dentsu | dasra

Unboxing Sustainable Consumption in the Digital Era

Fuel | Energy | Material | Natural Resources

February 2025

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List Of Abbreviations

ASM – Artisanal and Small-Scale Mining

ASSOCHAM – Associated Chambers of Commerce and Industry of India

BIS – Bureau of Indian Standards

BRSR – Business Responsibility and Sustainability Reporting

BRT – Bus Rapid Transit

CAGR – Compound Annual Growth Rate

CCEW – Centre for Circular Economy and Waste

CSMIA – Chhatrapati Shivaji Maharaj International Airport

DISCOM – Distribution Companies

ECBC – Energy Conservation Building Code

EEE – Electrical and Electronic Equipment

EPR – Extended Producer Responsibility

EPRON – Extended Producer Responsibility Organization Nigeria

EV – Electric Vehicle

FAME – Faster Adoption and Manufacturing of Hybrid and Electric Vehicles

FMCG – Fast-Moving Consumer Goods

FSSAI – Food Safety and Standards Authority of India

GDP – Gross Domestic Product

GHG – Greenhouse Gas

GSDP – Gross State Domestic Product

GW – Gigawatt

ICAP – India Cooling Action Plan

ICE – Internal Combustion Engine

IFSA – Indian Food Security Alliance

IPCC – Intergovernmental Panel on Climate Change

ITDP – Institute for Transportation and Development Policy

MAU – Monthly Active Users

MCGM – Municipal Corporation of Greater Mumbai

MIT Solve – Massachusetts Institute of Technology Solve

NAAQS – National Ambient Air Quality Standards

NCR – National Capital Region

NEP – National Electricity Plan

NITI – National Institution for Transforming India

ORS – Oral Rehydration Solution

PACE – Personal Advancement & Career Enhancement

PM – Particulate Matter

PM2.5 – Particulate Matter 2.5

PM10 – Particulate Matter 10

RVM – Reverse Vending Machine

SAMPADA – Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters

SDG – Sustainable Development Goals

SPI – Smart Power India

SPM – Suspended Particulate Matter

SWaCH – Solid Waste Collection and Handling Cooperative

TDS – Total Dissolved Solids

UHI – Urban Heat Island Effect

UNFPA – United Nations Population Fund

UV – Ultraviolet

VAT – Value-Added Tax

WEEE – Waste Electrical and Electronic Equipment

WHO – World Health Organization

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Executive Summary

Your Monthly Digital Footprint Unwrapped

Dear Readers,

India stands at the crossroads of a digital revolution that promises to reshape its future. As the nation hurtles towards greater connectivity, the intersection between digital penetration and resource utilization has become a defining challenge. This report unravels the complex web of consequences that increased digital consumption has on its people and the planet.

While the digital wave offers convenience and economic growth, it simultaneously intensifies environmental degradation and deepens social inequities. To safeguard the future of both people and the planet, this report urges a holistic approach to consumption, one that fosters collaboration among all sectors for sustainable development.

THANK YOU FOR SUBSCRIBING!

What's Inside This Box?

In this report, we delve into four key themes, each illustrating the intersection of digital consumption and sustainability challenges that must be addressed for a greener and more equitable future.

FUEL

The surge in E-commerce and ride-hailing services has led to an alarming rise in fuel consumption, contributing to urban congestion and skyrocketing emissions. The air we breathe and the climate we depend on are both at risk. Informal sector workers bear the brunt of this crisis, with their precarious livelihoods hanging in the balance.

MATERIALS

The growing demand for smartphones and high-speed internet connectivity drives a dangerous surge in mining for minerals and metals, escalating E-waste and overwhelming our recycling systems. Improper disposal is a ticking time bomb, with vulnerable communities, especially women and children, bearing the toxic consequences of informal recycling.

ENERGY

Digitalization has propelled efficiencies in energy use, but these gains have been offset by the soaring demand for power, leaving us in a rebound effect that strains sustainability efforts. The complex relationship between digitalization and energy consumption creates a daunting challenge for the nation's green future.

NATURAL RESOURCES

Data centers and Fast Fashion, both products of digitalization, are ravenous consumers of water and energy. Their voracious appetite is draining already-stressed resources, precipitating water scarcity and disturbing the ecological balance upon which both the environment and countless communities depend.

FUEL FOR THOUGHT

What's In The Box?

India's urban mobility is transforming with the rise of ride-hailing services, reducing private car ownership but worsening traffic and fuel consumption. Cities like Kolkata, Bengaluru, and Pune, among the slowest globally, are struggling with the environmental consequences of this shift. As online shopping grows, last-mile delivery fuels rising urban emissions. The rise of the gig economy due to these digital platforms exposes India's informal workforce to new set of challenges, increased vulnerability to extreme weather, health risks and workplace insecurity. With 1.4 billion people living in areas where PM2.5 levels exceed safe limits, the urgent need for interventions to reduce emissions becomes critical.

MATERIALS MATTER

What's In The Box?

India's smartphone users set to reach 1B users by 2026, is driving a surge in the demand for critical minerals. The country is now the world's third-largest E-waste producer, but recycles only 10% of the total, further increasing the demand for mining. The extraction of these minerals is further driving emissions and increased pollution. India's informal E-waste recycling sector processes most of the country's electronic waste but operates without adequate safety regulations, endangering workers. Similarly, the rapid expansion of E-commerce and quick commerce sector has led to a significant surge in packaging waste. The packaging often involves multiple layers of materials - plastic, paper, and cardboard, complicating the process of recycling!

ENERGY UNPLUGGED

What's In The Box?

Electricity consumption has surged four-fold since 2000, and will continue to rise with economic growth. Digitalization, particularly the adoption of appliances like air conditioners, is poised to further boost household electricity demand. The reliance on coal for electricity generation remains high, despite its decreasing share in the country's installed capacity. In 2024-25, coal represents 48% of installed capacity but still accounts for 72% of electricity generation! Quality of electricity access is uneven across India, with higher income groups consuming more, despite the widespread effects of emissions. India faces the challenge of improving access while decarbonizing its energy future.

NATURAL RESOURCES HAUL

What's In The Box?

Data centers are the building blocks of the digital infrastructure, steadily expanding in India, driven by increased need for data localization. Even as water usage by data centers is miniscule compared to agriculture and industrial purposes, the concentration of these data centers in the already water-stressed metro cities raises concerns about water security. Water shortages rarely affect everyone equally, with low-income neighborhoods likely to be disproportionately impacted. Fast fashion's water intensity usage too is set to increase further, driven by increased penetration of fashion E-commerce, as latter is projected to increase at a faster rate than the overall market for fast fashion.

FINAL DELIVERY

SOLUTION CHECKLIST

Philanthropy can support scaling of decentralized renewable energy solutions

- Philanthropists can play a critical role in rural and semi-urban areas by providing financial support, technical expertise and ecosystem development to bridge gaps in energy access
- Potential to de-risk investments, and support community-based energy enterprises in remote regions with unreliable energy supply

Explicit accounting of the environmental costs of digital innovations

- Improved resource monitoring of water and electricity usage to ensure sustainable management
- Ensuring greater transparency in usage of water and electricity by private sector to inform allocation
- Building dedicated sustainability assessment frameworks for private sector beyond ESG compliance

Addressing electrification as a technological roadmap, part (not whole) of the solution

- Promote high-capacity, integrated public transport over private EV ownership
- Invest in multi-modal mobility strategies - across all forms of public transport, instead of siloed focus on metro, bus or railways
- Address battery production emissions by focusing on recycling and renewable-powered grids

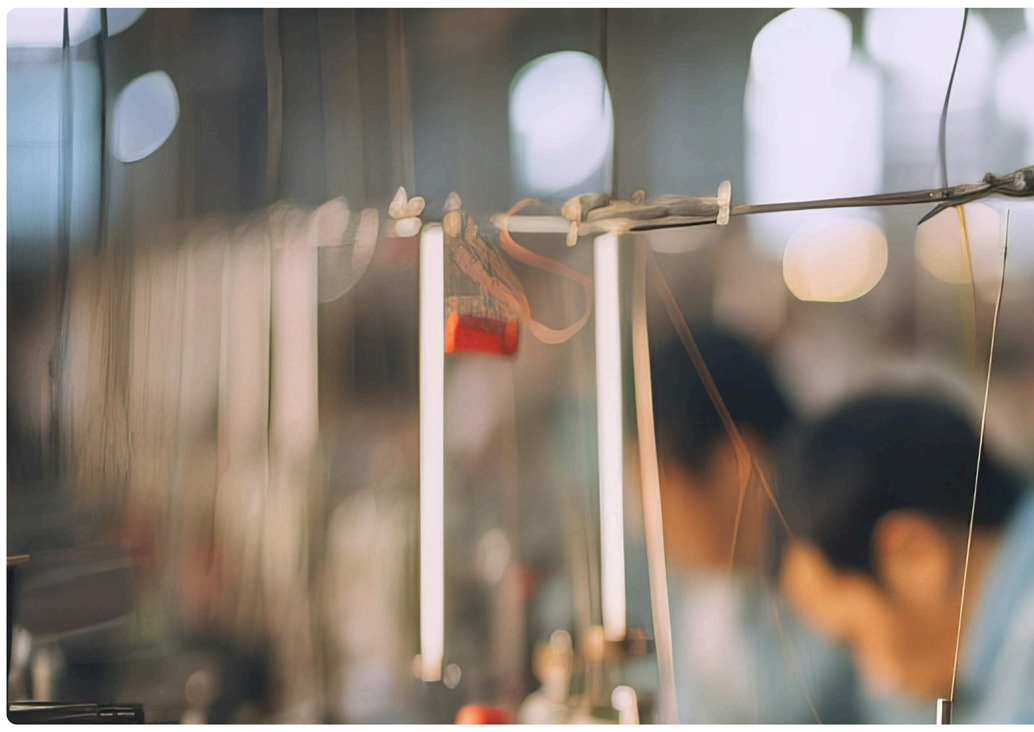
Government-Civil Society Partnerships for Waste Management

- Learn from global models (e.g., Bogotá, Switzerland, Norway) to formalize waste collection
- Scale up initiatives like SWaCH Pune and Hasiru Dala Bengaluru for integrating informal waste workers
- Enhance financial inclusion, training, and safety measures for waste pickers

Public Awareness and Incentive Programs

- Implement deposit refund schemes for electronic waste, similar to plastic bottles
- Expand Reverse Vending Machines (RVMs) with incentives like cashback and transit discounts
- Focused awareness campaigns on material literacy and responsible consumption

Introduction



"In nature's economy the currency is not money, it is life."
- Vandana Shiva

"The world has enough for everyone's needs, but not everyone's greed."
- MK Gandhi

India's digital evolution has made promising leaps

By bolstering digital public infrastructure and prioritizing widespread mobile internet access and affordability, India has taken millions into the digital age. Today, it has among the world's highest monthly average internet traffic, highest volume of digital payments, and second-highest cellular subscriptions,[1] with it being classified as an 'Outlier' on the global 2020 Digital Evolution Scorecard.[2] The scale of digitalization has revolutionized every facet of millions of lives – the way we eat, travel, consume, and socialize.

What could possibly go wrong?

Notwithstanding real-life transformations on the ground, these digital leaps have taken countless resources and labor to sustain, leaving a concerning trail of ecological fallouts. 'Smart solutions' are fundamentally altering the country's natural resource utilization patterns.[3] Behind every click and swipe are finite natural resources - depleting faster than these can replenish. Even in a cloud-connected, paperless, and electric-powered world, emissions and temperatures continue to rise. In India, while the emission burden of digitalization is slowing down in some sectors (fuel, natural resources), it is accelerating in others (minerals, electricity).

Blurred lines between critical needs, wants, and aspirations

A key factor driving this emission burden is the increasing over-consumption of non-essential items and services, enabled by the digital revolution. The rapid growth in smartphone usage and internet connectivity has offered Indian consumers unparalleled convenience through online shopping, ride-hailing apps, and food and grocery delivery services. There has been an explosion of demand across these markets.

- India's E-commerce consumer base grew at a CAGR of 20% between 2019-23 and is set to expand to 500 million by 2030.[4]
- The addressable customer base for the food delivery market is set to grow by an additional 100 million, reaching 430-450 million individuals by 2030.

This convenience comes at significant, yet often invisible environmental and social costs. Our parcels – from being produced, marketed, ordered, to reaching the warehouse, and finally being delivered at the doorstep are not merely driven by algorithms and automated assembly lines, but by thousands of liters of fossil fuels and a nearly invisible workforce.

All the world's goodness, for a handful of users

Another key facet of this consumption-emissions debate in the Indian context is inequity. Digital penetration has fast outpaced per capita growth, and as a result, **much of the new-age, high-end consumption in India is currently driven by a small set of ~250 million individuals,[5] about 17% of the total population, even as the burden of emissions is borne by 100% of the population.** Globally too, this disparity is glaring. While India is the third largest GHG emitter in the world,[6] its per capita emission, at 2 tonnes, is less than half of the global average of 4.7 tonnes.[7]

These statistics, combined with unfolding ground realities, should push us to situate ourselves and our wants and needs in the enormous web of global issues and inequalities. With each scroll, swipe and click, we have the power to consume mindfully and alter the digital revolution into a force for good, as it was envisioned.

As India's digital landscape rapidly expands, its implications extend far beyond connectivity, convenience, and economic growth. The rise in E-commerce, ride-hailing, and high-speed connectivity has triggered an unprecedented demand for fuel, energy, materials, and natural resources driving emissions, depleting ecosystems, and exacerbating inequalities. Likewise, the human cost of this boom remains largely overlooked, as millions of gig workers, warehouse laborers, and informal recyclers bear the brunt of economic instability, unsafe working conditions, and environmental degradation. If we simply celebrate how the digital age opens jobs for this group, while overlooking the conditions in which they work, and economies that perpetuate ecological stress, we are not realizing the full promise of this progress.

> **"When we talk about sustainability, we often focus on carbon emissions, but sustainability isn't just about that. We forget that sustainability is ultimately about people—about livelihoods, equity, and community resilience."**
>
> -Neelam Chibber, Industree Foundation

Both, accelerated consumption and inequities in consumption, necessitate a deeper examination of the resources that are enabling this consumption. In the following sections, we highlight the shifts in the utilization patterns of four key resources that are powering this shift in consumption:

Fuel – With the increased uptake of E-commerce and ride-hailing apps in urban environments, this section examines the consequent shifts in fuel consumption and emission burdens.

Energy – While digitalization has improved energy efficiency, the resultant cost savings have further propelled increased energy usage, offsetting the original gains and complicating the net impact on energy consumption.

Materials – Each product purchase, upgrade, and inbuilt high-speed internet connectivity necessitate more minerals and metals in increasingly minuscule proportions – generating considerable E-waste and making recycling difficult

Natural Resources – Data centers are the building blocks of the digital infrastructure, but are extremely resource intensive, guzzling more water and electricity than some countries in the world.

Sustainability is no longer a distant, abstract concept. It is an everyday reality that impacts producers and consumers in deeply personal ways.

There is widespread public discourse around sustainability today, including global climate agreements and corporate commitments. However, there remains a divide between how people experience sustainability concerns in their day-to-day lives and how institutional actors in the sustainability movement, including governments and private corporations, frame them. For instance, global data shows that while a majority of consumers acknowledge that sustainability is one of the key challenges of our time, many remain unsure of how to integrate it meaningfully into their lives.[8] There's a noticeable gap between the macroscopic ideal of sustainability—whether it's reducing the carbon footprint, using renewable energy, or embracing sustainable mobility, and the practical steps that individuals are willing or able to take. Factors like convenience, cost, and a lack of clear guidance often act as barriers. This disconnect can create friction between consumers and sustainable brands.

Consumers have unique journeys, living in a diverse ecosystem where attitudes towards sustainability span a spectrum, from fervent support to indifference. They might express a desire to act sustainably, but when faced with conflicting priorities, like the affordability of sustainable products or the convenience of traditional choices, they often struggle to follow through. These varying degrees of engagement shape how they prioritize sustainability within their personal lives, how they make consumption choices, and how they interact with brands, products, and services.

Beyond promoting sustainability, we must understand how it intersects with broader concerns linked to identity, well-being, financial stability, and social influence.

Corporations and policymakers alike must learn to account for different archetypes ofconsumers when it comes to sustainability, each with their own set of motivations, behaviors, and challenges. By examining the different ways consumers connect with sustainability, we can better envision solutions that speak to their diverse needs and values.

Consumers In The Digital Age

The following archetypes provide a clearer picture of how consumers today engage with sustainability in this evolving ecosystem, helping us map out their journeys and identify the barriers they face along the way.

The Savvy Saver

This consumer is someone who seeks the best deal, without sacrificing their principles if the cost is right. They are focused on practicality. They value cost and convenience above all else. They are open to sustainable options but are not willing to compromise on their budget or lifestyle. Their engagement with sustainability is often transactional-if the price and convenience align, they'll make the change.

The Trendy Socialite

This consumer views sustainability a means to an end, often for personal gain in social settings.

They are motivated by social validation and trends. They don't necessarily have a strong commitment to sustainability, but they embrace it when it aligns with popular culture or enhances their social status. Sustainability for them is often a passing trend rather than a core value

The Eco Crusader

This consumer, a determined voice of sustainability, is driven by a deep sense of responsibility toward sustainability. They are highly informed, checking labels and researching brands for their sustainable practices. They demand transparency and hold brands accountable for their environmental impact. Quick to call out greenwashing, they align themselves with companies that mirror their values and beliefs.

The Click-Bait Consumer

This consumer is impulsive and driven by trends, often making purchases based on what they see online without researching sustainability claims. They struggle to differentiate between genuinely sustainable products and greenwashed marketing.

Convenience and instant gratification drive their buying decisions, making them susceptible to misleading claims and unsustainable consumption patterns.

The Comfortable Compliant

This consumer is committed to positive, gradual changes that don't disrupt their world. Often older, they prefer stability and routine. They value incremental changes in sustainability but are unlikely to engage with more radical shifts. They appreciate when sustainability is a small, seamless part of their products or services, without disrupting their lifestyle.

The Eco Crusader

What is their key consumption behavior?

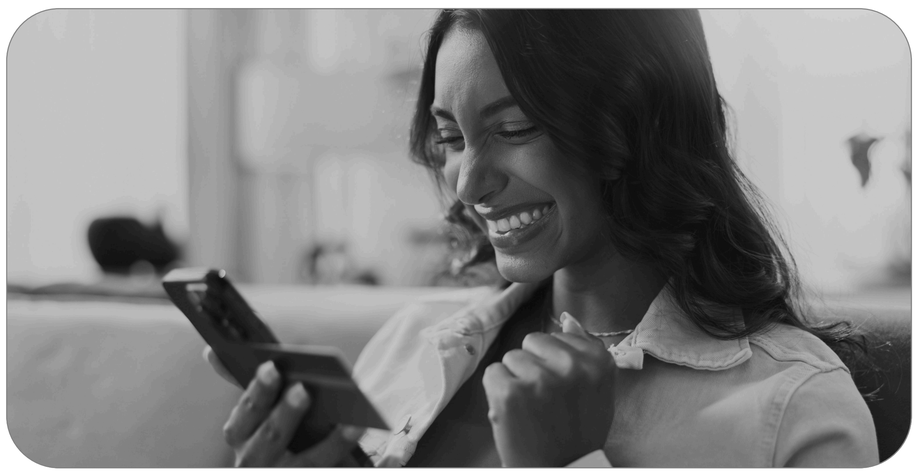
Their primary driver is sustainability. They seek transparency, authenticity, and ethical practices from brands and services. They are proactive in researching products, checking labels, and ensuring that the brands they support align with their values.

What challenges do they face?

- They are highly critical of brands that engage in greenwashing
- They struggle to identify genuine sustainability efforts amid digital misinformation
- They feel frustrated by brands using sustainability as a marketing buzzword without real impact
- They experience distrust due to a lack of verified, transparent sustainability practices.

What is the opportunity for action?

Sustainability-focused brands, CSOs, along with digital platforms and influencers, play a key role in engaging The Eco Crusader. The opportunity lies in fostering trust through transparency, offering verifiable sustainability practices, and creating authentic, informative digital spaces.



The Savvy Saver

What is their key consumption behavior?

Their primary driver is cost, convenience, and practicality. They are open to sustainable options, but are more focused on how well these fit into their budget and lifestyle.

What challenges do they face?

- They are deterred by the perceived high cost and inconvenience of sustainable options.
- They view sustainability as a luxury rather than a necessity.
- They find the digital marketplace overwhelming and difficult to navigate for cost-effective sustainable choices.

What is the opportunity for action?

Affordable sustainable brands, retailers, E-commerce platforms, and policymakers can help integrate sustainability into practical, everyday choices for The Savvy Savers. The opportunity lies in offering affordable, accessible, and clearly labeled sustainable products that are also cost-efficient. E-commerce platforms can simplify choices with clear comparisons.

The Click Bait Consumer

What is their key consumption behavior?

Their primary driver is instant gratification, social influence, and ease of purchase. They are attracted to visually appealing products and persuasive digital marketing, but lack the time or awareness to assess the sustainability of their purchases.

What challenges do they face?

- They struggle to differentiate between genuinely sustainable products and greenwashed marketing.
- They lack awareness about the environmental impact of packaging, delivery methods, and product life cycle.
- They are overwhelmed by too much information and find sustainability claims confusing or unverified.
- They prefer convenience over making informed, responsible choices.

What is the opportunity for action?

Brands, E-commerce platforms, consumer groups, and policymakers have a crucial role in creating transparent and trustworthy purchasing experiences for The Click Bait Consumer. E-commerce platforms can integrate verified sustainability labels, credible product comparisons, and easy-to-understand impact scores to help consumers make informed choices. Brands must prioritize clear, honest messaging on product sustainability and delivery methods to counter misleading claims. Regulatory bodies can strengthen guidelines to combat greenwashing and promote responsible consumption.

The Trendy Socialite

What is their key consumption behavior?

Their primary driver is social status and trends. They, engages with sustainability as a way to enhance their image and reputation, highly influenced by what's popular on social media, and prefer to follow trends rather than making informed decisions.

What challenges do they face?

- Their engagement with sustainability is often superficial and driven by social validation.
- They can be quick to shift preferences based on trends and social influence.
- They are inconsistent in sustainable choices, making the long-term impact of their consumption uncertain.

What is the opportunity for action?

Social media influencers, trendsetters, fashion and lifestyle brands, and celebrity endorsements, all of whom can position sustainability as fashionable and aspirational, can speak to the Trendy Socialite. The opportunity lies in aligning sustainability with social credibility by leveraging influencers and celebrities to promote eco-friendly choices.

The Comfortable Compliant

What is their key consumption behavior?

Their primary driver is stability, preferring incremental, non-disruptive changes. They might have an overall appreciation for sustainability but are not likely to be particularly engaged. They typically gain information about products and services through traditional media channels and are not as digitally engaged as younger cohorts.

What challenges do they face?

- They see sustainability as an abstract concept, not linked to daily choices.
- They feel disconnected from fast-paced digital discussions on sustainability.
- It is hard for brands to capture their attention or demonstrate tangible value

What is the opportunity for action?

Local community groups, private enterprises, and CSOs that focus on gentle behavioral nudges towards sustainability can help engage the Comfortable Compliant. The opportunity lies in introducing sustainability through small, manageable lifestyle changes that align with the group's preference for stability. By providing practical solutions alongside reassurance, stakeholders can cater to this group's desire for stability while fostering positive, incremental shifts toward sustainability.

Beyond promoting sustainability, it is important to understand how it intersects with broader concerns linked to identity, well-being, financial stability, and social influence.

Corporations and policymakers alike must learn to account for different archetypes of consumers when it comes to sustainability, each with their own set of motivations, behaviors, and challenges. By examining the different ways consumers connect with sustainability, we can better envision solutions that speak to their diverse needs and values.

It aims to inform awareness about these resource shifts driven by consumption, and their cumulative impact on the country's emission burden and the labor market welfare. It uncovers the resource utilization dynamics across different stages of the value chain - from the point of opening that application to placing the order to the point of the good or service being delivered to our doorstep. The report does not make a case for an outright reduction in consumption but, propagates a focus on bringing in more mindfulness in consumption.

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The Way Ahead

As digital penetration increases, most economies are likely to face a 'rebound effect', whereby the negative consequences could be higher than the benefits of energy efficiency and improved resource utilization.[9] Given India's vast population, and differing consumption trends playing out simultaneously, India is currently straddling across energy efficiency in select areas and rebound effects elsewhere.

We can, however, reverse this trend to a certain extent in the presence of a strong, equity-oriented institutional and policy framework and consistent implementation, that focuses on a conscientious transition toward a sustainable future.[10]

To enable this, multi-stakeholder alignment is the key, across state, industry, and civil society, as is a broad set of cross-cutting interventions. In this report, we profile such interventions – like leveraging digital infrastructure for monitoring energy usage, rethinking workplace insecurity against climate change, driving investments in improving awareness and literacy regarding various aspects of waste management, and leveraging technology for improved recycling. The report presents these solutions which, with appropriate scaling and adaptability to localized conditions, can potentially become positive tipping points.

How to read the report?

The findings of this report point toward the urgent need for systemic interventions—ones that balance innovation with inclusion, efficiency with equity, and digital expansion with environmental responsibility. The report, therefore, takes a People & Planet lens to examine the dual impact of digitalization-driven consumption, both on the environment and the millions of workers powering this transformation.

Through this People & Planet framing, the report moves beyond diagnosing the problem to identifying actionable pathways that can help steer India toward a more conscientious, sustainable, and just digital future.

Limitations

While the report covers some key consumption trends linked with digital penetration and the resource implications of the same, the report does not claim to be exhaustive in terms of covering all the major trends. Lastly, much of the technology in the realm of digitalization is constantly evolving, and the technical solutions to some of the issues discussed here might already be underway, as we write this report.

#2

The Back End

Unpacking The Impact Of Consumption On People & Planet

In this section, we outline the interlinkages between digital penetration and four key areas of consumption – Fuel, Materials, Energy and Natural Resources. We outline how the environmental and human impact associated with the shifts in the resource utilization dynamics across these four areas.

#2.1
Fuel For Thought

2.1.1. CONTEXT

Lifestyle-Driven Emissions and Urban Mobility Challenges

Cities are defined by their people—their choices, lifestyles, and movement. They are engines of aspirations, action and economic growth. However, they are also the world's chimneys - significantly driving global greenhouse gas emissions. The cumulative burden of daily human activities within these urban hubs manifests as a continual surge in emissions, making cities both the epicentre of opportunity and a crucible for environmental challenges.

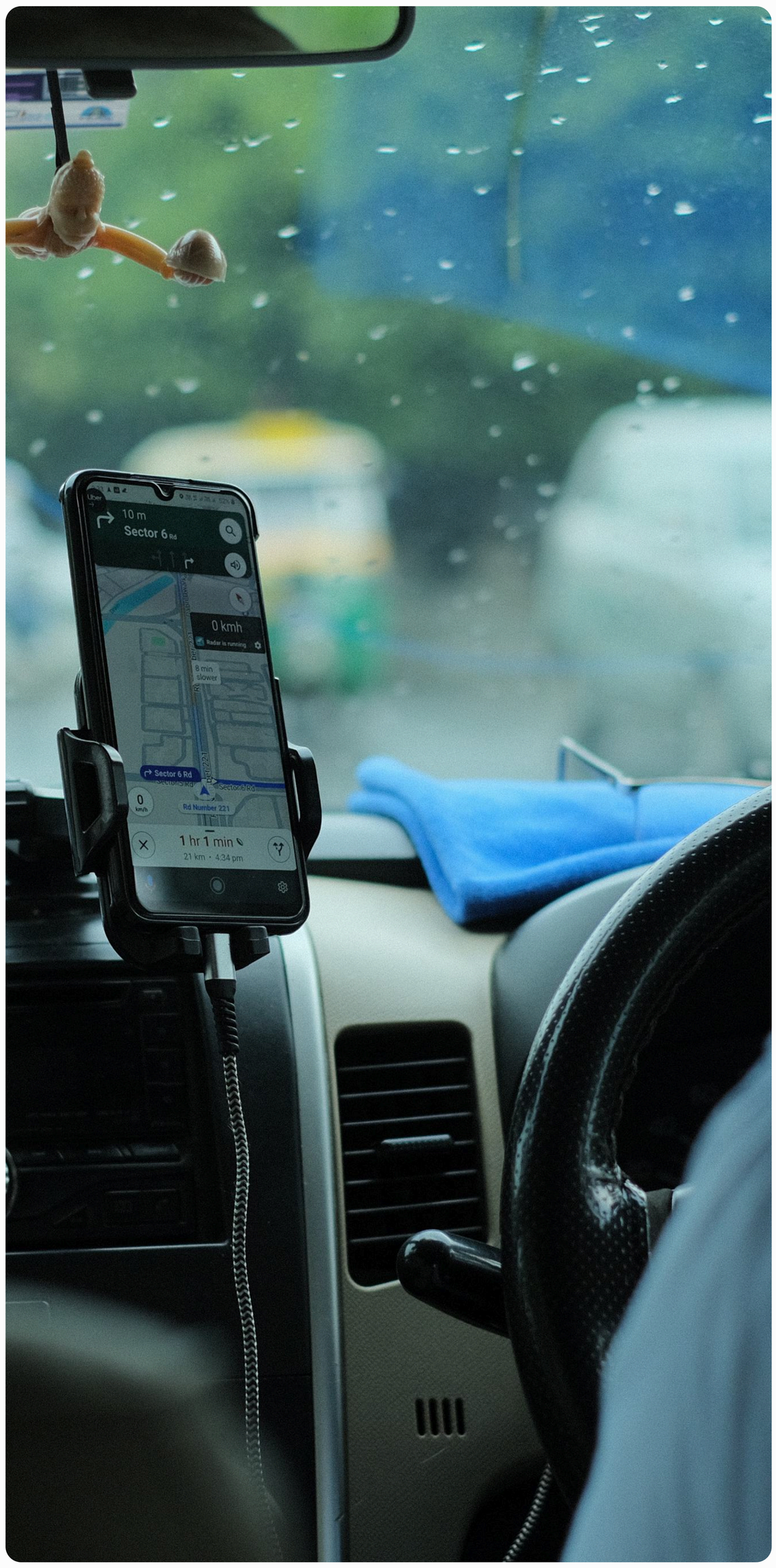
Mobility is a critical aspect of this dichotomy, shaping how people deploy resources to access opportunities. As cities expand and evolve, the way people move within them has undergone a seismic shift, catalyzed by technological advancements. A significant outcome of this shift has been the change in fuel consumption patterns in urban areas.

India is one of the largest and fastest-growing markets in the world for both these innovations. The dominance of ride-hailing services has changed the mobility landscape of the country. The ride-hailing market in India was valued at USD 6.42 billion in 2023.[11] The E-Commerce market in India is booming and is set to continue this trend with an expectation to hit USD 325 billion by 2030, growing at a CAGR of 21%.[12]

There are 8.5 million monthly active users (MAUs) in India on the popular ride-hailing application called Uber[13], followed by 17 million on Rapido[14], and 14 million[15] on Ola and they have a fleet size of at least 1 million vehicles.

From the increasing popularity of ride-hailing services to the booming E-commerce sector, urban mobility and consumption are intricately tied to fuel use – even when it comes to battery-operated vehicles. In the following pages, we specifically reflect on the underlying fuel consumption patterns that have been impacted by newer-age consumption trends in India-specific contexts.

In this section, we reflect on the underlying fuel consumption patterns that have been impacted by newer-age consumption trends. We examine the E-commerce boom and the rise of ride-hailing services as use-cases to illustrate this impact.



Shifts in Fuel Consumption: Evolving Consumption Patterns in E-Commerce and Ride-Hailing

E-commerce is revolutionizing shopping for middle-class India: The E-commerce boom in India is reshaping consumer behavior. Indian shoppers are increasingly turning to digital platforms for everything, from electronics and fashion to groceries, driven by competitive pricing and quick delivery options. Nielsen report highlighting a rise in FMCG purchases during Dusshera and Diwali notes that online grocery purchases surged from 13.5% in 2019 to 20% in 2022.[16] In the 2023 festive season, consumers from Tier-2, Tier-3, and Tier-4 cities accounted for over 80% of sales on online retail platforms such as Meesho and Amazon. [17] This trend has been particularly transformative for such geographies, where physical stores often lack variety and premium products. Social media has massively influenced people's aspirations and desires, creating demand for products featured on platforms like Facebook and Instagram. About 62% of consumers reported trying products they discovered on social media. [18] Urban shoppers in densely populated areas are opting for online platforms to avoid crowded malls, long commute times, and limitations in stock availability. Meanwhile, consumers in smaller cities are leveraging E-commerce to access goods previously unavailable locally.

