Exploring the Potential of E-mobility as a Booster for Local Economy and Livelihoods in India

1. Background

The rising awareness regarding the environmental footprint of conventional Internal Combustion Engine (ICE) vehicles has paved the way to cleaner Electric Vehicles (EVs). Summarising its commitment to the Paris Agreement under the Intended Nationally Determined Contributions, the Government of India has planned to make a significant shift towards EVs by 2030.

The EV industry in India has got momentum by the launch of the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) scheme in India in 2015. However, one of the major roadblocks for the E-mobility transition in India remains the high upfront cost of the vehicles resulting from high import dependency and limited local manufacturing of their components. Most EV components are imported from China, as there is no well-established EV component-making ecosystem in India.

The second phase of the FAME scheme launched in 2019 promotes local production by compensating 50 percent localisation criteria for availing incentives on the purchase of EVs. However, this makes it almost impossible for any manufacturer to benefit from the scheme as Indian component suppliers are not yet ready to manufacture components for the current low volume of EVs. Further, the process of safety tests, checking, vehicle testing will take at least 1-1.5 years.[1]

The COVID-19 pandemic has acted as a boon for this situation. The Indian government has issued a clarion call to localise manufacturing and self-reliance or '*Atmanirbharta* across the economy' to rebuild the economy. Union Minister Nitin Gadkari said, "About 81 percent of Lithium-ion battery components are available locally and India stands a perfect chance for value addition at lower costs."[2]

Taking an important step forward in the vision of 'Atmanirbhar Bharat', the Union Cabinet approved the Production Linked Incentive (PLI) scheme in May 2021, promoting the manufacturing, export, and storage of lithium-ion cells, essential for developing EVs.[3]

1 https://inc42.com/buzz/is-fame-ii-scheme-doing-more-harm-than-good-for-e-mobility/
2 https://economictimes.indiatimes.com/industry/auto/auto-news/govt-to-come-out-with-policy-on-advanced-battery-tech-to-power-evs-india-eyes-no-1-slot-nitin-gadkari/articleshow/80845721.cms
3 https://www.livemint.com/news/india/pli-scheme-could-help-make-india-a-hub-for-manufacturing-lithium-ion-batteries-11620897351672.html

Seeking to take advantage of the incentive, many companies, including Reliance Industries Ltd (RIL), Adani Group, Tata Chemicals, Larsen and Toubro Ltd (L&T), and a joint venture led by Japan's Suzuki Motor Corp. have shown interest in building lithium-ion cell manufacturing plants in India.[4]

In recent years, an increasing number of states have committed themselves to promote EVs manufactured within the state in their strategic mobility planning. Various states have industrial incentives in their EV policies aimed at vehicle manufacturers, battery producers, and ancillary companies to encourage EVs and components of the EV value chain.

The other industrial incentives that states have deployed relate to skill development, employment generation, and research and development. These will be crucial in developing the necessary human resources and effect the shift to higher-value manufacturing.

States with existing EV policies like Andhra Pradesh, Karnataka, Uttar Pradesh, and Tamil Nadu are now implementing and revising these policies. Recently, Karnataka decided to amend its EV policy by offering a 15 percent capital subsidy to investors on the value of fixed assets.[5]

More states like Haryana, Punjab, and Rajasthan are drafting their EV policy intending to foster the manufacturing of EVs within the state. With rising policy support and to meet the evolving regulatory deadlines, the OEMs have been rushing to design and develop EVs, batteries, and other EV components. With manufacturers such as Tesla entering India, the Indian EV market is likely to witness high-quality products and the entry of new and existing automobile manufacturers in the EV segment.[6]

NITI Aayog has collaborated with four IITs, including Guwahati and Delhi, for research in aluminium-ion battery, to find a substitute for lithium-ion batteries.[2]

For India's post-COVID economic recovery, a focus on electric mobility may boost localised manufacturing and livelihoods associated with it. According to studies, the localisation of pre-manufacturing and component manufacturing processes showcases the promising potential for creating business and livelihood opportunities. It can create new job roles and provide indigenised employment opportunities across the entire EV ecosystem. This project aims to explore the qualitative attributes and employment potential of the localised jobs, which will be created due to the indigenisation of the EV manufacturing ecosystem.

