

ACCESS TO ENERGY AND SUSTAINABLE MOBILITY: LANDSCAPING FUNDING AND INVESTMENTS IN INDIA



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Despite ‘100 per cent electrification’, in 12 out of the 29 states, fewer than 80 per cent of the households have been electrified.”

ABOUT THE REPORT

Asian Venture Philanthropy Network India (AVPN) has prepared this report for creating and disseminating knowledge about two critical sectors – Access to Energy (A2E) and Sustainable Mobility (SM).

CIIE has undertaken the conceptualization and development of this study and now presents it as a report titled “Access to Energy and Sustainable Mobility: Landscaping Funding and Investments in India.”

This report is structured as a funnel, with each section being more focused and pointed than the immediately preceding one. It presents an overview, current investment and funding landscape, and a guide for investors and funders for A2E and SM separately. It also outlines the current funding and investment scenario in both the sectors and details the three key takeaways for investors and funders – risks and challenges, opportunities and gaps, and an outlook for the future. We believe that readers will resonate with the insights presented. It is our hope that this report will spur positive financial support towards the innovation and entrepreneurial activity in these two critical sectors of the Indian economy.

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FOREWORD

India with a population growth rate of 17.7% between the census of 2001-11, now has 1.35 billion people residing on its land. With the increase in population there is an ever increasing demand for electricity and access to energy leading to huge pressure on limited resources. Despite 98% village electrification a million people still do not have access to energy. Though technology advances have made it possible to meet a lot of the electricity demand, lack of knowledge about the unserved and the underserved markets hampers the implementation of innovative energy solutions for these segments of population. Consequently, for a large number of people, the clean energy solutions that are on offer are non-accessible as well as unaffordable.

There is a huge need to identify the opportunities where significant energy investments can be made to make clean energy equitable and accessible to all. Similarly, the exploding population growth calls for attention to the transportation and mobility sector especially in urban areas, where there is a need for innovative models that deliver efficiency, mobility, speed, and overall sustainability. There is a need for funding of such models so that they are able to scale rapidly to make desirable impact.

Recognising these several needs, this brief report 'Access to Energy and Sustainable Mobility: Landscaping Funding and Investments in India' aims to provide an overview of the two sectors 'Access to Energy' and 'Sustainable Mobility' in India, highlight the innovative mechanisms currently in existence that provide energy access and sustainable mobility and provide an overview of the investment and funding landscape across these sectors.

AVPN strives to increase the flow of financial, human, and intellectual capital into the social sector to help multiply social impact. We hope this brief report encourages like-minded peers to come together to make a collective effort in maximising impact in the sectors of access to energy and sustainable mobility.

We are grateful to Shell Foundation for their generous funding and partnership for bringing out this report. We are also thankful to Centre for Innovation Incubation and Entrepreneurship (CIIE), our research partners and all the Knowledge Partners who have contributed in various ways to the report.

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EXECUTIVE SUMMARY

This report outlines the funding and investment landscape for two sectors of the Indian economy – Access to Energy (A2E) and Sustainable Mobility (SM). It is organized in two main sections representing the two sectors. Each section can be visualized as a funnel including three main subsections – Sectoral Overview, Current Funding and Investment Landscape, and Takeaways for Investors and Funders.

The Sectoral Overview outlines the history and the current scenario including, specifically, identifying the sub-sectors or domains, key products, and services. A significant government presence characterises both A2E and SM sectors. The overview section details the various government policies and schemes, highlighting their impact and outcomes, where relevant. The government intervention in the A2E sector spans various forms of energy including electricity, renewable energy, particularly solar power, and clean cooking. While some schemes are a few decades old (e.g. National Biogas and Manure Management Programme was launched in 1981), many have been launched recently (e.g. the imminent Draft National Energy Policy).

Amongst other forms of energy, a significant government intervention in SM sector pertains to electricity. Among various state and national government policies, the National Electric Mobility Mission Plan (NEMMP) 2020 was instituted with a target of reducing CO2 emissions by 4 million tons. Interestingly, much private participation is also happening in the electric space (including private and public transport, charging infrastructure and freight). Many other aspects of sustainable mobility including last mile connectivity still need considerable support.

Market failures in both the sectors can be seen as the reason for the conspicuous government presence. Long gestation periods, undependable returns, and high enterprise failure rates continue to characterise the sectors. Even with growing private participation, the government continues to be an active and important player in both the segments.

The sub-section Current Funding and Investment Landscape identifies the types of funding and investment support available in the sectors and the sources, i.e. the kinds of organizations providing this financial support. Government continues to have a noticeable presence in the funding space with a number of grants under various schemes at their disposal. Private sector participation, in the form of debt or equity support, continues to be low. The perceived riskiness of the A2E sector has led to only 40 per cent of the available capital being channeled into enterprises during 2013-2016.

SM presents varied trends in different sub-sectors including investments in setting up manufacturing establishments and physical infrastructure across India. This investment is coming from multi-national corporations such as Suzuki (investing \$600 million towards a new manufacturing facility in Gujarat), state governments (Andhra Pradesh government partnering with Toyota to set up a manufacturing unit in Amravati) and Indian conglomerates (Tata Power aiming to invest over INR 100 crore to set up 1000 charging stations).

The last sub-section of the report addresses the current and future investors and funding agencies. It presents pointed insights for investors in three categories – risks and challenges, opportunities and gaps, particularly crystal-gazing and outlining the way ahead.

Before delving into the two sections, the methodology and approach to data adopted for the study are described in detail. The report includes six case studies depicting investments and ecosystem building in A2E and SM. It also has five tables.



METHODOLOGY

This study draws on both primary and secondary data. Primary data include in-depth interviews with participants representing various institutions of the funding and investment ecosystem - investors, donors, funding agencies, sector consultants and investment experts. Secondary data include published and unpublished reports, data banks, and journalistic and academic articles. Secondary data was largely used to triangulate and nuance the insights generated from primary data collection. In some cases, secondary data shaped the interview process.

At the time of the initiation of this study, AVPN had shared an interview guide with CIIE. With this as a foundation, interviews were aimed at understanding the participant's and her/his organization's approach and experiences with funding and investment in the respective domains. Lessons and insights from the previous interviews were used to sharpen the focus of the subsequent ones. Using this approach, we were able to delve deeper and with focus into lesser-explored themes.

We conducted in-depth interviews with investors, subject matter experts, supporting organizations and research houses in A2E and SM sectors. Participants were contacted through network referrals by AVPN and CIIE. In total, engaging with 22 people, we conducted 27 interviews. Some people were interviewed from an investor's as well as an expert's perspective. Interviews lasted between 25-60 minutes and were conducted in person or over a voice call.

Applying a thematic analysis lens, we analysed the interviews and all secondary data. The objective was to get an insight into the current as well as expected or potential funding and investment scenario in India. Notwithstanding their innate connections, our analysis reveals differences between the funding and investment landscape of A2E and SM sectors. In the following sections, we present the findings and insights for the two sectors separately.

ACCESS TO ENERGY



INTRODUCTION

Today, the world is engaged in managing its depleting energy resources and mobilizing itself towards clean, environment-friendly, and renewable energy sources to meet the needs of the exploding population. Concurrently, it is constantly striving to ensure that this energy reaches the millions who don't have access to the electricity grid and other reliable sources of energy and are compelled to make do with unsustainable cooking methods and suffer substandard living conditions, mainly in developing and underdeveloped countries. According to United Nations Development Program (UNDP), more than 1.1 billion people remain without access to electricity and around 2.9 billion people still rely on solid fuels such as wood, animal dung, and charcoal for cooking and heating¹.

While energy in itself is an 'end' that needs to be met for these significant chunks of population, it is also an 'enabler' and a 'means' to achieve larger Sustainable Development Goals set by the United Nations. The absence of reliable energy services limits income-generating activities and hinders the provision of basic services such as health and education. In a nutshell, access to energy is vital for social development, economic prosperity, and environmental sustainability, to name a few².

The International Energy Agency (IEA) defines energy access as "a household having reliable and affordable access to both clean cooking facilities and to electricity, which is enough to supply a basic bundle of energy services initially, and then an increasing level of electricity over time to reach the regional average³". At a minimum, a basic bundle of energy services denotes several lightbulbs, task lighting (such as a flashlight), phone charging and a radio. Access to clean cooking facilities denotes access to (and primary use of) modern fuels and technologies, including natural gas, liquefied petroleum gas (LPG), electricity and biogas, or Improved Cook Stoves (ICS), as opposed to the basic biomass cookstoves and three-stone cooking fires used in developing countries⁴.

Almost all of our respondents defined 'Access to Energy' (A2E) sector as the one comprising government initiatives, non-profit organizations, and business enterprises which provide access of basic energy services to geographies which are energy deficient, possibly because they are remote. The end consumers of energy services and products in these geographies might also be customers for the enterprises bringing them. While one of the respondents emphasised the need to consider the whole A2E sector as a 'means' to achieve several ends such as eradication of poverty, enhanced education and health services, and improved and sustained livelihoods, another highlighted that the sector can be considered impactful and relevant if and when the consumers can have options to choose from different energy sources, depending on their liking, resources, and needs.

Various countries have adopted different approaches to boost their energy access initiatives in the past decade. China and India have been the frontrunners, making excellent progress by using a mix of technologies and business models, both on- and off-grid. Some unique purchase models, such as pay-as-you-go, have become increasingly attractive in many markets, expanding rapidly across Africa. Since 2010, organisations such as World Bank have also stepped up to provide more than \$5 billion for energy access in over 35 countries through some 70 projects. Over the last six years, its portfolio has included 28 last-mile access projects, 25 of which have included off-grid support⁵.

In this report, we shall focus on the current status of access to energy in India, the different mechanisms to provide energy access, and the investment and funding scenario across these mechanisms.

1 'Energy Access', UNDP

2 'Access to Energy', Energias de Portugal (EDP)

3 'Energy Access Outlook', International Energy Agency, 2017

4 'Energy Access Outlook', International Energy Agency, 2017

5 'Access to Energy is at the Heart of Development', The World Bank, 2018

STATUS OF ENERGY ACCESS IN INDIA

According to the Central Electricity Authority (CEA), the total installed capacity of power in India is 344GW, out of which the private sector accounts for 45 per cent⁶. The Renewable Energy Sources, which include small hydro projects, biomass gasifiers, biomass power, urban and industrial waste power, and solar and wind energy, constitute 20 per cent of it⁷. While there has been growth in the total installed capacity, the total energy supplied does not match the same due to several factors including varying climatic conditions (in case of hydro projects) and transmission and distribution losses⁸.

The Government of India has launched several marquee schemes in order to provide electricity to all the households. They are as follows:

1. Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY)
Launched in 2005 for intensive electrification of already electrified villages. The aim of the scheme was to provide benefits to households below the poverty line (BPL) through a free connection but chargeable consumption of power⁹. At present, intensive electrification has been completed in around 80 per cent of villages (as of February 2018)¹⁰.

2. Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY)
Launched in 2015 to provide 100 per cent village electrification by March 2017¹¹. On 29 April 2018, the Prime Minister announced that the target was achieved. However, that does not mean that electricity has reached all households across these villages. As per the Union power ministry's definition, a village is said to be electrified if at least 10 per cent of the households in it have power connections¹².

3. Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya Yojna) Launched in 2017, it's a `163 billion (US\$2.5 billion) programme that aims to electrify every willing household by December 2018, prior to the next Indian general election¹³. As per Saubhagya portal of the Rural Electrification Corporation, out of 181 million rural households in the country, 142 million or 78 per cent rural households have been electrified (as on 16 January 2018)¹⁴. This leaves 39 million households unelectrified.

There has been recent focus on providing energy access to all households in the country in the past decade. In the Energy Development Index rankings of developing countries in 2002, India ranked 52 out of 75 countries,¹⁵

while in 2010, it jumped to 41 out of 80 countries¹⁶. Being a fast developing country, India realises the importance of Power sector as an enabler to achieve a holistic development. There is still a long way to go despite "100 per cent electrification" of the country. In Uttar Pradesh, Jharkhand, and Assam, fewer than 60 per cent of households have electricity, and in 12 out of the 29 states, fewer than 80 per cent of the households have been electrified¹⁷.

