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EV-Ready India:

Leveraging Competitive Advantages of States for EV Manufacturing

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Abstract

Over the last few years, there has been growing encouragement of local manufacturing of lithium-ion batteries and other EV components with policy measures such as the PLI scheme and proposals for manufacturing giga factories entering the fray. In light of a tumultuous and unpredictable global trade environment, localisation of value chains and production capabilities has become a necessity, especially with the pandemic-induced disruption of supply chains overly dependent on China. This white paper locates itself in the context of such challenges and opportunities for India's EV manufacturing industry. It underscores the potential of Indian States to help India become an EV manufacturing powerhouse. Identifying certain vital factors that are essential for a region's manufacturing success, it points out states which possess a competitive advantage under the given domain. The white paper argues for states to strategically realign their supply-side incentives and industrial policy tenets to fully leverage their respective competitive advantages to hasten the creation of robust, localised EV value chains that can cater to the world.

Introduction

India is one of the largest producers of automobiles in the world with over 30 million vehicles produced in the year 2019 alone (*Sector: Automobile*, n.d.). The sector has been a leading protagonist in the country's growth story- contributing upwards of 7% to its overall GDP, a whopping 49% to its Manufacturing GDP and providing 37 million direct and indirect jobs (PIB Delhi, 2019). Despite the slowdown on account of the Covid-19 pandemic, the sector is quickly bouncing back to life, with Q4 in FY 21 seeing a year-on-year uptick of 42.40 % for passenger vehicle sales (*Indian Auto Industry Bounces Back in Q4 FY 2021*, 2021).

While the automotive sector is responsible for almost half of India's manufacturing output, it is missing a crown jewel. India's numbers for both production and uptake of electric vehicles (EVs), while promising, are currently less than ideal given its massive potential. EV sales were increasing on a near consistent basis for several years till the onset of the pandemic precipitated a 20% dip in sales for financial year 2020-21 (ET Auto, 2021). The sector seems to have revived admirably with June 2021 seeing a 236% month on month increase in sales figures (JMK Research & Analytics) and August 2021 witnessing record sales numbers (Ministry of Road Transport & Highways, 2021). Despite the unprecedented jump in sales in August 2021, the total proportion of EV registrations in the month amounted to just over 2% of the total vehicle registrations in the country (Ministry of Road Transport & Highways, 2021). At present, EVs constitute less than 1% of India's cumulative motor fleet.

In terms of manufacturing, there are currently as many as 432 registered EV manufacturers in the country (Ministry of Road Transport & Highways, 2021). But a vast majority of them do not have localised value chains and portray an unhealthy dependence on imports for meeting their battery and component requirements. Further, they continue to be committed to anachronism- using lead acid batteries and providing low range and low speed performance through their models. This is evident from analysis by CRISIL (2019), which assessed that nearly 95% of electric two wheelers would be ineligible for subsidies under FAME II after the central government revised the minimum eligibility thresholds for range, speed and localisation. At present, components constituting nearly 60% of the production cost of the vehicle are partially or entirely imported by most OEMs, with limited avenues for vitalising domestic capacity generation.

The reasons for India's relatively slow EV manufacturing growth are varied. Fragmented markets, credibility concerns regarding the products on offer, limited business-to-business interplay for manufacturing capacity, lack of attractive financing options, and volatile supply chains overly dependent on imports have stalled the electric revolution in India.

Notwithstanding the presence of deficiencies, opportunities exist for enhancing the scope and speed of production of electric vehicles in India. The recently approved PLI Auto scheme with its INR 26,058 crore budgetary outlay for the automobile and drone industries bodes well for the sector in this regard. The Champion OEM Incentive scheme component under the larger PLI Auto scheme is a 'sales value linked' scheme especially applicable on Battery Electric Vehicles (BEVs) and Hydrogen Fuel Cell Vehicles (FCEVs) of all segments, giving a much needed fillip to their production prospects (PIB, 2021). This white paper considers the role that Indian states can play by leveraging their manufacturing potential to make India an EV manufacturing hub.

Changing geopolitical and business realities

Recent developments on the global stage have changed incentive structures for automobile manufacturers and created an opening for India to establish itself as a desirable investment destination. Value chain disruptions caused on account of the COVID-19 pandemic have prompted companies to shift their manufacturing bases out of China, traditionally considered as the world's foremost manufacturing powerhouse. Further, even those who may be disinclined to incur the costs of relocating lock, stock, and barrel are increasingly keen to mitigate supply shocks from future events encompassing a similar scale by diversifying their supply chains and spreading their operations across multiple jurisdictions. There have been reports of companies showing interest in sourcing electronics and automobile components from India (Ghosh & Mukherji, 2020). US firms have been especially reluctant to continue operations in China given the multiyear trade war. Kearney's 2019 Reshoring Index shows that the shift of trade flows from China to other Asian low-cost countries (LCC), going on for more than five years, was accelerated by the US-China trade war. US imports worth USD 31 billion shifted from China to other Asian LLCs in 2019 (Kearney, 2020). The pandemic has further exacerbated the state of affairs.