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4 https://www.livemint.com/companies/news/ril-tata-adani-suzuki-jv-to-tap-pli-plan-for-li-ion-business-11622659504117.html

5 https://energy.economictimes.indiatimes.com/news/power/karnataka-tweaks-ev-policy-to-offer-15-per-cent-capital-subsidy-to-investors/83026435

6 https://www.ey.com/en_in/tax/how-pli-scheme-for-battery-manufacturing-will-boost-india-ev-market

With India being highly dependent on imports, especially from China, many manufacturing jobs are currently outsourced for EV components. Vehicle assembly is the main activity conducted domestically. Additionally, though EV start-ups seem to be on the rise in India, the current requirements are limited and tilted towards highly skilled or niche roles. In contrast, an ecosystem approach is needed for the creation of jobs across the skill spectrum. Thus, the concerns for a just transition seem imperative in the context of the impact of the changing skill requirement on the existing workforce and new entrants and gender disparities across the job and skill spectrum in the auto manufacturing sector.

2. Emerging Livelihood Opportunities

With the world adopting the revolutionary technology of EVs, it is vital to secure livelihoods locally to live a good life. This means enhancing the capacities and capabilities of people and places to adapt to the technological transformation. In the current scenario, the EV manufacturing sector's employment generation potential is in its nascent stage.

Like any change, the transportation sector transition from ICE vehicles to EVs will have winners and losers. With an increase in the adoption of EVs, there will be a loss of jobs in the conventional fuel industry of oil and gas.

Since EVs have a lesser number of parts and require far less maintenance than conventional ICE vehicles, there will also be a loss of jobs in the auto component manufacturing and the maintenance and mechanics industry. On the other hand, the transition will lead to direct jobs in the auto industry in manufacturing, research and development, and battery manufacturing. Indirect jobs will be created from the installation and maintenance of electric vehicle supply equipment (EVSE).[7]

Following are the jobs that would be generated and the jobs that require major reskilling in the transforming automotive sector.

Table 1: New and reskilling jobs in the various sub-sectors of the Automotive Industry[8]

Sub-sectors of the automotive industry	New jobs	Jobs that will require major reskilling
Research & Development and Manufacturing (OEM, Auto Component Manufacturers, Raw Material	• Mechatronics Technician • Electronics Technician • Automation and Robotics Engineer	• Machining • Maintenance (Mechanical and Electric) • Automotive Test

7 https://www.mdpi.com/2032-6653/8/4/996/pdf
8 https://careerguide.asdc.org.in/

Sub-sectors of the automotive industry	New jobs	Jobs that will require major reskilling
Suppliers)	• Equipment Maintenance Technician • Automotive Data Analyst	Technician • Welding • Vehicle and Component Assembly • Casting • Painting Process
Dealership Sales	• Home Sales Consultant • Sales Consultant Digital Marketing • Digital Content Writer • E-Outlet Sales Consultant	Sales Consultant
Automobile Service (OEM Authorised Service Centres and Private Garage Technicians)	• Auto Expert Technician • Advance Paint Technician • Battery Technician • Electric Vehicle Technician • Predictive Analyst	Service Technician
EV Charging Station	• Charging Attendant / Station Supervisor • Car Washer /Tyre Inflator /Punctures Repair • Field Failure Analysis Engineer • Customer Support Engineer	
Road Transport (New Skills required by Commercial Vehicle and Cab Drivers as a complementary skill to driving)	• Hospitality • Loading /Unloading • Handling Hazardous Materials • Basic Mechanics • Tablet Computer Training • Financial Management • Vehicle Detailing • Self-motivation Training • Transportation Management Training	

The generation of jobs in the automobile sector will also induce employment in the ancillary sectors. The list of potential jobs that would be generated in other sectors supporting E-mobility is as follows-[9,10]

i. **Battery cell manufacturing**: it includes R&D for improving battery chemistry and manufacturing of batteries.