Government policies and initiatives are not limited to access of grid electricity alone. Over the last few years, it has recognized the significant potential of renewable energy sources to provide off-grid energy, given the limitations of the existing grid system. It takes much time and substantial effort and expenditure to take the grid to the remote parts of the country. The Government has launched policies and programmes to boost off-grid Decentralized Renewable Energy (DRE) enterprises, solar energy enterprises, and policies to encourage access to clean cooking technology in rural households.

Some of these major national policies have been summarised below, in order of decreasing impact:

“

An estimated 780 million people still rely on biomass for cooking in India, which is extremely unhealthy.”

6 'Power Sector at a Glance ALL INDIA', Ministry of Power, Govt of India

7 'Power Sector at a Glance ALL INDIA', Ministry of Power, Govt of India

8 'Alternate Power Planning', Prayas, 2007

9 'Evaluation of The Scheme-RGGVY', data.gov.in

10 'Modi Announces 100% Electrification – But That Doesn't Mean Everyone Has Power', The Wire, 2018

11 DDUGJY website, Govt of India

12 DDUGJY website, Govt of India

13 'Energy Access to Millions in India by 2018', NRDC, 2017

14 'An Overview of India's Economic Performance in 2017-18', Govt of India

15 'Energy and Development', World Energy Outlook, 2004

16 'Energy and Environment: An Overview', TERI, 2015

17 'Modi Announces 100% Electrification – But That Doesn't Mean Everyone Has Power', The Wire, 2018

Table 1: Major national policies for alternative energy sources in India

Policy	Sector	Brief
Jawaharlal Nehru National Solar Mission (JNNSM)	Solar	The Ministry of New and Renewable Energy's (MNRE) flagship programme launched in 2010. Under the mission, the government seeks to increase the capacity of solar energy to 20000 MW by 2022, with 2000 MW off-grid, including solar home systems (SHS), solar pumps for irrigation and 20 million solar lighting systems ¹⁸ . The primary instrument of support is the subsidy provided on solar energy systems.
Pradhan Mantri Ujjwala Yojana (PMUY)	Clean Cooking	Launched in May 2016 by Ministry of Petroleum and Natural Gas (MoPNG), it aims to provide subsidized LPG connections to 80 million BPL households (increased from 50 million) by 2020 ¹⁹ . Against the first-year target of providing 15 million connections, PMUY has already provided 22 million connections in its first year and has helped LPG penetration to reach a national coverage of 70 per cent as of 2017 ²⁰ .
National Biogas and Manure Management Programme (NBMMP)²¹	Biogas/ Clean Cooking	First launched in 1981 and renamed in 2003, it offers Central Financial Assistance (CFA) for family-type biogas plants. Against an estimated potential of 12.3 million biogas plants across the country, as on 31 December 2016, only 4.9 million (40 per cent) have been constructed. An evaluation of 429 NBMMP systems across 13 states by the Comptroller and Auditor General of India (2015) revealed that only 74 per cent of installed plants were functioning.
Unnat Chulha Abhiyan²²	Clean Cooking	Launched in 2014 by MNRE with the aim of deploying 2.4 million household-level and 350,000 community-level improved cookstoves (ICS) by March 2017 with a `2.94 billion budget. However, only 1.3 percent of the target has been met by the programme completion date, with much of the budget having lapsed unutilised.
Draft National Energy Policy²³	All inclusive	Drafted by NITI Aayog and released for public consultation in 2017, it recognizes DRE solutions and biomass, with efficient cookstoves as supplementary options to grid extension and LPG provision. It also aims for full clean cooking coverage by 2022.

18 'State of the Indian Decentralised Renewable Energy Sector', USAID, CLEAN, Shakti, 2016-17

19 'An Overview of India's Economic Performance in 2017-18', Govt of India

20 FE Bureau, 2017; MoPNG, 2017a

21 'Access to Clean Cooking Energy in India', GIZ, 2017

22 'Access to Clean Cooking Energy in India', GIZ, 2017

23 'State of the Indian Decentralised Renewable Energy Sector', USAID, CLEAN, Shakti, 2016-17

Policy	Sector	Brief
Draft Mini Grid Policy	Renewable Energy (RE)	Through the draft policy, the MNRE has set a target of deploying at least 10,000 RE-based micro- and mini-grid projects across the country over a five-year period, with a minimum installed capacity of 500 MW ²⁴ .

Despite several initiatives and policies aiding access to clean cooking, an estimated 780 million people still rely on biomass for cooking in India; however, the share of population relying primarily on biomass for cooking has come down from 66 per cent in 2011 to 59 per cent in 2015²⁵. NITI Aayog's less pessimistic India Energy Security Scenario (IESS) predicts that 35 percent of rural households will still be reliant on biomass for cooking by 2032, and 20 per cent by 2047, and it also predicts that biomass will be mostly used in improved cookstoves²⁶.

MECHANISMS FOR ENERGY ACCESS IN INDIA

In addition to the challenge of ensuring access to all households in the 'grid-ified' villages, most rural areas with access to grid also face issues of reliability, availability, and quality of power supplied. Sometimes, the quality of suppliers may also not be good and the services may lack regular maintenance and timely crisis mitigation. These gaps can be addressed through off-grid, decentralised, renewable sources of energy. The Government of India propagates three major clean energy solutions to plug the gaps of existing grid infrastructure²⁷:

1. Grid Connected Power (alternate to existing grid) such as wind power, bio-power, small hydro power, and solar power.

2. Off-Grid Power such as biomass-based heat and power projects, waste-to-energy projects, biomass gasifiers, watermills/micro hydro projects, small wind energy and hybrid systems, and solar photovoltaic (PV) rooftop systems.

3. Decentralized systems such as family-size biogas plants, solar street lighting systems, solar lanterns and solar home lighting systems, solar water heating systems, solar cookers, standalone solar/biomass-based power generators and wind pumps.

The decentralized, off-grid energy enterprises, provide RE-based solutions that can operate independently or in conjunction with the grid. These enterprises supply Renewable Energy (RE) services to rural 'Bottom-of-the-Pyramid' (BoP) consumers through existing grids or company-owned distribution systems²⁸. Based on factors such as product categories, service models, and the types of organisation, they can be differentiated across categories.

Based on the product categories, they are spread majorly across three verticals:

²⁴ 'State of the Indian Decentralised Renewable Energy Sector', USAID, CLEAN, Shakti, 2016-17

²⁵ 'Energy Access Outlook', International Energy Agency, 2017

²⁶ 'Access to Clean Cooking Energy in India', GIZ, 2017

²⁷ 'Role of Finance in enhancing clean energy access', WWF, 2015

²⁸ 'Role of Finance in enhancing clean energy access', WWF, 2015

Table 2: Major product categories of DRE enterprises²⁹

Category	What are they	Impact	Market potential	Major Examples
Solar Home Systems (SHS)	Solar-based electricity-generating and storage systems	Provide cheap, efficient, and seamless electricity by replacing or in absence of main grid	Estimated potential market value for India's rural BoP segment is 1.26 billion per year	Boond, SIMPA
Solar Lanterns	Portable lamps (CFL/LED) that are powered by solar panels and can provide light for 4-8 hours	Replace polluting and inefficient kerosene lanterns and supply basic lighting for BoP households	Worth Rupee 855 million per year	SELCO, Onergy
Energy-efficient Cookstoves or Improved Cookstoves (ICS)	Fixed or portable cookstoves that burn solid-biomass cooking fuels 20-65 per cent more efficiently than traditional stoves	Replace traditional polluting stoves that cause indoor air pollution and enhance risk of respiratory problems in women and children	Worth ` 1.11 billion per year	Grameen Greenway, Envirofit, Samuchit

In terms of **business or service models**, most of the DREs in solar lighting are system integrators, and their payment mechanisms may fall under a spectrum ranging from individual loans, group loans to Self-Help Groups (SHGs), and subsidies routed through banks to pay-as-you-go models³⁰. Majority of DRE enterprises in clean cooking are either in manufacturing or distribution of ICS or in both. Many enterprises provide integrated end-to-end services to their customers. At the same time, there are enterprises that operate in individual services like sourcing, selling, or financial inclusion. Several organizations work on the periphery of the sector and provide support by creating an ecosystem by working on inter-capacity building, awareness building, consultancy, policy-making, and skill development.

In addition to for-profit enterprises, a variety of other **types of organisations** also operate in the domain. The sector represents a mix of philanthropic non-profit models (foundations, NGOs) as well as business entities (service providers, startups with technological and business model innovation). In the past, the foundations have outnumbered the enterprises, but, over the years, the proportion has shifted from non-profits to for-profits, predominantly due to government incentives for enterprises and reduced capital expenditure in the sector. For instance, post-National Solar Mission of 2010

which provided subsidies on solar systems, a number of local entrepreneurs have emerged to ride on the benefits provided by the policy. Many of them began to provide community-based solar lighting services but with time, household level electricity providers, including rooftop providers, SHS, and solar irrigation pumps have also grown in number.

According to one source among respondents, the total number of enterprises that would come under the umbrella of A2E in India could be somewhere around 500. These would include enterprises providing end-to-end services, individual services, and peripheral services across all product categories. The Clean Energy Access Network (CLEAN), a consortium of around 120 small and medium enterprises providing decentralized and off-grid RE solutions, is the largest network of A2E organizations in India.

There are only a handful of players in the sector who have succeeded in creating impact across large geographies, predominantly because the majority of enterprises are localised and take many years to expand and achieve impact. This can be attributed to the lack of ecosystem which could nurture startups. The key elements for a robust ecosystem in A2E are provided later in the report.

29 Adapted from 'Role of Finance in enhancing clean energy access', WWF, 2015
30 'Unlocking access to finance for decentralised energy solutions', CLEAN, 2015

CURRENT FUNDING AND INVESTMENT SCENARIO IN INDIA

Off-grid and decentralized energy enterprises require various kinds of capital such as grant, soft debt, impact equity, commercial equity, and affordable debt based on the stage of operation across the enterprise's overall lifecycle and the domain in which the enterprise is working.

Based on enterprise domain: Product or device manufacturers, assemblers, and distributors typically require short-to-medium term operating capital for R&D, sales, marketing, and distribution and working capital for inventory procurement, leasing, and purchase of assets/equipment³¹. Decentralized renewable energy micro/mini grid players additionally require long-term capital to finance construction, operations, and maintenance³². When analysed by category, the micro- and mini-grid players and clean cooking solution providers had a greater preference for long-term equipment financing in comparison to short-term working capital, while the standalone electricity system providers and

distributors of RE products were more interested in debt from the perspective of short-term working capital and facilitating end-user financing³³.

Based on enterprise life cycle: Mostly, enterprises require grant money at early stages till the stage when they could set up stable operating/business models. As they grow and require regular working capital, they often seek out debts and equity financing. As they scale up and expand, they can attract impact funds and venture capital money.

