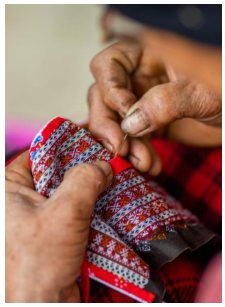
GEARING UP THE INDIAN WORKFORCE FOR A GREEN ECONOMY

Mapping Skills Landscape for Green Jobs in India








SATTVA
Delivering High Impact.

SCGJ
SKILL COUNCIL FOR GREEN JOBS
ISO 9001 : 2015 CERTIFIED

Supported By
J.P.Morgan

CREDITS

AUTHORS	Palagati Lekhya Reddy, Sukhada Ghosalkar, Satyasai Tatavarti, Ashwini Rajkumar of Sattva team
RESEARCH TEAM	Bhavin Chhaya, Ishani Dave, Vrinda Chaturvedi, Kriti Jain, Abhishek Sood, Khushi Nilani, Sahana Keshav
RESEARCH PARTNERS	Deepak Rai and Dr. Praveen Saxena of Skill Council for Green Jobs (SCGJ)
RESEARCH ADVISORS	Maneesha Chadha and Sourabh Anand of J.P. Morgan Nidhi Bali, Rathish Balakrishnan, Bobbymon George of Sattva Consulting

DISCLAIMER

This report has been produced by a joint team from Sattva Consulting, and Skill Council for Green Jobs (SCGJ), with support from J.P. Morgan. The authors take full responsibility for the content and conclusions. The participation of the industry experts and affiliates who were consulted and acknowledged here, does not necessarily imply endorsement of the report's content or conclusions. To quote this report, please use the following reference: Sattva Consulting, Skill Council for Green Jobs, supported by J.P. Morgan, Gearing up the Indian workforce for a Green Economy, May 2023. Use of visuals from the report must fully credit the respective copyright owner where indicated. Reproduction must be in original form with no adaptions or derivatives.

The images used in this report belong to the authors, with the consent of the individuals photographed. They are subject to the laws of copyright and intellectual property. This work is licensed under the Attribution-Non-Commercial-Share Alike 4.0 International License:

Attribution: You may give appropriate credit, provide a link to the licence, indicate if any changes were made.

Non-Commercial: You may not use the material for commercial purposes.

ShareALike: If you remix, transform, or build upon the material, you must distribute your contributions under the same licence as the original

TABLE OF CONTENTS

Foreword 4

Executive Summary 6

Chapter 1: India's big opportunity to drive skill development for green jobs 12

Chapter 2: Renewable energy 23
Powering energy security through workforce maturity

Introduction to Renewable Energy
2.1. Solar Energy
2.2. Wind Energy
2.3. Bioenergy
2.4. Green Hydrogen

Chapter 3: Waste Management 51
Value creation through formalisation

Introduction to Waste Management
3.1. E-Waste Management
3.2. Wastewater Management

Chapter 4: Green transitions in key traditional industries 63
Creating a climate-positive workforce

Nature of Green transitions occuring in traditional industries
4.1. Electric Vehicles
4.2. Sustainable Textiles and Apparels
4.3. Green construction

Chapter 5: Accelerating green skill development 88

References 92

FOREWORD

अतुल कुमार तिवारी, भा.प्र.से.
सचिव
Atul Kumar Tiwari, IAS
Secretary

सत्यमेव जयते

भारत सरकार
कौशल विकास और उद्यमशीलता मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
AND ENTREPRENEURSHIP

FOREWORD

Investing in skilling, within the rapidly growing green business sector, is crucial to power our country's transition towards green and sustainable economy. It is also essential to ensure equal opportunities particularly to those whose livelihood are currently tied to traditional sectors which would undergo changes due to transition to a green and climate-resilient economy. It would require high quality, industry-relevant training nation-wide supported by resilient and robust network of trainers and training partners equipped with necessary infrastructure. Along with transformative measures such as New Education Policy and National Credit Framework, both of which aim to bridge the gap between education, skilling and industry; targetting skill interventions would be key to position India as a global hub and growth engine. It is in this context that I welcome the report titled "Gearing up the Indian Workforce for a Green Economy", which maps the green jobs landscape and provides valuable insights into India's journey to green growth, identification of skill requirements and to prepare our workforce for future green jobs.

I congratulate all the stakeholders who provided their inputs for this Report and for the associated analysis, which augurs well for shaping the green and self-reliant India.

(Atul Kumar Tiwari)

Skill India
कौशल भारत-कुशल भारत

कमरा नंबर 524, पांचवा तल, श्रम शक्ति भवन, रफी मार्ग, नई दिल्ली - 110 001
Room No. 524, 5th Floor, Shram Shakti Bhawan, Rafi Marg, New Delhi - 110 001
Tel. : 011-23465833, 23465834, Fax : 011-23465837, E-mail : secy-msde@nic.in
Website : www.skillindia.gov.in

आज़ादी का अमृत महोत्सव

EXECUTIVE SUMMARY

India is emerging as one of the world leaders in green growth and has the potential to unlock $1 trillion in value by 2030 and $15 trillion by 2070.[1]

The country has outlined a bold roadmap for its own transformation over the next few decades, while influencing the global narrative on green growth. Internally, the government is driving several initiatives across energy generation, transportation, and manufacturing. This has reflected in the increasing capital flow towards initiatives promoting green growth. In FY22 alone, India witnessed a record-high investment of $14.5 billion in renewable energy, representing a 125% increase from the previous year. Furthermore, major policy reforms such as the Production Linked Incentives (PLI) schemes are set to boost local manufacturing of green products.

Globally, India's G20 presidency has come at a time when global leaders are facing the impact of multiple interconnected crises. India's emphasis on LiFE (Lifestyle for Environment) Mission focused on sustainable living, "Panchamrit", the government's five-step plan to achieve net-zero emissions, and India's steering of global initiatives such as the International Solar Alliance offer a unique leadership role for the country to shape the global direction on green growth.

Together, these trends have the potential to help India unlock $1 trillion in value by 2030 and $15 trillion by 2070 in its pursuit to be a climate positive economy.

India has the potential to create 35 million green jobs by 2047.[2] Strengthening the skill ecosystem consistently and equitably will ensure a just transition, leaving no vulnerable groups behind.

The promised green growth is an opportunity to create meaningful livelihoods for a large population through two interconnected strategies. Firstly, India should leverage the global need for skilled human resources to help India and other countries achieve the net-zero targets. Secondly, India should ensure just transitions for labour in traditional industries that are impacted due to these shifts.

India entered the demographic dividend opportunity window in 2005-06 and will remain there until 2055-56. India's working-age population as a share of the total population is expected to reach its highest level of 69% by 2030. [3]

The promised green growth is an opportunity to not only build the human potential to help India achieve its net-zero targets but also to contribute to the global need for talent to address the emerging crisis.

At the same time, as workforce demand undergoes shifts alongside rapid churn in the economy, ensuring just transitions across traditional sectors is critical. This includes establishing spaces for social dialogue at the workplace, adhering to labour standards and human rights, ensuring broad-based skill development, providing social protection and safety nets, and ensuring a special focus on small and medium-sized enterprises along supply chains. This will help mitigate any negative impacts due to the green transitions.

Renewable Energy, Waste Management, Electric Vehicles, Sustainable Textiles, and Green Construction will drive green growth in India and host the highest number of green jobs, especially in urban and peri-urban areas.

India is the fourth-highest contributor to renewable energy globally and has set ambitious targets to generate 50% of cumulative electricity requirements from renewables by 2030.[4] While the entire renewable energy sector is experiencing rapid growth, solar energy, wind energy, and bioenergy are the major drivers. In addition, the emphasis on green hydrogen will grow in the coming years, as evidenced in the 2023 Union Budget.[5] In terms of job growth, solar energy is projected to host 3.26 million jobs by 2050,[6] followed by wind energy, which is expected to support 0.18 million jobs by 2030.[7] Moreover, the bioenergy and green hydrogen sectors are predicted to create 0.27 million and 0.6 million green jobs by 2030, respectively.

India's waste management needs are growing due to rapid industrialisation, urbanisation and increasing consumption. With 60% of the country's population expected to live in urban areas by 2050,[8] the amount of waste generated is projected to increase by around 4% annually. However, currently, only 28% of waste in the country is treated.[9] E-waste and wastewater management are two of the largest and most lucrative sectors in waste management. Managing e-waste is estimated to create 0.5 million formal jobs in India by 2025,[10] while wastewater management sector, which currently employs 0.71 million people, is anticipated to require a large number of skilled workers in the next decade.

With regards to green transitions in traditional industries, more than 138 Indian companies have committed to achieving net-zero emissions by 2050. The automotive, construction, and textile sectors are leading the way in India's green transition, through electric vehicles (EVs), green construction, and sustainable textiles and apparel. The growth of EVs is expected to create 10 million direct and 50 million indirect jobs by 2030[11], offering an opportunity not only to hire new workers but also to upskill and integrate the existing 35 million Internal Combustion Engine (ICE) workforce.[12] The future of sustainable textiles provides an opportunity to further just transitions for 45 million textile workers in India.[13] Approximately 11 million jobs in the construction sector are predicted to be affected by 2030 due to sustainability transitions.[14]

Although the demand for emerging green jobs is expected to grow, the ecosystem that supports the development of the required skillsets is currently nascent and gaining momentum slowly.

To leverage the green growth opportunity, India needs to establish a scalable skill infrastructure to ensure high quality training and generate wider awareness about these job opportunities through targeted campaigns.

Currently, Skill Council for Green Jobs (SCGJ) and Green Skill Development Programme (GSDP), have collectively trained around one million candidates for opportunities related to green growth.[15] Despite the efforts being made by over 500 government and private training institutes, there is still a significant need to increase the number of candidates trained to achieve green growth at a faster pace. Several systemic challenges must be addressed to accelerate the skill-building efforts. These barriers include lack of policies for green skill development, funding gaps, inadequate skill infrastructure, exclusion of vulnerable groups, and lack of collaboration among key actors.

A survey conducted among 2,328 candidates across five metro cities as part of this study revealed that 85% of them had heard about 'green' or climate-positive jobs. However, this percentage significantly dropped to 35% across all sectors when they were asked about specific job roles in the sector or their awareness of skill-building programs for the same. Hence, investments in awareness and translating awareness to action is critical.

Given the nascency of the skills ecosystem, vis-à-vis the growing demand for green jobs, there is an urgent need to enable green skill development in India. Philanthropy can take five big bets to address skill-building needs and propel the country's transition to a green economy.

1. **Reskill and upskill existing workforce**
   Enabling existing workforce to adapt to changes in jobs due to greening
2. **Train entry-level workforce**
   Training incoming youth to meet the demand for new green jobs
3. **Support entrepreneur-led models**
   Creation of self-employment that can amplify job opportunities
4. **Foster Diversity and Inclusion**
   Ensuring diversity and inclusion in skill-building and jobs in the process of greening the economy
5. **Formalisation and decent jobs**
   Ensuring safety and social protection in the existing jobs

Across the high-growth sectors, philanthropic capital can support the following big bets to set the pace for India's green growth. An assessment of projected jobs, workforce aspirations, presence of policy/industry tailwinds, and maturity of skill infrastructure within each sector call out for these big bets.

Solar Energy	Upskill existing workforce across the solar value chain to meet industry demands	Train entry-level workforce in solar component manufacturing roles	Train women and PwD to enable diversity & inclusion
Wind Energy	-	Upskill O&M workers through mass adoption of existing O&M courses to meet demand for automation	Train entry-level workforce in wind manufacturing job roles by leveraging ITIs
Bioenergy (Biofuels)	Establish a distributed network of entrepreneur-led feedstock collectors	-	Train entry-level workforce for installation, production and O&M roles by collaborating with ITIs
Green Hydrogen	Reskill workforce from other sectors for job roles across the green hydrogen value chain	-	Train entry-level workforce in electrolyser manufacturing and installation roles
E-Waste Management	Train entry-level workforce to create a strong cadre for safe recovery, recycling, refurbishment roles	-	Upskill existing workforce in collection and segregation value chain segments
Wastewater Management	-	Skill ETP workforce across various industry sectors	Train entry-level workforce in emerging ETP/STP manufacturing by leveraging ITIs
Automotive (Electric Vehicles)	Train entry-level workforce for battery manufacturing and charging infrastructure roles by leveraging ITIs	Skill and enable transition of existing ICE workforce to EV, specifically EV assembly and manufacturing	Establish network of women entrepreneur-led after sales services and charging centres
Textiles & Apparel (Sustainable Textiles)	Institutionalise entry-level training of textile-waste workers on safe disposal, recovery, and recycling	Skill existing and entry-level workforce on sustainable textile production techniques, especially in sustainable fabric construction and apparel making.	
Construction (Green Construction)	Upskill existing construction workers towards green construction	Accelerate innovation in sustainable sourcing through skilled talent and market access	Upskill waste workers for disposal of construction and demolition waste

The report further provides a deep view of each sector, critical value chain segments, emerging green job roles, and detailed action steps.

CHAPTER 1

INDIA'S BIG OPPORTUNITY

TO DRIVE SKILL DEVELOPMENT FOR GREEN JOBS

Understanding green growth, the demand for green jobs, the need for training, and the role philanthropy can play in India's journey towards a green and sustainable economy through skill-building.

1.1. Introducing the Green economy paradigm

The green economy paradigm aims to address the twin goals of mitigating the climate crisis and providing an engine for economic growth and job creation.

Climate change is impacting economies and societies worldwide. According to the Intergovernmental Panel on Climate Change (IPCC) in 2021, unless there are immediate, rapid, and large-scale solutions to reduce greenhouse gas emissions, limiting global warming to 1.5°-2°C (Celsius) will be beyond reach.[16] To address this challenge, there is a need for a fundamental shift towards a paradigm that can combine the twin goals of preserving natural resources by reducing emissions and paving the way for economic growth and job creation.

A green economy is an economic model that aims to reduce the impact of production and consumption on the environment while also creating a virtuous relationship between economic growth and environmental wellbeing.[17] It extends beyond emission reduction to focus on building the capacity to adapt to climate change, developing circular value chains, reducing material consumption, and thus, decreasing waste generation. A green economy has the potential to provide financial and social benefits by fostering greater prosperity, boosting local growth and innovation, and encouraging competitiveness while enabling an inclusive society. [18]

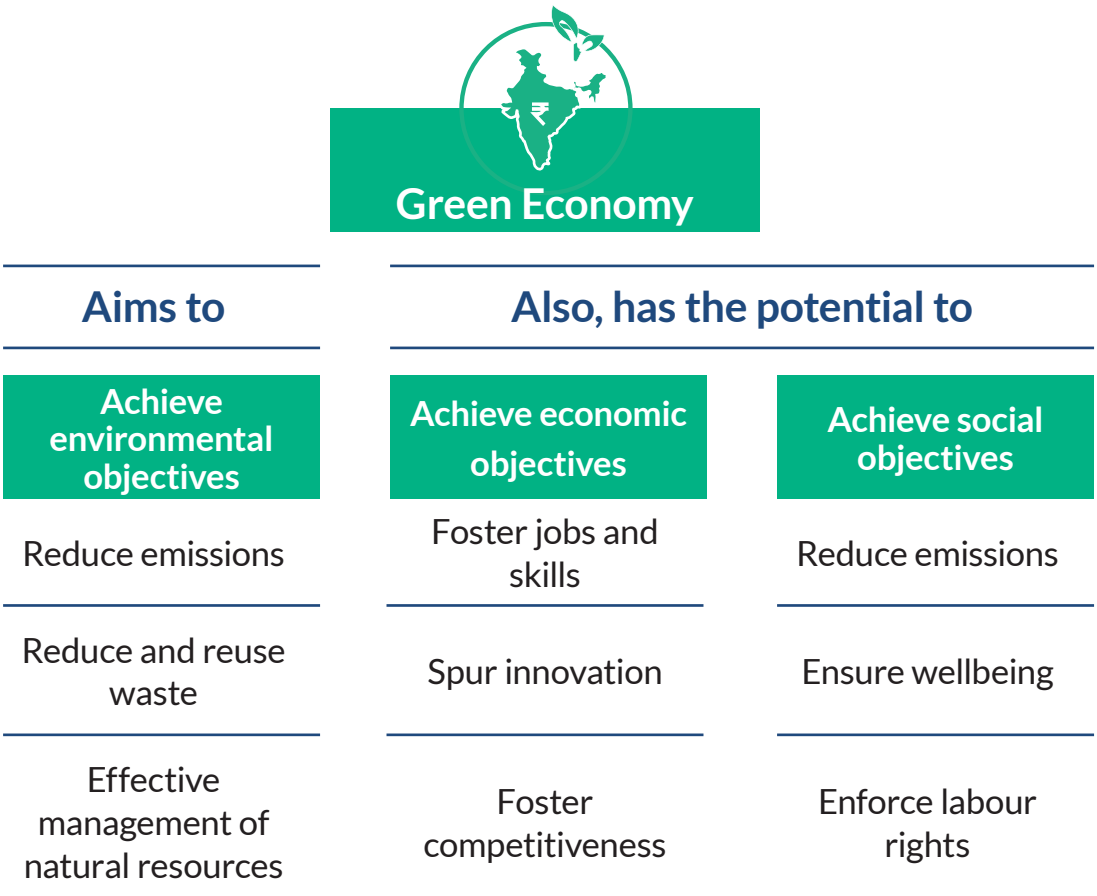


Fig. 1 | Objectives of a Green Economy

Transition to green economy is projected to contribute $10.3 trillion to global GDP, accounting for 5.2% of the global GDP by 2050.[19]

Enterprises developing and producing green goods and services are estimated to generate a value of $4 trillion, which could be further amplified by $6.3 trillion, backed by their ancillary supply chains. Renewable energy and electric vehicle manufacturing are the two key drivers behind this opportunity across the world, generating a value of over $8 trillion.[20] The transition to a green economy can potentially unlock trillions of dollars of economic value and bring other positive outcomes to the environment.

The 2021 United Nations Climate Change Conference (COP26) focused on uniting efforts to build the much-needed resilience against climate change. Participating nations reaffirmed their responsibility to fulfil the pledge of sourcing $100 billion annually from developed countries and redirect it to developing countries. They also collectively agreed to work towards bridging the gap between existing emission reduction plans and the required norms to limit the rise in global average temperature to 1.5° C by 2030.[21] With 135 countries committing to net-zero targets,[22] there has been a surge in green growth policies and investments. In 2022, renewable energy investment reached a milestone by matching fossil fuels at $1.1 trillion for the first time.[23] Moreover, a growing number of companies worldwide are prioritising climate mitigation, which is evident through the adoption of mandatory reporting on Environmental, Social, and Corporate Governance (ESG).

Green economy presents an opportunity to increase green skills intensity and create economic opportunities through this transition

Green skills intensity refers to the extent to which different countries, sectors, and jobs incorporate green skills.[24] The higher the green skills intensity and more the number of green jobs, the smoother will be the green transition of the economy. Over the last few years, there has been a steady increase across green skills intensity and the number of green jobs. In 2019, for example, hiring for green jobs edged ahead of the overall hiring rate in most economies, indicating a high demand. At the same time, the share of green talent in the global workforce increased from 9.6% in 2015 to 13.3% in 2021, with an annual growth rate of 6% and a cumulative growth rate of 38%. [25]

However, studies indicate that a limited pool of green talent and lack of avenues for developing green skills could impede the pace of green transitions. The existing workforce and the emerging workforce entering the job market must be equipped with critical skillsets to help them adapt to changing standards across sectors. The need for avenues to build green talent is also seeing an increased buy-in from industry players given the need to adhere to regulatory practices, invest in innovation and support skill-building of their existing workforce.

1.2. But what are Green Jobs?

> **ILO defines green jobs as "decent jobs that contribute to preserving or restoring the environment, whether in traditional sectors like manufacturing and construction, or in new, emerging green sectors such as renewable energy and waste management"[26]**

Globally, various studies and organizations have defined and measured 'green jobs' differently, with the most common requirements being to help achieve resource use efficiency, reduction of pollution and waste, and preservation of natural resources. According to the SCGJ, 'green jobs' refer to a class of jobs that directly have a positive impact on the planet and contribute to overall environmental welfare. These are jobs that seek to use or develop renewable forms of energy, conserve resources, ensure energy efficient means, regulate waste management, and promote sustainable development. These jobs seek to enforce regulations, support education and training, and increase public influence for benefit of the environment.

For the purpose of this study, we define green jobs as being at the intersection of decent work opportunities and environmental sustainability.[27] Green Jobs needs to be employed in the context of a just transition towards sustainable development.[28]

What are green jobs?

Green jobs are decent jobs* that preserve or restore the environment either in new green sectors such as renewable energy or in conventional sectors such as manufacturing

What are not green jobs?

Employment in roles that are extractive by character, harming the environment and/or do not involve protecting the environment through day-to-day responsibilities, and have exploitative/ harmful working conditions or don't pay a living wage, amongst other labor concerns

A "just transition" can accelerate the shift to an environmentally sustainable economy while promoting socially equitable labour practices.

In 2015, the Paris Agreement recognised the importance of considering the interests of workers and communities to ensure that net-zero transitions enable decent work and quality jobs. Extensive evidence suggests that creating a net-zero economy offers immense potential to generate more and better jobs, thereby enabling just green transitions.[29]

A 'Just Transition' means greening the economy in a way that creates decent work opportunities, and leaves no one behind. Assumptions of this definition include creating a process that:

- Amends operations and derived outcomes to be equitable
- Redresses the past harms experienced by vulnerable groups and communities
- Warrants economic and social agency for all

Just transitions in an Indian context should consider aspects such as establishing spaces for social dialogue at the workplace, promoting labor standards and human rights, facilitating economy-wide skill development, ensuring skill-building of existing workforce, and providing social protection and safety nets. Additionally, special attention needs to be given to small and medium-sized enterprises across supply chains and regional economies.[30]

1.3. Green growth in India

India has the potential to unlock $1 trillion value by 2030, and $15 trillion by 2070, on its path to net-zero transition.[31]

India is emerging as the one of the fastest growing economies worldwide and is the sixth largest economy globally. At 2.4 tCO2e (tonne carbon dioxide equivalent), India's per capita greenhouse gas emissions is below the world average of 6.3 tCO2e, as of 2022.[32]

India has committed to achieving net-zero by 2070 and released a low-carbon development strategy. In line with the strategy, India has established targets to reduce one million tons of CO2 emissions by 2030 and has also outlined various government targets and policies. These initiatives are fostering increased investments in the industry to propel India's rapid transition towards becoming a thriving green economy.

There is a tangible opportunity to mitigate climate risk in India.