These developments present a window of opportunity for India to attract investments in manufacturing, especially those in the EV space. States have been jostling with one another to secure foreign investments. Uttar Pradesh, Gujarat, and Madhya Pradesh introduced extensive labour reforms in May 2020 (ET Bureau, 2020). Tamil Nadu has announced land and transport subsidies in addition to refund of state GST levied on capital goods for foreign direct investments (FDI) flowing into the state for a period of one year (Mathew, 2021). Other states are expected to follow suit.

Domestic Imperatives for increased production

India has three key domestic imperatives to hasten EV production and uptake in the country. First is the necessity to deal with its massive problem of urban air pollution. 22 of the 30 most polluted cities in the world are in India (Pillai, 2021). There are serious costs associated with this figure- India sees over one million pollution-related deaths annually and an economic loss worth 5.4% of its GDP on account of air pollution (Greenpeace India, 2020). And the transport sector is a major culprit, accounting for nearly 13.5% of India's energy-related CO_2 emissions, with road transport alone making up 90% of the sector's total final energy consumption (International Energy Agency, 2020). The sector contributes as much as 23% to India's total GHG emissions (KPMG, 2020). EVs could eliminate tailpipe emissions- potentially lowering CO_2 emissions by 30-50% depending on the extent of EV penetration and renewable energy integration (Gopal et.al, 2015). Even when EVs are powered by a coal-dependent grid, they have a smaller carbon footprint over the entirety of their lifecycle when measured against conventional petrol or diesel vehicles (Bieker, 2021). This makes rapid adoption of EVs a key driver for making Indian cities cleaner and more livable, in line with globally negotiated Sustainable Development Goal (SDG) 11 that calls for inclusive, safe, resilient, and sustainable urban settings (*Goal 11: Make Cities Inclusive, Safe, Resilient and Sustainable*, 2020). Rapid adoption of EVs at scale is more likely and easier to achieve when manufacturing of said EVs takes place domestically: Local sourcing and manufacturing

will not only allow OEMs to produce products most appropriate for Indian conditions but also enable state authorities to design and implement incentive structures more effectively, keeping quality control in check.

Second, the vision of 'Atmanirbhar Bharat' has ushered in a renewed thrust on enhancing resilience and self-reliance through greater indigenous production and some degree of import substitution. While its efficacy as an economic policy may be up for debate, domestic OEMs are eager to avoid supply shortages in the future while positioning themselves for a greater role in global value chain servicing. This has the potential for deeper enmeshment of domestic Tier 1 and Tier 2 automotive suppliers in the industry through partnerships with OEMs that foster interdependence and eliminate cross-jurisdictional business risks. A long term realignment in terms of prioritisation of products, i.e. EVs over internal combustion engine (ICE) vehicles, may also be on the cards. EVs often require fewer parts and are thereby less likely to face disruption of the same magnitude to their supply chains when compared to their internal combustion engines counterparts. Additionally, mass adoption of EVs can help achieve other objectives such as limit India's burgeoning crude oil import bill by over INR 1 lakh crore on an annual basis thereby safeguarding India's energy security (Gupta, 2020). On average, the respective import burdens per private and commercial ICE cars will be 4.1 and 5.7 times higher than that for a private electric car in 2030 (Soman et. al, 2019).

Third, is the role EV manufacturing can play in revitalising India's industrial sector. Estimates suggest that EVs could present a market opportunity worth INR 14.4 lakh crore with a cumulative investment need of about INR 12.5 lakh crore during the course of FY21-FY30 (Singh et. al, 2020). For perspective, the market potential for EVs is, therefore, roughly equivalent to the current nominal GDP of Greece. The actual gains from the opportunity could be worth a lot more once network effects and the concomitant socio-economic advantages accruing to parties at each stage of the manufacturing process are accounted for. Provided skill development in domains such as design and testing, battery manufacturing and management, sales, services and infrastructure keeps pace, India's e-mobility industry could generate as many as 1 crore jobs in the future (Dogra, 2019).

For such benefits to be realised, India will have to act with alacrity. This study considers the avenues in front of States to support India's journey towards becoming an EV manufacturing hub. Identifying their competitive advantages and formulating their policies and incentive structures accordingly can help create different manufacturing fortes in the country, all of which, when put together, can push India's EV manufacturing vision forward.

Identifying factors for EV manufacturing success

In any domain, certain broad conditions and enablers can be identified which are indispensable for the growth of the sector. This section looks at important factors instrumental for States to fully leverage their respective manufacturing competitive advantages.

Presence of relevant minerals and processing facilities

EVs use a substantially greater degree of mineral components compared to ICE vehicles (see Figure 1). The Lithium-ion battery alone, for instance, may utilise minerals such as lithium, cobalt, aluminium, manganese, nickel, and graphite depending on the cell chemistry employed. Of the ones mentioned, India has globally consequential reserves or sizeable production volumes of only graphite, manganese, zinc, and aluminium (bauxite). The States with major presence of these minerals have been represented in Figure 2. It serves well to mention that Rajasthan and Odisha enjoy highly dominant positions in the production of zinc and bauxite respectively.