ii. **Power sector**: it covers jobs created due to additional electricity generation, a connection of the existing grid to EV chargers, and grid reinforcement, i.e., upgrading and extending the existing grid.

iii. **IT sector:** it considers developing algorithms for Battery Management System (BMS), making IoT modules for sharing real-time data generated by EVs, creating app-based solutions for EV charging, etc.

iv. **Installation of the electric vehicle chargers**: it covers the main task of installation of EV chargers as well as the consultancy service to customers regarding the technical and regulatory needs and requirements for the chargers. Electric vehicle chargers will probably increasingly be sold in a package with complementary technologies, such as solar PV and battery systems. This will contribute to making the electrician's job an increasingly skilled, wide-ranging, and green profession. This will also make the profession more attractive for young workers.

v. **Civil and road work**: it covers the groundworks that are a prerequisite for the subsequent installation and connection of the actual EV chargers.

vi. **Skill and training** include the jobs created for skill development and reskilling for all the roles mentioned above.

vii. **Wholesale market**: it includes the steps needed to bring EV parts from the components manufacturers to EV manufacturers and EV manufacturers to final customers.

A transition from ICE to EV and the subsequent generation of new jobs in the automobile sector has demanded a parallel transformation of the automotive engineering workforce. There is a vast and growing need for tech talent in the manufacturing of EVs.[11]

Programming and software development are the skills of the moment. Design and development engineers, either from mechanical or electronic fields, which can also programme, are highly sought-after talents in the EV sector. The car of the future relies heavily on IT skills. Thus, individuals who blend their skills to become a multi-disciplinary hybrid of several specialties are in demand. However, to meet the personnel requirements of

9 https://download.dalicloud.com/fis/download/66a8abe211271fa0ec3e2b07/c572c686-f52f-4c0d-88fc-51f9061126c5/Powering_a_new_value_chain_in_the_automotive_sector_-_the_job_potential_of_transport_electrification.pdf

10 https://skill-lync.com/blogs/career-opportunities-ev-industry-graduates

11 https://supplychaindigital.com/sustainability/engineering-skills-gap-challenges-uk-electric-vehicle-market

the industry, the current skill-building initiatives must be strengthened by the targeted integration of EV-specific contents and geared holistically to the needs of the new occupational profiles.

3. Impact on the Local Economy

Like any new revolutionary technology, EVs create a variety of opportunities for economic development. Since EVs are much cheaper to operate than conventional vehicles, EV users have more disposable income to spend. Every penny not spent on gasoline, or oil changes, or transmission fluid has the potential to return to the local economy. Spending in other sectors keeps more wealth moving within local economies and will drive job creation in sectors that may not be immediately connected to the manufacturing of EVs, causing a multiplier effect in the economy.

The employment effect of EV adoption will vary by region and so will be its economic impact. The EV market of India is in its early stage of development. The evolution of this market will have a specific impact on local economies depending on the region of a cluster. There are several jobs creation and economic impact studies that have been developed for particular cities and states. The Northwest Economic Research Centre (NERC) of Portland State University assessed the economic impacts of Oregon's EV cluster.[12]

The study estimates that the state's EV industry creates 1,579 jobs, 411 of which are full-time. In addition, the industry generates a gross economic impact of US$266.56mn, including US$89mn in salaries. The Electric Power Research Institute (EPRI) conducted a study of the possible employment impacts of direct, indirect, and induced jobs because of EV industries in the Greater Cleveland Area.[13]

EPRI examined how shifting transportation demand from oil to electricity may impact industries throughout the regional economy, using a regional input-output model.

The transformation to e-mobility leads to the generation of primary jobs, secondary jobs, and tertiary jobs, which are as follows:

- **Primary or direct jobs** are created through increased production by firms that make EVs, EV components, and EV infrastructure.
- **Secondary or indirect jobs** are those tied to firms that supply to these direct producers.
- Further, higher employment in direct and indirect jobs leads to more spending and livelihood opportunities in the broader local economy. These create **induced jobs** in industries like food, clothing, and entertainment.