50% of India's energy requirement
is targeted to be met with renewable energy by 2030.[I]

45% reduction in CO2 emissions intensity
by shifting to targeted renewable energy by 2030.[II]

4.7% increase in GDP expected
by achieving Net-zero carbon emission target by 2070.[III]

In the current 2023 budget, India has allocated $277.2 million of priority capital investment towards achieving net-zero emissions by 2070. A clean energy transition plan has also been announced to ensure the country's energy security. $1.1 billion have been earmarked annually as per the 2023 budget for Production Linked Incentives (PLI) schemes across 13 key sectors to promote green transitions.[33]

Viability gap funding and other direct and indirect subsidies such as tax rebates in specific sectors like EV purchasing are also creating traction for green practices.[34] Such initiatives could facilitate the much-needed steady decarbonisation of Indian industries, reduce dependency on fossil fuel imports, establish market leadership, and encourage consumers to adopt sustainable products and services. Sovereign Green Bonds, which were introduced in the 2022-23 budget as a new avenue of raising finance for green initiatives, recently witnessed a successful maiden auction.

With India's G20 presidency, the country has introduced the 'LiFE' (Lifestyle for Environment) Mission to promote responsible consumption. India's steering of global initiatives such as the International Solar Alliance offer a unique leadership role for the country to shape the global direction on green growth.

With India emerging as one of the world leaders, it has the potential to create 35 million green jobs by 2047.[35]

The envisioned green growth presents an opportunity to generate significant employment opportunities for a large population through two interrelated strategies. Firstly, India should capitalise on the global demand for skilled workforce to support not only its own efforts but also assist other countries in achieving their net-zero targets. Secondly, India should prioritise fair and equitable transitions for workers in traditional industries that may be affected by these transformative changes.

India's entry into the demographic dividend opportunity window in 2005-06, which is projected to continue until 2055-56,[36] presents a significant opportunity for the green jobs market to not only meet domestic targets but also contribute to the global workforce. By accelerating the development of the skill ecosystem, India can ensure an effective supply of talent to support green growth while consciously addressing the needs of populations such as women, persons with disabilities (PwDs), and individuals from remote regions of India, thus ensuring inclusive green growth.

1.4. Skill development for green jobs in India

An enabling ecosystem for productive employment of Indian workers, with the right set of skills, in decent jobs can help India capitalise on its demographic dividend and move towards a climate-positive economy.

India faces a considerable skill gap presently, with less than 10% of the youth reported to be receiving formal or informal training.[37] Falling labour force participation rates and rising unemployment are symptoms of widening skill gaps, greater disparities in job opportunities, and insecure education to employment transition.[38] Given that India's working age population will peak by 2030 at 65%, India has a short window of opportunity to harness its demographic dividend.

In the context of climate change, India is estimated to lose 3-6% of its GDP, annually from 2021,[39] largely due to the lack of a workforce whose skills are attuned to sustainable development needs. In order to fulfill this growing need, India needs to bridge both; skill gap and awareness gaps.

Firstly, while the demand for emerging green jobs is expected to grow, the supporting ecosystem to provide the skillsets required for these jobs is currently nascent. India needs to establish a scalable skill infrastructure that can provide high-quality training in line with industry demands. To meet the demand for skilled green workforce in the future, India has so far trained one million candidates. This has been done by Skill Council for Green Jobs (SCGJ) and Green Skill Development Programme (GSDP) .[40]

While there are more than 500 government and private skill-training institutes[41] offering online/offline courses for different sectors (as shown in the figure on next page), several challenges need to be addressed in the demand as well as the supply ecosystem to ensure industry-ready green-workforce. These challenges include:

- Lack of supportive policies on green skill development across sectors in line with emerging green job roles
- Lack of emphasis on green skill-building
- Insufficient coverage and depth of green skill development within existing interventions.
- Limited effectiveness of several programs due to factors such as missing synergies across skill-devvelopment bodies, scarcity of expert trainers and lack of equipment
- Lack of inclusion in training programs for catering to the needs of various marginalised groups

Secondly, there is limited awareness about specific job roles within Green jobs among youth. In a survey conducted by Sattva with 2328 candidates across five metro cities, it was observed that 85% candidates had heard about 'green' or climate-positive jobs. This percentage however, significantly dropped across all sectors to 35% when they were asked about specific job roles in the sector or awareness of skill development avenues for the same. Hence, efforts are needed in building awareness and aspirations of youth about green jobs.

9+

Government bodies and sectors Government bodies and Sector Skills Councils aligned with Skill India mission that are creating qualifications and certifying candidates

390+

Courses being implemented by private training players affiliated to Sector Skills Councils and providing training for qualifications

400+

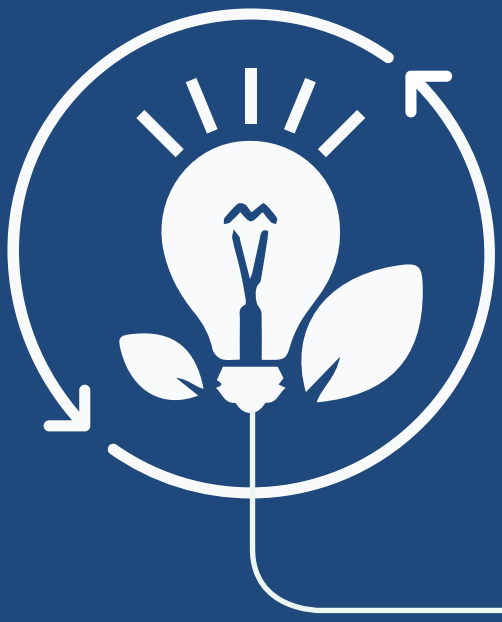
private non-affiliated, independent institutes like universities, private institutes, NGOs, etc. that are offering awareness modules for various sectors as well as specialized courses online/ offline

1.5. Urgent need for enabling green skill-developement: Potential role of Philanthropy.

Philanthropy can take five Big Bets to address skill-building needs and propel India's transition to a green economy.

1. **Reskill and upskill existing workforce**
   Enabling existing workforce to adapt to changes in jobs due to greening
2. **Train entry-level workforce**
   Skill incoming youth to meet the demand for new green jobs
3. **Support entrepreneur-led models**
   Creation of self-employment that can amplify job opportunities
4. **Foster Diversity and Inclusion**
   Ensuring diversity and inclusion in training programs and jobs in the process of greening the economy
5. **Formalisation and decent jobs**
   Ensuring safety and social protection in the existing jobs

Given India is at an inflection point in its transition to a green economy, there is a need to address skill-building needs across the high potential value chain segments. Actioning these big bets would help formalise the workforce, ensure social benefits, prevent exploitation, and enable economic growth. This will need collective action across Governments, policy makers, industry, civil society, and research stakeholders.



CHAPTER 2

RENEWABLE ENERGY

Powering energy security through workforce maturity

Understanding growth of renewable energy in India, and fast-growing sectors such as Solar Energy, Wind Energy, Bioenergy, and Green Hydrogen. This chapter will provide an overview of high-potential value chain segments for green jobs, the skill development ecosystem, and big bets for philanthropy to address training needs across these sectors.

India is the fourth highest contributor to renewable energy globally. It has set ambitious targets to generate 500 GW of non-fossil energy, with 50% of cumulative electric power coming from renewables by 2030.[42]

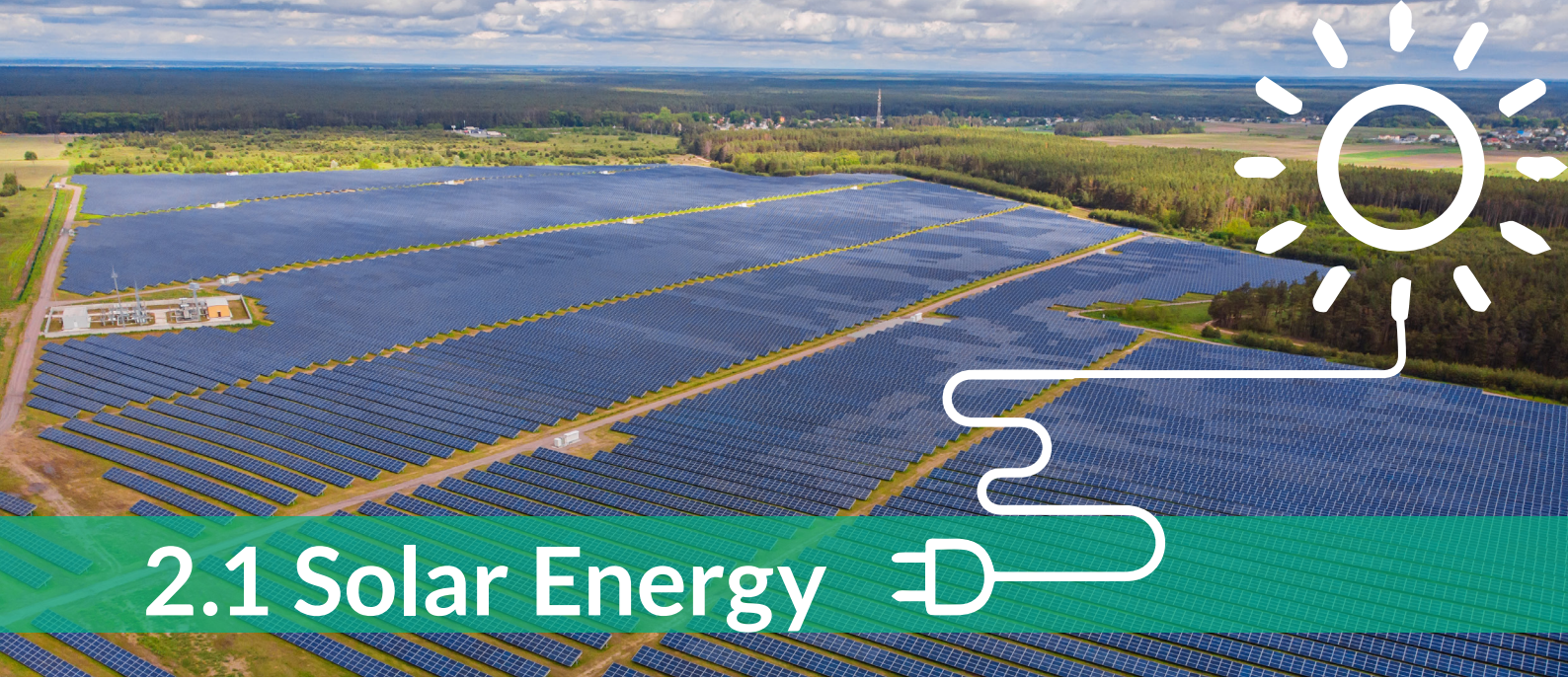
By 2050, 90% of global energy generation is expected to come from renewable energy sources, and the sector is poised to grow at a CAGR of 8.6% between 2022-2030.[43] The last five years have marked significant progress in renewable energy globally, with 257 GW of renewables added in 2021, contributing to 81% of power capacity additions.[44] The momentum is expected to sustain, with global renewable energy market predicted to exceed $2 billion by 2030.[45]

India is leading the global transition towards renewable energy and has a target to achieve net-zero carbon emissions by 2070, with its installed capacity of 169 GW in renewable energy as of February 2023.[46]

By reducing entry barriers through provisions of subsidies and incentives such as production linked incentives (PLI) schemes and custom tariff reductions for the renewable energy sector, the government is enabling greater industry interest in the sector. Foreign direct investments (FDI) of up to 100% are currently allowed in the renewable energy industry under the automatic route, with no prior government approval. Through the production linked incentive (PLI) scheme, the second tranche of $2.3 billion was announced to enhance manufacturing capacities, which will potentially enable further investments and focus on domestic production.[47] There are currently $196.98 billion worth of renewable energy projects underway in India. The Indian government has approved 45 solar parks with an aggregate capacity of 37 GW.[48] There have also been similar initiatives introduced for the wind energy sector. The 2023 Union Budget has emphasised green hydrogen as well as setting-up supply chains for biomass for biofuel production. Thriving market conditions including more private sector investments, strong policy action, and technological improvements focused on creating resilient supply chains are responsible for these positive trends in the sector.[49] With these strong tailwinds, it is estimated that the renewable energy sector would house 3.4 million jobs by 2030. [50]

While the renewable energy sector comprises energy produced from various sectors such as, solar energy, wind energy, bioenergy, hydro-energy, and tidal energy, this report prioritises and details the trends in solar energy, wind energy, and bioenergy (biofuels) as these sectors have shown the most activity and increase in installed capacity. In addition, the report focuses on green hydrogen given the recent emphasis on the same in the 2023 Union Budget. [51]

The upcoming sections of the chapter will deep-dive into the growth of solar energy, wind energy, bioenergy (biofuels), and green hydrogen to assess high-value chain segments, potential for green jobs, the skill development ecosystem, and big bets that philanthropy can take to address training needs for green jobs.



2.1 Solar Energy

Growth of the sector

The solar energy sector is a fast- growing, lucrative space, and is expected to grow at a CAGR of 8.6% between 2022-2030.[52]

Solar energy remains the powerhouse of growth in the renewable energy sector, with an 18-fold increase from 2.63 GW in 2014 to 49.3 GW in 2021, forming 60% of the government's 2030 energy target.[53] While domestic industry players are expanding on a massive scale, international investors and philanthropy are also collaborating with local organizations to boost investments in the sector. Further, policy initiatives like Jawaharlal Nehru National Solar Mission (JNNSM) and Solar Park scheme are enabling high growth.[54] A substantial budgetary allocation of $2.3 billion with the recent PLI scheme, coupled with over $8.1 billion of investments by industry players is poised to boost domestic manufacturing. [55]

Demand for green jobs

Solar energy sector is projected to have 3.26 million jobs by 2050.[56]

As of 2021-22, over 29,000 people were employed in the solar sector, and it is estimated to create up to 3.26 million cumulative jobs with an estimated installed capacity of 940 GW by 2050. As of 2021, rooftop applications reached 7.7 GW, and the Ministry of New and Renewable Energy (MNRE) has proposed an additional 100 GW. Currently, rooftop solar installations (both on-grid and off-grid applications) have the highest number of jobs compared to any other sub-sector or value chain segment. A greater focus on distributed renewable energy generation will facilitate the transition from utility-scale projects (solar farms).[57]

High-growth value chain segments

While the installation segment will create a significant number of semi-skilled and low-skilled jobs, these positions are likely to be short-term in nature. On the other hand, manufacturing jobs are expected to offer more sustained and long-term employment.

The solar value chain revolves around the lifecycle of Photovoltaic (PV) panels, which play a central role in solar farms/parks and rooftop solar (on-grid and off-grid) systems. The solar energy value chain typically includes design and business management, PV component manufacturing and assembly, installation, operation and maintenance, and sales and end-of-life cycle. Solar farms and rooftop on-grid systems may also involve additional processes such as business development, proposal evaluation, and facility management.

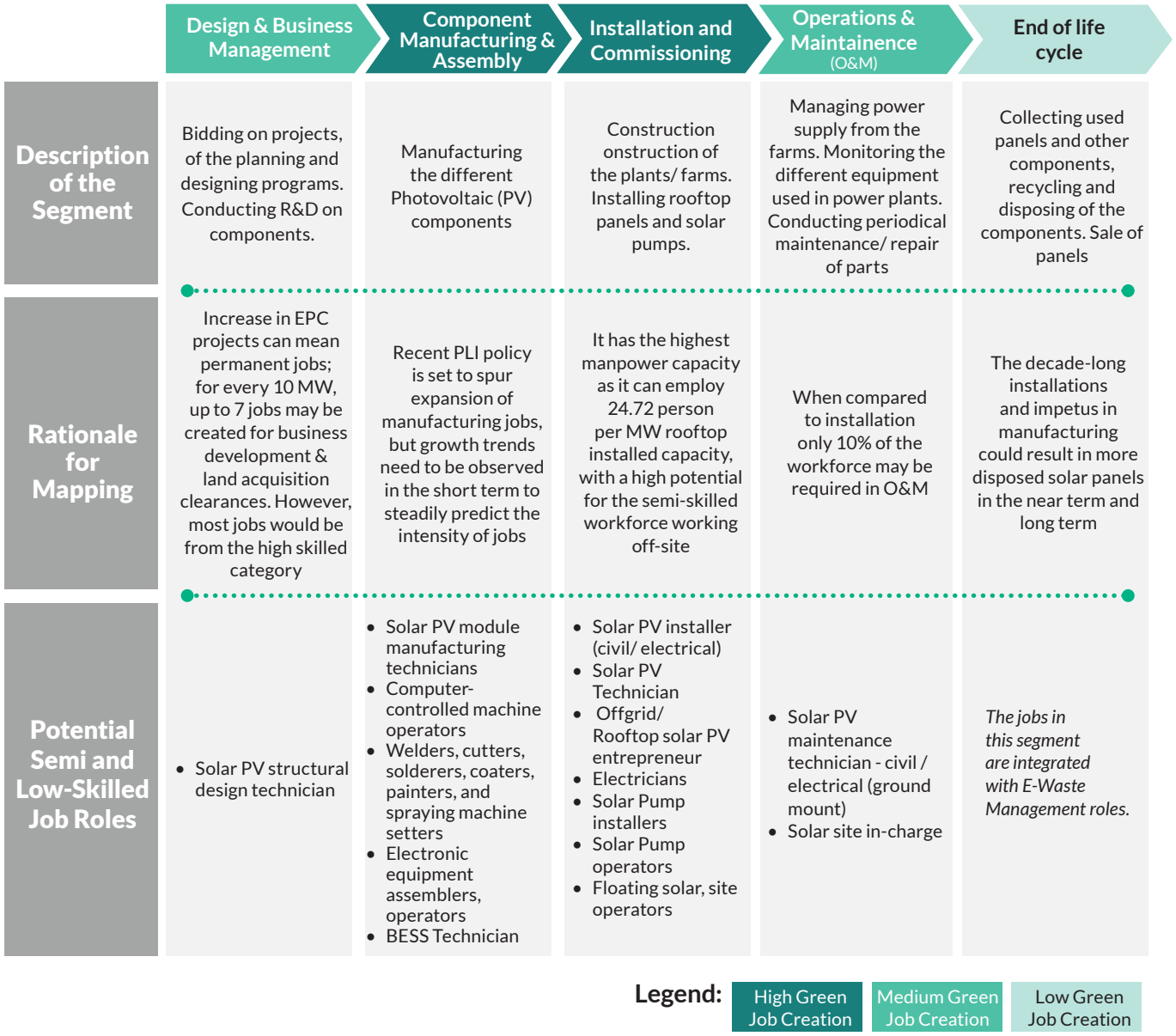


Fig. 2 | High-potential value chain segments and job roles for solar PV

The solar skill infrastructure is well-established, comprising two sector skill councils (SSCs): the Skill Council for Green Jobs (SCGJ) and the Electronic Sector Skill Council (ESSC), which have successfully trained over a hundred thousand candidates.[58] In addition to the SSC-affiliated training providers, NGOs and other organisations are also conducting private training programs to address the skill gaps of the sector. Currently, there are 25 qualifications available for the solar sector, but only the Solar PV installer (Suryamitra) program, along with its subsets Solar PV Installer (Electrical) and Solar PV Installer (Civil), are being implemented. [59]

3 Big Bets that philanthropy can take to enable skill development of workforce to meet the demand for green jobs.

Big Bet 1

Upskill existing workforce across the solar value chain to meet industry demands

To meet the demand for semi-skilled and low-skilled workforce across the solar value chain, it is necessary to upskill the existing solar workforce to meet the industry needs generated by the evolving technology. To operationalise this big bet, philanthropy can leverage the existing ecosystem of over 400 SSC-affiliated institutes. This includes training existing staff for short-term roles and enabling them to upgrade to new roles.

The assembly/installation segment has the highest manpower requirement, employing an average of 24.72 full-time equivalent (FTE) individuals per MW of rooftop installed capacity.[60] As of 2021, the Suryamitra qualification accounted for approximately 90% of trained and certified candidates in solar job roles,[61] supported by MNRE and PMKVY, and other state-led schemes and market mode programs.[62] Although plant construction work is temporary at project sites, a significant number of skilled workers are needed in India to achieve the target of 300 GW solar capacity by 2030.

To meet the requirement for trained and certified workforce capable of handling plant construction and operations and maintenance for various types of solar projects, it is necessary to address certain challenges. Analysis of implemented programs indicates that the scarcity of trainers, limited exposure to automation techniques, and limited practical/hands-on experience hinder the industry-readiness of candidates. Overcoming these challenges and ensuring geographical suitability to facilitate local hiring are crucial for the successful implementation of new

A 12x increase

in jobs is expected between 2020-2030 across the value chain due to government initiatives, giving an opportunity for the existing workforce to transition to new job roles.[IV]

Over 100,000 candidates

candidates have been trained in solar PV technician roles. They further require skill development to work in other high demand job roles. [V]

25 qualifications

for the solar sector. Of all, the Solar PV installer programmes is being implemented most at-scale. [VI]

With 400+ SSC affiliated

institutes, philanthropy can operationalise the big bet through existing infrastructure and channelise skill-building pathways for current and incoming workforce. [VII]

courses.

Furthermore, to enhance the growth of the solar skill development ecosystem, it is essential to foster collaboration and synergies with partners to align job roles with industry changes. Stakeholders can contribute to building resources that capture industry demands or upgrading existing courses to meet the evolving skill requirements. Moreover, they can facilitate collaboration between the industry and skill councils to bridge the demand-supply gap, devise relevant courses, and conduct joint reviews of existing solar programs to enhance their industry suitability.

2

Government bodies and sector Skills Councils (SSCs) aligned with Skill India mission, that have created 25 qualifications

- 2 certification bodies involved - SCGJ and ESSC
- SCGJ has 16 qualifications and they are focused on certifying candidates for various value chain segments such as business development, manufacturing, installation, and O&M
- The ESSC has 9 qualifications focusing on manufacturing, installation & O&M.

400+

SSC affiliated institutes providing training as per qualifications

- At least 400 institutes are associated with SCGJ, have private certifications for non-affiliated courses, such as solar maintenance, SCADA systems, etc, and they deliver in online mode as well.
- Despite this expanse, majority of the trainings have happened only for Suryamitra and Varunmitra programs

50+

Private non-affiliated, independent institutes like universities, private institutes, NGOs etc, providing specialised cources

- Many independent institutes and private universities provide specialised courses. However, trainings are mostly for the high skilled workforce.
- Few online portals offer 10-day courses for engineers, and architects
- For semi-skilled workforce, workshops are the only modality, where they are provided hands-on experience. Most of these participants are unable to attend online informative sessions due to the lack of resources.
- Employers have to re-train for roles such as Solar PV installer, O&M Technician, Manufacturing operators, etc. indicating a gap in skills

Fig. 3 | Solar Skill Ecosystem

Big Bet 2

Train entry-level workforce in solar component manufacturing roles

With a focus on making India 'Aatmanirbhar', policies such as JNNSM, PM-KUSUM, PLI, and the Ultra Mega Power Solar Scheme, are driving the growth of jobs in the solar manufacturing segment.[63] While the manufacturing segment is experiencing increased policy support and industry investments, the implementation of current manufacturing courses remains minimal due to a lack of incentivisation.