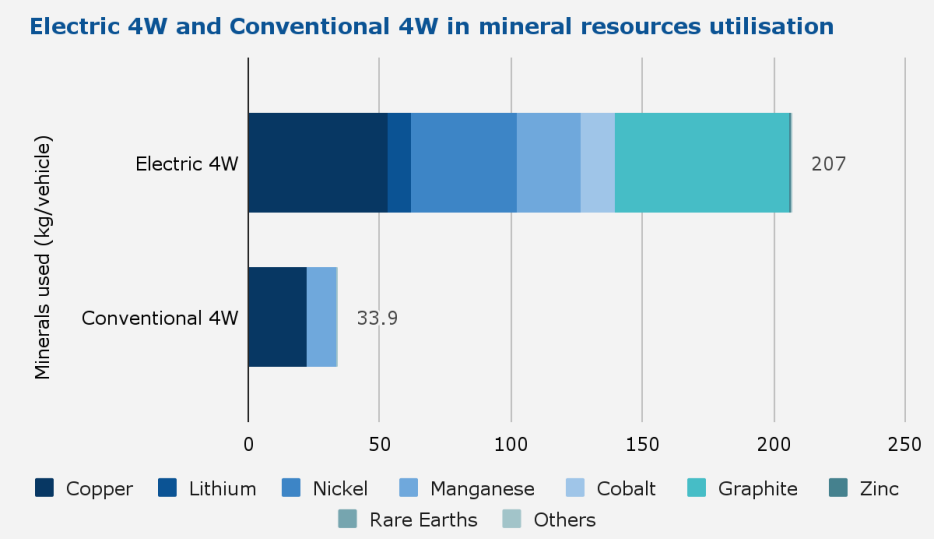

***Figure 1**: Amount of minerals (in kg/vehicle) used in electric cars compared to conventional cars[1].*

Source: The Role of Critical Minerals in Clean Energy Transitions, World Energy Outlook, IEA (International Energy Agency, 2021)