As a consequence of the requirement of so many financial instruments in the sector, a variety of financial institutions act as sources of capital. These include donors and foundations, multilateral financial institutions, impact investors, corporate investors, commercial banks, venture capital funds, and cleantech funds. Some examples of these investors/funders in the A2E space are as follows:

Table 3: Examples of sources of funds in Access to Energy in India and worldwide³⁴

Sources of Capital	Worldwide	India
Donors and Foundations	Shell Foundation, David & Packard Foundation, Opic, ODB, Lundin	Shell Foundation, Doen Foundation, IKEA Foundation, Rockefeller Foundation, Good Energies, UNDP, USAID
Multilateral/Development Financial Institutions	DFID, FMO, IFC, World Bank	SIDBI, World Bank, IFC, IDFC
Impact Investors	Acumen, responsAbility, Khosla Impact, Bamboo Finance, Energy Access Ventures, BMGF	Aavishkaar, Acumen, Insitor, Rianta Capital (Artha), LGT Impact, ICCO, Opes Fund, I3N

31 'Innovative Financing for Clean Energy Access in India', Shakti, Intellectap, n.d

32 'Innovative Financing for Clean Energy Access in India', Shakti, Intellectap, n.d

33 'State of the Indian Decentralised Renewable Energy Sector', USAID, CLEAN, Shakti, 2016-17

34 Compiled from 'Off-grid Solar Market trends report 2016, Bloomberg, and several sources in primary data collection.

Sources of Capital

Worldwide

India

Corporate Investors

Schneider, Solar City, Engie, Orange, Total

Tata Steel, ONGC, NMDC, Infosys, HDFC Bank, Axis Bank, Cairn Foundation

Commercial Banks

Deutsche Bank, Nexus, Fidelity Growth Partners, CBA, DFJ, Mahindra, Zouk, Barclays

Axis Bank, Canara Bank, ICICI Bank, RBL Bank, Yes Bank

Cleantech Funds

PowerShares, Guggenheim, Asia Cleantech Capital

Infuse Ventures, Tata Cleantech

Other sources of capital would include non-banking financial companies (NBFC), regional rural banks (RRB), exim banks, venture debt sources (such as Intellectap), high-net-worth Individuals (HNI) and blended finance facilities. Some of the major financing mechanisms, with sources of capital, salient features, and examples of enterprises benefitting from them, are given below:

Table 4: Different financing mechanisms in Access to Energy in India, and their characteristics³⁵

Financing Mechanisms	Sources of Capital	Salient features	End uses	Examples of enterprises
Grants	Government, Foundations, Donors, CSR Funds, Multilateral/Development Financial Institutions, competitions	Tenure: No tenure RA*: High RE*: Zero	<ul style="list-style-type: none"> • Capital Expenditure • Working Capital • End Consumer Finance 	Mera Gaon Power, Mlinda, Gautam Polymers, Greenway Grameen, Desi Power
Short-term Debts	RRBs, NBFCs, Indian DFIs, Micro Finance Institutions (MFIs), Venture Debt sources	Tenure: six months - five years RA: Low RE: 12-20 per cent	<ul style="list-style-type: none"> • End Consumer Finance • Working Capital • Equipment Finance • Capital Expenditures 	Boond, Orb Energy
Long-term Debts	Commercial Banks, Exim Banks, International DFIs, Indian DFIs	Tenure: 7-18 years RA: Low RE: 4-16 per cent	<ul style="list-style-type: none"> • Equipment Finance • Capital Expenditures 	Onergy, Mukti Solar Energy

³⁵ Adapted from 'State of the Indian Decentralised Renewable Energy Sector', USAID, CLEAN, Shakti, 2016-17 and 'Unlocking Access to Finance for Decentralized Energy Solutions', CLEAN, 2015

Financing Mechanisms	Sources of Capital	Salient features	End uses	Examples of enterprises
Impact Capital	Impact Investors, International DFIs, HNIs, Blended Finance Facilities	Tenure: 4-10 years RA: Medium and High RE: 5-35 percent	<ul style="list-style-type: none"> • Capital Expenditure • Working Capital • End Consumer Finance 	Mera Gaon Power, Van Vidyut Power, Boond, SIMPA
Commercial Equity	Private Equity & VC Funds, HNIs	Tenure: >5 years RA: Medium RE: 15-35 per cent	<ul style="list-style-type: none"> • Capital Expenditure • Working Capital 	Greenway Grameen, Promethean, Anthropower

*RA: Risk Appetite; RE: Return Expectation

MAJOR TRENDS IN CAPITAL DEPLOYED

1. Only 40 per cent of available capital has been deployed (US\$ 77 million) during 2013-16 due to lack of sustainable business models and new players; US\$ 110 million continues to be available in 2017³⁶. However, there has been a 100 per cent increase in available capital from FY 2013 to reach US\$ 151 million in FY 2017 due to a catalytic push from industry dialogues.

Available capital across DRE segments is as follows (in US\$ million): Micro/Mini grids – 81; SHS and Solar lighting – 35; Solar Pumps – 19; Biomass Cookstoves – 9; Pico Grids – 7.

2. Majority of investments have been in the solar sector, especially post-National Solar Mission. Investments in clean cooking enterprises are not very lucrative because of lower financial returns.

3. The proportion of international foundations and donors is high compared to indigenous ones, attributable to Indian funders' risk-averse approach and international funders' proactive approach to exploit the huge growth potential in India.

4. Barring long-term debt, all other types of financing are being used for working capital, indicative of the high demand for such capital³⁷.

5. Indian lenders are not comfortable in lending short-term and long-term debts because of risks associated with getting returns. As a consequence, most of the

money in the sector are grants, either supported by or coming through impact funds.

6. Various DRE categories present different gaps and investment trajectories³⁸:

a. SHS: Commercial banks show interest mainly in firms offering innovative payment options to customers, such as the pay-as-you-go model. Most equity investors, who had earlier taken bets, are apprehensive about committing more capital, as they do not see their earlier investments performing as envisioned.

b. Solar Lighting: Investors perceive solar lanterns segment to have matured and believe channel finance and end-user financing are its key drivers. Available funds have been insufficient to meet bridge finance and working capital needs.

c. Solar Pumps: Considerable traction in the past two years via capital commitments from several DFIs, NBFCs, and commercial banks due to government's backing is seen, though the quantum is limited, relative to the total requirement.

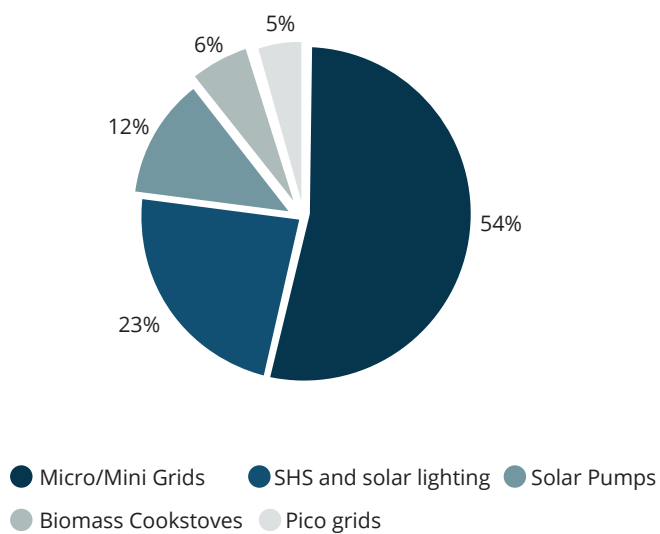
d. Biomass Cookstoves: Perceived to be of high risk by the investors – primarily debt providers – due to lack of sustained demand and insufficient consumer financing. Distributors operating in the sector are not able to attract funding due to the limited ability to offer guarantee/collateral.

³⁶ 'Evaluating Investment - Polity Interaction: DRE - based Energy Access in India', unpublished report by cKinetics and Shakti

³⁷ 'State of the Indian Decentralised Renewable Energy Sector', USAID, CLEAN, Shakti, 2016-17

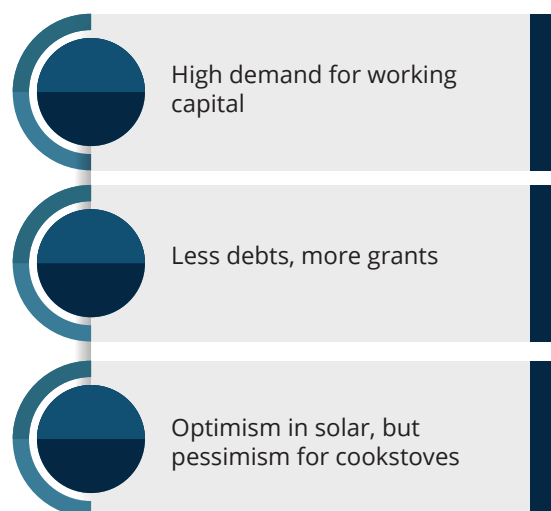
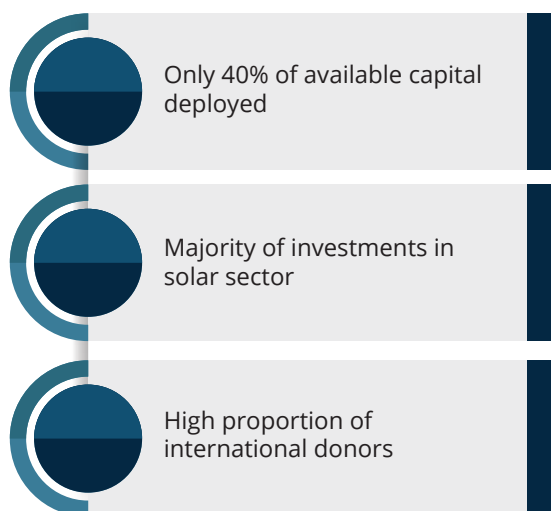
³⁸ 'Evaluating Investment - Polity Interaction: DRE - based Energy Access in India', unpublished report by cKinetics and Shakti

Available Capital in DRE Segment in India FY 2017 (in US\$ million)



DRE segment	Available Capital
Micro/Mini Grids	81
SHS and Solar Lighting	35
Solar Pumps	19
Biomass Cookstoves	9
Pico Grids	7

MAJOR TRENDS IN CAPITAL DEPLOYED



CASE STUDIES

Variety of financing mechanisms through different sources of capital in Access to Energy in India

Low Interest loans: Rockefeller Foundation³⁹

Considering the high capital costs of mini grids and associated risks, an initiative anchored by the Rockefeller Foundation, named Smart Power for Environmentally Sound Economic Development (SPEED) develops a portfolio/bundle of investment-ready mini-grid projects, which can then disperse the risks associated with single investments. Enterprises that are a part of the SPEED programme have revealed that it offers low-interest loans at five per cent interest rate with a tenure of seven years. The Rockefeller Foundation has instituted a new organisation, 'Smart Power India,' which will provide access to electricity to more than one million Indians in rural areas across 1,000 selected villages in India.

Venture fund: Sangam Ventures⁴⁰

Backed by the Shell Foundation, Sangam Ventures is a venture capital fund tailored for early-stage energy enterprises that improve access to sustainable energy and increase resource productivity. It has invested in Promethean Power Systems, Excellent Renewables, and AnthroPower.

Impact fund: Villgro⁴¹

India experiences over 30 per cent wastage of perishable agricultural products due to lack of efficient, affordable, and reliable storage capacities. It requires around 10 million tons of cold storage capacity. To fulfil the huge gap, Ecozen Solutions has come up with solar-powered cold storage systems designed specifically for the rural population. These systems can be run without grid electricity.

Villgro incubated the enterprise and provided seed funding to Ecozen in 2013 for product design and development and identifying potential customer segments. In 2015, the enterprise installed its first product and acquired its initial customers before raising a Series A investment of ₹ 62 million from Omnivore. Villgro made a successful exit in the investment round and its stake was bought by Omnivore.

39 'Innovative Financing for Clean Energy Access in India', Shakti, Intellectap, n.d

40 'Unlocking access to finance for decentralized energy solutions', CLEAN, 2015

41 Source: Villgro

ENTREPRENEURS - CHALLENGES IN FUNDING

1. The biggest challenges that entrepreneurs face in A2E are not very different from those faced by social entrepreneurs. Small and local entrepreneurs coming from remote rural areas don't get access to funding easily due to lack of awareness and exposure, and inclination of investing/funding institutions towards urban entrepreneurs with better communication and presentation skills.

Many of these entrepreneurs also don't have collateral to offer and can't afford high interest rates and hence fail to get debt financing. They also struggle to benefit from popular loan schemes from Mudra and NABARD since most of them don't have Cibil ratings.

2. Track record comes up as a key criterion for financing, particularly in the case of debt. This is also highlighted in the financier insights from the CLEAN study⁴², where track record was referred to in terms of implementation experience of the enterprise and the existence of a substantial number of operational systems on the ground⁴³.