Philanthropy can enable the required skills supply by demonstrating training models for manufacturing roles in ITIs that are industry-ready. In addition, Philanthropy can enhance awareness of skill development pathways among young individuals entering the workforce.

More than $8.1 billion

investments announced by leading domestic industry players in solar component manufacturing.

0.175 million jobs

are estimated to be created in solar component manufacturing segment by 2050, owing to increasing industry investments and government schemes. [VIII]

Five qualifications from SCGJ and ESSC with a focus on Manufacturing exist.

Implementation is yet to be scaled as they are not subsidised. [IX]

Big Bet 3

Train women and PwD to enable diversity and inclusion

Currently, there is a lack of affirmative action and industry drivers to encourage women's participation in the workforce. Skill-training organisations do not actively engage in targeted mobilisation of female candidates due to the low levels of placement.

Therefore, it is necessary to introduce the right incentives to promote inclusion of women in training and employment. Philanthropy can also provide funding to private training institutes and other ITIs to conduct inclusive pilots aimed at mobilising, training, and facilitating placements of diverse groups.

85% of trained candidates were men

indicating a lack of inclusivity of other diverse groups. [X]

90% of women indicated that social norms don't allow them

to participate in trainings. Further, affirmative action and industry drivers to enable their entry in the sector are required. [XI]

Very few training organisations

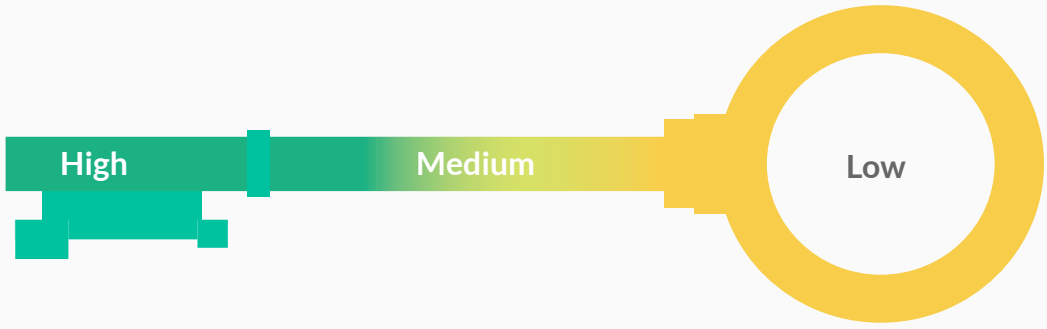
focus on women/PwDs since they are unable to meet their placement targets as industries don't hire them. [XII]

Big Bets

that will potentially derive increased value from philanthropic investments.

Given policy tailwinds, increasing industry investments, and existing skill infrastructure; efforts to upskill the existing workforce will derive most value from philanthropic investments. This is followed by working with ITIs to train the incoming workforce, considering the nascency of the skill infrastructure for component manufacturing roles.

Further, there is a need to have long-term focus on making the solar workforce diverse and inclusive. However, this will require creating systemic shifts in perceptions within the ecosystem, which will require sustained investments to demonstrate models of mobilising, training, and ensuring placements of diverse groups.



Big Bet 1
Upskill existing workforce across the solar value chain to meet industry demands

Big Bet 2
Train entry-level workforce in solar component manufacturing roles

Big Bet 3
Train women and PwD to enable diversity & inclusion

Fig. 4 | Big Bets

2.2 Wind Energy

Growth of the sector

As of 2022, India had the fourth-highest installed wind capacity in the world.[64] With increasing industry investments, India is on the path to achieve the government targets of 140 GW of wind capacity installation. [65]

According to Invest India, India ranked fourth in the total wind installed capacity in the world, with a capacity of 41.9 GW as of 2022. This is expected to increase by 50% in 2025 as multiple projects that were in the pipeline before COVID-19 are set to restart adding an additional wind power capacity of 20.2 GW.[66] The sector is seeing strong policy tailwinds like the National Wind Solar Hybrid Policy, which aims to promote the hybridisation of solar and wind farms. In addition to this, the government's custom tariff exemptions to produce certain wind turbine parts will further enable the growth of the wind sector.[67] The present growth in the sector is driven primarily by large-scale wind farms set up by large global and domestic players. This could be enhanced by the government's updated auctioning process,[68] where bids are being invited for wind projects worth 8 GW by 2030. [69]

Demand for green jobs

With over 60,000 people employed in the sector, as of 2022, the workforce is expected to grow three times by 2030.

By the end of 2022, 60,600 people were employed in the wind sector,[70] and the sector is on its way to creating as many as 0.18 million jobs cumulatively by 2030, to meet the updated government target of 140 GW of wind energy capacity by 2030. [71]

High-growth value chain segments

The manufacturing segment will see increased demand due to the introduction of PLI schemes[72] for manufacturing of offshore wind turbines. Additionally, due to potential automation, the O&M segment needs to be carefully monitored for skill requirements.

The growth of the wind value chain is rooted in industrial offshore/onshore farms and not residential/ community wind markets. Across both industrial onshore and offshore wind farms, the product value chain that flows commonly includes research and design (R&D), manufacturing, planning, construction, erection and commissioning, and operations and maintenance (O&M). Presently, onshore wind is driving the sector growth with large wind farms in operation. Offshore wind farms are growing across port cities due to higher rates of efficiency offered. For residential/community purposes, wind energy is currently not preferred. However, the emerging market for small wind turbines for residential settings needs to be observed as it is likely to be affordable in the future.

	R&D and Design	Manufacturing	Planning	Construction, Erection and Commissioning	Operations and Maintenance
Description of the Segment	Conducting R&D on components.	Manufacturing turbines and other components	Conducting wind resource assessment, micro sitting and technical feasibility, and business development	Construction of the plants/ farms.	Managing power supply from the farms. Monitoring the different equipment used in power plants. Conducting periodical maintenance/ repair of parts.
Rationale for Mapping	Need for R&D to reduce costs and enable increased entrants to make the sector more feasible. However, majority roles are from high-skilled category	Largest employer in the sector. Planned introduction of the PLI scheme is expected to grow the sector further to meet government targets & reduce import dependency	Majority of roles hired are high skilled roles and hence has a lower job creation potential for target vulnerable groups	Despite Hybrid policy driving growth, semi skilled jobs would not be as many since wind and solar would have same workforce	High requirement of technically trained labour to monitor automation tasks
Potential Semi and Low-Skilled Job Roles	• Structural design technician	• Wind manufacturing technician • Production operator • Maintenance technician • Computer-controlled machine tool operators • Electrical and electronic equipment assemblers • WTG production operator	• Site Surveyor	• Construction technician (Electrical)-WPP • Construction technician (Civil)-WPP • Construction technician (Mechanical)-WPP • Crane operator	• O&M Electrical and Instrumentation Technician - WPP • O&M Mechanical Technician - WPP

Legend: High Green Job Creation | Medium Green Job Creation | Low Green Job Creation

Fig. 5 | High-potential value chain segments and job roles for wind energy

2 Big Bets that philanthropy can take to enable skill development of workforce to meet the demand for green jobs.

Big Bet 1

Upskill O&M workers through mass adoption of existing O&M courses to meet demand for automation

To upskill O&M workers and meet the demand for automation, it is crucial to promote the mass adoption of existing O&M courses. The O&M segment in the renewable energy sector is embracing automation for day-to-day monitoring and maintenance of wind turbines.[73]

However, the current skill development landscape for O&M is in its early stages, as depicted in the figure on the next page. Only one SSC and one implementation partner have launched the initial pilot program called the Vayumitra program, which is funded by the MNRE. It is necessary to leverage the insights gained from this pilot program and facilitate the widespread adoption of O&M courses to prepare the workforce for the growing demands in this field.

Considering the increasing requirements, SCGJ has developed six qualifications for the wind energy sector, focusing on O&M, as well as design and construction aspects.[74] Philanthropy can play a vital role in supporting the expansion of O&M courses. Additionally, it can facilitate the establishment of standardised assessments of skills, enabling workers to transition to future roles in light of automation

40%

of the 0.18 million people to be employed in wind energy by 2030 would be in the O&M segment. [XIII]

50%

increase in wind power capacity expected in the next five years, with large investments made by industry players such as Suzlon, Vestas, etc. Therefore, increasing the demand for O&M workers.

Six qualifications exist

for the O&M segment in wind energy. However, only the Vayumitra course has been implemented as a pilot program. 1000 candidates have been certified so far.

1

Sector Skill Council with 6 qualifications

- 1 certification agency involved- SCGJ has 6 qualifications for O&M, design and construction roles

1

National Institute partnering with SSC to provide training in select states through training partners

- NIWE providing a pilot training for the Vayumitra course in affiliation with SCGJ

1

National Institute of Wind Energy (NIWE) is one of the few institutes that provides specialised wind training

- Provides specialised technical training for wind energy installation and O&M functions
- The programs offered by NIWE range from 200-400 hours and are provided in person often accompanied with internship opportunities post the training.

Fig. 6 | Wind Skill Ecosystem

Big Bet 2

Train entry-level workforce in wind manufacturing job roles by leveraging ITIs

While the manufacturing segment created only 4,000 jobs in 2021,[75] the planned private investments of $3 billion by industries, coupled with introduction of a PLI schemes[76] will enable manufacturing of more onshore and offshore turbines soon. The manufacturing segment will thus create a demand for skilled labour and contribute to produce more than 70% of wind equipment used in installations. [77]

To enable the long-term growth of the sector and reduce import dependency, the development of a trained manufacturing workforce will be crucial. Philanthropy can help build resources to capture industry demand to build new content and run training programs in high wind-capacity states. Furthermore, stakeholders can enable collaborative action to create courses, support the dissemination of courses, and set up the skill infrastructure.

More than $3.05 billion

investments announced by leading industry players in launching wind projects will lead to increased demand for components.

Planned PLI policies

would enable manufacturing of offshore wind turbines to achieve the additional 30 GW offshore wind energy targets by 2030.

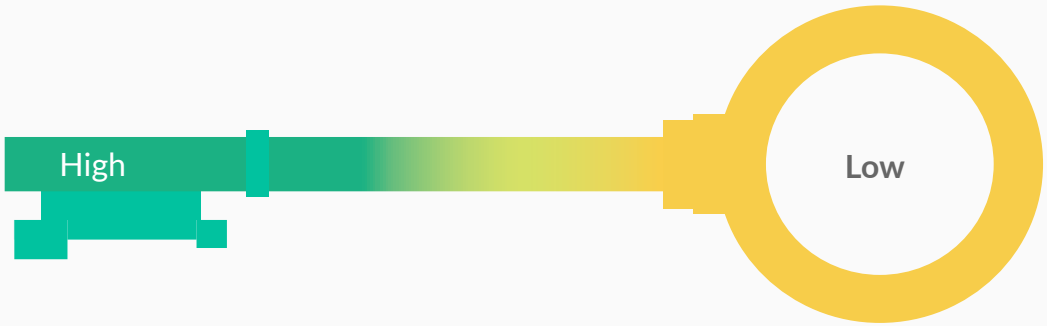
No qualifications exist

Courses are yet to be developed for manufacturing.

Big Bets

that will potentially derive increased value from philanthropic investments.

Given policy tailwinds, increasing industry investments, and existing qualifications, skill development of existing workforce in the O&M segments will derive most value from philanthropic investments, followed by collaborating with ITIs to train the incoming workforce in manufacturing, considering the nascent state of the skill ecosystem.



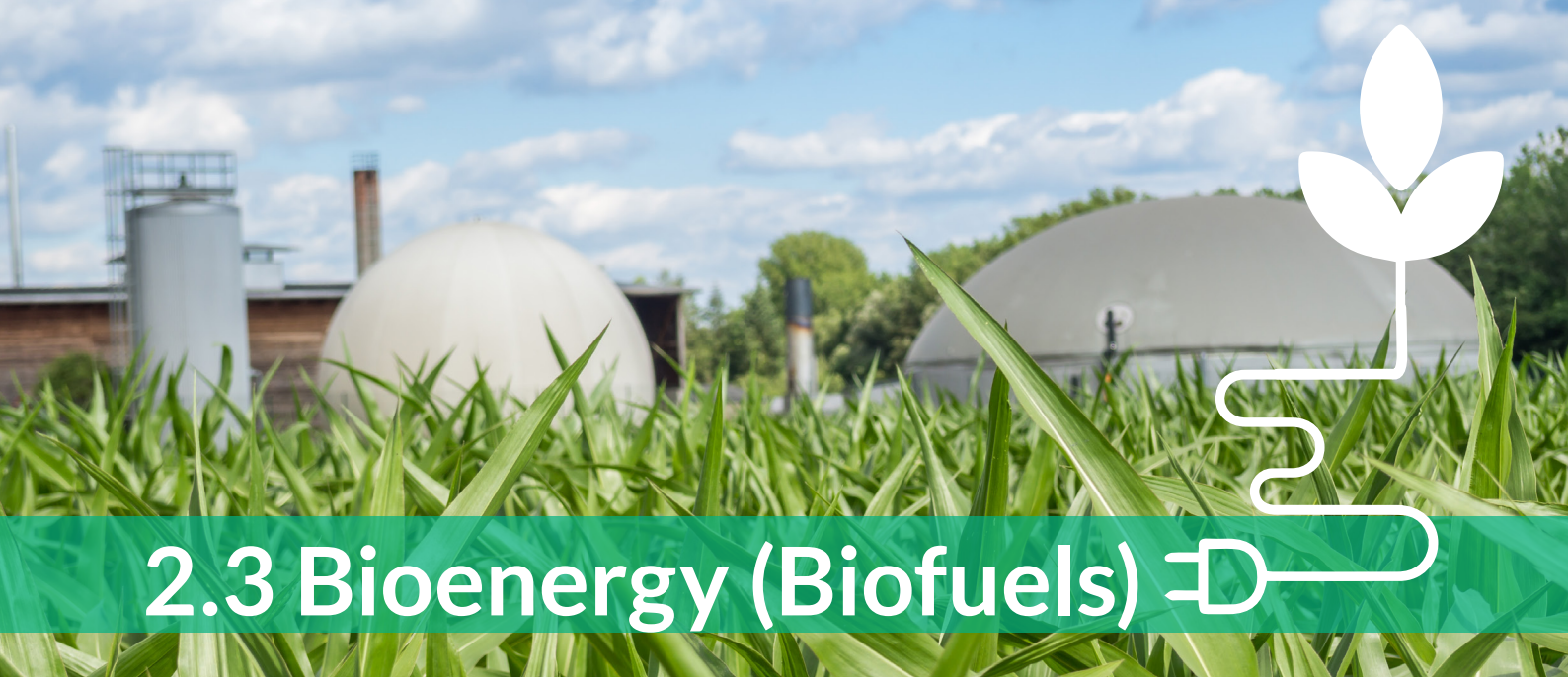
Big Bet 1

Upskill O&M workers through mass adoption of existing O&M courses designed to meet demand for automation

Big Bet 2

Train entry-level workforce in wind manufacturing job roles by leveraging ITIs

Fig. 7 | Big Bets



2.3 Bioenergy (Biofuels)

Growth of the sector

India's bioenergy sector is experiencing significant growth driven by its vast agricultural pastures, structural transformation in the agricultural sector, availability of 750 metric tonnes of biomass resources annually, and strong policy support.

The Government of India had initially set a target of 175 GW of renewable power installed capacity by the end of 2022, including 10 GW of bioenergy capacity. This goal has already been achieved, with the current installed capacity exceeding 10.17 GW of biomass power.[78] However, the surplus biomass availability of 230 million metric tons per annum, including agricultural residues, presents an untapped potential for further sectoral growth.[79] The utilisation of all forms of disposable bio-waste in India, estimated at around 600 million tons, could generate 25 times the current usage of compressed natural gas (CNG) and replace over 50 percent of total fuel imports.[80] To enable the productive usage of agricultural residues, the government has launched programs such as SATAT (Sustainable Alternative Towards Affordable Transportation), with MNRE also providing $0.3 million/MW of Central Financial Assistance (CFA) to Bagasse cogeneration projects and another $0.6 million/MW of CFA for Non-Bagasse cogeneration projects through their biomass cogeneration program.[81] The 2023-24 budget has further amplified this with the announcement of the "Waste to Wealth" initiative to set up 200 compressed biogas plants. [82]

Demand for green jobs

The bioenergy sector is projected to create an estimated 0.27 million cumulative jobs by 2030, offering substantial employment opportunities in India's green economy. [83]

The bioenergy sector encompasses two sub-sectors: biopower and biofuels. While job opportunities exist in both sub-sectors, the biofuels segment should be the focal point of skill-building efforts due to higher growth potential. The low feed-in tariff rates and high setup costs for biopower units is currently restricting private players from participating in this sub-sector, limiting industry investments, as compared to biofuels.

The biofuels sector is seeing multiple tailwinds. Despite the impact of COVID-19, the biogas space is projected to grow at a CAGR of 6.3% between 2021 and 2029.[84] Biogas is a cheap and commonly available renewable energy source that can be generated from organic feedstocks under anaerobic conditions. It is primarily methane and can be generated from various sources such as animal manure, crop residues, and municipal solid waste. For liquid biofuels, ethanol and biodiesel are the two main transport biofuels and can be produced from a variety of biomass sources. Specific schemes such as SATAT for biofuels are anticipated to generate direct employment for 75,000 individuals and produce 50 million tons of bio-manure for crops. [85]

Across both biofuels and biogas, the product value chain commonly includes feedstock collection, segregation and transportation, installation/construction, production and O&M, and distribution. The critical value chain segments are feedstock collection, installation/construction, and production and O&M.

High-growth value chain segments

Installation, production, and O&M segments of the value chain are expected to create 0.1 million jobs by 2030,[86] to generate high quality biomass for fuel and energy requirements.

	Feedstock collection	Segregation and Transportation	Installation/ construction	Production and O&M	Distribution
Description of the Segment	Collecting biomass from farms and other sources and ensure it's in the right form for transportation	Ensuring feedstock quality and transporting it to and from agents	Construction of the biogas/ biofuel plants	Creating and producing biogas/ biofuel through the use of feedstock and anaerobic processes	Distributing the created biogas/ biofuels to end consumers
Rationale for Mapping	In order to deal with the systemic issue of consistent feedstock supply, more than jobs, people need to be trained for entrepreneurship.	While significant labour is needed to ensure consistent supply, minimum skill-building is required	Skilled labour is needed for installation of densification plants which ensure longevity of biomass	Production and O&M segment helps maintain quality of the biomass by process such as briquette and pellet production.	Job roles in this segment are for high skilled roles
Potential Semi and Low-Skilled Job Roles	• Collection agents • Loaders • Animal waste manure aggregator • Agri-residue aggregator	• Sorters • Drivers	• Densification plant fabricator / mason • Biofuel plant store in-charge • Crane operator	• Pre cleaners/ treater • Electrical technicians • Helper • Biogas/ biofuels operator • Biomass depot operator • Scrubber • Bio CNG operators	

Legend: High Green Job Creation | Medium Green Job Creation | Low Green Job Creation

Fig. 8 | High-potential value chain segments and job roles for bio energy

2 Big Bets that philanthropy can take to enable skill development of workforce to meet the demand for green jobs.

Big Bet 1

Establish a distributed network of entrepreneur-led feedstock collectors.

India has the potential to produce an additional 28 GW of renewable energy annually by improving feedstock supply management.[87] However, the collection and storage of crop residues pose significant challenges. Crop residue is available intermittently, primarily during the harvest season, and it has high moisture content, necessitating large spaces for drying.

Skilled labor is essential for efficient feedstock collection, with a thorough understanding of briquetting processes to facilitate transportation and provide the industry with high-quality material for biofuel production. Funding entrepreneurship programs can create a cadre of local entrepreneurs who can leverage the opportunity. These entrepreneurs require comprehensive training to enable farmers to collect, store, and supply feedstock effectively. In addition to technical skills, they also need business development skills to establish strong networks for a continuous feedstock delivery system. Presence of entrepreneurs will further create demand for skilled talent which can be addressed by developing courses, implementing accreditation programs for feedstock management and subsidising existing courses.

230 million metric tons

of surplus raw biomass material is available per annum. However, most material is present intermittently and gets spoiled due to lack of storage/ management of feedstock.

The National Policy on Biofuels 2018

is enabling entrepreneurs to collect more feedstock. This urgent requirement for entrepreneurs was also highlighted by the budget announcements of 2023.[xiv]

Big Bet 2

Train entry-level workforce for installation, production, and O&M roles by collaborating with ITIs.

The bioenergy skill ecosystem is evolving, and there is an opportunity to optimise existing courses and infrastructure to meet the industry's need for high-quality feedstock and enhance biofuel production efficiency. While there are existing qualifications available for biofuels, such as Animal Waste Manure Aggregator, Agri Residue Aggregator, and Biomass Depot Operator, they do not currently focus on the installation and O&M segments.[88] Four of them are related to emerging installation and O&M requirements in Biogas/Bio-CNG segments. Additionally, the implementation of trainings for Biomass Depot Operator, faced challenges due to a lack of candidate awareness, resulting in its discontinuation. [89]

Philanthropy can address this gap by mobilising candidates and providing them with information about the available biofuels courses. Furthermore, developing online and offline placement platforms that match the industry's needs in rural and peri-urban locations, where production units are typically located, can help candidates realise the value of their skills and facilitate their entry into the bioenergy workforce.

5000

large scale bio- compressed natural gas plants are being set up by the end of 2023 due to the Sustainable Alternative Towards Affordable Transportation (SATAT) initiative. [xv]

100,000

jobs to be created by 2030 in installation, production, and O&M segments.

1+

Sector Skill Council with 7 qualifications

- These qualifications are available for activities related to feedstock collection, segregation, transportation, installation and O&M

>10

SSC affiliated institutes providing training as per qualifications

- Few institutes like Mahatma Gandhi Institute of Rural Energy and Development (MGIRED) or Technology Informatics Design Endeavour have attempted to include content into their solid waste management courses for biogas/biofuel generation
- These courses were not found to be successful due to low enrolment rates as a result of lack of candidate interest. Hence, MGIRED had to end their program

Fig. 9 | Bioenergy Skill Ecosystem

Big Bets

that will potentially derive increased value from philanthropic investments.