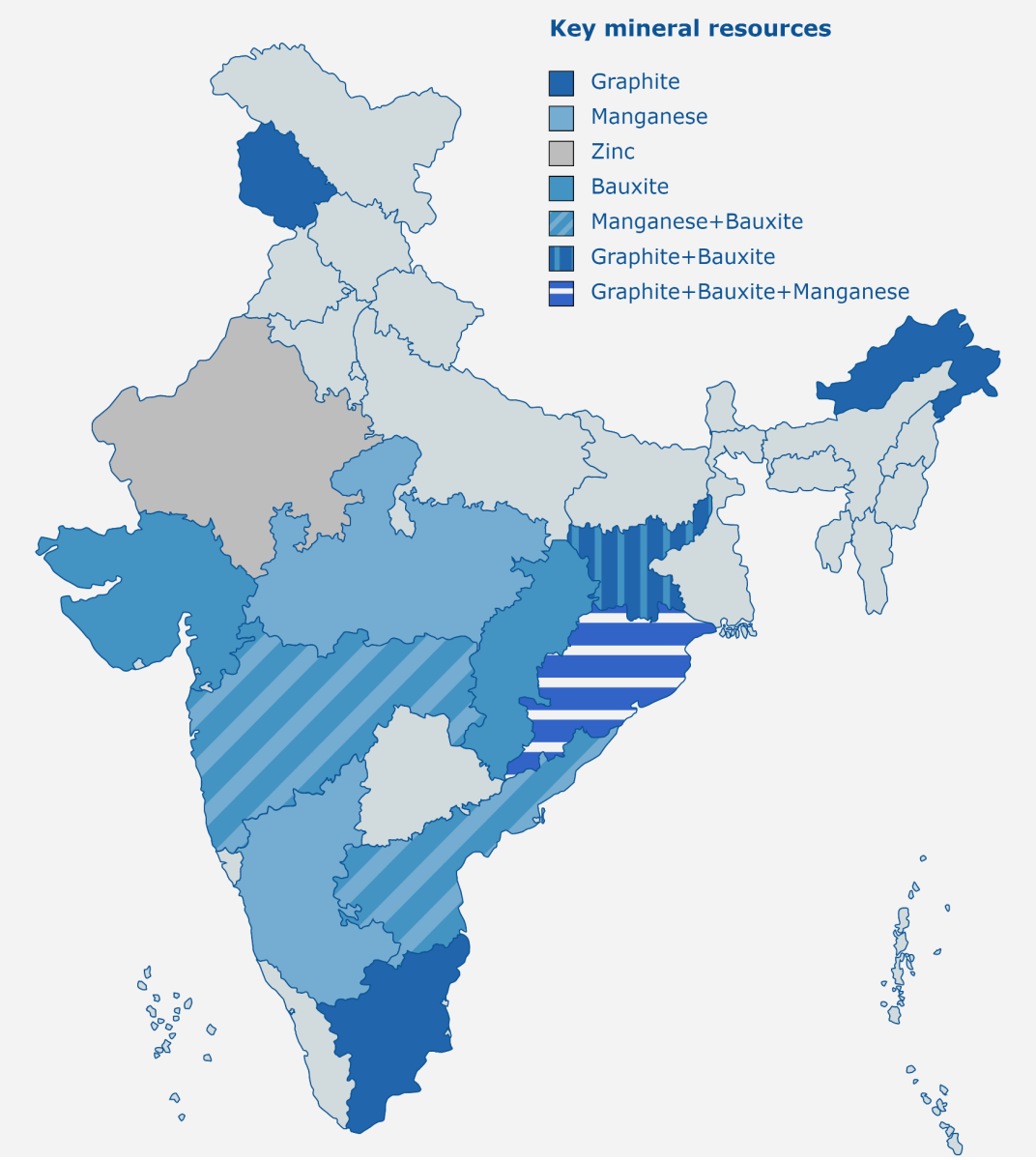

***Figure 2:** Distribution of key mineral resources.*

Source: Data collected from reports of the Indian Bureau of Mines.

[1] Note: Steel and aluminium not included. The values are for the entire vehicle including batteries, motors and glider. The intensities are based on a 75 kWh NMC (nickel manganese cobalt) 622 cathode and graphite-based anode (IEA).

As evident, India lacks globally consequential reserves of key EV-essential minerals such as Lithium and is thus forced to rely on imports for meeting its requirements for lithium-ion cells and batteries. Over the period 2016-18, India quadrupled its imports of lithium-ion (Li-ion) batteries and more than tripled its import bill on the product (Koshy, 2020). The trend is ominous, especially since India's demand for lithium in vehicular use is projected to touch 6kt by 2030 from less than 1kt in 2015 (Jones et. al, 2020). India's imports of rare earth elements such as neodymium and dysprosium, which are used in permanent magnet motors, have also increased nearly four times between 2009 and 2017 (Bhattacharjya et. al, 2018).

There are concerns regarding inadequacy of proper processing and refining facilities as well, with China churning out over 80% of the world's processed battery grade raw material and consequently enjoying a near monopoly over the raw material supply chain (Roychowdhury et. al, 2021). Manikaran Power Limited has announced the setting up of the country's first lithium refinery in Gujarat to process imported lithium ore from Australia (Nair, 2020). This is a good first step but more needs to be done.

In addition to enhancing its capacity for raw material processing, India could enter into long-term preferential purchase agreements and negotiate trade rules to ensure adequate raw material supply. Moreover, India could consider asset and equity investments in mines and mining companies abroad. Chinese firms, for instance, own eight of the fourteen large cobalt mining firms in Congo, accounting for almost half of Congo's output (Roychowdhury et. al, 2021). India is also looking to leverage this route. Three PSUs- NALCO, HCL and MECL- have come together to establish a joint venture named Khanij Bidesh India to scout for mineral assets like lithium and cobalt in foreign jurisdictions (Mazumdar, 2019). Finally, India must expedite exploratory efforts inside its own borders, open up its rare earth sector to private competition, establish battery manufacturing giga-factories to leverage economies of scale, improve pervasiveness and efficiency of end-of-life battery recycling to recover precious metals, and continue with its efforts to ensure an equitable, rules-based global trade regime. The last suggestion can help guard against the creation of trade monopolies with respect to key minerals and ensure that obstructive, and arbitrary, tariff or non tariff barriers are not erected to prevent India from accessing these vital resources.

Automotive and electronics manufacturing capacity and potential

EV manufacturing success necessitates a structural, ecosystem approach replete with value-making nodes and ancillary services support across the entire supply chain. Hence, it is imperative that existing auto-clusters will play a pivotal role in manufacturing EVs and EV components in India, especially with respect to components that are interchangeable between ICE vehicles and EVs. At present, India has three major auto clusters, namely, Mumbai–Pune–Nasik–Aurangabad in Maharashtra; Chennai-Sriperumbudur-Oragadam-SriCity in Tamil Nadu and Andhra Pradesh; and Manesar-Faridabad-Gurugram in Haryana (McKinsey,2018). Going by production volumes, Haryana leads the way with 50% of the passenger cars manufacturing and 60% of motorcycle manufacturing in the country (Invest India & JLL India,2020). In terms of value, Maharashtra accounts for 35% of India's automobile output (Invest India & JLL India,2020). Recently, two more clusters have emerged with significant auto manufacturing activity. These are Sanand-Mandal-Becharaji in Gujarat, and Bengaluru-Bidadi-Hosur in Karnataka and Tamil Nadu (Invest India & JLL India,2020). Most ICE OEMs and component manufacturers are located in and across the above mentioned clusters (McKinsey,2018).

While these clusters may serve as component feeders to the incipient EV industry for the foreseeable future, India will have to build its base to manufacture EV-exclusive component modules which contribute approximately 60% of the total component costs of an EV (Singh et al.,2020). The major component modules of this sort include the battery pack,

the electric drive, power electronics, and the vehicle interface control module. At present, most of these components are partially or entirely imported.

