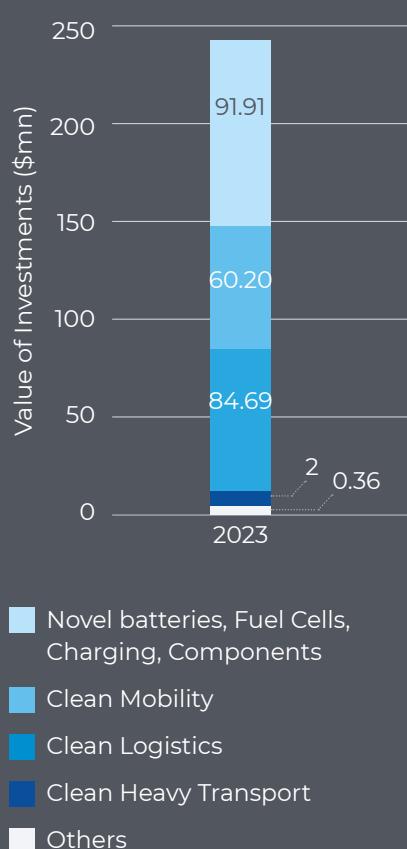
In 2022 we saw a small number of impact investors such as **ADB Ventures, Social Alpha, CIIE Innovation Fund and Green Frontier Capital**

participating in the space through co-investments with commercial investors. Through these co-deals, impact investors are seen mainly supporting EV OEMs who are in the early stages of their development. Euler motors, an e3W OEM, was the only enterprise who received support from impact investors in the later stages.

It is also important to note the consolidation of players and supply chains in the electric transport industry, with legacy players like Bajaj Auto, Hero Motocorp and TVS Motor investing in EV OEMs like Ather Energy and clean mobility service providers like Yulu Bikes.

Figure 5.1.8: Investment Snapshot for H1 2023

Where are we in H1 2023?



Sustainable Mobility		H1 2023
Deal Value (\$ Mn)		239
# of Deals		32

In H1 2023, sustainable mobility remains at the forefront of investment value and deal flows in the Climate Tech sector, in line with historic trends. Notably, there is a clear shift towards increased investments in supporting infrastructure, components and allied services related to the space. This includes efficient battery components and EV charging solutions that build supply chains for e-mobility.

There is a noticeable trend of rising investor interest in startups such as Zypp, Evera Cabs and Swytchd that adopt asset-light EV-as-a-service models to cater to consumers, capitalising on the low operational costs of EVs.



Key Enablers

1. Strategic partnerships between new-age startups

In India, collaborations between emerging EV startups that leverage their respective expertise are poised to enhance the e-mobility ecosystem. A notable example of such collaboration is between **Alti Green**, an e3W OEM, and **Exponent Energy**, a provider of rapid charging battery packs. Such partnerships are set to strengthen the capabilities of delivering high-quality EVs and establishing efficient fast-charging solutions.

2. Building a sustainable battery recycling ecosystem

A reliance on lithium imports contributes to a

significant increase in the manufacturing cost of EVs, as the cost of batteries accounts for nearly 50% of the total expenses.³⁸ The development of innovative battery recycling solutions shows promising potential in reducing the cost of lithium-ion batteries.

3. Aggregated platform for charging

Currently, charging stations are managed by different companies, each requiring a dedicated digital application. There have been discussions with the GoI about developing a master application³⁹ to locate and use EV charging stations, facilitating better EV adoption.

Outlook

1. Growth capital towards building charging infrastructure in India

As the adoption of EVs continues to rise, there is an unmet requirement for widespread fast charging and battery-swapping networks throughout the country. Currently, this space is still in its infancy with investments limited to only early stages. Since setting up charging stations is asset-heavy, enterprises that can effectively monetise these assets and convert them into revenue growth present potential opportunities for growth and late-stage equity financing.

2. Transition to debt-driven financing

The sustainable mobility space has been the most active in terms of investment volumes and deal flows over the last three years. However, given the capital-intensive nature of vehicle manufacturing, OEMs will require a larger quantum of financing. EV OEMs who have built a robust distribution channel can attract large-scale debt and possibly raise further equity through a public issue.

3. Asset light models to attract investor attention

Asset-light models for consumers, such as EV fleets, micro-mobility solutions for last-mile commuting or delivery, and clean logistics services, have the potential to scale and attract larger ticket deals.

Businesses actively seeking to transition their logistics operations from traditional ICE vehicles to EVs are paving the way for scaling up such models.

4. EV financing to emerge at scale

EV financing startups are poised to play a crucial role in facilitating financing for consumers by developing innovative financial products and leveraging technology to aid financial intermediaries to extend credit under EV financing. Given the innovative nature of the business, this space is likely to be of interest to early-stage equity investors in the coming years.





Case Study: Battery Smart

Founded:	2019
Founders:	Pulkit Khurana, Siddharth Sikka
Total Equity Investments:	\$74 million
Last Funding Stage Investor:	Tiger Global Management, Ecosystem Integrity Fund, British International Investment, Blume Ventures



Business Model

Battery Smart is one of India's largest and fastest-growing Battery Swapping Network for e2Ws and e3Ws. It offers advanced Li-ion batteries to e-rickshaws and e2Ws on a subscription basis. This model helps to reduce the high upfront costs of owning an EV and the swapping infrastructure helps EV drivers swap their batteries within two minutes.

partnerships with local businesses like small garages and mom-and-pop stores to rapidly establish swap stations without the need for commissioning new real estate. This approach helps in setting up swapping stations in densely populated neighbourhoods without any added labour or real estate cost.



Innovation

Recognising that building charging infrastructure is a cost and time intensive activity, Battery Smart works with an asset-light model by forming



Climate Impact

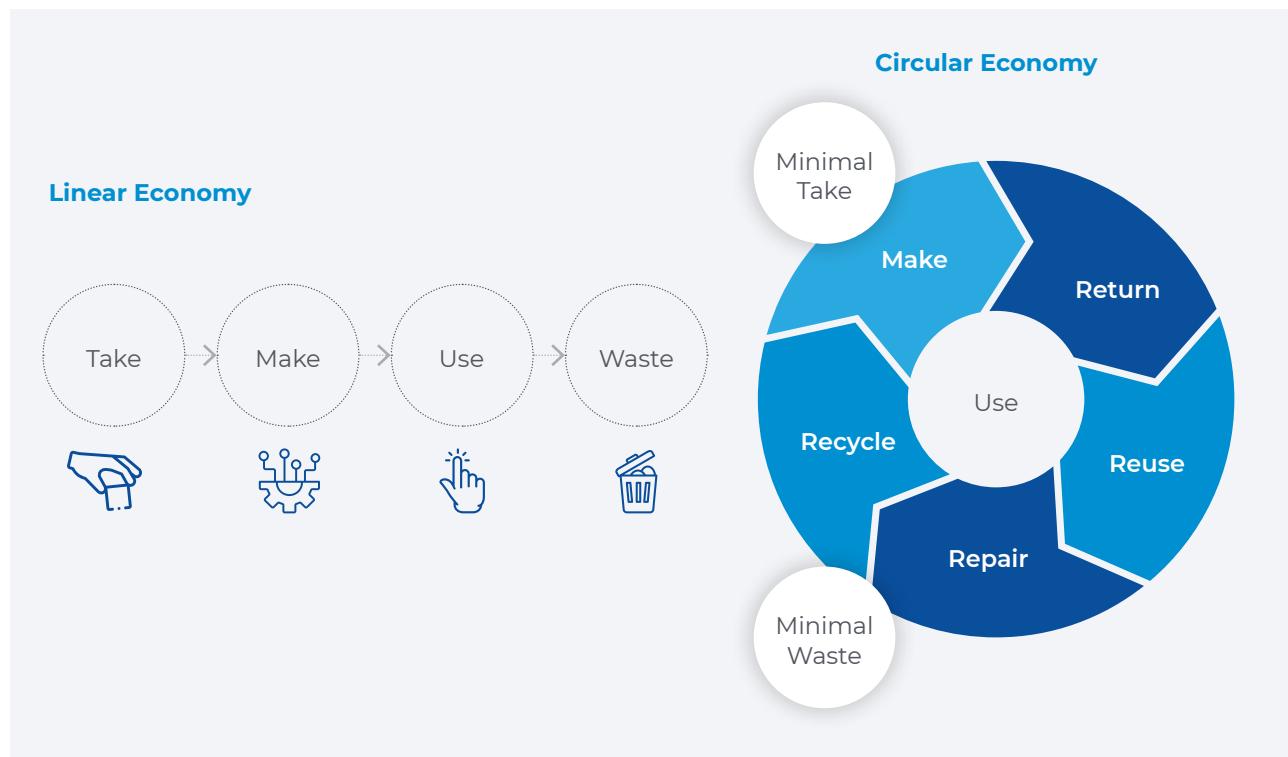
Battery Smart's battery swapping solution emerges as a potential remedy to address the challenge of yet-to-be- fully-developed charging infrastructure through an operational easy-to-handle model, fostering faster adoption of climate-friendly EVs.



Waste Management & Circular Economy

India houses 377 million citizens in urban areas, producing 55 million tonnes of Municipal Solid Waste (MSW) annually. With rapid urbanisation and consumption, this number is to increase to 125 million tonnes annually by 2031⁴⁰. While India has always had a culture of recycling and reuse, with increasing economic growth, heightened consumption and an escalating pollution, a shift from the traditional linear 'take-make-waste' model to the circular economy is imperative. Despite the immense relevance of the circular economy in India, its widespread adoption in India is hindered by the industry's varied levels of awareness about the concept, which is a significant concern in today's scenario⁴¹.

Figure 5.2.1: Understanding the Value Chain



Source: DXC Technology

Figure 5.2.2: Types of waste generated

India currently generates 62 million tons of waste every year contributing to around 4% of the total GHG emissions in India. The different kinds of waste generated can be classified into:



Source: Invest India

India recycles only 30 % of the 3.4 MT of plastic waste it generates annually⁴²

On ground complexities relating to the inadequate infrastructure for waste collection, segregation and treatment hinders an effective waste management system by municipal authorities. This merits the development and usage of alternatives to plastics by utilising materials such as paper, seaweed, wool, hemp, and other sustainable materials.

Combined with policy impetus such as the Extended Producer Responsibility (EPR) rules and the ban on single-use plastic, this has the potential to reduce waste from making its way to landfills.

India's recycling of C&D waste stands at a mere 1%⁴³

The construction industry accounts for around 20% of India's annual carbon emissions⁴⁴. As India strives to achieve its target of a \$5 trillion economy by 2025⁴⁵, there is a pressing need to shift towards sustainable green construction materials and establish comprehensive waste management systems that promote circularity for construction and demolition (C&D) waste.

Measures required to reduce the environmental hazard from battery waste

Increasing EV production and adoption also presents the possible hazard of unmanaged battery waste. India's transition towards a 30% EV adoption⁴⁶ by 2030 also necessitates an efficient battery recycling chain. To enable the safe disposal of end-of-life lithium-ion batteries (LIB) from EVs, comprehensive infrastructure and policy support for battery recycling is crucial. The recent Battery Management Rules, 2022, which include LIBs for recycling under extended producer responsibilities is a positive step towards promoting safe disposal of batteries, its effective implementation and stringent enforcement will be crucial as the volume of battery waste increases. The successful implementation will hold a significant impact in scaling up battery recycling efforts in India.

Although there can be various types of waste, such as agricultural residue, batteries, waste from C&D sites, as well as gasses, the difficulties associated with waste management are similar across industries. Several primary challenges include inadequate processing and segregation methods, inconsistent collection practices, insufficient infrastructure, and a lack of civic responsibility⁴⁷.

From a linear to a circular economy: Policy's critical role

To tackle these primary challenges and close the current infrastructure disparity, the involvement of the private sector is crucial. It can assist in handling and processing waste, creating value, developing sustainable products and minimising emissions. Considering that waste management and its efficient handling are concerns at the central level, the GoI has implemented various initiatives in recent years. Some of these include:

Figure 5.2.3: Policy Landscape

Municipal Solid Waste Management Rules, 2016	Waste generators need to segregate the waste at source and integrate waste pickers from informal to formal sector
Construction and Demolition Waste Management Rules 2016	Waste generators need to segregate construction and demolition waste
EPR Guidelines on Plastic Packaging, 2021	Producers to recycle up to 50% of the plastic they use or produce until 2025
Plastic Waste Management (Second Amendment) Rules, 2022	Increase the thickness of plastic carry bag and the phase-out of some single-use plastic products
E-waste Management Rules, 2022	Urban Local Bodies (ULBs) need to facilitate the establishment of waste collection, segregation and disposal systems
Battery Management Rules 2022	Producer and importer is responsible for collection and recycling of batteries
Swachh Bharat Mission 2.0	Source segregation of trash and safe sanitation in urban areas
GOBAR-Dhan scheme, 2023-24	Allocation of Rs.10,000 crores to set up waste-to-wealth plants

Source : Authors 2023



The larger impetus of these policies is to increase involvement and accountability of waste producers who are required to either recycle the waste themselves or collaborate with waste management enterprises. Such partnerships facilitate the development of an ecosystem for waste management, collection, and recycling. These policies have the potential to act as a catalyst for innovative startups.

The waste management and circular economy space is still in its nascent stage of development and deployment. To bridge the existing public infrastructural gap and address on-ground complexities, we witness enterprises leveraging technology to handle, process and recycle or upcycle waste, garnering investor attention. Emergent business models hold the potential to galvanise the circular economy in India.



Waste to Value

Technology solutions creating value-added products from either biodegradable waste, solid waste, electronic waste as well as gaseous waste. The value-added products include feed for cattle, packaging materials and high-density fuels and recycled batteries.

Waste Management & Recycling

Enterprises offering end-to-end waste management and recycling solutions with technology as an enabler. This includes the collection, segregation and processing of waste. The technology employed has enabled enterprises to come up with innovative models such as an online circular economy marketplace.

Green Construction Materials

Enterprises developing renewable eco-friendly building materials. This includes building materials like bricks and panels.*

Sustainable Consumables

This includes compostable & biodegradable consumer products using renewable and organic materials such as bamboo, cotton, sugarcane, seaweed and hemp.

*While some of the enterprises in this segment make use of waste recycling processes to create sustainable building materials, they have been mapped to the segment of 'green construction materials' specifically because of the nature of their end-use application.

Sustainable Solutions Fuelled as investments surge

Year 2022 witnessed 17 startups secure \$83 Million (over 18 deals), demonstrating an eight-fold increase in investment value, over 2021.

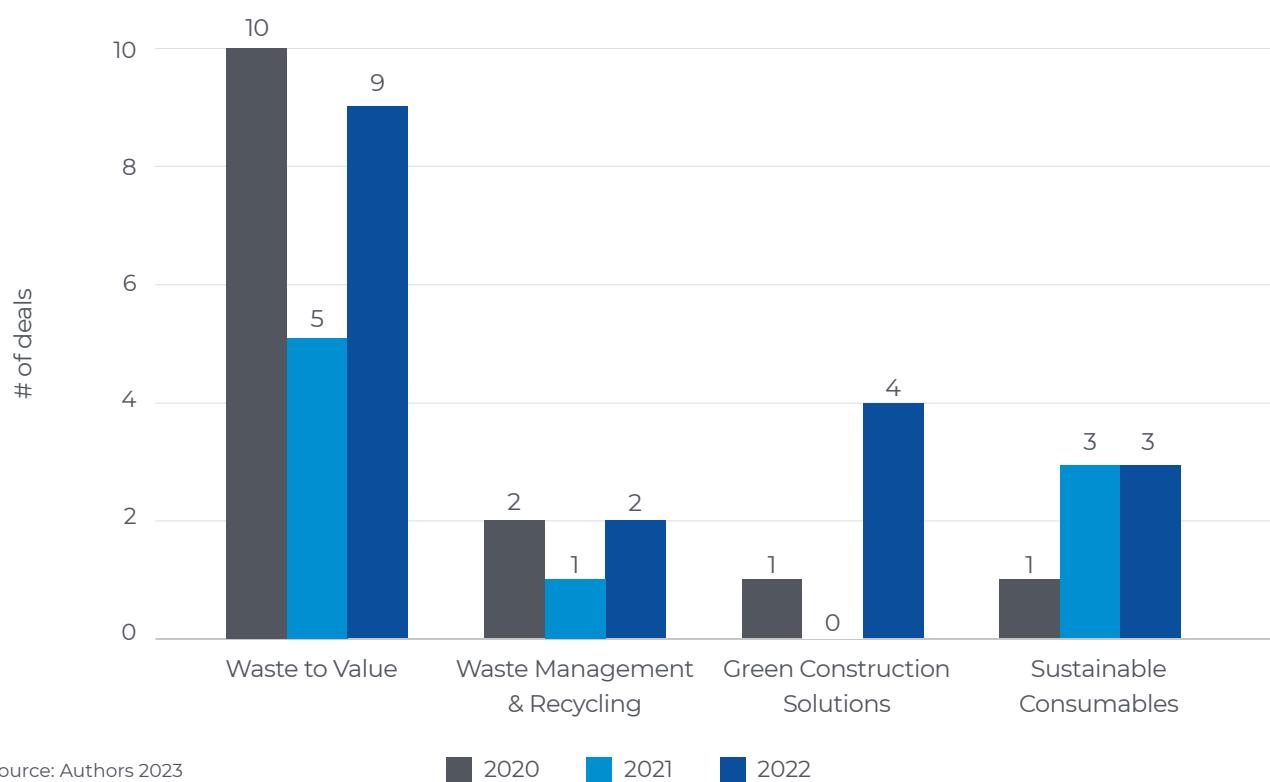
Figure 5.2.4: Investment Value (\$ mn) across Sub-segments (2020 - 2022)



Source: Authors 2023

■ 2020 ■ 2021 ■ 2022

Figure 5.2.5: Investment Volume across Sub-segments (2020 - 2022)



Source: Authors 2023

■ 2020 ■ 2021 ■ 2022

The increase in the deal flow in the **Waste to Value segment** is attributed to transactions in early stages as well as Series B stages, **with the highest deal value increasing from \$4.5 million in 2021 to \$10.5 million in 2022.** Enterprises that utilise agricultural or wet waste to create biofuels, such as **Carbon Masters and Green Joules.**

The Neev Fund supported GPS Renewables, and Blue Planet Environmental Solutions, also indicate investor interest towards supporting waste management enterprises. In 2022, **GPS Renewables progressed from Series A to Series B funding.** These innovative solutions represent the intersection between a material circularity and a clean energy ecosystem. Enterprises like **String Bio and Phool.Co**, that stand out for their innovative approach of converting waste into value-added

sustainable products, secured substantial **follow-on funding exceeding \$5 million indicating growing investor interest in waste related innovations.**

Likewise, the high amount invested in the waste management and recycling space indicates a trend with an innovative digital circular economy marketplace such as **Recykal** raising \$22 million Series A funding.