Considering recent policy announcements and the government's increased focus on biogas and feedstock supply, philanthropic investments can create significant value by supporting entrepreneurship development for managing feedstock supply. In the long run, establishing robust skill development systems for the entry-level workforce across installation, production, and O&M segments will play a crucial role. This aligns with policy initiatives like SATAT and the potential for increased employment in the bioenergy sector. By addressing the challenges in the skill ecosystem and aligning skill-building efforts with industry demand, philanthropy can contribute significantly to the growth and success of the bioenergy sector in India.

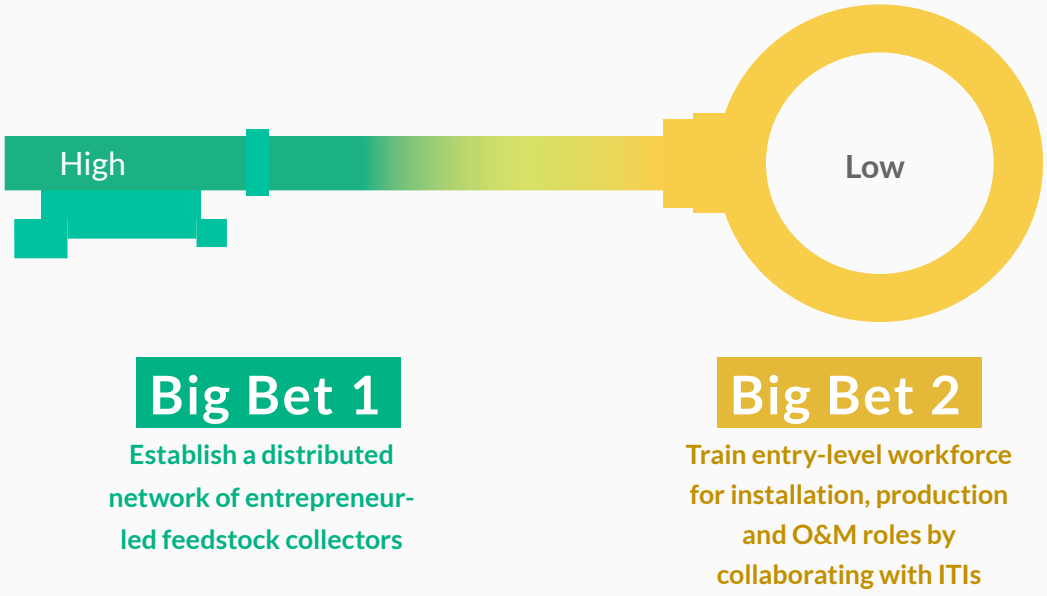
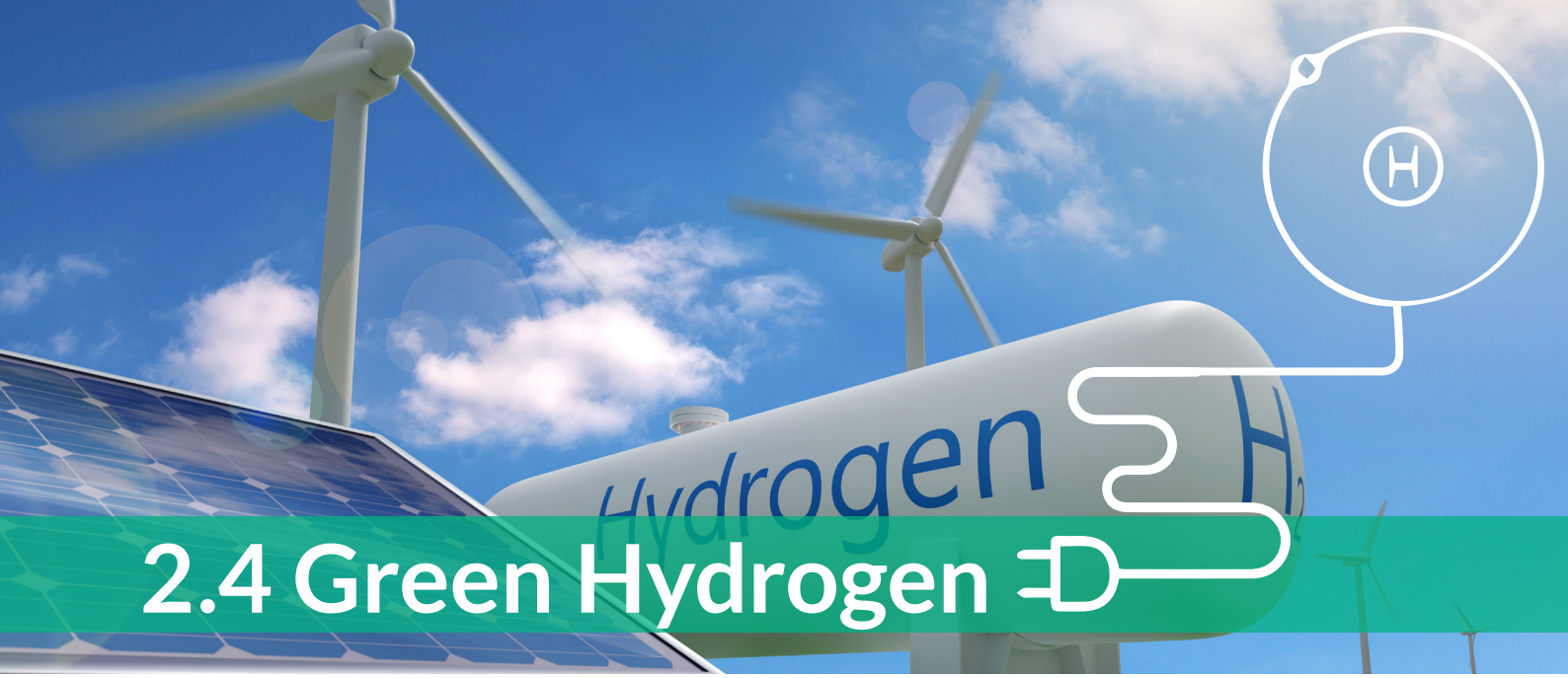


Fig. 10 | Big Bets



2.4 Green Hydrogen

Growth of the sector

India's green hydrogen sector has significant growth potential, with a projected CAGR of 20% between 2025 and 2030, driven by robust policy support.[90]

Green hydrogen is poised to play a crucial role in helping India achieve its 2030 greenhouse gas emission targets and decarbonise high-polluting and heavy-duty industrial sectors like steel production. Its high efficiency in fueling high-temperature industrial processes makes it an attractive solution. The government has shown strong support for the sector through initiatives like the National Green Hydrogen Mission, which has an initial outlay of $277.2[91] million. Private players have also announced substantial investments, up to $75 billion, in clean energy projects, with green hydrogen being a significant focus.[92]

Demand for green jobs

The green hydrogen sector is expected to create 0.6 million jobs by 2030.[93]

The green hydrogen value chain encompasses various stages, including renewable energy installation, electrolyser and component manufacturing, plant construction and commissioning, green hydrogen production, green hydrogen storage, distribution and transport, and application. Renewable energy supply will account for over 66% of the new jobs, while electrolyser manufacturing and plant construction/commissioning will contribute 4% and 11% respectively. Moreover, green hydrogen production and storage will generate 11% and 2% of the new jobs, and the distribution and transport segment will account for 4%.[94]

High-growth value chain segments

While renewable energy supply and plant construction will house maximum jobs, they will be short-term. Electrolyser and component manufacturing, and green hydrogen production would be critical segments, generating long-term employment.

To ensure the sector's growth, consistent availability of renewable energy is crucial. Additionally, developing the electrolyser and component manufacturing, as well as plant construction and commissioning segments, is essential to reduce dependencies and enable smooth operations.

	Renewable Energy Installation	Electrolyser & Component Manufacturing	Plant Construction & Commissioning	GH Production	GH Storage	Distribution & Transport	Application
Description of the Segment	Installing renewable energy sources like solar and wind energy to produce green electricity which is needed to produce Green Hydrogen	Electrolyser is an important component for green hydrogen production and India will have huge demand for electrolysers	New plants need to be built across the country to produce Green Hydrogen	Operation and Maintenance of the GH plant is an important part of the value chain which will create new jobs and require new skills.	Green Hydrogen that is produced would be required to be stored in the form of Urea, with care and safety	The stored Green Hydrogen needs to be transported throughout the country on demand	Green Hydrogen has demand in various industries such as Steel manufacturing, Transportation and electrification.
Rationale for Mapping	Green electricity produced green sources to ensure the hydrogen produced is green	India needs to be self sufficient in Electrolyser manufacturing to reduce import dependencies leading to increased industry announcements in manufacturing	New Green hydrogen plants need to be built throughout the country and this activity will generate a lot of jobs. Most of these jobs will be short term in nature.	New jobs will be created in the operation and maintenance of the Green Hydrogen plant	Green Hydrogen that is generated can be stored in the form of Urea, creating a potential for jobs	Hydrogen that is stored in the form of Urea needs to be transported throughout the country. This section will create jobs but will not likely demand new skills	Green Hydrogen will be used by multiple purposes. Some of the industries where green hydrogen will be in demand are transportation, steel manufacturing and electrification
Potential Semi and Low-Skilled Job Roles	• Renewable energy system installer (solar/ wind) • Plant operator • Supervisor	• Manufacturing technicians • Computer-controlled machine operators • Welders, cutters, solderers, coaters, painters, and spraying machine setters • Electrical and electronic equipment assemblers, operators	• Green Hydrogen Plant technician • Supervisor- green hydrogen system	• Fuel cell retrofit installer • Hydrogen energy system installer helper • Jr. Technician (electrolyser)	• Process safety technician • Green Hydrogen Storage Jr. Technician/ Operator • Pipeline / Service Technician	• Hydrogen fuel transporter trucker • Hydrogen pipeline construction worker	• Green Hydrogen enabled battery installer • Green Hydrogen enabled battery repair

Legend: High Green Job Creation | Medium Green Job Creation | Low Green Job Creation

Fig. 11 | High-potential value chain segments and job roles for green hydrogen

2 Big Bets that philanthropy can take to enable skill development of workforce to meet the demand for green jobs.

Big Bet 1

Reskill workforce from other sectors for job roles across the green hydrogen value chain

The creation of jobs in the plant construction and commissioning segments requires trained candidates. Many green hydrogen facilities are expected to be constructed within existing renewable energy facilities to ensure a consistent electricity supply. Manufacturing and production are segments that hold medium-term and long-term growth potential for the green hydrogen sector. The National Green Hydrogen Mission has recognised the importance of skill-building to reach renewable energy targets, and mandated the MSDE and the MNRE to lead skill development efforts.[95] MSDE has also formed a committee, including stakeholders like SCGJ, to design and implement skill interventions with a focus on designing, manufacturing, installation, O&M aspects of green hydrogen value chain as well as health and safety.

Developing qualifications and courses focused on various aspects of green hydrogen technologies and promoting skill enhancement for workers from other sectors can help create a wider talent pool. Philanthropy can enable the green hydrogen ecosystem by enabling collaborative action between training partners and industry to develop standard accreditations as well as have online job platforms. Further, conducting baseline assessments on current employment would help promote just transition for existing workforce.

600,000

jobs are expected to be created by 2030 across the value chain due to government initiatives, giving an opportunity for existing workforce from other sectors to transition to green hydrogen.

Over 300,000 jobs

expected in installation of renewable energy, thus, enabling the transition of candidates from other sectors.

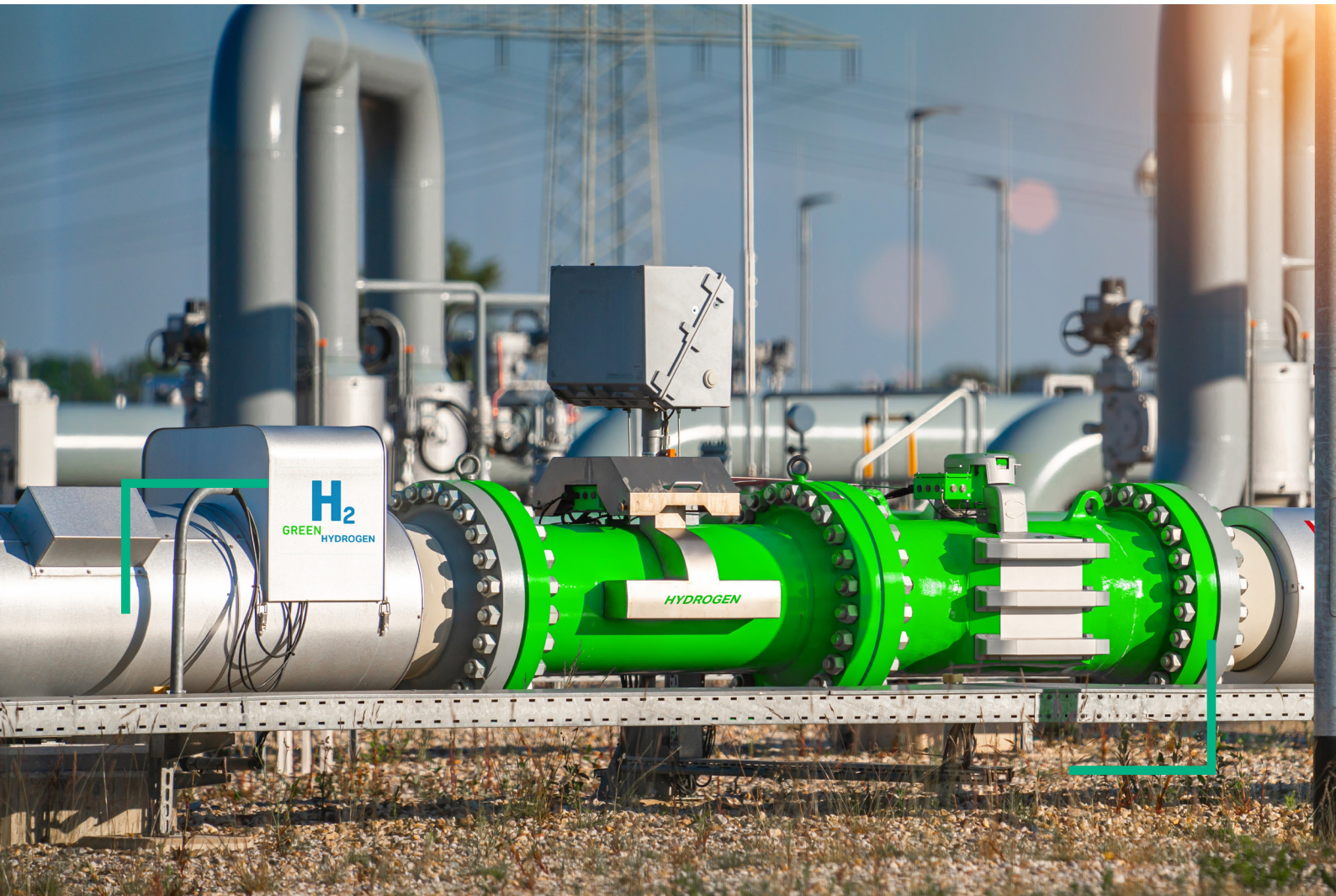
Four qualifications created

since the announcement of the mission for short-term roles. These courses can be modified for creating long-term skill-building courses. [xvi]

Big Bet 2

Train entry-level workforce in electrolyser manufacturing and installation roles.

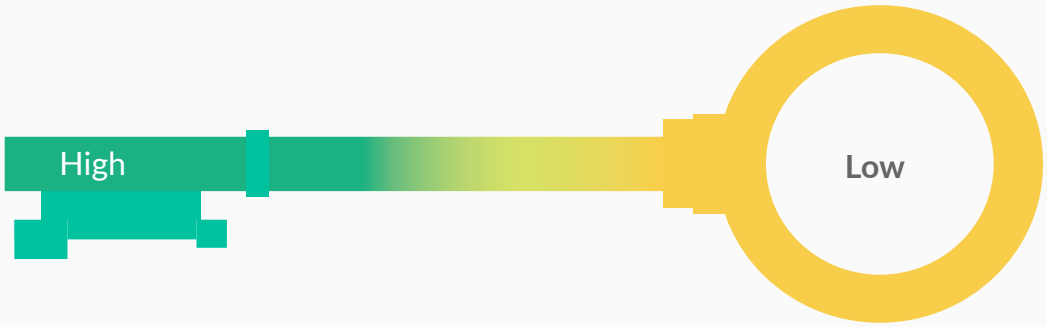
Although the green hydrogen sector in India is currently in its nascent stage, developing training modules to enable the entry-level workforce for manufacturing roles can reduce import dependencies and minimise capital expenditures. Investing in Train-the-Trainer programs in collaboration with the industry is also crucial for sustaining training efforts. Philanthropic organizations can contribute to the development of the skill infrastructure for green hydrogen by advocating, investing, and promoting diversity and inclusion in training programs.



Big Bets

that will potentially derive increased value from philanthropic investments.

Given the government's strong focus on creating a green hydrogen ecosystem and the existing synergies with other renewable energy sectors, philanthropic investments can facilitate the transition of aspiring workforce from conventional and renewable energy sectors to green hydrogen. Aligning training interventions with industry needs is crucial to develop industry-standard accreditations. Conducting baseline assessments to evaluate the current skills of the workforce in other sectors can help tailor courses accordingly and promote their smooth transition to the green hydrogen sector.



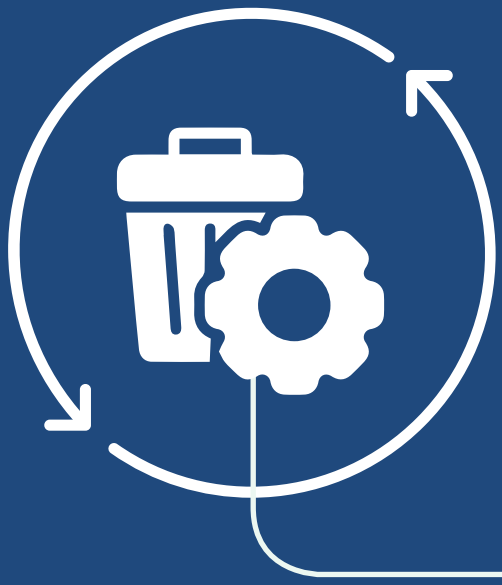
Big Bet 1

Reskill workforce from other sectors for job roles across the green hydrogen value chain

Big Bet 2

Training entry-level workforce in electrolyser manufacturing and installation roles

Fig. 12 | Big Bets



CHAPTER 3

WASTE MANAGEMENT

Value creation through formalisation

This chapter would help understand the high-growth sectors such as E-waste and Wastewater management. Further, it will provide an overview of high-potential value chain segments for green jobs in these sectors, skill ecosystem and big bets for philanthropy to address skill development needs for waste-management.

With industrialisation and urbanisation, India's waste management needs are rapidly boosting sector growth and creating jobs.

India generated 277.1 million tons (MT) of waste in 2021, forming approximately 80% of the total waste generated in South Asia and 13% of the global waste.[96] Due to increasing population, growing disposable incomes, rapid urbanisation, and linear production and consumption patterns, the demand for natural resources and material goods is rising in India. With 60% of the country's population expected to be in urban areas by 2050,[97] the amount of waste generated is expected to grow by approximately 4% per year. However, currently only 28% of waste is treated in the country. [98]

There are an estimated 1.5 million to 4 million waste pickers across India.[99] This makes up for 10% of the global waste sector workforce.[100]

However, only 10-25% of waste pickers are employed formally.[101] Informal workforce, due to lack of appropriate training and equipment, constantly run the risk of infections and communicable diseases due to wounds, chemical burns, and inhalation of toxic gases emerging from waste. Skill development of informal workers has the potential to not only formalise the workers but also help improve their efficiency, living conditions, and grow the capacity of waste treated. Awarding bodies like SCGJ have trained 0.3 million workers so far to enable their formalisation.[102]

E-waste and Wastewater Management are two of the most lucrative sectors in waste management.

There are multiple sectors that fall under the waste management sector, such as solid waste, e-waste, plastic waste, food waste, and textile waste, among others. However, e-waste and wastewater offer the highest opportunity for private training due to strong regulations and high growth. Further, these two sectors have the potential to hire increased number of semi-skilled workers compared to the others.

The upcoming sections of this chapter will deep dive into e-waste management and wastewater management, to assess high-potential value chain segments, potential for green jobs, skill ecosystem and big bets for philanthropy to address skill development needs for green jobs.

3.1 E-Waste Management

Growth of the sector

The e-waste sector in India provides a $3 billion opportunity.[103] While it is still nascent, recent policy interventions will enable the sector to grow further.

India ranks third in e-waste generation,[104] which is increasing by 7-10% annually.[105] The consumer electronics market in India has a projected revenue of $75 billion and is expected to grow by a CAGR of 5.61% from 2023-2027.[106] This increase in demand for electronic goods has resulted in a proportional increase in e-waste generation with two million tons of e-waste being generated every year.[107] To deal with this challenge, India has set out mandates such as the E-waste management rules (2018)[108] and Extended Producer Responsibility (EPR)[109] to regulate the way E-waste is disposed and recycled. While the sector is lucrative, with an estimated value of $3 billion worth of materials, only 0.78 million tons of e-waste is being recycled in the country currently. [110]

Demand for green jobs

Due to the growth in e-waste generation, the sector is estimated to create 0.5 million new jobs in India by 2025.[111]

E-waste currently employs over one million people informally in manual recycling operations,[112] and has the potential to create a further 0.5 million jobs across the value chain. 40% of the new jobs are expected to be in recycling and refurbishment,[113] as skilled workers will be required in recycling and refurbishment segments to shred and sort the different types of e-waste.[114] This process is typically labour-intensive to ensure the parts are accurately shredded and separated. While collection and segregation host a high number of jobs, workforce in these segments are largely informal and require health and safety training to reduce the risk of their exposure to toxic materials and chemicals like lead, cadmium, mercury, chlorofluorocarbons, etc.

High-growth value chain segments

Jobs in recycling and refurbishment are crucial for recovery of precious materials like gold and silver that are used in building high-end machinery in India.

