ICE to EV

An Evaluation of Workforce Impact and Considerations for Just Transition

iFOREST
INTERNATIONAL FORUM FOR ENVIRONMENT, SUSTAINABILITY & TECHNOLOGY

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List of Abbreviations

ACM	Auto Component Manufacturer
APS	Aspirational Policy Scenario
CAGR	Compound Annual Growth Rate
CPS	Current Policy Scenario
EV	Electric Vehicles
ICE	Internal Combustion Engine
ITI	Industrial Training Institute
MHRD	Ministry of Human Resource and Development
NAPS	National Apprenticeship Promotion Scheme
NCO	National Classification of Occupations
NIC	National Industrial Classification
NQR	National Qualification Register
NSDC	National Skill Development Corporation
NSQF	National Skills Qualification Framework
OEM	Original Equipment Manufacturer
PMKVY	Pradhan Mantri Kaushal Vikas Yojana
RPL	Recognition of Prior Learning

Executive Summary

The transition from internal combustion engine (ICE) vehicles to electric vehicles (EVs) will have implications for a large proportion of the workforce currently engaged in the manufacturing of ICE vehicles, as well as those engaged in the value chain of the ICE vehicle ecosystem. The digital transformation in the automobile industry will require a new set of skills from manufacturing to servicing. Therefore, a key consideration for the EV transition will be to ensure a planned transition of the existing workforce engaged in the ICE vehicle ecosystem to the EV ecosystem, and also prepare a future-ready workforce.

This study analyses the prospective impact on the workforce due to the transition from ICE vehicles to EVs. The analysis is based on a primary survey of three major automobile clusters in India-- Pune (in Maharashtra), Hosur (in Tamil Nadu), and Gurugram (in Haryana). The primary survey involved, a survey of 300 ACMs and a total of 1,184 workers in the three clusters, and interviews with OEMs. Besides, an extensive review of government and industry information was undertaken to evaluate the job roles the skill requirements, among others.

The analysis shows that there are at least 564 job roles in the entire automobile sector. About 54% of them are related to manufacturing. Due to the transition from ICE vehicles to EVs, about 31% of the total job roles will be affected. Of these, 14% will become obsolete and at least 17% will require reskilling to retain employment in the same roles. The maximum impact will be in the manufacturing segment were 21% of the job roles will become obsolete.

However, the EV ecosystem will create new job opportunities. While 66 job roles will become obsolete due to the transition, 93 new job roles will be created. Besides, while the number of jobs supported by EVs are slightly lower than ICE vehicles, there will be net increase in jobs in the automobile sector due to EV penetration.

For example, the study included a comprehensive modeling of jobs for the passenger car segment. The number of jobs was estimated for two scenarios- Current Policy Scenario (CPS) and Aspirational Policy Scenario (APS) till 2036-37. The two scenarios were compared with a scenario in which it was assumed that only ICE cars were produced (ICE Scenario). The results show that the total number of jobs in passenger car manufacturing is projected to grow from 1.7 million in 2023-24 to 3.3-3.7 million in 2036-37. However, the number of jobs created in the CPS and APS scenarios is lower than those in the ICE scenario. In 2036-37, 8–17% fewer jobs would be created than in the ICE scenario. Thus, the number of jobs supported by EVs is relatively lesser than ICE.

Considering the impact on the existing workforce and the requirements in the EV ecosystem, the study outlines a set of policy measures that should be considered for a just transition of the workforce. The most important intervention in this regard will be reskilling and skilling the workforce to retain jobs and create a future-ready workforce. While there are various schemes and programmes for skilling and workforce, development, but the skilling ecosystem remains inadequate for the EV ecosystem. Therefore, it will be extremely important to develop and invest in effective skilling programmes, through coordination between the government, industry, skilling agencies, educational and training institutions, and other concerned entities.

To facilitate a coordinated approach, a Skills Taskforce can be developed at the state level, consisting of members of original equipment manufacturers (OEMs), auto component manufacturers (ACMs), skill councils, training institutes, and research institutions. The Taskforce can support the generation of data on workforce profile, including their education and skills levels, to assess education and skill gaps, and enable the design of training, academic and vocational programmes.