3. Use of overdrafts and loans from NBFCs was widely reported, indicating poor accessibility to cheaper, longer-term sources of financing and reliance on channels with higher interest rates. While International lenders such as export credit agencies (ECA) and development banks are large potential funding sources, their stringent due diligence requirements prevent less 'sophisticated' enterprises from accessing these sources⁴⁴.

4. Inability of off-grid enterprises to access affordable debt through traditional routes highlights the need for alternate financing facilities⁴⁵. Several multilateral organizations, DFIs, and foundations are supporting such financing facilities. They can provide low-cost capital since they have access to large corporates, philanthropic funds for social causes, and no compulsory mandates for creating high profits for their entities. Some of these alternate financing structures are⁴⁶:

- a. Enhanced Credit Facility
- b. Blended debt fund with flexible repayment terms
- c. Decentralised rural electrification bonds
- d. Social impact bonds
- e. Guarantee- and asset-backed securitisation
- f. Asset lease financing
- g. Peer-to-peer-lending

5. Out of these alternate structures, asset lease financing and peer-to-peer-lending rank higher than others in ease of implementation. Enhanced credit facility and blended debt funds have better potential of scalability⁴⁷.

FOR INVESTORS AND FUNDERS

CHALLENGES AND RISKS FOR INVESTORS AND FUNDERS

Here are some of the most salient challenges which investors and funders face or could face while investing in this sector. These have been compiled from both primary and secondary research, and have been sequenced keeping in mind the frequency of data, i.e, the most commonly identified challenges across all sources are mentioned first.

1. Inherent challenges of the sector:

Any investment is high risk in this sector due to its inherent challenges. The energy-deficient geographies in India lie scattered and often located in difficult terrains. Establishing mini-grids, SHSs, and ICSs in these difficult-to-reach regions requires high operational and maintenance costs and high risk of power failures. Assets are difficult to monitor; overhead costs are high; revenues are minuscule if rural consumers are the customers them

selves. Due to the combined effect of all these factors, the uncertain success of DRE enterprises adds to the pessimism of investors. The financial returns in investments in the sector are not lucrative. Even though returns from impact capital and commercial equity can go as high as 35 per cent, those are exceptional cases. On an average, returns on investment in A2E sector range from anywhere between 0 to 10 per cent with a 10 per cent return considered significantly good. Profitable exits in the sector are extremely rare.

42 State of the Indian Decentralised Renewable Energy Sector', USAID, CLEAN, Shakti, 2016-17

43 State of the Indian Decentralised Renewable Energy Sector', USAID, CLEAN, Shakti, 2016-17

44 State of the Indian Decentralised Renewable Energy Sector', USAID, CLEAN, Shakti, 2016-17

45 'Alternate Financing Facility for Energy Access in India', Shakti, Intellectap, n.d

46 'Alternate Financing Facility for Energy Access in India', Shakti, Intellectap, n.d

47 'Alternate Financing Facility for Energy Access in India', Shakti, Intellectap, n.d

2. Uncertain policy environment:

Policy environment in the sector is ambiguous and makes the investors hesitant to pursue its opportunities. It's difficult to make long-term bets. Sudden policy announcements on national grids, off-grid, solar and clean cooking ecosystem can change the business potential of the sector. The national grid is also seen as competition to off-grid DRE enterprises. There is no clarity on the possibilities of parallel distribution and simultaneous presence of off-grid measures in areas where the grid has reached all households. The common understanding is that, if the government does well in energy access through its national grid, the demand for alternate sources will come down; hence the conundrum. Different states have independent policies for DREs; that leads to some states becoming more favourable for business. Enterprises and investors tend to cluster in those states.

3. Challenges with financial mechanisms:

Different financial mechanisms for investing in and funding of DREs have their own variegated risks. Two significant risks are involved in the case of equity – not receiving expected financial returns and failure to make a successful exit. In the case of debts, there is the risk of losing the principal amount, owing to the background of recipients who are mostly rural entrepreneurs with little or no collateral. In the case of donors, ensuring impact and adherence to their mandate is the biggest challenge.

4. Mission Drift:

Several investors and enterprises diverge from their original mission during their journeys by shifting focus to get quick business opportunities in different markets. For example, several solar service providers in remote villages tend to shift their markets to urban areas to exploit their reliable revenue sources and the possibility of upside. However, while doing that, their activities fall out of the purview of Access to Energy since they are no longer providing energy to energy-deficient areas.

5. Lack of understanding and expectation setting between investors and entrepreneurs⁴⁸:

Long-tenure debt is difficult to access; enterprises need to rely on expensive, short-term debt with high expectations of returns. Investors often fail to understand the requirements of entrepreneurs in the sector. At the same time, entrepreneurs are also often unrealistic in communicating their goals and estimates. Divergent views and expectations on scaling up of startups; misleading Internal Rate of Return (IRR); high costs of raising capital due to extensive due diligence; focus on results instead of processes; and the constant conflict between ensuring impact and ensuring revenues are some of the major points of disagreement between entrepreneurs and investors.

6. Early Mover Risks:

Investors and end consumers can be bullish when it comes to using renewable energy sources because of the strong prevailing perception that these sources are makeshift arrangements till the national grid reaches each household. That prevents investors from actively seeking investment opportunities in the sector.

7. Less lucrative Clean Cooking segment:

Investors are not particularly inclined towards clean cooking enterprises as smokeless ICSs don't give excellent economic returns. At the same time, ICSs have failed to capture and align with the cooking habits of rural India. Most of the end consumers complain about bad user experience, resulting in non-retention of customers and failure to scale up as enterprises.



ENTREPRENEUR CHALLENGES

- Lack of exposure to funding opportunities
- Lack of successful track record to attract funding
- Poor accessibility to low interest, long term sources of financing
- Inability to access affordable debt
- Lack of alternate financing structures

INVESTORS' AND FUNDERS' CHALLENGES

- Difficult terrains impede infrastructure development
- Uncertain policy environment
- Uncertainty of financial returns and impact created
- Mission drift towards more profitable domains
- Mismatched understanding and expectations from entrepreneurs
- Early mover risks

OPPORTUNITIES AND WAY AHEAD FOR INVESTORS AND FUNDERS

Here are some of the opportunities and gaps which investors and funders can identify to leverage, or should keep in consideration, if they wish to invest in this sector. These have been compiled from both primary and secondary research, and have been sequenced keeping in mind the frequency of data, i.e, the most commonly identified opportunities across all sources are mentioned first.

1. Natural demand:

The volume of potential demand – arising from the size of India's population who have no access to clean and efficient energy – is the biggest natural incentive to enter the sector.

2. Debt and equity deficit⁴⁹:

There are significant gaps between the availability and need for both debt and equity in the financing of DRE enterprises. The debt mismatch on an annual basis in India can range between Rs. 0.3-4.1 billion. At the same time, the equity gap ranges between Rs. 1.7-8.13 billion.

3. Patient Capital:

Investor expectations, which include high financial returns at market rates and rapid impact, are often unrealistic. However, the sector is tough to invest in and has its own set of challenges and uncertainties. Hence, it calls for 'patient capital' – wherein one invests money into enterprises, acts as a strategic partner with them, helps build the ecosystem, enables the rural consumers to be partners and asset owners, and allow for the impact to grow over time.

4. Gaps in product and service efficiency:

There is a huge potential to exploit gaps in last mile connectivity, system integrators, and efficient appliances. All these three areas in energy access are waiting for more enterprises to take up the challenges. There is a need to identify and nurture enterprises to fulfil these gaps.

5. Enterprise-friendly state policies:

Several state governments, like Chhattisgarh, Jharkhand, and Uttar Pradesh, have come up, or are in the process of coming up, with enterprise-friendly policies in mini-grids and DREs. That is likely to increase the number of enterprises in these regions.

a. Uttar Pradesh Mini-Grid Policy 2016:

To install mini-grids through multiple RE sources in un-electrified areas (mostly rural) with no access to the national grid or in areas with low levels of electricity supply⁵⁰.

b. Mini-Grid Policy 2018 for Jharkhand:

Draft policy prepared by Centre for Environment and Energy Development (CEED) and Jharkhand Renewable Energy Development Agency (JREDA), it aims to provide electricity to 55 per cent households in the state without energy access through RE sources⁵¹.

c. Chhattisgarh government:

With significant investments in solar power generation and solar pumps, Chhattisgarh is also planning to add 2640 MW of additional renewable energy capacity by financial year 2018-19⁵².

6. Emphasizing and Measuring Impact:

Investors with impact focus can cover up for the lacklustre financial returns by ensuring social return. Returns on investments have been generally high when measured in terms of impact on the lives of people and energy reach.

7. Innovative payment mechanisms:

Several startups are coming up with business model innovations, i.e. innovations in the supply chain models and distribution mechanisms. Companies like SELCO and SIMPA are also trying various innovative payment mechanisms which include mobile money, aggregating small borrowings into group loans, pay-as-you-go models, monthly instalments, etc⁵³. These models enable individual customers avoid the hassles of obtaining loans from banks and micro-finance Institutions. Such models have been extremely popular in African markets and are slowly seeing an uptake in India. Investors can look out for enterprises with these models.

8. Complementary Co-existence:

The perception that grid and off-grid electricity mechanisms are in direct competition can be changed. A more efficient and penetrating grid can result in reduction in demand of RE sources. However, RE systems can significantly reduce the excessive load on the grid if deployed as a part of the policy that permits conflict-less co-existence of both delivery models. Better intent, clarity, and support from the government on the complementary co-existence of grid and off-grid mechanisms would be beneficial.

49 'State of the Indian Decentralised Renewable Energy Sector', USAID, CLEAN, Shakti, 2016-17

50 Uttar Pradesh Mini Grid Policy.

51 'Mini grid solution to rural power crisis', The Times of India, 2018

52 'Chhattisgarh Renewable Energy Development Agency (CREDA) to Install Solar Power Plants in 6 Bastar Districts', Sustainability Outlook, 2017

53 'Building market for off-grid solar lighting', IISD, 2017

9. Risk Mitigation through Financial Innovation:

Several institutions are apprehensive about financial risks involved in investing in the sector. Several ways can be proposed to mitigate these risks and alleviate, to some extent, financial setbacks to these institutions.

a. Risk mitigants such as a first-loss guarantee. It works best when housed within a financing institution that brings core expertise in evaluating off-grid enterprises⁵⁴.

b. Mitigating risk by having intermediaries to provide appropriate capital plus technical expertise and business skills support to early-stage energy enterprises with different risk profiles. One example is Factor (E), a venture development firm that offsets 'technology risk' by supporting early-stage energy innovators with a blend of risk capital and world-class engineering support from the Colorado State University⁵⁵.

c. For institutions providing debt funding, the cash flow risk can be mitigated if the business models are dependent on local enterprises serving as captive consumers which can ensure operational expenses and interest payments⁵⁶.

d. The concept of bonds can be extended to the renewable energy market, in which banks can create an opportunity for common people to invest in renewable energy⁵⁷.

e. Carbon credits can be monetized to mitigate financial risks and the money can be used to enhance respective clean energy programmes. Banks such as Grameen Bank of Aryavrat, Bank of India, and MFIs such as Muthoot and Fullerton have been using carbon credits to improve their clean energy programmes⁵⁸.

10. A shift to private-public partnerships⁵⁹:

The evolution of different types of partnerships between development agencies and foundations can be explored. Such partnerships can leverage private sector's higher ability to innovate and the public sector's capacity to validate new markets.

11. Creating a robust ecosystem:

SELCO Foundation has defined five key gap areas that have contributed to a weak ecosystem for nurturing startups in the A2E sector: Access to technology and design, access to finance, lack of capacity building and skill development, non-inclusive policy making, and lack of supply chain models and market linkages⁶⁰. In remote areas, where the ecosystem doesn't exist due to absence of any or all of the above factors, the enterprises need to apply additional resources and finances to fill the gaps of the ecosystem before they can provide the services.