While the e-waste value chain has similarities to the Solid Waste Management (SWM) value chain, operations such as recycling and refurbishment are significantly different. The collection and segregation segments requires candidates who are trained in safety and efficient handling of high value goods. Recycling and refurbishment segments involve expert tasks of dismantling the individual electronic product, sorting the parts by type of materials, cleaning the parts, and then repacking them for use.[115]

	Collection	Segregation	Recycling	Refurbishment
Description of the Segment	Collecting e-waste from private residences, industries etc.	Segregating E-Waste from other solid waste. Within e-waste, segregating different types of e-waste	Dismantling the individual e-waste materials, retrieving different e-waste parts, packing them for reuse.	Fixing old electronic items and making them into products that can be sold again
Rationale for Mapping	While high number of jobs are present at these segments of the value chain, most of them are informal requiring minimum training. Health and safety are a concern as practices are highly dangerous for the workforce and toxic for the environment		A skilled workforce is needed in these segments for efficiently dismantling E-waste by sustaining its high value; maximising retrieval of E-waste components and hence, fostering sector growth	
Potential Semi and Low-Skilled Job Roles	• Waste collector • Sorter • Landfill operator • Drivers	• Supervisors • Waste collectors • Sorters • Drivers	• Supervisors • Dismantlers • Hand separators • Machine operators • Safe packers and drivers transporting E-waste	

Legend: High Green Job Creation | Medium Green Job Creation | Low Green Job Creation

Fig. 13 | High-potential value chain segments and job roles roles for e-waste

2 Big Bets that philanthropy can take to enable skill development of workforce to meet the demand for green jobs.

Big Bet 1

Train entry-level workforce to create a strong cadre for safe recovery, recycling, refurbishment roles

E-waste Management Rules (2018) have been instrumental in putting the onus on Producer Responsibility Organizations (PROs) to skill their employees. However, currently very few PROs skill their employees formally.[116] Most of the training in the sector occurs informally, through contractors/bulk waste collectors, who train the workforce in segregation techniques. Thus, there exists an opportunity for the private training partners to train the incoming candidates and actualise a skill premium for them.

Centre for Materials for Electronics Technology (CMET) under Ministry of Electronics and Information Technology (MEITY), Telecom SSC, and E-PROs like Karo Sambhav have piloted skill-building models wherein existing and incoming workforce are trained, and can earn livelihoods at the training facility, i.e., in-situ models. Philanthropy can support the growth of the skill ecosystem and demonstrate similar end-to-end models, with ITI-led skill development for recycling and refurbishment. The coursework should be developed with deep industry engagement to ensure relevant content is provided. Further, investments are also needed to create accreditation mechanisms for job roles in these segments, in close coordination with PROs.

More than 1 million people

were employed in manual recycling in 2020, hence substantiating the highly informal nature of jobs.

0.5 million more workers

are needed in the e-waste sector by 2025, out of which 40% are needed in recycling and refurbishment.

E-Waste management rules 2018 and EPR

are driving the recovery of e-waste productively as well as enabling formalisation. Currently, India is the only South Asian country with a policy on e-waste management.

1+

Sector Skill Council with 1 qualification for e-waste collector.

~8

Industry players or social enterprises affiliated with Telecom skills council or ministries intending to train their own workforce. These programs include an E-waste segregation and processing course by CMET affiliated with Ministry of Electronic and Information Technology or online Digital Portal called GREENE.

Telecom Sector Skill Council

Ministry of Electronics and Information Technology Government of India

CMET

Fig. 14 | : E-waste management skill ecosystem

Big Bet 2

Upskill existing workforce in collection and segregation value chain segments.

While the core focus of e-waste skill-building can remain on the recycling and refurbishment segment, collection and segregation provides an opportunity for philanthropy to formalise the e-waste value chain by prioritising health and safety related skill enhancement programs. Contractors/bulk waste collectors working with large e-waste generator companies train the workforce in environments where safety protocols are not followed, putting them at high risk of accidents during collection and segregation. [117]

Training programs can focus on operationalising guidelines mandated by E-waste Rules 2018 towards safety of the workers. Philanthropy can demonstrate models of industry collaboration that enables contractors and collectors to leverage existing training providers to raise awareness among the workforce, ensure adoption of safety practices and ongoing monitoring through safety audits.

30% of the 0.5 million

workers are needed in the collection and segregation segments by 2025. Presently, 90% of the workforce in these segments operates informally and training could enable mainstreaming and formalisation. [XVII]

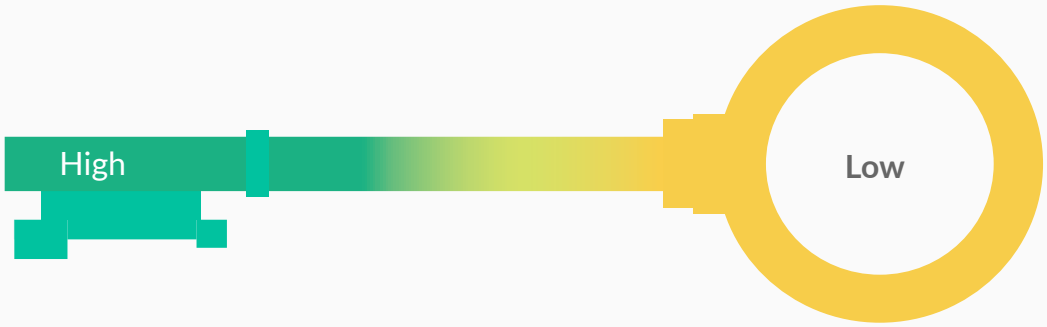
E-Waste Management rules 2018

mandate safe working conditions and skill-building of workers in health, safety, and appropriate methods for e-waste management. [XVIII]

Big Bets

that will potentially derive increased value from philanthropic investments.

Given the highly informal nature of e-waste workforce, philanthropic investments focused on recycling and refurbishment segments of the value chain can derive the highest value. It would also be critical to upskill existing collection and segregation workforce in health and safety protocols to protect them from any risks they could face in the e-waste collection. Across the value chain, there is a need to develop tools to conduct social audits, monitor and have mechanisms for effective implementation of E-Waste Management rules 2018 and EPR.



Big Bet 1

Train entry-level workforce to create a strong cadre for safe recovery, recycling, refurbishment roles

Big Bet 2

Upskill existing workforce in collection and segregation value chain segments

Fig. 15 | Big Bets

3.2 Wastewater Management

Growth of the sector

The wastewater management sector is set to grow at 13% CAGR between 2020 to 2027,[118] which would enable India to meet its water needs across various sectors.

India consumes over 3000 billion cubic metres of water, and this is increasing with agriculture, residential, and industrial water usage[119] growing every year. In this scenario of growing needs, where India houses 18% of world's population, it has only 4% of freshwater sources,[120] resulting in 600 million people being water deprived.[121] With a developing economy and large industrial investments, the water consumption is further increasing and so is the possibility of contamination.

Missions such as Jal Jeevan Mission are striving to provide safe and clean drinking water across all communities in India, hence, accelerating the need for wastewater management.[122] The sector is also being supported by an impetus from large waste recycling programs like Swachh Bharat[123] and Namami Gange.[124] Various state and central regulations such as the revisions to the Environment (Protection) Act, 1986 and the Water (Prevention & Control of Pollution) Act, 1974[125] present strict regulations and seek compliance from industries to clean their water.

Demand for green jobs

The wastewater management sector currently employs 0.71 million people, and this number is expected to increase further given the growth rate of sector.[126] [127]

Increased need for managing industrial waste will result in rise in the number of jobs across sewage treatment plants (STP) and effluent treatment plants (ETP) for managing industrial and residential wastewater. Sectors like textiles, chemical manufacturing, food processing are heavy contributors to industrial wastewater, especially in tier two cities.

High-growth value chain segments

Bulk water transmission, water treatment, and manufacturing of STP/ETP parts are estimated to generate most jobs.

Bulk water transmission, water treatment and distribution segments require work round the clock and thus, workers for three shifts a day.[128] Additionally, due to industrial wastewater regulations, there is a high demand for ETP operators. Skilled workers will be required to supervise and run wastewater operations, conduct periodic maintenance, and conduct process sampling to accurately gauge and monitor levels. Workers will also need to be familiar with the different scenarios to identify weaknesses in the systems and ways to troubleshoot machine breakdowns iteratively.

Most of the construction/installation jobs will be public sector driven, whereas operations and maintenance will be managed by the private sector. It is expected that government funding will support the high capital expenditure requirements for construction of plants.

	Project development	Manufacture of STP/ ETP parts	Construction/ installation of plants	Bulk water transmission and O&M	Water treatment & distribution
Description of the Segment	Bidding on projects, planning and designing plants, allocating budgets, deciding materials etc.	Manufacturing the different Parts and machines required for STPs and ETPs	Construction of the plants. Installing machines and different components	Collecting and managing the supply of wastewater to a plant and sending it to the level of cleaning it requires	Cleaning of the wastewater and then distributing it to be used post cleaning
Rationale for Mapping	While project development is extremely crucial to construct the plants required to increase the water treatment capacity, job roles here are only high skilled	To enable greater construction of plants, there is a requirement to manufacture the parts domestically rather than importing parts	Given the lack of current capacity and increasing government push, there will be a need to construct more wastewater plants in near future	Presence of high labour requirement, requiring 3 shifts a day, therefore majority of job creation will occur in these segments. Additionally due to industrial wastewater regulations, there is high demand for ETP operators	
Potential Semi and Low-Skilled Job Roles		• Electrical technician • Process technician • Equipment assembler	• Electricians • Plumber	• Drivers • Fecal sludge collector/ transmitter • Wastewater plant technician • Desludging operators	• Supervisors / attendant • Water plant technician • STP/WTP operator • Plumber

Legend: High Green Job Creation | Medium Green Job Creation | Low Green Job Creation

Fig. 16 | High-potential value chain segments and job roles for wastewater management

2 Big Bets that philanthropy can take to enable skill development of workforce to meet the demand for green jobs.

Big Bet 1

Skill ETP workforce across various industry sectors

The wastewater skill landscape is mature, consisting of four sector skill councils (SSCs). Apart from affiliated Training Providers (TPs), there are private trainings being undertaken by NGOs to address inclusion and safety challenges that exist in the sector. While there exists more than nine qualifications for the wastewater sector, currently less than 1000 candidates have been trained by SCGJ in two qualifications (Wastewater Treatment Plant Technician and Wastewater Treatment Plant Helper).[129] Current courses also target STP workers, whereas the demand for skilled workforce is in the ETP segment.

There is hence a need to skill ETP workforce across existing sectors in the near-medium term. To enable the ETP workforce to be skilled, it would be important to incentivise training institutes, subsidise course costs for candidates to enable uptake of courses and ensure demand-side engagement with ETPs.

8000 ETP plants

in Maharashtra alone are experiencing worker shortage.[xix] This is a challenge faced across the country.

170+ common ETPs

in industrial parks and thousands of ETPs installed at individual industries are driving demand for workforce.[xx]

Two SSCs

have sector-specific plant operator qualifications. Training focus is however on STP trainings. There is a need for ETP trainings in institutes like ITIs; because industry players need to reskill the entry-level workforce for 6-10 days.[xxi]

4

Government bodies and Sector Skills Councils (SSCs) aligned with Skill India mission, that have created qualifications for their respective sectors

- 4 certification bodies involved
- The different SSCs share the responsibilities of developing qualifications and certifying candidates in different wastewater management in their respective sectors
- Life science and food processing have sector-specific treatment plant operator qualifications

50+

SSC affiliated institutes providing training as per qualifications

- Roughly 50 institutes associated with different SSCs
- Institutes are providing training primarily for O&M of treatment plants
- Most of these courses focus on tasks and not on the logic behind them, thus impacting skills of candidates

30+

private non-affiliated, independent institutes like universities, private institutes, NGOs, etc. providing specialised courses

- Around 30 institutes not associated with any SSC
- Institutes are providing training primarily for O&M independently and not based on any existing qualifications
- Many of these programs are not affordable for low-income groups.

Fig. 17 | Wastewater management skill ecosystem

Big Bet 2

Train entry-level workforce in emerging ETP/STP manufacturing by leveraging ITIs

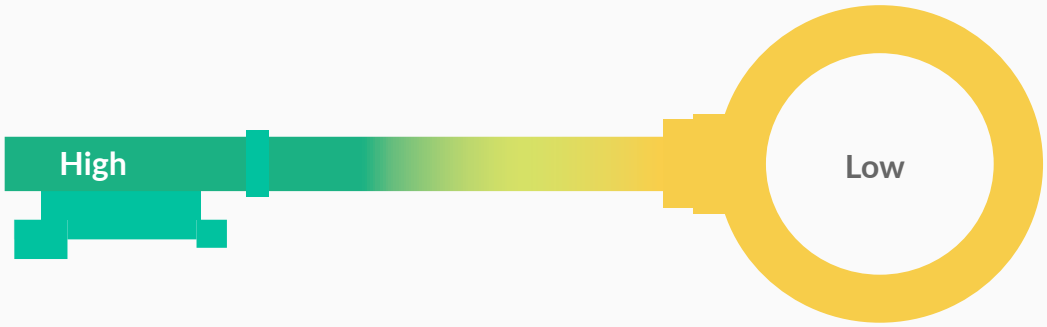
With the emergence of players like GE and Voltas as well as large recycling programs like Namami Gange or Swachh Bharat, there is an impetus to reduce further discharge into water bodies. This would make it crucial to develop the workforce to manufacture STP/ETP parts to reduce import dependency. However, currently, there are no qualifications for STP/ETP manufacturing. Philanthropy can support by demonstrating a holistic skill development model from course creation to placement. This is possible with deep industry engagement, developing industry aligned curriculum, and creating public goods like hiring platforms which would lead to seamless placements.

Big Bets

that will potentially derive increased value from philanthropic investments.

Given the huge demand for labour required for ETP operators, as well as the existing maturity of the sector with over 170 common ETPs in industrial parks, philanthropy can derive most value by enabling the ETP workforce to be trained.

In terms of a long-term focus, it would be important to develop a domestic manufacturing industry, and a skilled workforce to develop STP and ETP plants. This would support the established industry players to grow their presence in the sector and make larger investments.



Big Bet 1

Skill ETP workforce across various industry sectors

Big Bet 2

Train entry-level workforce in emerging ETP/STP manufacturing by leveraging ITIs

Fig. 18 | Big Bets

CHAPTER 4

GREEN TRANSITIONS

IN KEY TRADITIONAL INDUSTRIES

Creating a climate-positive workforce

Understanding green transitions in traditional industries, such as Automobiles, Construction, and Textiles. Further, this chapter also provides an overview of high-potential value chain segments for green jobs, the skill ecosystem and opportunities for philanthropy to address skill development needs across the sectors.

India is experiencing a huge wave of green transitions across traditional sectors with 138 companies having set targets to achieve net-zero emissions by 2050.[130]

Sustainability is becoming a critical aspect of businesses, with a growing emphasis on Environmental, Social, and Governance (ESG) reporting. Global sustainability standards emerging from climate action frameworks like the Sustainable Development Goals (SDGs) and the United Nations Framework Convention on Climate Change (UNFCCC) are driving a strong focus on environmentally positive practices. These international trends are also influencing domestic policies. For example, the Indian Green Building Council (IGBC) is leading efforts to promote environmentally positive operations in the construction sector. About 138 organisations are taking initiatives to monitor and manage their emissions output and other sustainability metrics.[131] As a result, sustainability principles such as reducing resource intensity, improving energy efficiency, and minimising waste are becoming key across various sectors.

Among the traditional sectors, automotive, construction, and textiles are expected to be the largest contributors to the green economy and will require a skilled workforce.

The automotive sector is undergoing significant changes due to green transitions, particularly the shift from traditional Internal Combustion Engine (ICE) vehicles to Electric Vehicles (EVs). This transition is supported by a favorable regulatory ecosystem, including initiatives to build charging infrastructure for EVs. The Ministry of Heavy Industries has already approved 4,453 charging stations with an investment of $81.23 million under the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME II) scheme.[132] Additionally, various incentives are being offered to both manufacturers and consumers to encourage the adoption of EVs.

In the construction and textile sectors, green transitions are crucial due to their significant employment generation potential and their current environmental impact. The construction industry alone accounts for 22% of the total emissions in the country.[133] Moreover, the textile industry is known for its high water usage throughout the value chain, from crop production to fabric processing and manufacturing.[134]

In the textile sector, various certifications and standards are being developed to ensure sustainable practices. These include certifications for organic textiles, fair trade practices, and responsible manufacturing processes. This has led to a growing adoption of sustainable materials in the industry, with companies exploring alternatives to conventional fabrics and utilizing eco-friendly materials. Furthermore, the construction industry is also witnessing a rise in green building certifications such as LEED (Leadership in Energy and Environmental Design) and GRIHA (Green Rating for Integrated Habitat Assessment). These certifications promote sustainable design, energy efficiency, and the use of eco-friendly materials in construction projects. The concept of a circular economy is gaining traction in both the textile and construction sectors, with a focus on recycling, upcycling, and waste reduction. This approach aims to minimize waste generation and maximize resource efficiency.

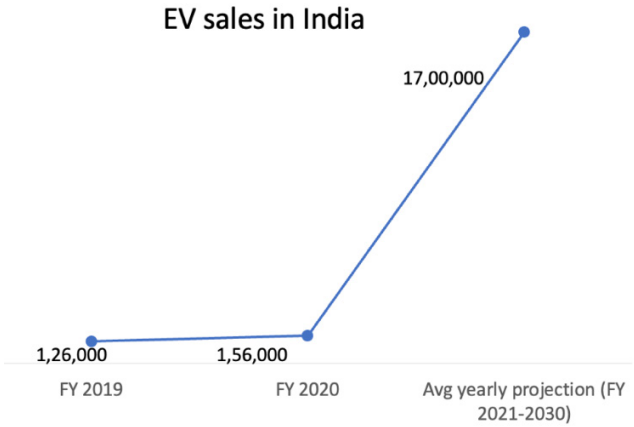
The upcoming sections of this chapter will delve deeper into the Electric Vehicles, Green Construction, and Green Textiles sectors, while assessing high-potential value chain segments, the potential for green jobs, the skill ecosystem, and the potential role of philanthropy in addressing the skill development needs for green jobs.

4.1 Electric vehicles

Growth of the sector

The Electric Vehicles sector in India is projected to grow at a CAGR of 90% between 2021 and 2030.[135] This rapid growth can be attributed to significant technological advancements that are driving the transition towards more environmentally friendly automotive solutions

Prominent players such as Tata, Hyundai, Mahindra, and others have entered the EV market, underscoring the immense potential of the sector. Additionally, there has been a surge in investments in EV startups, with 486 startups receiving a cumulative funding of $444 million in 2022.[136] Production Linked Incentive (PLI) schemes have played a pivotal role in boosting local EV production. Notably, investments totaling $3.1 billion have been made in battery electric technology, while advanced chemistry cell manufacturing has attracted capital worth $2.4 billion.[137] Furthermore, policies such as the FAME I and II have significantly influenced customer attitudes towards EV adoption. Several states, including Maharashtra, Delhi, and Haryana are offering additional subsidies to incentivise new buyers.[138] Moreover, the Vehicle Scrappage Policy (2021) provides tax rebates, discounts, and waivers to customers who opt to replace their old Internal Combustion Engine (ICE) vehicles with EVs. Overall, the favorable policy landscape, combined with the participation of influential industry players and growing investments in EV startups, the EV sector is poised to propel growth in India.



Demand for green jobs

The increased production of EVs is projected to generate 10 million direct jobs and 50 million indirect jobs by 2030.[139] This presents a significant opportunity to absorb the existing workforce of 35 million workers from the ICE sector,[140] as well as create employment opportunities for new workforce.

High-growth value chain segments

Manufacturing, after-sales services, and the installation of charging infrastructure are vital segments in the value chain for skill development and job creation

With the transition to EVs, the automotive sector is poised to become both compact and complex. Technology advancements will have a substantial impact across the entire value chain, with a particular emphasis on the battery as the primary component. This shift will involve a significant transformation, reducing the number of moving parts from around 2000 in internal combustion engine (ICE) vehicles to approximately 20 in EVs. Consequently, operational procedures will undergo substantial changes. The battery component relies on various segments within the value chain, including research and development, design, manufacturing, assembly, service, and charging infrastructure. Understanding the interdependence of these segments is crucial when considering the new skills required for the workforce. Furthermore, the installation of charging infrastructure and EV servicing represent additional segments that will generate job opportunities across different regions in India, demanding a semi-skilled workforce.[141]

Source: Context via Clean Technica

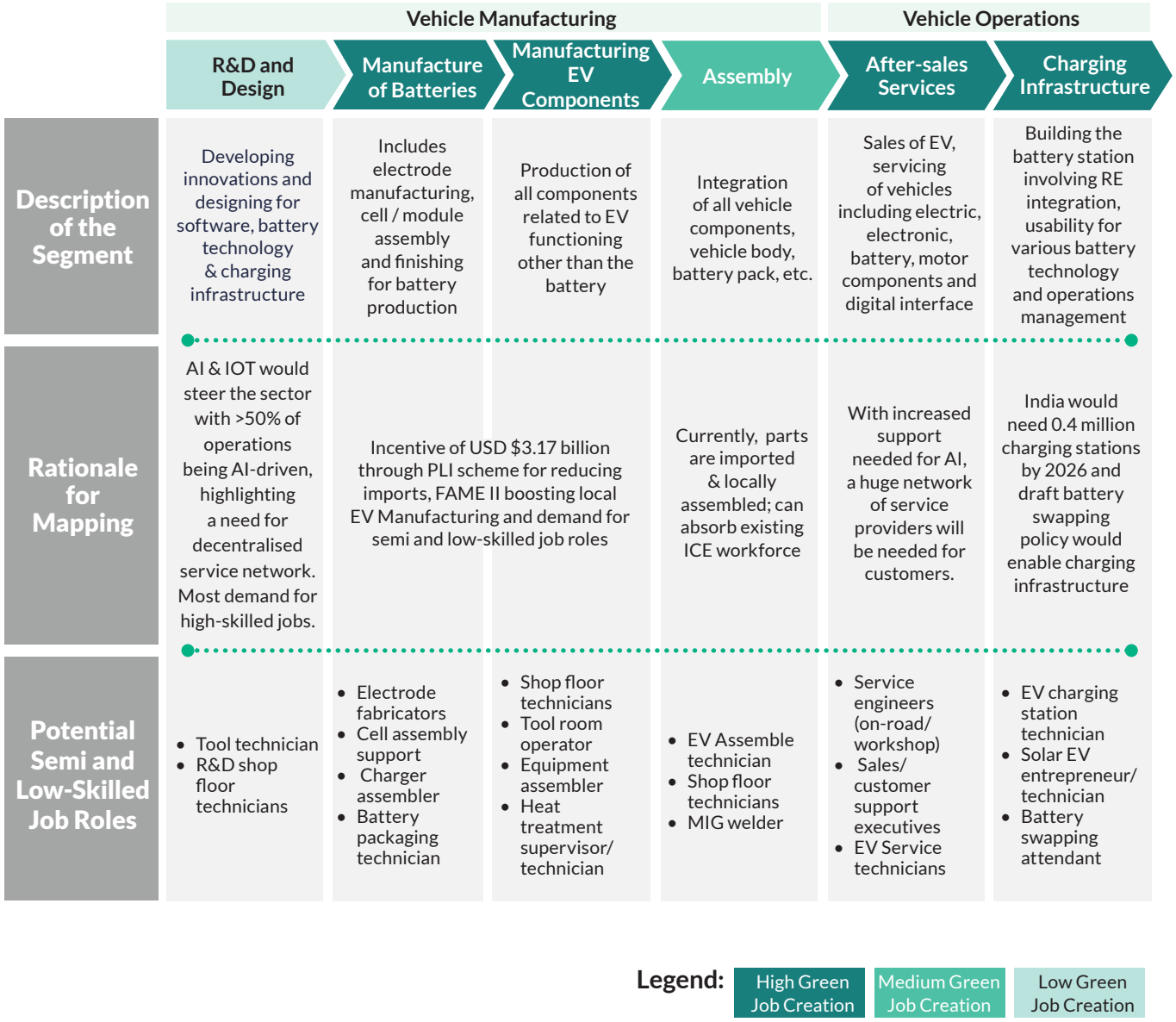


Fig. 19 | High-potential value chain segments and job roles for EV

3 Big Bets that philanthropy can take to enable skill development of workforce and meet the demand for green jobs.

Big Bet 1

Train entry-level workforce for battery manufacturing and charging infrastructure roles by leveraging ITIs

While battery and EV component manufacturing are expected to host the majority of jobs, there is a shortage of skilled labor in these segments. With a predicted 1600% growth in demand for Li-ion batteries from 2020 to 2030,[142] this segment presents a huge opportunity for employment for incoming workforce. Local manufacturing is also bolstered by the PLI scheme, with players such as Tata Power and Hero MotoCorp either setting up their own plant facilities or investing in organisations like Log9, and Ather Energy. Other EV auto parts are predicted to have a 22.1% compound annual growth rate (CAGR) between 2020 and 2030,[143] with key market players like Panasonic, Samsung, and Bosch making their foray into the industry. Currently, these segments do not have a readily available workforce, and training interventions are central to meet the growing demand.