Another effective policy measure will be mandating the development of workforce transition plans by the OEMs. This can facilitate measures of workforce transition at the enterprise level, and complement government policies and transition measures. The plan for workforce transition should be output-oriented, outlining key performance indicators (KPIs) for monitoring its implementation. Similarly, to reduce the vulnerability of workers in the servicing and repairing segment, a 'Right to Repair and Servicing' policy can be effective. The policy should enable EV manufacturers to involve local service centers in repair and servicing and retain employment.

Overall, to ensure a just transition of the workforce, a broad-based intervention of reskilling and job creation, and measures of job retention will be necessary through government support and industry investments.

1. Introduction

The automobile sector is the third largest employer in the manufacturing sector accounting for 9.58% of employment after food products (11.05%) and textiles (9.64%).[1] While the shift from Internal Combustion Engine (ICE) vehicles to Electric Vehicles (EV), supported by government policies and industry targets, is going to revolutionise India's automobile sector in the coming years, it will have implications for a large proportion of the workforce currently engaged in the manufacturing of ICE vehicles, as well as those engaged in the downstream value chain such as servicing and repairs.

The automotive industry is expected to play a critical role in India's green transition. The total EV sales have significantly increased to 1.53 million in 2023, up from 1.02 million in 2022, indicating a strong growth trajectory in the adoption of EVs.[2] Corresponding to the growing demand, the share of production of EVs in the total production of vehicles is also increasing. Modelling studies by iFOREST show that under Current Policy Scenario (CPS) (assuming EV growth CAGR of 6.5%) EV production is projected to reach about 16 million in 2030, which is 29% of the total vehicle production, and 36 million in 2036, which translates to 46.7% of the total production. Under an Aspirational Policy Scenario (APS) (assuming EV growth CAGR of 8%), the EV production will reach 20.7 million by 2030 which is 38% of the total vehicle production, and 51 million in 2036, which is 6% of the total production.

The digital transformation in the automobile industry will require a new set of skills from manufacturing to servicing. Therefore, a key consideration for the EV transition will be to ensure a planned transition of the existing workforce engaged in the ICE vehicle ecosystem to the EV ecosystem. Simultaneously, there will be a need for the development of a new workforce.

Given the context, this report analyses the impacts of the EV transition on the workforce in India's automobile sector. The report specifically looks into the following aspects:

- Analysis of the types of jobs that will be impacted, including those that will become redundant or obsolete in the EV ecosystem, the type of jobs that can be retained through timely reskilling, and the new job opportunities that will be created by the EV transition.
- Analysis of impact on employment (with preference to passenger cars).
- Evaluation of the skilling ecosystem that currently exists in the context of the skills required by the EV industry.

Based on the observations of the workforce impact assessment and the skill ecosystem assessment, the report outlines some of the key interventions that will be necessary by the government and industry to ensure a just transition of the existing workforce and development of future workforce to meet the requirement of the EV transition.

2. Study approach

The impact assessment on workforce relies on both primary survey and secondary research. The following are the key steps that have been followed.

a. **Primary survey:** The primary survey was based on a purpose sampling approach involving on-ground surveys in three top automobile clusters of India, Pune (in Maharashtra), Hosur (in Tamin Nadu) and Gurugram (in Haryana). The survey involved the following components:

i. Survey of 300 auto component manufacturers (ACMs) in the three clusters.

ii. Survey of 1,184 workers in the three clusters.

iii. Interviews with representatives of original equipment manufacturers (OEMs), such as Mahindra, Maruti, Tata Motors, TVS and Force Motors.

Table 1: Distribution of ACM workers surveyed

Cluster	Large	Medium	Micro	Small	Cluster total
Hosur	56	90	149	124	419
Gurugram	46	117	37	115	315
Pune	10	104	173	163	450
Total workers	**112**	**311**	**359**	**402**	**1,184**

b. **Secondary research:** The secondary research involved comprehensive analysis of all job roles in the automobile ecosystem considering various secondary data sources, including National Qualification Register (NQR),[3] National Classification of Occupations (NCO) codes (mapped with 17 National Industrial Classification (NIC) codes identified for the auto sector).[4] The job roles were further verified during meetings with OEMs and ACMs to arrive at an exhaustive list for impact analysis.