Power electronics, and automotive electronics in general, have a massive import reliance, the presence of which was widely felt during the recent semiconductor supply crisis. EVs often use a wider variety of electronics than similar ICE vehicles. Currently, only 9% of auto component manufacturers in the country work in the electronics space, with a relatively high dependence on foreign JV partners and imports (Khan,2021). Imports make up for around 65-70% of the related OEM demand (McKinsey,2018). According to industry analysis, the average electronic component cost per passenger vehicle could reach as high as INR 2 lakh by 2027 (Press Trust of India,2021). As for the freight sector, with e-commerce companies swiftly switching to electric, embedded telematics could eventuate similar growth trajectories . To get an indication of the States that could emerge as manufacturing centres for EV specific component modules and advanced electronics, perhaps it makes sense to look at upcoming EV manufacturing clusters in the country and assess if, and to what extent, their geographic location differs from existing auto clusters. Take the E-2W segment, for example. The overall market leader, Hero Electric, has a manufacturing plant in Ludhiana, Punjab. Revolt Motors and Okinawa Autotech have plants located in Manesar, Haryana and Bhiwadi, Rajasthan respectively. While this may suggest scattering, certain incipient clusters are already discernible. Chakan, in Pune, Maharashtra, for instance, is home to a range of EV manufacturers including Tork Motors and BGauss. Mahindra Electric is also building a new EV powertrain manufacturing unit in the region which will manufacture internal permanent magnets- the first to do so in India- along with transmission and power electronics (Dalvi,2019).

The biggest winner of India's E-2W gold rush, however, has been Tamil Nadu. The State has witnessed the setting up of Ather Energy's plant in Hosur, Ola Electric's Futurefactory in Krishnagiri, and is slated to host Ampere Electric's plant at Ranipet (Mint, 2021). This, of course, is in addition to the existing plants of legacy manufacturers such as TVS which is manufacturing its electric scooters from its Hosur plant. The State has been successful at luring investments with a plethora of progressive supply-side incentives. These include reimbursement of SGST on electric vehicle manufacturing; subsidy between 15 and 50 per cent on land cost; capital subsidy for battery manufacturing; exemption from payment of Electricity Tax till 2025; employment incentive in terms of reimbursement of EPF for one year etc. (Government of Tamil Nadu, 2019). States with existing strengths in automotive manufacturing are indeed better placed to potentially leverage the manufacturing opportunity afforded by the transition. But as Tamil Nadu's example shows, this will fructify only when legacy advantages are ably bolstered by strong supply side incentives.

Technical Capital

Yet another imperative for manufacturing high quality EVs is the presence of skilled personnel and substantial R&D support. EV manufacturing requires skills in domains as varied as mechatronics, telematics etc. Table 1 shows some of the skills and domain expertise required for various EV manufacturing and testing-related tasks.

Table 1: Skill domains and relevant EV processes and tasks	
Chemical Engineering	Manufacturing of lithium-ion cells and assembly of battery packs; recycling of batteries
Computer science and engineering	Developing algorithms for the Battery Management System (BMS); making IoT modules for sharing real-time data generated by EVs; using AI to improve the efficiency of BMS
Mechanical engineering	Thermal systems; vehicles and parts design and manufacturing

Electronics and communication engineering	Developing firmware for the BMS; manufacturing and installing sensors; power electronics
Electrical engineering	Working on motors; developing wire harnesses; quality control; testing of battery packs
Mechatronics engineering	Vehicle design; robotics for part assembly; powertrain development

Source : EVreporter (EVreporter, 2021)

At present, only a handful of engineering colleges in the country have dedicated course modules for EV-related engineering and research. The rest either do not teach vital components like mechatronics or teach them as combinations of existing fields, using conventional curriculum tools thereby eschewing holistic pedagogical inputs. National Programme on Technology Enhanced Learning (NPTEL) and Automotive Skills Development Council (ASDC) are providing courses relating to electric mobility but their impact is limited when compared to formal, brick and mortar educational programmes.

To gauge the potential of the States in EV manufacturing related skill-sets, one approximate barometer could be the quality of their respective engineering institutes.[2] Analysing the top 200 engineering institutes from NIRF 2021 rankings, it is found that Tamil Nadu has the highest number of top ranked engineering institutes in the country with 36 colleges out of the top 200. The next four are Maharashtra (19), Karnataka (19), Telangana (14), and Uttar Pradesh (14) (*MoE, National Institute Ranking Framework (NIRF)*, 2021). IIT Madras, the number one engineering college in the rankings, also happens to be a trendsetter in the electric mobility domain with a dedicated Centre for Battery Engineering and Electric Vehicles and an upcoming MTech course in electric mobility (Indian Express, 2021).

Established technology powerhouses will additionally enjoy definite advantages going forward. Bengaluru, for instance, houses 70% of India's chip designers, is responsible for 38% of India's IT exports, and has the largest number of R&D centres in the country (Invest India & JLL India,2020). Similarly, Hyderabad is quickly becoming a technology-driven cluster, with the highest number of IT SEZs employing a large number of skilled personnel (Invest India & JLL India, 2020).