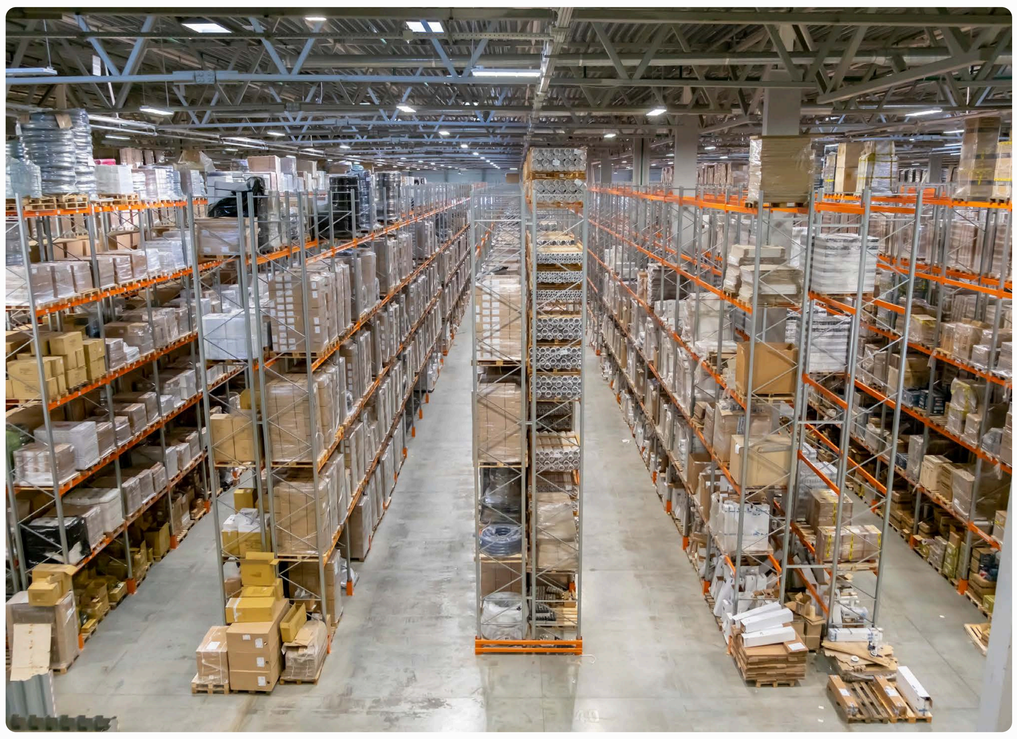
Ride-hailing services are bridging the transport gap

Ride-hailing services like Ola and Uber have become integral to urban mobility, with 32% of Indian consumers using these services at least once a week, far surpassing usage rates in countries such as USA (11%) and Germany (4%).[19] These platforms aim to bridge the personal-to-public transport divide by offering reliable, on-demand travel without the need for personal vehicle ownership. Interestingly, 57% of Indian consumers[20] prefer ride-hailing services over owning a car.[21] This adoption pattern is different compared to other countries. However, cultural perceptions also influence this shift. In India, car ownership is often seen as a status symbol, which impacts attitudes toward ride-hailing services. While these platforms offer utilitarian benefits, many consumers still prioritize the perceived prestige of owning a car, limiting their affinity for ride-hailing options. It is worth noting that para-transit systems have long been a part of India's mobility landscape, even before the digital boom. Informal and semi-formal transit solutions such as auto-rickshaws, e-rickshaws, and Gramin Seva vehicles have historically been the primary mode of public transport in smaller Indian towns and cities, lacking robust bus and metro systems.

2.1.2. PLANET

The Vicious Cycle: The Interplay Of Commerce, Commute And Congestion

Commerce: As consumption patterns linked to E-commerce intensify, their contribution to fuel usage and emissions is becoming significant. E-commerce drives an extensive logistics network, relying on fuel-intensive delivery mechanisms to meet the demand for quick and efficient services. Although this boom has reduced the need for frequent trips to physical markets and often curbed personal motorized travel, ultra-fast "rush delivery" services have led to a surge in delivery-related transport. The environmental impact of this shift is substantial: last-mile emissions from e-commerce deliveries in just five major Indian cities surpass the combined last-mile emissions generated by France and Canada.[22]



Moreover, the fleet structure and the constraints of urban planning have resulted in a disproportionately high carbon footprint per capita for India, reaching 285g CO_2 per capita in 2021—considerably higher than the global average of 204g.[23] Compounding this challenge is the widespread subcontracting of delivery services to local players, making it difficult to accurately quantify the true emission burden of E-commerce-driven logistics in India. This fragmented and opaque supply chain poses a significant barrier to implementing effective sustainability measures and emissions reduction strategies.

Commute: Likewise, ride-hailing platforms are adding to urban traffic and fuel consumption as they scale to serve a growing user base. India's transport sector, still heavily reliant on fossil fuels, currently accounts for about 50% of its oil demand, and is the third-largest emitter of greenhouse gases (GHGs) in the country.[24] Projections state that these emissions will double by 2050 with energy and carbon intensity of the transport sector expected to increase 3-4 times between 2020 and 2050, with the bulk of this growth driven by heavy-duty vehicles and personal cars.[25] Road transport is also responsible for approximately 12% of India's energy-related CO2 emissions, contributing to urban air pollution with harmful pollutants like nitrogen oxides (NOx) and fine particulate matter (PM2.5).[26] Global trends paint a cautionary tale: emissions from transport have risen steadily in cities across the world and remain notoriously difficult to control. India, evidently, faces this challenge too.

Ride-hailing and E-commerce have specific effects on fuel consumption. The demand aggregation models of transport and quick delivery services depend on high-mileage vehicles traveling long distances. This exacerbates excessive motorization in densely populated areas. The rise of dead mileage—where app-based taxis and logistics services have to travel long one-way distances to service passengers—is another such negative consequence. Research suggests that the increase in traffic congestion in cities including Delhi, Mumbai, and Bangalore is correlated with the use of ride-hailing services, with people increasingly opting to book taxis rather than walking even for shorter distances.[27]

As per Agarwal et al (2022), there is an increase in congestion in Delhi, Mumbai and Bangalore due to usage of ride-hailing services. The time during which ride-hailing services are unavailable has resulted in a reduction in travel time. Agarwal et al (2022) also report that drivers in India participate full-time versus predominantly part-time drivers in the US context, which has resulted in increased deadheading.[28]

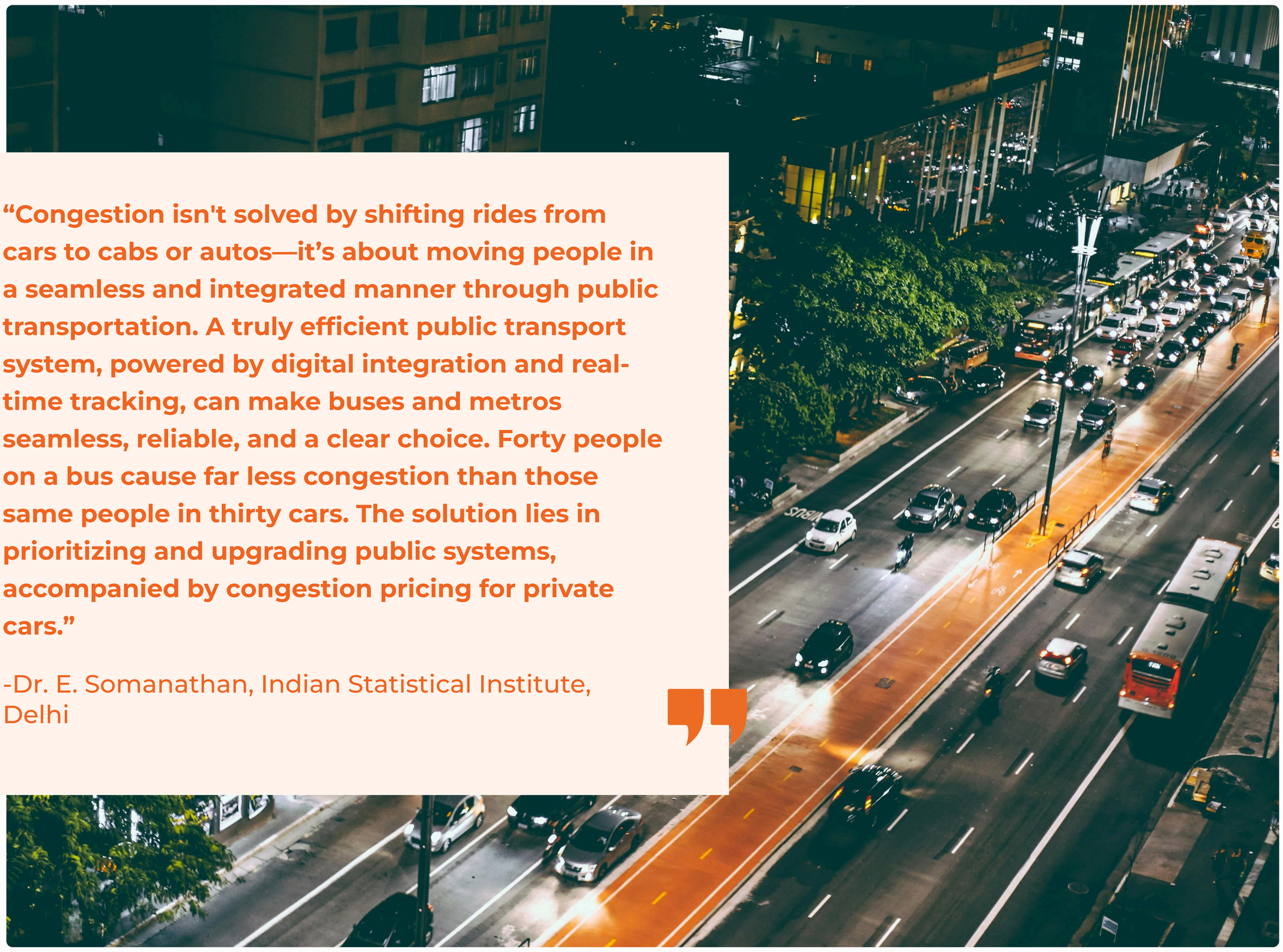
Congestion: The growing number of cars and two-wheelers has also led to a rise in traffic congestion. Traffic congestion not only slows vehicles down but also increases fuel consumption and emissions, compounding environmental harm. The 2024 TomTom Traffic Index highlights India's growing traffic woes, with three cities ranking among the world's top five slowest-moving urban areas.[29] Following Barranquilla (Colombia), Kolkata takes second place, with Bengaluru and Pune in third and fourth place respectively.

Beyond the environmental and economic toll, persistent congestion also affects the quality of life. Prolonged commuting times reduce time available for work, education, and leisure. The stress of navigating congested roads, coupled with increased exposure to pollution, takes a toll on public health.

Additionally, the financial burden of traffic management and infrastructure maintenance diverts resources from other critical urban development priorities.

This is a crucial area for India as urban residential areas are increasingly facing a crisis of space, with a large portion of valuable land being taken up by parked vehicles. This not only limits the potential for creating low-emission zones but also reduces the space available for children to play, green areas, and public amenities.

Footpaths, property entrances, and streets are often overtaken by parked cars, further exacerbating congestion. To manage the surge in demand for personal vehicles, a shift in approach is needed, particularly in how we treat parking.

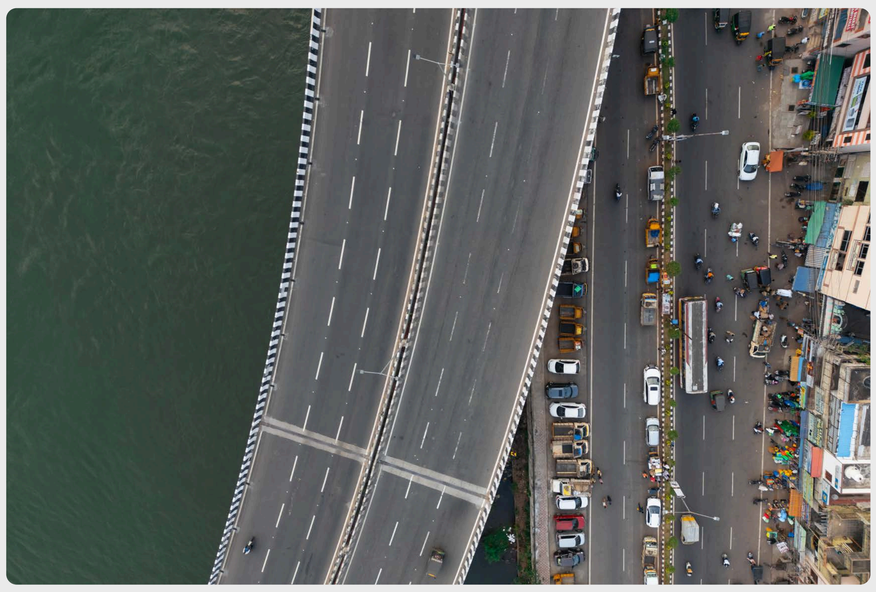


"Congestion isn't solved by shifting rides from cars to cabs or autos—it's about moving people in a seamless and integrated manner through public transportation. A truly efficient public transport system, powered by digital integration and real-time tracking, can make buses and metros seamless, reliable, and a clear choice. Forty people on a bus cause far less congestion than those same people in thirty cars. The solution lies in prioritizing and upgrading public systems, accompanied by congestion pricing for private cars."

-Dr. E. Somanathan, Indian Statistical Institute, Delhi

Box: India's Mobility Paradox: Rising Car Ownership Amid Declining Public Transport Use

Public transport use is steadily declining: Over the past few years, major cities like Delhi and Mumbai have witnessed alarming decrease in the share of public transport users. According to a study by the Centre for Science and Environment (CSE), public transport use is projected to plummet from 75.7% in 2000–01 to just 44.7% in 2030–31.[30] This decline underscores a shift in travel behavior that is both reflective of aspiration and indicative of systemic gaps. The growing reliance on personal vehicles must also be examined alongside challenges linked to public transportation systems. One study conducted in Bengaluru revealed that nearly 60% of commuters would opt for public transport options if they were more accessible and reliable.[31] While bus and metro services offer efficient transport on primary routes, the absence of comprehensive first- and last-mile connectivity prevents seamless access for commuters from their origin to their final destination. In the past decade, investments in urban transport infrastructure have focused on building roadways and flyovers, rather than improving public transport.



Urban India is experiencing a sharp rise in personal vehicle ownership: Vehicle sales grew by 27% in 2022–23 and are projected to grow by 6–8% in 2024.[32] In Delhi alone, nearly 14 million vehicles were registered by the end of 2023.[33] Mumbai mirrored a similar trend, with 1.3 million cars and 2.7 million two-wheelers being registered in 2023.[34] Socioeconomic factors such as population growth, rising incomes, and suburbanization are contributing to this surge, as is a cultural inclination toward conspicuous consumption—often described as "keeping up with the Joneses." However, this trend raises serious concerns amidst increasing traffic congestion, worsening air pollution, and the prevailing strategy of addressing mobility issues by building more roads.

The surging demand for travel and the declining capacity of public transport are creating a vicious cycle of consumption: A lack of reliable public transport infrastructure drives a growing dependence on personal vehicles, even as the demand and urgency for improving public transit is diminishing. Major cities like Delhi, Mumbai, and Bangalore exemplify this struggle, with peak hour jams on a daily basis, and buses and metro networks failing to meet expectations amid growing demand. Despite appearing to overflow during peak hours, metro rail networks operating in India currently service a mere 25%-35% of their projected ridership.[35] This points to the need for more robust infrastructure that can improve end-to-end connectivity and inspire greater public transport uptake.

"Our growing dependence on personal vehicles is choking cities with congestion and pollution. Personal vehicles are inefficient modes as they carry fewer people, occupy more road space, emit more and consume more energy per capita than public transport. In cities like Delhi, nearly 1/3rd of the land is committed to roads and parking, diverting precious land from other valuable usage. This has high health, environmental, and economic costs. This demands rethink and reinvention of urban mobility for a liveable city."

-Anumita Roychowdhury, Centre for Science and Environment

Reducing allocation of public land for parking can restrain private vehicle use: Cities have traditionally responded to the growing demand for personal vehicles by increasing free or low-cost parking. This approach, focused on improving the convenience of private transport, necessitates a critical rethinking of land use to support sustainable mobility. A survey estimates that a car in India is parked for over 95% of the time and is only driven for less than 5%.[36] As urban residential areas in India increasingly face a crisis of space, rethinking the valuable land that is being taken up by parked vehicles will prove to be critical. The implementation of parking policies as demand restraint measures entail limiting land allocation for parking and imposing premium costs to discourage personal vehicle use. In Hong Kong, for example, parking spaces are deliberately limited and prohibitively priced. Parking lots under the Housing Authority charge hourly rates of USD 13–USD 20 (INR 144–222), while other properties and shopping malls begin at INR 222 per hour. On weekends, some malls charge over INR 700 per hour. These high costs have successfully reduced the reliance on personal vehicles and significantly increased public transport ridership.

This is a crucial area for India as urban residential areas are increasingly facing a crisis of space, with a large portion of valuable land being taken up by parked vehicles. This not only limits the potential for creating low-emission zones but also reduces the space available for children to play, green areas, and public amenities. Footpaths, property entrances, and streets are often overtaken by parked cars, further exacerbating congestion. To manage the surge in demand for personal vehicles, a shift in approach is needed, particularly in how we treat parking. Data shows an Indian car is parked for over 95% of the time and is driven for less than 5%.

DID YOU KNOW?

In Delhi, the demand for parking from new vehicles annually is equivalent to finding land area equal to 310 football fields.

2.1.3. PEOPLE

Choking Hazards: Economy, Emissions, Public Health

In recent years, Indian cities have faced dystopian realities, enduring smog so dense it has effectively forced schools and offices to close, halted major sporting events, and wreaked havoc on health and livelihoods. Its chronic and annual occurrence underscores its catastrophic effects: 2 million deaths in India annually.[37] If we fail to curb these emissions, cities will grow even more polluted, amplifying the health risks and economic burdens borne by urban populations, especially among marginalized groups. For example, the impact of these emissions can be devastating for those living in informal settlements or occupying streets for prolonged periods, often without access to basic infrastructure, air purifiers, open spaces, or quality healthcare.

DID YOU KNOW?

Fact #1: The World Health Organization (WHO) recommends an annual safe limit for PM2.5 at just 5 μg/m³—but India's National Ambient Air Quality Standard (NAAQS) is set at a more realistic 40 μg/m³ due to the country's extremely high pollution levels. With most of India's population living in areas exceeding even these relaxed limits, the focus now is on adopting high intermediate targets and progressively tightening the standards to bridge the gap over time. According to The Lancet Planetary Health[38] long-term exposure to air pollution contributes to 1.5 million deaths annually (nearly 20% of the global burden).

Fact #2: PM2.5 particles are so tiny that it would take 30 of them lined up to match the diameter of a single strand of human hair, which averages 70 micrometers. Unlike larger particles like PM10 (often blocked by our lungs), PM2.5's minuscule size allows it to penetrate deep into our respiratory system, reaching vital organs and posing severe health risks. These ultra-fine particles are the most dangerous pollutants.

Efforts to address air pollution remain sparse and underfunded, despite looming risks linked to the economy and the environment. The repercussions in terms of public health are more immediate and far-reaching. Fine particulate matter (PM2.5) poses the greatest threat to health, with particles small enough to penetrate vital organs. Low- and middle-income countries, including India, bear the brunt of a crisis wherein PM2.5 exposure can exceed World Health Organization's (WHO) air quality guidelines by up to four times.[39]

Today, India's entire population of 1.4 billion lives in areas exceeding safe PM2.5 levels, with some regions reporting levels as high as 119 micrograms per cubic meter - several times above permissible limits.[40] This prolonged exposure has been linked to a host of severe health outcomes, including stroke, heart attack, diabetes, lung cancer, chronic respiratory diseases, neonatal illnesses, and even dementia and diabetes. While natural processes generate some PM2.5, the majority comes from human activities like vehicle emissions, which contribute a 20-35% share.[41] Addressing PM2.5 is not only essential for health but also an economic imperative; research suggests that a 20% reduction in PM2.5 levels could boost employment by 16% and enhance labor productivity by a third.[42]

Mobility, Fuel Consumption and the Gig Economy

The digital revolution has not only transformed how people travel, but it has also reshaped livelihoods, giving rise to a booming gig economy. Delivery workers, app-based drivers, and other gig service providers have become its cornerstones – accounting for over 80% of the urban workforce.[43] They are regularly exposed to extreme weather events such as heatwaves, cold spells, and severe pollution—without the benefit of air conditioning or institutional protections, underscoring the vulnerabilities inherent in their work. They remain, however, overlooked in conversations about sustainable mobility and climate resilience.

The year 2024 amplified the vulnerability of these workers, as India experienced extreme weather events through the year's first nine months, marked by heatwaves, cyclones, lightning, and floods.[44] Extreme heat alone has caused the loss of 181 billion labor hours, disproportionately affecting informal workers.[45] For gig workers delivering for E-commerce platforms, braving the scorching sun and hazardous pollution is a daily reality.

Many report working extended hours, often during times of peak demand. According to one set of estimates, 85% of gig workers log over eight hours daily.[46] Being on the road for extended hours in extreme weather conditions, navigating traffic, and enduring pollution leaves these workers vulnerable to exhaustion and illness. The rising demand for ultra-fast delivery has intensified these risks, exposing workers to physical threats such as accidents and heat stress, as well as psychological pressures to meet tight deadlines.

A significant complexity in the gig economy arises from the lack of accountability as workers often operate across multiple platforms, diluting any single platform's responsibility for their well-being. Though these jobs are marketed as flexible, the actual degree of flexibility is questionable, with workers subject to opaque algorithmic task allocations. This highlights the need for a nuanced approach to ensure worker security without undermining the economic dynamism of the sector.

> **"The gig economy's complexity lies in the lack of accountability as workers juggle multiple platforms, often leaving no single entity responsible for their well-being. While these jobs are touted as flexible, the reality is shaped by opaque algorithmic controls that limit true agency. Addressing this challenge requires a nuanced approach that balances government regulation and industry collaboration to ensure worker security without stifling the sector's economic dynamism."**
>
> -Smit Gade, Good Business Lab

Gender disparities are also pronounced in this realm. Most jobs in the Indian gig economy, such as drivers for ride-hailing services and delivery workers for E-commerce platforms, are dominated by men.[47] Women's participation in this economy appears to be concentrated in sectors such as domestic work and personal care, through platforms including Urban Company and Yes Madam, aligning with traditional sectors where women have historically been present.[48] While digitalization has transformed the way women can engage within these sectors, it has done little to facilitate their entry into entirely new domains.

Women face unique barriers in migrating for gig work. For instance, delivery jobs often require a level of local knowledge (topography, route maps etc.), access to personal vehicles, and greater autonomy while navigating public spaces, making it harder for migrant women to participate. The lack of gender-sensitive urban infrastructure further exacerbates these challenges. Delivery workers often spend long hours outdoors, navigating poorly designed urban spaces that do not account for women's safety and comfort.

The absence of basic amenities like rest areas, specifically for women gig workers, by the digital platforms makes it harder for women to access these occupational opportunities. These infrastructure gaps reinforce male-dominated norms in these roles, as men are often left to fend for themselves in such situations, a reality less acceptable for women due to societal and safety concerns.

#2.2
Materials Matter

"When we see materialistic things, we feel happy, but how much do we understand? We are materialistic, but we're not materialistic enough to respect materials."

- Shubhi Sachan, Material Library of India

2.2.1. CONTEXT

The underlying composition of the products we use is closely linked to shifting consumption patterns and their interlinkage with the environment. The process of sourcing materials, manufacturing products from them, the lifecycle of the products, and the ease of recycling after use, are among the key dimensions to be considered while understanding material composition. In the context of increasing digital penetration and its impact on different consumption trends, we discuss the material usage associated with smartphone use, and the additional increase in the plastic and packaging waste caused by increased E-commerce and quick commerce penetration.

Smart Phones and E-Waste Generation

A smartphone is composed of 30-50% plastics and synthetics, 10-20% glass and ceramics, and 40-60% metals.[49] In general, the manufacturing of electronic devices requires 50 to 350 times their final material weight in raw materials.[50] Mining operations are energy-intensive and heavily reliant on fossil fuels and require large volumes of water. This heavy water use by mining companies can limit access for local communities and harm wildlife.[51] This growth is set to increase further,[52]

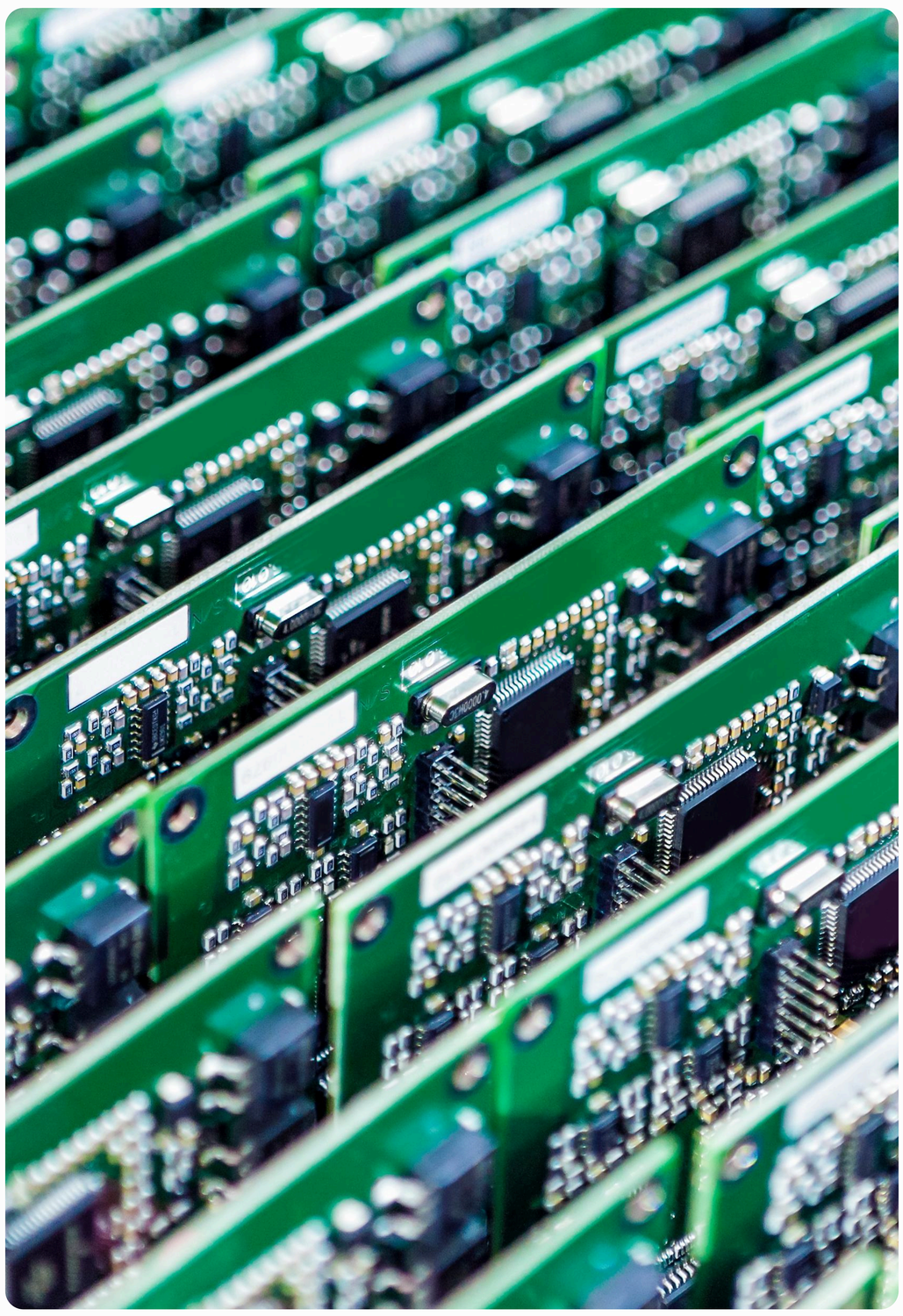
As this growth accelerates in India and globally, the demand for materials utilized for making new smartphones is also growing. Additionally, the average replacement cycle of the smartphone in India is 3 years[53]. A survey conducted in Delhi in 2022 revealed that only ~20% individuals retained their phones for 3-4 years,[54] while ~23% kept their devices for more than four years. Together, these factors account for the rising material demand for smartphones.

Smartphones we use today are made up of 63 different elements, compared to a typical telephone from 1990s, which included 27 elements, while a telephone from 1960 contained 10.

The increased material usage has direct linkages with increased demand for critical minerals, which in turn has an impact on the demand for mining. The problem is exacerbated by the absence of adequate facilities for disposing of cell phones after use. The same survey conducted in Delhi found that 46.5% of respondents admitted to storing old phones at home after they had stopped using them, 20% gifted them to friends or family, and 11.2% sold them to scrap dealers.[55] Only 3.8% took their phones to recycling centers, while 9.5% left them at stores when purchasing new devices.[56] The absence of sustainable disposal mechanisms further exacerbates the material waste created by smartphone use.

A paucity of adequate E-waste recycling infrastructure has also meant that new demand for smartphones must be met by mining, instead of using the materials already present in existing phones. To illustrate, one tonne of ore has an extractable reserve of about 1.4 grams of gold, while a tonne of mobile phone printed circuit boards (PCBs) can yield approximately 1.5 kilograms of gold.[57] Unfortunately, most of the E-waste recycling is managed by the informal sector, resulting in an annual revenue loss of approximately INR 80,000 crores for both central and state governments.[58]

Thus, a shorter in-use lifespan of smartphones, constant feature upgradation of smartphones, and the absence of adequate formal E-waste recycling infrastructure has meant that E-waste is expected to further mount in the Indian context. India is the third-largest generator of E-waste globally, producing approximately 3.2 million metric tons annually.[59] Examining the critical implications of increased demand and production of smartphones is key.



“The informal recycling sector needs to be cleaned up and formalized to tap into waste - particularly electronic waste - as a key source of minerals. Currently, local scrap collectors handle this without the use of scientific methods, which harms both their own health and the environment. The government is taking notice, with the National Critical Minerals Mission proposing separate guidelines to streamline the informal mineral recycling sector, and incentives to promote recycling. These and more efforts are required to streamline the sector and support a circular economy.”

-Ganesh Sivamani, Center for Social and Economic Progress

E-commerce and Packaging Waste

With the growth of smartphones, the rapid expansion of India's E-commerce and quick commerce sector has led to a significant increase in packaging waste, particularly in the form of plastics. E-commerce packaging often involves multiple layers of materials, including plastic, paper, bubble wrap, and cardboard, many of which are not recycled effectively. In 2019, India ranked third globally in terms of the plastic packaging waste generated from E-commerce, after China and the United States.[60] It is estimated that India’s E-commerce industry generated around 98,000 metric tons of packaging plastic waste in 2021, a 73% increase compared to the same in 2020.[61]

"The shift towards mono-material solutions, like single-material packaging, is crucial for effective recycling. For instance, waste processed through Material Recovery Facilities (MRFs) is often segregated, but when materials like plastic bags are woven with other components, recycling becomes difficult. "

-Shubhi Sachan, Material Library of India

This surge in packaging waste, driven by an explosion of E-commerce and quick commerce options, and related delivery services, poses substantial environmental challenges. India's inadequate recycling infrastructure exacerbates the problem, leading to increased pollution and strain on waste management systems. However, no agency in India tracks the quantum of packaging waste generated by E-commerce companies.

DID YOU KNOW?

According to data from the national Extended Producer Responsibility (EPR) portal under the Central Pollution Control Board, Amazon India has reportedly introduced 17,643 metric tons of plastic waste into the market since the launch of the EPR portal in 2022. EPR is a policy that makes manufacturers responsible for the collection and recycling of their products' waste. Similarly, Flipkart reported 16,639 metric tons, while Zomato Hyperpure, a Zomato company that supplies groceries exclusively to restaurants introduced 2,285 metric tons.[62]

DID YOU KNOW?