Besides, job role assessment, the secondary research also involved detailed assessment on the skilling ecosystem, considering government schemes and programmes, and also the training by the industry.

c. **Projections based on modelling study:** Further, to estimate the impact on employment, a detailed study was conducted on cars (passenger cars). The employments projections are based on Annual Survey of Industries (ASI) data, and primary survey at an OEM (site visit and interviews), and have been done considering various policy scenarios *(see Section 7 for details)*.

3. Workforce dependence

The automobile sector is estimated to employ about 30.7 million people considering direct (13.7%) and indirect employment (86.3%).[5]

Table 2: Auto sector employment

Employment	Employment linkage	No. of workers
Direct employment	Employees and workers directly involved in the manufacturing of vehicle and its components, vehicles sales and services, related to OEMs, ACMs, dealerships and sales.	4.2 million
Indirect employment (upstream and downstream linkages)	Engagement in upstream linkage include providing raw materials and services to vehicle and component manufacturers. This includes, steel, aluminium industry workers, etc.	26.5 million
	Downstream linkage involves employees and workers engaged in post-production. This includes workers engaged in transportation, warehousing etc.	
Total workers		**30.7 million**

Source: Ministry of Heavy Industries, 2023

Among the workers employed directly in the automobile sector, there are a high share of contractual workers. For example, an analysis of the Annual Survey of Industries (ASI) data[6] of registered organized manufacturing units (as of 2021-22), shows that about 36% of the workforce are permanent workers and the rest 64% are contractual workers.[7]

4. Workforce profile

The workforce profile of the automobile sector has been analysed considering the observations of the worker survey conducted in the three clusters. The assessment provides an understanding on the following aspects:

i. Types of workers;

ii. Education levels; and,

iii. Skill levels.

Worker type: The assessment shows that the largest share of workers in the ACMs are contractual workers. These include sizable proportion of workers who do not have any employer-provided benefits. Besides, there is a significant proportion of informal workers. Overall, contractual, and informal workers constitute nearly two-thirds (66%) of the workers in ACMs. The informality is higher in micro and small enterprises. In OEMs, however, the proportion of formal workers are much higher, as was shared by officials during interviews.

Table 3: Workforce distribution in ACMs

Type of employment	Share (%)
Permanent employees	34.6
Contractual workers	37.5
Causal labour/daily wager	28.6
Self-employed	0.9 %

Source: iFOREST analysis

Education levels: a large proportion of the workforce (95%) has completed secondary education. More than 38% of workers also have completed Industrial Training Institute (ITI) courses, or have other Diploma/ Certification across different enterprise sizes. Close to half of all the workers working in large and medium enterprises have done ITI courses or have other Diploma/Certification.

Table 4: Education level

Education level (% of workers)	Large	Medium	Small	Micro	Total
Not literate	0	1.6	1.2	0.6	1
Middle education, up to 8th class	2.7	3.2	4.5	4.5	3.9
Secondary education, up to 10th class	9.8	19	16.7	34.8	21.4
Higher secondary education (up to 12th Class)	14.3	14.5	26.1	24.5	22.1
ITI/Diploma/ Certification course	52.7	46	37.3	30.1	38.8
Graduate	19.6	14.5	12.9	5.3	11.7
Post-graduate	0.9	1.3	1.2	0.3	0.9

Source: iFOREST analysis

Skill levels: The majority of the workforce in the auto sector is also semi-skilled or skilled. However, a large proportion of the workforce (80%) relies on on-the-job learning or training. Only 7% of workers were found to have completed formal vocational training.

Table 5: Training of workforce

Training level (% of workers)	Large	Medium	Small	Micro
Did not receive any vocational Training	9.8	5.8	8	4.2
Formal vocational training	0.9	10.6	10.7	1.7
On-the-job learning/training	85.7	72.3	76.1	88.9
Self-learning	3.6	11.3	5.2	5.3

Source: iFOREST analysis

Overall, the assessment of the workforce profile shows that the majority of workers in ACMs hold contractual or informal positions, possess education and skills, and depend on on-the-job training. While the informal status of their employment presents a risk to job security, their educational background and skill set offer them the capability to adapt to new opportunities. Consequently, developing a transition strategy for the workforce is crucial for the automobile industry.

5. Job role assessment

The assessment of job roles is important for understanding which sections/assembly lines of auto eco-system have maximum variety of job roles and which are likely to be impacted by the ICE vehicles to EV transition. It also, provides and understanding on the education and skills the auto industry requires.