12 https://pdxscholar.library.pdx.edu/nerc_pub/21/
13 https://www.issuelab.org/resources/10863/10863.pdf

4. Livelihood and Local Economy Indicators

The World Economic Forum has introduced a dashboard for capturing sustainable economic growth in the modern context.[14] It consists of four indicators which are prosperity, planet, people, and institutions. Since the Gross Domestic Product (GDP) metric depicts only the nation's income and overlooks the welfare of the environment and people, in this study, the multidimensional indicators given by WEF have been considered. Based on these indicators, a comprehensive set of quantitative and qualitative parameters has been developed for understanding the impact of the EV manufacturing ecosystem on the local economy and livelihoods.

The 'Prosperity' indicator includes economic recovery, income and wealth inequality, financial resilience, etc. This study will measure these aspects of local business growth, sales, and employment generation (primary, secondary and tertiary) due to establishing an EV-related unit.

The 'People' metric of the dashboard takes into account human capital development and social resilience. Since industrialisation leads to urbanisation, therefore, under this dimension we will measure the infrastructure development for the local community, including basic infrastructure (water, electricity, connectivity) plus health, education, and skill development. Along with that, the parameter of women's empowerment and community confidence will be considered for capturing the overall impact on the local people.

The 'Planet' dimension considers the cost of the environmental impact of the business and its mitigation. This study focuses on determining the impact on the local community on account of measures taken to mitigate carbon emission due to EV manufacturing plants and EV manufacturing-related waste management.

The 'Institutions' indicator determines the trust of people in the government and its policies. In the context of e-mobility, we will determine the policies by the government for the benefit of EV manufacturing units and the policies by these units or corporate offices for the benefit of local people.

The indicators have been summarised in Table 2.

[14] https://www.weforum.org/agenda/2021/05/gdp-new-measure-economic-growth/?utm_source=sfmc&utm_medium=email&utm_campaign=2747176_Agenda_weekly-4June2021&utm_term=&emailType=Newsletter

Table 2 Indicators for local economy and livelihood

S. No.	Indicator	Parameters	Details
1	Prosperity	Local business growth	• Type and number of new enterprises linked to the EV ecosystem, • Change in Sales/Output in last five years
		Local employment effect	• Type, number of jobs linked to the EV ecosystem (including primary, secondary and tertiary), • Wages/ Change in wages in last five years
2	People	Human capital development	• Infrastructure for health, education, and skill development • Dynamics of expenditure on health, education, and skill development
		Women empowerment	• Type of job opportunities for women, • Percentage of females in the workforce, • Gender-sensitive infrastructure
		Community confidence	• Community perception towards the impact of industry on local economic growth
3	Planet	Carbon emission mitigation	• Carbon emission in the manufacturing process and measures to mitigate (green investments/activities)
		Industrial waste management	• Modes of waste generation and respective mitigation activities/efforts
4	Institutions	Government policies for manufacturing units	• Subsidies/schemes for setting up a manufacturing unit and employment generation
		Corporate policies for local benefits	• Schemes for the benefit of employees, • CSR activities for the benefit of local communities

5. EV Industry Clusters

In this project, we are trying to analyse the impact of the EV industry of two Indian automobile clusters on livelihood and the local economy. The clusters from across the country have been selected, which are, i) the National Capital Region (NCR), and ii) Bengaluru-Coimbatore (Karnataka, Tamil Nadu). While the first is a significant automobile

component manufacturing cluster, the Bengaluru-Coimbatore cluster is emerging as a hub for EV manufacturing.

National Capital Region (NCR)

Top automobile companies like BMW, Eicher Motors, Hero, Honda, Hyundai, Yamaha, and Maruti Suzuki have their headquarters, manufacturing plants, and/or training centers in NCR. In the NCR cluster, New Gurgaon and Manesar serve as adjoining manufacturing hubs for Gurugram. After finalisation of state EV policy (currently in draft stage), it will further get thrust as the policy focuses on developing a manufacturing ecosystem. On the other hand, the national capital New Delhi is known for its large consumer market and the availability of skilled labour. Delhi has been focusing on demand-side incentives for EVs and is coming up as a training hub. Therefore, the first cluster has been further narrowed down to the **Gurugram-Delhi** cluster.