Another segment that requires immediate attention is EV charging infrastructure, as it shows strong potential for job creation with 2.9 million public chargers required in India by 2030.[144] Organisations like Sunfuel Electric, Sun Mobility, and others are also driving innovation by utilising interoperable energy infrastructure and adopting battery swapping models, which necessitate an immediate workforce for the installation of charging infrastructure.[145]

In order to cater to the needs of the EV sector, the current EV skill infrastructure is mature but requires more collaborative initiatives among different players. Presently, EV training is

Six million semi & low- skilled

workers would be required for battery manufacturing and charging infrastructure. [xxii]

$2.2 billion PLI

announced as incentives for advanced chemistry cell to reduce imports.

~5000 charging stations

have been approved under FAME I and II. [xxiii]

regulated by three Sector Skill Councils (SSCs) that provide the necessary requirements and have created 11 qualifications for semi-skilled workers in various subsectors.[146] Several small and medium-scale private training institutes, such as Skill Shark, provide modular online/offline short-term certification courses to prepare candidates for specific segments like battery operations and repair. Independent institutes like Autobot Academy also offer technical courses and diplomas on battery pack or EV servicing.

However, these efforts are occurring in isolation, and there is a need for collaboration between industry and training institutes in terms of curriculum design and training to meet the workforce demands. An example of this from the existing automotive initiatives is the Toyota Technical Education Program (T-TEP), which has partnered with 56 ITI/Polytechnic colleges covering 21 states. Over 10,000 students have been trained through this program, with 70% of them employed in various automobile companies.[147] Similar models in ITI/Polytechnic colleges need to be scaled by philanthropy to meet skill-building needs in battery manufacturing and charging infrastructure segments. Additionally, while designing the action steps for significant investments in this big bet, job roles such as Cell Assembler, Battery Packaging Technician, EV Charging Station Technician, and Battery Swapping Attendant need to be prioritised for regular course development, upgradation, and large-scale training implementation.

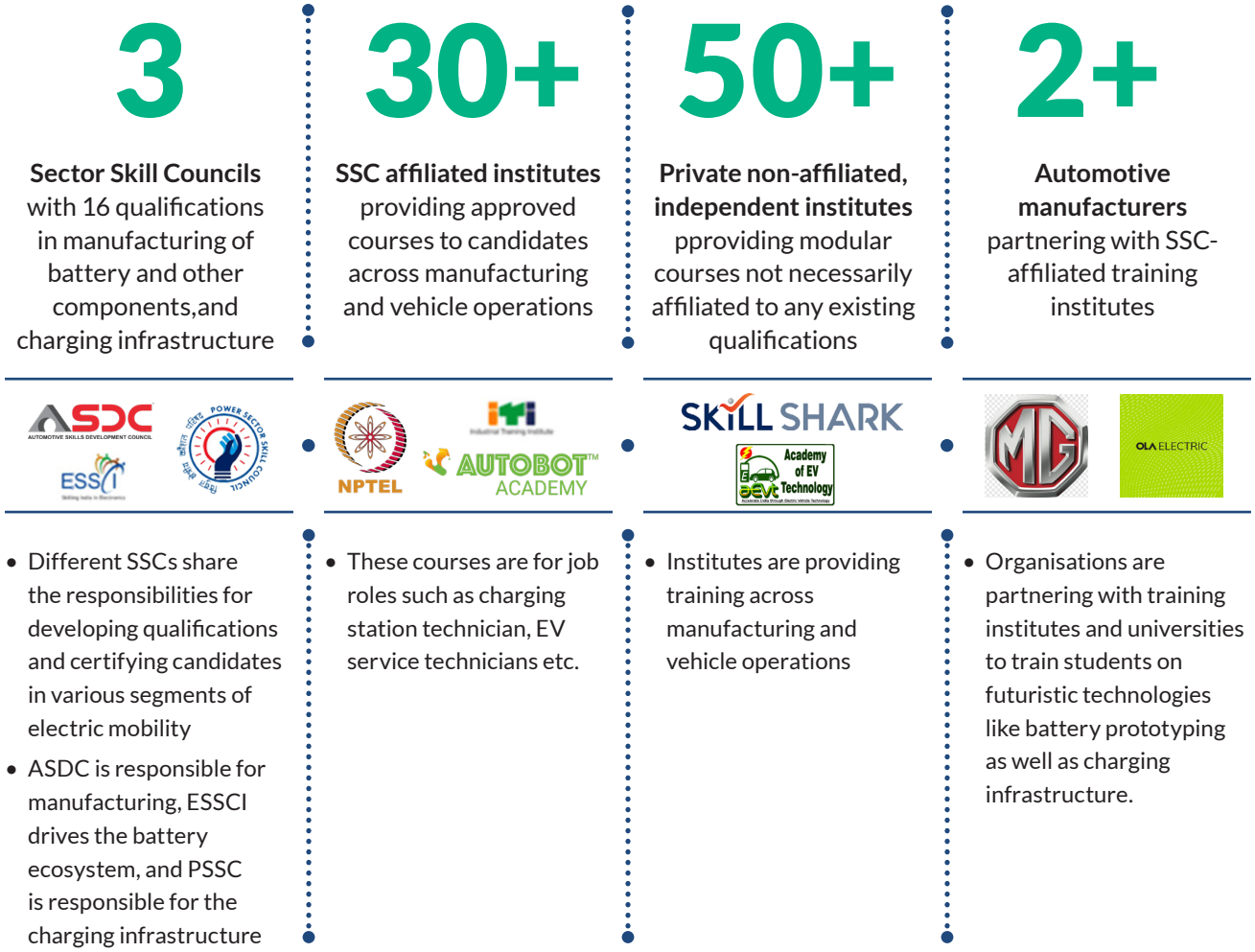


Fig. 20 | EV skill ecosystem

Big Bet 2

Skill and enable transition of existing ICE workforce to EV, specifically EV assembly and manufacturing

As the entire automotive industry transitions to EVs, it is crucial to minimise job losses among the existing ICE workforce and utilise their skillset to facilitate their entry into the EV value chain. Infrastructure such as Industrial Training Institutes (ITIs) could play a pivotal role in realising this opportunity. Skill-building of the existing ICE workforce depends largely on a clear understanding of the industry's needs. Therefore, philanthropic investments can help in establishing connections between industry stakeholders and training institutions to develop standardised accreditations and online job platforms that ensure job continuity for ICE workforce. The ecosystem can learn from examples such as that of Hero Electric, which has partnered with Ready Assist to train and upskill 20,000 mechanics for EV servicing.[148]

35 million
workers could be potentially upskilled and reabsorbed into the EV workforce.

Established players like TATA, Hyundai and Mahindra
transitioning to EVs.

Ease of transitioning to EV assembly
value chain segment, especially for ICE workers.

Source: Reuters

Big Bet 3

Establish network of women entrepreneur-led after sales services and charging centres

In order to achieve long-term diversity and inclusivity in the EV workforce, it is essential for skill-building initiatives to address the low participation rate of women in the automotive sector. Targeted interventions can be designed to create employment and entrepreneurship opportunities for women in after-sales service centers. Valuable insights from existing training and employability models focusing on women can be implemented. For instance, Poise Scooters has successfully built an entire sales and logistics team comprising women,[149] while Ola's Future Factory aims to employ and upskill over 10,000 women, targeting a 100% women workforce. [150]

To support the establishment of a women-led after-sales service network, conducting a baseline study to assess current employment rates, working conditions, and skill development needs of women would lay the foundation for achieving gender equity. Handholding support can be provided to women entrepreneurs in accessing finance, identifying market opportunities, and obtaining necessary resources for establishing after-sales service and charging centers. Such initiatives would not only contribute to the wider adoption of EVs but also create space for women, particularly in tier I and tier II cities, in the coming years.

66% of female candidates

surveyed wished to work in the sector. [xxiv]

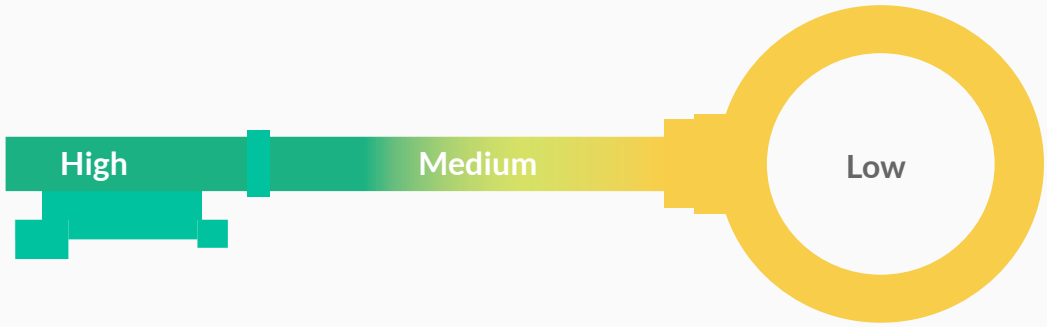
Lack of targeted mobilisation towards women

as there are stereotypes about women's ability to perform operations in the EV sector. [xxv]

Big Bets

that will potentially derive increased value from philanthropic investments.

With the rapid growth and transformation of the EV segment, it becomes crucial to expand the skilled workforce in manufacturing and charging segments to facilitate accelerated adoption and enhance reliability. Additionally, it is vital to ensure that the transition from ICE to EV does not marginalise the existing workforce. Moreover, there is a long-term need to foster diversity and inclusivity within the EV workforce. However, achieving this goal necessitates systemic changes in perceptions within the ecosystem, which can be accomplished through sustained long-term investments that showcase entrepreneurship-based training models.



Big Bet 1

Train entry-level workforce for battery manufacturing and charging infrastructure roles by leveraging ITIs

Big Bet 2

Skill and enable transition of existing ICE workforce to EV, specifically EV assembly and manufacturing

Big Bet 3

Establish network of women entrepreneur-led after sales services and charging centres

Fig. 21 | Big Bets

4.2 Sustainable Textiles and Apparels sector

Growth of the sector

The size of the Indian textile and apparel market reached $172.3 billion in 2022 and is projected to reach $387.3 billion by 2028, exhibiting a CAGR of 14.59% during this period.[151] The industry's shift towards green practices will pave the way for sustainable and carbon-free growth.

The domestic apparel and textile industry in India contributes approximately 2% to the country's GDP, and 7% of industry output in value terms. With it being one of the largest producers of cotton and Jute in world, India ranks sixth in the exports of cotton globally and holds 4% share of the global trade in textiles and apparel.[152] The industry attracted foreign direct investment (FDI) worth US$ 4.03 billion between April 2000-June 2022.[153]

As the textiles sector has witnessed a spurt in investments, the global movement towards sustainability and ethical fashion is deepening India too. Initiatives such as the UNFCC's Fashion Industry Charter for Climate Action, which focuses on achieving net-zero emissions, and the EU's strategy for sustainable and circular textiles are gaining traction in India. Furthermore, industry players in India are adopting standards like the Better Cotton Initiative (BCI) for sustainable cotton production, Fair Trade for promoting organic cotton exports, Recycled Claimed Cotton (RCS), Global Organic Cotton Standard (GOTS), and more. Indian and international organizations such as H&M, Birla Cellulose, Coats Group, Renewcell, and iSKO have implemented sustainable fashion policies. These policies have also furthered into action with Welspun India, and Aditya Birla Retail Fashion Ltd, developing assessment tools to measure sustainability in production. [154]

The movement towards sustainability in the textile industry in India will have multiple environmental impacts, including the reduction of significant water consumption in cultivation and dyeing processes, as well as addressing textile waste generation. Without adopting circular fashion practices, it is estimated that 73% of textile fabric waste will end up in landfills.[155] However, by following an accelerated abatement pathway aligned with the 1.5-degree goal in the next decade, the industry can potentially reduce 50% of its emissions globally,[156] with India playing a significant role.

Demand for green jobs

The future of sustainable textiles presents a significant opportunity to promote just transitions for 45 million textile workers in India.[157]

The textile sector, the second largest employer after agriculture, directly employs around 45 million workers and indirectly supports 100 million workers.[158] The exact number of workers currently impacted by greening transitions is unknown. However, it is estimated that for every 1,000 pieces of textile waste that are handled and recycled, approximately 20 green jobs can be created.[159] Given the significant presence of women and informal labor in textile waste management, promoting greening initiatives in the sector through skill development would not only expedite formalisation but also enhance the wellbeing of these vulnerable groups.

High-growth value chain segments

Fabric construction, apparel making, and end-of-life segments are of utmost importance for sustainable textiles. These are the areas where the majority of semi-skilled and low-skilled jobs will be affected, necessitating significant efforts for skill-building of existing workforce.

Across the value chain, various transitions are taking place in the sustainable textiles industry. In the fiber procurement and processing segment, there is a shift towards alternative materials such as hemp, jute, bamboo, and fibers made from agricultural waste, with social enterprises leading the way. To process these natural fibers, plant waste dyes, or nano dyes are being utilized to address the issue of excessive use of chemical dyes and the resulting water pollution. In the apparel-making stage, sustainable clothing production is being embraced by major brands like Birla Cellulose and Arvind Fashions, who are using organic cotton, khadi, and similar materials on a large scale. To meet export quality standards, organizations like BL International are conducting sustainability assessments and implementing resource-efficient practices.

In the distribution and retail segments, there are changes aimed at using clean energy sources, adopting green buildings for operations, and incorporating electric vehicles for logistics. At the end of the product life cycle, textile waste management and closed-loop systems are being prioritized, driven by both operational changes and shifting consumer attitudes towards circularity. While the entire textiles value chain is undergoing greening transitions, segments such as fabric construction and apparel making are experiencing significant transformations due to their high resource consumption and waste generation.

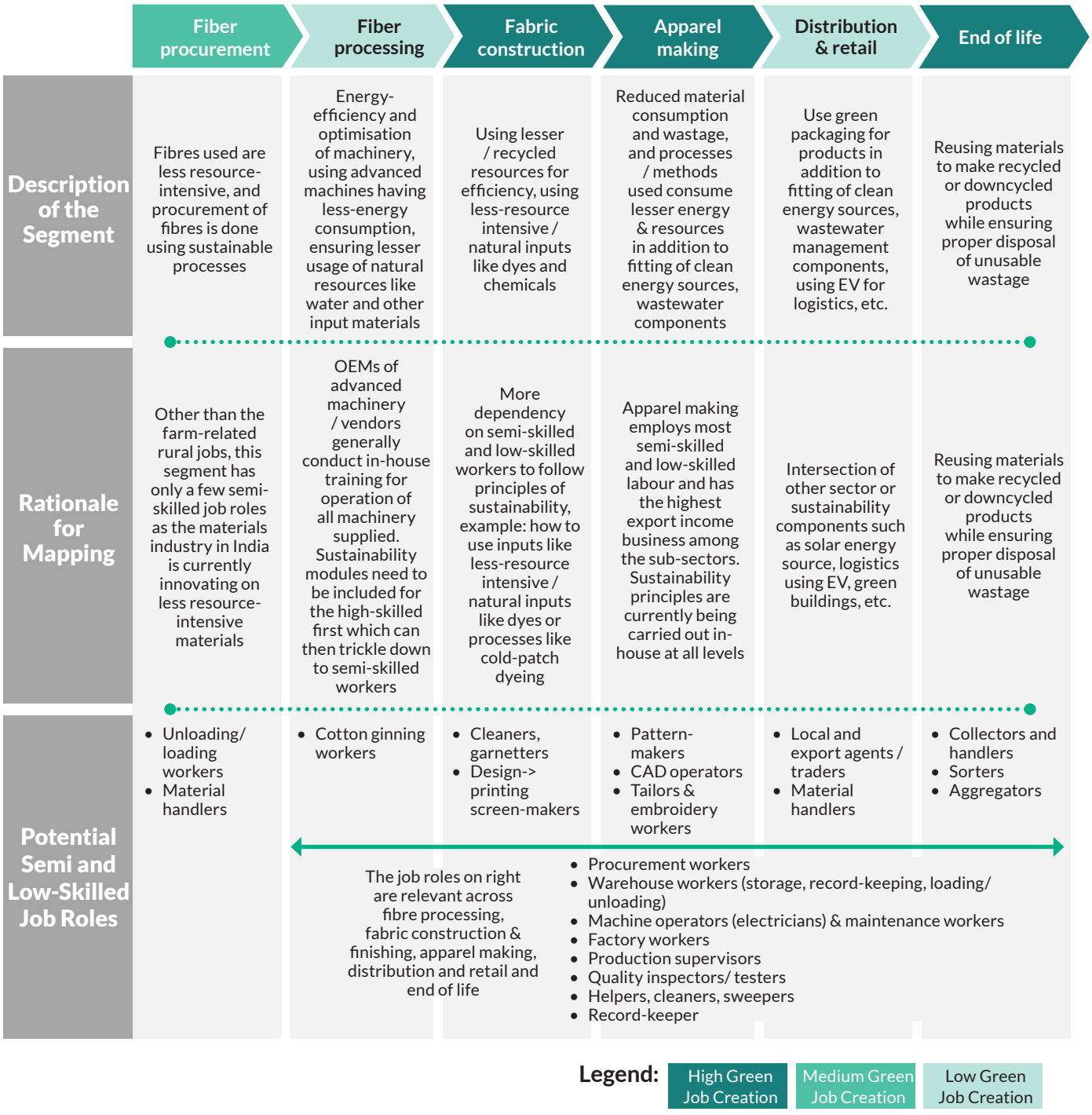


Fig. 22 | High-potential value chain segments and job roles for sustainable textiles and apparel

2 Big Bets that philanthropy can take to enable skill development of workforce to meet the demand for green jobs.

Big Bet 1

Institutionalise entry-level training of textile-waste workers on safe disposal, recovery, and recycling

Focusing on the end-of-life segment is crucial for promoting circularity in the textiles value chain and achieving global sustainability standards, while also facilitating waste recovery. The textile waste sector has long been plagued by informality and a lack of adequate training and safety measures for workers. Several social sector organisations are working to address this issue by focusing on capability building of workforce in practices such as waste sorting, recycling, and promoting worker rights and social security. Sustained attention to this segment is essential for ensuring circularity in the textiles value chain and creating decent work opportunities.

To support the skill ecosystem, philanthropy can initiate collaborative efforts to scale up the training of entry-level workforce in textile waste management. Further, in-situ training models for waste recovery can be implemented to develop practical-oriented curricula and ensure that waste workers continue to earn wages while undergoing training. Additionally, credentialing initiatives and assessments are needed to provide trained waste workers with recognised status, that can enable skill premiums. These initiatives will contribute to achieving sustainable growth and addressing the 17% of textile waste that currently ends up in landfills in India. [160]

Multiple for profit and non-profit organizations like **Fashion for Good, Saahas Zero Waste, and Hasiru Dala**, are working in textile waste management; and aiding in formalisation of

~4 million textile waste workers.

While there are no domestic standards, **global sustainability standards like RCS and GRS, provide criteria for environmental/ chemical processing of waste.** These are influencing waste management practices in India gradually.

Most trainings currently happen on the job, informally. **Very few organisations** conduct capability-building programmes for textile waste workers; and it is necessary **to institutionalise skill development to actualise formalisation of waste workers in the textile sector.**

Big Bet 2

Skill existing and entry-level workforce on sustainable textile production techniques, especially in sustainable fabric construction and apparel making.

Many semi-skilled jobs in fabric construction and apparel making are expected to be affected as these segments transition to become less resource-intensive and rely on sustainable materials. The industry is focusing on alternative methods of processing, reducing water and electricity usage, and creating recyclable fabrics. Training millions of workers in suitable methods such as exhaust piece/continuous/cold-patch dyeing, sustainable laundry, and techniques like preheating water using solar thermal boilers is necessary. Other functions include extracting useful salts from processed water and recycling water. For instance, Welspun India Pvt. Ltd. stated in 2021 that they have recycled around 7,000 billion liters of water and harvested approximately 3,000 million liters of rainwater, which required a skilled workforce.[161]

45 million workers

existing in the textile value chain can be upskilled on sustainable production techniques.

Opportunity to streamline in-house training conducted by various industries working on green products.

Opportunity for enabling decent growth and tackle the bundled disadvantage of gender, informality as well as health challenges.