54 'Alternate Financing Facility for Energy Access in India', Shakti, Intellectap, n.d

55 'Accelerating Access to Energy', Shell Foundation, 2014

56 'Imperatives of Scaling up Off-Grid Renewable Energy in India', Yes Bank, 2015

57 'Imperatives of Scaling up Off-Grid Renewable Energy in India', Yes Bank, 2015

58 'Building market for off-grid solar lighting', IISD, 2017

59 'Accelerating Access to Energy', Shell Foundation, 2014

60 Source: SELCO Foundation

CASE STUDY

Ecosystem Development: SELCO Foundation⁶¹

SELCO, established in 1993 and now the leading organization in India providing access to energy through solar products and services, concluded a decade ago that the most effective way to catalyse broader adoption of solar products was to cultivate a conducive market environment with five key ecosystem conditions: financial inclusion (access to funding), human resource development (local talent), inclusive policies (government support), market linkages (local suppliers), and technology and design (products that meet customer needs).

SELCO built partnerships to support each of these key areas and focused on the state of Karnataka which has more infrastructure in place with less staggering levels of poverty than many northern Indian states. Having established its model in Karnataka over the last five years, SELCO Foundation, along with Tata Trusts, is now focused on rolling out its ecosystem approach in the North-East states, which are far more rugged and underdeveloped and lacking the same infrastructure as in Karnataka. Both organizations are working together to build a holistic ecosystem for the dissemination of RE solutions to underserved communities in the North-East under their 'Sustainable Energy Ecosystem Development' (SEED) Programme. The key activities under this programme include:

1. Appropriate human resource development at various levels.
2. Incubation of local entrepreneurs and enterprises.
3. Unlocking local finance for clean energy solutions.

As indicated above, asset-based financing for the poor is a key piece to initiate, sustain, and replicate sustainable energy solutions across the underserved communities. To give an impetus to such financing, Tata Trusts, in partnership with SELCO Foundation, has initiated a revolving fund to catalyse local capital by engaging financial institutions (banks and MFIs) in Manipur. This will be managed by the Centre for Microfinance and Livelihood (CML). The focus of the programme is to unlock capital for:

1. High quality decentralized solar-powered lighting systems with long-term doorstep servicing for rural households.
2. Solar-powered, livelihood-driven solutions for entrepreneurs, self-help groups, and cooperatives (e.g. solar sewing machines, rice hullers, feed grinders etc.).

61 Source: SELCO Foundation



SUSTAINABLE MOBILITY



INTRODUCTION

About 54 per cent¹ of the world's population lives in urban areas and are responsible for 70 per cent of global carbon dioxide emissions, according to United Nations Development Program (UNDP)². By 2030, passenger traffic is expected to exceed 80,000 billion passenger-kilometres, a 50 per cent increase from current levels³. Globally, the number of vehicles on the road is expected to double by 2050⁴, and freight movement could also rise more than threefold during the same period⁵.

These numbers indicate that with the accelerating growth of developing countries, the number of cities and their populations are growing rapidly. This growth is exerting excessive pressure on cities to sustain themselves economically, socially, and environmentally. As increasingly people 'move' within and across the cities, the phenomenon of 'mobility' has become an integral part of the dynamics of urbanisation. Today, transportation is the largest end-user of energy in developed countries and the fastest growing in most developing countries⁶, where billions of people are having higher lifestyle expectations and new mobility aspirations⁷.

However, lack of vision and long-term planning for implementing efficient urban mobility policies and interventions, and failure to establish proper transport

systems in the cities have led to a significant amount of transportation problems with critical impact. Wide-spread congestion and traffic gridlock have now become the norm in many cities, impacting urban life through negative externalities such as pollution, massive emissions of greenhouse gases, stress from noise pollution, and accidents⁸. An overwhelming majority of vehicles across the world still use internal combustion engines (ICE) which run on fossil fuels contributing nearly one-fourth of all greenhouse emissions in the world⁹. Not merely vehicular pollution, the indirect damage the society suffers because of the fractured mobility systems through congestion, traffic gridlocks, driver and passenger stress, and other deleterious effects cost the world economy \$2 trillion annually¹⁰.

While 'mobility' is easily defined as the movement of goods and people from one place to another, we asked our respondents how they would define 'sustainable mobility'. From the common responses it was evident that Sustainable Mobility could be defined as a set of solutions that help movement of large numbers of people in urban areas, or, a set of activities which would ensure that mobility is achieved through sustainable means keeping in mind economic, social, and environmental welfare of urban population.

“

By 2030, passenger traffic is expected to exceed 80,000 billion passenger-kilometres, a 50 per cent increase from current levels”

1 'The World Urban Population - Infographics', Urbanet, 2016

2 'Sustainable cities and transport', UNDP

3 'Sustainable Mobility for the 21st Century', World Bank, 2017

4 'Sustainable Mobility for the 21st Century', World Bank, 2017

5 'Mobility', UN Habitat

6 'Sustainable Transport', Sustainable Development Knowledge Program, United Nations

7 'Sustainable Mobility for the 21st Century', World Bank, 2017

8 'Mobility', UN Habitat

9 'Sustainable cities and transport', UNDP

10 'Transformative Mobility Solutions for India', Niti Aayog, n.d

The world is finding the inability of the mobility sector to adopt 'sustainable' mode of operations as its default quite alarming. The international community adopted the New Urban Agenda at the Habitat III Conference in Quito, Ecuador, which outlined the importance and imperative of improving the sustainability of transport systems to mitigate the challenges of rapid urbanization¹¹. As a part of his five-year Action Agenda, announced in January 2012, the UN Secretary General identified transport as a major component of sustainable development¹². This was a significant step forward in promoting sustainable transport worldwide. Transport is a critical enabler of economic and social development necessary to reach the SDGs on energy, sustainable cities and communities, and building resilient infrastructure¹³.

Many cities and countries have made significant progress in sustainable mobility. Some of the examples are given below¹⁴:

Austin, Texas:	Mobility transformation
Curitiba, Brazil:	World's first BRT
Tokyo, Japan:	Robot Taxi Autonomous Vehicles
Munich, Germany:	Purpose Design Vehicles.
France, Norway:	Leaders in EV deployment in fleet vehicles and buses
Portland, Oregon:	Smart-growth city

There is a tremendous upsurge in the Electric Vehicles (EV) market in the world with several Original Equipment Manufacturers (OEM) of automobiles shifting their manufacturing priorities to Hybrid Electric Vehicles (HEV), Plug-In Hybrid Electric Vehicles (PHEV) and Battery Electric Vehicles (BEV). The shift can be attributed to the growing consensus on reducing greenhouse gas emission from automobiles running on fossil fuels. While HEVs and PHEVs are likely to be key technologies adopted in the European Union (EU), the Chinese government is also pushing vehicle electrification through robust policies. Full hybrid standardisation is also likely across automobile models in Japan by 2025¹⁵.

The global EV market grew over 15 times at a remarkable compound annual growth rate (CAGR) of 72.1 per cent from 2011 to 2017. Over 770,000 EVs were sold globally in 2016, of which 63.4 per cent were BEVs and 36.6 per cent PHEVs. The Chinese market alone grew by 85 per cent, with over 351,071 unit sales representing 45.4 per cent of the global EV market share¹⁶.

The market and cost efficiency of EVs depend significantly on battery costs and storage capacities. Currently, most of the batteries constitute lead acid but there is accelerating shift towards lithium-ion storage batteries which are cheaper and more efficient. Frost & Sullivan expects battery cost to drop rapidly and reach \$130-180/kWh levels by 2020, making it attractive for applications in emerging economies such as India and China¹⁷.

STATUS OF SUSTAINABLE MOBILITY IN INDIA

Among developing nations, India has one of the highest rates of urbanisation (31 per cent)¹⁸. With the number of cities expected to rise from 35 at present to 68, by 2030 about 40 per cent of Indian population is expected to live in urban areas¹⁹. Currently the fifth largest automobile market, the country is racing towards becoming the third largest market by 2020²⁰. To put it in perspective, the number of private vehicles has grown 2.7 times from 59 million to a staggering 160 million between 2002-2013²¹.

To compound the issue of high density of vehicular traffic in Indian cities, their urban public transport are not affordable and accessible to the majority of commuters. Although public transport is receiving more attention from the government over the past few years, the 'last-mile connectivity' is a major inconvenience and strain on the budgets of millions of daily commuters. Poor urban planning and lack of sustainable urban development are estimated to cause somewhere between 1-6 per cent loss in Indian GDP. Traffic fatalities cause more than 150,000 deaths annually, making this worse²².

11 'Sustainable Mobility for the 21st Century', World Bank, 2017

12 'Sustainable Transport', Sustainable Development Knowledge Program, United Nations

13 'Sustainable Mobility for the 21st Century', World Bank, 2017

14 'Transformative Mobility Solutions for India', Niti Aayog, n.d

15 'India's Tryst With Electric Vehicles – What Is At Stake?', Auto Tech Review, 2018

16 'India's Tryst With Electric Vehicles – What Is At Stake?', Auto Tech Review, 2018

17 'India's Tryst With Electric Vehicles – What Is At Stake?', Auto Tech Review, 2018

18 2001 Census of India

19 'Sustainable Cities', WRI India

20 'Karnataka govt approves electric vehicle policy to reduce dependency on fossil fuels', Livemint, 2017

21 'Transformative Mobility Solutions for India', Niti Aayog, n.d

22 'Transformative Mobility Solutions for India', Niti Aayog, n.d

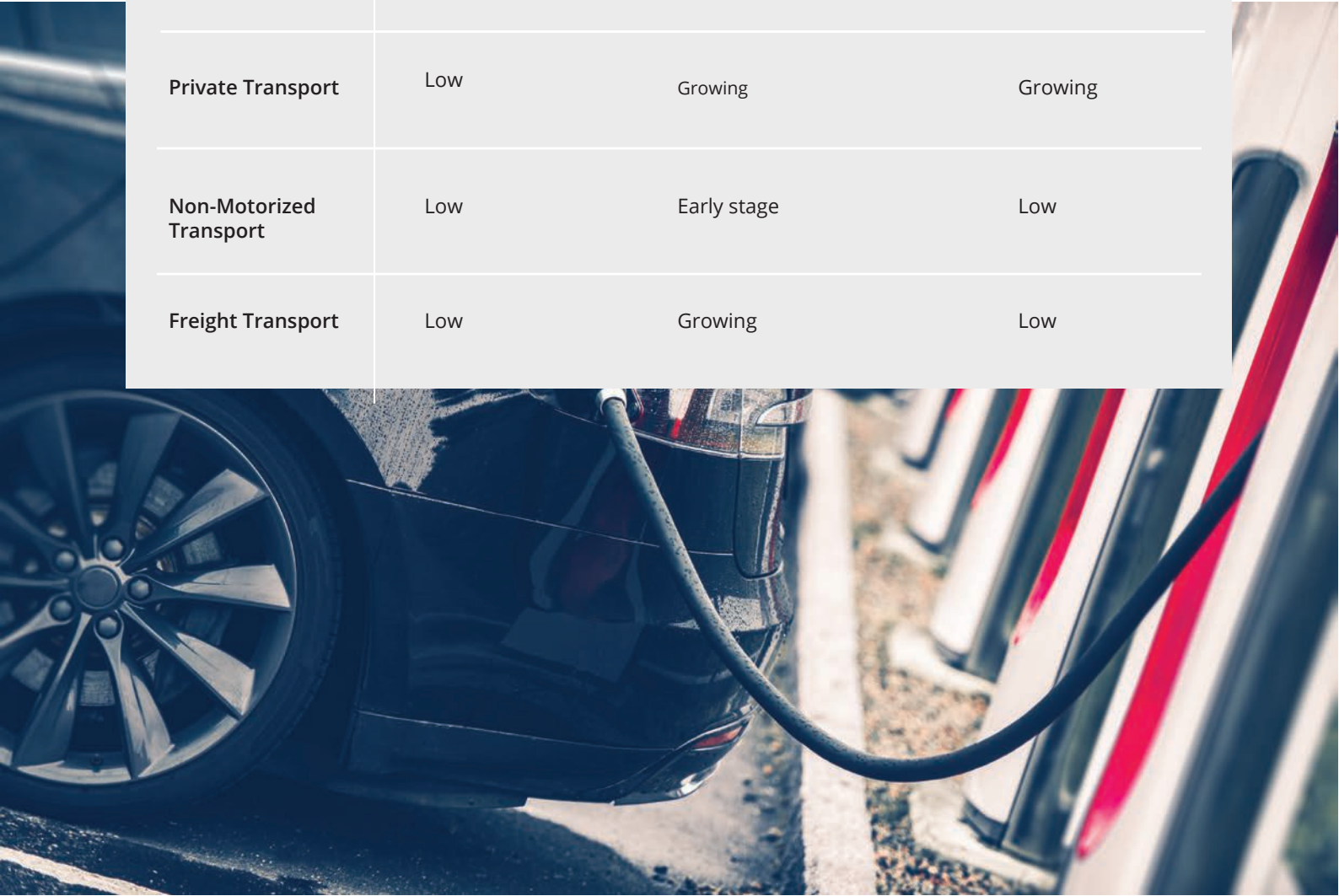
Mobility sector in India can be understood through following 5 categories. For the purpose of the study, we are excluding air and water transportation. We have also excluded Railways and Metro from the purview of public transport.