EV-specific upskilling is essential for India to support a strong, local supply chain. China was successfully able to create learning opportunities through EdTech and traditional engineering programmes to generate a skilled workforce for its transition (Mandal, 2020). New industry relevant courses on electric mobility were launched in engineering institutes and existing courses were modified to include information on hybrid vehicles and retrofitments. For India to be successful, Centre and States need to undertake proactive curriculum revision, structured reskilling through the existing ecosystem of ITI and other vocational institutes, and the establishment of EV specific scholarships, research grants and centres of excellence.

Investment Climate and Ease of Doing Business

A favourable investment climate is a prerequisite for any manufacturing growth, more so when the industry is at an incipient stage and requires both regulatory hand-holding while relying on disruptive business innovation to break existing glass ceilings. A positive investment climate for EV manufacturing would be characterised by- a dogged

[2] The author understands that this may not be the best indicator but believes it serves well in the absence of specific data. There are some obvious caveats that can need to be called out. For instance, it is possible that students graduating in a particular State may not go on to work there or, as pointed out earlier, the curriculum being taught at the engineering colleges considered may have little relevance for the field of EV manufacturing.

protection of physical and intellectual private property, streamlined procedures for investment clearances, strong enforcement of competition laws, support of enterprise through taxation holidays and subsidies, provisioning of incubation facilities, facilitation of land procurement etc. While it is the Central Government's prerogative to guarantee most of these, the States do have a substantial role to play, especially with respect to bureaucratic clearances, land procurement as well as in facilitating ease of doing business. The table below lists down the top performers on some of the common rankings which can be used to gauge a State's investment climate and ease of doing business.

Table 2: Top performing states in Investment Climate Indicators	
States Startup Ranking 2019 (Department for Promotion of Industry and Internal Trade)	Best Performer- Gujarat Top Performers- Karnataka, Kerala Leaders- Bihar, Maharashtra, Odisha, Rajasthan
4th edition of Ease of Doing Business Rankings based on the State Business Reform Action Plan (State BRAP) (Department for Promotion of Industry and Internal Trade)	Top 5 States- Andhra Pradesh, Uttar Pradesh, Telangana, Madhya Pradesh, and Jharkhand
FDI inflow over FY 2020-21 (Department for Promotion of Industry and Internal Trade)	Top 5 States in terms of amount of FDI inflow - Gujarat, Maharashtra, Karnataka, Delhi, and Tamil Nadu
State Investment Potential Index 2018 (NCAER)	Top 5 most attractive states for investors- Delhi, Tamil Nadu, Gujarat, Haryana, and Maharashtra

Source: Data taken from respective indices

With specific reference to manufacturing in the EV domain, targeted demand incentives for adoption can also play a strong role in creating the right environment for rapid manufacturing by creating viable local demand and influencing policy decisions to buttress and leverage the same through indigenous manufacturing. Delhi, Maharashtra, and Gujarat have some of the most progressive EV policies in the country with strong fiscal and non-fiscal demand incentives, including purchase subsidies over and above the amount being provided under FAME II (Garg,2021).

For India, and its constituent states, attracting established domestic and international capital while promoting innovative startups will both have to be pursued simultaneously. For the former, States must attempt to link supply-side incentives mentioned in their respective State EV policies with existing industrial policy or SEZ regulations in their jurisdictions in addition to offering support through capital subsidies, interest subvention on industry-oriented loans, low cost water and power tariffs etc. Linkages with industrial policy will provide a sense of continuity and raise confidence among investors, besides laying the ground for scale-reliant, efficient, mega projects that service and leverage multiple industrial sectors such as battery gigafactories. Maharashtra, for instance, seeks to provide all EV-related manufacturing units with benefits associated with a D+ industrial grouping, ordinarily available only to enterprises setting base in hitherto neglected rural or semi-rural areas (Government of Maharashtra, 2021).[3]

Similarly, to create an atmosphere where startups can emerge and thrive, provisioning holistic incubatory support will be imperative. States should try to create a range of institutions in collaboration with industry and academia that can address all concerns that may emerge at any stage from seeding to scaling up of a startup. Telangana has an elaborate network in this regard. T-Fund, T-Works Automotive Prototyping Center, and T-Hub seek to offer financial support to

[3] Benefits may include stamp duty exemption, electricity duty exemption, interest subsidies, subsidised power tariffs etc.

EV startups, a plug-and-play prototyping centre, and act as an innovation intermediary-cum-business incubator respectively (Government of Telangana, 2020).

Logistical support and export preparedness

Manufacturing units need strong transport and communication linkages to ferry raw materials to the unit and transport manufactured end products out of it. They further need a variety of logistical support. Unsurprisingly, states which do well on the manufacturing front often have the most well connected network of road, rail, and air connectivity. Added port presence makes it easier for arranging exports. Table 3 looks at two indicators that can be used to get an idea of the states which possess advantages in this domain.