Gurugram, formerly known as Gurgaon, is a city located in the northern Indian state of Haryana. It is one of the major satellite cities of Delhi. Leveraging vehicle segment and energy storage expertise, several electric mobility component manufacturing plants have been established in Manesar, Gurugram. Some of them are Lectrix EV Pvt. Ltd, GreenRick, Delta Electronics Pvt. Ltd, Exicom Power Solutions, Fortum India Pvt. Ltd, Napino Auto and Electronics Ltd, and Greenfuel Energy Solutions Pvt. Ltd. Also, the manufacturing plant of EV Motors Pvt. Ltd is there in Dharuhera town of Haryana, a new growth corridor of Gurgaon and New Delhi.

The EV policy of **Delhi** focuses on incentivising the purchase and use of electric two-wheelers and supporting the electrification of public/shared transport and goods carriers to drive the large-scale adoption of EVs and maximise the reduction of vehicle pollution.[15]

Delhi envisions becoming a hub to facilitate the training related to jobs in the EV ecosystem. Vocational courses shall be designed to train EV drivers, mechanics, and charging station staff in partnership with auto OEMs and the Energy Operators. Recently, IIT Delhi has announced to offer M Tech. course in electric mobility from the year 2021.[16]

PManifold EV Academy, based in Delhi, provides various EV-related training courses for upgrading and reskilling existing industry employees. Other guiding and decision-making organisations like the Society of Indian Automobile Manufacturers (SIAM), the Automobile Component Manufacturing Association (ACMA), Society of Manufacturers of Electric Vehicles (SMEV), Bureau of Energy Efficiency and Automotive Skills Development Council (ASDC) are also based in Delhi.

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15 https://transport.delhi.gov.in/sites/default/files/All-PDF/Delhi_Electric_Vehicles_Policy_2020.pdf

16 https://indianexpress.com/article/education/iit-delhi-to-offer-new-mtech-course-in-electric-mobility-from-this-year-7352419/

Bengaluru-Coimbatore (Karnataka, Tamil Nadu)

In the second cluster, the value created in the EV ecosystem is split between hardware and software. Hosur in Tamil Nadu has the upper hand in hardware, essentially manufacturing, and Bangalore in Karnataka certainly has the software edge, i.e. coding. Thus, the primary data collection points for this cluster are **Hosur-Bangalore**.

Hosur is an industrial city located in the north-western part of the district of Krishnagiri in the Indian state of Tamil Nadu. It is also considered the satellite city of Bengaluru and houses several automobile manufacturing industries. It is home to major manufacturing industries, including Ashok Leyland, Titan, TVS Motors, Caterpillar, Sundaram Fasteners, Schaffler, etc. Proximity to Bangalore is seen as an advantage. Many IT companies prefer Hosur for their initial operations. In December 2019, Electric vehicle manufacturer Ather Energy signed an MoU with the Government of Tamil Nadu to set up a 400,000 sq. ft. (37,000 m^2) manufacturing plant.[17]

TVS, a well-established auto industry, has started making its electric scooter in the Hosur plant. Ola Electric is constructing its manufacturing facility in Krishnagiri. Delta Electronics has one of its manufacturing facilities in Hosur and the R&D Centre at Bengaluru. By the provisions of Tamil Nadu EV policy, acquisition of land in Tamil Nadu is easier, as there is bipartisan support for industrialisation. Tamil Nadu also offers stamp-duty exemption and subsidised land from the state's land bank in SIPCOT (State Industries Promotion Corporation of Tamil Nadu), SIDCO (Small Industries Development Corporation), and TIDCO (Tamil Nadu Industrial Development Corporation). The Tamil Nadu policy also tries to leverage its position as a power surplus state. Tamil Nadu has a high share of wind and solar energy to its advantage. It is also investing in charging infrastructure. The presence of such charging infrastructure every 25km, as is the plan, goes a long way in assuaging range anxiety among buyers, stimulating demand.