Moreover, the apparel industry's emphasis on export-quality products also necessitates skill-building of the existing semi-skilled workforce to meet ESG data requirements and perform related tasks. While SSCs such as the Textile Skill Sector Council (TSSC), Apparels Made-ups Home Furnishing Sector Skill Council (AMHSSC), and Leather Skill Sector Council offer courses with some emphasis on efficient material usage and waste reduction, these modules are primarily aligned with traditional sector operations and lack a sustainability focus.[162]

Further, various corporations, social enterprises, and non-profit organizations are conducting in-house training modules in different value chain segments, covering areas such as advanced machinery usage, sustainable materials, energy efficiency, resource usage data entry, and sustainable laundry of finished products. However, to address immediate greening needs in the sector, there is a need for sustainable courses targeting job roles such as procurement workers, warehouse workers, and machine operators in fabric construction and apparel making. Short-term skill development and apprenticeship training models with specialised modules or specialisations in fabric construction and production techniques would facilitate scalable training and provide candidates with specialisation options. Institutes like the Apparel Training and Design Centre (ATDC) can be leveraged in partnership with ITIs to offer these courses.

Formal training initiatives will also help address the existing informality in the sector and the lack

of governance to monitor working conditions. Currently, workers often face long hours of work in ergonomically unsuitable conditions, dimly lit rooms, and exposure to dust, chemicals, and toxic materials. Informal contracts leave them without agency to address issues like gender wage gaps, irregular payments, and abuse.[163]

Developing synergies between the industry and skill development bodies and institutes is critical to enable a smooth transition for the existing workforce and develop the entry-level workforce. This will ensure clear alignment of skills and capacities and support the transition of existing workers.

1

Private institute offering course in Textile waste management

- The institute has one course in textile waste management amidst the several other conventional textile courses

35+

Social enterprises / startups / MSMEs working in green businesses and enabling skill-building in-house

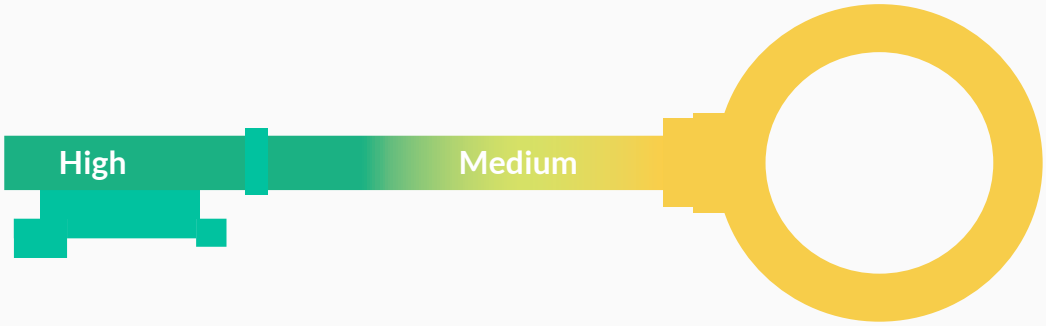
- In-house skill development initiatives may be conducted for ESG reporting / assessments, advanced machinery training, adoption of sustainable practices and processes, and formalising textile waste workers in raw material production, fabric construction and end of life value chain segments

Fig. 23 | Sustainable textiles and apparels skill ecosystem

Big Bets

that will potentially derive increased value from philanthropic investments.

Textile waste is one of the largest contributors to GHG emissions. Enabling the waste workforce has the potential to help reduce the emissions and bring in a circular approach to the textile industries. Further, it has the potential to positively impact over four million informal textile waste workers. It would also be important to enable the fabric construction and apparel making segments of the value chain segments to start taking a more sustainable approach to reduce the amount of waste generate and decrease consumption of resources



Big Bet 1

Institutionalise entry-level training of textile-waste workers on safe disposal, recovery, and recycling

Big Bet 2

Skill existing and entry-level workforce on sustainable textile production techniques, especially in sustainable fabric construction and apparel making.

Fig. 24 | Big Bets

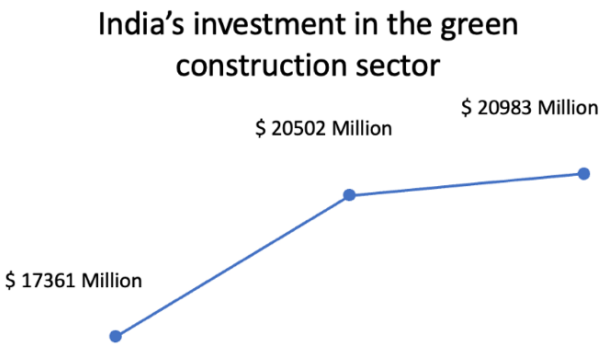
4.3 Green Construction

Growth of the sector

The green construction sector witnessed a CAGR of 7.2% between 2017 and 2021, reaching a total investment of $20,983 million in 2021.[164] This substantial growth can be attributed to the increasing emphasis on international and domestic standards and the decarbonization targets set by companies, which are driving the focus on green buildings.

Every year, 12 million people in India migrate to urban areas, resulting in a need for approximately 110 million additional homes. This translates to around 900 million square meters of new residential and commercial space.[165] However, if these buildings were constructed using green and sustainable processes, India could have unlocked potential to reduce energy usage by 30% and CO2 emissions by 35%.[166]

The implementation of global and national green rating systems by organisations like the Indian Green Building Council (IGBC) and GRIHA is driving the transformation of the sector towards sustainability and circularity. Moreover, several major private players are acknowledging these advancements and setting decarbonisation targets for themselves. As a result, the green material market is being significantly influenced, impacting various construction processes.



Demand for green jobs

By 2030, around 11 million jobs in the construction sector could be affected by green transitions.[167] Addressing the prevalent informality in the sector, skill development initiatives can play a crucial role in facilitating the creation of decent jobs.

The construction industry is the second largest employer in India, with a predicted employment of over 76 million workers in various segments of the value chain in 2022.[168] However, 97% of the workforce in this sector operates informally, and it predominantly comprises migrants and individuals from marginalized communities with limited or no education.[169] By formalising this workforce through training initiatives, they can be entitled to receive minimum wages, ensure occupational safety and health standards, and gain access to social benefits such as housing and childcare.

High-growth value chain segments

The procurement of sustainable construction materials and management of end-of-life processes are considered to be the most lucrative segments due to the increasing demand for recyclable materials and the need for efficient management of demolition waste.

At each stage of the construction process, there is a growing awareness and commitment to sustainable practices, reshaping traditional approaches to building structures. Beginning with the design and approvals stage, architects and designers are incorporating sustainability principles into site plans. Builders like Good Earth and Green Evolution are leading by example, demonstrating the positive impact of green designs and collaborating with knowledgeable masons who have a deep understanding of local materials. These designs prioritize elements such as natural light and cross ventilation, while also minimising the impact on regional biodiversity.[170]

In the subsequent stages of material procurement and construction, there is an increasing focus on using environmentally friendly materials and adopting sustainable processes. In response to the urgent need to protect the environment, several early-stage startups, including Green Jams, Strawcture, Zerund Bricks, Geeli Mitti, and Carbon Craft Design, are exploring innovative and sustainable raw materials. These include eco-friendly cement, alternative brick materials, and materials made from agricultural waste, among others.[171] Furthermore, larger private players are also exploring ways to source local materials, reducing the carbon footprint associated with logistics.

Operations such as facility management, housekeeping, and maintenance are also transitioning towards resource-efficient solutions, such as the use of renewable energy and water harvesting practices.[172]

To address the management of construction waste, the sector requires significant changes, which are closely tied to the design of the site plan. Encouragingly, early efforts to manage demolition waste are already underway, with industry players segregating and reusing materials. The adoption of green practices will have a transformative impact on the entire construction value chain, with certain segments, such as material procurement and end-of-life management, undergoing significant changes that will also influence other segments.

	Design and approvals	Material procurement	Construction process	O&M (generally outsourced)	End of life / recycling
Description of the Segment	The design of the building, planning for upcoming processes follows principles of sustainability	The materials are procured locally (reducing carbon footprint) and processes for making the materials are sustainable either by scientific or intergenerational knowledge	The materials and processes used during construction is sustainable, and methods used either reduce pollution, use lesser energy and conserve natural resources like water	Processes / activities are carried out by using resources conservatively and also ensuring the repair and management of sustainable components such as solar energy source, wastewater systems, etc.	Energy-efficient execution of demolition, land-friendly disposal that leads to minimum / no emissions and maximum recovery
Rationale for Mapping	More high skilled jobs are set to be impacted in this value chain segment as design stage relies on effective / sustainable architecture and planning	Procurement of either local / sustainable materials requires intergenerational knowledge or scientific guidance from high skilled workforce and this segment is crucial to enable a major transition for the sector	More sector-agnostic job roles will be impacted and most tradespeople are upskilled on the job by the high skilled workforce currently	O&M requires maintenance of the materials or components already fitted to conserve energy, resources like water, wastewater, etc	Only 1% of India's C&D waste is either recovered or recycled, with the remaining going into landfills and the workforce involved is currently upskilled on the site
Potential Semi and Low-Skilled Job Roles	• Office assistants • Record-keepers	• Machine operators • Procurement workers • Material handlers	• Foremen for various trades • Site supervisors and timekeepers • Carpenters and bar-benders • Masons • Fitters • Painters and helpers • Electricians • Plumbers • Construction workers	• Electrician • Plumbers • Housekeeping staff • STP/ WTP Operators • Gardeners • Security guards/ supervisors	• Drillers • Dismantlers of internal and external brickworks • Wire pullers • Wrapping of buildings • Blasting helpers • Demolition labourer • Demolition cleaners • Waste sorters / collector

Legend: High Green Job Creation | Medium Green Job Creation | Low Green Job Creation

Fig. 25 | High-potential value chain segments and job roles for Green Construction

3 Big Bets that philanthropy can take to enable skill development of workforce to meet the demand for green jobs.

Big Bet 1

Upskill existing construction workers towards green construction

There is a pressing need for comprehensive sustainability courses throughout the construction value chain to facilitate the skill-building of existing workers. These courses could address the immediate requirements for adopting green practices in the sector and empower individuals to secure decent livelihoods. The employment of unskilled migrant labor in this sector is predominantly informal, which deprives workers of basic rights, including fair wages and adequate safety measures. Consequently, their overall wellbeing and safety are compromised.

By skill-building of the existing workforce through source-side and in-situ programs that focus on green transitions across the value chain, philanthropy can enable sensitisation of workers towards environmentally friendly practices. This could help foster a mindset that embraces sustainable approaches. To facilitate such programs, it is essential to invest in the development of platforms for certifying workers in emerging skills. Currently, industry players like Good Earth are undertaking training initiatives for specific job roles such as masons. Similar training modules could be leveraged to enable candidates to acquire a skill premium for various roles throughout the value chain.

Green building ratings such as GRIHA, IGBC & energy conservation

measures such as ECBC are beginning to drive change in the demand ecosystem.

Large players such as

Prestige, DLF and Lodha

are transitioning to green construction because of consumer demands towards sustainable housing. [xxvi]

Big Bet 2

Accelerate innovation in sustainable sourcing through skilled talent and market access

Rating agencies like IGBC provide scores based on the percentage of green and local materials used.[173] To attain these scores and ratings, industry players have started to revamp their material procurement processes, employing local procurers who possess expertise in sustainable materials and a deep understanding of the region's indigenous practices. This shift towards sustainable sourcing is leading to the emergence of more green jobs. Incubators such as Acumen India are further supporting this movement by offering a platform for entrepreneurs specializing in sustainable materials, fostering learning and innovation in the sector.[174]

The skill ecosystem for sustainable sourcing presents a significant opportunity for action, as it is currently in a nascent stage with a few Skill Councils and green construction start-ups offering in-house training. Existing skill development councils such as the Construction Skill Development Council (CSDC), Painting and Coatings Skill Council (PCSC), and Water Management and Plumbing Skills Council (WMPSC) primarily focus on conventional training programs in the construction sector. However, efforts are underway by awarding bodies such as SCGJ to develop specific courses for sustainable brick production. [175]

In addition to these initiatives, start-ups are conducting in-house training programs for operating advanced machinery to process green materials, and handling locally available materials. Skilli-development programs for sustainable materials would not only leverage indigenous knowledge and skills but also create entrepreneurship opportunities for local procurers. This collaboration can be catalysed by philanthropy so that support is provided to innovators focusing on sustainable materials. They can further facilitate networking opportunities and help these entreprenuers scale up their operations in collaboration with larger construction players.

One qualification developed by SCGJ and Greentech on sustainable brick production and awaiting approval. Philanthropic efforts are critical to enable large-scale skill-building of the construction workforce.

IGBC provides a credit score based on the percentage of green and local materials used for total costs.

Presence of players such as **Total Environment and Good Earth** who are building on indigenous expertise for procuring material is a trend that is growing

1

Sector Skills Councils (SSCs) aaligned with Skill India mission, that have created 1 qualification, due for approval

- 1 qualification in Sustainable Brick production, in collaboration with Greentech

3

Startups providing in-house training

- Green machinery operations: OEMs (machine suppliers) provide orientation for operating the machine
- Green/eco-materials production: Proprietor of eco-materials or agri-bio-panels provide training for making panels on the site
- Using locally available materials: The site supervisor trains the locally available semi-skilled workforce to handle materials such as wire-cut bricks or mud blocks

Fig. 26 | Green construction skill ecosystem

Big Bet 3

Upskill waste workers for disposal of construction and demolition waste

The growth of the end-of-life/recycling segment in the value chain is influenced by increasing need for smooth demolition processes. The rise in redevelopment projects that receive government approvals has led to a higher demand for workers in the construction and demolition waste (C&D) segment.[176] Currently, the Indian Demolition Association (IDA) has registered 200 demolition companies to meet the growing demand, employing over four thousand workers directly and collaborating with numerous medium and small contractors.[177]

Furthermore, the segregation of demolition waste is now considered in the credit scoring for IGBC green ratings.[178] This inclusion emphasises the importance of using scientific and formal methods for the disposal of construction waste. Philanthropic investments can play a significant role in demonstrating and implementing in-situ training models for skill development of waste workers, ensuring they are equipped to handle construction waste safely and responsibly.

200 demolition companies registered

with the Indian Demolition Association (IDA) to cater to the increasing demolition needs.

No courses present for building skills of existing workforce

in disposal of construction waste. Presently, most training happens on-the-job in informal markets.

Big Bets

that will potentially derive increased value from philanthropic investments.

Enabling the conventional construction workforce to transition towards green construction has the potential to help reduce emissions as well as facilitate their formalisation. Furthermore, philanthropic support would be needed to expedite the adoption of sustainable materials. In the long term, as the demolition market grows, there will be a need to train individuals in the safe disposal of construction waste.

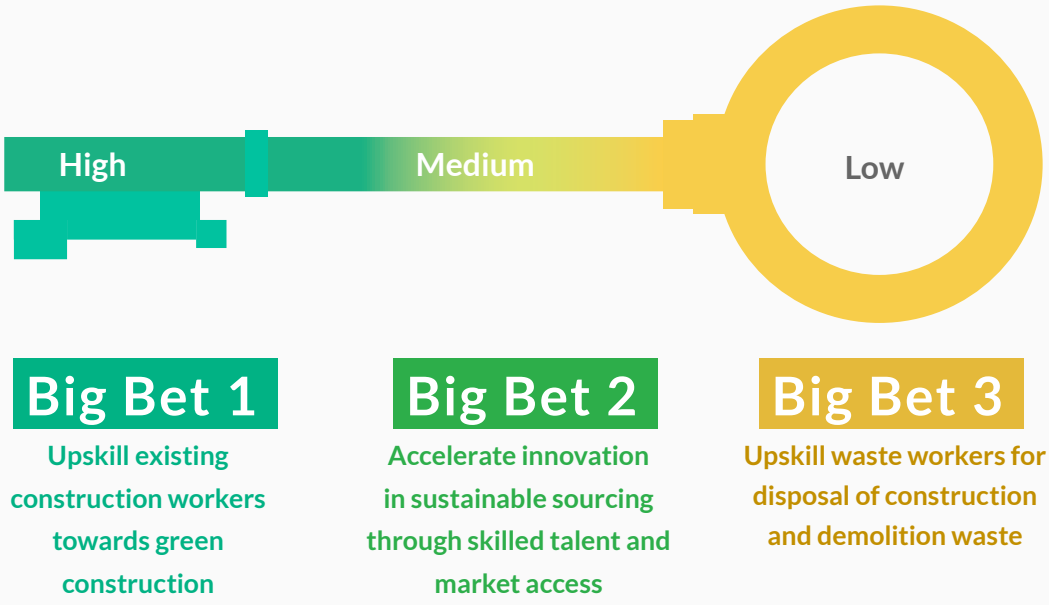
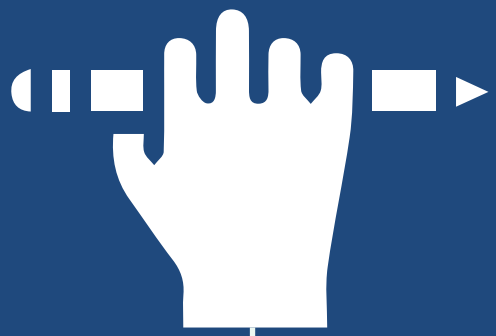


Fig. 27 | Big Bets



CHAPTER 5

ACCELERATING

GREEN SKILL DEVELOPMENT

In high-potential segments of the value chain across sectors, ecosystems can demonstrate scalable solutions, collaborate to create public goods, and catalyse collective action to accelerate the growth of green skill development.

There is a pressing need to enhance the intensity of green skills in every sector undergoing green transitions in order to build the necessary workforce supply and meet the demand required to achieve net-zero transitions. While the demand for emerging green jobs is expected to grow, the supporting ecosystem that provides the required skillsets for these jobs is currently in its nascent stage but gaining momentum. Despite the presence of over 500 government and private training institutes offering online and offline courses for various sectors and job roles, very few of them specifically focus on green skills. Moving forward, it is crucial to prioritise initiatives that reskill and upskill the existing workforce, as well as those which provide training to entry-level workforce. Supporting entrepreneur-led models, fostering diversity and inclusion, and ensuring formalisation and the creation of decent jobs are also essential aspects to consider.

While actualising these big bets, it is critical that philanthropic investments also focus on interventions building green skills awareness in schools. These actions would help act on the National Education Policy, 2020 recommendations about building employability skills for Jobs of the future and enable a smooth school-to-work transition. Government has taken a range of measures for re-engineering the education and skill development system including the recent launch of the National Credit Framework (NCrF) which enables that youth are provided with educational opportunities with quality skills for better employability. These measures will create a significant impact for transforming green skill-building and ensure avenues for employment.

Before implementing these models at a large scale, it is necessary to demonstrate and pilot solutions, develop public goods that facilitate decision-making, and foster collective action as explained further below. These initiatives will help ensure that skill-building efforts are demand-led and effectively address the evolving skill development needs of the workforce at the same time.

Demonstrate Scalable Solutions

Demonstrating skill development models for incoming and existing workforce, and incubating models for entrepreneurs.

- Building and amplifying awareness among incoming youth on green job roles and skill-building pathways
- Designing models for training incoming workforce in the latest emerging technologies and roles
- Training models for skill-building of current workers given upcoming greening changes
- Incubating models for skill enhancement of entrepreneurs and initial development
- Incorporating health and safety guidelines during training, compliant with domestic and international policies

Co-create Public Goods

Co-building platforms, developing resources and assessments for the ecosystem.

- Building platforms for updating industry demands dynamically
- Developing industry- aligned curriculum and resources
- Developing baseline and endline assessments for the existing workforce

Catalyse Collective Action

Catalysing relationships, knowledge sharing and establishing channels between industry and skill ecosystem.