While the larger investment volumes in the industry still prioritise waste to value and waste management & recycling, **we are observing increasing attention towards seed-stage investments in green construction materials, sustainable consumables and battery recycling.**



Green Construction Materials

Zerund, which focuses on the development of environmentally friendly bricks, **Deluxe Recycling** and **Strawcture Eco**, who produce panel replacements using packaging plastics and agricultural residues secure seed funding.



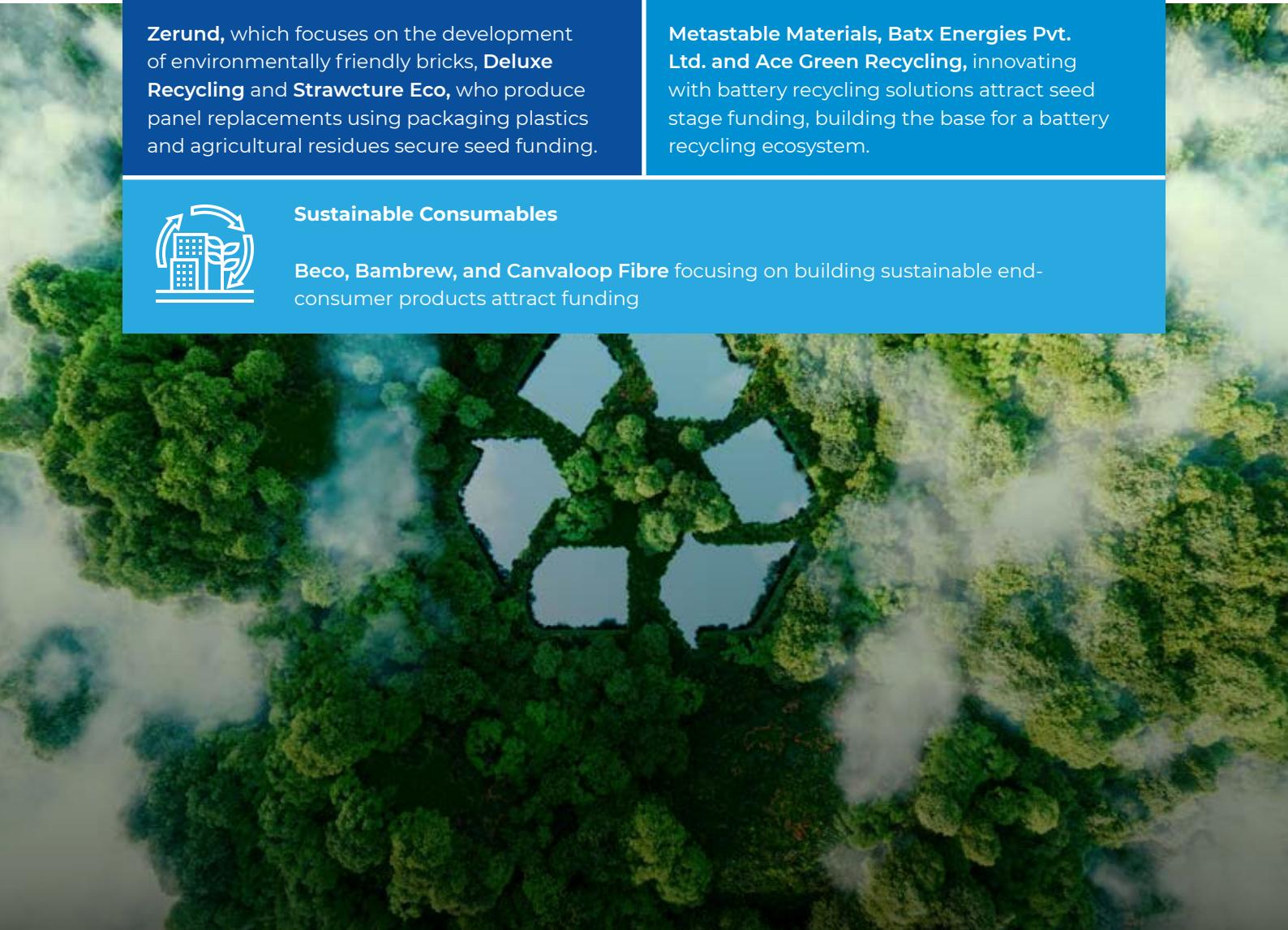
Battery Recycling

Metastable Materials, Batx Energies Pvt. Ltd. and Ace Green Recycling, innovating with battery recycling solutions attract seed stage funding, building the base for a battery recycling ecosystem.



Sustainable Consumables

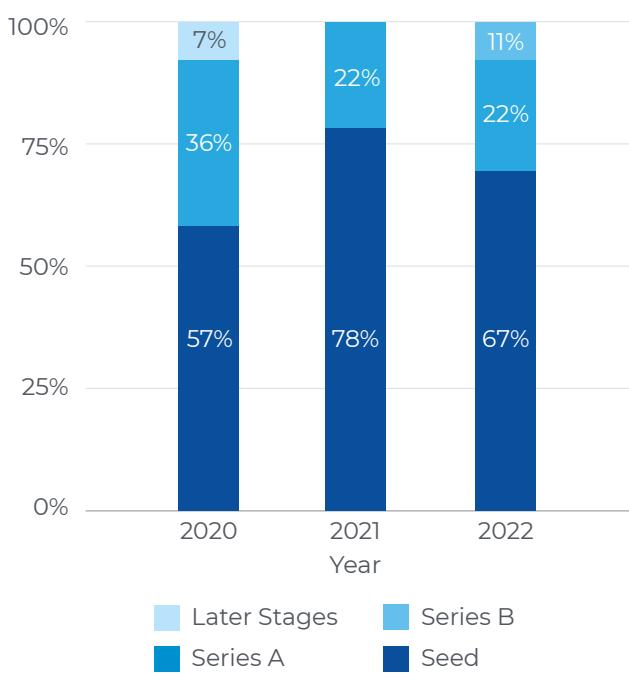
Beco, Bambrew, and Canvaloop Fibre focusing on building sustainable end-consumer products attract funding



Focus on early stage investments

With close to 70% of the deals pertaining to **Seed-Stage Funding**, the sector is gaining momentum towards early-stage innovations. While we are witnessing the increasing emergence of innovative enterprises, there is an equal requirement and opportunity for investors willing to support companies in their mid to growth stages, given the volume of waste generated.

Figure 5.2.6: Stage-wise Contribution to Deal Flow (2020 - 2022)

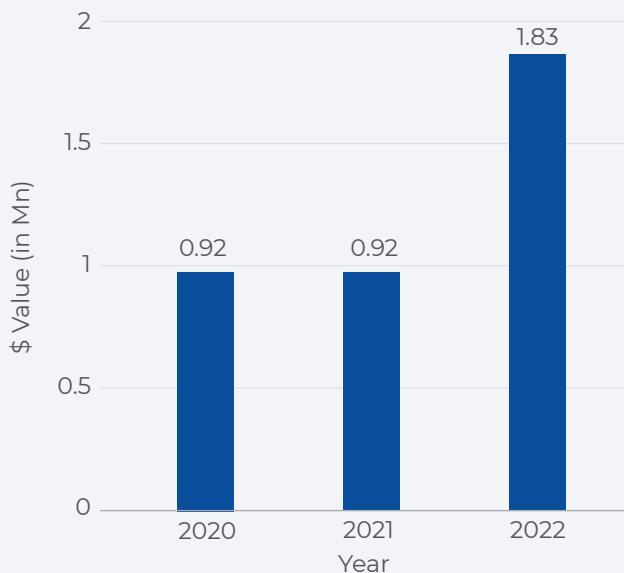


Source: Authors 2023



Although the number of deals in the Seed stage has stayed steady at approximately 70% over the past three years, the average ticket size has doubled, rising from \$0.9 million in 2020 to \$1.8 million in 2022.

Figure 5.2.7: Average Deal Value across seed-stage (2020 - 2022)



Source: Authors 2023

Figure 5.2.8: Investments (\$ mn) by Commercial, Impact, and Club Investors (2020 - 2022)



Source: Authors 2023

Given the intricate nature of solutions and the varied forms of waste meriting technology that supports their management, a focussed investment approach to the sector holds great value, as demonstrated by **Circulate Capital**, which has a sector focussed investment strategy which participated in 4 out of the 18 deals in 2022.

However, we see an increasing number of impact investors including **Sangam Ventures**, **Circulate Capital**, **Aavishkaar Capital**, and **Hivos-Triodos Fund** across early and later stages of funding.

Impact investors like Ankur Capital and Blue Ashva Capital have been providing early and growth stage financial backing, by participating in club deals.

With the growing potential for solutions to become commercially viable, there has been a steady rise in the number of deals, and investment volumes from commercial investors such as **Titan Capital**, **Morgan Stanley** and enterprises such as **Log9Materials**, in early stage enterprises.

Figure 5.2.9: Investment Snapshot for H1 2023

Where are we in H1 2023?



Source: Authors 2023

Key Enablers

1. Introduction and strict implementation of waste management policies

Strict implementation of waste management practices for waste producers at the individual as well as commercial level, will play a large role in building the ecosystem. By implementing measures, such as providing incentives for segregation or imposing penalties for non-compliance, policies hold potential to address the key obstacle - collection and segregation of waste at source.

2. Effective implementation of EPR guidelines

The 'producer pays' principle embodied in the EPR rules represents a positive stride towards waste management in India by involving waste producers in the process. However, the current framework requires a significant overhaul to ensure proper monitoring of waste generation, recycling levels, and on-ground compliance. Implementing stringent measures and establishing a robust framework will foster collaboration between waste producers and recycling enterprises, allowing producers to achieve their EPR targets with the assistance of recycling and waste collection enterprises.

3. Partnerships and collaborations

across the value chain

Effective waste management and circular economy implementation necessitate collaboration among

the government, social enterprises, civil society organisations, and civilian communities, given the intricate value chain and involvement of multiple intermediaries. Through these partnerships, the stakeholders can enhance infrastructure, formalise the waste picker workforce, and build technical capacity to ensure efficient waste management practices on ground.

4. Financial and technical assistance to emerging technologies

The sector has been seeing innovative solutions coming up for different forms of waste. Given the evolving stage of the space, there is a need to provide financial as well as technical support for commercial deployment of technologies. This would include efforts towards R&D as well piloting new age technologies for adoption on ground.

5. Consumer awareness for sustainable products

Awareness among consumers regarding sustainable products has been gradually increasing, although it is currently limited to a niche subset who are proactively seeking eco-friendly options. Hence, partnerships between the public and private sectors to amplify awareness through initiatives and encourage early adopters through incentives can foster a positive shift in consumption patterns and promote greener sustainable alternatives.



Outlook

1. End to end waste management solutions will continue to garner investor interest

Revenue visibility in this sector is significantly influenced by the accessibility of segregated waste for recycling. Enterprises that have built or are in the process of innovating to provide more efficient waste management processes across the value chain have a great potential for achieving scale. Solutions that help bring stronger linkages across the ecosystem, by bringing the demand and supply sides closer help to effectively address the complexities and enhance the viability of the sector. Such an end-to-end value chain of new age enterprises will provide revenue visibility and business viability that investors watch out for.

2. Battery recycling solution to attract investor attention on the heels of an increasing demand in application industries

The battery recycling sector in India is currently in its nascent phase, but it is projected to grow given the increasing demand for lithium in mobility as well as energy storage applications and the current high reliance on imports. Given the increasing relevance of battery recycling and the high economic value of rare earth metals, these recycling solutions will present an opportunity for both, early-stage investors to support innovative and sustainable recycling solutions as well as growth-stage investors to support the scaling of these solutions.

3. Sustainable consumables to see demand, driven by increasing consumer awareness

As consumers become increasingly aware of climate change and the importance of sustainable products, there is a paradigm shift from conventional materials to eco-friendly sustainable products. To support the transition to green, we will witness an increasing number of innovative startups develop materials made from renewable resources. Considering the nascent stage of this space, startups with the right market-fit product will attract greater focus of early stage equity investors.

4. Sector focussed funds will play important role in driving growth

Despite the relatively lower investment volumes in the industry, sector-focussed investors such as **Circulate Capital, Blue Ashva Capital, Sangam Ventures** are actively supporting innovations in this space. As the need for effective waste management and the opportunity to derive value from waste continue to grow, we will witness clear investment mandates towards a circular economy. Such mandates have the potential to drive the sector's growth and foster the development of innovative waste management and recycling solutions.

5. Catalytic capital inflow to join hands with commercial capital

Apart from financing through equity investments the sector also indicates the requirement for innovative financing structures that combine philanthropic and grant capital with commercial investments to facilitate the scale-up of enterprises. In 2022, **Krimanshi Technologies**, was awarded a grant support by DBS Bank in collaboration with Social Alpha⁴⁸. Krimanshi Technologies is currently recycling waste produce to cattle fodder and this grant will enable Krimanshi to expand its product range and to introduce poultry and aqua feed. Such capital inflow will also play a critical role in aggregating the unorganised waste picker workforce. It will not just build the case for emerging technologies but also create meaningful impact at scale.





Case Study: Recykal

Founded:	2015
Founders:	Anirudha Jalan, Abhishek Deshpande, Abhay Deshpande
Total Equity Investments:	\$37 million
Last Funding Stage Investor:	Morgan Stanley, Circulate Capital and Angel Investors



Business Model

Recykal is an end-to-end waste management digital platform leveraging technology to aggregate waste generators, collectors, ragpickers, processors and recyclers. The platform acts as a digital marketplace where waste generators such as FMCG companies, electronics manufacturers, IT and hospitality firms can connect with registered and verified processors and recyclers to recycle their waste effectively.

segregation at source. This efficiency in collection and segregation will subsequently increase the supply of clean waste to recyclers and upcyclers, consequently reducing the amount of waste dumped in landfills. With end-to-end linkages the platform will enable efficient exchange of recyclable materials, ensuring that valuable resources are recycled effectively, thus reducing the need for new, virgin materials. This approach promotes sustainability and reduces the environmental impact associated with waste disposal and the extraction of raw materials.



Innovation (Process & Business model innovation):

In India, the waste management and recycling value chain is fragmented with minimal traceability on the amount of waste generated and collected, the nature of the waste collected, source of generation and the amount recycled. Most of the waste management and recycling activities, are, in fact carried out by the informal sector, making traceability a challenge. Capitalising on technology, Recykal has built a SaaS-based platform which has the potential to formalise and organise this sector, providing better opportunities for waste pickers, recyclers, waste generators and other stakeholders; while improving traceability in the ecosystem and overall efficiency of the recycling process.



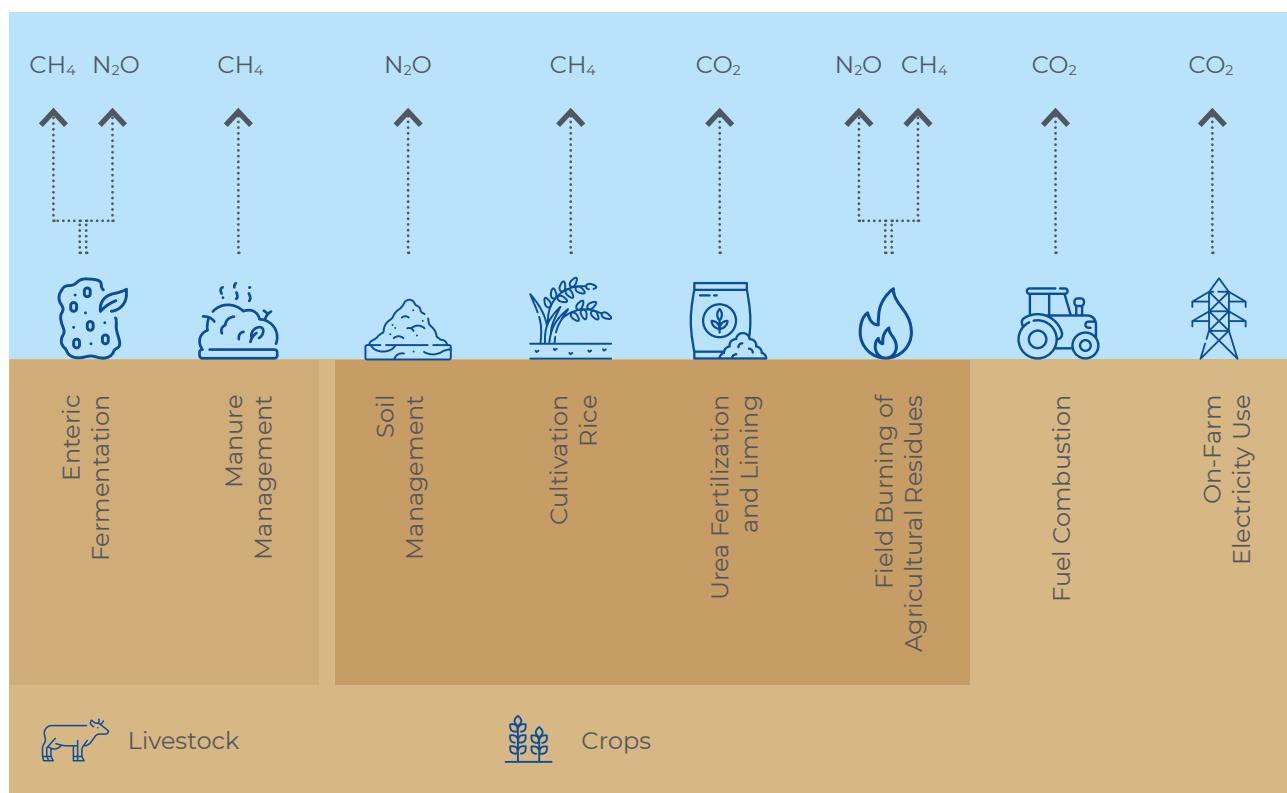
Climate Impact

Recykal's digital platform aims to enhance transparency in the waste management value chain, resulting in improved collection and

Climate Smart Agriculture & Food

India holds a significant position in the field of agriculture, which serves as the primary means of sustenance for 55% of its population.⁴⁹ With a larger segment of the population relying on agriculture, it accounts for 19.6% of the total greenhouse gas (GHG) emissions.⁵⁰ The primary stages of agricultural production, involving the utilisation of inputs like fertilisers, pesticides, heavy machinery, residue management, and irrigation, are the primary sources of GHG emissions.⁵¹

Figure 5.3.1: GHG emissions by different agricultural activities



Source: GreenBiz, 2021.