Vegan leather, popular in mobile cases and fashion, mimics real leather without using animal products. Made primarily from petroleum-based plastics, it raises environmental concerns due to harmful chemicals and non-biodegradability, contributing to plastic pollution. However, newer options use natural materials like pineapple leaves, apple peels, or mushroom fibers. Many prefer vegan leather for its ethical stance against using animal hides.[63]

2.2.2. PLANET

E-WASTE

India has witnessed a surge in E-waste generation over the past five years, a 73% increase, from 1.01 million metric tons (MT) in 2019-20 to 1.75 million MT in 2023-24.[64] The proportion of E-waste processed, dismantled, refurbished, or recycled, has risen from 22% in 2019-20 to 43% in 2023-24. However, this does not necessarily mean all processed e-waste is fully recycled.[65] Electrical and electronic items contain toxic substances, which are typically safe during use but can harm the environment when improperly discarded.

WIND

Common hazardous E-waste practices include scavenging, dumping in land or water, landfilling, open burning, acid leaching, and manual disassembly.[66] These actions release toxic pollutants into the air, soil, and water, posing severe risks to the well-being of nearby communities and ecosystems. Open burning and heating are particularly dangerous, due to toxic fumes with pollutants capable of spreading far from their source and endangering distant populations.[67]

At informal E-waste recycling sites, pollution levels far exceed safe thresholds, posing severe risks to both human health and the environment. Air pollution, measured by PM2.5, reaches an alarming 185 µg/m^3,[68] which is more than three times higher than India's National Ambient Air Quality Standards (NAAQS) 24-hour limit of 60 µg/m^{3}lxv - the maximum average concentration of PM2.5 permitted over a single day, and 12 times higher than the World Health Organization (WHO) safe limit of 15 µg/m^3.[69] Such extreme pollution levels can lead to severe respiratory and cardiovascular issues, posing significant risks to public health.

WATER & EARTH

Groundwater contamination around landfill sites is also a key challenge. Toxic heavy metals such as lead, cadmium, mercury, and chromium, are often present at these sites in levels that substantially exceed permissible limits set by the WHO and the Bureau of Indian Standards (BIS). The most severe contamination occurs within 200 meters of the landfills, but can be detected up to 1,000 meters away.[70] Areas such as the Ghazipur landfill, near New Delhi, and sites in Erode, Tamil Nadu, have shown alarmingly high levels of pollutants, particularly during the rainy season.[71] Over 75% of groundwater samples taken near E-waste landfills were found to be unsafe for drinking or irrigation due to elevated concentrations of heavy metals, total dissolved solids (TDS), and persistent organic pollutants (POPs).[72] [73]

The following figures illustrate the extreme environmental degradation and health hazards caused by unsafe recycling practices:[74] toxic chemicals like Polychlorinated Biphenyls (PCBs) are detected in the air at concentrations of 5.2-15.8 ng/m^3,[75] far above safe levels, with no amount of exposure considered harmless due to their cancer-causing and reproductive health effects. Similarly, soil contamination reveals hazardous concentrations of PCBs, ranging from 0.5-5 mg/kg, exceeding international safety standards. Heavy metals like lead, cadmium, and copper are also present in the soil at levels 3-4 times higher than permissible thresholds, with lead reaching 850 mg/kg compared to the industrial limit of 300 mg/kg.[76]

"Improper E-waste recycling releases toxic substances like Persistent Organic Pollutants (POPs), which can contaminate the food chain. Dioxins, for example, have been found in eggshells, highlighting their permeability and potential to spread widely. Such toxins mimic hormones, disrupt reproductive health, and cause cancers, with instances of contaminated fish in Japan and dairy in France underscoring the severe health risks. These findings emphasize the urgent need for safer recycling practices to prevent toxic exposure."

-Bharati Chaturvedi, Chintan

Mounting packaging waste

The accumulation of plastic packaging in landfills presents numerous environmental challenges, exacerbated by the significant consumption of plastic by packaging industries. Packaging consumes most of the nation's plastic, with 42% of total consumption used in flexible packaging and 17% in rigid packaging, translating to 8.37 kg of plastic packaging consumption per capita.[77]

The production of plastic packaging relies heavily on fossil fuels and is an energy-intensive process. This extensive use of plastic packaging contributes to heavy greenhouse gas emissions. Leachate contamination is another issue,[78] where rainwater percolating through landfills can leach harmful substances, contaminating soil and groundwater. Landfills also require vast amounts of space, leading to habitat loss and land-use conflicts. The environmental damage extends to marine ecosystems, with approximately 0.6 million tonnes of plastic entering India's oceans each year.[79]

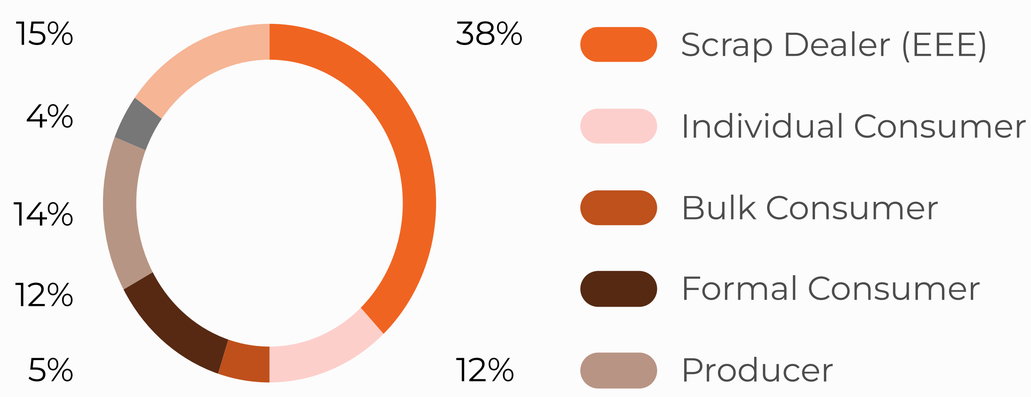
Plastic packaging has low recycling rates, with only 15% effectively recycled in India. Multi-material packaging (multi-layered packaging, which involves combining multiple layers of different materials to create a single packaging structure), constitutes 35% of total packaging in India. Informal recycling practices, such as downcycling (recycling materials into products of lower quality or value), further limit the recyclability of plastic waste. The informal recycling sector in India, which processes around 60% of plastic waste, may unintentionally add to microplastic pollution due to a lack of proper recycling technologies.[80] Moreover, the burning of plastic waste releases harmful toxins, including dioxins and furans, exacerbating air pollution and health risks. [81]

2.2.3. PEOPLE

Informal E-Waste Management in India: A Critical Yet Hazardous System

India's e-waste management is predominantly informal, with 90% of the collection volume and 70% of the recycling volume managed by the informal sector.[82] As per one set of estimates in 2018, only 14% of E-waste inflow was from the producers themselves, with the rest being collected by informal workers. Waste pickers collect E-waste from households and businesses, transporting it to kabadi shops where it is sorted and sold to scrap dealers. These dealers process and resell materials to refurbishing agents, dismantlers, recyclers, or formal dealers. Only 22% of Waste from Electrical and Electronic Equipment (WEEE) is processed formally.

Figure 1:
Inflow of waste Electrical and Electronic Equipment (WEEE) into the informal Sector



Source: Toxic Links (2018)

Hubs like Delhi's Seelampur and Gaffar Market employ over 150,000 workers in dismantling and material recovery, earning ₹500–₹1,000 daily, with women and children paid relatively lower wages. Moradabad, another major hub, processes nearly 50% of India's waste PCBs, employing 1.5 to 2 lakh workers. Despite its efficiency and low costs, this sector relies on hazardous methods like open burning, acid leaching, and mercury amalgamation, posing significant health risks to workers and local communities. Bringing informal waste operations under the ambit of the formal sector to enable regulations linked to sustainability and worker safety is crucial.[83] Leveraging technology, such as automated dismantling systems and advanced material recovery processes, can significantly enhance the safety and efficiency of recycling practices, reducing reliance on harmful practices.

"In absence of cutting edge recycling technology, extraction of precious and rare metals are not optimized, resulting in loss of important and critical resources. Most dismantlers processing E-waste, only recover a handful of metals and this technology gap requires to be bridged. While the informal sector plays a key role but operates with minimal regulation, contributing to environmental harm and unregulated financial flows. Strengthening technology, enforcing regulations, and improving data transparency are essential for sustainable E-waste management."

Satish Sinha, Toxics Link

E-waste recycling exposes workers to inhalation of toxic fumes and dust during the burning and dismantling of PCBs, ingestion of contaminated food and water in and around worksites, and dermal absorption from direct physical contact with hazardous materials.[84] Health impacts include respiratory illnesses like asthma and bronchitis caused by fine particulate matter, neurological disorders from heavy metals like lead and mercury, reproductive complications due to hormone-disrupting substances, developmental disorders in children and pregnant women, and increased cancer risk from carcinogens.[85] To mitigate these risks, investing in advanced recycling technologies, integrating informal workers into regulated systems, and enforcing stricter E-waste management policies are crucial. Public awareness, protective equipment for workers, and Extended Producer Responsibility (EPR) can further reduce health hazards.

Health Risks for Women and Children in Informal E-Waste Recycling

In India, over 4.5 lakh children aged 10-14 are engaged in E-waste recycling, with regions like Seelampur and Moradabad serving as major hubs.[86] Children as young as eight years old handle hazardous tasks like dismantling batteries and washing motherboards with acid for as little as ₹200 per day.[87] This leads to respiratory issues, skin diseases, and impaired brain growth from exposure to heavy metals like lead, cadmium, and mercury. Despite laws and regulations like the E-Waste Management Rules (2015) and the Child Labour Prohibition and Regulation Act (1986), over 90% of the collection volumes are managed by a highly competitive informal sector, often with companies bypassing compliance and relying on unregulated scrap dealers.

Women in this workforce are often relegated to low-paying, hazardous roles such as wire stripping and waste collection, with minimal safety measures or protective equipment in place. Chronic exposure to toxic substances like lead, cadmium, and mercury impacts their reproductive health, leading to adverse outcomes such as premature births, stillbirths, and developmental issues in their children. Pregnant women are especially vulnerable, with exposure to E-waste toxins affecting fetal development. Despite women's contributions to the recycling value chain, the lack of gender-specific safety measures and policies exacerbates the risks they face due to their livelihoods.

Hazardous impact of microplastics from packaging waste

In India, microplastics are present in 83% of tap water samples. They also contaminate agricultural soils through polluted irrigation and wastewater, further jeopardizing food safety and soil health.[88] Their infiltration into drinking water and the food chain raises serious concerns, as they carry harmful chemicals and can accumulate in the human body, potentially leading to long-term health risks.

#2.3
Energy Unplugged

"One of the largest hidden costs of digitalization is its energy footprint. With increasing reliance on digital services, the energy demand from this transition is growing fast. The key concern is whether this demand will outpace India's green energy capacity, further entrenching dependence on thermal power."

-Karthik Bansal, Centre for Social and Economic Progress

Energy is vital for the functioning of modern society. It is a fundamental need for improving the well-being and welfare of people. Its uses include, but are not limited to cooking, heating, cooling, operating appliances, machines, lighting, and mobility. While energy finds its end use in various sectors, this chapter will focus only on electricity. India's electricity demand and production have grown multi-fold over the last two decades as the country has seen major economic and population growth.

This section will give an overview of key characteristics of electricity production and consumption, future projections of electricity demand (and interlinkages with digitalization), and an overview of renewable energy in India. Further, it will explore the impacts of the current usage of electricity on climate change and pollution and its implications for communities.

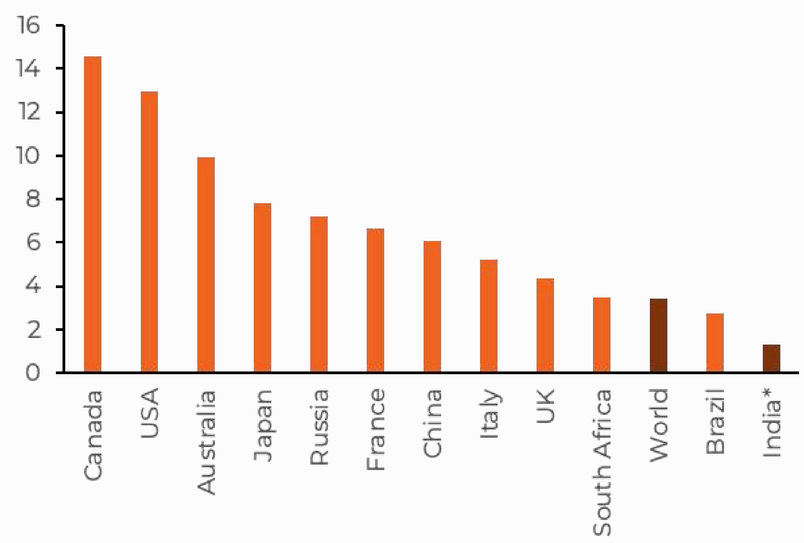
While India is the third largest producer of electricity, per capita consumption is low

India's electricity production has increased by more than three times (223%) from 5,61,058 GWh to 18,14,062 GWh between 2000 and 2022.third largest, after China and USA, respectively.[89] While in absolute terms India is one of the highest producers of electricity, its per capita consumption of electricity is relatively low. India's per capita electricity consumption ranks 108th in the world at 1.3 MWh, v/s global per capita consumption of 3.4 MWh, 6.1 MWh in China, and 2.7 MWh in Brazil (See Figure 2). It is likely to increase as the economy grows and more people get access to improved quality of electricity. Thus, as per capita consumption increases, it is likely to impact the overall production and consumption of electricity.

Surge in supply, access, and consumption

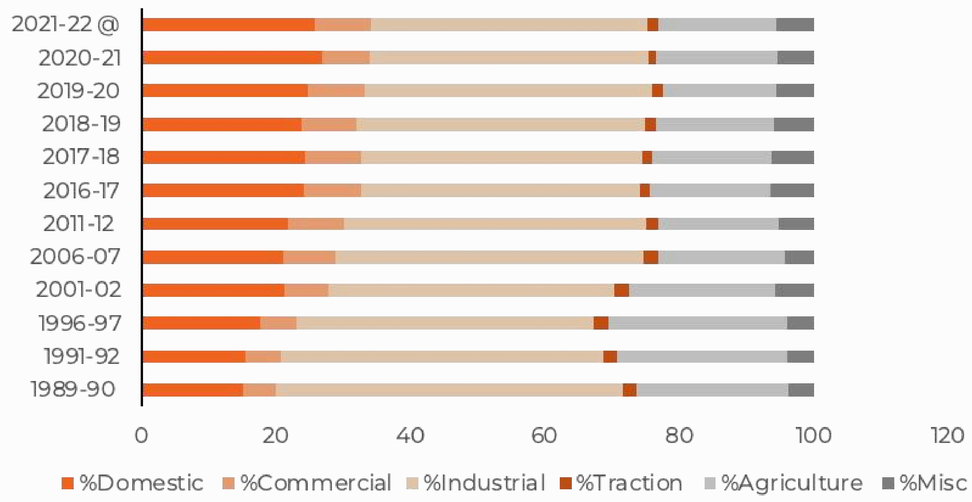
While looking at the end uses of electricity in the country, it can be observed (in Figure 3) that electricity consumption for industrial uses in 2021-22 accounts for the highest consumption of electricity (41%), followed by the domestic sector (26%). By 2031-32, the domestic sector will account for 32% of the total, while the industrial sector will account for 23%.[90] The domestic sector's share in consumption of electricity has been increasing over the years due to increased access to electricity by households, an increase in urbanization, and an increase in the use of appliances.

Figure 2:
Per capita electricity consumption (MWh)- Country-wise



*Source: International Energy Agency; * For India- All India Electricity Statistics, General Review 2024, Central Electricity Authority, Ministry of Power, Government of India, May 2024; Dasra analysis*

Figure 3:
Electricity consumption in India (% Category)



Source: Growth of Electricity Sector In India from 1947-2021, Central Electricity Authority, Ministry of Power, Government of India

Demand for electricity and digitalization

Digitalization, when defined as the penetration of technology, is observed to have clear linkages with rising demand for electricity. While there are direct, positive linkages between digitalization and electricity consumption, this relationship is not linear but extremely complex.

- **Increased appliance ownership driving increased demand for electricity**
  Increased digitalization, leading to increased use of appliances will lead to an increased demand for electricity. Much of this increased demand stems from the increased uptake of household appliances – TVs, refrigerators, washing machines, computers, and air conditioners. The share of electricity in total energy demand in buildings will rise from currently 20% to almost 50% by 2040.[91]
- **Rebound effect**
  Digitalization also implies improved technology leading to increased efficiencies in energy use, thereby resulting in a reduced demand for electricity. However, the efficiency gains made by improved technology may be offset by the rebound effect. This occurs when increased efficiency leads to increased usage (of the appliance). For instance, if a user has an energy-efficient AC, they might use it for longer periods, negating some of the savings. The reduced cost of electricity due to energy-efficient appliances may also incentivize more people to use electricity. Thus, the impact of efficiency on electricity consumption might be mixed.

"When energy-efficient appliances are purchased, people often use them more than necessary due to perceived cost savings. For example, someone might run a 5-star-rated air conditioner for three hours instead of one, thinking it's efficient. This is the rebound effect, where energy savings are offset by behavior that increases consumption, sometimes negating the positive effect of efficiency."

- Dharini Sridharan & Stuti Goyal, AEEE

India Cooling Action Plan (ICAP)

Launched in 2019, the ICAP aims to provide sustainable cooling, and thermal comfort and achieve environmental and socio-economic benefits for society.[92] By 2037-38, it aims to reduce (i) cooling demand across sectors by 20-25%, (ii) refrigerant demand by 25-30%, and (iii) cooling energy requirement by 25-40%.

The plan estimates that penetration of room air conditioners owned by households is likely to increase from the current 8% to 40% in 2037-38. Its recommendations include incorporating the Energy Conservation Building Code (ECBC) to minimize active cooling needs by using design elements (such as ventilation) that contribute to optimal thermal comfort for all commercial buildings, incorporating energy-efficient technologies, enacting guidelines to set minimum thermostat settings, and retrofitting existing buildings with efficient cooling systems. However, the IEA has observed that the ICAP does not outline the precise nature of its commitments.[91]

Measures for Energy Efficiency

The Bureau of Energy Efficiency (BEE), has taken several measures to improve energy efficiency. As of FY23, these measures have resulted in an annual reduction of 306MM tons of CO2.[93] The energy savings is equivalent to 53.6 MM tons of Oil equivalent, about 5.9% of total primary energy supply for FY24.[94]

- **Standards and Labelling Program**
  Launched in 2006, initiative helps consumers make an informed choice about their energy-consuming appliances, in terms of their energy savings and implied cost-saving potential. It aims to nudge consumer behavior towards more energy-efficient appliances, by rating their energy efficiency, from one (lowest) to five-star (highest).[95] The scheme currently covers 38 appliances (22 mandatory and 16 voluntary).[96] Some of the key appliances include refrigerators, ACs, washing machines, televisions, and microwave ovens. As digitalization leads to greater uptake of electricity-consuming appliances, such programs are critical in nudging consumers towards more ecologically friendly choices.

- **Eco Niwas Samhita (ENS) – Residential**
  An amendment to the Energy Conservation Act in 2022 increased the ambit of the BEE's codes to include sustainability features as part of it. Further, it widened the applicability of the code to residential buildings with certain minimum connected loads.[97] The code has certain mandatory provisions that accord ENS compliance. Certain incremental provisions lead to an ENS+ or Super ENS compliance. The standards provided for by the ENS include, site management, building envelope, water conservation, waste management, and indoor environmental quality.

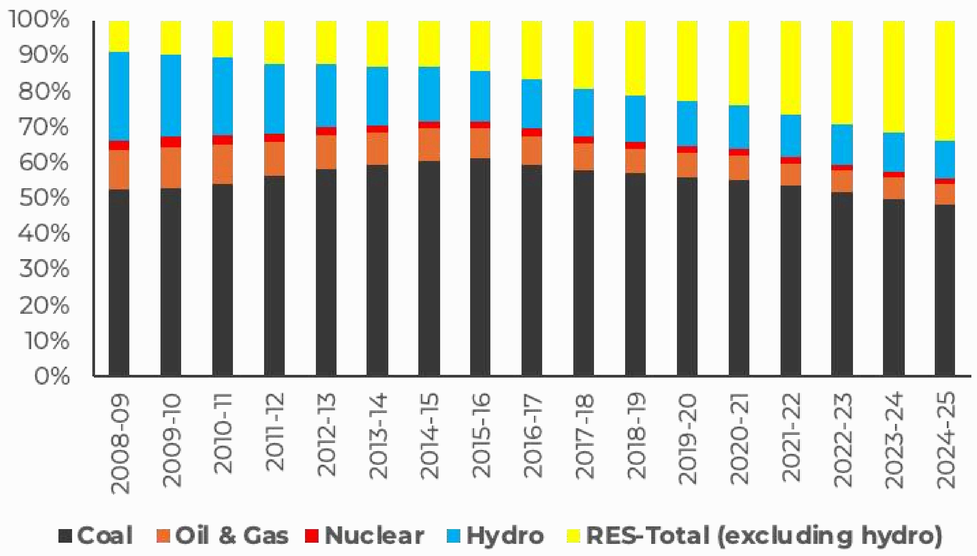
- **Smart Homes**
  The ENS acknowledges the impact of increasing digital penetration and various other factors on the rise in demand for 'smart homes' and a corresponding rise in per capita electricity consumption. The ENS recognizes the need for a Smart Home Energy Management System (SHEMS) to optimize energy use. SHEMS consists of hardware and software to monitor energy use, provide feedback, and control the energy use of appliances that use electricity. The adoption of SHEMS could lead to 20-30% savings in electricity usage.[98]

- **Proposed Residential Homes Labelling Program**[99]
  The proposed program aims to label residential houses based on their energy efficiency. This will enable consumers to compare homes over energy efficiency standards. Thus, this program is expected to encourage a preference for, and thereby construction of energy-efficient homes. The estimated savings of energy through this program is around 388 BU2 by 2030, approximately 27% of India's total electricity consumption in 2021-22.

Where does our electricity come from?

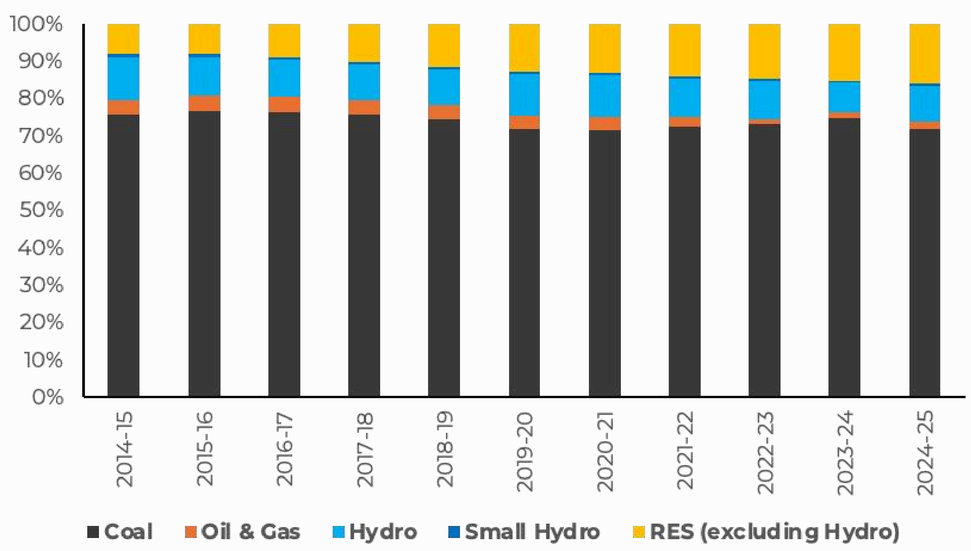
- **Renewable energy installation constitutes nearly half of the total installed capacity -**
  The total installed electricity capacity in the country is 456.8 GW as on November 2024. Of this, the non-fossil fuel sources - solar, wind, bio-power, hydro, and nuclear power, constituted 213.7 GW (46.8% of the total).[100] The government aims to more than double the installed capacity of renewable energy to 500 GW by 2030.
- **But increased installed capacity for renewables is not entirely translating into increased generation -**
  Even as renewable energy constitutes 46.8% of the total installed capacity, it constitutes only 16% of the total generation capacity. Coal continues to occupy the largest share in electricity generation, at 72% in 2024-25 (see Figures 4 and 5). The lack of translation of increased installation capacity into increased generation capacity could be attributed to the many challenges associated with renewable energy. Some of these challenges include -- unreliable supply (solar and wind energy depend on the weather, and supply fluctuates based on weather), grid compatibility issues (the current electricity grid can only handle a limited amount of fluctuations without disruptions), and uneven resource availability (not all regions have enough sunlight or wind), making it hard to distribute renewable energy evenly.[101]

Figure 4:
Installed capacity of electricity sources (Source wise %)



Source: India Climate and Energy Dashboard, NITI Aayog, Dasra Analysis. Note: Data for 2024-25 is updated as of November 2024

Figure 5:
Generation of electricity (Source wise %)



Source: India Climate and Energy Dashboard, NITI Aayog, Dasra Analysis. Note: Data for 2024-25 is updated as of November 2024.

Where does our electricity come from?

- **Coal's relative contribution to electricity installation reduced, but near tripling in absolute terms** - While the share of coal in the installed capacity is reducing (from 52% in 2008-09 to 48% in 2024-25), it is not reducing in absolute terms . During the same period, the installed capacity of coal has nearly tripled, from 77.6 GW to 217.6 GW.[102] Thus, even in recent years as the yearly growth rate of the coal capacity addition is declining from 16% in FY12 to less than 1% in FY25), and there is a steady increase in generation by renewable energy, coal continues to be the biggest source of electricity generation.

- **Gap between renewable energy installed capacity and generation will persist** - The share of installed capacity renewable energy has been increasing in the country and accounts for 34% (excluding hydro) of the total electricity generating capacity of India in 2024-25. As per the National Electricity Plan (2022-23) (NEP), the total installed electricity capacity of the country by 2031-32 is projected to be 900 GW. Of this, renewable energy (excluding hydro) is expected to account for 58% (521 GW) and coal is projected to account for 28.8% (260 GW).[103] However, as per the NEP's projections, renewable energy (including large hydro) will still account for only ~44% of the total electricity generated by 2031-32, underscoring that gap between installation and generation will persist.[101]

DID YOU KNOW?

Our cities face a phenomenon known as the 'urban heat island effect' (UHI).[104] Structures typically found in a city such as buildings, roads, and other heavy infrastructure absorb and re-emit more heat than natural terrain. In cities where these structures are highly concentrated, and natural greenery is limited, the temperature of the cities is usually higher than their surrounding areas. The surface temperature also tends to be higher than the air temperature (during the day). Besides urban structures and reduced greenery, other causes contributing to the UHI effect include city design, heat generated by vehicles, air conditioners and industries, and weather and geography. The India Meteorological Department found 21 and 38 cities out of 44 selected cities studied showed UHI during daytime and night-time respectively.[105]

2.3.2. PLANET

GHG EMISSIONS

The energy sector is the largest contributor to India's greenhouse gases (GHG) (75.66%), followed by the agriculture sector (13.72%), industrial processes and product use (8.06%), and waste (2.56%).[106] The combustion of coal has a highly degrading impact on the environment (air, water, and land). Burning of coal leads to the production of nitrogen oxide (NO2), sulphur dioxide (SO2), CO2, suspended particulate matter (SPM), and mercury emissions, all of which have adverse implications on air quality and public health.[107] A breakup of the emission contributors in India shows that electricity production accounts for 39% of emissions in terms of carbon dioxide equivalent (CO_{2e}), making it the highest emitting category in India.[102]

FLY ASH GENERATION

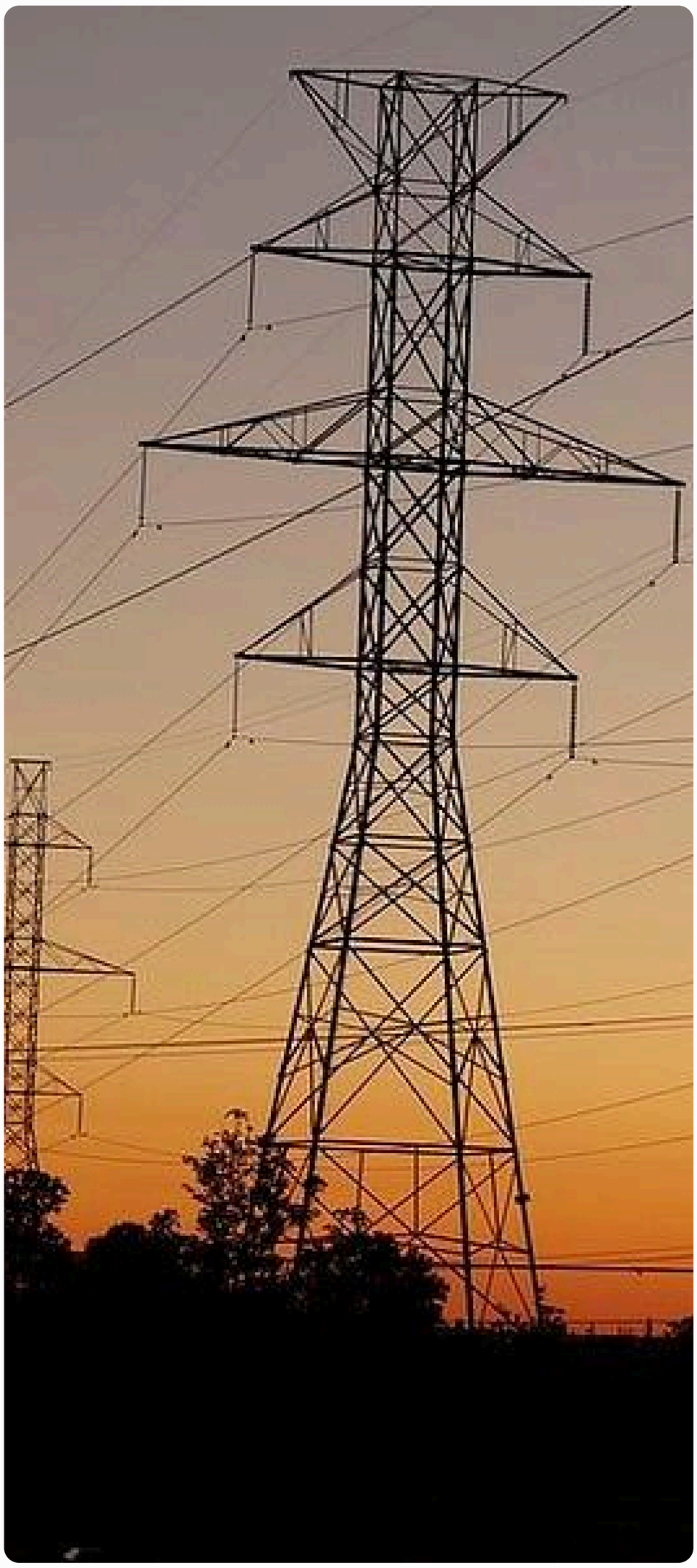
Fly ash is a major by-product of the combustion of coal. It has several environmental and health hazards, primarily due to its fine particulate nature and heavy metal content. Its harmful effects include air pollution, water contamination, respiratory illnesses, and loss of productive land due to disposal. Indian coal is of low grade, with higher ash content (30-45%) as compared to imported coal (ash content 2-15%). The Ministry of Environment and Forests has issued various targets over the years for the utilization of fly ash generated as raw material in other sectors. It aims to achieve 100% utilization of fly ash. In 2020-21, 92.41% of the total fly ash generated was utilized in various sectors. Fly ash finds its use in many sectors and productive activities such as cement, mine filling, bricks and tiles, reclamation of low-lying land, and roads and flyovers.[107]

Vicious cycle between cooling and climate change -
Demand for cooling and air conditioners stems from rising urban temperatures, as well as rising per capita incomes. Air conditioners see the fastest growing demand as compared to any other household appliance over the period 2040.[xci] The total cooling demand is projected to increase eight times by 2037-38 (from 2017-18) and the building sector is projected to constitute 74% of the total cooling demand.[108] The increased usage of ACs, in turn, contributes to increased GHG emissions and rising temperatures, perpetuating a vicious cycle between climate change and cooling needs.[109]

Renewable energy: A solution to mitigate emissions

Renewable energy plays an important role in moving towards producing electricity with minimal environmental impact.[101] Renewable energy sources are clean, have no CO_2 emissions, are inexhaustible, and do not emit any pollutants.[110] Besides being a tool for the mitigation of climate change, renewable energy can also contribute to sustainable development. In areas without access to electricity, or a reliable supply of electricity, renewable energy can help with providing access to electricity. Decentralized renewable energy grids can expand and improve access to energy. Many residential units and small enterprises use diesel generators as a choice for backup energy during outages, which results in environmental pollution.[111] [101] Renewable energy can be used as an effective way to provide electricity in the absence of grid-connected electricity/ outages. It is a cheaper, and non-polluting alternative.