Table 3: Top performing states in Logistics and Export preparedness Indicators	
Logistics Ease Across Different States (LEADS) 2019 (Department of Commerce, Ministry of Commerce and Industry)	Top 5 States: Gujarat, Punjab, Andhra Pradesh, Maharashtra, and Tamil Nadu
Export Preparedness Index 2020 (NITI Aayog)	Top 5 States: Gujarat, Maharashtra, Tamil Nadu, Rajasthan, and Odisha

Source: Data taken from respective indices

While the length of a state's road network is mostly determined by its area and is a poor indicator of its connectivity, the length of the National Highway (NH) and the State Highway (SH) networks can give an idea about the extent of a state's road accessibility. Maharashtra tops the charts for both NH and SH length, while Rajasthan and Karnataka are in the top 5 for both. Maharashtra also has the most number of ports with 53 major and non-major ports, including the Jawaharlal Nehru Port Trust (JNPT), the largest container port in the country. It is followed by Gujarat with 40 ports. In terms of major ports, Tamil Nadu leads the way with three major ports. In the LEADS assessment, Punjab emerges as the best performing state in the Northern landlocked cluster, registering the best scores for indicators such as safety of cargo movement, quality of logistics infrastructure etc.

Assessment of States' competitive manufacturing advantages

Based on the discussion above, the competitive advantages of different states can be summarised as follows.

Table 4: Summarisation of States' competitive advantages

Selected States/ UTs[4]	Consequential reserves of relevant raw materials	Presence of auto clusters/ substantial manufact	Top 5 States with highest number of top	Top performers on Investment Climate indicators	Top performers on Logistics and Export Preparedness

[4] This table includes only those states which possess competence in at least one of the chosen indicators.

	Graphite	Manganese	Zinc	Bauxite	uring presence	ranked engineering institutes	SSR[5]	EOB[6]	FDI Inflow[7]	SIP[8]	LEADS[9]	Export Preparedness Index[10]
Andhra Pradesh		✓		✓	✓			✓			✓	
Arunachal Pradesh	✓											
Bihar							✓					
Chattisgarh				✓								
Delhi									✓	✓		
Gujarat				✓	✓		✓		✓	✓	✓	✓
Haryana					✓					✓		
Jammu and Kashmir	✓											
Jharkhand	✓			✓				✓				
Karnataka		✓			✓	✓	✓		✓			
Kerala							✓					
Madhya Pradesh		✓						✓				
Maharashtra		✓		✓	✓	✓	✓		✓	✓	✓	✓
Odisha	✓	✓		✓			✓					✓
Punjab											✓	
Rajasthan			✓				✓					✓
Tamil Nadu	✓				✓	✓			✓	✓	✓	✓
Telangana						✓		✓				
Uttar Pradesh						✓		✓				

[5] SSR- States' Startup Ranking 2019
[6] EOB- 4th edition of Ease of Doing Business Rankings based on the State Business Reform Action Plan
[7] FDI - FDI inflow over FY 2020-21
[8] SIP- State Investment Potential Index 2018
[9] LEADS- Logistics Ease Across Different States (LEADS) 2019
[10] Export Preparedness Index 2020

Are States leveraging their competitive advantages?

A cursory glance at the table above mixed with a familiarity with existing state EV policies will reveal that the states which have strong competitive advantages for EV manufacturing also happen to be some of the most progressive when it comes to outlining supply side incentives in their respective EV policies. These include states such as Tamil Nadu. A summary of different supply-side industry incentives on offer in select states is provided in the following table.

Table 5: Supply-side industry incentives in States with competitive advantages in EV manufacturing

Selected States[11]	Capital Subsidies	Land conversion fee subsidy/ Land development incentives	Infrastructure concessions and Subsidies	SGST / Stamp Duty / Electricity Duty/ Interest subsidies or exemptions	Skill Development initiatives	Employment Incentives	R&D initiatives	Battery recycling initiatives	Promotion of clean fuel
Andhra Pradesh	✓	✓	✓	✓	✓		✓	✓	✓
Bihar		✓		✓		✓	✓		
Delhi					✓		✓	✓	
Gujarat	✓	✓	✓	✓			✓		
Haryana	✓	✓	✓	✓	✓				✓
Karnataka	✓	✓	✓	✓	✓		✓		
Kerala	✓	✓	✓	✓	✓	✓	✓		
Madhya Pradesh					✓		✓	✓	
Maharashtra		✓	✓	✓	✓		✓	✓	✓
Odisha	✓	✓	✓	✓	✓		✓	✓	
Punjab			✓	✓	✓	✓	✓	✓	
Tamil Nadu	✓	✓	✓	✓	✓	✓	✓	✓	
Telangana	✓	✓	✓	✓			✓	✓	
Uttar Pradesh		✓					✓	✓	✓

Source: Format of the table adapted from Kanuri et al. (2021). Analysis author's own.
Data taken from respective State EV policy and related documents

[11] This table includes only those states from Table 4 which have a dedicated EV policy (including those with one at the draft stage)