It also stands out as a sector that experiences the highest vulnerability to climate change, with **rising temperatures and unpredictable rainfall patterns**, adversely affecting crop yields and overall food production. Variations in weather patterns pose a growing challenge to agriculture, as exemplified by states like Haryana, where an unprecedented **80% excess rainfall** in 2022 resulted in an **estimated 20% loss in agricultural output**.⁵² Climate change is a rising threat to India's food security with seven crore Indians to suffer from hunger due to climate change by 2050.⁵³

Figure 5.3.2: Wheat production bears the backlash of climate change⁵⁴

Wheat stocks in India have been decreasing consistently since 2021-22. They are estimated to be at second lowest levels in the last 15 years in 2023-24, according to trade estimates.



Source: Reuters

Technological transformation of food systems

It is vital to focus on the development and adoption of technologies that enable the agriculture segment to mitigate and adapt to the impact of climate change. Implementing climate smart measures on ground will not only boost productivity and the efficient use of inputs but will also yield co-benefits for GHG mitigation.

Figure 5.3.3: Recent policy developments towards making Indian Agriculture Climate resilient



Combining Policy Efforts with Technological Advancement

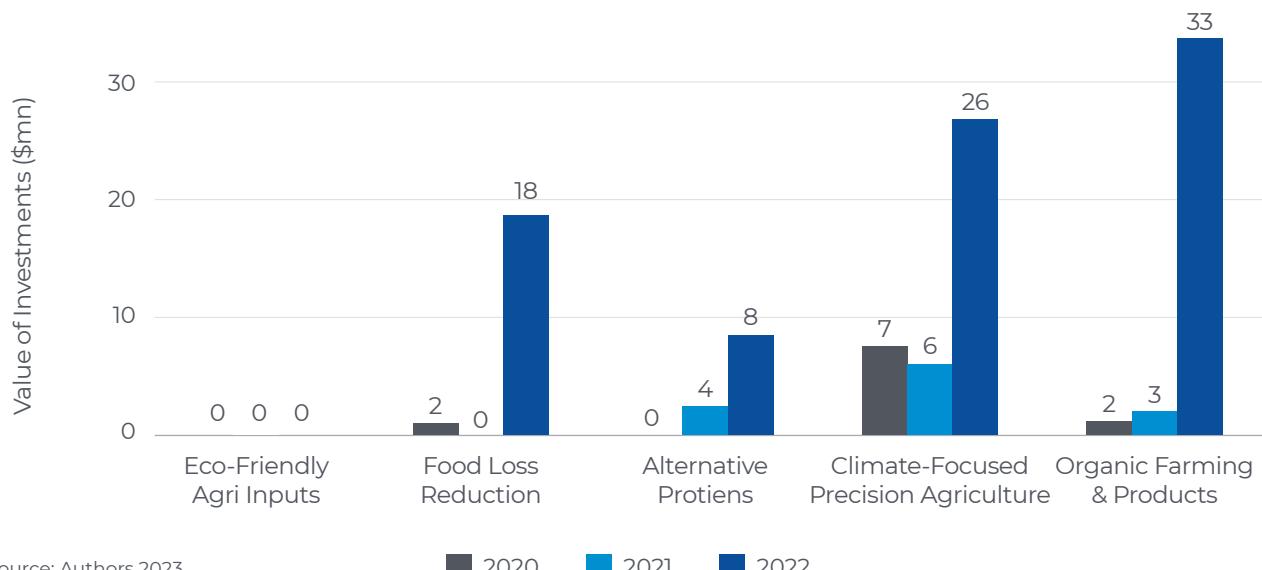
While the government has been actively devising policies to foster the growth and adoption of agricultural solutions, there is a need for increasing investment in innovative agri focused enterprises. While farmers have traditionally depended on their instincts and experience for farming practices, a changing weather, soil and water pattern merit technology to aid in farming.

Climate Precision Agriculture Data analytics aiding in monitoring farms and studying climate impact on farming productivity, thus aiding in optimal utilisation of resources.	Alternative Proteins Bio-technology driven products that present climate smart alternatives to animal protein.
Eco-Friendly Agri Inputs Enterprises leveraging deep science to develop eco-friendly agricultural inputs, which are climate resilient and more productive.	Organic Farming and Products Enterprises provide eco-friendly farm products through sustainable farming practices.
Food Loss Reduction Enterprises seen working on solutions to minimize food or agricultural produce wastage, either through nature-based solutions or through enhancing the supply chain with product-based solutions.	

Upstream and Midstream Farming Solutions garner interest; Alternative Proteins come under spotlight

Year 2022 saw 18 Climate-Smart Agri Startups Raise \$85 million across 22 deals, thus contributing 7% to the investment quantum of climate tech as a whole. With investments as high as \$25 million, the climate-smart agriculture segment has witnessed a ~ **6x spike in investment value, over 2021**.

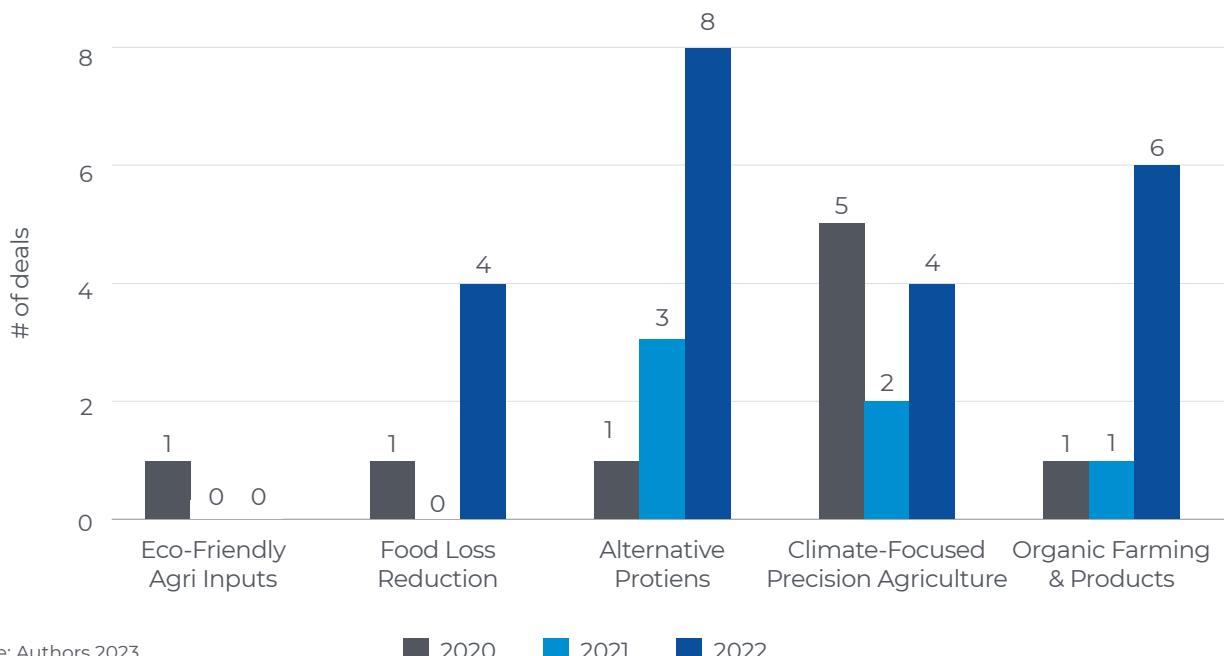
Figure 5.3.4: Investment Value (\$ mn) across Sub-segments (2020 - 2022)



Source: Authors 2023

■ 2020 ■ 2021 ■ 2022

Figure 5.3.5: Investment Volume across Sub-segments (2020 - 2022)



Source: Authors 2023

■ 2020 ■ 2021 ■ 2022

Notable Mentions

Farmer-centric solutions aimed at helping farmers increase their yield and income, along with **innovative sustainable farming solutions** that yield organic produce, are witnessing increasing and gaining growing attention from investors.

For instance, **Ecozen**, offering solar-powered cold storage solutions and **Akshayakalpa**, producer of organic milk have attracted high ticket deals. Similarly, **NutriFresh** and **Eeki Foods**, using hydroponics to provide organic and pest-free produce to consumers, have received funding from investors such as Neev Fund, Green Frontier Capital, and Avaana Capital.



Digitising the agriculture ecosystem underway as technologies work to derive climate insights on crop and soil.

Pixxel, offering hyperspectral imaging, has attracted high ticket investments of \$25 million in 2022. **The target market for Pixxel's solutions is what sets it apart from other agtech startups**. Its solutions are **B2B**, catering to agricultural intermediaries and corporates developing agricultural products (e.g., a fertiliser company) across the globe.



The alternative protein industry sees innovations from enterprises experimenting with **plant-based proteins, fermentation-based proteins, and cultivated lab-grown meat**.⁵⁶

Embracing Transformation with Alternative Proteins

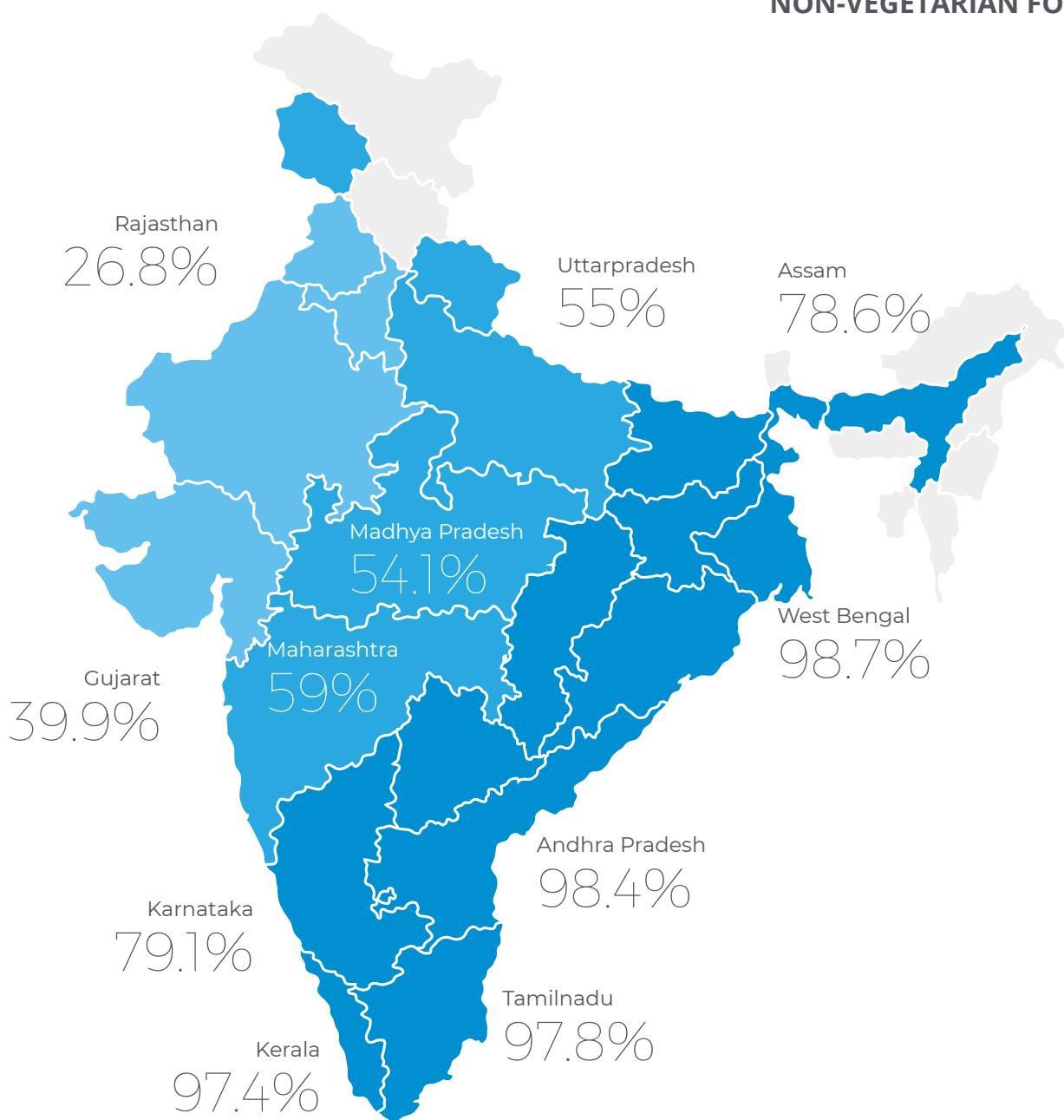
While more than 70% of Indians consuming meat,⁵⁷ the per capita meat consumption remains relatively low at only 3kg, in contrast to Germany and the US where it is 87 kg and 124kg,⁵⁸ respectively. In recent years, the demand

for healthy, sustainable, and high-protein food, including meat alternatives, has been on the rise thus demonstrating a huge potential for meat and animal protein alternatives to gain market traction. The value proposition of the plant-based meat sector revolves around innovative solutions that ensure these protein alternatives closely resemble traditional meat products.⁵⁹

Figure 5.3.6: A Snapshot of the Indian Alternative Protein Market

MEAT ON THE MENU

MORE THAN 75 % INDIAN EAT NON-VEGETARIAN FOOD



[Source: National Family Health Survey](#)

Figure 5.3.7: Types of Alternative Proteins with Accompanying Examples of Enterprises and Investors

Alternative Proteins	Plant Based	Fermentation Based	Cultivation Based
Name of the enterprise	SHAKA HARRY	Phyx 44	MyoWorks Pvt. Ltd.
Investors	BETTER BITE ventures Panthera Peak capital ventures & Angel Investors	BETTER BITE ventures & Angel Investors	ankur capital
Nature of Funding	<	Seed Stage equity support	>

Source: Authors 2023

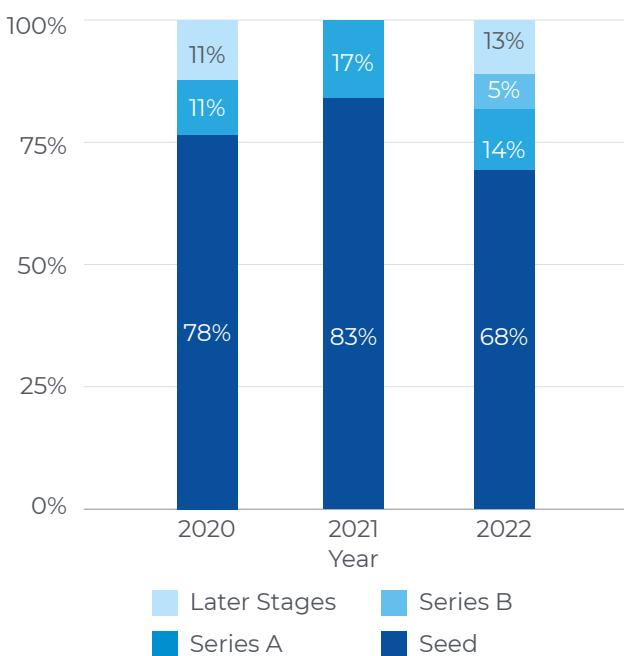
The alternative protein space is poised to grow as consumers become more health-conscious and startups create innovative solutions to make these protein alternatives closely resemble traditional meat products. Although the nutritional aspects of alternative protein products and their effects on human health are still being debated in India, the growth of this industry will heavily rely on policy directives to facilitate its expansion.



Investment Trends

Close to **70% of deal flows are seen in the seed stage**. While innovative solutions working to improve farm yield and build climate resilient farming practices continue to garner investments, **in 2022, we witness remarkable innovations and also early-stage investments in enterprises innovating with alternative sources of protein.**

Figure 5.3.8: Stage-wise Contribution to Deal Flow (2020 - 2022)



Source: Authors 2023

Year 2022 saw later stage funding as well, especially with enterprises that have demonstrated the ability to not only meet farmer requirements but also transform the agricultural ecosystem. These funding rounds were of deal sizes **greater than \$5 million**, in enterprises like **Akshayakalpa** and **Ecozen** which have distinctive business models. These models focus on enhancing the sustainability and quality of farm produce, reducing farm losses and establishing strong market linkages for farmers, thus improving their incomes and resulting in wider adoption among farming communities.

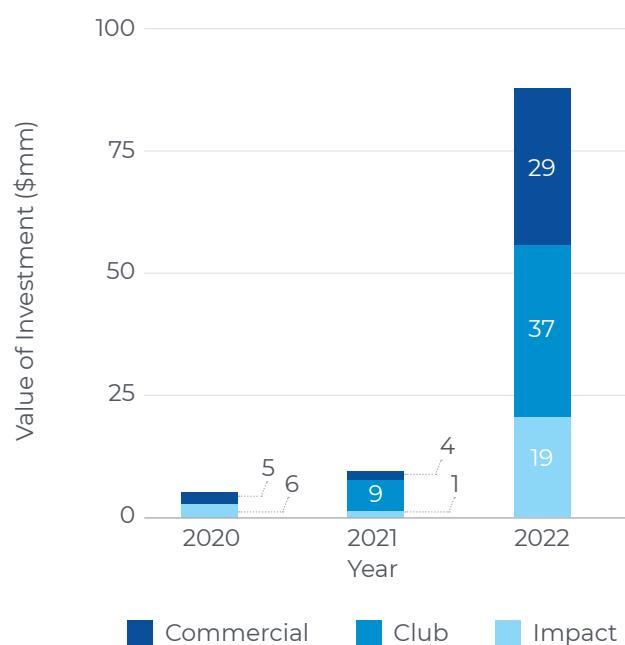
This trend was also observed in early-stage enterprises with a distinct innovative business model. **Pixxel**, a hyperspectral imagery startup that uses satellite imagery for deriving climate related insights on crop and soil health has raised multiple rounds of funding, while **Eeki Foods** with its pesticide free IoT-enabled Smart Farms

demonstrate investor confidence in technological advancements transforming how the agricultural ecosystem functions.