Renewable sources in India include, wind, solar, hydro, nuclear, and bio-power. Of all the renewable energy resources available in India, solar is the most secure as it is abundantly available. Wind energy is mainly concentrated in eight states.[112] Over other energy sources, its advantages include relatively high-power density (it can produce more power per unit of space). Further, solar energy systems work without moving parts, making them a quiet way to produce electricity. They operate efficiently at normal temperatures and pressure and capacity expansion can be easily undertaken by adding more panels.[113]



A Brief Overview of Renewable Energy in India

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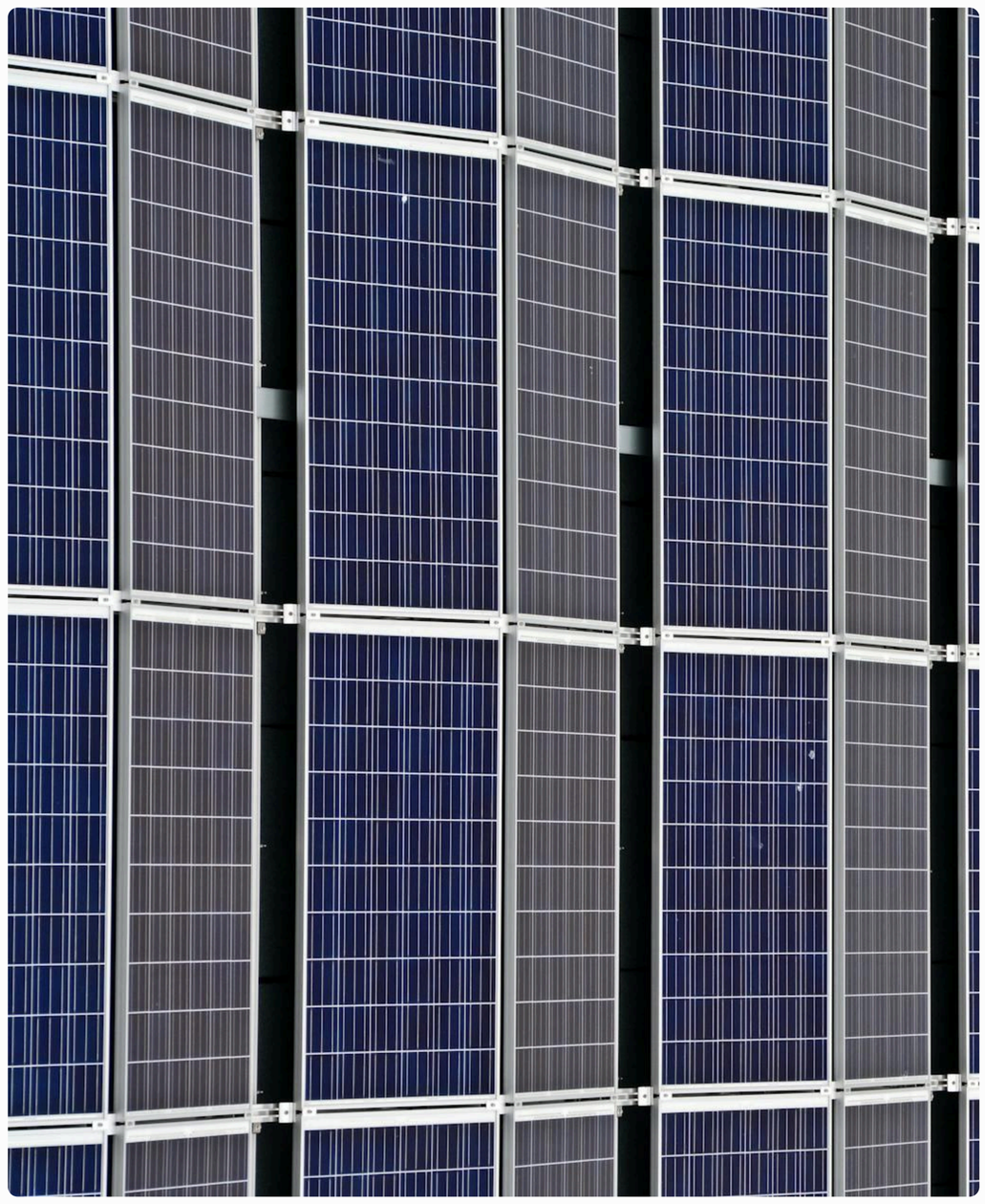
Barriers to adoption of solar energy

Lack of awareness about the benefits
A significant barrier to the adoption of renewable energy, particularly rooftop solar solutions, is the lack of awareness about its benefits. Many consumers are unfamiliar with how renewable energy compares to conventional sources in terms of cost savings, environmental impact, and long-term reliability. Misconceptions and a lack of clear information often lead to unrealistic expectations or hesitancy in adoption.

Knowledge gaps
Additionally, the constantly evolving technology and multiple available options add to consumer confusion, making it difficult to identify the most suitable solution. Knowledge gaps persist, not only in understanding the advantages of renewable energy but also in accessing vendors and business models that facilitate adoption. While consumers have shown willingness to shift renewable energy, a study found that consumers lacked the knowledge of vendors and the actual process of adopting rooftop systems (See Section 5 for demystified version of this process).[118] Furthermore, consumers often struggle to access reliable information on renewable energy benefits, leading to misconceptions and overselling of expectations about cost savings and energy generation. Installers sometimes promise unrealistic savings that may not be achievable due to various factors, such as improper installation or not maintaining systems clearly.

Although initiatives like the National Solar Rooftop Portal aim to simplify adoption, a stronger emphasis on consumer education, on-ground engagement, and transparent communication about both the economic and environmental benefits of renewables is necessary to drive greater adoption. A study also found that a lack of awareness of the benefits of rooftop solar systems amongst Micro and Small Enterprises (MSMEs) acts as a barrier to the uptake of the systems.[119]



The Non-Renewable part of Renewable Energy

While renewable energy continues to be the best suited solution for decarbonizing electricity production, with much lower lifecycle emissions than fossil fuel alternatives, there are still some environmental impacts one must consider.[120] As Dr Phillip Tortell said in the context of renewable energy, “But there was a catch—all of those new renewable energy sources required a fundamentally non-renewable resource; minerals and metals needed for batteries, circuit boards, wiring and other components of the digital, carbon-neutral economy”[121] These include emissions from energy intensive mining processes, loss of biodiversity and pollution, and also the social impacts of mining.[122]

2.3.3. PEOPLE

Inequities in access to electricity

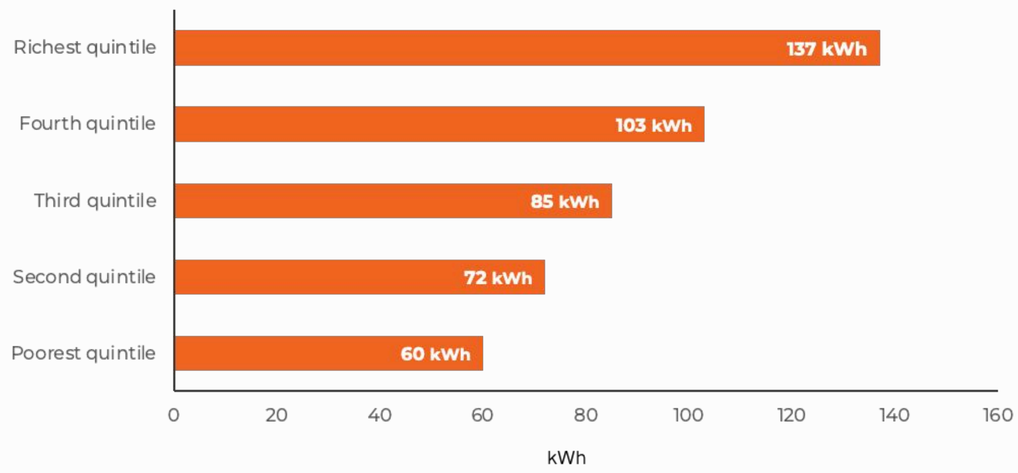
The ability to produce electricity (using various sources such as fossil fuels, solar energy, water, wind, and nuclear) has revolutionized the way we power our activities. Just a few centuries ago, economic activities were primarily powered by human or animal muscle. Electricity (generated mostly by fossil fuels) forms the basis of powering most activities in a modern economy today. If one has to break down and list their activities in a day, it is almost impossible to imagine a day without depending on electricity.

In this context, universal access to electricity becomes extremely imperative for people to achieve their full (economic) potential. Lack of access to electricity can disempower one's ability to be educated, get access to healthcare, and impede the ability to make use of the gains of convenience that electricity provides. SDG 7 calls to "ensure access to affordable, reliable, sustainable and modern energy for all"[123] There is no universally agreed definition of energy access.[124] However, access should go beyond the 'basic necessity' of providing a light bulb. A minimum level of electricity should be able to empower individuals to engage in productive activities, access services and power livelihoods.

In the last decade India has made great strides in providing access to millions of Indians living in energy poverty. India has now achieved near 100% electrification.[124] In 2021, about 96.7% households in India were found to be electrified (connected to the grid), and only 0.33% relied exclusively on off-grid solutions.[125]

However, what really matters is the quality of supply of electricity. To be able to achieve one's economic potential, access to reliable electricity without disruptions is necessary. There were great interstate variations in duration of electricity supply and power outages.[125] While the top performers (Delhi, Kerala, Gujarat, and Tamil Nadu) receive around 23 hours electricity supply, the least performing states (Uttar Pradesh, Jharkhand, Haryana, Assam, and Bihar) face 5-6 hours of power outages daily. This shows inequitable access to electricity in the country.

Figure 6:
Average Monthly household electricity consumption by wealth (2023)



Source: Reproduced from Data for India, based on Household Consumer Expenditure Survey (HCES) 2022-23 by National Sample Survey Office (NSSO)

Common but differentiated responsibility

While looking at the burden of emissions, one must keep in mind, not everyone bears equal responsibility. Globally, developed countries have a much higher per capita electricity consumption than developing countries. India has a relatively low per capita consumption of 1,397 kWh, against the global average 3,427 kWh. However, within India as well there is a great variance of per capita electricity consumption between income groups, and geography.

- Data for India's analysis shows that the richest households in India consume monthly on average more than twice the amount of electricity over their poorest counterparts (see Figure 6). [126]
- There is also a difference between urban and rural households in electricity consumption. Over 50% of urban households consume more than 100 units a month. Less than 25% of rural households reach this level.

Our analysis based on NITI Aayog data found that the top nine states with the highest per capita GSDP (excluding Sikkim) have an average per capita electricity consumption of 2,094 kWh, 50% higher than the national average. The bottom eight states with the lowest per capita GSDP have an average per capita electricity consumption of 700 kWh, 50% lower than the average. Notwithstanding the inequities in electricity consumption, the effects of emissions are felt by all states.

This shows that the burden of emissions is higher on the richer states. While on one hand a certain group of people are able use electricity to achieve their economic potential, another group cannot, yet they face the same ill effects of the related emissions. As we grow as a nation, millions need to get access to better quality of electricity. The demand for electricity consumption is only set to increase. As this demand increases, it is important to ensure equitable, quality access to all. While fulfilling this demand, it is imperative to keep in mind that renewable energy is the only way to go for a more sustainable future.

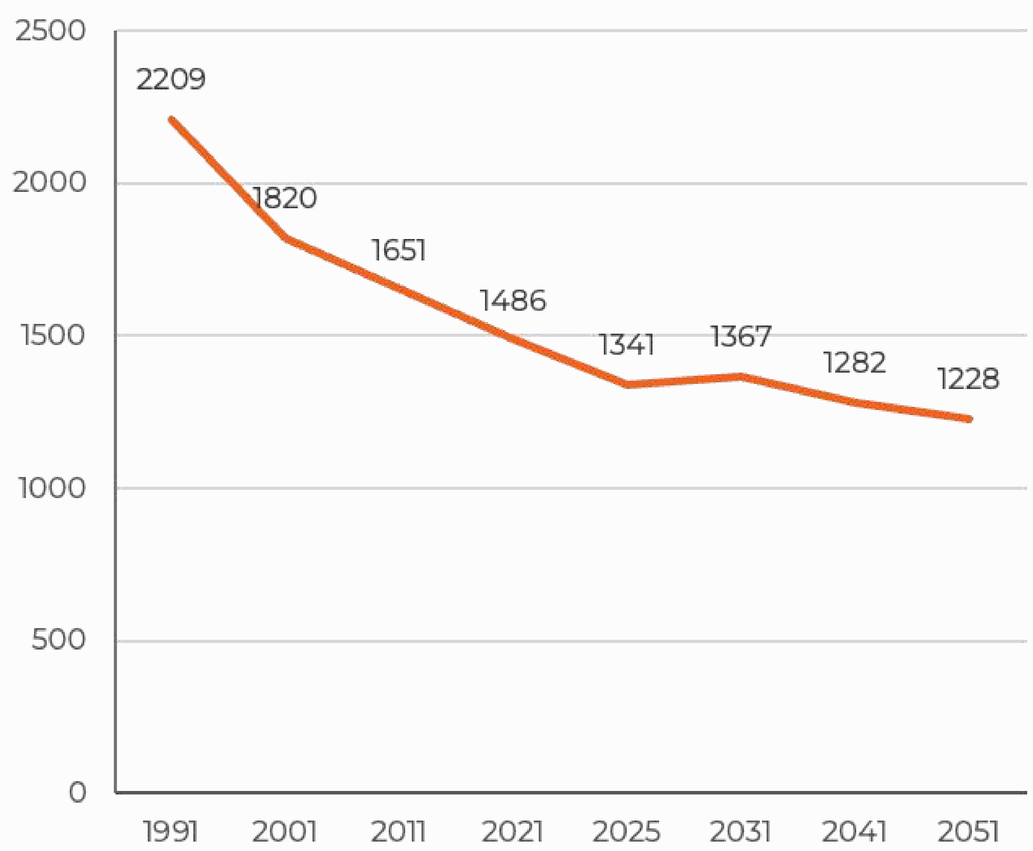
#2.4

Natural Resources Haul

2.4.1. CONTEXT

Natural resources form the backbone of our ecosystems and economies, encompassing air, water, minerals, fossil fuels, forests, and wildlife. In this section, we focus on water—a vital resource that underpins multiple supply chains yet is becoming increasingly scarce for both consumption and production. Between 2000 and 2021, India's average annual per capita water availability dropped by nearly 18%, from 1,816 cubic meters to 1,486 cubic meters (See Figure 7).[127] However, this decline masks deep inequalities across regions and communities. Beyond scarcity, issues of quality and accessibility further exacerbate challenges, impacting sanitation and public health.[128] In 2023, about 163 million Indians lacked access to clean drinking water, while 210 million lack improved sanitation.[129] India also records the world's highest number of deaths from diarrheal diseases linked to unsafe water, with approximately 508.3 deaths per million people in 2019.[130]

Figure 7:
Trends in Per Capita Availability of Water (in cubic meters)



Source: IndiaStat

The pressure on India's water sources has intensified in recent years due to the increase in demand for water for different consumption purposes. This is mainly driven by the twin forces of rapid urbanization and industrial expansion. On a per capita basis, average domestic water demand is projected to increase from 85 liters per capita per day (lpcd) in 2000 to 125 lpcd in 2025 and further to 170 lpcd by 2050.[131] This rising demand underscores the urgent need to examine how water is being used across industries, particularly in the context of digital penetration.

We explore two key trends shaping water consumption in the digital economy – related to setting up of data centers and fast fashion. While data centers are a recent phenomenon, the textile sector has historically been amongst the leading consumers of industrial water in the Indian context. [132] The growing dependence on digital infrastructure, combined with the relentless pace of fast fashion, presents new challenges in water management. Understanding the scale and impact of these industries is essential as India navigates the complex balance between economic growth and sustainable resource use.

Data Centers exacerbating water-crisis in already stressed regions

Data centers serve as the building blocks of the digital infrastructure in the country. These facilities house vast networks of high-powered computers and related hardware, enabling the storage, processing, and management of enormous volumes of data. Each time a photo is uploaded on a cloud, or one uses GenAI applications like ChatGPT, data centers handle these operations. As of 2023, sources indicate that India had 151 data centers.[133] India's data center capacity is set for a remarkable expansion, with projections indicating it will reach approximately 2,070 megawatts (MW) by the end of 2025.[134] This rapid growth is backed by significant investment commitments.

Cumulative investments in India's data center sector are expected to surpass USD 100 billion by the end of 2027. Between 2019 and 2024 alone, the sector attracted USD 60.3 billion in commitments from both domestic and international investors, underscoring the growing importance of digital infrastructure in India's economic landscape.[132]

While these projections come from different sources, they collectively point to an undeniable trend—the country is on the cusp of a significant expansion in both the number and scale of data centers. Therefore, the demand for data centers is set to increase driven by increased demand for data localization[135], expansion of the 5G network services, increased demand for generative AI and an overall increase in data creation and data consumption. India already ranks among the highest, with respect to average wireless data usage per subscriber per month.[136] The increased smartphone and computer usage will further accelerate demand.

As data centers process huge amount of data every minute, they operate as resource-intensive powerhouses, demanding a constant and uninterrupted energy supply. Besides requiring huge amounts of uninterrupted power supply, they rely heavily on water to prevent their systems from overheating, given their 24/7 operational nature.

However, this water usage presents a significant challenge—not only is the potential for reusability limited, but much of the water evaporates during the cooling process, and any wastewater generated must undergo extensive treatment before it can be reused, if at all.[137] While estimates vary, one widely cited figure suggests that a single 1 MW data center consumes approximately 25.5 million litres of water annually for cooling alone.[137] In the Indian context, at the 2023-24 capacity of 950 MW, this translates into 24.2 billion liters of water. [135] **For context, this would satisfy annual water needs of 0.5 million individuals in urban areas (at 125 lpcd) or 1.2 million individuals in rural areas (at 55 lpcd).**[138] With India's data center capacity projected to more than double to 2,100 MW by 2026-27, concerns over water security in regions hosting these facilities are rising.[139]

The need to address this is specifically more important in context of water, because unlike electricity, which can be sourced from other states, water dependency is largely localized. Given that 80% of domestic water come from ground water reserves[140], this is likely to put additional stress on the local communities, which are already reeling under water stress. Notably, data centers are predominantly concentrated in urban areas, where water stress is an ongoing crisis. Mumbai alone hosts more than 50% of India's data centers, exacerbating concerns about sustainable water management in an era of rapid digital expansion.[141]

E-commerce fueling the demand for fast fashion, intensifying water consumption

An improved and a widened distribution and logistics network, along with increasing E-commerce penetration, has driven the demand for fast fashion in India beyond Metro and Tier-I cities. By 2030, an estimated 150 million new shoppers from emerging market segments are forecasted to buy from E-commerce platforms. [142] Fueled by both these new shoppers and growing demand from existing shoppers, the fashion E-commerce market is projected to grow at approximately 20% between 2023 and 2030, outpacing the overall fashion industry's growth rate of around 11%.[142]

Beyond domestic demand, India is also a key global hub for fast fashion manufacturing, further intensifying resource consumption.[143] The increased demand for fast fashion translates into higher demand for raw materials, particularly textiles, which are both labor and water intensive. This is compounded by inefficiencies in manufacturing, which result in increase in the water usage. Estimates suggest that producing one tonne of cotton in India requires 2–2.5 lakh liters of water—significantly higher than the less than 1 lakh liters used by leading global manufacturers. Moreover, every stage of the textile production process, from cotton cultivation to dyeing, contributes substantially to water pollution, amplifying environmental concerns.[144]

DID YOU KNOW?

Denim manufacturing is among the most water-intensive apparel. A single pair of jeans requires 3,781 liters of water over the entire lifecycle of manufacturing--equivalent to the amount of water a person in rural areas requires to fulfil all their water needs for more than two months (~68 days), and drinking water needs of any person over three years.[145] [146]

The rising demand for fast fashion, combined with a decreasing lifespan of clothing, has significantly contributed to the growing volume of textile waste in landfills. A substantial portion of this waste originates at the household level, underscoring the need for a shift in consumer behavior and more sustainable consumption patterns. The ease of returns, a feature widely promoted by E-commerce platforms, has further amplified the environmental impact of fast fashion by increasing both logistical emissions and waste generation.[147]

One estimate suggests that clothing has become the most frequently returned product category, with online purchases witnessing a staggering return rate of 24.4% in 2023—well above the global average of 16.5%.[148] High return rates not only lead to greater transportation emissions but also increase the likelihood of discarded apparel, as many returned items never re-enter circulation due to quality control measures and cost inefficiencies. This cycle of excessive production, consumption, and disposal further exacerbates the carbon footprint of the fashion industry, making it imperative to rethink both production and consumer habits in favor of more sustainable alternatives.

DID YOU KNOW?

In a proposed Anti-Fast Fashion Bill, the French government envisions a USD 10.5 penalty on every fast fashion item, raising its final price, along with a ban on fast fashion advertisements.[149] The bill was unanimously passed in the lower house of the Parliament in March 2024.[150]

2.4.2. PLANET

Framing the Water Challenge: Contextualizing Data Centers and Fast Fashion

Before delving further into the environmental impact of expanding data centers and the surging demand for fast fashion, it is essential to first understand India's broader water sourcing and supply landscape. As the world's **largest** consumer of groundwater, India relies heavily on this resource to sustain its agricultural, industrial, and domestic needs.[151] Groundwater serves as the backbone of the country's water supply, playing a critical role in supporting livelihoods, economic activities, and daily consumption.

However, this dependence is heavily skewed towards agriculture, which alone accounts for **89% of total groundwater usage**, leaving only **11%** for domestic and industrial consumption.[152] This imbalance, coupled with increasing demand across sectors, is rapidly pushing India toward a severe water crisis. By 2030, India's total water demand is projected to be **twice the available supply**, raising urgent concerns about long-term sustainability. Reflecting this growing scarcity, India ranked **133rd out of 180 countries** in global water availability.[153] Against this backdrop, the water consumption by data centers and the textile industry might seem relatively minor when compared to agriculture's overwhelming share. However, as we will argue in the following sub-sections, even their comparatively lower consumption plays a significant role in exacerbating water stress – particularly in regions already facing acute shortages. Given the accelerating expansion of data centers and the relentless pace of fast fashion production, ignoring their contributions to the water crisis is no longer an option.

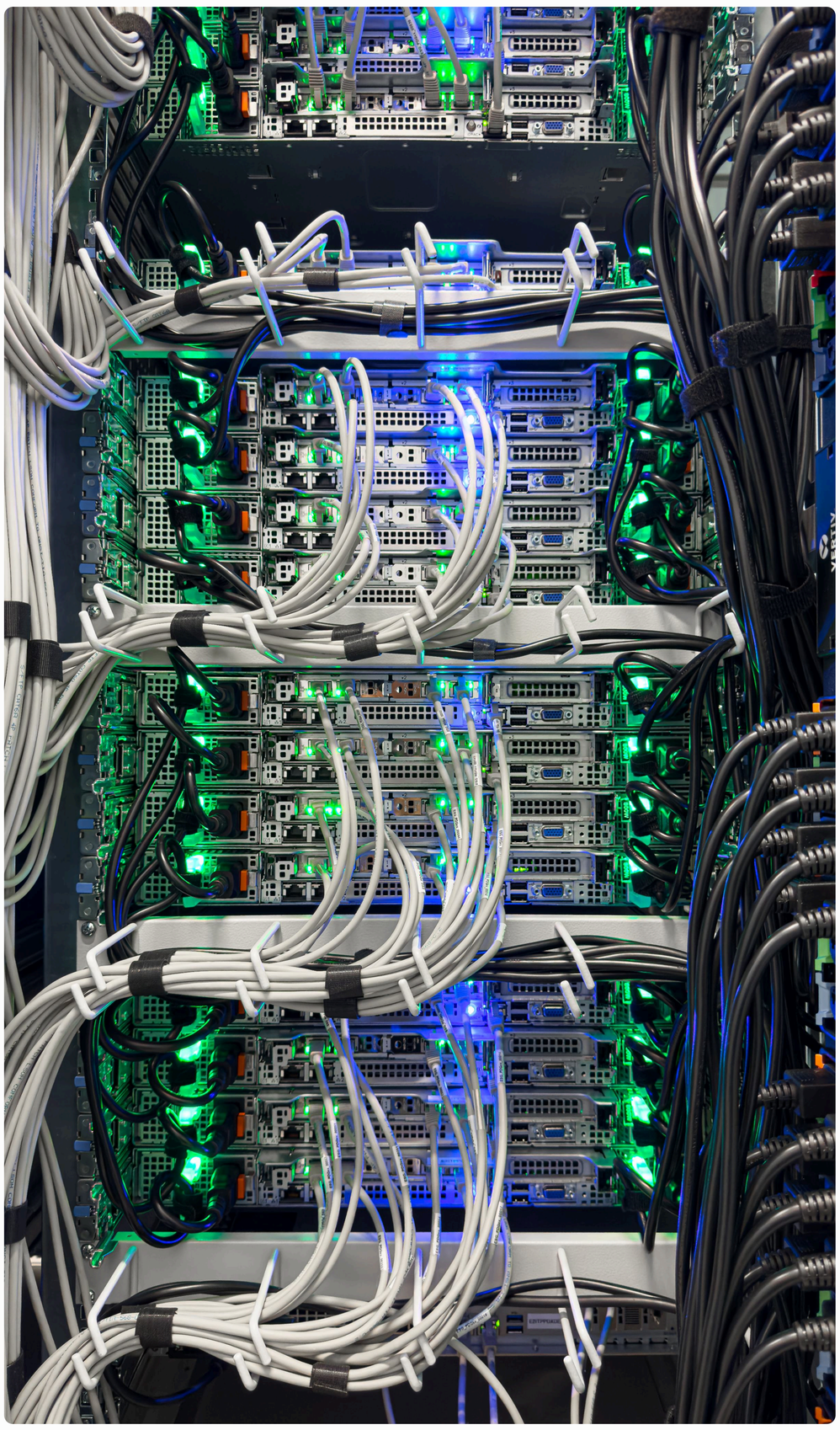
Essentiality of Data Centers

As highlighted earlier, most of India's data centers are concentrated in metro cities — regions already struggling with chronic water shortages.A detailed mapping of these facilities reveals that they are spread across 28 cities, many of which are facing periodic water cuts as climate change intensifies. Even Delhi, a city that has already extracted most of its available groundwater,[154] is home to 26 data centers, compounding the region's water scarcity.[155]

What further exacerbates the issue is the lack of transparency surrounding the actual water consumption by data centers. The lack of availability of detailed data on water consumption makes it difficult to determine the true extent of impact they have on the local groundwater tables. This opacity not only hinders effective water management but also increases the vulnerability of these regions to groundwater depletion. Given that an average data center has a lifespan of about 15-20 years, the crisis unfolds over an extended timeline, often resulting in decline in availability of water for other purposes. Enhancing transparency in reporting of water usage will benefit both the government and firms alike. While it will enable the former to promote sustainable water management practices and also improved location planning, it will also enable private sector in better assessing the long-term feasibility of their projects.

"A data center is not a short-term infrastructure project—it is a 15-20-year investment. While setting it up in water-stressed regions today, businesses must consider how it will operate in the future when climate change and urban expansion further deplete water sources. Beyond the environmental impact—it is a serious financial and operational risk, and businesses risk significant disruptions and cost overruns in the coming decades."

-Sahana Goswami,
WRI India



The issue of absence of adequate monitoring is exacerbated by the fact that the 'Essential Service' status accorded to them under the National Data Center Policy 2020, further exacerbates the crisis, as it entails re-distribution of the already scarce resources. It also entails, that during peak summers, while select parts of these cities will face water cuts and scarcity, the data centers continue to have access to round-the-clock access to water, irrespective of the purpose they are serving.

"If these zones receive priority water allocations, what does that mean for households and industries already competing for limited resources? Without validated, publicly available data on water usage and allocation, cities will struggle to balance water security with the rapid expansion of digital infrastructure."

-Sahana Goswami, WRI India

DID YOU KNOW?

Over 100 data center operators and trade associations have committed to the Climate Neutral Data Centre Impact, whereby signatories have pledged to an ambitious target of making their European operations carbon neutral by 2030.

Recently, there was also discussion of granting 'infrastructure' status to data centers, with additional incentives to firms setting up AI and ML data centers.[156] The latter are likely to be even more resource-intensive with respect to their power and water requirements.[157]

Waste Generation from Fast Fashion

In the textile industry, there's a focus on collecting used textiles, converting them into fiber, and creating new clothes, often labeled as sustainable. However, this approach often ignores the material's true potential. For example, a jacket that could last another 10 years might instead be shredded and turned into another product marketed as sustainable, losing its original value. This highlights the need for a better understanding of circularity. Many believe they are engaging in sustainable practices, but true sustainability lies in maximizing a material's lifecycle rather than prematurely recycling it.

- Anita Patil, Goonj

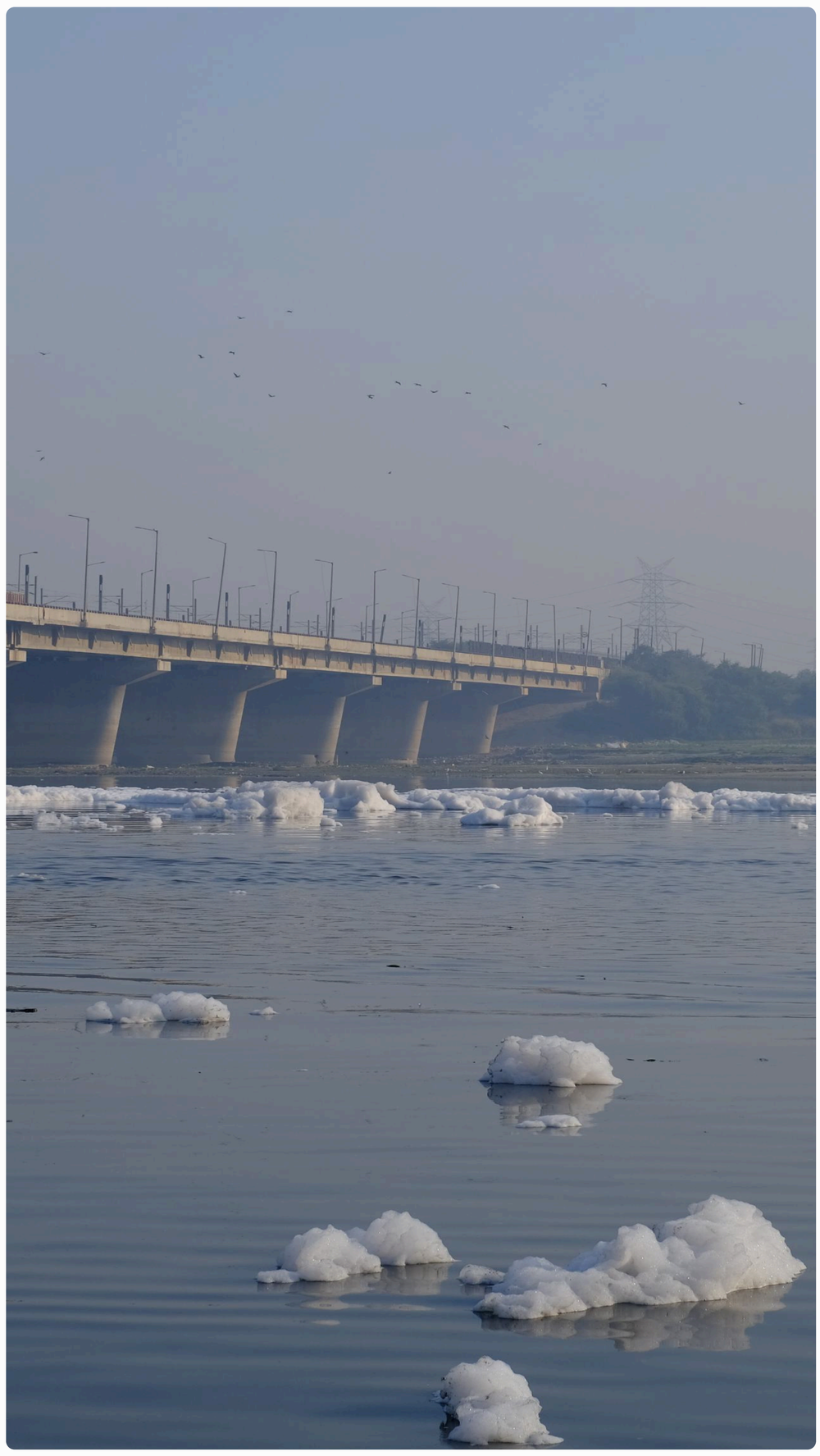
The increased demand for fast fashion coupled with the decline in the average lifespan of the clothing have further contributed to the already existing problem of high textile waste in the country. India is the largest generator of textile waste in the world[158], generating 7,793 ktons of textile waste on an annual basis.[159] Of the total waste generated, less than 50% of the total textile waste is collected.[160] Of the recovered waste, only 25% is recycled and 10% is upcycled.[161] Thus, a sizeable portion of the waste is getting accumulated in the landfill and/or being incinerated, leading to harmful emissions.[162]

Even the existing recycling apparatus is fraught with multiple challenges – heterogenous industry with wide variety of players, operating at different scale and technology readiness, intensive reliance on non-renewable sources of energy and pre-dominance of informal sector operating in poor working conditions.[163] This translates into recycling being a resource-intensive activity leaving a major carbon footprint. Similarly, the predominance of low-grade recycling has also meant that bulk of the recycled yarn is concentrated in the Indian markets, instead of becoming part of the global textile supply chain.