- 1. Public Transport : Includes railways, metro, buses.
- 2. Informal/Intermediate Public Transport: three-wheelers, taxis, rikshaws (vehicles doing last-mile transport)
- 3. Private Transport: cars and two-wheelers.
- 4. Non-Motorized Transport: bicycles, walking pedestrians.
- 5. Freight Transport: railways and trucks.

To study all these components of mobility through the lens of sustainable mobility, we explored them through three major areas of intervention - the frequency and impact of government initiatives and investments, the thrust for Electric Vehicles and the presence of for-profit enterprises working for sustainable mobility in each of them. The strength of these intervention areas in each of these mobility categories is shown below:

Table 5: Strength of intervention areas in mobility categories

	Government Initiatives	Presence of For Profit Enterprises	Thrust for Electric
Public Transport	High	Early Stage	Growing
Informal Public Transport	High	Early Stage	Growing
Private Transport	Low	Growing	Growing
Non-Motorized Transport	Low	Early stage	Low
Freight Transport	Low	Growing	Low



We will explore all these three intervention areas one by one.

GOVERNMENT POLICIES AND INITIATIVES

The government is investing heavily in building infrastructure for public transport. By 2030, India is expected to build 7,400 km of metros and subways²³. Recently, the majority of government initiatives have been directed towards pushing for EVs. Ambitious projects like Make in India, Digital India and Smart Cities Initiative are also expected to provide supporting environment in this direction.

1. ELECTRIFICATION OF ALL VEHICLES BY 2030²⁴

In 2017, the Indian government announced that it aims to become the first country of its size which will run 100% of electric vehicles. It announced 2030 as the year by which it planned to achieve its target. The government seemed to put the money where their mouth is, when the GST Council set a tax rate of 12% for electric vehicles, compared with 28% plus cess for petrol and diesel cars and hybrid vehicles.

For the time being, the government has backtracked on its process to have a dedicated EV policy and has pruned down its target to 30 per cent electrification by 2030²⁵. The policy framework was expected to address a number of issues involving infrastructure-creation for charging of vehicles and manufacturing of components for electric cars in the country. On 15th February 2018, Transport Minister Nitin Gadkari said that the government will come up with an action plan on EVs soon.

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2. NATIONAL ELECTRIC MOBILITY MISSION PLAN (NEMMP) 2020

The NEMMP was set up to encourage production of hybrid and electric vehicles in India, with a target of deploying 5 to 7 million electric vehicles in the country by 2020. With an emphasis on coordination between industry and academia, it aims to manufacture 400,000

passenger BEVs by 2020, thus saving 120 million barrels of oil and reducing emissions of 4 million tons of CO₂. The government is seeking investments of approx. US\$ 3 billion.

3. FAME INDIA SCHEME (FASTER ADOPTION AND MANUFACTURING OF HYBRID AND EV)²⁷

Government of India has notified FAME for implementation with effect from 1st April 2015, for supporting hybrid/electric vehicles market development and manufacturing ecosystem. Under FAME, subsidy is being given to 11 cities – Delhi, Ahmedabad, Bangalore, Jaipur, Mumbai, Lucknow, Hyderabad, Indore, Kolkata, Jammu and Guwahati (the last two under special category) – for

launching electric buses, taxis, and three-wheelers. The subsidy will be 60 per cent of the purchase cost of electric buses, Rs 1.24 lakh for electric four-wheelers, and Rs 61,000 for electric three-wheelers²⁸, for a total of 390 buses, 370 car taxis, and 720 three-wheelers.

23 'Transformative Mobility Solutions for India', Niti Aayog, n.d

24 'The Indian government isn't ready to walk the talk on electric vehicles', Quartz India, 2018

25 'India Says Never Targeted 100% Electric Mobility By 2030, Scales Down Aim', Bloomberg Quint, 2018

26 'Electric Vehicles in India and its Impact on Grid', NSGM-PMU

27 'Electric Vehicles in India and its Impact on Grid', NSGM-PMU

28 'How Karnataka is Becoming The Centrepiece of India's Electric Vehicle Revolution', The Better India, 2018



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CASE STUDY

Karnataka Government's 'Electric Vehicle and Energy Storage Policy 2017'²⁹

Policy: Through the biggest policy in EVs by a state government in India, Karnataka aims to attract investments worth Rs 31,000 crore and create around 55,000 employment opportunities into EV manufacturing. The key provisions include the development of manufacturing zones with readymade infrastructural capabilities, establishment of charging infrastructure with the aid of private investment, exemption from taxes on all-electric transport and non-transport vehicles including e-rickshaws and e-carts, and subsidise the use of charging and battery swapping stations, among others. The government will offer a capital subsidy of 25% on equipment / machinery subject to a maximum of Rs 10,00,000 per station for the first 100 fast charging stations in the state. Similar provisions are in place for battery switching/swapping stations.

Impact: Barely months after the State government released its policy document, the Bangalore Electric Supply Company (BESCOM) set up the first public electric vehicle charging station in Bengaluru (India's first fast-charging EV station). For a nominal fee, citizens can access this charging station based out of its KR Circle office. The power distributions company is looking to open 11 more charging stations across the city within three months.

THRUST FOR ELECTRIC

Majority of EV market in India consists of two-wheelers, with the remaining made up of cars, three-wheelers, e-rickshaws and buses. The number of collective EVs on Indian roads across different categories are as follows³⁰:

Two-wheelers:	650000+
Three-wheelers:	250000+
Private vehicles:	4400+
Buses:	25+

However, the EV market in India is currently at a very nascent stage with total EV penetration accounting for less than one per cent of the new vehicle sales³¹.

Given below are some examples of startups and corporates that have ventured into EV manufacturing and business across different mobility categories.

1. PUBLIC TRANSPORT

Just a handful of corporate companies have ventured into electric buses, with Ashok Leyland leading the way by launching its electric bus in October 2016³². It has collaborated with Sun Mobility to incorporate their proprietary smart batteries and network of quick interchange battery stations.

Tata Motors also launched its pure electric bus 'Starbus Electric 9m' and hybrid 'StarBus Electric 12m' in January 2017³³ and delivered 25 'Made in India' buses in Maharashtra in March 2018. In addition to the corporate giants, Goldstone Infratech has also supplied Himachal Pradesh Transport Corporation with 25 electric buses in September 2017³⁴.

29 'How Karnataka is Becoming The Centrepiece of India's Electric Vehicle Revolution', The Better India, 2018

30 'India's Tryst With Electric Vehicles – What Is At Stake?', Auto Tech Review, 2018

31 'India's Tryst With Electric Vehicles – What Is At Stake?', Auto Tech Review, 2018

32 'Ashok Leyland unveils India's first indigenous electric bus', The Economic Times, 2016

33 'Ashok Leyland unveils India's first indigenous electric bus', The Economic Times, 2016

34 'Goldstone Infratech's electric bus joins HRTC fleet', The Hindu, 2017

2. INTERMEDIATE PUBLIC TRANSPORT

There are around 10 startups that are manufacturing electric three-wheelers in India³⁵. Gayam Motor Works is the manufacturer of India's first electric three-wheelers powered by lithium-ion (Li-ion) batteries with a swapping system. Pune-based Kinetic Green Energy and Power Solutions Limited launched its e-rickshaws, Kinetic Safar, with Li-ion batteries last year³⁶.

However, even before the advent of startups, Delhi had already launched e-rickshaws in 2010 with an objective to eventually phase out the physically taxing cycle

rickshaws³⁷. These battery-fitted three-wheelers were able to provide the much needed first and last mile access to Delhi Metro. The number of battery operated e-rickshaws in Delhi has risen from 4,000 in 2010 to more than 1,00,000 in 2014 and is now an integral part of the transport ecosystem in the state³⁸. However, only 35,000 of these e-rickshaws are legal.

Not just three-wheelers, car rental companies are also beginning to enter the Electric wave. Zoomcar has plans to add 12,500 EVs to its fleet in two years³⁹.

CASE STUDY

Lithium Urban Technologies⁴⁰

Bengaluru-based Lithium Urban Technologies, India's first all-EV fleet for corporates, set up by Sanjay Krishnan, CEO, and ex-Nasa scientist Ashwin Mahesh, in 2015, has over 400 e-vehicles in its fleet. They plan to expand this to 10,000 vehicles in the next 36 months.

Under Non-Motorized transport, there are merely 6 startups that manufacture electric bicycles⁴¹. All of them are at a nascent stage.

3. PRIVATE TRANSPORT

According to a report by industry group Auto Component Manufacturers Association and Munich consultancy Roland Berger, just 1,300 electric cars and 44,000 electric bikes were sold in 2016-17 in India⁴². The number of companies manufacturing electric motorcycles and scooters is growing and is currently around 15-20. The most notable among them are 22 Motors, Okinawa Autotech and Ather Energy (to launch smart scooters).

Among electric cars, big automobile manufacturers have invested heavily in developing internal capacities to

manufacture EVs. Reva Electric Cars, acquired by Mahindra & Mahindra in 2010, was the first automaker to sell a fully electric car in the country. Since then, Mahindra has launched three EV models till date. Mahindra is now joined by Tata in manufacturing and selling fully electric cars in India.

Other automobile giants including Maruti Suzuki India, Toyota Motor, BMW, and Honda Motors offer hybrid versions. Volvo has also announced that it would phase out the internal combustion engine and manufacture only electric or hybrid vehicles by 2019⁴³.

4. EV CHARGING INFRASTRUCTURE

The most crucial element in the Electric Vehicle landscape is the availability of charging infrastructure. Compared to 60,000 gas (CNG) and fuel (petrol and diesel) stations, India has only about 222 EV charging stations with 353 charging points, according to a report. The number is extremely low and presents a huge area of opportunities for investors. It is estimated that it costs between \$500 and \$25,000 to set up a station in addition

to the land costs. The ministry of heavy industries estimates that a subsidy of `140 billion (US\$ 2.2 billion) will be needed to promote EVs and charging infrastructure in India⁴⁴.

There are also several companies that manufacture batteries and battery components. They are also a part of the sustainable mobility ecosystem.

35 'Electric Vehicle Industry in India', Wikipedia, 2018

36 'Indian automobile startups: Ahead of the EV game', Forbes India, 2018

37 'The E-rickshaw story: Was the advent of electric mobility in India planned', TERI, 2018

38 'Electric vehicles in India and its impact on Grid', NSGM - PMU, n.d

39 'Indian automobile startups: Ahead of the EV game', Forbes India, 2018

40 'Indian automobile startups: Ahead of the EV game', Forbes India, 2018

41 'Electric Vehicle Industry in India', Wikipedia, 2018

42 'The story of India's flip-flops on its electric vehicle policy - and how it will hurt', Factor Daily, 2018

43 'India's electric vehicle drive: Challenges and opportunities', Livemint, 2017

44 'Insight: Ola's sputtering India electric vehicle trial a red flag for Modi plan', Reuters, 2018

5. FREIGHT

Majority of startups in freight in India are catering to last mile delivery services, which are discussed in the next section in the report. In EVs, the market in India is very nascent with only three major automobile players,

Mahindra, Tata Motors, and Ashok Leyland, who have launched electric pickup trucks. Competition may come in the form of Tesla which is planning to build electric pickup trucks in India.