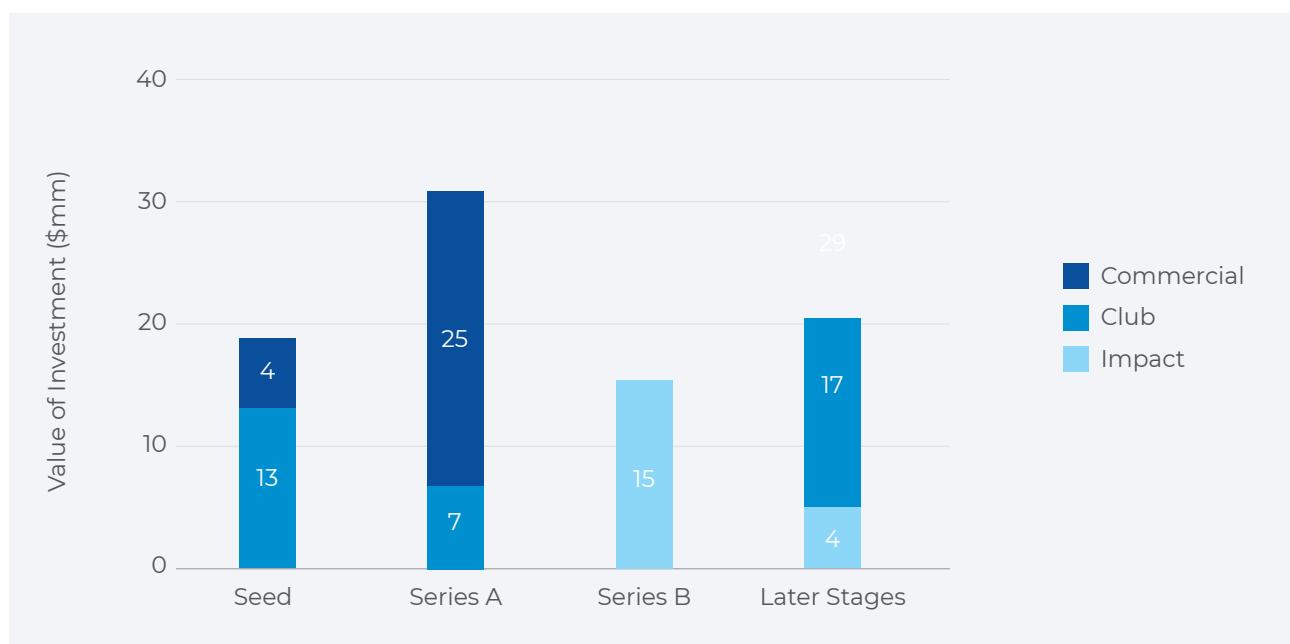
Conundrum of Impact and Economics in India's Priority Sector

Figure 5.3.9: Investments (\$ mn) by Commercial, Impact, and Club Investors (2020 - 2022)



Source: Authors 2023

Figure 5.3.10: Investments (\$ mn) by Commercial, Impact, and Club Investors across stages in 2022



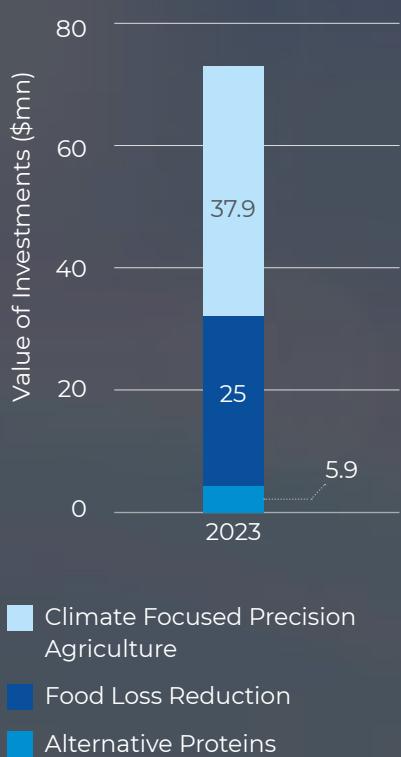
Source: Authors 2023

Over the past three years, impact investors have played a crucial role in providing vital support to sectors like Climate Smart Agriculture, which typically have a high gestation period. In 2022, several impact-focused investors, including British International Investment, Rainmatter Technology, Caspian, and Samunnati, actively supported enterprises such as Akshayakalpa and Ecozen by providing growth and late-stage equity support. Notably, in these high-value deals, commercial investors like Dare Ventures and Northern Arc participated alongside impact investors through club deals, facilitating the scaling of these enterprises and creating a significant impact on a larger scale.

Furthermore, 2022 witnessed a notable increase in support from commercial investors like Accenture, Blume Ventures, Radical Ventures, and high net-worth individuals (HNIs) such as Virat Kohli and MS Dhoni with a particular focus on climate precision agriculture technologies and alternative proteins.

Figure 5.3.11: Investment Snapshot for H1 2023

Where are we in H1 2023?



Climate Smart Agriculture & Food		H1 2023
Deal Value (\$ Mn)	68.8	
# of Deals	9	

During the first half of 2023, investments in the Climate Smart Agriculture & Food sector were spread across segments with a total investment volume of \$68.8 million through nine deals. The growth in the investment volumes can be attributed to the follow-on growth and late stage funding to Pixxel (\$36 million) and Ecozen (\$25 million).

Moreover, In H1 2023, there was an increase in, funding-towards-precision-agriculture with four out of the nine enterprises falling in this segment. Enterprises like Satyukt Analytics and Pixxel that have been raising follow-on funding from both impact and commercial investors, indicate investor interest towards on-farm solutions that leverage technology for climate related insights.

Impact investors, such as the Neev Fund, are also increasingly supporting startup enterprises in the CSA sector, such as NutriFresh. Startups such as NutriFresh are at the forefront of producing organic and pest-free produce using new and sustainable farming methods. The investment made by the Neev Fund in NutriFresh, in July 2023 would play a crucial role in scaling such early-stage innovative farming approaches.

Key Enablers

1. Building Digital Agristack

A common platform by the central government digitising on-farm data for all stakeholders in the agri-value chain can integrate innovative agri-focussed solutions and enable them to access farm data to enhance their solutions.

2. Strengthening the Farmer Producer Organisation (FPO) network

Farmer Producer Organisations (FPOs) play a vital role in uniting small and marginal farmers. By aggregating farmers, this approach facilitates the wider adoption of climate-smart solutions, allowing

for scalability and localisation of offerings to cater to the specific needs of farmers at a local level.

3. Technical assistance and guidance for Climate Smart AgTechs to build market linkages

With the shifting climate conditions, farmers are open to adopting climate-smart practices, but their willingness hinges on having a reliable market for their produce. To address this concern, emerging climate-smart AgTech startups need increased guidance and support from ecosystem players to establish strong linkages with mandis and institutional buyers.

4. Policy enablers to mainstream alternative proteins

A favourable regulatory framework, providing economic incentives to companies that leverage plant-based proteins will be essential for such enterprises to expand their presence and also build consumer interest and confidence to transition away from animal protein.

Outlook

1. Vertical integration among climate smart agricultural startups to scale

India, being an agrarian economy with diverse land characteristics, offers a unique path to scale for agtech start-ups. The key lies in establishing an end-to-end value-chain rooted in specific regions. As farmers become more aware, they are increasingly open to adopting climate-smart solutions, provided they receive assured prices for their produce. Enterprises that build linkages spanning farm inputs, advisory services, financing, and output markets will enjoy substantial network effects by participating across various segments of the value chain.

2. Agtechs to enhance agri-finance

One of the primary challenges faced by small and marginal farmers is the lack of access to affordable financing. Conventional financial institutions that lack visibility on farm and farmer level data can be supported with insights from enterprises that provide real-time on-farm data. Collaborations between conventional financial institutions and AgTechs will lead to customised financing products

tailored to the specific needs of farmers and rural agri SMEs.

3. The market for alternative foods will steadily expand

The rising awareness among consumers and their focus on health are anticipated to boost the demand for alternative protein sources in forthcoming years. To foster further innovation and cater to this increasing demand, early-stage investors are expected to continue supporting new and existing enterprises in this space.

4. Increased ecosystem collaborations to build on ground adoption of solutions

To ensure successful adoption of new-age climate-smart agricultural practices among farmers, it is imperative to address their limited digital literacy and awareness. While equity investors continue to invest in innovations, there will be emerging financing structures that also extend technical capacity building to farmers for on-ground deployment of these solutions.



Case Study: Akshayakalpa

Founded:	2010
Founders:	Shashi Kumar
Total Equity Investments:	\$32 million
Last Funding Stage Investor:	British International Investment (BII), Rainmatter Foundation, Venture Dairy



Business Model

Akshayakalpa Organic is the first certified organic milk brand in India providing organic milk and dairy products free of antibiotics, chemicals and preservatives.⁶⁰ It follows a hub-and-spoke model with farm networks in rural, agricultural areas strategically located near an urban hub for production and distribution of organic dairy products. With its business model, Akshayakalpa has empowered farmers through training, enabling them with easier access to finance by acting as a guarantor and providing assured prices for their produce with market linkages.



Innovation (Process & Business model innovation):

Akshayakalpa stands apart as more than just any organic milk D2C/B2C brand. It is building an entire value chain in the dairy space by leveraging the farmer community in setting up and managing organic farms. Here, farmers are trained and empowered with the knowledge, resources and technology to sustainably manage and scale up farms that in turn help reduce the carbon footprint. What sets Akshayakalpa apart is its innovative approach, which involves implementing organic and mechanised processes right from cattle feed to milking and storage. This distinctive

strategy allows it to achieve cost reduction and sustainability by recycling farm and cattle waste into biogas. The biogas, in turn, powers dairy farm, leading to a significant reduction in energy consumption. These end-to-end farming solutions are enabling farmers to reduce losses and increase farm income.



Climate Impact

Akshayakalpa farms prioritise the circular economy and co-existence of farming principles to reduce their ecological footprint⁶¹. It has an innovative approach to reusing resources; any product that has fulfilled its purpose enters a new cycle of use. For instance, cow-dung is collected and processed in a bio-digester to produce methane gas, which is then harnessed by farmers to run their machinery and equipment, as well as used their kitchens as domestic fuel. Additionally, the residue sludge from the bio-digester is converted into slurry, contributing to the fertility of their farmland. These ingenious methods enable Akshayakalpa to maintain the ecological balance and integrity of its farms while demonstrating a commitment to sustainability.





Energy

As per World Energy Outlook 2021 of the International Energy Agency (IEA), India is the third largest primary energy consuming country in the world⁶². Combined with the twin forces of urbanisation and industrialisation, this underpins rapid growth in energy demand, which is forecasted to rise by more than 3% per year from 2021 to 2030⁶³, in the Stated Policies Scenario (STEPS)⁶⁴.

In India, emissions increased by approximately 6% in 2022, driven mostly by a 5% increase in coal emissions,⁶⁵ making it imperative for India to reduce its reliance on fossil fuels and call for increased investments to transition to alternative sources of energy to achieve the target of net zero emissions by 2070⁶⁶.

Figure 5.4.1: Macro Landscape: Initiatives Taken by the Government of India

2023	2022	2021
<ul style="list-style-type: none">Ministry of New and Renewable Energy budget increased by ~48% to ₹10,222 crore₹19,744 crore allocated for National Green Hydrogen Mission₹ 37.6 billion (\$455.2 million) in incentives for battery storage projectsGreen Growth is one of the priorities within SAPTARISHISupport for 4 GWh Battery Energy Storage Systems via Viability Gap Funding	<ul style="list-style-type: none">MNRE deployed ₹4,500 crore to support the manufacturing of solar PV modulesGreen Energy Open Access Rules: Enabling consumers to directly procure renewable energy from generators of their choiceThe National Green Hydrogen Mission launched to accelerate the production and adoption of clean hydrogenThe Ministry of Power issued Renewable Purchase Obligation trajectories until 2029-2030, which includes energy storageIndia Battery Supply Chain Council (IBSCC) launched to work on the complete development of the battery supply chain	<ul style="list-style-type: none">Launched the Mission Innovation CleanTech Exchange, to create a network of incubators across 23 member countriesDirect Foreign Investments by USAID and JICA for renewable energy solutionsNational Programme on Advanced Chemistry Cell (ACC) Battery Storage with a budgetary outlay of \$2.19 billion

Source: Authors 2023

Despite policy push, challenges continue to exist

Low Domestic Supply of Solar Panels and Solar Cells

Even though solar contributes to more than 50% of the RE capacity in the country, the domestic component supplies have not kept up with the rapid pace of production.

Preparedness of the Electricity Grid

Recent trends underlying the integration of the grid with renewable energy generation pose challenges such as increasing variability of hourly demand, increasing ramping requirements to meet the net demand, short-term frequency variations, and local voltage issues⁶⁷.

Limited access to clean energy solutions for low income communities

The reliance on traditional fossil fuels for energy generation also contributes to air pollution and GHG emissions, exacerbating health issues and environmental degradation. Improved and affordable access to clean energy is essential to provide electricity to underserved communities.

High costs associated with clean fuel production

The production and adoption of clean fuels in India are hampered by high costs, including substantial upfront investments in research, infrastructure, and production facilities. These costs can deter both private and public sector entities from actively pursuing clean fuel projects.

High cost of financing and the lack of longer-term debt capital

The high capital expenditure associated with clean energy solutions makes it challenging for mid and small-sized enterprises to access low-cost finance. To overcome this challenge, extending a combination of supportive policies and financial incentives to innovative ventures is necessary to drive down costs and promote the widespread use of clean fuels in India.



At least \$900 billion will be required for the energy transition in India over the next 30 years⁶⁸. Hence, to tackle the challenges mentioned above, the mobilisation of finance is necessary to ensure that we do not only transition to green energy sources but also ensure equitable access to them by providing last mile solutions in an optimal manner.



A value chain approach:

The different enterprises innovating with solutions for sustainable energy generation and usage, can be categorised into the following segments based on their impact imperative.

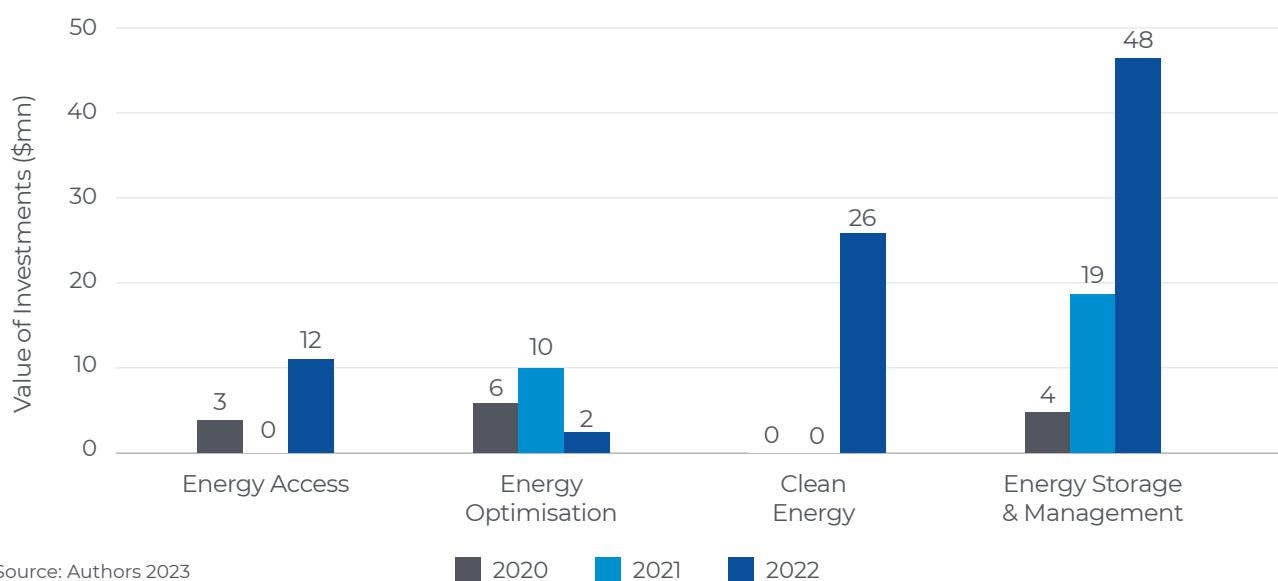
Clean Energy/ Sustainable Fuel Innovative solutions that enable the production of clean fuels from renewable materials/energy sources. This includes innovations enabling green hydrogen production as well as conventional fuels from new feedstocks.*	Energy Storage & Management Technologies and systems used to store and manage energy from renewable sources. These technologies are used to store excess energy generated during times of low demand for use during periods of high demand, which helps to balance the grid.
Energy Optimisation Solutions focussed on improving the efficiency of energy production, distribution, and consumption processes. The goal is to reduce energy waste, lower GHG gas emissions, and increase the reliability and affordability of energy services.	Energy Access Efforts to provide affordable, reliable, and sustainable energy services to people who lack access to clean energy or clean cooking fuels. The enterprises in this segment help integrate rural and urban economies by enabling last-mile delivery of clean energy products.

*While there are early-stage investments in rooftop solar startups (Energy as a Service or EaaS companies, solar project financing platforms), for this study, we have excluded them and focused on early-stage capital investments in emergent, disruptive clean energy generation technologies in India.

Investment trends

Thirty entities raised capital of ~\$ 130 million over 41 deals during 2020-2022; of which ~ 87 million was raised over 17 deals in 2022.