This further strengthens the case for re-usability and upcycling of the products, which enhance the lifespan of the product and delay the process of recycling.

Water Pollution from textile manufacturing

At multiple stages of the apparel manufacturing process, water is not only heavily utilized but also significantly contaminated, exacerbating water pollution and reducing access to clean water. One of the most concerning aspects of this industry is the release of untreated effluents during the process of dyeing and coloring, which often flow directly into water bodies without adequate treatment. These effluents contain high concentrations of synthetic dyes, bleaching agents, acids, heavy metals, many of which are highly toxic and exceed permissible safety limits. [164] Since most of these chemicals are non-biodegradable, they persist in the environment, creating long-term hazards for ecosystems and human populations alike.[165]



Globally, textile production has been linked to the pollution of approximately 20% of the world's clean water reserves.[166] In the Indian context, case studies have revealed alarmingly high concentrations of pollutants in water bodies near textile hubs, often surpassing WHO's recommended safety thresholds.[167] This not only poses severe health risks to local communities but also compromises the availability of safe water for essential needs like drinking, cooking, and irrigation. Similarly, the widespread use of synthetic fibers—such as polyester and nylon—in fast fashion contributes significantly to aquatic pollution through the release of microplastics. Each time synthetic garments are washed, they shed microplastic fibers, which are too small to be effectively filtered out by wastewater treatment plants.[168] One estimate suggests that microfibers released from washing synthetic clothing account for nearly one-third of all plastic debris accumulating in the oceans.

These tiny plastic particles are ingested by marine life, entering the food chain and ultimately posing risks to human health as well. The cumulative impact of water-intensive production, chemical pollution, and microplastic contamination underscores the urgent need for sustainable interventions in the fashion industry. [169]

Efforts focused on deployment of the advanced filtration, and waste water treatment technologies have met with limited success. This has been due to the pre-dominance of the micro, small and medium-scale enterprises, which do not have the necessary resources to invest in this infrastructure.[170] Further, the home-based operation of some activities like dyeing and washing means that they do not fall within the ambit of most of the regulations relating to water treatment.[171] Addressing these challenges requires stricter enforcement of regulations, and scalable technical solutions that support smaller manufacturers in adopting sustainable practices.

2.4.3. PEOPLE

Health Impact of water pollution and contamination

The unchecked release of heavy metals and toxic chemicals into water bodies due to industrial effluents, particularly from textile manufacturing, poses a severe and far-reaching public health crisis. These contaminants not only degrade water quality but also have cascading effects on human health, soil fertility, and aquatic ecosystems. The direct consumption of polluted water—whether through drinking, cooking, or bathing[172] —exposes individuals to an array of health hazards, ranging from acute conditions like diarrhea and hemorrhage to long-term consequences such as central nervous system disorders, kidney malfunctions, and even cancer.[173] Many of these heavy metals, including lead, mercury, and cadmium, are bio accumulative, meaning they persist in the environment and magnify in toxicity as they travel up the food chain, eventually making their way into human diets through contaminated crops, fish, and livestock.[174]

The scale of water pollution in India is staggering. Nearly 70% of surface water resources are contaminated, rendering them unfit for direct human consumption.[175] This crisis disproportionately affects 11.5% of population who already lack access to clean water, exacerbating health inequalities and leading to a persistent cycle of disease and poverty. The prevalence of waterborne illnesses —caused by exposure to contaminated sources —remains alarmingly high, placing an immense burden on public health infrastructure.

Beyond its devastating impact on human lives, water pollution also carries substantial economic costs. The widespread incidence of waterborne diseases results in an annual financial loss estimated between USD 6.7–8.7 billion, stemming from healthcare expenses, lost productivity, and premature deaths.[176] Additionally, the degradation of water quality has direct implications for agriculture, where polluted irrigation sources lead to lower crop yields and declining soil fertility. Studies indicate that water pollution has contributed to an estimated 9% reduction in agricultural revenues, disproportionately affecting small-scale farmers and rural economies.[177]

Inequities in access to water

One of the most pressing yet overlooked consequences of rapid industrialization and digital expansion is the question of who bears the greatest burden of these innovations. The fast fashion industry and the ever-expanding data center infrastructure—both of which rely heavily on water—primarily serve a relatively small segment of the population, estimated to be less than 50% of the population. Yet, the disproportionate burden of water scarcity, depletion, and diversion falls on those least likely to directly benefit from these services. While urban consumers enjoy the conveniences of on-demand fashion and seamless digital connectivity, millions at the margins struggle with unreliable or unaffordable access to the most basic necessity: water.

In cities already grappling with water shortages, accessibility is not just about availability—it is shaped by multiple dimensions, including the sufficiency of supply, seasonal fluctuations, reliability of distribution, affordability, and ownership of water sources. A singular focus on access statistics fails to capture the deep inequalities embedded in water security.[178] Water shortages rarely affect everyone equally. When supply dwindles, it is often the low-income neighborhoods and informal settlements that bear the brunt of the crisis, while high-rise apartments and affluent enclaves continue to enjoy uninterrupted piped water. In 2019, residents of informal settlements in Indian cities reported receiving piped water for only three hours, three days a week, whereas those in Mumbai's middle- and high-income areas had access to seven hours per day.[179]

The financial burden of water insecurity only worsens these inequities. The urban poor, already struggling with economic precarity, often spend an alarmingly high proportion of their income just to secure safe drinking water. One estimate suggests that low-income households in India allocate 15% of their earnings to purchase water—an essential resource that wealthier communities obtain at a fraction of the cost.[180] The price disparity is staggering: in Bengaluru, water delivered by tanker trucks costs 12 times more than piped water; in some cities, this gap rises to 52 times.[181] Given that piped water in India is heavily subsidized, those with the least access—predominantly the poor—are effectively excluded from the very benefits meant to ensure equity.[182]

Food Wastage In India: A Paradox Of Abundance And Hunger

In 2022, the world wasted an estimated 1.05 billion tons of food.[183] This massive food waste contributes to 8-10% of annual global GHGs, almost 5x greater than emissions from the aviation sector.[184] Besides the emission burden, this also depletes critical natural resources like water, energy, and land. India, despite ranking 105th out of 127 countries on the 2024 Global Hunger Index, wastes approximately 78.2 million tons of food annually, amounting to 55 kg/capita, making it the second highest globally for household food waste.[185] This paradox of widespread hunger and significant food wastage highlights the urgent need for action to improve food security, reduce economic losses, and mitigate environmental harm.

A significant amount of food in India is lost along the supply chain, from production to consumption. Estimates suggest that 1/3rd of all food produced in India is wasted or spoiled, primarily due to post-harvest losses caused by poor transportation, inadequate storage, and improper handling. Shockingly, 40% of food produced in India is wasted, resulting in a financial loss of approximately INR 92,000 crores annually, equivalent to 1% of the country's GDP.[186] Urban areas tend to waste more food compared to rural regions, reflecting disparities in consumption and waste patterns.[187] Despite these alarming figures, systematic efforts to measure and combat food waste in India remain in their nascent stage, emphasizing the need for coordinated policies and practices.

Key Government Efforts To Reduce Food Wastage

- The Indian government has taken notable steps to address food wastage. The Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters (SAMPADA) scheme 2016 focuses on building cold chain infrastructure and enhancing food processing, while Mega Food Parks aim to provide modern storage facilities and improve food preservation.

- The Indian Food Sharing Alliance (IFSA) is a social initiative by the Food Safety and Standards Authority of India (FSSAI) aimed at addressing India's food waste and hunger crisis by integrating various partner organizations, Food Recovery Agencies, and NGOs. FSSAI's objectives through IFSA include minimizing food wastage by redistributing it to the needy, raising awareness to reduce food waste, ensuring safe distribution of surplus food, educating food businesses on best practices to prevent food loss, and providing strategic support for food loss and waste reduction initiatives.

Civil Society Interventions

Robin Hood Army

- **The Robin Hood Army** is a volunteer-based organization that works towards eliminating hunger and food waste in India. The organization has a presence in over 200 cities and a wide network of over 50K volunteers. The volunteers collect surplus food from restaurants and distribute it to those in need. It also runs community kitchens in various cities.

NO FOOD WASTE

- **No Food Waste** based out of Chennai and nearby areas, that works towards reducing food waste in India. The organization has an ambitious network of volunteers who collect food from weddings, parties, and other events and distribute it to those in need. The organization also runs community fridges in various cities across the country, where people can donate and collect food.

Private Sector Initiatives

wastelink

- **Wastelink**
  This Delhi based startup collects food by-products and other surplus raw materials from food producers and converts them to high-value nutrition rich innovative bakery feed ingredients for animals.

zomato

- **Zomato's 'Food Rescue' Initiative**
  Zomato's innovative "Food Rescue" program tackles food waste from canceled orders by notifying customers within a 3 km radius to claim the food at a discounted price. Food is delivered in untampered packaging, and proceeds are shared with the original customer and restaurant, while Zomato retains only government taxes.

#3 Solutions

In this section, we present a list of potential solutions to some of the key issues and challenges identified in the previous section. These solutions range from localised solutions emerging from India, which have the potential to be scaled and replicated, to some of the best practices at the global level. We have divided these solutions based on the stakeholders which have championed these solutions – Government, Civil Society, Private Sector and Social Enterprise.

#3.1 Government Initiatives: Driving Change From The Top

1. Electric Vehicle Revolution in India

While paratransit and ride-hailing services meet a critical need, they still contribute to air pollution and CO2 emissions if they use internal combustion engines (ICE). So, to address this, electrification of these vehicles is an essential step toward decarbonizing urban mobility.

Electric vehicles (EVs) are emerging as a game-changer in tackling last-mile logistics challenges. E-commerce businesses are also looking at decarbonizing their mobility operations because their long-term success depends on thriving healthy cities. Data shows that a 100% adoption of EVs for E-commerce in India by 2030 could prevent 44% of the total CO2 emissions caused equivalent to ICE vehicle variants.[188] While upfront costs may seem steep, EVs are a prudent long-term investment for E-commerce players, especially with renewable energy powering much of their operations. Industry leaders are already paving the way: Zomato plans to deploy only electric vehicles by 2030 through partnerships like Yulu, while Flipkart aims to roll out 25,000 EVs within the same timeframe. Swiggy, in collaboration with Gogoro, has introduced electric vans for high-volume deliveries, signaling the shift toward greener logistics. These lightweight, smaller vehicles for last-mile deliveries are particularly suited to dense cityscapes, ensuring quick deliveries while significantly reducing carbon footprints. This vision aligns seamlessly with NITI Aayog's "Shoonya - Zero Pollution Mobility" campaign, which aspires to pave the way for 100% electrification in India's urban last-mile connectivity and delivery sectors. By accelerating the adoption of electric vehicles (EVs) for ride-hailing and delivery services, the campaign aims to deploy over 11 million EVs by 2030 and establish 350,000 charging points by 2025, among other ambitious targets.

The private sector has been in line with these targets and has set its individual mandates in line with the mandates from GoI. In the case of ride-hailing firms, Uber has committed to 100% of its rides in zero emission vehicles, on public transit or with micro-mobility by 2040.[189] Ola, through its "Ola Electric" mission, has been advancing efforts to electrify its fleet, focusing primarily on two-wheelers for its bike taxi business in select locations.[190] BluSmart, India's largest fully electric cab fleet, operates approximately 7,000 electric vehicles under its mission to "Decarbonize Mobility at Scale." However, its services are currently limited to Delhi NCR and Bengaluru.[191]

Similar targets are adopted by delivery services as well – Zomato is a member of The Climate Group's EV100 initiative, which aims to achieve 100% EV adoption by 2030.[192] Swiggy has set an ambitious target to cover 8 lakh kms/ day with EVs by 2025. It has collaborated with companies like Gogoro to provide easy access to battery swapping stations near delivery hubs.[193]

DID YOU KNOW?

***Tata Motors** – India's largest electric passenger vehicle manufacturer – signed an agreement with Uber to supply **25,000 EVs**. This agreement is the **largest EV commitment** between an automative manufacturer and ride-sharing platform in the country.[194]*

Clearing the Air: Why EVs Outperform ICE Vehicles on Emissions

Electrification not only eliminates tailpipe emissions, which is a significant public health benefit, but it also contributes to broader climate goals. While concerns about EVs typically center around the carbon footprint of battery production and the reliance on coal-powered grids, the evidence strongly supports EVs in terms of their overall environmental impact. Studies indicate that EVs produce 20–30% lower lifecycle emissions compared to ICE vehicles[195], even with India's current grid composition, which is approximately 70% coal-powered. While battery production initially contributes to higher emissions, these are offset within about two years of use due to the absence of ongoing tailpipe emissions. In contrast, ICE vehicles continue to generate emissions at every stage—from oil extraction to fuel consumption during operation. Moreover, as India works toward its 500 GW renewable energy target by 2030, the grid will increasingly rely on cleaner sources of energy, further reducing the emissions associated with charging EVs.

Besides, the concerns about CO2 emissions, the higher prices of EVs relative to ICE, has been another area of concern. Globally, as battery prices decline due to economies of scale, EV costs are becoming more competitive with traditional ICE vehicles. In India, manufacturers like Tata are producing electric cars at prices comparable to ICE models, signaling significant progress.

India's unique strategy of prioritizing public and commercial mobility for electrification

India stands out globally for its unique approach to incentivizing EV adoption with its forward-looking demand-incentive schemes for public and commercial transport, such as buses, taxis, and delivery vehicles. The focus is on vehicles serving mass commuting and commercial purposes, aligning with the broader goals of

sustainability and accessibility. This is in stark contrast to Global North, where the focus has been on cross-subsidizing of personal cars. In this light, India's approach to incentivizing EV adoption rightly emphasizes public and commercial transport, as seen in the Central Government's FAME-II scheme, which reduced subsidies for personal electric cars. The scheme lowered the maximum subsidy cap from 40% to 15% of a vehicle's cost in 2023[196], signaling a shift away from using public funds for private benefits. Instead, this money should be invested in strengthening public transport and para-transit systems, aligning with sustainability and accessibility goals.

By leveraging new technologies and aligning them with conditional funding that mandates disciplined implementation, the mobility sector can be transformed. This means to ensure strict adherence to timelines, quality standards, and project objectives in funded initiatives. This will come with regular monitoring and evaluation to track progress and achieve set goals. GoI is devising a plan to replace 800,000 diesel buses, constituting 1/3rd of the total fleet.[197] To address the high upfront costs of EVs, India's demand incentives aim to reduce the total cost of ownership over the vehicle's lifetime, making them more economical.

2. Whole is greater than sum of its parts: Lessons from the Mobility landscape in the world

EV reduces pollution, but congestion on roads will persist: The transition to EVs in India is undoubtedly a step toward cleaner mobility, but it is only a small piece of the larger puzzle. While EVs reduce tailpipe emissions, they fail to address the growing challenge of urban congestion, which is set to worsen as personal car ownership continues to rise. The solution lies not just in electrification but in reshaping the way we move—by reducing reliance on personal vehicles and emphasizing high-capacity, integrated public transport systems.

Need to shift gears towards multi-modal strategies for energy-efficient mobility: Even a complete transition to EVs will remain energy inefficient unless supported by a comprehensive, multi-modal public transport strategy. Without this, the energy demand merely shifts from fossil fuels to solar, failing to rationalize consumption. Seamless first- and last-mile connectivity must complement such efforts, making public transport not only viable but also the most attractive option for commuters.

Several **global cities** have demonstrated how to align clean energy mobility with effective congestion management:

#1 London's Ambitious Mobility Overhaul
London is a beacon of integrated transport strategy. Its electrification push is complemented by policies to discourage personal car use:

- **Low-Emission Zones:** Driving a personal car in central London incurs hefty congestion and emission charges, making personal vehicle use financially prohibitive.
- **Public Transport Renaissance:** The iconic London Tube, buses, and train systems have become the preferred modes of transport. Data shows people in London have significantly increased their use of public transport – Tube journeys are reaching close to 90% of pre-pandemic levels.[198]
- **Phasing Out ICE Vehicles:** London plans to eliminate all ICE vehicles by 2035, replacing them with electric alternatives. Alongside, ultra-low emission zones only permit EVs, enforcing cleaner, shared mobility.

#2 Beijing's Strategic Balance
Beijing offers another example of success through:

- **Concerted Investment in Public Transport Infrastructure:** China's investment in public transit far surpasses India's, underscoring a significant gap in funding priorities. In 2024 alone, China allocated approximately USD 173 billion to transportation projects, reflecting a USD 3.5 billion increase from the previous year. This robust investment supports an ambitious plan to expand railways, airports, and metro lines significantly by 2025. In stark contrast, India has earmarked only USD 15 billion for urban transport projects in the fiscal year 2024-2025, including funding for metro rail systems and other urban transit initiatives. [199]
- **Capping ICE Vehicles:** Strict annual limits on ICE car sales, with relaxed norms for EVs. This discourages traditional car use while incentivizing cleaner alternatives.
- **Integrated Mobility:** By simultaneously improving public transit and controlling ICE ownership, Beijing has reduced dependence on personal vehicles.

3. Extended Producer Responsibility to streamline waste management

The rise of e-commerce, increased smartphone penetration, and evolving packaging trends have led to a dramatic increase in the use of materials—particularly plastics, metals, and rare minerals. This growth has also intensified problems related to e-waste accumulation and packaging waste. The informal sector largely dominates e-waste recycling, often relying on hazardous methods that pose risks to both human health and ecosystems. Additionally, the unchecked proliferation of plastic packaging and microplastics continues to put pressure on India's waste management infrastructure, which lacks effective formal tracking mechanisms.

Recognizing these pressing concerns, the government is implementing policies to address the challenges posed by waste generation and material consumption. One such key policy intervention is Extended Producer Responsibility (EPR),[200] an environmental framework that mandates producers to take responsibility for managing the post-consumer waste of their products, introduced in India under the E-Waste (Management and Handling) Rules, 2011. The E-Waste (Management) Rules, 2022, further refined the policy by shifting greater responsibility to authorized recyclers and manufacturers, introducing a digital EPR certificate system managed by the Central Pollution Control Board (CPCB). Non-compliance with EPR regulations carries significant legal and financial risks. The EPR law mandates registration with the CPCB and fulfillment of EPR obligations, with failure to comply resulting in fines of up to INR 1 lakh per day for each violation,[201] potential imprisonment for serious offenses, and the burden of covering waste management costs. While the EPR framework is in place, achieving high compliance rates across all producers remains a challenge due to factors like awareness gaps and the presence of a large informal sector, though efforts are ongoing to improve adherence.

Additionally, the framework integrated Producer Responsibility Organizations (PROs) to facilitate E-waste collection, raise awareness, and ensure compliance with regulations, making waste management more structured and efficient.[202] However, challenges such as monitoring compliance, public awareness, and inadequate recycling facilities persist. Strengthening regulations, enforcement mechanisms, and investment in waste management infrastructure will be essential for India to maximize the benefits of EPR and transition toward a circular economy.[203]

Globally, 63 nations around the world have launched their own EPR systems, each adapting it to their waste management systems.[204] Countries like South Africa, Turkey, and the Dominican Republic have established EPR frameworks to formalize recycling and integrate informal workers. Example-South Africa has made strides in EPR, notably by prioritizing inclusivity and setting material-specific targets. Their regulations aim to integrate informal waste pickers into the formal recycling system, recognizing their importance.[205] Ambitious targets, particularly for plastics, drive collection and recycling efforts. While challenges like infrastructure limitations persist, South Africa's focus on inclusivity and targeted action, supported by PROs,[206] makes it a leading example of EPR implementation in a developing country.

4. Government-Civil Society Partnerships for Waste Management

Globally, formalizing E-waste recycling has proven to be an effective strategy. Switzerland, the first country to introduce a comprehensive electronic waste recycling system in 1991, has achieved a recycling rate of over 90% today by requiring manufacturers to finance recycling operations.[207] The country's efficient collection programs ensure that most E-waste is processed through formal channels. In Bogotá, Colombia, an initiative led by Asociación de Recicladores de Bogotá (ARB), a civil society organization, has integrated over 24,000 waste pickers into the city's formal waste management system following a 2011 legal mandate.[208] These workers now receive direct payments for waste collection, and have also increased Bogotá's recycling rate to 17%, surpassing the national average of 8.7%.[209] Similarly, Norway has implemented strong environmental education and producer responsibility initiatives, leading to recycling rates exceeding 72%.[210] Incentive-based systems and public awareness campaigns have further contributed to this success.

India experiences an annual revenue loss of almost INR 80,000 crores to its vast informal recycling economy.[211] Collaborations between government and civil society are paving the way for ground-up solutions that seek to formalize this precarious form of work. The SWaCH Cooperative in Pune, India, is a workers' cooperative owned and operated by waste pickers. Seeded in 2006 by the Kagad Kach Patra Kashtakari Panchayat (KKPKP), a waste pickers' trade union, in partnership with the Pune Municipal Cooperation (PMC), SWaCH has formalized the livelihoods of over 3,500 waste pickers, providing them with training, safety gear, and financial inclusion opportunities.[212] Through this partnership, 80% of the city's dry waste is now managed efficiently, reducing landfill dependence and increasing recycling rates.[213] Similarly, in Bengaluru, the Hasiru Dala initiative, in collaboration with the city government, has trained informal waste workers to handle electronic waste safely. This is diverting over 23,612 metric tons of waste from landfills annually.[214]

These models illustrate how a structured approach combining policy nudges, engagement with local communities, and public awareness can significantly improve E-waste recycling rates. Civil society partnerships can play a critical role in engendering the systemic shifts that are required to formalize the burgeoning informal waste economy. These models illustrate how a structured approach combining policy nudges, engagement with local communities, and public awareness can significantly improve E-waste recycling rates, while improving waste workers' livelihoods.

5. Public Awareness and Incentive Programs to Drive Responsible Consumption

Government-led consumer incentive programs, coupled with civil society, have proven effective in shifting behaviors. Germany's deposit refund system has achieved a 97% return rate for plastic bottles by offering small cash incentives for recycling.[215] In India, Reverse Vending Machines (RVMs) piloted by the Municipal Corporation of Greater Mumbai (MCGM) in partnership with civil society organizations like Sampurna Earth have led to increased PET bottle recycling rates. The Chhatrapati Shivaji Maharaj International Airport (CSMIA) in Mumbai has also installed RVMs that can accept and compress 450 plastic bottles per hour, reducing waste volume by about 70% for efficient transportation to recyclers. To encourage participation, users are rewarded with coupons from partners like Zingbus, Myntra, and Swiggy, which are delivered via SMS to minimize paper use.[216] Similarly, Hyderabad launched three RVMs under the Enhancing Circular Economy Perspectives – Plastic Waste Management Strategy and Action Plan for Greater Hyderabad Municipal Corporation project. These machines accept waste PET bottles and offer incentives like cashbacks or bus ticket discounts, promoting responsible disposal habits.[217] Building on these initiatives, India can introduce buy-back or deposit-refund schemes for discarded electronics such as smartphones, laptops, and chargers, encouraging responsible disposal.

6. Solar Energy Schemes

Under the NSM, the Ministry of New and Renewable Energy (MNRE) is implementing various schemes to achieve its target. Some of these schemes include[218],

- Scheme for the Development of Solar Parks and Ultra-mega Solar Power Projects to expedite the development of utility-scale solar projects in the country. Its target is 40 GW capacity
- PM Surya Ghar Muft Bijli Yojana to install solar rooftop systems on one crore households
- PM KUSUM Scheme aims to install 20 lakh standalone solar powered agriculture pumps, solarise 15 lakh existing pumps, and install 10 GW of grid connected solar power plants[219]
- The CPSU Scheme Phase-II facilitates government producers in establishing 12 GW of grid-connected solar PV projects using domestically manufactured cells and modules, supported by Viability Gap Funding (VGF), for self-use or supply to government entities

New Solar Power Scheme (for Particularly Vulnerable Tribal Groups (PVTG) Habitations/ Villages) to provide off grid solar systems to electrify one lakh unelectrified households in PVTG areas where grid connection is not feasible.

The PM Surya Ghar Muft Bijli Yojana in particular has taken into account various recommendations from various Standing Committee Reports to simplify the process of installing rooftop solar systems. Through the scheme portal, it has streamlined the process into simple steps to be followed by the consumer. A challenge that was observed was lack of information on vendors to install solar rooftops. The portal provides for a list of verified vendors which the beneficiaries can choose from. Further, it also has a mechanism to obtain the subsidy through the portal. The portal also provides information on various financing options provided by different banks.

#3.2
Civil Society Interventions: Spotlighting Action From The Ground*

1. Janpahal (https://www.janpahal.com/)

Organization Overview

Founded: 2005 | **Head Office:** New Delhi | **Annual Budget:** ~INR 3-4 crore

- **Geographical focus:** New Delhi NCR, Uttar Pradesh, Uttarakhand, Bihar, Maharashtra, Madhya Pradesh, West Bengal
- **Leadership:** Janpahal is led by **Sri Dharmendra Kumar**
- **Partners and Funders:** Partners include Hawkers Joint Action Committee, Gig Workers Association (GigWA), Amazon India Workers Association, Association of Healthcare Workers and Technicians among others. Funders include Food Safety and Standards Authority of India, Delhi Commission for Women, Development Alternatives, Azim Premji Foundation, Delhi Urban Shelter Improvement Board among others.
- **Awards and Endorsements:** Janpahal has engaged with national and state authorities to support informal workers' well-being and support E-Shram registrations. It is a member of the Livelihood Alliance Development Partner under the MoHUA, focusing on gig and platform workers. It is also empanelled as Training Partner by FoSTAC and FSSAI. Additionally, Janpahal's Programme Director contributed to the Ministerial Group on the Gig Economy.

Program Overview

Janpahal operates in 34 cities across 13 states, addressing urban issues affecting low-income migrant families, informal workers, street vendors, and gig workers through initiatives that enhance livelihoods, well-being, and social security access.

Key Interventions

EVIDENCE BUILDING & RESEARCH

Their legislative contributions include supporting the well-being of informal workers, notably contributing to the enactment and amendment of the Street Vendors (Protection & Regulation of Street Vending) Act, 2014. Janpahal has been actively involved in championing for the well-being of gig workers, contributing to the formation and amendment of gig worker legislation in three states: Rajasthan, Karnataka, and Delhi. The organization also fosters the formation of collectives among informal workers for their well-being.

COMMUNITY ENGAGEMENT

They provide support to informal workers facing issues like wage theft, workplace harassment, and compensation claims for workplace accidents through the India Labourline. They have registered numerous cases related to these issues, successfully resolving many. Janpahal assists gig workers and informal sector employees in accessing government entitlements and welfare schemes, including support for registration on platforms like e-Shram

CAPACITY BUILDING

Janpahal and GigWA have championed climate-responsive policies for informal and gig economy workers, emphasizing their vulnerability to climate impacts like heatwaves. They have urged the Ministry of Labour and Employment and the National Disaster Management Authority to adopt measures for immediate relief and long-term solutions, as detailed in their memorandum and press release.

Note: The organizations profiled were chosen based on a desk review and limited primary interviews. The listed organizations are indicative to spotlight the landscape of efforts in the space of sustainability. Therefore, please note it is non-exhaustive, and further due diligence may be needed.

These demands, outlined in a memorandum to the Ministry of Labour and Employment and in a press release, focus on recognizing the vulnerability of gig workers, providing immediate relief during heat waves, and enacting long-term solutions. Here's a summary of their key demands and Recommendations:

Immediate Relief and Protection:

- Declare heat waves as a disaster: This declaration would enable the allocation of resources and support for gig workers during extreme heat events.
- Implement heat surcharges: Gig workers should receive additional pay when working during heat waves to compensate for the increased risk and discomfort
- Prevent identity blocks during heat waves: Gig workers fear losing access to work if they take breaks or reduce their hours due to extreme heat. Janpahal demands protection against such penalties.
- Provide access to basic amenities: Municipal authorities should ensure easy access to shade, drinking water, and toilets at pick-up and delivery locations. The memorandum also highlights the need for Pink Toilet access audits for the safety and well-being of female platform workers.
- Training and Resources: Platform companies should provide training on heatstroke prevention, along with regular weather alerts and advisories.
- Protective gear: Companies should provide free protective gear, including UV-protected clothing, sunglasses, sunscreen, and oral rehydration solutions (ORS)
- Emergency response: Establish a dedicated helpline for heatstroke and include a reporting option within the apps to protect workers from identity blocks.
- Compensation for heat illness: Workers should receive compensation for lost earnings and medical expenses in case of heatstroke or heat-related illness.
- Compensation for loss of life: In the unfortunate event of death due to heatstroke, families should receive adequate compensation.

Long-Term Solutions and Urban Planning:

- Urban design for climate resilience: Janpahal suggests implementing green infrastructure initiatives like vertical horticulture to mitigate urban heat island effects.
- Protection of green spaces: The memorandum emphasizes the need to protect existing trees and forests on public and private land to combat the urban heat island effect.

2. Good Business Lab (GBL)

(https://goodbusinesslab.org/)

Organization Overview

Founded: 2017 | **Head Office:** New Delhi, India

Annual Budget: 329,582,740 INR

- **Geographical focus:** South Asia, Latin America and United States
- **Leadership:** GBL is led by the combined expertise of economists **Achutya Adhvaryu** and **Anant Nyshadham**, along with organizational development leader **Anant Ahuja.**
- **Partners and Funders:** GBL collaborates with organizations across sectors. Some notable partners include Shadi Motors, Mahindra & Mahindra, Tata Motors, World Benchmarking Alliance and Humanity United. Funders include Bill & Melinda Gates Foundation, the Agency Fund, Harvard University, University of California San Diego and Michigan Ross.
- **Awards and Endorsements:** GBL developed a unique return on investment tool for United Nations Population Fund (UNFPA) to assess health program impacts on women workers; received the Zendesk Tech for Good Award and recognised by MIT Solve's "Future for Work in India and Indonesia Challenge"

Program Overview

Good Business Lab (GBL) is a global NGO dedicated to improving the lives of the working poor by creating economic opportunities that benefit both workers and businesses. Operating at the intersection of data science, behavioral insights, and operational strategy, GBL designs evidence-based interventions that enhance worker well-being while driving business growth. The organization believes formal, high-quality jobs are key to economic empowerment and works with firms to develop scalable, research-backed solutions. With expertise in climate adaptation, financial security, gender equity, health, and workplace environments, GBL partners with companies, policymakers, and research institutions to generate actionable insights. From research to implementation, GBL's work has impacted over 2 million workers globally, fostering inclusive and sustainable workplaces.

Key Interventions

CAPACITY BUILDING

GBL collaborates with firms to enhance leadership training and workplace efficiency. Inache has enabled 896,280 female workers to access anonymous grievance redressal, while STITCH has improved management training for 448,140 frontline female workers. Both initiatives expanded features, scaled across factories, and secured partnerships with Nike, Labor Solutions, and NSDC, driving broader impact and industry adoption.

PROGRAM DEPLOYMENT

GBL implements worker-focused programs that create value for businesses while improving worker livelihoods. The PACE (Personal Advancement & Career Enhancement) initiative, piloted and evaluated by GBL, has been widely adopted in labor-intensive industries and has led to productivity gains of up to 20% by equipping workers with soft skills necessary for career growth. The STITCH Program, designed for frontline managers, enhances leadership skills and fosters workplace environments that prioritize efficiency and employee well-being.

MEASUREMENT & EVALUATION

GBL uses Randomized Controlled Trials (RCTs) and other impact assessment methodologies. By rigorously evaluating interventions, GBL ensures that its programs deliver measurable impact. GBL applies AI-driven analytics to operational, administrative, and survey-based datasets, generating insights that optimize worker well-being and business performance.