Bangalore, officially known as Bengaluru, is the capital city of the Indian state of Karnataka. Bangalore is widely regarded as the "Silicon Valley of India" (or "IT capital of India") because of its role as the nation's leading information technology (IT) exporter. Karnataka has a well-established ecosystem for a vibrant automotive sector with a wide pool of technical manpower, robust R&D capabilities, and manufacturing expertise. At least 47 startups are working in the EV sector, including Ola Electric, Sun Mobility, Kwh Bikes, and Ather Energy.[18]

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17 https://timesofindia.indiatimes.com/business/india-business/ather-energy-to-set-up-electric-vehicle-manufacturing-facility-at-hosur-in-tn/articleshow/72331050.cms

18 https://energy.economictimes.indiatimes.com/news/power/karnataka-tweaks-ev-policy-to-offer-15-per-cent-capital-subsidy-to-investors/83026435

The Government of Karnataka intends to make Bengaluru, the EV capital of India. EV policy of Karnataka provides incentives to attract investments for EV manufacturing, support charging infrastructure, R&D, and skill development as well as demand-side incentives.[19]

Autobot India has been conducting an EV Bootcamp programme since 2016, which gives engineering students a platform for industrial internships in electric vehicle technology learning. Institute for Design of Electrical Measuring Instruments (IDEMI) has its extension centre in Bangalore. It provides online training for the EV charging station and retrofitting business.

6. Proposed Research Methodology

Step 1: Literature Review

An extensive review of existing literature on EV manufacturing ecosystem, job and skill opportunities linked to EVs, and the EV ecosystem in the two selected clusters. Additionally, a review of methodologies used for studying the local economic impact of auto-sector developments and mapping of jobs and skills.

Step 2: Mapping of Stakeholders (Scoping Visits) and Secondary Data Collection

i. Mapping of relevant stakeholders from the EV manufacturing and skill development ecosystem in the two selected clusters through secondary research and scoping visits to the relevant clusters.

ii. Utilising Google earth data for exploring the trends of development around selected EV manufacturing plants since their establishment

iii. Mapping of specific job roles, skill sets, and respective training courses/modules for the EV ecosystem

iv. Collection of data related to local economic development from relevant Government databases and departments

Step 3: Preliminary Analysis

Spatial-temporal analysis of development around manufacturing plants after their establishment using Google Earth Engine (refer to the glimpses shown below for an EV component manufacturing plant). Such analyses will be done for two or three plants of each cluster, and then case studies will be drawn by comparing the development in old and new clusters and/or in the Gurugram-Delhi and Bangalore-Hosur clusters. This exercise will strengthen the approach and develop reference points for primary data collection.

[19] https://kum.karnataka.gov.in/KUM/PDFS/KEVESPPolicyInsidepagesfinal.pdf

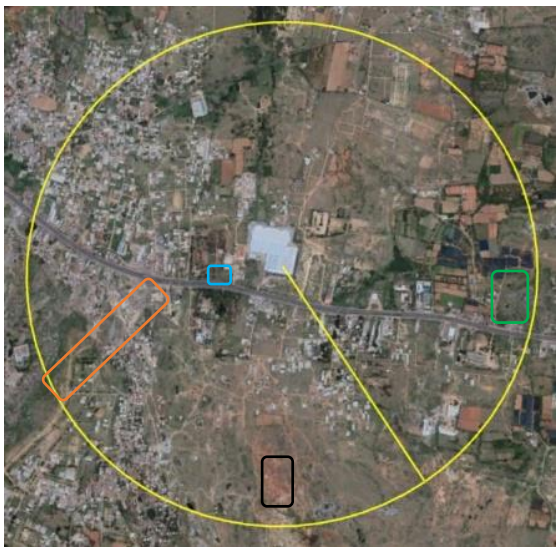
Glimpses of spatial-temporal change detection using Google Earth Data

Land use is simply a representation of the different human activities. With industrialisation and urbanisation, land use is changing. These changes can be detected in a spatial[20] and temporal[21] term using Google Earth.