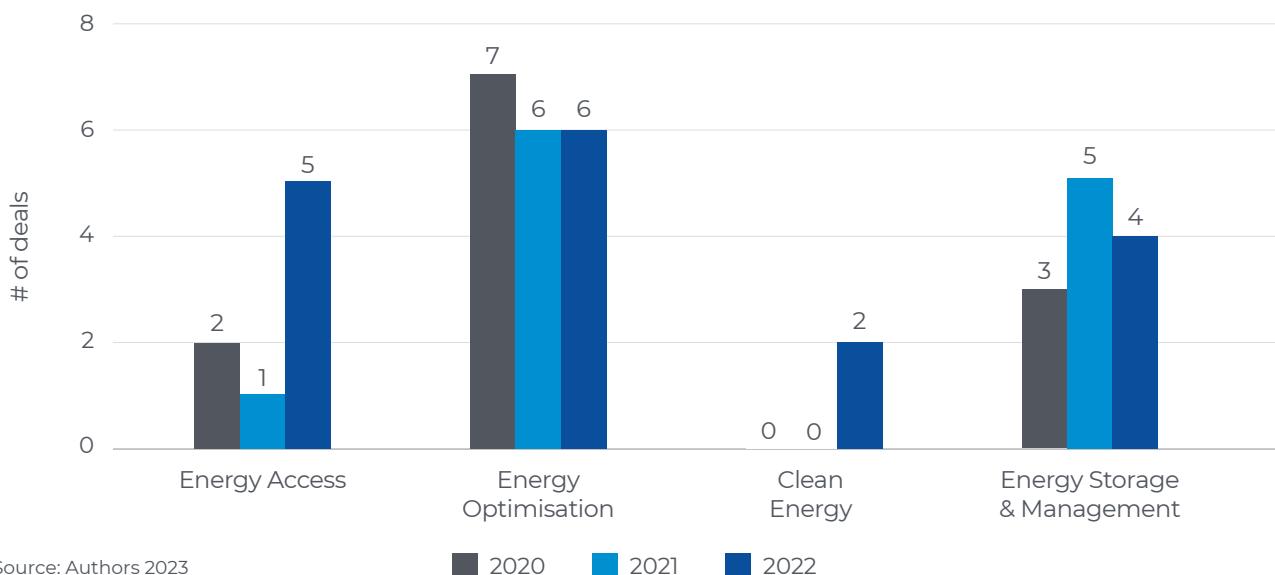
Figure 5.4.2: Investment Value (\$ mn) across Sub-segments (2020 - 2022)



Source: Authors 2023

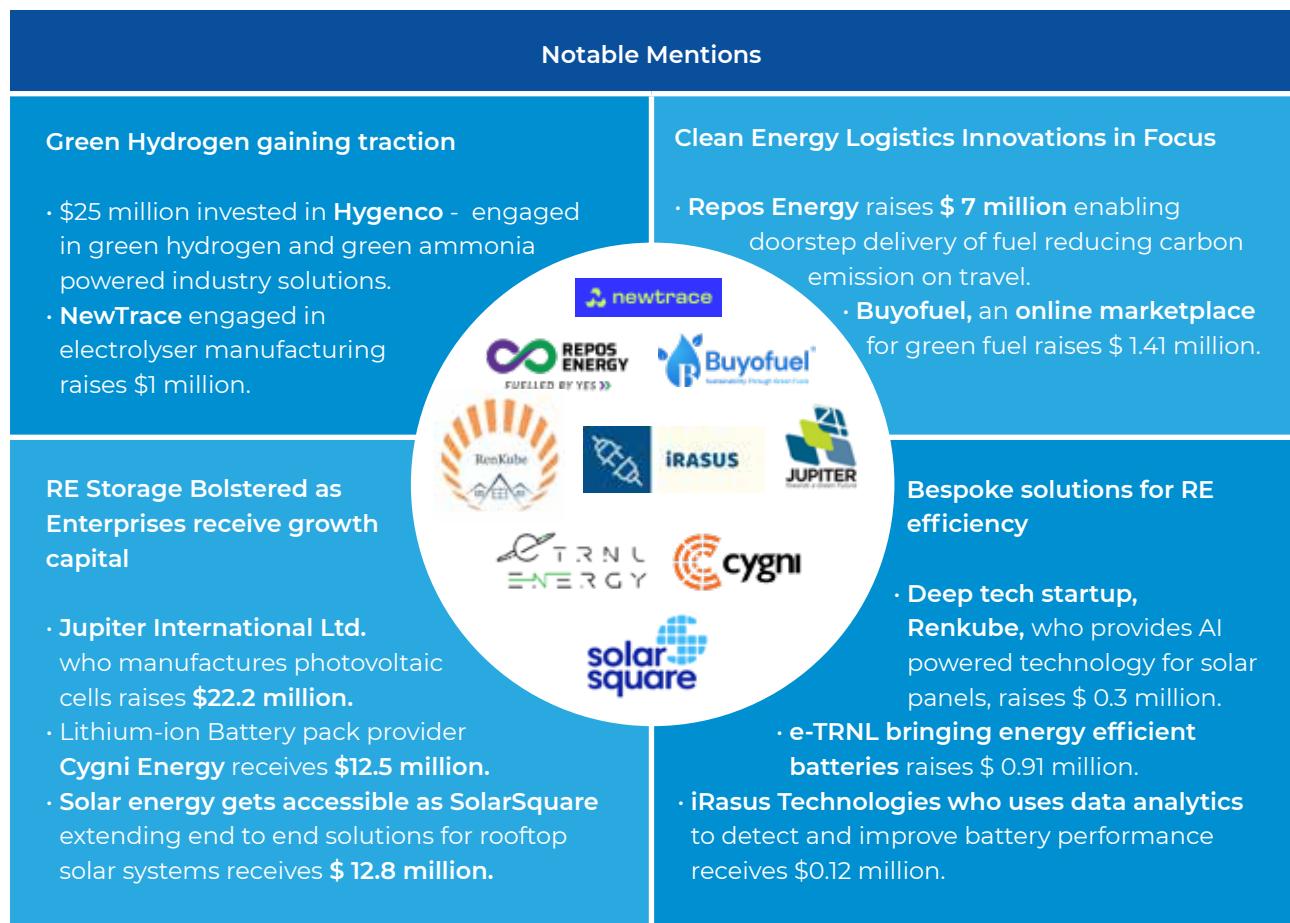
■ 2020 ■ 2021 ■ 2022

Figure 5.4.3: Investment Volume across Sub-segments (2020 - 2022)



Source: Authors 2023

■ 2020 ■ 2021 ■ 2022



Each of the above segments are building an efficient and easy-to-manage renewable energy ecosystem. While energy access carries the dual impact of social equity along with a strong climate

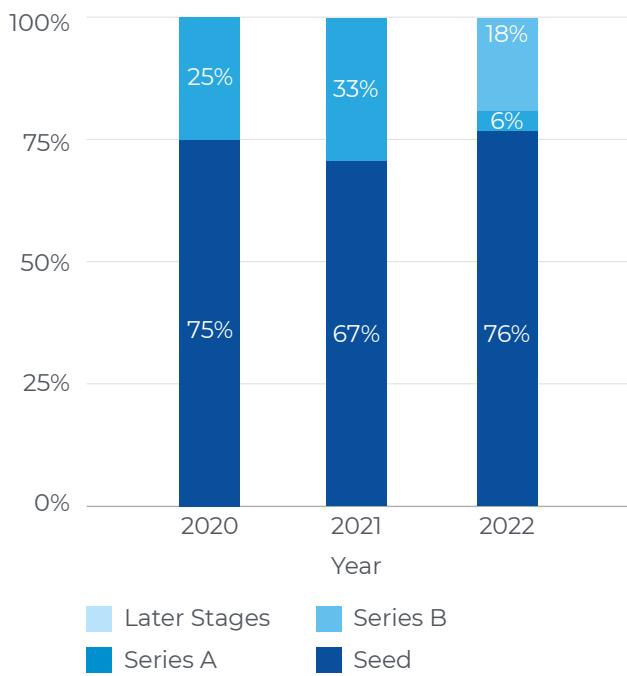
impact, innovations with RE generation, storage and management form the backbone for ensuring a sustainable transition to RE across domestic and commercial segments.

Enterprises experimenting with deep technology to come up with bespoke solutions for detecting and improving the performance of RE storage solutions, albeit in the nascent stage, herald the relevance

of innovations to gradually build the sustainability of an RE ecosystem. While the investment ticket sizes are smaller in this segment, the nature of innovation merits a case for impact capital to encourage research, development and deployment of such technologies.

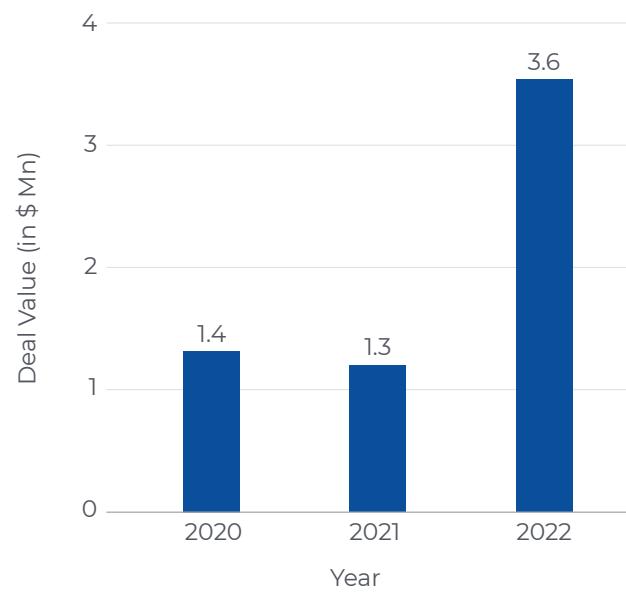
As early-stage funding grows, enterprises in later stages garner interest

Figure 5.4.4: Stage-wise Contribution to Deal Flow (2020 - 2022)



Source: Authors 2023

Figure 5.4.4: Average Ticket Size for Seed Stage (2020 to 2022)



Source: Authors 2023

Down the years, a major share of the funding has been going towards the seed stage. **The average ticket size for the stage has also increased by 3x from ~\$1 million in 2020 to ~\$3.6 million in 2022.** Investments in this stage primarily cater to the 'Energy Optimisation' segment indicating the emerging importance of technology to enable a smooth transition from conventional energy sources and increasing the efficiency of existing RE systems.

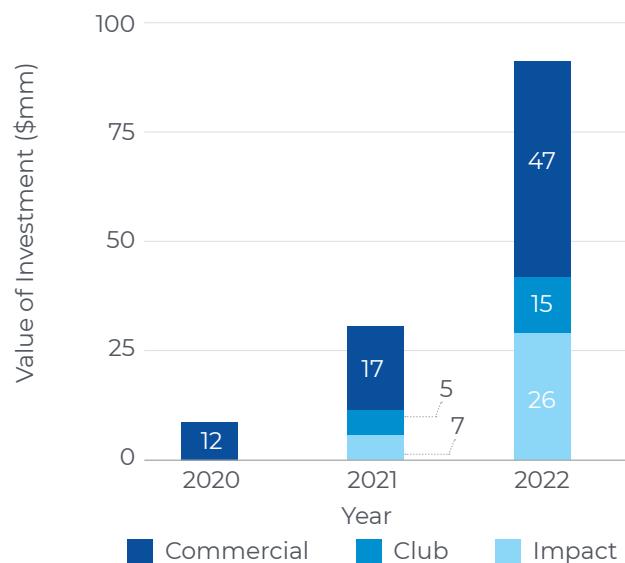
Unlike previous years, 2022 saw Series B investments wherein energy storage solutions received investor backing. As the demand for EVs gathers steam and RE deployments increase, there is a need to supplement these efforts with supporting infrastructure for a consistent and uninterrupted supply of energy from renewable sources. Energy storage solutions are critical for this transition and the year-on-year growth capital received by such enterprises, is indicative of industry recognising this.

Impact Lens transitions as commercial investors back innovations

Over the past three years, the number of commercial investors who have taken an interest in the energy space has increased, both in terms of deal volumes as well as value. This possibly indicates a shift in the way the sector is viewed by investors with a commercial lens. While they support smaller ticket sizes in early-stage enterprises, we also see them veering towards enterprises in the growth stage.

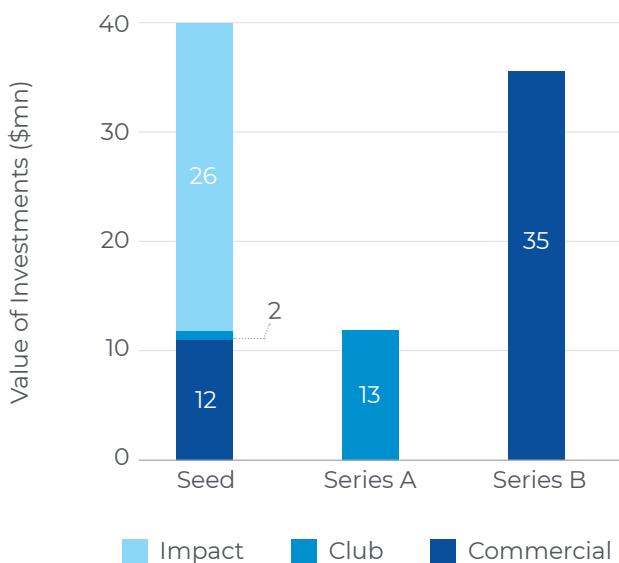
However it is important to note that impact investors continue to support breakthrough technologies that hold the potential to become commercially viable at scale - case in point being **Neev Fund** which invested in a green hydrogen solution.

Figure 5.4.6: Investments (\$ mn) by Commercial, Impact, and Club Investors (2020 - 2022)



Source: Authors 2023

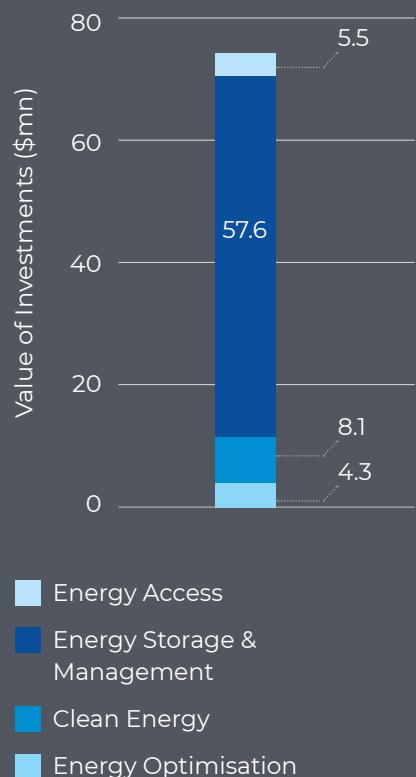
Figure 5.4.7: Investments (\$ mn) by Commercial, Impact, and Club Investors across stages in 2022



Source: Authors 2023

Figure 5.4.8: Investment Snapshot for H1 2023

Where are we in H1 2023?



Energy	H1 2023
Deal Value (\$ Mn)	75.5
# of Deals	12

In 2023, of the 12 deals that raised funding, five were from the Energy Storage & Management. In H1 2023, the sub-sector raised ~\$58 million. Log9 Materials, for instance, raised a cumulative amount of ~\$51 million across two Series B deals.

Log9 Materials is emerging as a startup with tremendous potential in the sub-sector. The energy storage and management sub-sector, especially the market for battery energy storage systems (BESS) is expected to increase in size given the increasing penetration of EVs and power generation via renewable energy.

It is necessary to focus upon innovations in the BESS space that help in the domestic manufacturing of cells. Innovations are being seen in producing cells by altering the existing chemistries.

Key Enablers

1. Policy incentives and mandates to increase demand of clean energy

While there has been a strong policy impetus towards clean energy solutions including the green hydrogen sector, there remains little economic incentives for end-user industries to transition to clean energy which in certain cases is more expensive than fossil fuel energy. A strong policy mandate ensuring consistent demand offtake for clean energy solutions will aid the growth of such solutions, boosting investor confidence.

2. Increased policy push to fostering innovation

The clean energy space in India is still constrained by challenges and requires technological advancement to make the solutions accessible and affordable, for end consumers. The segment would greatly benefit from a strong policy focus

towards investments encouraging innovation and implementation of best practices from international markets, all of which requires financial and technical assistance from both the public and private sector.

3. Introduction of a National Carbon Credit Market

The Ministry of Power's (MoP) Carbon Credit Trading Scheme (CCTS) 2023 aims at creating a domestic market for tracking and trading carbon credits⁶⁹. The implementation of a national carbon credit market in India presents a transformative opportunity to bolster the growth of renewable energy sources. By incentivising emission reduction, this market would motivate industries to adopt cleaner technologies and practices, fostering a shift towards renewable energy. It could serve as an additional revenue stream for RE projects, attracting investment and improving their financial viability.

Outlook

1. Battery Energy Storage Systems to receive growth capital

Increasing attention to EVs and RE projects is leading the way for an energy storage economy to emerge. With the Policy Push providing viability gap funding for development of Battery Energy Storage Systems, will lead to more enterprises innovating with battery storage packs and alternate battery chemistries.

2. Impact capital to support innovations improving efficiency of energy storage

As Energy Storage and Management continues to gain traction, the need for reducing energy wastage and monitoring the performance of different systems would also see increased demand. 'Energy Optimisation', currently a nascent segment, would witness increased demand via applications like data analytics that help monitor the performance of different applications.

3. Green hydrogen sector to witness collaborations across the value chain

There has been a rising sense of urgency to shift to Green Hydrogen (G-H2) as outlined under the National Hydrogen Mission 2022 with the aim of making India a leading producer and global

supplier of green hydrogen. While the production cost of G-H2 is higher than grey hydrogen, the sector would see increasing partnerships and collaborations between producers and project partners that will help gradually increase its application and build evidence for the solutions.

4. Equity investments to lay the ground for debt capital to step in

As Cygni Energy Pvt. Ltd. raises growth capital in a mix of debt and equity, an increasing number of enterprises maturing into the growth phase will attract debt capital on the heels of increased equity support. Given the nature of industry which has high capital demands, it is imperative for low cost debt capital to step in, given the push from early stage equity investments.





Case Study: Hygenco

Founded:	2020
Founders:	Amit Bansal, Aashish Gupta, Anshul Gupta
Total Equity Investments:	\$25.4 million
Last Funding Stage Investor:	Neev Fund



Business Model

Hygenco is a developer and deployer of green hydrogen and green ammonia based industry solutions. It aims to Build-Own-Operate green hydrogen facilities across the country, that have the potential for application in large-scale processing industries and transport⁷⁰.

alliances Hygenco has been venturing into setting up green hydrogen plants, thereby bringing scale and sustainability to the value chain.



Climate Impact

Decarbonising our planet is one of the primary goals that countries around the world have set for 2050. To achieve this, decarbonising the production of an element like hydrogen and giving rise to green hydrogen is key since it is currently responsible for more than 2% of total global CO₂ emissions⁷¹. From a price parity basis alone, G-H₂'s share of demand could grow from 16% in 2030 to almost 94% by 2050⁷². This translates to an implied cumulative electrolyser capacity demand of 20 GW by 2030 and 226 GW by 2050⁷³.