COALITION BUILDING

The organization works closely with government agencies, industry groups, and civil society. Discussions at the Good Business Forum: Redesigning the Bottom Line 2024 highlighted how integrating gender equity into business strategy can drive improvements in worker well-being, productivity, wages, and overall firm performance. The Gender Champions Consortium (GCC) was launched as a joint initiative by the Good Business Lab, Automotive Components Manufacturers Association of India (ACMA), Society of Indian Automobile Manufacturers (SIAM), the Gates Foundation, along with other participating organizations.

TECH FOCUSED SOLUTIONS

Through behavioral research and operational analysis, GBL develops targeted interventions that tackle workplace challenges. One such initiative, the Inache Tool, a two-way, anonymized worker-management communication platform, has significantly impacted worker retention. Studies show that employees who had an opportunity to express their dissatisfaction through the platform were 20% less likely to quit after a disappointing wage hike.

3. Chintan Environmental Research and Action Group

(https://www.chintan-india.org/)

Organization Overview

Founded: 1999 | **Head Office:** New Delhi | **Annual Budget:** NA

- **Geographical focus:** Primarily urban areas in India, with a focus on New Delhi, Uttar Pradesh and Uttarakhand
- **Leadership:** Chintan is led by **Bharati Chaturvedi**
- **Partners and Funders:** Partners include Google, World Bank, United Nations Development Program, Uttar Pradesh government, Swachh Bharat among others. Funders include Action Solidarity Tier Monde,, Give India Foundation (Give.do), Bindaas Unlimited
- **Awards and Endorsements:** ASSOCHAM Ladies League Award All Grassroots Woman of the Decade Award (2014), United Nations Climate Solution Award at COP21 (2015), Secretary of State and French Presidents Human Rights

Program Overview

Chintan is a Circular Society Do-Tank that works towards improving lives, livelihoods and leadership to equitably manage waste and reduce consumption and its effects on pollution, air quality and the climate. The three key focus area are - Circular Economy and Waste, Air Pollution and Climate Change.

Key Interventions

CAPACITY BUILDING

Chintan empowers waste pickers and informal recyclers through structured training programs designed to enhance their technical and entrepreneurial skills. These programs provide waste workers with knowledge about safe handling practices, recycling techniques, and legal rights. The training programs offer hands-on education to individuals, communities, and institutions, focusing on reducing consumption and waste, segregation, recycling, and composting. Chintan also trains government officials to integrate waste pickers into formal waste management systems.

EVIDENCE BUILDING AND POLICY RESEARCH

Chintan empowers waste pickers and informal recyclers through structured training programs designed to enhance their technical and entrepreneurial skills. These programs provide waste workers with knowledge about safe handling practices, recycling techniques, and legal rights. The training programs offer hands-on education to individuals, communities, and institutions, focusing on reducing consumption and waste, segregation, recycling, and composting. Chintan also trains government officials to integrate waste pickers into formal waste management systems.

SERVICE DELIVERY

Chintan manages over 30 tons of solid and electronic waste daily in the Delhi region through doorstep collection, segregation, recycling, and composting. Unlike traditional waste contractors, Chintan collaborates with waste pickers to improve their livelihoods and reduce the harmful effects of waste on their health. By transforming waste pickers from scavengers to managers, Chintan helps them profit from recycling and composting while mitigating environmental damage.

AWARENESS AND BEHAVIOR CHANGE

The No Child in Trash initiative targets the elimination of child labour in waste picking. Chintan works with waste pickers' communities to help children transition out of hazardous work, enrol and stay in school, and access life-skills training. These programs empower children to build better futures and create safer, more equitable communities. Awareness campaigns in schools and neighbourhoods further promote responsible waste management practices, including segregation and recycling.

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4. Goonj

(https://goonj.org/)

Organization Overview

Founded: 1999 **| Head Office:** New Delhi **Annual Budget:** NA

- **Geographical focus:** Focus on 26 states, including Bihar, Assam, Tamil Nadu, and Himachal Pradesh.
- **Leadership:** Goonj is led by **Anshu Gupta**
- **Partners and Funders:** Partners include ABFRL, Benetton, Taneira Shoppers Stop, Godrej, Marks & Spencer, Raymond, among others. Funders: NA
- **Awards and Endorsements:** GDN Japanese Award for Most Innovative Development Project, 'Jamnalal Bajaj CFBP Award' for Fair Practices, NGO of the Year Award by Resource Alliance, iF Social Impact Prize, International Lien i3 Challenge Award, Marico Innovation Awards, Mother Teresa Memorial Awards for Social Justice (2020), Recognition by Rajasthan Patrika (2021), Mackenzie Scott Gift (2021)

Program Overview

Goonj aims to create an equitable relationship of strength, sustenance, and dignity between urban and rural India by utilizing under-utilized materials as tools for development. The organization envisions expanding as an idea across regions and economies, using urban surplus to address neglected issues of financially and materially marginalized communities. Goonj's unique approach involves empowering communities to design and implement their own solutions, leveraging their efforts and knowledge, while material is provided as a reward for their participation, ensuring dignity and ownership in the process.

Relevant area(s) of consumption:

Materials **Natural resources**

Key Interventions

URBAN MASS PARTICIPATION

Goonj transforms contributed under-utilised materials into currency for development through 5 R's: Recycle, Repurpose, Restore, Revive, and Repair. Our volunteers, contributors, and friends of Goonj play a key role as an equal stakeholder in bridging the gap between resourceful and resource-scarce, fostering a culture of sustainability.

LOCALISED SOLUTIONS TO LOCAL PROBLEMS

Empowering rural communities through initiatives like 'Cloth for Work,' where villagers are mobilized, motivated, and enabled to undertake development activities such as building bridges, repairing roads, or creating irrigation systems and are rewarded with Cloth for Work kits that has essentials like clothing, household items, and other need-based things. This approach fosters a sense of ownership and dignity while addressing infrastructural gaps in marginalized areas. By involving communities directly in development, Goonj empowers grassroots wisdom and re-ignites self-reliance.

AWARENESS AND BEHAVIOR CHANGE (COMMUNITY ENGAGEMENT)

Through its 'Not Just a Piece of Cloth' initiative, Goonj makes affordable cloth sanitary napkins from surplus cotton and semi-cotton material and raises awareness about the health and hygiene around menstrual practices. They work with the community on breaking the stigma around menstruation through 'Chuppi Todo Baithak' (Break the Silence) workshops and campaigns, improving overall health and dignity for women in rural and urban slums.

5. Toxics Link

(https://toxicslink.org/)

Organization Overview

Founded: 1996 | **Head Office:** New Delhi | **Annual Budget:** NA

- **Geographical focus:** New Delhi
- **Leadership:** Toxics Link is led by **Mr. Ravi Agarwal**
- **Partners and Funders:** Partners include Centre for Innovation in Science and Social Action, Darjeeling Ladenla Road Prerna, Ganapati Sabata Foundation, Indian Agricultural Development Foundation. Funders include the World Health Organization, UN Environmental program, Swedish Society for Nature Conservation, International Pollutants Elimination Network
- **Awards and Endorsements:** NA

Program Overview

Toxics Link, a New Delhi-based not-for-profit, works under The Just Environment Charitable Trust to address the impacts of toxicity and waste on human health and the environment, particularly for marginalized communities. By conducting cutting-edge field research, the organization promotes dialogue and sustainable solutions and has influenced policies and standards at national and international levels. Through collaborations with diverse partners, it strengthens capacity and drives impactful change for a healthier environment.

Key Interventions

CAPACITY BUILDING

Toxics Link partnered with institutions like XLRI and organizations such as GIZ to build stakeholder capacity in the electronics sector, focusing on sustainable practices like urban mining and circularity in E-waste management. Additionally, they engaged local organizations and community leaders through training programs aimed at reducing single-use plastics and effectively managing plastic pollution in both urban and rural areas.

AWARENESS AND BEHAVIOR CHANGE

Toxics Link actively raised awareness about environmental and health issues through targeted campaigns. Their #BreakFreeFromSingleUsePlastics initiative educated citizens on reducing plastic usage and promoted sustainable alternatives at events like Vikalp Mela. It also conducted workshops to promote sustainable hygiene practices.

EVIDENCE BUILDING AND POLICY RESEARCH

Toxics Link has extensively contributed to bridging gaps in evidence regarding environmental issues through their studies on E-Waste management, recycling and segregation, microplastic pollution in soils, water, cosmetics, and textiles. They have also widely engaged with state governments, institutions, and the general public.

6. Selco Foundation

https://selcofoundation.org/

Organization Overview

Founded: 2010 | **Head Office:** Bengaluru, Karnataka

Annual Budget: INR 50 crore

- **Geographical focus:** Pan-India
- **Leadership:** SELCO Foundation is led by **Harish Hande**
- **Partners and Funders:** Partners and funders include IKEA Foundation, Ashraya Hastha Trust, SAP, Accenture and HT Parekh Foundation.
- **Awards and Endorsements:** SELCO Foundation received the prestigious Skoll Award for Social Entrepreneurship and Zayed Prize for Sustainability in 2018.

Program Overview

SELCO's programs focus on seeding models that leverage sustainable energy to strengthen livelihoods, healthcare, education, and community wellbeing. The organization's approach is rooted in developing the ecosystem around scalable sustainable energy solutions that can be adapted to diverse contexts. SELCO identifies five key enabling conditions that are required to move the needle in this direction — innovation, finance, skills & capacity-building, building backward and forward linkages, and policy.

Relevant area(s) of consumption:

Energy

Key Interventions

CAPACITY BUILDING

SELCO's capacity-building initiatives aim to equip underserved communities in grassroots geographies with technical skills that can mainstream sustainable energy while enhancing socio-economic development.

When it comes to solar energy, SELCO focuses on equipping local communities with the skills to maintain the solar infrastructure and avoid defunct systems. The organization's efforts to improve livelihoods through sustainable energy have engaged 900,000 people so far.

EVIDENCE BUILDING AND POLICY RESEARCH

SELCO supports innovation, narrative change, and policy development through its work as an ecosystem enabler for sustainable energy. The organization creates benchmarks and replicable processes, leverages technology, and seeks to facilitate context-responsive finance, training, and policy environments to carry forth its efforts in this direction. Evidence-building to codify innovative models and demonstrate the potential for them to be scaled is another key aspect of its model.

SERVICE DELIVERY

Bringing solar energy solutions to remote areas that don't have access to grid electricity is a key focus area for SELCO. In addition to training local communities to support these solutions, SELCO also collaborates with local entrepreneurs, public institutions, and civil society organizations to scale its models. The organization has developed more than 120 solutions which demonstrate the link between sustainable energy and development.

7. Industree Foundation

https://www.industree.co.in/

Organization Overview

Founded: 2000 | **Head Office:** Bengaluru, Karnataka

Annual Budget: ~INR 50+ Cr

- **Geographical focus:** Pan-India, with a focus on 10 states
- **Leadership:** Industree Foundation is led by **Neju George Abraham**
- **Partners and Funders:** Partners and funders include Infyosys Foundation, HSBC, SAP, Rainmatter Foundation, IndusInd Bank, BNP Paribas, Gates Foundation, Wells Fargo, Cartier Philanthropy, Bank of America, target Foundation, 360 One Foundation, Tesco, Kantar India Foundation and Empowerment Foundation.
- **Awards and Endorsements:** Our pioneering work was acknowledged and awarded early on through the UNESCO Seal of Excellence for Handicrafts (2003), India Development Marketplace, World Bank (2011), National Contest on Social Innovation, Government of India, and Ministry of External Affairs (2017). Our Co-founder, Ms Neelam Chhiber, has won Schwab Foundation for Social Entrepreneurship, Social Entrepreneur of the Year India (2011), The Womanity Foundation Outstanding Women Entrepreneur of the Year (2013), The Economic Times Evoke, Social Entrepreneur of the Year, India (2020) and the Women Transforming India Award by Niti Aayog (2021).

Program Overview

Industree Foundation, has been working to create an organized farm and off-farm enterprise ecosystem for women's economic empowerment in India for over two decades. Industree, through an ecosystem approach, holistically tackles the root causes of poverty by enabling rural women from marginalised communities to set up collectively owned enterprises linked to the market. This has led to significant economic and social gains for women, substantially increasing incomes, social security, improved resilience to crisis, and positive climate action.

Industree incubates and supports farmer/ producer collectives focusing on value addition at source and building traceable supply chains in agroforestry/ natural fibre value chains. Presently, Industree's value chain work focuses on Bamboo, Banana, and NTFP/biodegradable leaf plates aggregated into collectives spread across Karnataka, Tamil Nadu, Odisha, and Maharashtra. These nature-based solutions promote biodiversity at source and sustainable use of local materials for high-level value addition linked to national and global demand.

CAPACITY BUILDING

Industree works with women producers and craftspeople to build their capacities in leadership, and domains such as digital and financial literacy. Since its establishment, the organization has impacted 600,000 lives by building the capacities of rural women and supporting women-led sustainable enterprises.

AWARENESS AND BEHAVIOUR CHANGE

Through its focus on women's livelihoods, Industree has been strengthening women's agency and meaningful representation in entrepreneurship. The organization has facilitated the integration of the women it works with into the national and global creative economy, enabling over 59.7 million USD in trade.

SERVICE DELIVERY

Industree's programs in the bamboo, Sal leaves, and banana value chains have helped link smallholder women producers to mainstream markets, while bringing new sustainable products and platforms to consumers. These efforts have enabled them to impact more than 10,000 women producers working in these value chains.

8. WaterAid India

(https://www.wateraid.org/in/)

Organization Overview

Founded: 1986 | **Head Office:** New Delhi | **Annual Budget:** NA

- **Geographical focus:** Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Odisha, West Bengal, Bihar
- **Leadership:** WaterAid India is led by **VK Madhavan**
- **Partners and Funders:** Partners and funders include Google, Genpact, HSBC, UNICEF, BMGF, and Microsoft.
- **Awards and Endorsements:** WaterAid India's Chhattisgarh team was honored for its contributions to the Swachh Bharat Mission and Jal Jeevan Mission, as part of its work in the Durg district — the first in the state to be declared a Model Open Defacation Free (ODF) Plus District.

Program Overview

WaterAid India seeks to improve access to clean water, decent toilets and good hygiene for everyone, everywhere. Since 1986, WAI has worked with rural and urban communities and with governments to address the water, sanitation and hygiene (WASH) needs of community members especially the marginalized in India. A crucial element of the organization's approach and pathway to scale is to build on the learnings from demonstration at the community level, and to engage with government- district, state and Union- to get them adopt our experiences and expand them. WaterAid India is the thematic lead in the Rural WASH Partners' Forum of the Department of Drinking Water and Sanitation, Government of India, on Grey Water Management, Operation & Maintenance of Piped Water Supply Systems (PWSS), WASH in Institutions, and gender in WASH.

Key Interventions

CAPACITY BUILDING

WaterAid's capacity-building programs seek to enable last mile access to quality water and sanitation. The organization works with district labs and government bodies to provide technical support with water quality assessment, and directly with grassroots communities to strengthen their participation in local governance.

AWARENESS AND BEHAVIOR CHANGE

WaterAid leverages its decades of experience in India to mainstream scalable practices linked to sanitation and hygiene. Through research, multi-stakeholder engagement and collaboration, the organization has emerged as a resource hub and a technical partner to government bodies across Indian geographies.

SERVICE DELIVERY

WaterAid India has pioneered on-ground, scalable models linked to community-led water supply and quality management, and solid and liquid waste management. The organization is leveraging these models to support district governments with integrating inclusive design into their annual plans.

#3.3
Private Sector & Social Enterprise: Tech-Focused Innovation*

1. Tech-Driven Transit: The Rise of Smart Demand-Aggregation Models in India

Several private sector companies in India are leveraging digital platforms to revolutionize urban mobility through innovative demand-aggregation models. Cityflo (in Mumbai, Thane and Hyderabad), Uber-Bus (in Delhi NCR, Mumbai, Kolkata and Hyderabad) and Chalo Bus (in Mumbai, Pune, Nashik, Indore and Bhopal) are at the forefront of this shift, using technology to connect commuters with more sustainable and accessible transportation options. By integrating digital apps, these platforms can efficiently aggregate demand from individuals who otherwise might rely on personal vehicles or traditional taxis. This model not only reduces the number of cars on the road but also helps in optimizing routes, reducing traffic congestion, and offering commuters a more affordable and eco-friendly alternative to their daily commute. These services provide users with the flexibility to schedule rides or book seats in shared buses, enhancing convenience and accessibility. Platforms like Cityflo and Chalo Bus, for instance, focus on integrating bus routes with real-time tracking and scheduling, making it easier for commuters to plan their travel. The model's success lies in its ability to create a seamless experience where technology not only aggregates demand but also enhances operational efficiency.

2. Powering the Gig Economy: How Battery Swapping is Transforming Mobility

Emerging innovations like **battery swapping** is transforming the gig economy by eliminating long EV charging downtimes.

Note: The organizations profiled were chosen based on a desk review and limited primary interviews. The listed organizations are indicative to spotlight the landscape of efforts in the space of sustainability. Therefore, please note it is non-exhaustive, and further due diligence may be needed.

For on-demand delivery workers, who rely on speed and efficiency, waiting 4-5 hours for a full charge is not an option. Battery swapping allows them to replace a depleted battery with a fully charged one in just a few minutes, ensuring uninterrupted service and increased productivity. This innovation also eliminates "range anxiety"—the fear of running out of charge before completing a task. For gig workers, particularly those in last-mile deliveries, this anxiety is heightened as they often operate under tight time constraints and unpredictable travel routes. By providing quick and easy access to fully charged batteries, swapping stations ensure their vehicles remain operational throughout their shifts. Moreover, battery swapping reduces upfront costs, as many models operate on a subscription basis, making EVs more affordable for commercial use. This solution is particularly impactful in supporting gig workers who rely on their vehicles to earn a living, empowering them with reliable, cost-effective, and efficient mobility.

Table 1 Companies in Battery Swapping Domain

COMPANY NAME	HEADQUARTERS	WEBSITE
Sun Mobility	Bengaluru	sunmobility.co.in
Ola Electric	Bengaluru	olaelectric.com
Lithium Power	New Delhi	lithionpower.com
Voltup	Mumbai	voltup.in
Race Energy	Hyderabad	racenergy.in
Esmito	Chennai	esmito.com
Numocity	Bengaluru	numocity.com
Battery Smart	New Delhi	batterysmart.in
ChargeUp	New Delhi	echargeup.com
Okaya Power Group	New Delhi	okayapower.com

Note: This list of companies operating in the battery swapping domain for EVs in India has been compiled from a non-exhaustive review conducted by the research team through secondary literature sources

3. Attero*

(https://www.chintan-india.org/)

Organization Overview

Founded: 2008 **| Head Office:** Noida, Uttar Pradesh **| Annual Budget:** INR 249 Cr

Program Overview

Attero is a pioneer in the domestic E-waste recycling market. It is the first and only end-to-end E-waste recycler officially recognized by the Government of India for its environmentally sound management facilities. Attero aims to lead the E-waste recycling sector in India by expanding its recycling capacity, raising awareness about safe E-waste disposal, improving logistics for sourcing E-waste, and augmenting its recycling operations through ongoing research and development.

- **Geographical focus:** Noida, Utter Pradesh
- **Leadership:** Founded by **Nitin Gupta** and **Rohan Gupta**
- **Awards and Endorsements:** National Award of Excellence for Best Non-Motor Transport Practice in the Country, by Ministry of Urban Development, GoI (2011)

EPR COMPLIANCE & E-WASTE PROCESSING

Attero is a leader in responsible E-waste management in India, helping the consumer durables industry—which produces long-lasting products like smartphones, laptops, and home appliances—achieve over two-thirds of its Extended Producer Responsibility (EPR) targets. With partnerships with more than 200 clients, including major IT companies and manufacturers, Attero processes 144,000 metric tons (MT) of E-waste annually at its facility in Roorkee. The company aims to scale this capacity to nearly 415,000 MT within the next five years.

Note: This profile was created based on public information

DIGITAL SOLUTIONS FOR E-WASTE RECYCLING

Attero has introduced MetalMandi, a mobile app that formalizes the unorganized E-waste recycling sector by enabling B2B E-commerce transactions. Additionally, Selsmart, Attero's direct-to-consumer platform, simplifies E-waste recycling for individuals by allowing them to sell used appliances in three steps, ensuring responsible disposal.

GREEN METAL EXTRACTION & SUSTAINABILITY

Attero is at the forefront of green metal extraction from E-waste and end-of-life lithium-ion batteries, supporting India's transition to a low-carbon, circular economy. Green metals, which are sustainably sourced and processed with minimal environmental impact, often from recycled materials, are vital for electric vehicles, energy storage, and renewable energy technologies, aligning with India's net-zero emission goals for 2070.

4. Material Library of India (MLI)

(https://materiallibraryofindia.com/)

Organization Overview

Founded: 2017 **| Head Office:** Noida, Uttar Pradesh **| Annual Budget:** NA

- **Geographical focus:** Noida, Utter Pradesh
- **Leadership:** Founded by **Shubhi Sachan**
- **Awards and Endorsements:** Lexus Design Award Finalist (2018), CII GreenCo Best Practices Award (2016)

Program Overview

Material Library of India (MLI) is a research and design consultancy firms that transforms industrial and agricultural waste into valuable resources. The organization develops innovative, data-driven solutions at the intersection of sustainability and design. Through its material literacy and immersion workshops, MLI raises awareness by helping individuals, academics, and businesses rethink material use and sustainability. Through consultation, research, and education, MLI drives sustainable practices and reshapes perceptions of waste for a more conscious future.

Key Interventions

WASTE-TO-RESOURCE TRANSFORMATION

MLI pioneers innovative methods to repurpose industrial and agricultural waste into high-value materials, reducing environmental impact and promoting circular economy models. Their solutions are integrated across the design, construction, and manufacturing sectors, ensuring waste materials are efficiently utilized in sustainable production processes. For example, MLI has developed a Textile Recovery Facility that recycles discarded fabrics into reusable materials, preventing textile waste from ending up in landfills. Additionally, MLI conducts Material Literacy Workshops, engaging individuals, academics, and businesses in rethinking material use and creatively repurposing waste, fostering sustainable design innovations.

RESEARCH, CONSULTATION, & MATERIAL LITERACY

MLI provides expert consultancy services to industries, guiding them in adopting sustainable materials and circular economy practices. Their Material Literacy Program engages individuals, academics, and organizations in hands-on learning, fostering a deeper understanding of material sustainability, lifecycle impact, and alternative material applications.

DESIGN SOLUTIONS & EVIDENCE BUILDING

MLI collaborates with designers, architects, and businesses to create eco-friendly products and systems that prioritize sustainability. Through workshops, exhibitions, and research-driven publications, they actively promote responsible consumption and work towards the adoption of sustainable materials within various industries and communities.

5. Fairphone*

(https://www.fairphone.com/nl)

Organization Overview

Founded: 2013 | **Head Office:** Amsterdam, Netherlands

Annual Budget: NA

- **Geographical focus:** Western and Central Europe
- **Leadership:** Founded by **Bas van Abel, Tessa Wernink**, and **Miquel Ballester Salvà**
- **Awards and Endorsements:** German Environmental Award (2016), B Corporation Certification (2015), UN Momentum for Change Award (2015), GreenTec Awards (2015)

Program Overview

Fairphone is a Dutch social enterprise committed to developing sustainable and ethical smartphones. The company minimizes environmental impact by using recycled, Fairtrade certification ensures that materials like gold, tin, tungsten, and tantalum are sourced ethically, free from exploitation, child labor, and unsafe working conditions,. Their modular phone design extends product lifespan, reducing E-waste and allowing easy repairs. Fairphone also works towards ethical sourcing and industry-wide transparency, working with various stakeholders to promote systemic change in electronics manufacturing.

Note: This profile was created based on public information

Key Interventions

FAIR MATERIALS SOURCING & ETHICAL SUPPLY CHAINS

Fairphone actively integrates responsibly sourced materials such as Fairtrade gold, conflict-free tin, tantalum, tungsten, and recycled rare earth metals into their smartphones. They support artisanal and small-scale mining (ASM) communities, ensuring better wages and safer working conditions. The company also partners with local cooperatives and NGOs to improve labor well-being and environmental practices in mining regions across Africa and South America.

MODULAR DESIGN FOR LONGEVITY & RIGHT TO REPAIR

Fairphone devices are designed with a fully modular architecture allowing users to easily replace and upgrade components like batteries, cameras, and screens. This extends the product lifespan, significantly reducing E-waste and aligning with global Right to Repair movements. By promoting consumer repairability, Fairphone empowers users to maintain their devices rather than frequently replacing them, fostering a culture of sustainable consumption.

NARRATIVE BUILDING, CIRCULAR ECONOMY, AND INDUSTRY INFLUENCE

Fairphone challenges the electronics industry's status quo by promoting transparency in supply chains and pushing for better labor and environmental standards. The company works towards policies supporting circular economy principles, emphasizing recycling, responsible disposal, and reuse of materials. Through collaborations with Fairtrade International, the European Commission, and sustainability coalitions, Fairphone influences legislation and encourages major tech companies to adopt fairer and greener practices.

6. Bindi International

(https://www.bindi-international.org/)

Organization Overview

Launched: 2015 | **Head Office:** Kishangarh, Rajasthan

Annual Budget: INR 18.6 Cr

- **Geographical focus:** Pan-India (rural areas)
- **Leadership:** Atul Prasad, Vinati Dev, Harsh Tiwari, Shobhit Tiwari
- **Awards and Endorsements:** World Economic Forum recognized as one of India's top 50 last-mile responders during COVID-19, Energy Globe Award under the FIRE category for their Global Solar Initiative. Featured in NITI Aayog's report on 'best development practices' for Aspirational Districts of India. Winner of WomenConnect Challenge India supported by USAID and Reliance Foundation.

Program Overview

Bindi International works with women from last-mile rural communities in 19 Indian states, enabling self-sufficiency and fostering localized approaches to sustainability. Its solar training programs focus specifically on training semi-literate women who haven't had access to traditional education, equipping them to become engineers who can mainstream sustainable energy in their regions. Its Women Prosper Initiative leverages vocational training, personal development, access to technology, marketing support, and capital to support women entrepreneurs engaged in the solar energy sector.

Bindi International firmly believes that energy serves as the foundation for social and economic development. Therefore, democratizing energy access—particularly through women-led initiatives and decentralized or locally centralized solar solutions—is essential. This approach enables rural and semi-urban communities in India to leapfrog into the renewable energy era, ensuring an equitable and sustainable energy transition. While we list Bindi International as under social enterprise, it is also a registered not-for-profit organization

Relevant area(s) of consumption:

Energy

Key Interventions

CAPACITY BUILDING

Through its capacity-building programs focused on building technical skills linked to renewable energy among women, the organization has trained 700 women to become solar engineers. Their programs in regenerative agriculture for sustainable livelihoods focus on landless, small, and marginal farmers, and foraging/tribal communities.

SERVICE DELIVERY

Rooted in an ethos of making rural regions self-sufficient, Bindi's programs focus on enabling solar electrification in remote and inaccessible rural areas. They have electrified 3,000 households as part of this program.

TECH FOCUSED SOLUTIONS

The organization uses technology to facilitate the meaningful participation of rural women in the renewable energy supply chain, by building women's technical capabilities and introducing digital tools for entrepreneurship.

7. Solar Ladder

(https://www.solarladder.com/)

Organization Overview

Launched: 2015 | **Originated:** Amsterdam, Netherlands

Annual Budget: INR 18.6 CR

- **Geographical focus:** India
- **Leadership:** Founded by **Manan Mehta** and **Abhishek Pillai**.
- **Awards and Endorsements:** Awards and grants from the Government of India, YCombinator Startup School, London School of Economics, and Facebook.

Program Overview

Solar Ladder is an Indian supply chain platform for solar installation companies. The company aims to provide end-to-end ecosystem services to solar installers, contributing to scaling the use of rooftop solar energy in the country. As ana SaaS (Software as a Service) platform, Solar Ladder distributes software that enables solar installers to automate and scale their services. The company also offers support with procurement and provides support with financing options.

Relevant area(s) of consumption:

Energy

Key Interventions

TECH-BASED SOLUTIONS AND ECOSYSTEM STRENGTHENING

Solar Ladder's software leverages technology to enable the solar installers it partners with to achieve greater scale in their operations. In addition to facilitating project management and the tracking of existing solar projects, the software encourages installers to provide after-sales services and troubleshooting assistance to customers, promoting greater ecosystem-level uptake for solar energy. To date, 70,000+ solar projects have been managed on Solar Ladder's software, saving installers an average of 7.5+ years in their journeys to scale.

SUSTAINABLE PROCUREMENT AND CIRCULAR ECONOMY

Through its procurement services, Solar Ladder focuses on providing solar installers with cost-efficient acquisition of solar modules, inverters, structures, and other necessary raw materials. Sustainability and offsetting the negative environmental effects of sourcing are priority areas for the company, which has procured 35+ MW worth of raw material so far and saved more than 10 million trees in the process.

MAINSTREAMING SOLAR ENERGY THROUGH FINANCIAL SUPPORT

Solar Ladder provides financial support to installers in the form of low-cost credit for short-term financing to platform customers. It also offers long-term financing to end consumers, mainstreaming the shift towards solar energy in Indian households as well as the private sector. Solar Ladder is a trusted platform for 400+ companies using solar energy, including key players in the space such as Mahindra Solarize, ONergy Solar, and Fourth Partner Energy.

#4
Recommendations
Cues For Collective Action

In this section, we outline a list of action-oriented Recommendations for four key stakeholders – Government, Civil Society, Philanthropy, and the Private Sector. Grounded in insights from Sections 2 and 3, these Recommendations emphasize the adoption of solutions and paradigms which enable India's leapfrogging in its journey towards sustainable consumption.

#4.1
Government

I. Fuel Consumption

FOCUS ON INCLUSIVE MULTI-MODAL URBAN MOBILITY

Electrification offers an exciting opportunity to reform public transportation and urban mobility. It is imperative to bring in multimodal transportation, and to make it a reality by reimagining urban mobility in a way that allows people to own cars but significantly reduces the need to rely on them daily.

The foundation for this shift lies when cities are designed with low-emission zones, and pedestrianization is at the heart of their transformation, complemented by electrification as a key technological enabler for public transport. There is a high cost of fragmented transit. India's investment in public transit has heavily focused on metro rail systems, but these come with significant challenges. Metro systems are expensive, costing approximately INR 300 crore per kilometer, and offer limited connectivity without integrated first- and last-mile solutions.

"The lack of coordination between metro rail (state-run) and bus services (municipal-run) has led to fragmented urban mobility. Metro projects are often standalone, limiting coverage despite high capacity. In Ahmedabad, with 2,000 km of roads, only 40 km is covered by metro, leaving vast areas unserviced—more than a "last-mile" issue, but a "last three-mile" gap. An integrated system would ensure public transport stops every 200-300 meters and seamless transfers across modes with a single card."

- Rutul Joshi, CEPT University

LEVERAGE PARKING POLICIES TO CURB PERSONAL VEHICLE OVERUSE

A critical first step in addressing the challenges posed by personal vehicle use is implementing first-generation restraint measures through comprehensive car management strategies. Each municipal ward should develop a well-defined parking management plan, delineating legal parking areas both on-street and off-street. This approach not only ensures orderly parking but also enables the enforcement of penalties for illegal parking. Introducing variable parking pricing can further incentivize responsible parking behavior, while a "proof of parking" requirement for new car purchases can help limit unnecessary vehicle ownership. By introducing market-based mechanisms like parking pricing, it can encourage optimal land use for essential services instead of excessive parking spaces and disincentivize private vehicle use. Treat parking as a real estate asset, pricing it appropriately to reflect its value when using private vehicles.

INTEGRATE MOBILITY THROUGH A SEAMLESS APPROACH OF ONE APP, ONE EXPERIENCE

India's urban transport system can be transformed through an integrated public transportation network powered by technology. By creating a seamless mobility experience, we can provide a unified app or digital card that covers all modes of transport, from buses to metros to taxis. This system would eliminate the hassle of using multiple tickets or cards for different modes of transportation, improving convenience and encouraging more people to rely on public transit. India's transport ecosystem needs a unified information system that integrates buses, metros, taxis, and ride-hailing services. A single app displaying all travel options with prices would help commuters make informed choices based on cost and convenience. Harmonized fare structures across services could further streamline the experience, promoting public transit use and fostering a competitive, customer-centric market. Real-time tracking, predictive arrival times, and easy payment solutions would not only make commuting more reliable but also enhance the overall efficiency of the system. Such integration, much like the UPI revolution, could help bridge India's digital divide and boost confidence in using public transportation.