FOR PROFIT ENTERPRISES (OTHER THAN ELECTRIC)

Other than in EVs, majority of for-profit enterprises in sustainable mobility in India vary across different categories – aggregators in buses, three-wheelers and taxis, ride-sharing platforms across different modes of transport, transport information apps, and enterprises working in smart cities. There is a debate on whether digital cab aggregators like Uber and Ola would come under sustainable mobility. According to Bloomberg New Energy Finance, the total valuation of the top five digital taxi-hailing companies internationally is more than \$129 billion as of January, 2018, more than the combined market capitalization of General Motors and Ford Motors. Also, the numbers are expected to rise. The number of passengers using digital taxi-hailing apps worldwide skyrocketed to 769 million by the end of 2017, which marked a 28 per cent increase from just six months earlier⁴⁵.

However, cab aggregators or transport aggregators do not generally have a sustainable agenda and have unidirectional focus on business activities. As a result, it is difficult to conclude that aggregators come under sustainable mobility. Still, we provide some glimpse into what startups fall under these categories, especially among bus and three-wheeler aggregators, and bicycle sharing startups.

Shuttl is one of the major private bus aggregator in India. Operating in Delhi with a fleet of more than 500 buses, it has raised significant investments despite

facing losses and regulatory issues from state governments. rBus, Zipgo and Cityflo are other major bus aggregating startups in the country. Similarly, for three-wheelers, Autowale, AutoRaja and mGaadi, based in Pune and Chennai, have been major aggregators.

Bicycle sharing businesses definitely falls under sustainable mobility since they allow for last mile connectivity while reducing carbon footprints by encouraging people to skip their fuel-run vehicles and opt for bicycles instead. This section is rapidly growing in India with validation and patronage coming to initial startup models in metro cities such as Gurugram and Bengaluru. These startups rely on big data and strong on-ground operation teams and are betting on infrastructure being put in place once demand is created for their services. Zoomcar launched PEDL, its cycle-sharing service in Bengaluru in October 2017⁴⁶. It has since expanded its service to parts of Pune, Chennai, Kolkata, and Mumbai. Several other domestic players include Ola Pedal, InMobi Yulu, Mobycy, WheelStreet and Chartered Bike.

Chinese majors Ofo and Mobike have also announced plans to enter cycle-sharing business in India. Mobike, which is present in 200 cities in 12 countries, is making plans to launch in India and will soon raise funds for investment in assets⁴⁷.

Other tech startups working in sustainable mobility would include transport information apps like Birds Eye, m-indicator and TransitPedia.

FREIGHT

It forms the major sector among for-profit enterprises in sustainable mobility. Any enterprise that works to improve the existing last mile delivery structure through technological or business model innovation can be considered to be contributing to sustainable mobility.

Currently, different estimates put the Indian freight industry somewhere between \$100 billion and \$150 billion, contributing to nearly 6 per cent of the GDP. Inter-city logistics accounts for a massive 95 per cent of road freight movement and the entire freight transport market in India is expected to be worth around \$300 billion by 2020⁴⁸. Out of the approx. 12 million trucks

in India⁴⁹, about 90 per cent belong to single-truck owners, which makes the sector ripe for digital connectivity and aggregation platforms. Several of these startups include Rivigo, Delhivery, TruckSuvidha, LEAP India, 4tigo, ElasticRun, Locus, LogiNext, Shipy, Shadowfax and Fareye⁵⁰.

In the case of larger players, Amazon and Flipkart lead the way in India in bringing innovation in last mile delivery mechanisms. 70% of deliveries for Amazon and Flipkart are executed through their in-house logistics entities⁵¹.

45 'There's Never Been More Money Pouring Into Mobility Startups', Bloomberg, 2018

46 'Bike-sharing startups go the last mile', Times of India, 2018

47 'Bike-sharing startups go the last mile', Times of India, 2018

48 'Last Mile Delivery Startups Poised To Drive Global Ecommerce Sales To \$2.48 Tn By 2018', Inc 42, 2016

49 'Mobility and transportation: the opportunity for intelligent logistics', Yourstory, 2018

50 'Startup Watchlist: 7 Indian Logistics Startups To Watch Out For In 2018', Inc 42, 2017

51 'Mobility and transportation: the opportunity for intelligent logistics', Yourstory, 2018

CURRENT FUNDING AND INVESTMENT SCENARIO IN INDIA

We studied the investment scenario in for-profit enterprises for electric vehicles, freight and other business enterprises like aggregators and ride sharing companies. Under EVs, we divided the sector in three verticals namely, integrated vehicle and manufacturing, batteries and storage, and charging infrastructure.

ELECTRIC VEHICLES

INTEGRATED VEHICLES AND MANUFACTURING

Since the private car space in EVs in India is dominated by handful of major OEMs and no startup players, it is attracting more corporate funding from within India and from abroad. Mahindra & Mahindra has announced ₹ 4000 million investment in Karnataka for the next five years to expand production capacity and to set up new EV technology innovation centres⁵². Overall, it plans to invest an additional ₹ 9000 million in the next 3-5 years in EV manufacturing in India⁵³. Other Indian and international investors planning big corporate funding in EV manufacturing are:

- Suzuki is planning to invest \$600 million in a new manufacturing facility in Gujarat⁵⁴.
- Sajjan Jindal's JSW Group is exploring a partnership with China's Zhejiang Geely Holding Group.
- British Petroleum is planning to leverage its partnership with Reliance Industries to explore unconventional mobility solutions.
- China's Zhuhai Yinlong New Energy Ltd is planning to set up an EV manufacturing plant in Punjab.
- Chinese manufacturers like BYD and Changsha Sunda New Energy Vehicles Technology have announced plans to enter the Indian market⁵⁵.

State governments are also seeking funds for EV projects. Andhra Pradesh government has entered into a partnership with Toyota to introduce PHEVs and EVs for their ambitious Smart City project at Amaravati, the new state capital⁵⁶.

BATTERIES AND STORAGE

Batteries form a major component of EV manufacturing and operating costs, and with the expected decline in the cost of lithium-ion batteries in coming years, this sector can be expected to gather attraction of entrepreneurs and investors. NITI Aayog predicts that India's vision of mass conversion to EVs can create a \$300 billion potential domestic market for EV batteries by 2030. This could be around 2/5th of the global battery demand and 25-40% of this market can be captured through 'Make in India', aimed at encouraging manufacturing and attracting foreign investment to India⁵⁷.

The potential in storage market has already begun to gather momentum. Some of the examples of investments are:

- Swiss Leclanché SA is planning to partner with SUN Mobility for developing battery storage solutions⁵⁸.
- Honda is investing in lithium-ion battery manufacturing plant in India
- Honda partnering with Nissan to develop solid state battery technology⁵⁹

52 'How Karnataka is Becoming The Centrepiece of India's Electric Vehicle Revolution', The Better India, 2018

53 'The Indian government isn't ready to walk the talk on electric vehicles', Quartz India, 2018

54 'Electric Vehicles Market in India', Erincon, 2017

55 'The story of India's flip-flops on its electric vehicle policy - and how it will hurt', Factor Daily, 2018

56 'Electric Vehicles: Scope and Challenges', Energy Future, 2018

57 'Govt's electric vehicle campaign can create \$300 billion domestic battery market: NITI Aayog', Livemint, 2017

58 'The story of India's flip-flops on its electric vehicle policy - and how it will hurt', Factor Daily, 2018

59 'Electric Vehicles: Scope and Challenges', Energy Future, 2018

CHARGING INFRASTRUCTURE

Setting up a strong and conducive charging infrastructure in India is most critical to develop ecosystem for EVs. Currently corporate entities and government initiatives have begun to invest in the area. Some of the major examples of corporate investment are as follows:

- Tata Power Delhi Distribution Ltd. is planning to invest Rs 100 crore to set up 1,000 charging stations in Delhi by in the next five years⁶⁰.
- Finnish state-controlled energy utility Fortum is planning to develop EV charging infrastructure in India⁶¹.
- In 2017, Tata Power launched Mumbai's first commercial EV charging station, with customers paying rates set by the Maharashtra Electricity Regulatory Commission.
- Reliance is also reported to be looking at the EV charging market.
- Mahindra Reva has an agreement with the Gopalan chain of malls to set up free charging points at its retail centres⁶².

From the government side, Energy Efficiency Services Limited (EESL) is planning tenders for nearly 4,000 EV charging stations in the NCR. Established under the Ministry of Power, EESL is a joint venture of NTPC Limited, Power Finance Corporation, Rural Electrification Corporation, and Power Grid Corporation of India⁶³.

Apart from government and corporate funding, VC funding hasn't got any successes in this space. Softbank-backed Ola, a major cab aggregator, launched a fleet of 50 EV cabs, with charging stations, in Nagpur in 2017. However, the programme hit a snag after a few months: it is reported that Ola drivers, unhappy with long wait times at charging stations and high operating expenses, want to return their cars and switch to regular fuel cars⁶⁴. It might take few years for the infrastructure to reach a maturity which VCs and aggregators can ride upon.

OTHER FOR-PROFIT ENTERPRISES⁶⁵

Among bus and three-wheeler aggregators, Shuttle has led the way in attracting significant investments from Sequoia Capital, Lightspeed Venture Partners, Times Internet, and AdvantEdge Partners. Other major investments include:

- ZipGo: Omidyar, Orios Venture Partners, VenturEast, Angel
- CityFlo: IDG Ventures
- rBus: India Quotient, Angel
- Limo: Rainmaker Ventures

However, the recent exit of Ola from the bus aggregator market in early 2018 has cast doubts over the business potential of the sector.

Of the 10 bicycle-sharing startups operating in the country, only Mobycy and Yulu, both founded in 2017, have venture capital funding. Mobycy has raised \$500,000 in funding, and Yulu an undisclosed sum.

FREIGHT

In terms of the amount being invested in first half in 2017 in India in tech startups, transport and logistics took the third and fourth spots, respectively, with \$528 million and \$271 million in funding. In total, the logistics startups received over \$271 million funding for 18 deals in first half of 2017⁶⁶. Some of the major investors which have invested in logistics startups in India are India Angel Network, Blume Ventures, Kalaari Capital, Excel Partners, Eight Roads Ventures, SAIF Partners, BeeNext and IndiaNivesh Growth Fund⁶⁷.

Enterprises which have grabbed major investments are BlackBuck (\$90 million in 2017) and Rivigo (\$70 million in 2016). In January 2018, Rivigo raised \$50 million in Series D round, with a valuation of more than \$900 million⁶⁸.

60 'India's electric vehicle drive: Challenges and opportunities', Livemint, 2017

61 'The story of India's flip-flops on its electric vehicle policy - and how it will hurt', Factor Daily, 2018

62 'Challenges and solutions to developing India's Electric Vehicle charging infrastructure', Firstpost, 2017

63 'Challenges and solutions to developing India's Electric Vehicle charging infrastructure', Firstpost, 2017

64 'Insight: Ola's sputtering India electric vehicle trial a red flag for Modi plan', Reuters, 2018

65 From multiple sources through secondary research

66 'Indian Tech Startup Funding Report, H1 2017', Inc 42, 2017

67 'Startup Watchlist: 7 Indian Logistics Startups To Watch Out For In 2018', Inc 42, 2017

68 'Startup Watchlist: 7 Indian Logistics Startups To Watch Out For In 2018', Inc 42, 2017

Challenges

- Lack of policy support for EVs
- Weak ecosystem and charging infrastructure for EVs
- Lack of synergies with power sector
- Possible backlash from automotive sector
- Competition from international market

Opportunities

- Stressed transportation system – unfulfilled demand
- Last mile mobility not serviced by public infrastructure
 - Synergies with solar energy
 - Lowering prices in the battery market
- Massive scope for business model innovation

FOR INVESTORS AND FUNDERS

CHALLENGES AND RISKS FOR INVESTORS AND FUNDERS

1. Lack of policies to push for EVs:

India doesn't yet have a dedicated policy for EVs while other countries like China and EU are already racing far ahead. Absence of a stable policy thrust from the government, that incentivise EV manufacturing industry, boost enterprises producing batteries, EV components, and create provisions for establishment of charging stations discourages investors from actively seeking options and opportunities. India's Electricity Act is also a major deterrent. The law currently does not permit entities other than state-run distribution firms to sell power⁶⁹. A revision of the Act is crucial because in order to set-up charging mechanisms for their vehicles, OEMs would need partners to distribute power.