Process innovation

Hygenco established India's first off-grid solar photovoltaic based green hydrogen pilot plant in Madhya Pradesh. This innovation that operates entirely off-grid is free from reliance on fossil-powered backup, ensuring a 100% green energy source. Through strategic partnerships and



Environment & Natural Resources

The Fifth Annual World Air Quality Report released by IQAir reveals the abysmal state of India's air quality. India has been ranked Eight in the list of countries with the worst air quality index while 12 of the 15 most polluted cities in Central and South Asia are in India⁷⁴. The World Health Organisation estimates that air pollution in India is responsible for over 1.2 million deaths each year⁷⁵. The numbers are further staggering when monetised: according to the report, the yearly economic loss to India stands at \$150 million⁷⁶.

There are also growing concerns about water pollution and groundwater exploitation. As per the World Bank, despite holding 18% of the world's population, India only has enough water resources for 4% of its people, hence making it the world's most water-stressed country.⁷⁷

India's combination of urbanisation and impact of climate change with infrastructure ill equipped to handle these changes, call for an increasing need for public and private sector interventions that can arrest potential health hazards through a combination of policy initiatives and technological advancements.

Navigating the Policy Landscape

Figure 5.5.1: Policy Landscape

Scheme	Theme	Notable observations
Atal Bhujal Yojana	Sustainable groundwater management in water-stressed areas	Supporting emerging technologies like smart water meters
Jal Jeevan Mission	Enabling access to clean and safe drinking water in rural areas	Decentralised approach including community participation in management of water supply schemes in respective areas
National Clean Air programme (NCAP)	Strengthening air quality monitoring network	Aim to reduce the concentration of particulate matter (PM) in the air by 20-30% by 2024
Atal Mission for Rejuvenation & Urban Transformation	Water recycling and reuse	City Water Balance Plan (CWBP) focusing on water management, recycling and conservation
National Water Mission	Building a comprehensive water database to monitor usage and wastage	Aim to conserve water by minimising its wastage and ensuring its equitable distribution both across and within states

Source: Authors 2023

Even though the government has stepped in with different policies and initiatives in place, certain challenges continue to exist for the sector.

Challenges:

1. Government Policy Targets fall behind:

Flagship policies such as the National Clean Air Programme (NCAP) launched in 2019 to improve air quality in over 100 of India's most polluted cities, have been constrained by limited funding and challenges in on-ground implementation⁷⁸. Able on ground support through technological and technical assistance is required to ensure effective implementation of schemes.

2. Diverse geographical topography and scale:

Air density, pollution and water networks differ in India, making it even more complex to implement a unified policy framework and scale up technical solutions.

3. Limited availability of technologies at scale:

Given the non-economic nature of the impact, and with water being a public good, it is challenging to develop solutions that are deployable at scale and can be monetised.

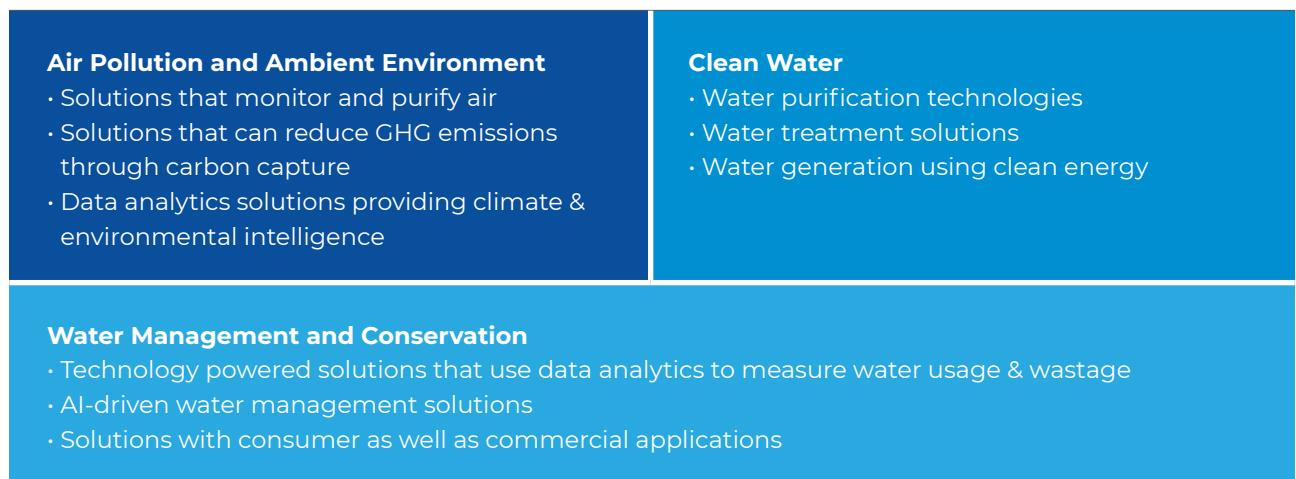
4. Limited funding availability to innovative solutions:

While certain startups are venturing into the space to help combat these problems, the limited availability of funding makes it difficult for them to scale up. A dire need of funding persists for these enterprises to invest in R&D and help make them commercially viable.

The sector is facing an urgent funding requirement to address the persistent challenges it encounters. There is no one size fits all solution and this is a sector that would witness innovations as we need more efficient answers to deal with the existing problems.

Key Investment Hypotheses:

The Environment and Natural Resources sub-sector covers a wide range of climate tech innovations with a direct impact on water, air and the ambient environment. Technologies in this space are still evolving and over a period of time may merit a separate segment analysis for each of the broad areas of impact. For the purpose of this study, we have categorised existing solutions into the following categories:

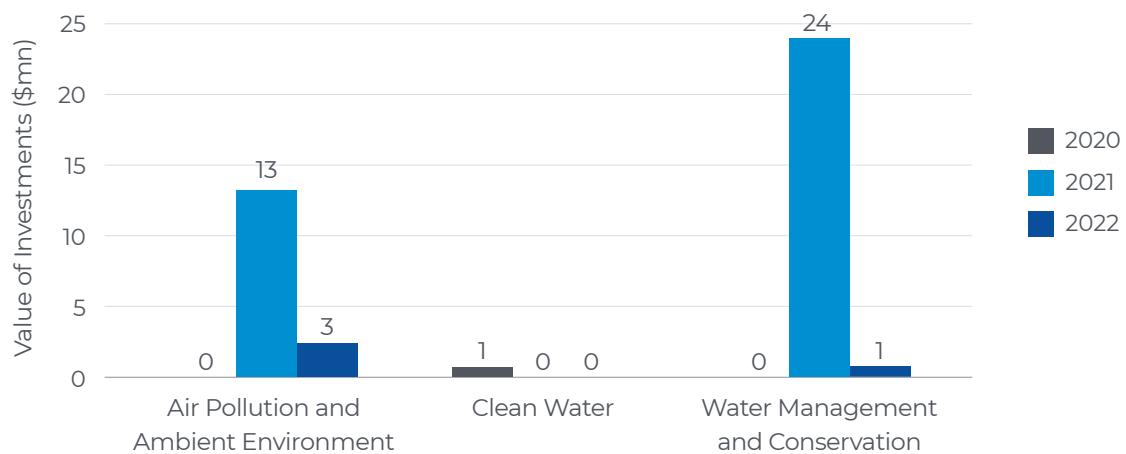


Investment Trends:

Total investments in this space reduced drastically from \$37 million in 2021 to \$4 million in 2022 i.e.a decline of ~90%. While investments in 2022 remained muted, this drastic variation is because of an unusually high-ticket size investment in 2021 - that of \$20 million in Haber

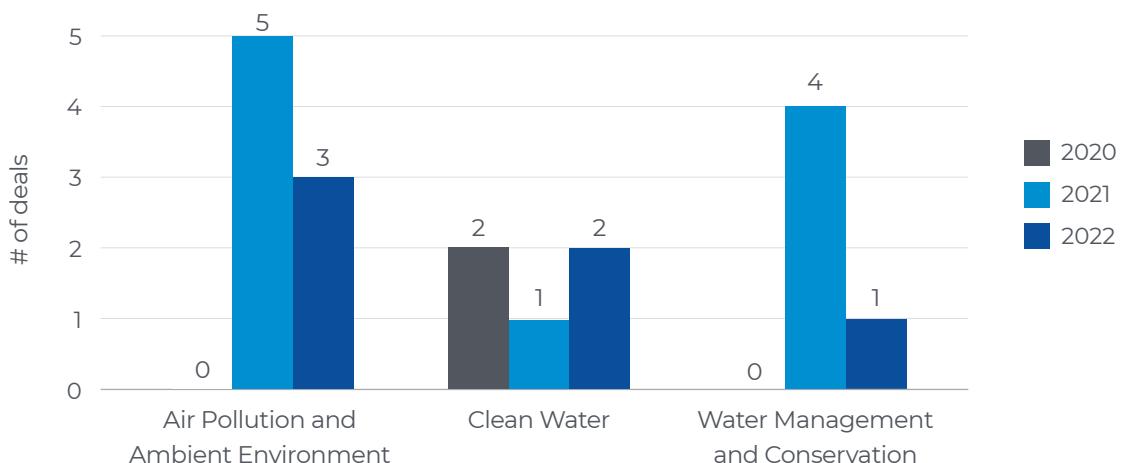
Technologies; an amount uncharacteristically high for a space that is still evolving. If we consider the growth from 2020, when the investments were at **\$0.79 million**, the space recorded a growth of **more than 100%** by 2022.

Figure 5.5.2: Investment Value (\$ mn) across Sub-segments (2020 - 2022)



Source: Authors 2023

Figure 5.5.3: Investment Volume across Sub-segments (2020 - 2022)



Source: Authors 2023

Unlike other sectors where investment trends are indicative of its growth narrative, given the wide ambit of solutions in this space as well as the evolving nature of technologies, each year presents a different picture into the kind of enterprises getting funded.

Year 2021 saw a wide range of investments both in terms of deal value as well as the stage of

funding. This included early-stage enterprises across the broad themes of focus as well as enterprises in their growth stage demonstrating a wide demand for application. In 2022, while we saw only seed-stage funding, there have been certain interesting investment trends that we observe.

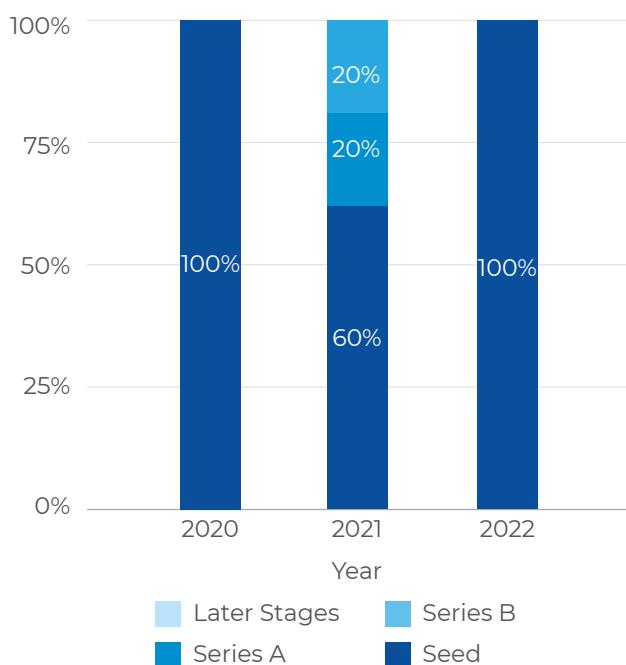
Notable Mentions		
AI drives solutions detecting water usage <ul style="list-style-type: none"> Smart water systems, water meters and data-driven water management Technology powered solutions with consumer as well as commercial application Kritsnam with its 'water budgeting' application raises \$0.8 million 	Circularity in Water Conservation <ul style="list-style-type: none"> Water treatment & recycling 'Clean' water generation - innovative patented processes to generate water through environment-friendly methods Urvavu Labs which generates water from 'air' on a growth path with follow on funding in 2022 	Deep Tech Solutions for Carbon Capture <ul style="list-style-type: none"> Solutions that control, manage & arrest air pollution Interlinkage between climate mitigation and adaptation as solutions purify air and arrest carbon generation Ecosystem collaborations to ensure accessible of 'clean air' to citizens Outdoor and indoor air purification gets a shot in the arm with enterprises like Praan and ActiveBuildings purifying the air in public spaces

While the electrification of transport systems continues to grow, it is equally necessary to not just arrest carbon generation but also sequester it from the environment. This would include air purification in closed as well as public spaces, ensuring water purification and access to a clean and sustainable ambient environment.

Over the last three years, although climate tech has witnessed significant investment volumes, **investments in the environment and natural resource space continue to be muted** in comparison to other sectors such as Energy and Sustainable Mobility. **Investment volumes have increased over the last three years, but are relatively lower than other sectors.** The high level of technology innovation, limited awareness and understanding of such solutions as well as challenges in adopting such solutions by consumers result in a high gestation period.

Such solutions, hence merit increased investment volumes as well as a **focussed investment strategy with patient capital given their high social impact.**

Figure 5.5.4: Stage-wise Contribution to Deal Flow (2020 - 2022)



Source: Authors 2023

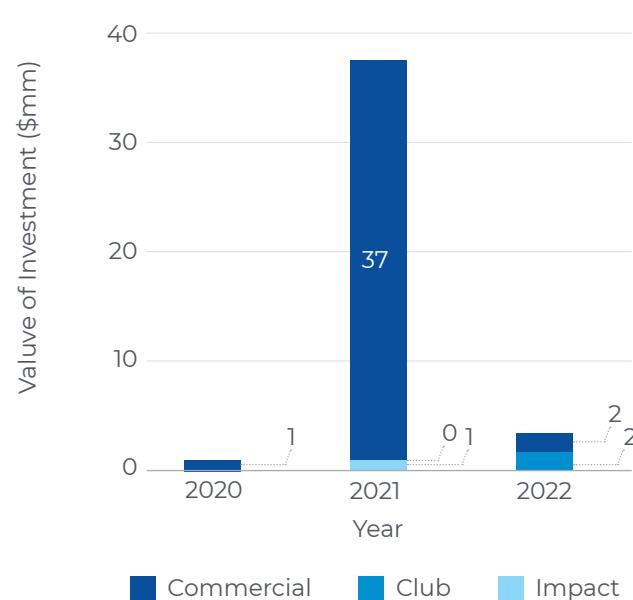
Deep tech drives innovations, creating social impact

Maximum investments continue to take place in the seed stage, given the nature of solutions that merit a high effort in researching and developing patented innovative technologies.

While most of these investments are largely in the early stages, in 2022 we saw enterprises like **Uravu Labs** and **Praan** raising follow-on funding. Over the last two years, enterprises that have raised funding beyond the seed stage include **Chakr Innovations, Haber Water Technologies, and PI Green Innovations**, wherein each of them cater to commercial applications. It was also noteworthy that these solutions operated on a **B2B model, attracting investments from commercial investors** while impact capital remained for the seed stage.

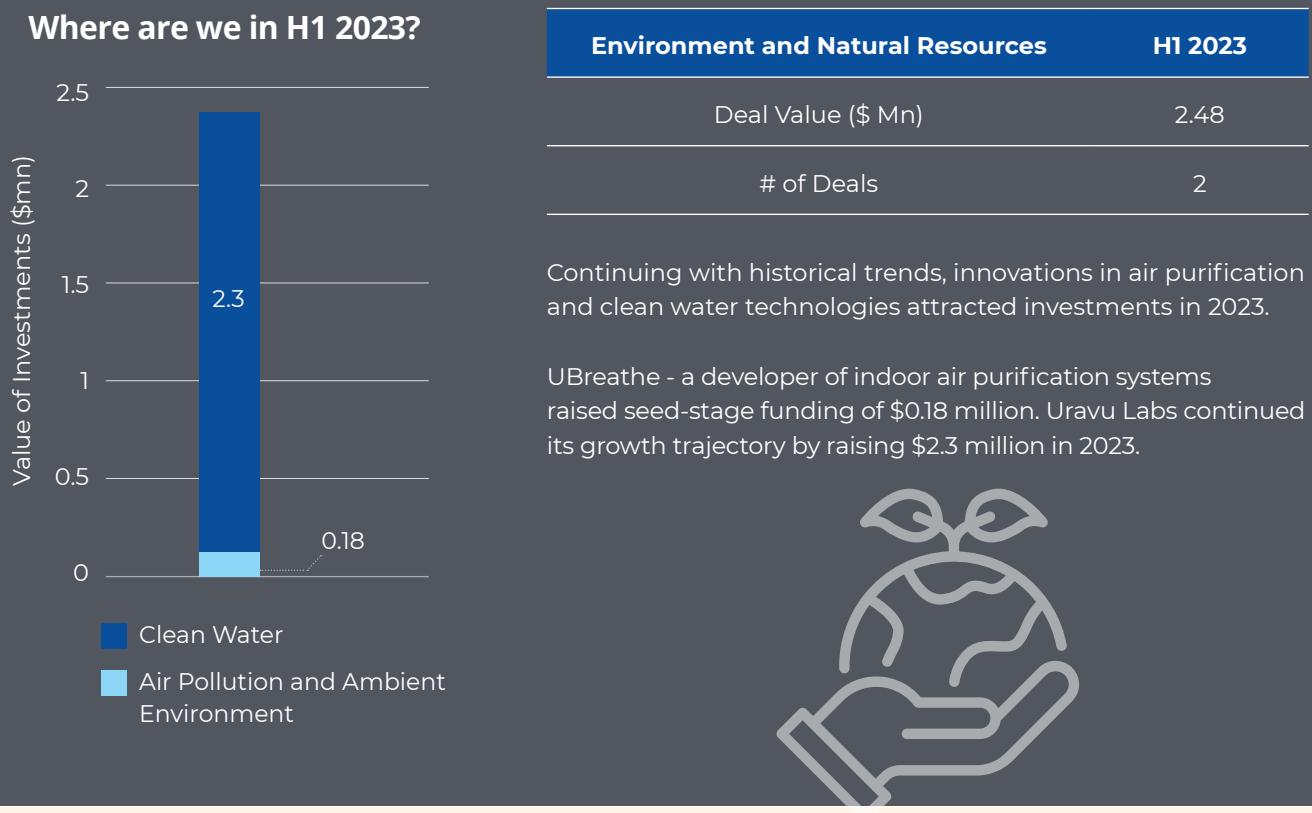
Impact investors like **Avaana Capital and Aera VC** that operate at the convergence of deep technology and sustainability made investments in an early-stage enterprise like **Praan** demonstrating the need for a **focussed investment approach to such innovations**. These investors have participated in club deals indicating the potential commercial viability of such solutions.