Seamless Travel and Beyond: The Success of Hong Kong's Octopus Card

The Octopus Card, originally introduced in Hong Kong, is a prime example of how a seamless, integrated payment system can revolutionize urban mobility. It is a contact less, reusable stored value smart card for making electronic payments in online and offline systems in Honk Kong. Inspired by the success of Hong Kong's system, Taipei adopted the same approach though its EasyCard to simplify and unify payment for public transport. The card allows users to pay for various transportation options, from buses and metros to taxis, making it incredibly convenient for commuters. Notably, the card isn't limited to transport—it also serves as a tool for direct benefit transfers and social security benefits, a feature that makes it an indispensable part of daily life for many residents.

What sets the Octopus Card apart in is its accessibility and user-friendliness. The card can be purchased at virtually any grocery store, making it accessible to everyone. It's a simple piece of plastic, often adorned with popular stickers like Hello Kitty or Star Wars, adding a fun, personalized touch. This democratization of the payment system, where the card has no overt government branding, encourages wider adoption and makes it feel less like a public utility and more like a personal, everyday tool. In addition to paying for transportation, the Octopus Card can also be used for parking charges, showing the potential for expanding its role in urban mobility and infrastructure.

BUILD PLATFORM WORKERS' PROTECTION AND WELFARE INTO REGULATION

Establishing sector-wide worker protection policies can ensure fair wages, safety nets, and mental health support while promoting sustainable mobility.

For example, in the UK, there is growing momentum to recognize gig workers as employees, granting them benefits such as health insurance and paid sick leave. India can adopt a similar approach by introducing policies that provide gig workers with essential protections, including accident insurance, access to healthcare, and paid leave. Platforms like Uber and Ola could be mandated to offer health insurance and contribute to a workers' social security fund.

To address mental health challenges, the government and social enterprises can collaborate to develop targeted mental health programs and resources, ensuring gig workers receive the support they need.

II. Electricity Consumption

INCREASE AWARENESS AND SOLVE FOR BOTTLENECKS TO PROMOTE UPTAKE OF SOLAR ROOFTOP SYSTEMS

a) The Parliamentary Standing Committee on Energy (2020-21) noted that in order to achieve their targets, the Ministry of Power must dedicate funds to widely advertise the benefits of the rooftop solar systems, and the existing schemes for installation, through a variety of mediums and in multiple regional languages.[220]

b) The Committee also recommended that the government must simplify the experience for consumers to install these systems.

In this regard it suggested that the government must create a single window clearance system, with a transparent system for disbursement of subsidy and build in minimum human interface. The Standing Committee on Energy (2022-23) noted that in 2023 while a national portal existed for applying to install solar rooftop systems, the DISCOM approval for technical feasibility of the project was a bottleneck in terms of achievement of timelines for installing projects.[221] The subsidy is released only after approval from the DISCOM. This could lead to a situation wherein the consumer has to start paying their EMIs (if taken a loan) before they can start reaping the benefits of a rooftop solar system.

LEVERAGE STATE-SPECIFIC LEARNINGS TO MEET THE TARGET OF 10 MILLION SOLAR ROOFTOP INSTALLATIONS BY MARCH 2027

Given the given current pace of installation of rooftop solar systems, it might not be clear how the government will meet its target of covering one crore households by 2026-27 under the PM Surya Har Ghar Bijli Yojana, according to the Standing Committee on Energy (2024-25).[222] Of the total households (638,352) that have currently benefited from the scheme, the highest number of households (287,814) are in Gujarat.[223] The steps taken by the Gujarat government can be used a case study for other governments to follow in ensuring that maximum households benefit in the stipulated timeframe. Some of the steps taken by the Gujarat government to facilitate large scale uptake of the scheme include, conducting door to door awareness campaigns, sending messages through SMS, calls, radio, hoardings, social media and also introduced an AI based WhatsApp chatbot.

ENSURE WIDESPREAD IMPLEMENTATION OF THE ECBC THROUGH INTER-MINISTERIAL COORDINATION

To improve the implementation of the Energy Conservation Building Code (ECBC) in India, it has been noted that the government must enhance coordination between the Ministry of Power and state Urban Development Departments, ensuring ECBC is treated as a national priority rather than a sectoral initiative.[224] Strengthening capacity building by increasing staff at state departments, conducting regular training for architects and planners, and integrating ECBC compliance into building approval processes will be crucial. States should adopt best practices from Andhra Pradesh, Telangana, and Karnataka, where technical committees have successfully created roadmaps for ECBC adoption. Providing financial incentives, ensuring the availability of energy-efficient materials, and promoting large-scale demonstration projects can further encourage compliance. Given the rapid growth of commercial spaces, it is imperative to mandate ECBC across all states, streamline enforcement mechanisms, and leverage digital tools for monitoring compliance, ultimately driving India's transition towards energy-efficient buildings.

III. Material Consumption

EXTEND THE SCOPE OF THE E-WASTE MANAGEMENT RULES 2022 FOR GREATER IMPACT

The E-Waste Management Rules (2022) marked a significant policy shift by streamlining the Extended Producer Responsibility (EPR) framework and introducing stricter compliance measures for producers. However, the exclusion of some of the key stakeholders from the formal waste management sector - such as consumers, collection centers, and E-retailers[225] was a missed opportunity in terms of further streamlining the operations of the formal sector. To enhance policy effectiveness, the government must expand the scope of EPR obligations to include these three stakeholders, ensuring a comprehensive and structured E-waste collection system. The lack of their participation hampers the efficiency of formal recycling channels, leading to large volumes of E-waste being diverted to the informal sector, where unsafe processing methods cause severe environmental and health hazards.

STRENGTHEN THE IMPLEMENTATION OF THE EXTENDED PRODUCER RESPONSIBILITY PRINCIPLES

Additionally, while EPR mandates compliance, enforcement remains weak, allowing producers to evade their responsibilities without facing significant penalties. The absence of a robust monitoring mechanism further reduces the effectiveness of the framework, making it difficult to ensure that collected E-waste is properly recycled.[226] Implementing a national digital tracking system—similar to South Korea's,[227] which boasts an 82% E-waste recovery rate—would increase transparency and compliance by allowing real-time monitoring of waste disposal and material recovery. Furthermore, periodic third-party audits of EPR obligations could strengthen accountability and enforcement, ensuring that producers actively contribute to responsible recycling practices.

Financial incentives for compliant manufacturers and stricter penalties for non-compliance could further encourage participation, making India's E-waste regulations truly impactful and helping transition towards a circular economy.

INTEGRATE THE INFORMAL SECTOR INTO THE FORMAL SECTOR TO UNLOCK INDIA'S RECYCLING POTENTIAL

While the E-Waste Management Rules (2022) emphasize registration for recyclers, they lack a clear roadmap for integrating informal workers into the formal economy. The informal sector handles nearly 90% of E-waste collection and 70% of recycling, yet these workers operate without legal protections, technical training, or financial support, leading to unsafe dismantling practices and environmental hazards. Creating pathways for formal employment will not only improve worker conditions but also enhance resource efficiency by channeling E-waste through environmentally sound recycling systems.A proven model for integration is Pune Municipal Corporation's SWaCH initiative,[228] which has successfully formalized over 3,500 informal waste workers by providing them livelihood security and structured waste collection responsibilities. Encouraging worker cooperative formations along similar lines for E-waste management could help scale up formal recycling efforts nationwide.

REFORM GST ON WASTE: MAKING RECYCLING ECONOMICALLY VIABLE

A major roadblock to sustainable waste management in India is the 18% GST imposed on waste collection and recycling services, which discourages formalized recycling and shifts waste processing back into the unregulated informal sector. This counterintuitive taxation policy places waste management on par with luxury goods, making it financially unviable for formal recyclers to operate, despite waste recycling being a national priority. To rectify this, the government must reduce the GST on waste management services to the earlier 5% or remove it entirely for critical waste streams like E-waste and plastics. A lower tax rate would encourage investment in formal recycling enterprises, create thousands of green jobs, and significantly reduce landfill waste. Countries like Germany,[229] which have prioritized sustainable waste management, demonstrate the effectiveness of lower tax rates. In Germany, while the standard VAT rate is 19%, a reduced rate of 7% often applies to waste management services, and some may even be exempt.

IV. Natural Resources

ACCOUNT FOR THE ENVIRONMENTAL COSTS OF DIGITAL-BASED INNOVATIONS EXPLICITLY

Currently, the policy focus has been restricted to the financial and infrastructure costs for setting up data centers, with limited attention to the ecological costs. State governments, in fact, have been providing financial concessions for land acquisition, electricity consumption, and fuel subsidies to attract increased private sector investment.[230] However, there is a need to explicitly account for the natural resource requirements of these innovations – specifically the water and electricity usage requisite for these data centers. This will, in turn, facilitate improved resource monitoring and better inform the environmental impact of these innovations.[231]

ENFORCE GREATER TRANSPARENCY IN RESOURCE USAGE REPORTING BY THE PRIVATE SECTOR

One of the key impediments to a comprehensive understanding of the environmental impact of the data centers has been a lack of detailed and transparent reporting by the private sector regarding – electricity use, water use, emissions burden, etc. This results in gaps in understanding the true cost of these innovations and biases the cost-benefit analysis by the government before providing permits for setting up this infrastructure. Ensuring greater transparency in reporting by private sector will also enable improved enforcement of sustainable water and electricity usage practices.[232]

> **"There is a need for bringing in standardized reporting on water, electricity usage and emissions. As long as there are no consistent, global standards of reporting, the data center operators will always have the option to re-locate to geographies with relatively weaker disclosure norms – shifting, rather than solving, the strain on natural resources."**
>
> - Trisha Ray, Atlantic Council

RENEW LICENSES FOR OPERATION PERIODICALLY

The technology utilized for the infrastructure for digital penetration is rapidly evolving, which means that the underlying resource usage and intensity of usage are also changing, accordingly. A one-time approval for setting up infrastructure like data centers, as is currently the case in the Indian context, will not adequately account for the shifts in resource usage and the environmental implications of the same. This poses risks in terms of extractive usage of electricity, water, and other resources.

INCREASE FOCUS ON TEXTILE UPCYCLING INSTEAD OF RECYCLING

Currently, only 10% of the textile waste is upcycled, while 25% is recycled. Given the environmental costs associated with recycling textiles, a concomitant focus on upcycling can help in extending the lifecycle of the product [233]. The low resource demand also makes it a more financially viable option for communities and small-scale enterprises. Upcycling entails transforming discarded textile products into a new product of improved quality and value.

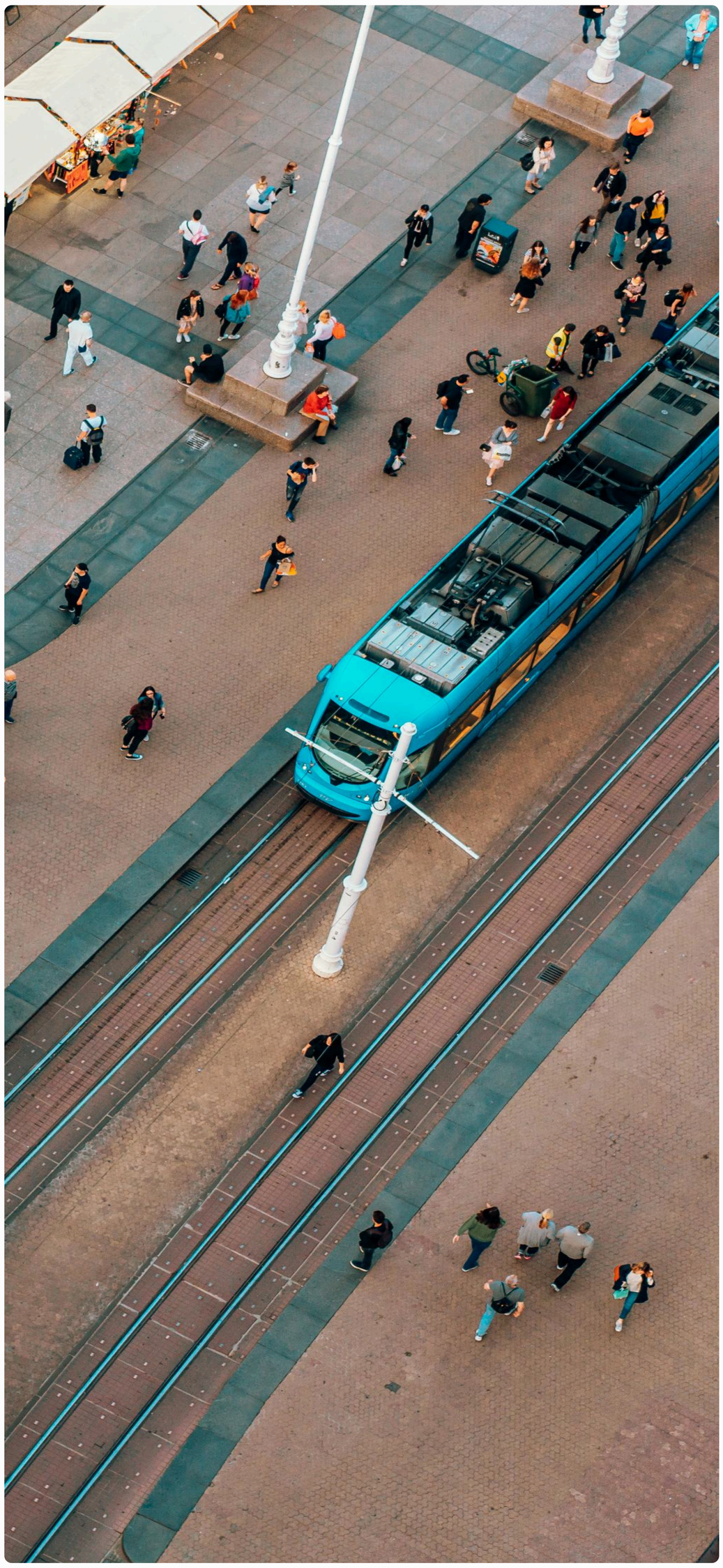
While the government has been proactively addressing this through various initiatives, there is a need for a more concerted approach towards mainstreaming upcycling. In March 2024, a tripartite agreement was signed between the Union Ministry of Textiles, the Union Ministry of Commerce and Industry, and the Department of Public Enterprises to promote upcycling as a key solution to reduce waste generation and minimize the need for textile materials. The initiative aims to empower last-mile upcyclers and provide them with improved market access to the end market by eliminating intermediaries.

#4.2
Civil Society

I. Fuel Consumption

UTILIZE PUBLIC SPACES: EXPANDING CAR-FREE ZONES FOR SUSTAINABLE URBAN LIVING

Cities like Paris (France) and Bogotá (Colombia) have successfully implemented car-free initiatives—Paris hosts monthly car-free days and pedestrian-only zones, while Bogotá's Ciclovía transforms major roads into cycling and walking corridors every Sunday. These efforts have reduced congestion and improved air quality. India's opportunity lies in civil society to push for more frequent and permanent car-free zones, pilot temporary street closures, and mobilize community-driven support for pedestrian-friendly spaces. India's **Raahgiri Day**, launched in Gurgaon in 2013 and later expanded to Delhi, successfully promoted car-free Sundays with cycling, walking, and community events. Though inconsistent post-pandemic, Raahgiri resumed in some areas, including Connaught Place, Delhi, in March 2023. To scale impact, civil society must work towards sustained car-free initiatives, integrate them into urban planning, and foster public participation to make pedestrian-first mobility a permanent reality.



COLLABORATE FOR GREATER ACCOUNTABILITY

In London, groups like London TravelWatch serve as citizen watchdogs, holding public transit agencies accountable by gathering passenger feedback and pushing for service improvements, ensuring that public transport remains reliable, accessible, and affordable for all. While there have been few consumer passenger survey initiatives in global south, civil society can play a pivotal role by formalizing public transport accountability platforms, where commuters can share real-time data on bus and train services. By leveraging technology to track reliability, accessibility, and affordability, these platforms can amplify citizen voices and create significant pressure for public transportation agencies to meet the demands of the public. Civil society organizations can establish regular communication channels for feedback, partner with local governments for data-sharing agreements, and mobilize campaigns that hold public transport systems to higher standards. With a robust framework for real-time reporting and evidence dissemination, India can make its public transport system more responsive and efficient.

London TravelWatch

London TravelWatch is an independent statutory organization that plays a crucial role in promoting sustainable mobility in London by ensuring the public transport system is reliable, accessible, and efficient. Established as a consumer awareness group in July 2000, it serves as a bridge between commuters and transport agencies. TravelWatch collects passenger feedback through surveys, consultations, and direct input from commuters. They focus on key issues such as service reliability, accessibility for people with disabilities, safety, and affordability. The organization regularly publishes reports that highlight areas of improvement and pushes for changes to transport policies, systems, and infrastructure based on public concerns.

It is interested in the passenger experience of all the services operated and licensed by Transport for London (TfL).

TfL is a local government body responsible for most of the transport network in London. London TravelWatch works towards policy reforms, supports the implementation of new routes, and ensures transparency in decision-making. They also help hold transport authorities accountable, pushing for better customer service, clearer communication, and more sustainable transport options. Over the years, London TravelWatch has successfully influenced improvements in public transport services, including better accessibility measures, more frequent services during peak hours, and an emphasis on reducing carbon emissions in the transport sector. Their efforts have directly contributed to making London's public transport system more sustainable and commuter-friendly, demonstrating the critical role of citizen-driven accountability in fostering long-term urban mobility solutions.

Transforming Urban Mobility in India: Institute for Transportation and Development Policy's (ITDP) Impact on Sustainable Transportation

The Institute for Transportation and Development Policy (ITDP) is an international organization and global example in promoting sustainable urban transportation. In India, ITDP has been instrumental in shaping the future of urban mobility by working towards policies and infrastructure that prioritize public transport, walking, and cycling.

Key Initiatives in India:

BUS RAPID TRANSIT (BRT) SYSTEMS

ITDP played a critical role in the development of BRT systems in cities like **Pune** and **Ahmedabad**. The BRT in Ahmedabad, known as the Janmarg, is considered one of the most successful in India, offering efficient, high-capacity bus services, with dedicated lanes, reduced travel time, and improved air quality.

COMPLETE STREETS

ITDP has worked extensively to transform streets to be more inclusive of all users. In **Mumbai**, it has supported projects that prioritize pedestrians and cyclists, redesigning roads to reduce congestion and improve safety.

SUSTAINABLE URBAN MOBILITY PLANS (SUMPS)

ITDP has partnered with various state and municipal governments to create SUMPs, which include strategies for reducing car dependency and promoting sustainable transport options. This approach has been implemented in **Chennai** and **Bangalore**, where ITDP has helped local authorities develop plans to improve walking and cycling infrastructure, alongside public transport improvements.

ITDP's work has not only improved public transportation systems but also contributed to better air quality, reduced traffic congestion, and enhanced accessibility. By focusing on equitable and sustainable mobility solutions, ITDP has set benchmarks for urban transport systems in India, ensuring that they are more inclusive and resilient for future generations.

INFORM ATTITUDE, BEHAVIOR AND LIFESTYLE SHIFTS TOWARDS A SUSTAINABLE MOBILITY FUTURE

Civil society must play an active role in driving sustainable mobility by promoting awareness campaigns that encourage lifestyle changes, particularly in favor of public transport. By collaborating with the government, civil society can provide critical knowledge support for sustainable initiatives and help drive policy improvements. They can serve as independent watchdogs, disseminating key information, generating data, and conducting research to assess the effectiveness of policies. This will enable them to offer valuable feedback and inform necessary changes, ensuring that society can lead impactful campaigns to accelerate the shift towards more sustainable transportation options.

II. Electricity Consumption

CIVIL SOCIETY ORGANIZATIONS IN INDIA CAN PLAY A CRUCIAL ROLE IN BRIDGING KNOWLEDGE GAPS AND DRIVING RENEWABLE ENERGY ADOPTION

By implementing localized awareness campaigns, simplifying consumer education through multilingual toolkits, explainer videos, and interactive digital platforms, civil society can help demystify the benefits and processes of adopting rooftop solar and other decentralized solutions. Establishing consumer helpdesks can prevent misinformation and build trust in the sector. By fostering community-led engagement and public-private partnerships, civil society can ensure that renewable energy becomes a viable and well-understood choice for households. Additionally, CSOs should collaborate with industry associations, microfinance institutions, and government bodies to create accessible financing models and demonstration projects that showcase real-world benefits.

EMBED RENEWABLE ENERGY AWARENESS INTO SCHOOLS, COLLEGES, AND COMMUNITY LEARNING SPACES TO DRIVE LONG-TERM BEHAVIORAL CHANGE

Civil society organizations can develop renewable energy literacy programs, engaging students, teachers, and parents through interactive workshops, real-life case studies, and hands-on demonstrations. Schools and universities can host energy clubs, competitions, and awareness drives to encourage young people to champion solar and other clean energy solutions in their homes and communities. By normalizing discussions around renewable energy and making sustainability a part of everyday learning, civil society can foster a generational shift in mindset, ensuring greater acceptance and proactive adoption of clean energy solutions in the future.

III. Material Consumption

BUILD A CULTURE OF MATERIAL LITERACY AND WASTE SEGREGATION FOR EFFECTIVE WASTE MANAGEMENT

Most consumers do not consider what their products are made of, how materials are sourced, or their recyclability. This lack of material literacy leads to higher waste generation and inefficient recycling systems. Understanding the composition, environmental impact, and recyclability of materials is essential to drive sustainable consumption and better waste management practices. However, without proper consumer awareness, both consumers and businesses have little incentive to transition toward sustainable materials. To address these challenges, civil society organizations must take the lead in educating both consumers and businesses on material literacy and waste segregation. Workshops, digital campaigns, and school-based programs can raise awareness about sustainable materials and the benefits of waste sorting, ensuring that consumers demand better product designs and adopt proper segregation habits. CSOs can also partner with businesses to implement in-office waste sorting policies, making segregation a systemic habit across consumption points. By integrating material literacy with proper waste segregation efforts, India can reduce waste at the source, improve recycling efficiency, and promote a circular economy, ensuring long-term environmental sustainability.

Source: Waste Segregation Poster for Bangalore Municipal Corporation trucks and public places

STRENGTHEN COLLABORATION BETWEEN CIVIL SOCIETY AND GOVERNMENT

For lasting impact, CSOs and government agencies must work together to scale successful waste management models. A great example of this is seen in Lebanon, where civil society groups joined forces with policymakers to tackle the country's waste crisis after the 2015 landfill closure led to waste piling up on streets, causing severe health and environmental hazards. In response, CSOs championed for decentralized waste management systems, pushed for new environmental regulations, and promoted sustainable waste treatment solutions. As a result, Lebanon saw higher recycling rates, improved municipal waste collection strategies, and the establishment of new waste treatment facilities, significantly reducing landfill dependency and mitigating the crisis. CSOs should actively participate in policymaking discussions, provide research-based insights, and push for stronger waste management regulations. By collaborating with governments, they can ensure policies are evidence-based and lead to long-term environmental sustainability.

IV. Natural Resources

PROMOTE INCREASED TRANSPARENCY IN WATER CONSUMPTION AND POLLUTION DISCLOSURE BY THE PRIVATE SECTOR

Private sector companies in India, working across data centers, lack adequate transparency regarding the water footprint of their activities. While global tech firms like Google, Meta, Amazon Web Service, and Microsoft have started reporting their water usage internationally, Indian data center firms still lack standardized reporting norms on their water consumption.[234] As the expansion of data centers continues in India, primarily in the water-stressed metro cities,[235] civil society can play a critical role in initiating the dialogue on improved transparency in the disclosure of water and energy resources by these data centers. Given the technical complexity of the subject, civil society's stewardship will be a critical first step in demanding increased accountability from the private sector, thereby enhancing the scope of implementation of sustainable water practices. In October 2024, 20+ civil society groups, including Athena Coalition, Piedmont Environmental Council, Good Jobs First, People's Action Institute, in a joint comment, outlined in extensive detail the need to more seriously consider the environmental impact of the unchecked expansion of data centers and also highlighted the need for greater transparency about the climate impact of the same.[236]

PROMOTE INCREASED AWARENESS ABOUT THE WATER FOOTPRINT OF FAST FASHION

Civil society can play a critical role in fostering increased awareness about the hidden water footprint associated with fast fashion. Initiatives like Good on You and Fashion Revolution have been explicitly assessing and rating brands on their water footprint, along with other key environmental and human indicators.[237] [238] These efforts have nudged global fashion brands toward more responsible practices and also promoted more sustainable consumer choices. Similar initiatives can be replicated by the Indian civil society and social impact organizations for Indian brands to promote increased consumer awareness about the environmental and human costs associated with fast fashion brands. With the increased expansion of the fashion E-commerce market in India[239], these initiatives will be critical in promoting a dialogue on sustainability. Collaborative efforts with leading fashion design and climate studies universities can foster in creation of robust monitoring and assessment frameworks for evaluating the sustainability readiness of leading fashion brands in the country.

#4.3
Philanthropy

I. Fuel Consumption

SCALE UP AND SUPPORTING EXISTING SUCCESSFUL MODELS

Philanthropy can play a transformative role in scaling initiatives already proving successful in India and globally. Foundations can offer funding, strategic partnerships, and technical assistance to amplify these efforts, making them more frequent, widespread, and integrated into city planning. Philanthropic funding could also focus on developing toolkits and resources for local governments and communities to replicate successful models across smaller towns and cities.

STRENGTHEN MULTI-STAKEHOLDER PARTNERSHIPS FOR EVIDENCE BUILDING

Philanthropy can also take a leading role in convening multi-stakeholder partnerships between civil society, governments, and the private sector to champion for policy reforms that promote sustainable mobility. This could involve supporting research and awareness initiatives focused on creating public transport incentives, implementing congestion pricing models, and improving urban planning policies to prioritize non-motorized forms of transport. A key example is the World Resources Institute's work on sustainable cities in India, which has effectively influenced policy changes in several major cities. Additionally, fostering multi-stakeholder partnerships focused on worker welfare in India, such as those supporting gig worker protections and fair wages, can help ensure that the needs of the labor force are integrated into mobility policy reforms, creating more inclusive and equitable urban mobility solutions.

SUPPORT BEHAVIORAL CHANGE CAMPAIGNS

Shifting public attitudes toward personal car usage is a key step in advancing sustainable mobility. Philanthropic foundations can play a vital role by investing in large-scale public awareness campaigns that highlight the environmental, social, and economic benefits of reducing personal car dependency. These campaigns can focus on fostering a cultural shift towards public transport, walking, and cycling as viable, sustainable alternatives. While the success of global initiatives like The European Mobility Week and New York's "Car-Free Day" shows the potential of such campaigns, India also celebrates its own Car-Free Day on September 22nd – which is observed as the World Car Free Day - where cities like Delhi and Bengaluru encourage citizens to leave their vehicles at home. Indian cities, including Delhi, Mumbai, and Bengaluru, have also experimented with similar consumer behavior change campaigns, such as "Pedestrian Day" and "Cycle Day," to encourage walking and cycling as part of the urban mobility conversation. These initiatives, though in their infancy, point to the potential of grassroots mobilization and policy-driven efforts to transform urban transport choices in India.

In India, the challenge often lies in the insufficient supply of reliable public transport, which can hinder demand for sustainable options. A cultural shift toward more sustainable transport options must be paired with improvements in infrastructure to ensure that citizens have access to practical, safe, and efficient alternatives. Both supply and demand are intricately linked, and any effort to reduce car usage must account for the need to simultaneously enhance public transport networks.

II. Electricity Consumption

INVEST IN NEW TECHNOLOGIES, RESEARCH AND DEVELOPMENT

The Standing Committee on Energy (2024-25) noted reduced budgetary allocations towards research and development in the renewable energy sector. The allocations for the same was a mere Rs 4 crore in 2023-24.[240] Further, the Committee has also noted that the utilization of the allocated funds has been low. To undertake research for development of new technologies, a substantive amount of investment in needed. Philanthropic capital can be invested in the development of technologies that will improve the access of electricity and associated benefits for communities that currently do not have access. Often such communities face the brunt of climate change more than others. This is further exasperated by the Urban Heat Island effect. In this context, as demand for cooling and air conditioners is set to increase (and drive demand for electricity), it is important to keep in mind communities who may not be able to afford this. Philanthropic capital can play a role by investing in research to develop technologies that provide green energy solutions (such as cooling) for those who currently do not have access.

HELP SCALING MODELS FOR DECENTRALIZED RENEWABLE ENERGY

Philanthropists can play a crucial role in advancing decentralized renewable technologies in rural and semi-urban areas by providing financial support, technical expertise, and ecosystem development to bridge gaps in energy access. A strong example of this is Smart Power India (SPI), an initiative by the Rockefeller Foundation, which had successfully deployed solar-powered mini-grids to electrify remote communities and enable economic growth.[241] By supporting similar models, philanthropy can help scale decentralized solutions, ensuring reliable electricity for households, businesses, and essential services like healthcare and education. Since many rural and peri-urban areas struggle with financing and service infrastructure, philanthropic funding can de-risk investments, and support community-based energy enterprises.

III. Material Consumption

BUILD A CULTURE OF MATERIAL LITERACY AND WASTE SEGREGATION FOR EFFECTIVE WASTE MANAGEMENT

Most consumers do not consider what their products are made of, how materials are sourced, or their recyclability. This lack of material literacy leads to higher waste generation and inefficient recycling systems. Understanding the composition, environmental impact, and recyclability of materials is essential to drive sustainable consumption and better waste management practices. However, without proper consumer awareness, both consumers and businesses have little incentive to transition toward sustainable materials. To address these challenges, civil society organizations must take the lead in educating both consumers and businesses on material literacy and waste segregation. Workshops, digital campaigns, and school-based programs can raise awareness about sustainable materials and the benefits of waste sorting, ensuring that consumers demand better product designs and adopt proper segregation habits. CSOs can also partner

with businesses to implement in-office waste sorting policies, making segregation a systemic habit across consumption points. By integrating material literacy with proper waste segregation efforts, India can reduce waste at the source, improve recycling efficiency, and promote a circular economy, ensuring long-term environmental sustainability.

CATALYZE SCALABLE AND COLLABORATIVE WASTE MANAGEMENT SOLUTIONS

Philanthropic organizations have a unique opportunity to drive significant impact in sustainable waste management by scaling and replicating successful solutions across diverse geographies and populations. As discussed in the solutions section (See Section 3.1), numerous city- and state-specific models in India focus on effective waste management. With concerted philanthropic investments, these models can be expanded by existing NGOs into new locations and also be adopted by other organizations, amplifying their reach and impact. For instance, the Global Environment Facility's Small Grants Programme offers such support to local CSOs, focusing on community-based approaches to environmental challenges. The program funds grants of up to USD 75,000, with strategic projects receiving up to USD 150,000, allowing for scaling up successful initiatives.

Beyond funding, philanthropy fosters collaborative partnerships among governments, private enterprises, and non-profits to address complex waste management issues. Initiatives such as the National Faecal Sludge and Septage Management (NFSSM) Alliance in India demonstrate how philanthropic contributions can support knowledge-sharing, policy dissemination, and large-scale interventions in waste management. The NFSSM Alliance is a national working group focused on fostering collaborative action towards inclusive sanitation at the national, state, and city levels, working with a network of partners in over 14 states to build consensus and encourage discourse on inclusive sanitation.

IV. Natural Resources

BUILD A STRONG KNOWLEDGE AND RESEARCH ECOSYSTEM

Philanthropy can play a critical role in funding the technical support requisite for promoting greater transparency and accountability from the private sector. Unlike the Global North, where initiatives like Good On You, Fashion Revolution, CDP Water Disclosure, and the Science-Based Targets Network have pioneered sustainability ratings, India still lacks dedicated, data-driven assessment models for ensuring corporate water accountability. Both the rating and assessment frameworks for evaluating the sustainability readiness of fast fashion brands and the demand for greater accountability by data center operators necessitate an investment in specialized talent by civil society. An inter-disciplinary collaborative partnership across grassroots NGOs and think tanks would be necessitated for a holistic assessment of these new-age issues. The research-focused nature of these subjects necessitates concerted multi-year, long-term investments that require patient capital.

FOSTER INCREASED PARTICIPATION BETWEEN THE PRIVATE SECTOR AND CIVIL SOCIETY FOR A MORE HOLISTIC NARRATIVE ON THE ADOPTION OF SUSTAINABILITY

Evaluation of sustainability readiness in the Indian context requires a careful weighing of the economic and environmental trade-offs. Besides the evolving regulatory framework in context of ESG and EPR, much of the reticence of the private sector regarding the adoption of sustainability paradigms are concerns regarding the stiff competition they face against their global peers.[242] As the sector continues to be a labor-intensive sector, any considerations of just transition and green jobs, will entail considerations about the re-skilling of the workforce for integration into these new supply-chains[243] and adoption of cleaner energy alternatives. A close partnership between private sector and civil society will enable incorporation of more nuanced understanding of these trade-offs and thereby a more holistic understanding of sustainability.