For optimal manufacturing output, supply-side incentives must be duly aligned with the existing competitive advantages of the States. A thorough evaluation of the incentives being offered by States against their existing competitive advantages is beyond the scope of this white paper. A few interesting observations and insights, however, are worth noting. It is praiseworthy for states such as Kerala and Punjab to provide attractive incentives to manufacturers despite having a relatively lower endowment of competitive advantages. Other states should look to follow suit. States which may lack some of the advantages discussed in Table 4, can still become hubs for manufacturing-related activities provided they leverage their existing advantages and offset their inadequacies through targeted supply-side provisions. Delhi, for instance, with its obvious, and wholly understandable, limitations in establishing mega industrial projects, has still endeavoured to make a mark for itself in battery recycling. It seeks to set up battery recycling businesses in collaboration with manufacturers with a focus on urban mining thereby offsetting some of its limitations by making full use of its high per-capita EV penetration. It is also heartening to note that States are open to revising their policies and making them align to a greater degree with their existing advantages. Until recently, there was a muted manufacturing push from Karnataka. While the State was offering capital subsidies for battery manufacturing/ assembly and charging infrastructure manufacturing, its incentives on offer for EV manufacturing were short of ideal. Recognising its advantages, and its linkages to a thriving automotive cluster, Karnataka recently tweaked its provisions and is now offering a range of incentives including a 15% capital subsidy on fixed assets over five equal annual payments, a production-linked subsidy of 1% on turnover for five years etc. (Moudgal, 2021). Karnataka as well as Tamil Nadu, two of the top performing states with respect to potential for generating an EV-ready workforce, additionally provide a stipend or reskilling allowance for training of employees by companies (Kanuri et al., 2021).

There is, however, scope for greater congruence between the incentives on offer and the advantages a State possesses. Odisha, for instance, may strongly prioritise battery or cell manufacturing given its impressive reserves of several EV-relevant minerals. While the recently approved Odisha State EV policy does mention a manufacturing focus on batteries, there are a gamut of incentives which can be provisioned to make disruptive progress in this domain. Some of these measures include preferential and subsidised port access for battery manufacturers, a sector-specific production-linked subsidy scheme etc. Similarly, Uttar Pradesh- given its large pool of high quality engineering institutes may- increase its focus on skilling. Coupled with its vast demographic potential, it can emerge as a new hub of skilled manpower reserves for India's impending transition. To take another example, Punjab provides strong employment incentives with direct subsidies to companies at the rate of INR 36,000 per male employee per year, and INR 48,000 for each female and SC/ ST/ OBC employee, for a period of 5 years (Kanuri et al., 2021). Innovatively leveraging such incentive grants to further cement its position as North India's leading logistics player should augur well for the State's EV manufacturing ambitions. Suggestions of this sort can be made for all States.

Going forward, It will be prudent for states to base their policy targets on a holistic assessment of their competitive advantages. Anything less will constitute a dent to India's dreams of becoming a global EV manufacturing hub.

Conclusion

At present, there is an abundance of untapped EV manufacturing potential in Indian States just waiting to be unearthed and productively utilised. States are currently not leveraging their existing competitive advantages to their fullest potential. As the summary of supply-side incentives makes amply clear, current manufacturing focus of states seems to be widely dispersed across domains which may not necessarily represent their strongest suits. This approach is likely to result in expectedly suboptimal outcomes not just for the individual states but also at an aggregate level for the country at large. Given the seismic demands placed on the manufacturing sector by the transition to electric mobility, India will

be much more likely to attain rapid success at scale if its constituent states create manufacturing niches for themselves in line with their existing competitive advantages instead of simultaneously pursuing gains across all elements of the production process. Strategic prioritisation of this sort, supportive of cooperative federalism, can ensure that India's response to the impending paradigm shift in vehicle manufacturing is collectively deliberated, considering the interests of the country as a whole, yet individually calibrated by each state.

States should endeavour to devote a disproportionate amount of their economic, administrative and industrial resources to domains where they possess a discernible competitive edge. Supply-side incentives for EV manufacturing and a broader set of rules and factors dictating industrial policy should be aligned to capitalise on, and further develop these prevailing advantages. Additionally, states could provide enhanced sector-specific incentives to attract domestic and foreign capital to channelise investments into select, advantageous domains. The EV industry can potentially become a flagbearer for the 'Make in India' programme, catalysing domain-relevant investments worth millions in states that are best placed to gainfully utilise them.

With its impressive credentials in automotive manufacturing to lean on, the birth of high quality, domestically manufactured EV products, and widely reported adoption projections featuring hockey stick growth, India's EV manufacturing industry is at a veritable tipping point. To fully capitalise on this opportunity, states must augment their efforts at leveraging their existing competitive advantages by building an ecosystem of associated, ancillary services around said advantages. This could include setting up adequate financing infrastructure for provisioning diverse, long-term financing options to mitigate against asset-liability mismatches, galvanising international expertise for relevant R&D, shoring up insurance and intellectual property protection firms etc. as the case may be. Mechanisms for strengthening contract compliance, expeditious disposal of appeals by pertinent executive and judicial agencies, transparent and seamless handling of sensitive industrial data, and instituting orderly and secure processes for information, money, and cargo exchange will have to be streamlined in all states.

India, through its different states, possesses all prerequisites needed to achieve EV manufacturing success. With all states leveraging their respective competitive advantages, combining the concomitant gains can help propel India towards pole position in the global race for EV manufacturing. Design and implementation of policies premised upon these advantages should make India a global EV manufacturing powerhouse- building robust, localised value chains that can cater to the world.

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