Figure 5.5.5: Investments (\$ mn) by Commercial, Impact, and Club Investors (2020 - 2022)



Source: Authors 2023

Figure 5.4.8: Investment Snapshot for H1 2023



Key Enablers

1. International Commitments

India's commitment to international environmental agreements and sustainable development goals is instrumental in bolstering growth within the Environment and Natural Resources sector. Alignment with the Paris Agreement and SDGs provides a clear roadmap for addressing critical environmental challenges. This alignment not only promotes the adoption of clean energy technologies but also incentivises innovations in carbon capture technologies, as well as data analytics for monitoring the quality of air and the usage of water.

2. Government Policy Support

Continued support and proactive policies from the Indian government are essential for fostering growth in the sector. Policies that incentivise clean technologies, set environmental standards, and promote sustainable practices create a conducive

environment for innovation and investment. Emission caps would require organisations to monitor their carbon footprint resulting in increased demand for data analytics solutions. Organisations would rely on data-driven insights to optimise resource allocation, monitor pollution levels, and plan effective climate action strategies.

3. Air Quality Management & Water Conservation Requirements

India's rapid urbanisation raises concerns about air quality, leading to measures like clean fuel standards and expanded public transport. This drive to combat air pollution creates opportunities for air monitoring and purification solutions. Simultaneously, water scarcity due to factors like population growth necessitates efficient water management. Technologies monitoring water use, reducing waste, and treating wastewater for clean water production are essential, ensuring a more reliable and accessible source of clean drinking water for the growing population.

Outlook:

1. Patented Technologies for increasing expertise in building Deep Tech solutions

The sector holds the potential to accelerate India's trajectory towards innovative patented solutions that have a commercial and social impact. On the heels of innovations garnering attention from commercial investors as well, we will see more solutions with economical and easy-to-scale commercially viable technologies.

2. Ecosystem partnerships for impact creation

Given the all pervasive nature of air and water purification, these solutions find application in multiple commercial and industrial applications

as well as in consumer usage. This would result in enterprises building ecosystem partnerships for the commercialisation of such technologies, paving the way for on-ground adoption of many others.

3. Increased Traction towards solutions with B2B focus

The solutions that are currently being developed in the segment will be more economical and feasible for businesses and industries to deploy. The firms that transitioned from the seed stage to Series A & B mainly cater to industrial users since industries are trying to reduce their carbon footprint. If the government imposes stringent emission caps, then these solutions would further witness increased demand among industries.





Case Study: Uravu Labs

Founded:	2017
Founders:	Pardeep Garg, Venkatesh RY, Swapnil Shrivastav, Govinda Balaji B
Total Equity Investments:	\$4.22 million
Last Funding Stage Investor:	JITO Incubation & Innovation Foundation, Rocketship, Anicut Capital, Speciale Invest, Z Nation Lab, Verso Capital, Echo River Capital, Vesta Ventures, Spectrum Impact



Business Model

Uravu Labs works to generate water from air. The production of water is powered by solar heat, waste heat of industrial sectors, and biomass waste.

millions of people. The panel can also collect rainwater, purify it and store it for later use⁷⁹.



Climate Impact

By utilising 100% renewable energy and harnessing inexhaustible atmospheric moisture, Uravu Labs' patented solution produces high-quality drinking water in a carbon-neutral manner. This process significantly reduces carbon emissions, making a substantial contribution to mitigating GHG emissions and combating climate change. Additionally, its decentralised approach to water production helps conserve traditional water resources and fosters water security for industries and communities. With scalability to produce hundreds of thousands of litres per day, Uravu Labs' technology is setting a precedent for sustainable water solutions and driving measurable environmental and social impacts, creating a more resilient and sustainable future for all.

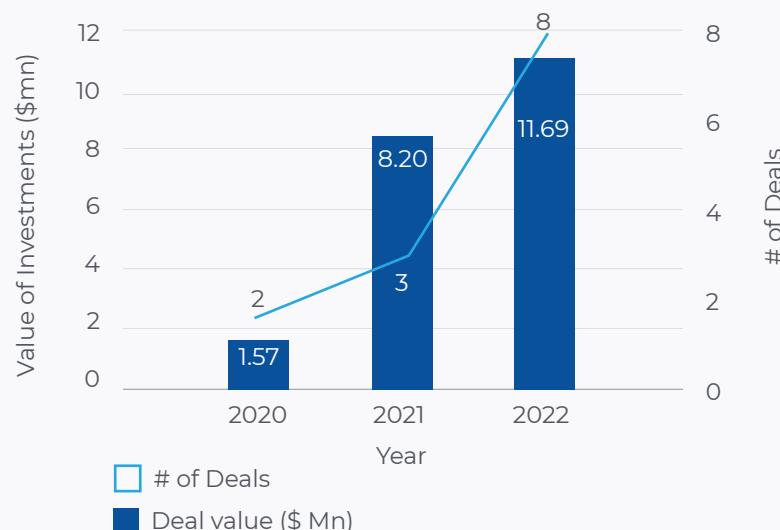


Others

Innovative climate focussed solutions which fall outside the scope of the previously mentioned sub-sectors, have also witnessed equity funding. These enterprises have collectively garnered ~\$21 million through 13 equity deals between 2020 and 2022.

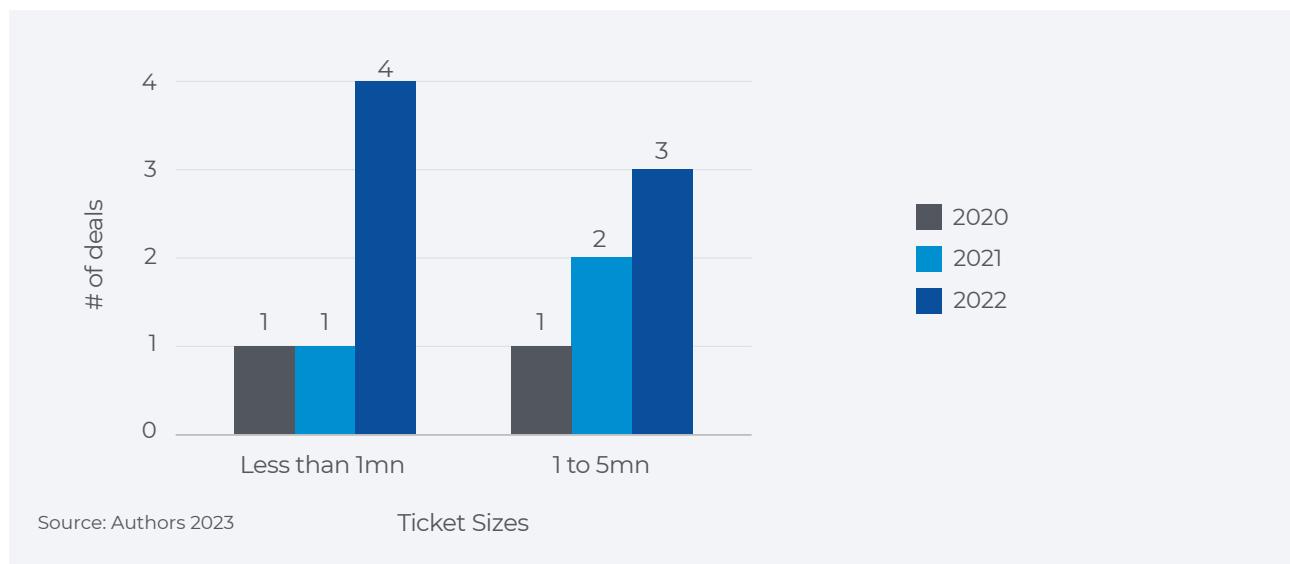
Over the past three years, alongside significant breakthrough innovations in the five core sub-sectors, we have witnessed the emergence of unique business models. These business models are leveraging technology to build **platforms for carbon accounting and trading, climate education and jobs and marketplaces for sustainable products**. Considering the **nascent stage** of some of these solutions, they are mainly supported by early stage equity investors with ticket sizes upto \$5 million.

Figure 5.6.1: Investment Value (\$ mn) and Volume (2020 - 2022)



Source: Authors 2023

Figure 5.6.2: Number of Deals across Different Ticket Sizes (2020 - 2022)



Monitoring of carbon emissions emerging as area of interest

- As the conversation around industries monitoring and controlling their carbon emissions gathers momentum, solutions that enable businesses to offset their carbon emissions will start picking up. Solutions are enabling organisations to invest in carbon offset projects enabling them to generate carbon credits that can be traded.
- Although carbon credits and trading are still nascent concepts in India we witness efforts by

enterprises like **Climes**, **TRST01** and **Varaha**, who are developing platforms for carbon monitoring, measurement and trading. These business models hold significant potential for growth as regulatory and policy frameworks around a national carbon market become clearer. These early-stage innovations are supported by prominent investors such as **Sequoia Capital**, **Kalaari Capital**, **Avaana Capital**, **Omnivore** and **HNIs**

Table 5.6.3: Emerging Business Models in 2022

Other Emerging Business Models in 2022	
Marketplace for Sustainable Products As consumer awareness of sustainable living continues to increase, enterprises like Sustainkart are emerging to create marketplaces that connect the supply and demand for sustainable products.	
Digital Platforms for Climate Education, Jobs & Investments Terra.do's platform is aimed at elevating the knowledge and expertise of the workforce towards modern climate-smart practices and fostering a community inclined towards climate action. SustVest has a crowdfunding platform for investing in green assets bringing a mainstream approach to mobilising green finance.	 

Source: Authors 2023

Figure 5.6.4: Investment Snapshot for H1 2023

Where are we in H1 2023?

In H1 2023, we see solutions driving Carbon Credits trading for organisations as they focus on assessment of their climate impact. In the first half of 2023 alone, these enterprises have collectively garnered approximately \$7 million through five equity deals.

Key Enablers

Policy and regulatory guidelines have spurred enterprises to monitor and assess their 'Environmenal, Social and Governance i.e ESG' impact thus increasing the relevance of platforms that enable this monitoring.

In conjunction as regulations come up to mitigate the risk of ESG 'greenwashing' and the Central government looks at a National Carbon Market, the private sector would require increased support to brace itself to measure, mitigate and trade its carbon footprint. A clearer

mandate on the carbon trading norms in India, sectoral mandates towards decarbonisation and regulations for ESG-related disclosures would act as very strong enablers for carbon trading and monitoring platforms.

Outlook

1. Carbon credits and trading to attract Mainstream Attention

As India strives to achieve its net-zero emission targets, carbon markets in the country will play a crucial role in achieving them. Given the growing need to offset carbon emissions, PPP structures will ensure in-building transparency, market integrity, and standardisation across carbon markets. With such partnerships in place, we can expect to see a rise in entrepreneurial and investor engagement focused on developing and supporting these solutions.

2. E-commerce for Climate Innovation

With increased consumer awareness regarding sustainable products, we can expect a surge in enterprises developing e-commerce platforms that act as digital marketplaces, enabling market linkages and financial solutions for green assets.





Case Study: Varaha

Founded:	2022
Founders:	Madhur Jain, Ankita Grag, Vishal Kuchanur
Total Equity Investments:	\$4 million
Last Funding Stage Investor:	Orios Venture Partners, Omnivore, RTP Global, Better Capital, Kunal Shah



Business Model

Varaha's tech-enabled platform generates carbon credits by incentivising carbon-neutral nature-based practices. Their projects generate credits that are meticulously vetted through machine learning (ML) algorithms, ensuring every investment results in carbon removal and creates an additional income source for smallholder farmers. With their carbon credit platform, Varaha helps companies offset their emissions and achieve their net zero emission targets by purchasing carbon credits.



Process Innovation

Varaha focusses on implementing regenerative agricultural practices among small holder farmers to improve farm productivity and incomes and also aid in carbon sequestering. After implementation, the platform provides buyers with access to reliable, trustworthy, scientific, and tamper-proof carbon credits at fair prices.



Climate Impact

Varaha promotes regenerative agriculture practices among farmers to help reduce GHG emissions and integrate themselves into the carbon trading economy. Varaha's carbon removal projects and credits, help companies meet their net-zero emission targets by purchasing high-quality carbon credits.⁸⁰





Emerging Innovations

Nexus Power

Founded: 2019

Founders: Nishita Baliarsingh, Nikita Baliarsingh

Latest Funding Stage: Seed

Last Funding Stage Investor: JITO Angel Network

Sector: Sustainable Mobility

Segment: Novel Batteries, Fuel Cells, Charging Components

Nexus Power pioneers sustainable energy storage with biodegradable batteries that are crafted from crop residue. These innovative batteries decompose naturally, reducing environmental impact. Operating on a B2B model, Nexus targets EV manufacturers and dealers, generating additional revenue from by-products like organic manure and ethanol⁸¹.

Vidyut

Founded: 2021

Founders: Gaurav Srivastava, Xitij Kothi

Latest Funding Stage: Seed

Last Funding Stage Investor: Force Ventures, Veda VC, Sujeet Kumar, Sahil Barua, Kunal Shah, Sriharsha Majety, Rajat Verma

Sector: Sustainable Mobility

Segment: Other Innovations

Vidyut aids customers in procuring EVs with an immensely competitive effective interest rate. This transformative approach addresses a substantial consumer requirement for stimulating the widespread adoption of commercial EVs. The enterprise offers two ownership plans: a hybrid financing model of a vehicle loan with a battery subscription, which is estimated to bring down the upfront EV cost by 40-50%, and a traditional term loan plan⁸².

Yulu Bikes

Founded: 2017

Founders: Amit Gupta, Naveen Dachuri, Hemant Gupta, RK Mishra

Latest Funding Stage: Series B

Last Funding Stage Investor: Magna International, Bajaj Auto

Sector: Sustainable Mobility

Segment: Clean Logistics, Fleets and Connected Vehicles

Yulu Bikes revolutionises urban mobility with its innovative last-mile connectivity solution. Offering smart, dockless bicycles by integrating GPS and IoT tech for easy access through a mobile app. Yulu's tech-driven, eco-friendly approach solves last-mile challenges while promoting environmentally conscious travel.



Exponent Energy

Founded: 2021

Founders: Sanjay Byalal Jagannath, Arun Vinayak

Latest Funding Stage: Series A

Last Funding Stage Investor: Lightspeed Venture Partners, Zone4 Capital, YourNest, AdvantEdge, Pawan Munjal Family Trust, Sukalpit Trust, Radix Business Services

Sector: Sustainable Mobility

Segment: Novel Batteries, Fuel Cells, Charging Components

Exponent Energy has developed a 15-minute rapid charging technology for EVs, enabling vehicles to be fitted with a smaller battery thus making the EVs cheaper and more accessible⁸³. Exponent uses water-based technology to cool the battery while charging which prevents overheating⁸⁴. It also makes the charging business more viable because of faster turnaround times.



Renkube

Founded: 2017

Founders: Balaji LakshmiKanth Bangolae, Deepika Gopal, Janardhana V, Lakshmi Santhanam

Latest Funding Stage: Seed

Last Funding Stage Investor: CIIIE, JITO Incubation & Innovation Foundation, Keiretsu Forum, Halliburton Labs

Sector: Energy

Segment: Energy Optimisation

Renkube presents an innovative solar panel solution that utilises patented technology to track sunlight optically, eliminating the need for servos and motors. These panels, with installation similar to traditional solar panels, require no extra maintenance beyond regular cleaning⁸⁵.



Offgrid Energy Labs

Founded: 2018

Founders: Tejas Kusurkar, Rishi Srivastava, Brindan Tulachan, Ankur Agarwal

Latest Funding Stage: Seed

Last Funding Stage Investor: Ankur Capital, APVC, Shell Technology Ventures

Sector: Energy

Segment: Energy Storage & Management

Offgrid Energy Labs, an advanced battery technology provider, pioneers advanced ZincGel Battery Technology, a standout innovation in sustainable energy storage. With more than 15 patents, its ZincGel platform overcomes environmental concerns with non-flammable, recyclable materials, and offers cost-efficient, long-lasting performance, ideal for low-powered EVs. Its modular design adapts to diverse applications, setting it apart in the evolving energy storage landscape while addressing current battery technology challenges, aligning with the growing demand for sustainable energy solutions.



iRasus Technologies

Founded: 2018

Founders: Arjun Sinha Roy, Anirudh Ramesh

Latest Funding Stage: Seed

Last Funding Stage Investor: Digital Futurists
Angel Networks, Elina Investments, Others

Sector: Energy

Segment: Energy Optimisation

Irasus Technologies, an EV data analytics startup, employs AI and ML to predict battery malfunctions in real-time, enhancing safety and longevity. It utilises cloud-based analytics to monitor battery performance and offer solutions, mitigating accidents and issues in the EV sector. Additionally, Irasus aids safe grid operations through solar photovoltaic analytics, predicting generation with available stored energy using historical and present weather data, load data, battery state data and system configurations.

ECOSTP[®] sewage to gold™ ECOSTP

Founded: 2017

Founders: E Muralidharan, Praseed K.K, Simar Kohli Das, Tharun Kumar

Latest Funding Stage: Seed

Last Funding Stage Investor: Habitat for Humanity

Sector: Environment and Natural Resources

Segment: Clean Water

ECOSTP offers a sustainable wastewater treatment solution for urban India, utilising cow dung bacteria to break down water pollutants. It targets residential property builders in the B2B market. The process involves anaerobic breakdown, filtration, and disinfection, resulting in clean water, energy-generating gas, and sludge⁸⁶.

newtrace NewTrace

Founded: 2021

Founders: Rochan Sinha, Prasanta Sarkar

Latest Funding Stage: Seed

Last Funding Stage Investor: Speciale Invest,
Micelio, Amit Shrinivas Soman, Sameer Brij Verma

Sector: Energy

Segment: Clean Energy

In an attempt to bring down the cost of green hydrogen, NewTrace has developed an innovative “membrane-less” electrolyser technology pegged to substantially reduce the cost of green hydrogen.



P R A A N®

Praan

Founded: 2017

Founders: Angad Daryani

Latest Funding Stage: Seed

Last Funding Stage Investor: Better Capital, Paradigm Shift Capital, Avaana Capital Advisors, Maulik Majmudar, Ritesh Malik, Akshay Singhal, Surya Panditi, Mehul Shah, Dhruv Chitgopekar, Ashwin Kandoi

Sector: Environment and Natural Resources

Segment: Air Pollution and Ambient Environment

Praan offers innovative outdoor air purification systems driven by AI technology, without the need for conventional filters. Their flagship product is a tall cylindrical purifier designed for outdoor use. Most air purifiers use replaceable filters, which adds to the cost and maintenance efforts. The brand's patent - filter-less technology helps the device adjust its operation based on air quality, increasing air intake and fan speed in higher pollution environments, automatically turning off in improved conditions to save power⁸⁷.