- Enabling knowledge sharing with training partners
- Standardising accreditation and certification
- Establishing channels for seamless placement opportunities

REFERENCES

1. Kearney and Observer Research Foundation. 2021. Mission 2070: A Green New Deal for a Net Zero India. Whitepaper, World Economic Forum, from https://www3.weforum.org/docs/WEF_Mission_2070_A_Green_New_Deal_for_a_Net_Zero_India_2021.pdf
2. Skill Council for Green Jobs. 2022. Green Jobs Handbook. Information handbook, Skill Council for Green Jobs from https://sscgj.in/wp-content/uploads/2022/06/Green-Jobs-Hand-Book-PDF.pdf
3. UNFPA, 2022, State of the Word Population Report 2022. Statistics paper, from https://india.unfpa.org/en/seeing-unseen
4. Press Information Bureau. 2022. Renewable Energy in India. 09 September. https://pib.gov.in/FeaturesDeatils.aspx?NoteId=151141&ModuleId%20=%202.
5. Ministry of Finance, Government of India. 2023. "Economic Survey: 2022-2023," from https://www.indiabudget.gov.in/economicsurvey/doc/echapter.pdf
6. Tyagi, Akanksha, Charu Lata, Jessica Korsh, Ankit Nagarwal, Deepak Rai, Sameer Kwatra, Neeraj Kuldeep, and Praveen Saxena. 2021. India's Expanding Clean Energy Workforce. New Delhi: Council on Energy, Environment and Water, Natural Resources Defense Council, and Skill Council for Green Jobs, from https://www.ceew.in/publications/indias-expanding-clean-energy-workforce
7. Ibid
8. United Nations: Department of Economic and Social Affairs. 2018. World Urbanization Prospects The 2018 Revision. Whitepaper, United Nations, from https://population.un.org/wup/publications/Files/WUP2018-Report.pdf
9. Press Information Bureau. 2016. "'Solid Waste Management Rules Revised After 16 Years; Rules Now Extend to Urban and Industrial Areas': Javadekar." 5th April, from https://pib.gov.in/newsite/printrelease.aspx?relid=138591
10. International Labour Organisation, 2019, "From Waste to Jobs Decent work challenges and opportunities in the management of e-waste in India" from https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/publication/wcms_732426.pdf
11. EY-Parthenon, IVCA, IndusLaw. 2022. ELECTRIFYING INDIAN MOBILITY. EY-Parthenon, from https://www.ey.com/en_in/automotive-transportation/electrifying-indian-mobility-accelerating-the-pace-of-electric-mobility
12. Sattva analysis of PLFS 2019-20
13. Press Information Bureau. 2022. "'Direct Employment in Textiles sector is estimated at 45 million: Centre." 21 December, from https://pib.gov.in/Pressreleaseshare.aspx?PRID=1885412
14. Ibid, 8
15. Sattva analysis
16. IPCC. 2023. AR6 Synthesis Report: Climate Change 2023. Whitepaper, IPCC., from https://www.ipcc.ch/report/ar6/syr/
17. Economic Consulting Team. 2023. The Global Green Economy: Understanding and capturing the opportunity. Whitepaper, Oxford Economics, from https://www.oxfordeconomics.com/resource/the-global-green-economy-understanding-and-capturing-the-opportunity/
18. Richard, Brice. 2022. "A new understanding of the green economy." Arup Advisory services, November, from https://www.arup.com/perspectives/a-new-understanding-of-the-green-economy
19. Ibid, 17
20. Ibid,17
21. United Nations. 2022. Report of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on its third session, held in Glasgow from 31 October to 13 November 2021. Conference report, United Nations from https://unfccc.int/documents/460952
22. Statista. 2021. "The Road to Net Zero." Statista. 17 November. From, https://cdn.statcdn.com/Infographic/images/normal/26053.jpeg.
23. fDi Markets, 2021, "Energy transition reaches tipping point in 2020", from https://www.fdiintelligence.com/content/data-trends/energy-transition-reaches-tipping-point-in-2020-79429
24. LinkedIn. 2022. Global Green Skills Report 2022. Whitepaper, LinkedIn, from https://economicgraph.linkedin.com/content/dam/me/economicgraph/en-us/global-green-skills-report/global-green-skills-report-pdf/li-green-economy-report-2022.pdf
25. ibid
26. ILO. n.d. Definitions of green jobs used in the employment and environment policy context . Presentation, ILO, from https://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/presentation/wcms_195740.pdf
27. Ibid
28. Ibid
29. Nick Robins, Vonda Brunsting and David Wood. 2018. Climate change and the just transition A guide for investor action. LSE, from https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2018/11/IJT-guidance-for-investors_web-spreads.pdf
30. Ibid
31. Ibid, 1
32. UNEP . 2022. Emissions Gap Report 2022. Whitepaper, UNEP, from https://www.unep.org/resources/emissions-gap-report-2022
33. Ministry of Finance, Government of India. 2023. "Budget 2023, from https://www.indiabudget.gov.in/
34. Sattva analysis of Green Policies in India
35. Ibid, 2
36. Ibid, 3
37. Ibid, 15
38. Ibid, 16

39. Angela Picciariello, Sarah Colenbrander, Amir Bazaz and Rathin Roy. 2021. The costs of climate change in India. Working paper, ODI, from https://odi.org/en/publications/the-costs-of-climate-change-in-india-a-review-of-the-climate-related-risks-facing-india-and-their-economic-and-social-costs/
40. Sattva analysis
41. NSDC. n.d. NSDC PARTNER NETWORK. https://nsdcindia.org/existingpartners#:~:text=With%20a%20Training%20Partner%20(TP,to%20the%20Skill%20India%20Mission.
42. Press Information Bureau. 2022. "Year-End- Review of Ministry of Heavy Industries – 2022." Press Information Bureau, from https://pib.gov.in/PressReleasePage.aspx?PRID=1887129#:~:text=Till%2006th%20December%202022%2C%20Total,against%20quantities%20sanctioned%20by%20MHI.
43. IEA. 2022. Renewables 2022. Whitepaper, IEA, from https://www.iea.org/reports/renewables-2022
44. IRENA. 2022. RENEWABLE CAPACITY STATISTICS 2022. Statistics , IRENA, from https://www.irena.org/publications/2022/Apr/Renewable-Capacity-Statistics-2022
45. IEA. 2022. Renewable Energy Market Update: Outlook for 2022 and 2023, from https://www.iea.org/reports/renewable-energy-market-update-may-2022
46. Press Information Bureau . 2023. "Government declares plan to add 50 GW of renewable energy capacity annually for next 5 years to achieve the target of 500 GW by 2030 ." Press Information Bureau , 5 April, from https://www.pib.gov.in/PressReleasePage.aspx?PRID=1913789
47. Press Information Bureau. 2023. "Government of India takes several steps to promote renewable energy in the country." Press Information Bureau, 3 February, from https://pib.gov.in/PressReleasePage.aspx?PRID=1896066 [1]
48. Press Information Bureau . 2023. "Government implementing PLI scheme for boosting domestic production of Solar Modules: Union Power & NRE Minister." 23 March, from https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1909958#:~:text=The%20Government%20of%20India%20is,24%2C000%20crore.
49. EY. 2021. Renewable Energy Country Attractiveness Index. EY, from https://www.ey.com/en_in/recai
50. Ibid, 33
51. Ibid, 33
52. Ibid, 45
53. ibef. N.d. Renewable Energy Industry in India, from https://www.ibef.org/industry/renewable-energy
54. MNRE. n.d. Policies, solar, from https://mnre.gov.in/Solar/policy-and-guidelines/
55. Press Information Bureau . 2022. "Cabinet approves Production Linked Incentive Scheme on 'National programme on High Efficiency Solar PV Modules' for achieving manufacturing capacity of Giga Watt (GW) scale in High Efficiency Solar PV Modules." Press Information Bureau , 21 September, from https://pib.gov.in/PressReleasePage.aspx?PRID=1861127
56. Ibid, 6
57. Ibid,6
58. Ibid, 6
59. Ibid, 2
60. Ibid, 6
61. Sattva analysis of SCGJ provided data.
62. Sattva analysis of SCGJ provided data.
63. Sattva analysis of green policies
64. Invest India. n.d. Invest India. www.investindia.gov.in/sector/renewable-energy.
65. GWEC, 2022, "ACCELERATING ONSHORE WIND CAPACITY ADDITION IN INDIA TO ACHIEVE THE 2030 TARGET" from, https://gwec.net/wp-content/uploads/2022/09/GWECIndia_-Accelerating-OnshoreWind_India_Sep2022_ReleaseVersion.pdf
66. GWEC. June. Wind: The Critical Link to India's Clean Energy Transition: India Wind Energy Market Outlook 2025. Whitepaper, GWEC, from https://gwec.net/wp-content/uploads/2021/06/GWEC-MEC-India-2021-10-June.pdf
67. MNRE, n.d, "MANUFACTURING", from https://mnre.gov.in/wind/manufacturers-and-quality-control
68. Chaturvedi, Shekhar. 2022. India @2030: A Roadmap for Atma Nirbhar Bharat in Renewable Energy. Confederation of Indian Industry's (CII's), from https://www.moneycontrol.com/news/environment/govt-revamps-auction-norms-bans-reverse-bidding-for-wind-energy-projects-9856271.html
69. MNRE. 2023. "Review of competitive bidding mechanism for procurement of power from wind power projects - Reg." MNRE. 9 January, from https://mnre.gov.in/img/documents/uploads/file_f-1673515455900.pdf.
70. Ibid, 6
71. Ibid, 65
72. Baruah, Rituraj. 2022. Edtorial on PLI scheme for offshore wind turbines, from https://www.livemint.com/industry/energy/pli-scheme-likely-for-offshore-wind-turbine-makers-11659897383866.html
73. Sattva analysis of expert interviews and KIIs
74. Sattva analysis of SCGJ provided data
75. Ibid, 6
76. Ibid, 72
77. Ibid, 67
78. MNRE. n.d. Bioenergy from https://mnre.gov.in/bio-energy/current-status.
79. Ibid
80. Okcredit, 2021, "What Is The Future of the Biogas Industry in India?", from https://okcredit.in/blog/the-future-of-biogas-industry-in-india/
81. Ibid, 78

82. Ibid, 5
83. Fortune Business Insights. n.d. India biogas market is expected to grow from $1.47 billion in 2022 to $2.25 Billion in 2029 at a CAGR of 6.3% in forecast period, 2022-2029. Market report, Fortune Business Insights, from https://www.fortunebusinessinsights.com/india-biogas-market-106563
84. International Labour Organisation, 2019, "Skills for Green Jobs in India, from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_706945.pdf
85. Ibid
86. Ibid, 6
87. Ibid, 78
88. Sattva analysis of QP listing
89. Sattva analysis
90. MarkNtel advisors. n.d. India Green Hydrogen Market Research Report: Forecast (2025-2030). Market report, MarkNtel advisors, from https://www.marknteladvisors.com/research-library/india-green-hydrogen-market.html
91. MNRE. 2023. NATIONAL GREEN HYDROGEN MISSION. Mission launch, MNRE, from https://mnre.gov.in/img/documents/uploads/file_f-1673581748609.pdf
92. Sattva analysis of industry announcements
93. Press Information Bureau . 2023. "Cabinet approves National Green Hydrogen Mission." Press Information Bureau , 04 January, https://pib.gov.in/PressReleasePage.aspx?PRID=1888547
94. Skill Council for Green Jobs Analysis
95. Ibid, 91
96. Statista. n.d. Projected municipal solid waste generation across India from 2016 to 2050, from https://www.statista.com/statistics/1154532/municipal-solid-waste-generation-india-forecast/#:~:text=According%20to%202016%20estimates%2C%20India,543%20million%20tons%20in%202050.
97. Ibid, 8
98. Ibid, 9
99. Swachh Bharat. 2019. "SWACHHATA SANDESH", from http://swachhbharaturban.gov.in/Auth/dsdocumentsfile.aspx?DOCTYPE=922&DOCID=659
100. Josyula K. Lakshmi, Barathi Nakkeeran , Shrutika Murthy , Lana Whittaker, Botlagunta Ramanamurthi, Varun Sai , Prasanna S. Saligram , and Surekha Garimella. 2021. Health and Well-being of Waste Workers in India. Policy Brief, The George Institute, from https://www.georgeinstitute.org.in/our-impact/policy-and-recommendations/health-and-well-being-of-waste-workers-in-india.
101. Vanek, Govindan Raveendran and Joann. 2020. Informal Workers in India: A Statistical Profile. Statistical Brief, WIEGO, from https://www.wiego.org/sites/default/files/publications/file/WIEGO_Statistical_Brief_N24_India.pdf
102. Sattva analysis of SCGJ data
103. Kopacek, Bernd. 2021. Edtorial on value in store in e-waste, from https://www.thehindubusinessline.com/opinion/columns/theres-much-value-in-store-in-e-waste/article62297588.ece
104. Vanessa Forti, Cornelis Peter Baldé, Ruediger Kuehr, Garam Bel. 2020. The Global E-waste Monitor 2020. Whitepaper, ITU, from https://www.itu.int/en/ITU-D/Environment/Documents/Toolbox/GEM_2020_def.pdf
105. Chatterjee, Dr. S. n.d. Electronic Waste and India . Department of Information Technology Electronics Niketan, from https://www.meity.gov.in/writereaddata/files/EWaste_Sep11_892011.pdf
106. Statista. N.d. "Consumer Electronics - India." Statista, from, https://www.statista.com/outlook/cmo/consumer-electronics/india
107. Ibid,103
108. Central Pollution Control Board. N.d. e-waste, from https://cpcb.nic.in/e-waste/
109. Press Information Bureau . 2022. "Government notifies Guidelines on Extended Producers Responsibility on plastic packaging under Plastic Waste Management Rules, 2016," 18 Feb, from https://pib.gov.in/PressReleasePage.aspx?PRID=1799170
110. Ibid, 103
111. Ibid, 84
112. Ibid, 104
113. Sattva analysis of CSC data
114. Conserve energy future n.d, What is E-waste Recycling and Process of Recycling Electronic Waste, from https://www.conserve-energy-future.com/e-waste-recycling-process.php
115. Sattva analysis
116. Sattva analysis
117. Sattva analysis
118. Knowledge sourcing intelligence n.d, "India wastewater treatment market was valued at US$3.981 billion in 2020 and is expected to grow at a CAGR of 12.92% over the forecast period to reach a market size of US$9.320 billion by 2027," from https://www.knowledge-sourcing.com/report/india-wastewater-treatment-market
119. Central Water Commission 2021, "WATER AND RELATED STATISTICS", from https://cwc.gov.in/sites/default/files/water-and-related-statistics-2021compressed-2.pdf
120. Ibid
121. NITI Aayog. 2019. COMPOSITE WATER MANAGEMENT INDEX. Whitepaper, NITI Aayog, from https://social.niti.gov.in/uploads/sample/water_index_report2.pdf
122. Department of Drinking Water & Sanitation n.d, "Jal Jeevan Mission", from https://jaljeevanmission.gov.in/
123. Swachh Bharat Mission. n.d. About SBM. From, https://swachhbharatmission.gov.in/sbmcms/index.htm.
124. National Mission for Clean Ganga, n.d, Namami Gange Programme, from https://nmcg.nic.in/NamamiGanga.aspx
125. Central Pollution Control Board, n.d. Water Pollution, from https://cpcb.nic.in/water-pollution/#:~:text=The%20Water%20

(Prevention%20and%20Control,Act%20was%20amended%20in%201988.

126. As of 2020, 136 thousand people worked in sewerage and its treatment, while another 573 thousand people worked in Water collection, treatment, and supply.
127. Sattva analysis of PLFS 2019-20
128. Sattva analysis of expert interviews and KIIs
129. Sattva analysis
130. Sattva analysis of industry announcements
131. Sattva analysis of industry announcements
132. Press Information Bureau, 2022. "Ministry of Heavy Industries sanctions 1576 EV Charging Stations across 16 Highways & 9 Expressways under Phase-II of FAME India Scheme". Press Information Bureau, 22 March 2022, from https://pib.gov.in/Pressreleaseshare.aspx?PRID=1808115
133. M. Santamouris, K. Vasilakopoulou. 2021. Present and future energy consumption of buildings: Challenges and opportunities towards decarbonisation. Journal report, e-Prime - Advances in Electrical Engineering, Electronics and Energy Volume 1, from https://www.sciencedirect.com/science/article/pii/S2772671121000024
134. Muthu, Subramanian Senthilkannan. 2019. Water in Textiles and Fashion Consumption, Footprint, and Life Cycle Assessment. Science Direct, from https://www.sciencedirect.com/book/9780081026335/water-in-textiles-and-fashion
135. RBSA advisors. n.d. Indian Electric Vehicle Market to Reach More than $150 Billion by 2030. Market report, RBSA advisors, from https://www.vrg.net/india-electric-vehicle-market-value-trends/
136. ETAuto Research . 2022. EV funding hits all-time high in 2021 as investors bet big on support systems. ETAuto Research, from https://auto.economictimes.indiatimes.com/news/industry/ev-funding-scales-new-peak-in-2021-as-investors-bet-big-on-support-systems/88674432
137. Press Information Bureau . 2022. "Three Companies signed Program Agreement under (PLI) Scheme for Advanced Chemistry Cell (ACC) Battery Storage." Press Information Bureau , 29 July, from https://pib.gov.in/PressReleasePage.aspx?PRID=1846078
138. Press Information Bureau 2022. "Under Phase-II of FAME India Scheme, 7,45,713 Electric Vehicles supported till 07 Dec 2022 by way of Demand Incentive amounting to about Rs. 3,200 Cr." Press Information Bureau , 13 December, from https://pib.gov.in/PressReleasePage.aspx?PRID=1846078
139. bid, 11
140. Sattva analysis of PLFS 2019-20
141. Sattva analysis
142. Bullard, Nathaniel. 2020. "This Is the Dawning of the Age of the Battery." Bloomberg, 17 December, from https://www.bloomberg.com/news/articles/2020-12-17/this-is-the-dawning-of-the-age-of-the-battery
143. Prescient & Strategic Intelligence . 2020. Indian Electric Vehicle Component Market Research Report: Two-Wheeler (Scooters, Motorcycle), Three-Wheeler (E-Rickshaw, E-Auto, Retrofitted Rickshaw), Passenger Car, Commercial Vehicle – Industry Analysis and Growth Forecast to 2030. Market Report, Prescient & Strategic Intelligence, from https://www.psmarketresearch.com/market-analysis/indian-electric-vehicle-component-market
144. Vaibhav Pratap Singh, Kanika Chawla, and Saloni Jain. 2020. Financing India's Transition to Electric Vehicles. Report, CEEW, from https://www.ceew.in/cef/solutions-factory/publications/CEEW-CEF-financing-india-transition-to-electric-vehicles.pdf
145. Sattva analysis of expert interviews and KIIs
146. Sattva analysis of QP listing
147. Press Information Bureau . 2022. "Pact for training 18,000 students, especially from rural & tribal areas to be trained in the next three years." Press Information Bureau , 19 July, from https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1842817
148. Hero Electric. 2022. Hero Electric joins hands with ReadyAssist to train 20,000 mechanics, 07 Februrary 2022, from https://heroelectric.in/hero-electric-joins-hands-with-readyassist-to-train-20000-mechanics/#:~:text=Hero%20Electric%20joins%20hands%20with%20ReadyAssist%20for%20training%2020%2C000%20mechanics,CEO%20%26%20Founder%20Vimal%20Singh%20stated.
149. Sattva analysis of expert interviews and KIIs
150. Aggarwal, Bhavish. 2021. 10,000 WOMEN TO POWER THE GLOBAL EV REVOLUTION. September, from https://blog.olaelectric.com/10000-women-to-power-the-global-ev-revolution/.
151. imarc group. n.d. Indian Textile and Apparel Market: Industry Trends, Share, Size, Growth, Opportunity and Forecast 2023-2028. Market Report, imarc group, from https://www.imarcgroup.com/indian-textiles-apparel-market
152. Invest India. n.d. Textiles & Apparel, from https://www.investindia.gov.in/sector/textiles-apparel#:~:text=India%20is%20among%20the%20world's,11.4%25%20in%202020%2D21.
153. ibef. 2022. Indian Textiles and Apparel Industry Analysis. November. From, https://www.ibef.org/industry/indian-textiles-and-apparel-industry-analysis-presentation#:~:text=The%20textiles%20industry%20(including%20dyed,to%20optimise%20the%20value%20chain.
154. Sattva analysis
155. Ellen MacArthur Foundation . 2017. A NEW TEXTILES ECONOMY: REDESIGNING FASHION'S FUTURE. Whitepaper, Ellen MacArthur Foundation, from https://ellenmacarthurfoundation.org/a-new-textiles-economy
156. Sattva analysis of COP21 announcements
157. Ibid, 13
158. Ibid, 152
159. EURATEX. 2020. ReHubs A joint initiative for industrial upcycling of textile waste streams & circular materials . Whitepaper, EURATEX, from https://euratex.eu/wp-content/uploads/Recycling-Hubs-FIN-LQ.pdf
160. Fashion for Good, Sattva Consulting, Saahas Zero waste, Reverse Resources. 2022. Wealth in Waste: INDIA'S POTENTIAL TO BRING

TEXTILE WASTE BACK INTO THE SUPPLY CHAIN. Whitepaper, Fashion for Good, from https://reports.fashionforgood.com/wp-content/uploads/2022/07/Sorting-for-Circularity-Wealth-in-Waste.pdf

161. Welspun. 2022. "Annual Report 2021-22." From, https://www.welspunenterprises.com/userfiles/file/AnnualReport_2021-22.pdf
162. Sattva analysis of QP listing
163. Sattva analysis
164. Global Data. n.d. Market Value of Green Building in India (2017-2021, $ Million). Market report, Global Data, from https://www.globaldata.com/data-insights/construction/market-value-of-green-building-in-india/#:~:text=The%20five%20countries%20leading%20the,7.2%25%20during%202017%E2%80%9321.
165. Mckinsey. 2010. India's urban awakening: Building inclusive cities, sustaining economic growth. Mckinsey, from https://www.mckinsey.com/featured-insights/urbanization/urban-awakening-in-india
166. UNECE. n.d. Green Building, from https://unece.org/forests/green-building.
167. Ibid, 84
168. Madhavi Lokhande, Hema D, J Santosh Rupa. 2018. A study on the implementation of welfare programs for migrant construction workers with reference to Bangalore city, Karnataka. Journal report, Journal of Management Research and Analysis, from https://www.researchgate.net/publication/329605766_A_study_on_the_implementation_of_welfare_programs_for_migrant_construction_workers_with_reference_to_Bangalore_city_Karnataka
169. Jha, Ajit. 2021. "Vulnerability of Construction Workers During COVID-19: Tracking Welfare Responses and Challenges." The Indian Journal of Labour Economics, from https://link.springer.com/article/10.1007/s41027-021-00348-4
170. Sattva analysis
171. Sattva analysis
172. Sattva analysis
173. IGBC. 2014. IGBC Green New Buildings rating system. Rating system, IGBC, from https://igbc.in/igbc/html_pdfs/abridged/IGBC%20Green%20New%20Buildings%20Rating%20System%20(Version%203.0).pdf
174. Sattva analysis
175. Sattva analysis of expert interviews and KIIs
176. Indian Demolition Association. 2019. IDA Demolition Association LLP. Newsletter, Indian Demolition Association, from https://drive.google.com/file/d/1un4X_fddd2_HYlAncLSuoM-cJvkYLQAT/view
177. Ibid, 173

I. Ibid, 4
II. Ibid, 5
III. Ibid, 1
IV. Sattva analysis
V. Sattva analysis of SCGJ provided data
VI. Sattva analysis of SCGJ provided data
VII. Sattva analysis of SCGJ provided data
VIII. Sattva analysis of Ibid, 6
IX. Sattva analysis of QP listing NSDC. n.d. QP Listings. https://www.skillindia.gov.in/qpListings.
X. Sattva analysis of SCGJ provided data
XI. Sattva conducted survey
XII. Sattva analysis of expert interviews and KIIs
XIII. Sattva analysis of Ibid, 6
XIV. Ministry of Petroleum and Natural Gas. 2018. "National Policy on Biofuels." Ministry of Petroleum and Natural Gas. From, https://mopng.gov.in/files/uploads/NATIONAL_POLICY_ON_BIOFUELS-2018.pdf.
XV. Ministry of Petroleum and Natural Gas. n.d. "About SATAT." satat.co.in. from, https://satat.co.in/satat/about.html#:~:text=It%20will%20boost%20entrepreneurship%2C%20rural,oil%20and%20gas%20price%20fluctuations.
XVI. Sattva analysis of SCGJ provided data
XVII. Sattva analysis of CSC data
XVIII. Sattva analysis of E-Waste Management rules 2018
XIX. B, Viju. Opinion piece on "State planning 10K 'green' jobs.", 2011, from https://timesofindia.indiatimes.com/city/mumbai/state-planning-10k-green-jobs/articleshow/8794256.cms
XX. Central Pollution Control Board. 2018. Status of CETP. 29 August, from https://cpcb.nic.in/status-of-cetps/.
XXI. Sattva analysis
XXII. Ibid, 44
XXIII. Sattva conducted survey
XXIV. Sattva analysis of expert interviews and KIIs
XXV. Sattva analysis of industry announcements

Printed on recycled paper