The assessment of job roles in the ACMs and OEMs has been done based on secondary research and interviews with representatives of ACMs and OEMs.

iFOREST research shows that there are at least 564 job roles in the entire automobile sector. This includes roles in various sub-assemblies/processes/stages for production of ICE vehicles and EVs and other aspects like dealership, services etc.

More than 50% of job roles are in manufacturing (considering both OEMs and ACMs), where a majority of workers are directly employed in the auto industry. The second largest number of job roles are in service/ repair (15.9%). Overall, the manufacturing and service/repair segments account for 70% of all the job roles in the sector.

Table 6: Category-wise job roles of auto ecosystem

Categories of auto ecosystem	Number of job roles
Dealership	59 (10.5%)
EV charging stations/Fuel pumps	21 (3.7%)
Manufacturing	304(53.9%)
Research and Development (R&D)	75(13.3%)
Service/Repair	90(15/9%)
Supply chain and logistics	15(2.6%)
Total	564 (100%)

Source: iFOREST analysis
Note: Job role is not equal to job. An individual can have more than one job role.

ICE VS. EV MANUFACTURING

The sub-assembly-wise assessment of job roles in the manufacturing segment shows that the total number of job roles will increase slightly in the case of EV. The new job roles will be created in Battery manufacturing and EV motors, while job roles in engine, fuel and exhaust in the ICE vehicles will be affected.

Table 7: Sub-assembly-wise job roles in the manufacturing segment

Job roles	ICE	EV
Battery		37
Body and chassis	89	88
Design	9	11
Drive line	11	11
Electronics and control systems	5	8
EV motor		7
Engine	31	
Fuel system and exhaust	9	
General purpose components and assembly line job roles	33	32
Machining job roles	34	34
Plant and equipment maintenance	10	11
Transmission	12	12
Total	**243**	**251**

Source: iFOREST analysis

The education and skill levels of workers as per the job roles (564) have been further evaluated considering the National Skills Qualification Framework (NSQF).

NATIONAL SKILLS QUALIFICATION FRAMEWORK

The National Skills Qualification Framework (NSQF) is a nationally integrated education and competency-based framework that enables persons to acquire desired competency levels. NSQF organises qualifications according to a series of levels of knowledge, skills, and aptitude. These levels, graded from level one to level eight are defined in terms of the learning outcomes that the learner must possess. It categorises job roles based on their skill levels, ranging from basic to advanced.

Each NSQF level is defined and described by a set of level descriptors expressed in terms of learning outcomes in five domains, which describe in general terms, the minimum knowledge, skills, and attributes that a learner needs to acquire to be certified for that level. The five domains are (i) professional theoretical knowledge, (ii) professional and technical skills/ expertise, (iii) aptitude, mind-set, soft skills, employment readiness and entrepreneurship skills, (iv) broad learning outcomes and (v) level of responsibility.[8]

The analysis shows that most of the auto sector workforce falls between NSQF levels 4 and 5. These two NSQF levels generally represent jobs such as operators, technicians and specialists in various assembly lines. Around 66% of the auto sector workforce is between these two categories. These two levels generally represent jobs such as operators/technicians and managers. People working at NSQF 4 and 5 also have at least a higher secondary level education. Ideally, most of them are graduates, including those completing courses from polytechnic institutes or ITIs. Around two-thirds of the auto sector job roles are between these two categories. On the other hand, NSQF level 7, which represents the highest skill level in the auto sector, the job roles are few.

Table 8: Total number of job roles in auto ecosystem according to NSQF levels

NSQF levels	Examples of auto job roles	Number of job roles		
		Non-manufacturing	Manufacturing	Auto ecosystem total
Level 2	Press shop assistant/ helper, automotive washer	13 (2.2%)	20 (6.6%)	33 (2.6%)
Level 3	Mechanical assembles	21 (5.3%)	19 (6.2%)	40 (4.8%)
Level 3.5	Toolroom operator, die maker	9 (2.7%)	39 (12.8%)	48 (6.8%)
Level 4	Press operator, technicians	77 (26.2%)	82 (26.9%)	159 (25.7%)
Level 4.5	Production in charge	25 (9.5%)	13 (4.3%)	38 (6.9%)
Level 5	Quality control engineer	58 (24.6%)	108 (35.5%)	166 (33.6%)
Level 5.5	Sales manager	5 (2.3%)	5 (1.6%)	10 (2.22%)
Level 6	Designer, chip programmer	46 (23.4%)	18 (5.9%)	64 (15.53%)
Level 7	Regional manager	6 (3.6%)	0	6 (1.7%)
Total		**260 (100%)**	**304 (100%)**	**564 (100%)**