#4.4
Private Sector

Sustainability is often framed in negative light—'consume less, sacrifice more.' But this narrative fails to resonate because people inherently aspire to a better quality of life. The real opportunity lies in embedding sustainability within these aspirations, positioning it as an enabler rather than a limitation. Businesses have a responsibility to provide solutions that align with consumers desires while driving innovations that fuel growth and minimizes harm to the planet.

- Joe Phelan, Executive Director, World Business Council for Sustainable Development

I. Fuel Consumption

DRIVE SUSTAINABLE MOBILITY VIA UNIFIED MaaS PLATFORM FOR INDIA

The private sector can revolutionize urban mobility in India by creating a Mobility-as-a-Service (MaaS) platform that integrates buses, metros, shared mobility, rideshares, and first-mile/last-mile solutions into a single app. This platform can offer real-time tracking, cost comparisons, and subscription-based seamless travel, encouraging commuters to shift from private vehicles to sustainable options, similar to solutions developed in China and Finland (See Box 2). By incentivizing green choices, leveraging AI for route optimization, and collaborating with public transit systems, this solution can reduce congestion, cut emissions, and position public transport as a modern, eco-conscious alternative. Indian cities could implement MaaS solutions where private companies collaborate with metro, bus, and ride-hailing services (like Ola, Uber, Rapido) for seamless urban mobility.

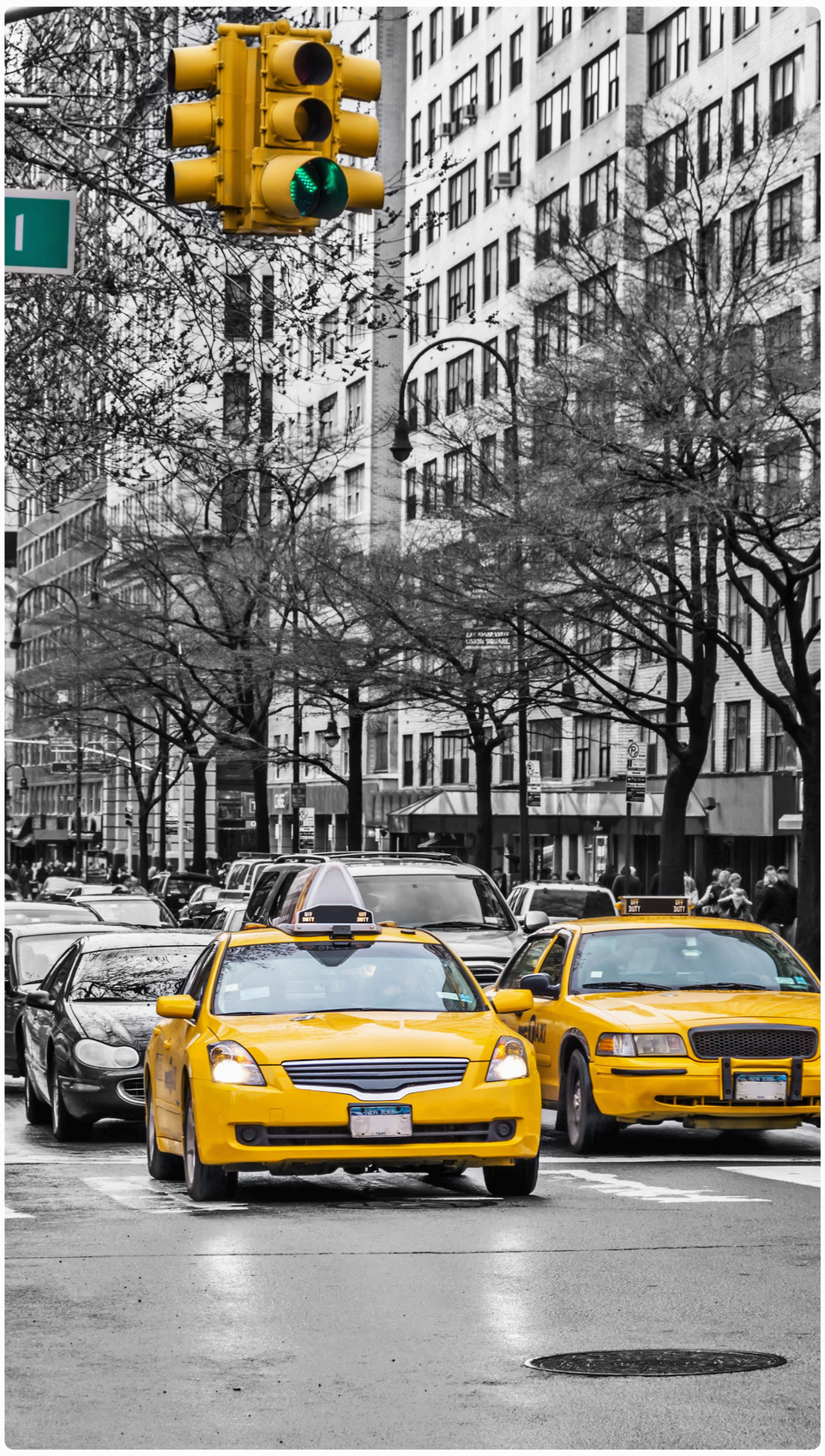
Spotlight on Global Mobility Innovations: A Look at Beijing and Helsinki's MaaS Models

Beijing's Mobility-as-a-Service: A Model for the Future: Beijing's Green Mobility-as-a-Service initiative is a standout example. By simply entering a destination on a mobile app, users can access diverse travel options with details on duration, mode, cost, and more. The platform seamlessly integrates various transport services, including buses, metro, shared bikes, rideshares, and taxis. To date, it has served over 30 million users, facilitating 4.5 million daily trips with green transport solutions.

Whim (Finland): The **Whim app in Helsinki** integrates public transport, ride-hailing, bike-sharing, and car rentals into a single subscription service. This resulted in reduced personal vehicle usage by making shared and public transport more convenient and seamless.

BUILD COLLABORATIVE WORKER WELFARE MODELS FOR THE GIG AND PLATFORM WORKERS

To address the growing needs of gig economy workers, particularly in sectors like ride-sharing and delivery services, collaborative responsibility models should be encouraged. For instance, a pooled resource initiative is underway in New York, where ride-sharing platforms and other gig economy players collectively provide health benefits, insurance, and minimum wage guarantees to workers. This shared responsibility approach ensures that workers receive essential benefits without overburdening any single company. Similar approach is necessitated in India enabling the balance of worker welfare, with industry competitiveness and mitigating the impact of climate change.



II. Electricity Consumption

INVEST IN TECHNOLOGIES TO HELP CONSUMERS ENHANCE ENERGY CONSERVATION

Smart meters use two way communication to provide real-time or near real-time energy usage insights. The private sector can play a pivotal role in developing a smart energy management app that helps consumers monitor, manage, and reduce their electricity consumption through real-time tracking, AI-powered Recommendations, and automation features. By integrating with smart meters, SHEMS, and energy-efficient appliances, the app can provide detailed energy usage insights, suggest optimal usage times, and automate power-saving settings. Incorporating gamification elements, behavioral nudges, and financial incentives such as rebates and discounts on BEE-certified appliances can further encourage sustainable energy habits.

ENCOURAGE REAL ESTATE DEVELOPERS TO INCORPORATE PASSIVE COOLING DESIGNS

In new building construction, reducing the reliance on air conditioning and minimizing energy consumption. By integrating climate-responsive architecture, developers can use natural ventilation, reflective roofing, shaded windows, high thermal-mass materials, and green roofs to maintain comfortable indoor temperatures. Features like courtyards, cross-ventilation, and strategically placed vegetation can further enhance cooling while improving air quality. These passive design elements, when aligned with the Eco Niwas Samhita (ENS) and Energy Conservation Building Code (ECBC), can significantly lower indoor temperatures, reduce peak electricity demand, and enhance long-term sustainability.

III. Material Consumption

EMBRACE SCIENTIFIC RECYCLING AND LEVERAGING TECHNOLOGY

The private sector must prioritize the adoption of advanced recycling technologies to manage waste more effectively, given the low rates of formal recycling. Implementing state-of-the-art methods, such as automated sorting systems and chemical recycling, can significantly improve the efficiency and effectiveness of waste processing.[244] Investing in research and development to innovate recycling processes can lead to higher recovery rates of valuable materials and reduce the environmental impact of waste. Collaborations with technology providers and research institutions can facilitate the integration of cutting-edge solutions, positioning companies as leaders in sustainable waste management.

COLLABORATE WITH THE INFORMAL SECTOR

In India, the informal sector plays a crucial role in waste management. Waste pickers and small-scale recyclers contribute significantly to material recovery but often operate without formal recognition or support.[245] The private sector can enhance waste management efficiency by supporting the integrationg informal workers into formal supply chains. This collaboration can be achieved through training programs, fair compensation, and providing access to better tools and safety equipment. Such partnerships not only improve the livelihoods of informal workers but also enhance the overall effectiveness of waste collection and recycling systems.

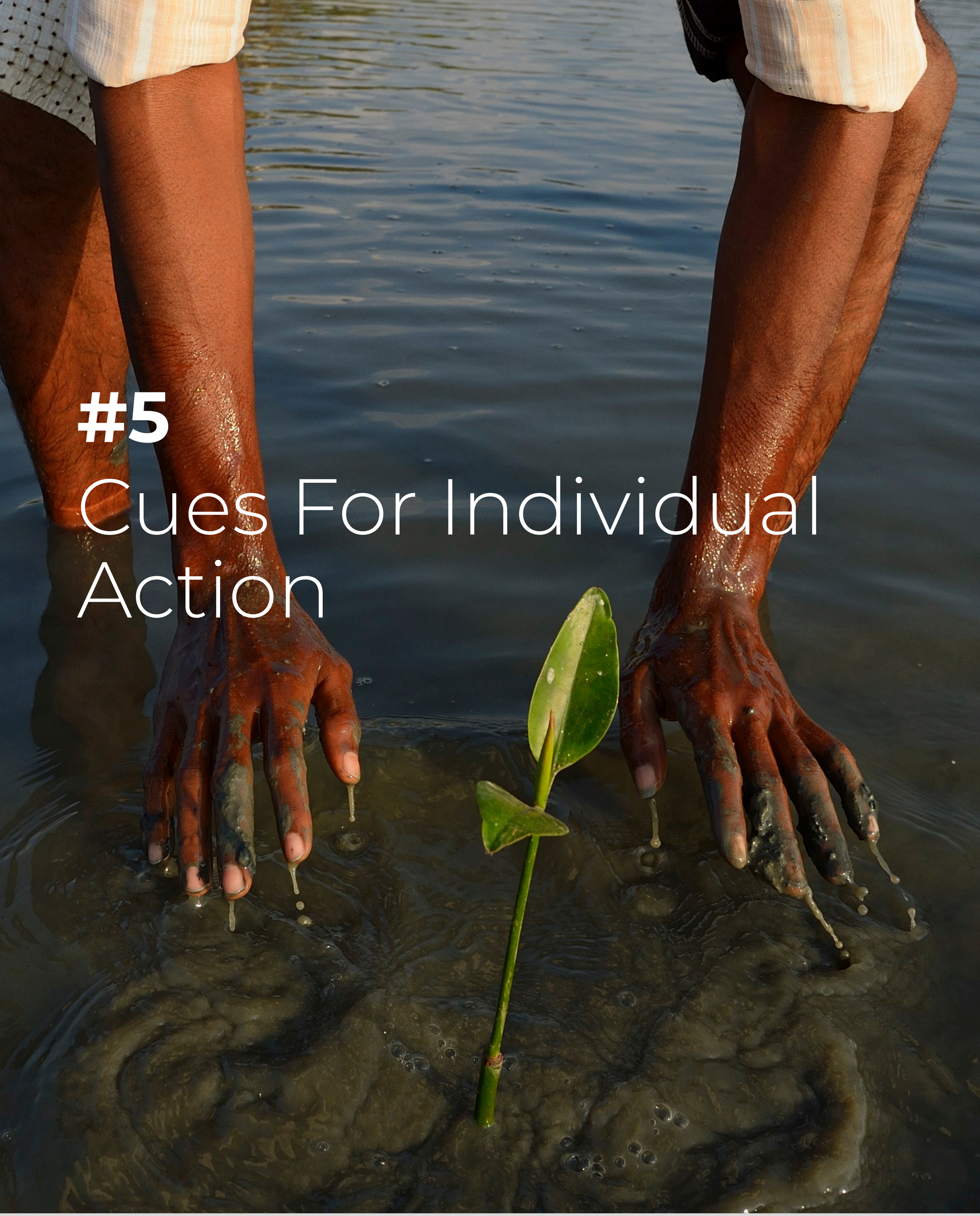
IV. Natural Resources

IMPROVE PRIVATE SECTOR DISCLOSURES REGARDING THEIR WATER FOOTPRINT

Besides the aforementioned reasons, in the preceding sections (4.1 and 4.2), increased transparency in water disclosure by the data centers will also enable in improved planning of the risks to the groundwater table, which is not only a risk for the neighboring communities, but is a critical risk to the businesses as well. Thus, improved disclosures will help the private sector from a strategic perspective, but will also enable better planning by the government while awarding permits for setting up of the data centers.

PAVE PATHWAYS FOR THE CORPORATES WITH RESPECT TO THE ADOPTION OF SUSTAINABILITY PARADIGMS

With a slow but steady growth in the sustainable clothing fashion brands in promoting slow fashion and more proactively disclosing various aspects of their sourcing, the brands have demonstrated that sustainability can be a reality at all scales and is also not necessarily accessible only to a select few. The availability of these choices at multiple price points has also meant that mainstream fashion brands will need to respond to these trends, and incorporate similar changes in their supply chain. Social enterprises in India have also taken the lead on upcycling and thrifting, which has been slowly gaining traction in the Indian context. These trends, when adopted by the wider textile industry have the potential to substantially reduce textile waste, and a strengthened commitment to waste circularity.



#5 Cues For Individual Action

In this section, we identify some of the steps which can be at an individual level towards a more sustainable future.

A. Steps to adopt solar energy solutions at the household level

PM Surya Ghar Muft Bijli Yojana

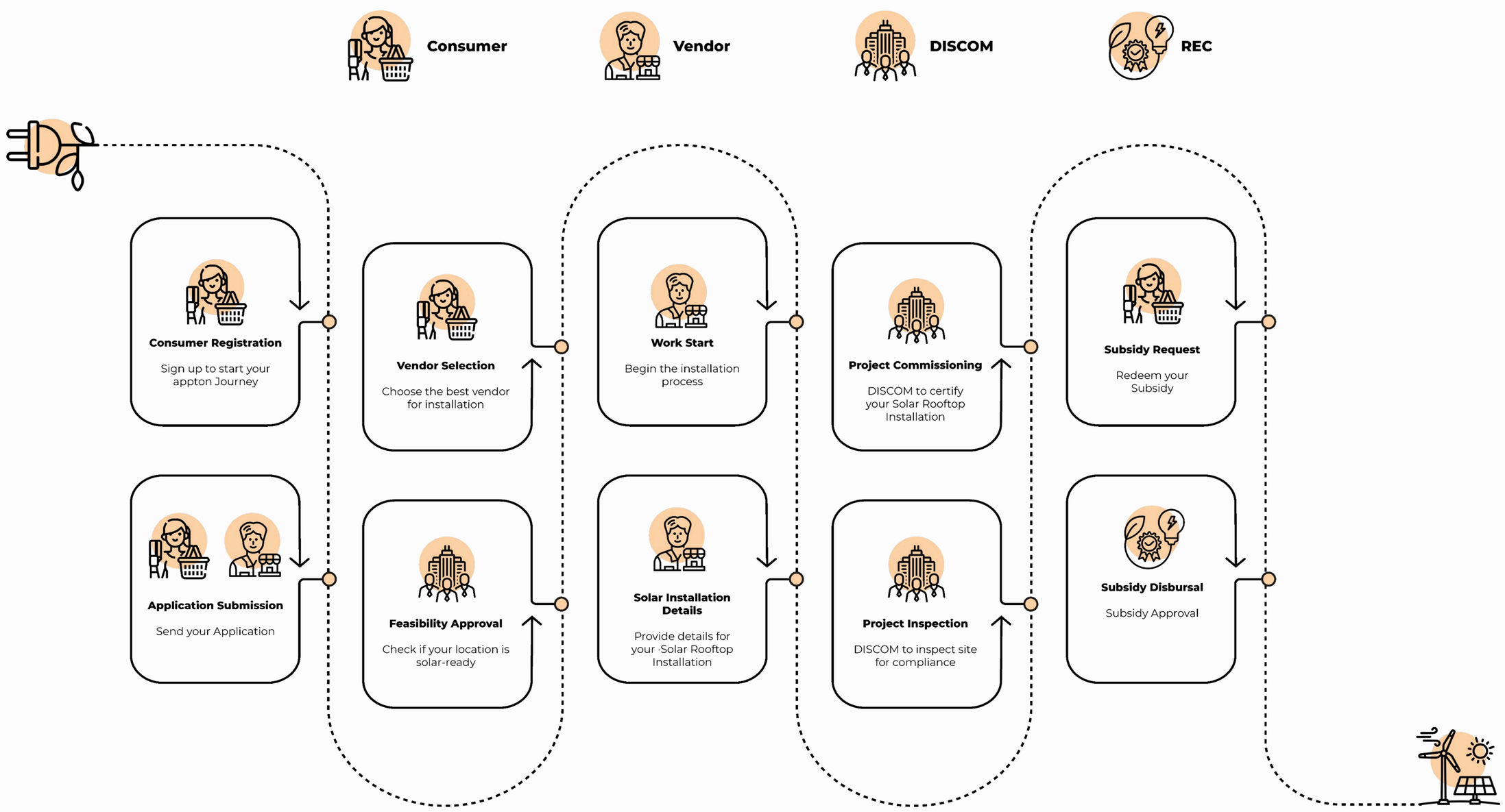
Launched in February 2024, by simplifying the process of installation, and providing a subsidy, the scheme aims to install solar rooftops on one crore households. The subsidy provided is 60% of system cost for 2 kW systems and 40% of additional system cost for systems between 2 to 3 kW capacity. The subsidy is capped at 3kW. Further, consumers will also benefit by earning income through selling excess power to DISCOMS.

The national portal launched for this scheme aims to be a one stop shop for the entire process of installing the rooftop solar systems, including obtaining the subsidy. The steps for an individual are illustrated below.

As of November 2024, the scheme received 1.45 crore registrations, 26 lakh applications, and 6.38 lakh households have benefited.[246]

Certain aspects to keep in mind while applying for the scheme are:

- Only residential consumers or Residential Welfare Societies (RWA) are eligible to apply for the scheme.
- Some of the documents required during the application process include[247], (i) identity proof, (ii) proof of address, (iii) electricity bill, and (iv) roof ownership certificate. In addition, to avail the subsidy the beneficiaries require a cancelled cheque/copy of passbook.
- There is an option to give up the subsidy if the household feels it doesn't need one.
- The consumers can opt for filling the application by vendor on behalf of themselves.
- The vendor fills the data regarding the installation and submits it to the beneficiary for review.



Source: https://pmsuryaghar.gov.in/#/consumer-how-to-apply

B. Checklist to avoid greenwashing practices

In recent years, sustainable consumption has gained new momentum as a lifestyle shift in India. Mission Lifestyle for Environment (LiFE), initiated by the Government of India in 2022, is a mass movement to nudge individual and community action to protect the environment. It emphasizes how sustainable practices are already inherent to some aspects of Indian culture and traditions, and envisions a change in consumer behavior and demand as the first step towards making retail more sustainable. In 2024, a survey on consumer preferences in India indicated that almost 43% of consumers are taking sustainability into account while making purchases.i The movement to make sustainable consumption an accessible reality for the country's critical mass challenges perceptions that such a lifestyle is only feasible for those who are resource-privileged. We have outlined four actionable steps below that individuals can use to make their everyday consumption more aligned with sustainability ideals. Each step is accompanied with reflective questions that can help individuals streamline their sustainable consumption journeys.

1. **Educate yourself about sustainable consumption.**

- What are the various ways a product can be sustainable at each step of the supply chain — from sourcing to manufacture to post-consumption disposal?
- How can being aware and informed about supply chains, product lifecycles, and ecological costs prevent one from being misled by brands that greenwash (use sustainability as a marketing tactic without making real impact)?
- How does consumer demand influence businesses to adopt more sustainable practices, and what role do policies and certifications play in holding companies accountable?

2. **Learn more about what different sustainability labels indicate.**

- Do the labels indicate how environmental costs have been mitigated or offset in the lifecycle of the product?
- Do the labels highlight how ethical labor practices have been followed throughout the supply chain?
- Do the labels suggest how products can be reused or recycled, or if upcycled materials are already being used to manufacture them?

3. **Identify brands that prioritize transparency and accountability while marketing sustainable products.**

- Do brands offer an exhaustive list of the ingredients in their products, and provide information on how they are sourced?
- Is there publicly available information on companies' Business Responsibility and Sustainability Reporting (BRSR) and other forms of sustainability compliance?

4. **Examine the negative downstream effects your consumption can have on the environment.**

- Which products are responsible for causing heavy indirect emissions due to longer supply chains that necessitate transport?

#6
Conclusion

This report makes a case for re-thinking the sustainability of consumption in the age of digital penetration. It urges to recognize the shifting resource dynamics across fuel, energy, materials, and natural resources —driven by evolving consumption patterns. While the report acknowledges the perils of increased digital penetration, it also, in the same breath, acknowledges its transformative potential in advancing sustainability. As indicated in our recommendations, leveraging digital-based solutions hinges on a collaborative, multi-stakeholder effort among - state, market, and civil society. This synergy will ensure a comprehensive and more well-rounded representation of different vulnerable groups and that people's interests precede technological convenience.

"While ESG audits and sustainability metrics exist, these still lean toward compliance rather than broader behavioral change. Sustainability can't remain confined to boardrooms and office policies; it needs to embedded within the consciousness of future generations, across educational institutions, shaping mindsets early and making sustainability second nature rather than an afterthought."

- Narayan Devanathan, Dentsu India

"We need digital platforms that are not merely focused on maximizing sales, but also focused on ensuring authenticity, fair wages, and responsible sourcing."

- Neelam Chibber, Industree Foundation

Our analysis across these four sectors unveils a web of deep interconnections—where industries, ecosystems, and human lives are intricately woven together. This necessitates a more coordinated action across different stakeholders internally as well as externally. It also reveals that the evaluation and assessment frameworks relating to sustainability have been, by design, largely focused on compliance and audits, instead of promoting large-scale mindset and behavioral change. As the scale of the problem is only set to intensify in the future, it is critical to promote the mindset shift across different demographics differently.

Global discussions on sustainability have often framed India as a lower-middle–income country, highlighting the economic trade-offs associated with transitioning to more sustainable practices. While India's low per-capita emissions validate this perspective, its position as the world's third-largest emitter, alongside the escalating vulnerabilities of climate change, calls for deeper reflection. The question is not whether India can afford to prioritize sustainability but rather how it can integrate it into its growth trajectory without compromising its developmental aspirations. India's remarkable leapfrogging in the digital landscape stands as a testament to its ability to embrace rapid transformation. This same spirit of innovation and adaptability must now be harnessed to reimagine sustainability—not as a constraint but as an enabler of long-term resilience, economic opportunity, and social equity.

Building on this perspective, it becomes evident that India is not merely a passive participant in the global sustainability discourse but a crucible of innovation, where traditional wisdom and modern solutions coalesce to forge a distinct pathway toward sustainable development. As outlined in the Solutions section, focus on upcycling, improved understanding of materials usage, and grassroots efforts towards worker security for platform workers reveal that India is a bedrock of innovation and has successfully integrated indigenous knowledge with modern solutions. India's longstanding ethos of circularity, reflected in indigenous practices and now reinforced through frameworks like Mission LiFE, must be elevated from pockets of excellence to mainstream practice.

However, this transition must avoid the pitfalls of guilt-driven narratives and apocalyptic rhetoric. Instead, it should be framed as a pragmatic and empowering journey—one that acknowledges the complexities of consumption patterns and the disproportionate burdens of emissions within the country. True sustainability will emerge not from prescriptive mandates alone but through a fundamental shift in how individuals, businesses, and policymakers perceive and engage with the idea of responsible consumption and production. By embracing this shift, India has the potential to chart a pioneering course, proving that sustainability and economic growth need not be at odds but can, in fact, be mutually reinforcing forces in shaping a more resilient and equitable future.

Annexure 1: Acknowledgments

This report represents a significant advancement in our understanding of the relationship between expansion of digital footprint and sustainability. As India increasingly adopts digital consumption practices—such as E-commerce, ride-hailing, and other related on-demand services—it is essential to recognize the hidden environmental and social costs associated with these trends. This report highlights shifts in resource usage, emissions, and labour market dynamics, providing a comprehensive perspective on the sustainability challenges we face in the digital age.

By examining these evolving consumption patterns through the lens of People & Planet, the report not only emphasizes critical concerns but also offers actionable insights for promoting responsible consumption. Through data-driven analysis and practical Recommendations, it encourages collaboration among governments, businesses, and civil society to shape a more sustainable and equitable future. We hope this report will serve as a valuable resource for informed decision-making, policy innovation, and long-term sustainability efforts.

We would like to extend our gratitude to individuals who shared their insights with the authors, contributing to the depth of this report.

Table 2 List of experts

NAME	ORGANIZATION
Abhishek Pillai	Solar Ladder
Abhinav Goyal	World Bank
Anirudh Tagat	BIAS Inc
Anita Patil	Goonj
Ankit Kumar Gupta	Turing
Anumita Roychowdhury	Centre for Science and Environment
Aditya Sharma	Spiber
Asheerwad Dwivedi	Faculty of Management Studies, University of Delhi
Bharati Chaturvedi	Chintan Environmental Research & Action Group
Dharini Sridharan	Alliance for an Energy-Efficient Economy
E. Somanathan	Indian Statistical Institute
Ganesh Sivamani	Centre for Social and Economic Progress
Joe Phelan	World Business Council for Sustainable Development
Karthik Bansal	Centre for Social and Economic Progress
Harsh Tiwari	Bindi International
Huda Jaffer	Selco Foundation
Mohd. Aslam Naved	WaterAid India
Mukhtar Alam	Janpahal
Narayan Devanathan	Dentsu
Neelam Chibber	Industree Foundation
Rutul Joshi	CEPT University
Sahana Goswami	WRI India
Satyajit Ghosh	WaterAid India
Satish Sinha	Toxics Link
Shreya Saumya	IIT Hyderabad
Shubhi Sachan	Material Library of India
Simrin Chhachhi	Selco Foundation
Smit Gade	Good Business Lab
Stuti Goyal	Alliance for an Energy-Efficient Economy
Trisha Ray	Atlantic Council
Warsha Thakur	Selco Foundation

The Dasra team who have led this effort include Aditya Viswakarma, Khushboo Balani, Rupsha Mitra, and Sanat Kanwar - along with support from Ami Misra, Kasturi Gandhi, Pratyaksha Jha, and Srinjoy Ray. The Dentsu team includes Irwin Raj, Gitanjali Singh, Megha Das, Rohan Pandit, Sanchita Barua, and Yaquta Contractor.

Annexure 2: Methodology

This report aims to shed the light on the interlinkages between increased digital penetration and its implications for consumption. The report focuses on the changes in the four key areas of consumption – fuel, material, energy, and natural resources. The report focuses on environmental and human impact of the shift in the usage of these four key sectors.

Secondary Research

We examined the interlinkages between digital penetration and consumption across these four key sectors - fuel, material, energy, and natural resources by reviewing journal articles, reports by multilateral organizations, think tanks, and Parliament Standing Committee, policy brief and newspaper articles. We also utilized publicly available data for analysis of trends in electricity generation and water availability. All analysis was conducted on Microsoft Excel.

The profiles and case studies discussed under Solutions are not exhaustive. Our profiling approach was largely informed by two key factors. First is their alignment with the key themes covered in the report. Second, the availability of stakeholders from these organizations for interaction, who could elaborate on the various aspects of their work and further enable us to build a more nuanced understanding of the environmental and human impact of the new innovations.

Primary Research

The primary research process entailed speaking to three different set of stakeholders – sector experts, civil society stakeholders and representative from private sector and social enterprises. The corroboration of the insights across these different stakeholders, enabled us refine our understanding on some of the critical issues discussed in this report. These interactions also enabled us to better contextualize the key trends emerging from the secondary research. We conducted over 28 semi-structured interviews with a diverse cohort of stakeholders.

The mixed-methods approach employed here enabled us draft detailed Recommendations for four key stakeholders – government, civil society, private sector and philanthropy, across these four sectors.

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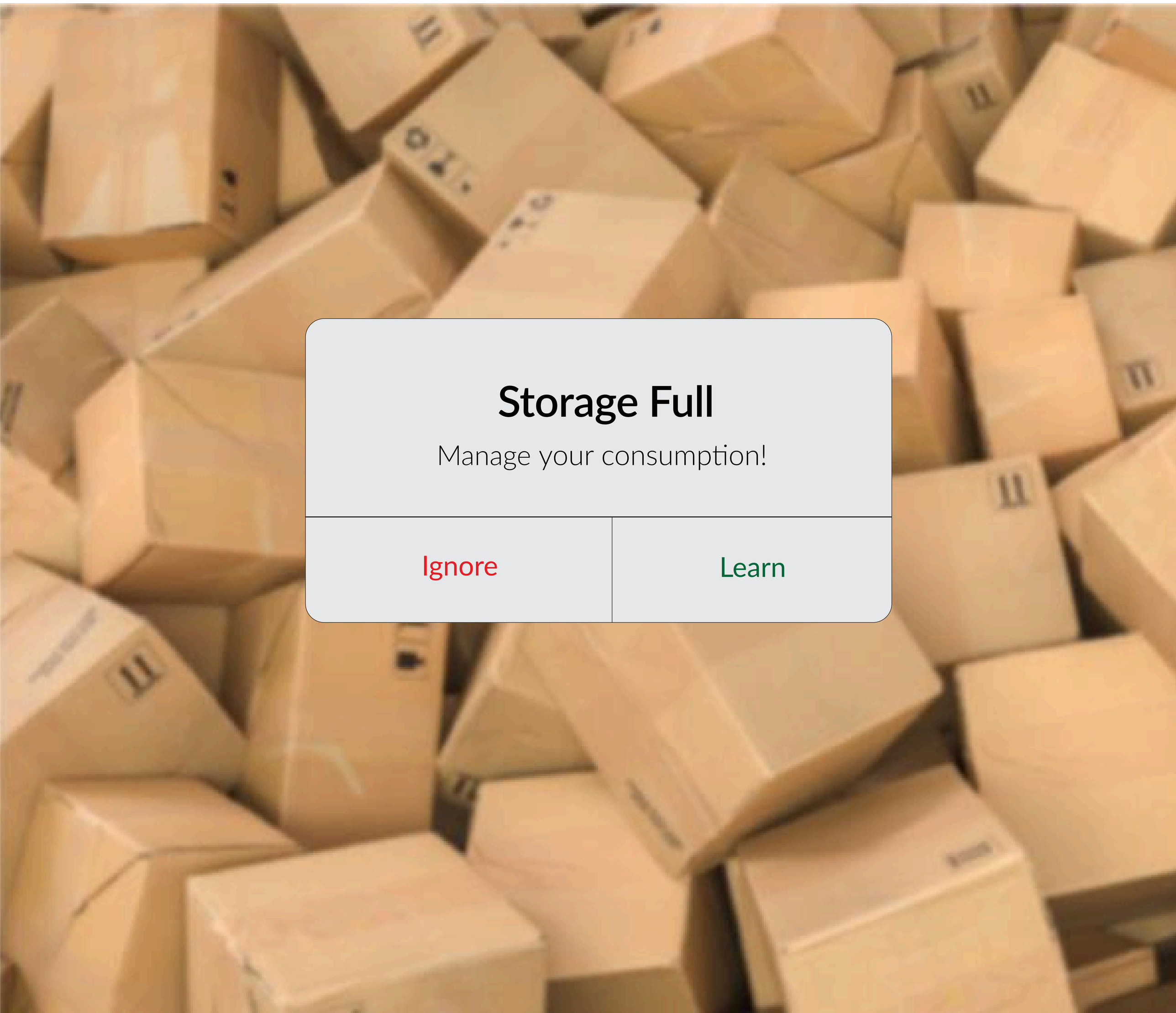

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