2. Weak ecosystem for EVs:

Nascent market, fewer investors, highly underdeveloped charging infrastructure and lack of manufacturing capacity are the major reasons for the weak ecosystem for EVs' growth in India. For a VC to invest in a startup, it requires potential for scalability. However, most of the business enterprises in EVs today are struggling to scale up due to high initial costs and slow adoption rate by customers. New enterprises need to create an ecosystem for themselves where they have to figure out the product, sourcing, service network and the entire supply chain building on their own.

3. Lack of synergies with Power sector:

Reliable and efficient power is the chief requirement for EVs to survive. In India, power sector in itself is grappling with its own issues with access to energy still a major challenge.

4. Possible backlash from the automotive sector:

Increase in demand for EVs will have adverse effect on demand for ICE vehicles. OEMs are trying to mitigate their future risks by already investing heavily in building their individual EV capacities. However, not everyone wants to take up the electric route yet. ICE, which is used in most cars, has more than 2,000 moving parts, while an electric vehicle has about 20, resulting in fewer breakdowns. Among the parts that will see demand dry up once electric vehicles dominate in India are engines, transmission, aluminium castings, cylinder blocks and cast iron. These will give way to an electric motor run by batteries. According to ACMA, the ICE powertrain contributes to over 60 per cent of the employment generation in the auto component sector, and that a switch to 100% per cent electric vehicles could impact up to 5.6 million jobs by 2025-26⁷⁰.

5. International externalities:

Chinese firms are already acquiring assets in countries such as Bolivia, Australia, and Chile, which have substantial lithium reserves, trying to establish a monopoly in lithium and consequently in the battery market. With China overtaking the US last year as the world's biggest electric car market, there have been concerns about supply shocks⁷¹.

69 'The Indian government isn't ready to walk the talk on electric vehicles', Quartz India, 2018

70 'Auto industry braces for impact as India begins shift to electric vehicles', Livemint, 2018

71 'India's electric vehicle drive: Challenges and opportunities', Livemint, 2017

OPPORTUNITIES AND WAY AHEAD FOR INVESTORS AND FUNDERS

1. Highly stressed transportation system:

The existing transportation and mobility status in Indian cities are either highly stressed or in a state of complete breakdown. During peak hours, the system breaks down and traffic congestions are the norm. The loss of productive hours and inconvenience that commuters face on a daily basis is a huge area for enterprises and investors to target.

2. Last mile focus:

While the government is slowly intervening in the last mile mobility solutions, it still has a lot of potential for startups and EVs to tap. With increasing number of metros and subways being constructed all across the country, the need for last mile transport services will only increase.

3. Solar Energy, battery storage and EVs – the ideal trio:

The fates of solar power and electrical vehicles in India are likely to be closely interlinked, given that EVs have batteries that can offer a storage solution to India's clean energy push. Solar power generated during the day needs to be stored in batteries. The storage capability of EV batteries could help with grid balancing. The combination of solar energy,

battery storage, and electric mobility presents a win-win for India⁷². Collaborative approach by OEMs, charging infra enablers, battery suppliers and smart grid service utilities are must to power EV's business case in India⁷³.

4. Potential in battery market:

With lithium battery prices having nosedived from \$600 per kilowatt-hour (kWh) in 2012 to \$250 per kWh in 2017, the storage market is already picking up. The EV industry is betting on a further drop to \$100 per kWh by 2024⁷⁴. This presents an ideal opportunity for entrepreneurs and investors to jump into the battery and storage space.

5. Business model innovation:

Cab-aggregators have a great opportunity to work on sustainable mobility given the extensive market reach they have established. Companies like Lithium have already integrated aggregation and EVs. We might see more pan-India cab aggregators coming up with linkages in EV industry.

72 'India's electric vehicle drive: Challenges and opportunities', Livemint, 2017

73 'Electric Vehicles Market in India', Erincon, 2017

74 'India's electric vehicle drive: Challenges and opportunities', Livemint, 2017



CONCLUSION

Distilling from the various trends and findings highlighted in this report, SM and A2E sectors present diverse geographic focus areas. Much of the government interventions and entrepreneurial activity in SM is focused mainly on urban mobility. Most products and solutions are designed keeping an urban use in perspective. A key objective of these initiatives - reduce negative environmental impact of motorized transport. However, we do not find many initiatives directed towards improving rural or semi-rural mobility. On the contrary, A2E presents a rural leaning. Various government policies and initiatives are aimed at taking electricity to villages and remote areas. Most startups in the A2E sector also design products and services for a rural consumer segment (including clean cooking solutions etc.).

There are also deep connections between A2E and SM as sectors in India. There is a significant thrust on electric vehicles and a key requirement of such vehicles is strong electric vehicle charging infrastructure. The success of entrepreneurial forays into electric vehicles critically depends on a robust charging infrastructure. Therefore, to push towards a more vibrant sustainable mobility ecosystem, there is need for state-of-the-art access to energy.

OUR KNOWLEDGE PARTNERS

OKAPI RESEARCH & ADVISORY



Okapi is a social innovation strategy consultancy. It helps its clients achieve lasting social and environmental impact by understanding and shaping the ecosystems around complex challenges. Okapi works closely with public and private sector leaders to help them create policy environments, ecosystems, and organizations that sustainably aggregate individual contributions to broader public purposes. It has undertaken a wide range of research and strategic consulting on entrepreneurship, innovation systems, and the implications of policy, regulatory, economic and technology change for institutional design across various sectors including clean energy, health, agriculture, transport and urbanization. Its current and past clients include high-level national government committees such as the Kelkar Committee on Public Private Partnerships and the Prime Minister's National Transport Development Policy Committee; academic institutions, international organizations and Indian impact investors.

For more information about Okapi and its work, please visit <http://okapia.co>

SHAKTI SUSTAINABLE ENERGY FOUNDATION



Shakti seeks to facilitate India's transition to a sustainable energy future by aiding the design and implementation of policies that promote clean power, energy efficiency, sustainable urban transport, climate action and clean energy finance. Working together with policy makers, civil society, academia, industry and other stakeholders, it takes concerted action to craft robust energy policies. Given India's commitments under the Paris Agreement, it seeks to facilitate meaningful efforts to tackle climate change.

In the areas of energy access and sustainable transport, Shakti has aided the design and implementation of policy solutions that will foster a cleaner growth path for the country. After Uttar Pradesh announced a mini-grid policy in 2016, Shakti engaged with the Uttar Pradesh Electricity Regulatory Commission (UPERC) to develop and announce a regulatory framework for mini-grid development.

For more information about Shakti and its work, please visit <http://shaktifoundation.in/>

IKEA FOUNDATION

IKEA Foundation



The IKEA Foundation is the philanthropic arm of INGKA Foundation, the owner of the IKEA Group of companies. It aims to improve opportunities for children and youth in some of the world's poorest communities by funding holistic, long-term programmes that can create substantial, lasting change. The IKEA Foundation works with strong strategic partners applying innovative approaches to achieve large-scale results in four fundamental areas of a child's life: a place to call home; a healthy start in life; a quality education; and a sustainable family income, while helping these communities fight and cope with climate change.

Visit IKEA on social media at:

<https://www.facebook.com/IKEAFoundation/>

<https://www.linkedin.com/company/ikea-foundation/?originalSubdomain=in>

VNV ADVISORY SERVICES



VNV Advisory has been at the forefront of working with climate change and livelihoods. Their decade-long experience has seen them develop low-carbon projects that support these communities in getting their basic needs while adapting to and mitigating the harsh impacts of climate change. They work in areas of clean cooking, social forestry, sustainable agriculture, rural energy access and many other related community based technologies. With support from over 40 NGOs and implementation partners, their work encompasses over 3 million rural households across the South Asian (India, Bangladesh, Nepal and Sri Lanka) region. They have also been able to engage with businesses to address issues of Social Responsibility, Environmental Sustainability and Carbon Neutrality.

Visit VNV on social media at:

<https://www.instagram.com/vnvadvisoryservices/>

<https://in.linkedin.com/in/sandeep-roy-choudhury-0077501b>

ASHDEN INDIA COLLECTIVE



Ashden India is a network of India-based winners of the prestigious Ashden Awards (UK). The Ashden Awards are international awards given to organisations promoting pro-poor and sustainable energy interventions. The collective is now having 30 active members (Ashden Award winners), who have been supporting the collective in its outreaching and policy development activities. Ashden India Collective (AIC) members are committed to fostering sustainable energy access. AIC constitutes a pan-India, technology-agnostic network sensitive to the energy and development needs of poor communities. While individually Ashden India Collective members are all active in developing and disseminating sustainable energy solutions; at a collective level, Ashden India Collective endeavours to develop a favourable ecosystem for large-scale deployment of decentralised renewable energy options in ways that spur economic growth and social development, while protecting the local and global environment.

Visit Ashden on social media at:

<https://www.facebook.com/ashdenindiacollective/>

<https://in.linkedin.com/company/ashden-india-renewable-energy-collective>

ABOUT THE PARTNERS



ABOUT AVPN

AVPN is a unique funders' network based in Singapore committed to building a vibrant and high impact philanthropy and social investment community across Asia. As an advocate, capacity builder, and platform that cuts across private, public and social sectors, AVPN embraces all types of engagement to improve the effectiveness of members across the Asia Pacific region.

The core mission of AVPN is to increase the flow of financial, human and intellectual capital to the social sector by connecting and empowering key stakeholders from funders to the social purpose organizations they support. With over 380 members across 28 countries, AVPN is catalysing the movement towards a more strategic, collaborative and outcome focussed approach to philanthropy and social investing, ensuring that resources are deployed as effectively as possible to address key social challenges facing Asia today and in the future.

Visit us at: www.avpn.asia
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ABOUT CIIE

Centre for Innovation Incubation and Entrepreneurship (CIIE), the technology business incubator at IIM Ahmedabad, helps entrepreneurs turn ideas into viable businesses. In partnership with their mentors, corporates, development agencies, IIMA community and investors, CIIE cultivates a rare breed of entrepreneurs by incubating, accelerating, mentoring and funding innovative start-ups.

CIIE has, over the years, played a multi-dimensional role in the entrepreneurial landscape of India. Their deep understanding of the evolving gaps, needs, and opportunities in the markets and the entrepreneurial ecosystem has enabled it to design initiatives that have attracted and supported the best entrepreneurs in various sectors.

Visit us at: ciie.co
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ABOUT SHELL FOUNDATION

Shell Foundation is an independent UK-registered charity established by the Shell Group in 2000 to create and scale new solutions to global development challenges. We apply business thinking to major social and environmental issues linked to the energy sector – and seek to leverage the skills and networks of Shell where possible to deliver greater development impact.

Shell Foundation works with a small number of entrepreneurial partners to identify the market failures that underpin many of the world's problems and co-creates new social enterprises to solve them. We provide patient grant funding, extensive business support and access to networks to help pioneers to validate new models, achieve financial independence and to expand across geographies.

Once a new solution is proven to be viable we create specialist intermediaries to facilitate growth and replication at an industry level.

By applying this approach to major global challenges such as job creation, access to energy, urban mobility and sustainable supply chains, we have created several strategic partners that are now delivering large-scale impact in multiple countries across Africa, Asia and Latin America.

Visit us at: <http://shellfoundation.org>

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AVPN is a unique Pan-Asian funders' network catalysing the movement toward a more strategic and collaborative approach to philanthropy and social investment to address key social challenges facing Asia today and in the future.

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