ACE Green Recycling

Ace Green Recycling

Founded: 2019

Founders: Nishchay Chadha, Vipin Tyagi

Latest Funding Stage: Series A

Last Funding Stage Investor: Circulate Capital, Climate Angels

Sector: Waste Management & Circular Economy

Segment: Waste to Value

Ace Green Recycling is building an integrated recycling process and supply chain platform for lead and lithium-ion batteries. The integrated supply chain collects end-of-life batteries from various sources, processes and recycles them using its proprietary hydrometallurgy technology. What makes this business unique is the modular recycling technology, which can be used by battery manufacturers, EV OEMs, and traditional recyclers using smelting to recycle. This modularity ensures sustainable recycling of essential battery materials and has the potential to foster collaboration across the battery value chain.



STRAWCTURE ECO
EMPOWERING SUSTAINABLE CONSTRUCTION

Strawcture ECO

Founded: 2018

Founders: Shriti Pandey

Latest Funding Stage: Seed

Last Funding Stage Investor: Social Alpha, Villgro Innovations, Brigade REAP

Sector: Waste Management & Circular Economy

Segment: Green Construction Solutions

Strawcture Eco is a B2B company that manufactures carbon-negative building products such as panels made from straw, a by-product of rice and wheat farming. It sources the straw directly from farmers, fostering the local agrarian ecosystem. This provides farmers an opportunity to earn supplementary income for a material they consider as waste. Its customers include architects, designers, consultants, contractors, and material dealers, with end-users being institutional building developers or owners.



Founded: 2018

Founders: Vaibhav Anant, Saikat De

Latest Funding Stage: Seed

Last Funding Stage Investor: Blue Ashva Capital and Angel Investors

Sector: Waste Management & Circular Economy

Segment: Sustainable Consumables

Bambrew produces eco-friendly packaging products made of bamboo, sugarcane and seaweed. It sources raw materials from indigenous communities across the country, supporting them and building their livelihoods while ensuring environmental sustainability for future generations. Its products are instrumental in replacing conventional high-pollution packaging materials with sustainable alternatives to food packaging in the F&B industry, pouches and foldable cartons in the FMCG industry, PVC (Polyvinyl Chloride) in the pharmaceutical industry, and plastic packaging in e-commerce.⁸⁸



NutriFresh

Founded: 2014

Founders: Ganesh Nikam, Sanket Mehta

Latest Funding Stage: Seed

Last Funding Stage Investor: Neev Fund

Sector: Climate Smart Agriculture & Food

Segment: Organic Farming & Products

Nutrifresh employs hydroponic farming, which involves growing nutritious, pesticide-free, and residue-free produce without the use of soil. They nurture these crops at their own farms and adhere to a comprehensive farm-to-fork approach, ensuring improved quality, transparency, and traceability throughout the entire cultivation process. The startup serves both B2B clients and B2C customers, including institutional buyers and emerging aggregators like hyper delivery and e-commerce platforms.



Phyx44

Founded: 2021

Founders: Bharath Bakaraju

Latest Funding Stage: Seed

Last Funding Stage Investor: BCG, Shiok Meats, Better Bite, PEER, Ahimsa, Spectrum Impact, and Angel Investors

Sector: Climate Smart Agriculture & Food

Segment: Alternative Proteins

Phyx44 is in the process of creating dairy product alternatives that closely mimic natural counterparts through cell-derived methods. It employs precision fermentation to generate whey and casein proteins, as well as dairy-like fatty acids, while eliminating lactose and significantly reducing the environmental footprint over conventional dairy production. Demand for its products is expected to arise from consumers looking to avoid or reduce their consumption of dairy, driven by concerns related to animal welfare, environmental impact, or lactose intolerance.



In Conclusion: What is needed?



1. Building an Ecosystem for Climate Tech Solutions

a. Market Linkages for Innovative Climate Tech Solutions

While the development of innovative technologies is crucial, it is equally important to identify customers willing to embrace these solutions. Climate tech enterprises are high on climate impact and can be greatly supported by an enabling environment that builds a readily available market for the adoption of new age technologies.

In addition to providing financial support to early-stage startups, investors and funding organisations should emphasise on extending technical guidance and mentorship for establishing tangible connections within the industry. Strong market linkages with collectives, institutional buyers, and local government authorities will enable wider and faster adoption of these solutions on the ground.

b. Technology as a lever to develop the value chain

In the realm of modern climate-focused enterprises, there is a strong emphasis on technological innovations for their product development. However, this same technology plays a pivotal role in the enhancement and optimisation of the entire value chain across multiple sectors.

Achieving climate impact merits a sustainable approach for value chain creation and enhancement in which technology plays a crucial

role. Hence, there is an imminent need for the public and private sectors to focus on developing technology stacks across sectors. This would aid in information dissemination, building transparency in processes, streamlining successful pilots and fostering ecosystem linkages.

c. Increasing awareness among consumers to build the demand

Since certain climate tech solutions are innovative and necessitate changes in end-user behaviour, it is crucial to conduct awareness programmes for end-consumers and value chain players to adopt emerging climate-smart practices. Collaborative efforts between climate tech enterprises and grassroots civil society organisations, as well as self-help groups, are vital for understanding localised needs and developing tailored awareness programmes to achieve maximum adoption of new-age practices.



2. Financing Climate Tech

a. Patient capital towards early-stage enterprises

Innovative early-stage climate tech enterprises working on solutions for climate change have a high gestation period before they witness increasing adoption on the ground. These prolonged timelines, coupled with typical Venture

Role of technology across sectors in developing the value chain



Waste Management & Circular Economy

Building traceability in the waste collection & management process, organizing the waste picker workforce, and improving efficiency.



Energy

Systems to enhance the efficiency at every step of energy production, distribution, and consumption.



Climate Smart Agriculture & Food

Real-time on-farm data for agri input manufacturers, agri focused financial institutions to develop geographic specific products.

Capital fund tenures of 10 years,⁸⁹ and innovative solutions warrant patient capital from investors.

b. Financing the missing middle

As an increasing number of enterprises expand their product offering and customer reach, there is a need for financing enterprises that are at a growth stage. For startups going from the seed stage to scaling up their operations there is a requirement for both - more number of investors supporting the 'middle' stage as well as higher ticket sizes of funding. This nature of funding can also pave the way for startups availing debt finance with impact investors playing a vital role in improving their credit access.

c. Sector-focused funds for fostering growth

Recognising the diverse nature and unique demands within the climate tech space across various sectors - a sector-focused fund with allocations for both technical guidance/advisory support and early-to-growth-stage financing can serve as a robust pillar of support. Developing a strategic sector focussed approach can build the understanding and capacity of investors to invest in solutions as they develop as well as assist enterprises with a sounder business model development.

Recognizing the diverse nature and unique demands within the climate tech space across various sectors, a sector-focused fund with allocations for both technical guidance/advisory support and early-to-growth-stage financing can serve as a robust pillar of support.

3. Fostering Innovation

An Institutionalised framework to foster development of climate tech in India

Given its high impact and urgency of action, there is a pressing need climate tech innovations

in India to be supported by an institutionalised framework that could enable financial as well as technical support to scale up such enterprises. Such a framework could pave the way for a climate tech focussed industry body or a digital open-stack that builds greater traction in investments and collaborations between stakeholders.



Sharing successful & replicable pilot programmes & innovative financing structures



Creating conducive environment for collaboration among public, philanthropic, & private stakeholders



Mobilising capital to support early-stage climate tech enterprises



Providing business model support & mentorship access to help climate tech enterprises unlock their potential at scale



4. Policy support

As the impact of climate change escalates, the Indian government has been actively shaping policies to reduce GHG emissions and advance towards a greener economy. Recent initiatives, including subsidies under the FAME scheme for EVs, guidelines for Extended Producer Responsibility (EPR) and battery waste management, the establishment of Green Hydrogen Standards and the imminent introduction of National Carbon Markets reflect India's commitment to its climate objectives and the transition to a sustainable, low-carbon future.



As the impact of climate change escalates, the Indian government has been actively shaping policies to reduce greenhouse gas emissions and advance towards a greener economy.



Vitalise transition to green and low carbon alternatives

Transition to climate smart practices by either setting and enforcing emission reduction targets to drive industries to adopt cleaner technologies and reduce their carbon footprint or through upfront subsidies or other financial incentives to transition.



Create unified taxonomy for green investments

To enhance the transparency and effectiveness of green financing strategies for commercial lenders and minimise the risk of greenwashing.



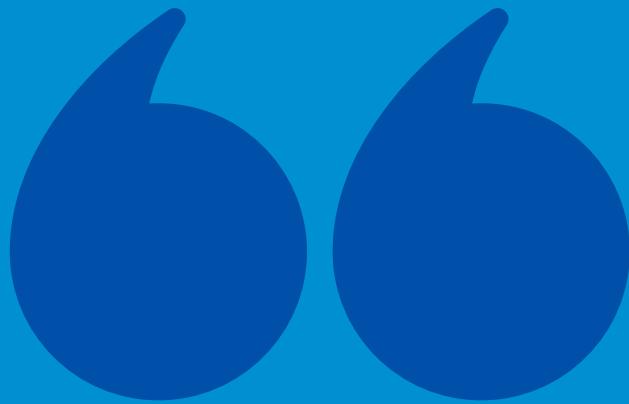
Create enabling environment for public-private collaborations

To adopt / replicate successfully piloted climate-smart low carbon innovations, support R&D on innovative climate technologies, and develop sector specific frameworks and guidelines.



Focus on R&D centres & labs to support early-stage, climate tech startups

Create labs or R&D centres to support climate tech startups with incubation support to validate solutions and build market linkages and raise capital for proof of concept.



"Many countries of the Global South are at various stages of development and climate action must be a complementary pursuit. Ambitions for climate action must be matched with actions on climate finance and transfer of technology."

Shri Narendra Modi
Prime Minister of India

Source: Press Information Bureau

Appendix 1: Glossary of Terms

The following table provides a comprehensive list of terms and their corresponding meanings used throughout the report.

Sr. no.	Term to be defined	Definition	Source
1	Air pollution	The presence of contaminant or pollutant substances in the air that do not disperse properly and that interfere with human health or welfare or produce other harmful environmental effects.	http://data.un.org/Glossary.aspx?q=air+pollution#:~:text=the%20presence%20of%20contaminant%20or,produce%20other%20harmful%20environmental%20effects.
2	Angel Investors	Angel investors predominantly invest in pre-seed or seed funding rounds in early-stage or start-up companies in exchange for an equity ownership interest.	https://www.investopedia.com/terms/a/angelinvestor.asp#:~:text=An%20angel%20investor%20provides%20initial,an%20entrepreneur's%20family%20and%20friends.
3	Circular Economy	The circular economy is a system where materials never become waste and nature is regenerated. Products and materials are kept in circulation through processes like maintenance, reuse, refurbishment, remanufacture, recycling, and composting.	https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview
4	Climate-Smart Agriculture	Climate-smart agriculture (CSA) is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support the development and ensure food security in a changing climate.	https://www.fao.org/climate-smart-agriculture/en/
5	Carbon Markets	Carbon markets aim to reduce greenhouse gas emissions enabling the trading of emission units (carbon credits), which are certificates representing emission reductions. Trading enables entities that can reduce emissions at a lower cost to be paid to do so by higher-cost emitters.	https://www.indiancarbon.org/the-carbon-credit-market/
6	Climate tech	Climate tech includes low-to-negative carbon approaches by leveraging technology across industries along with cross-cutting aspects such as carbon capture/storage, historically known as "clean tech" in investor terminology.	https://www.pwc.com/jg/en/ghost-templates-jg-en/pwc-the-state-of-climate-tech-2020.html

Sr. no.	Term to be defined	Definition	Source
7	Clean Energy	In this study, we categorise all energy types as 'Clean Energy,' which includes renewable and green energy sources like wind, solar, geothermal, hydropower, tidal energy, and emerging options such as green hydrogen.	https://world-nuclear.org/information-library/energy-and-the-environment/renewable-energy-and-electricity.aspx
8	Energy access	Refers to household access to clean and sustainable energy for cooking, heating, and electricity, supporting economic activities, and providing energy for public services like healthcare and education	https://www.who.int/health-topics/energy-and-health
9	Energy efficiency	Energy efficiency simply means using less energy to perform the same task – that is, eliminating energy waste.	https://www.peakventures.in/energyefficiency#:~:text=Energy%20efficiency%20simply%20means%20using,household%20and%20economy%2Dwide%20level.
10	Energy storage	Energy storage captures and delivers energy for future use, improving power quality and reliability through various methods, including mechanical, electrical, chemical, electrochemical, and thermal storage.	https://www.blackridgeresearch.com/blog/all-you-need-to-know-about-an-energy-storage-system-ess-components-technologies-benefits-risks-applications-bess-battery-energy-storage-system
11	Environment and Natural Resources	Natural and environmental resources encompass elements from nature used or usable in the economy, including physical resources like soil, water, forests, minerals, gasses, and abstract resources like landscapes, clean air, and water.	https://www.nationalgeographic.org/article/conserving-earth/
12	GHG emissions	Greenhouse gas (GHG) emissions include gasses like CO ₂ , CH ₄ , N ₂ O, CFCs, HFCs, PFCs, SF ₆ , and NF ₃ , contributing to global warming	https://www.europarl.europa.eu/news/en/headlines/society/20230316STO77629/climate-change-the-greenhouse-gases-causing-global-warming#:~:text=Fluorinated%20greenhouse%20gases%20(F%2Dgases,an%20Nitrogen%20trifluoride%20(NF3).
13	Green finance	Green financing is to increase the level of financial flows (from banking, micro-credit, insurance, and investment) from the public, private and not-for-profit sectors to sustainable development priorities.	https://m.economictimes.com/industry/renewables/world-earth-day-what-is-green-finance-and-why-do-we-need-it-so-much/articleshow/99688450.cms#:~:text=What%20is%20green%20finance%3F,the%20United%20Nations%20Environment%20Programme.

Sr. no.	Term to be defined	Definition	Source
14	Climate Finance	Climate finance refers to local, national or transnational financing—drawn from public, private and alternative sources of financing—that seeks to support mitigation and adaptation actions that will address climate change.	https://unfccc.int/topics/introduction-to-climate-finance
15	Impact investing	Impact investments aim for positive social and environmental outcomes while also generating financial returns. They can be made in various markets and offer different return rates based on investor objectives.	https://thegiin.org/impact-investing/need-to-know/
16	Private Equity	Private equity (PE) involves investors buying illiquid equity in private companies, often taking ownership stakes.	https://www.investopedia.com/articles/financial-careers/09/private-equity.asp#:~:text=Private%20equity%20is%20ownership%20or,delist%20them%20from%20stock%20exchanges.
17	Upcycling	Upcycling transforms used materials into higher-value products, reducing resource consumption and promoting sustainability.	https://www.researchgate.net/publication/299559229_A_Review_on_Upcycling_Current_Body_of_Literature_Knowledge_Gaps_and_a_Way_Foward
18	Startup	Startups are innovative, young companies that introduce unique products or services to the market, disrupting established industries.	https://www.forbes.com/advisor/business/what-is-a-startup/
19	Sustainable Mobility	Sustainable mobility focuses on infrastructure and services for equitable, safe, efficient, and climate-responsive movement of goods and people.	https://www.worldbank.org/en/news/feature/2017/07/10/sustainable-mobility-for-the-21st-century
20	Venture capital	Venture Capital (VC) firms invest in the private securities of operating companies. VC firms are known for investing in early-stage companies that are typically riskier in nature than the investments made by their Private Equity counterparts.	https://www.svb.com/startup-insights/vc-relations/what-is-venture-capital

Sr. no.	Term to be defined	Definition	Source
21	Waste management	Waste Management activities encompass waste collection, treatment, disposal, monitoring, regulation, and waste prevention through reuse and recycling.	https://www.conserve-energy-future.com/waste-management-and-waste-disposal-methods.php#:~:text=%E2%80%9CWaste%20management%20or%20Waste%20disposal,together%20with%20monitoring%20and%20regulation.
22	Water pollution	Water pollution is the contamination of water sources by substances which make the water unusable for drinking, cooking, cleaning, swimming, and other activities.	https://www.hsph.harvard.edu/ehep/82-2/#:~:text=Water%20pollution%20is%20the%20contamination,make%20their%20way%20to%20water.
23	Carbon capture and management	Carbon capture, utilisation, and storage (CCUS), captures and repurposes carbon dioxide emissions, including other GHGs, to create new products or store them, mitigating their release into the atmosphere	https://www.lse.ac.uk/grantham-institute/explainers/what-is-carbon-capture-and-storage-and-what-role-can-it-play-in-tackling-climate-change/#:~:text=What%20is%20carbon%20capture%2C%20usage%20and%20storage%20(CCUS)%3F,CO2%20from%20the%20atmosphere.
24	Climate mitigation	Mitigation involves reducing emissions and increasing carbon sinks like forests to address climate change	https://unfccc.int/topics/introduction-to-mitigation
25	Climate adaptation	Adaptation involves making adjustments in response to climate-related changes, including modifying practices to reduce potential harm and seize opportunities presented by climate shifts.	https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction#:~:text=Adaptation%20refers%20to%20adjustments%20in,opportunities%20associated%20with%20climate%20change.
26	Climate resilience	Climate resilience is the capacity to anticipate, prepare for, and respond to climate-related hazards, including assessing and mitigating new or changing risks.	https://www.c2es.org/content/climate-resilience-overview/#:~:text=Climate%20resilience%20is%20the%20ability,better%20cope%20with%20these%20risks.
27	Family Office	A family office is an ecosystem built by a family to manage their assets and various lifestyle needs, including financial investments, business transactions, philanthropic endeavours, and household management.	https://kpmg.com/xx/en/home/insights/2019/11/the-emergence-of-the-family-office.html

Appendix 2: Investor Classification

To facilitate our analysis of capital sources and gain insights into investor participation, we have categorised the deals into three groups based on the investor types involved:

Impact deals: These are investments by capital providers who state that their primary objective is to create social impact along with financial returns. This includes impact investors, foundations, Development Finance Institutions (DFIs) etc.

Commercial deals: These are investments by capital providers who focus solely on financial returns, with impact being an ancillary agenda, if at all. This includes VCs, PEs.

Club deals: These are co-investments that include both types of capital providers - impact and commercial. For example, if an impact investor co-invests with a commercial VC, the investment will be classified as a club investment.

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