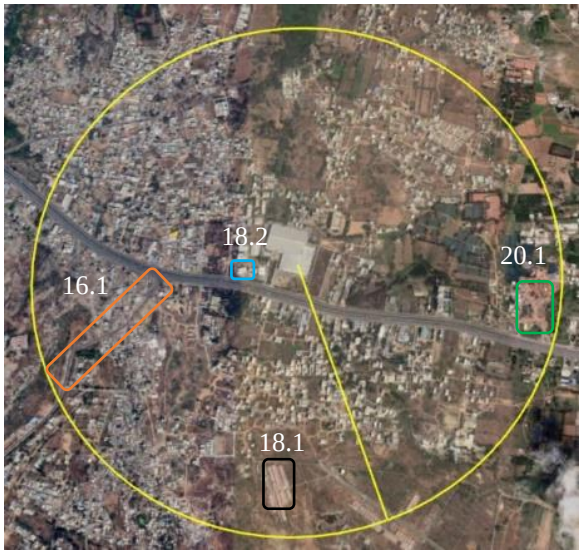
Spatial-temporal databases host data that are collected across both space and time that describe a phenomenon in a particular location and time. This tool has been used in several studies that aim to track patterns in land utilisation or area-specific development over time and will be used similarly in this study.[22, 23]

For example, the detection of some of the developments around a 1km radius of the Delta Electronics plant after its establishment in 2011 has been shown in Figure 1. Delta electronics manufactures products related to power electronics, automation, and infrastructure. Under their e-mobility vertical, they provide solutions for EV charging, EV/HEV powertrain, and energy storage.

Figure 1: Change detection using Google Earth throughout the years around Delta Electronics Pvt. Ltd., Hosur, Tamil Nadu



2011



2020

[20] Related to space
[21] Related to time
[22] A study was conducted for Situ Cipondoh in Tangerang City that used temporal archived Google Earth data between 2004, 2010 and 2015. https://iopscience.iop.org/article/10.1088/1755-1315/47/1/012031/pdf
[23] A study was undertaken in which anthropogenic land conversion across East Africa was manually identified using Google Earth. https://www.sciencedirect.com/science/article/pii/S1364815215001747?via%3Dihub

The number of changes is depicted in the 'YY.N' format, where YY is the last two digits of the year YYYY in which the development happened and N represents the number of developments in that year. The orange box gives information about a new road in the year 2016. The black box shows a construction of a housing colony in the year 2018 and the blue box showed another change in 2018. The green box shows setups for transport service in the year 2020.

Step 3: Primary Data Collection

Collection of primary data on the various indicators of the local economy and livelihood development, i.e., prosperity, people, planet, and institutions using the following tools.

i. Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) with identified stakeholders using semi-structured questionnaires. Key stakeholders for this purpose will include stakeholders from EV and component manufacturing industries, EV charging infra and technology development enterprises, government departments, industry associations, and skill development centres across the two selected clusters. The main objective of KIIs will be to explore the potential of business growth, local economic development, and job roles (and quantum of jobs) that will emerge due to the indigenisation of the EV manufacturing ecosystem and assess existing gaps in job roles, skills, and other attributes of a just transition.

Step 4: Data Analysis and Preparation of Outputs

The stakeholders responding to the survey will be classified based on their EV-related business area. It may include manufacturing of any segment of EVs, manufacturing of EV battery or any of its components, education and training, and advocacy. The data collected will be analysed using a combination of qualitative and quantitative methods.

For the qualitative analysis, a systems approach will be adopted to map and draw linkages between various EV ecosystems and allied economy components, including skill

development. Further, in-depth case stories will be developed on critical themes of the study. In the case of the qualitative analysis, the linkages between the characteristics of the EV manufacturing ecosystem of the selected clusters and the indicators for economic growth will be drawn. The characteristics of both clusters in terms of demography, nature of industries, administration, employment, infrastructure, etc. will also be examined. These analyses will be combined to develop a comprehensive report, infographics, and other short, interactive outputs.