Source: iFOREST analysis

6. Impact on job roles

The impact on the workforce due to EV transition has been done considering job roles in auto sector which would be important while designing framework for transition of workforce according to their skill levels. The impact on job roles provides a detailed understanding of the types of jobs that will become redundant/obsolete due to the EV transition, the jobs that can be retained through timely reskilling and skilling interventions, and the new opportunities that will arise for which workers will need to be trained (see Annexures 1 and 2).

IMPACT CATEGORIES

Jobs that may become obsolete: This includes job roles in assembly lines mainly of engine assembly, fuel tank and exhaust, and service and engine-repair-related job roles.

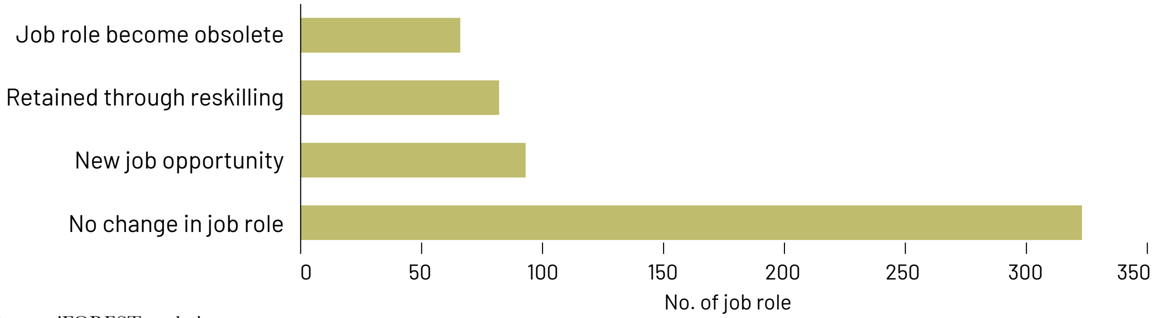
Jobs that can be retained through reskilling: This includes job roles in areas such as vehicle system engineering, software-related roles, transmission, and axles assembly line as well as service-oriented positions such as brake systems, maintenance, and the manufacturing of vehicle bodies and components.

New job opportunities due to EV transition: This includes job roles in areas, such as comprehensive battery management, the establishment and operation of charging infrastructure and stations, manufacturing battery components, expertise in digital technology, and servicing electronic and electrical components, among others.

No change: This category includes overlapping job roles between ICE vehicles and EV. These are job roles that will not be affected by the transition towards EV, as the employees/workers can continue to perform the same work as in the traditional ICE value chain.

The analysis shows that about 31% of the job roles in the ICE ecosystem will be affected – 14% will become obsolete and 17% will require reskilling. Maximum job roles will be affected in ICE manufacturing. Out of the total job roles in ICE manufacturing, 21.4% would become obsolete. This includes jobs like carburetor technicians, clutch system specialists, and exhaust system inspectors, among others. Further 12.3% of jobs in the segment will require major reskilling interventions. These include jobs in sub-assemblies such as transmission and drive lines, among others. In the non-manufacturing segment, however, only 5% of the job roles will become obsolete.

Figure 1: Impact on job roles due to EV transition



Source: iFOREST analysis

Table 9: Comparative evaluation of job role in ICE and EV ecosystem and impacts

Job role status	Manufacturing		Non-manufacturing		Auto ecosystem	
	ICE	EV	ICE	EV	ICE	EV
Job roles may get obsolete	52	0	14	0	66	0
Retained through reskilling	31	31	51	51	82	82
New job opportunity	0	60		32	0	92
No change in job role	160	160	163	163	323	323
Total	**243**	**251**	**228**	**246**	**471**	**497**

Source: iFOREST analysis

Overall, both in the manufacturing and the non-manufacturing segments, while a total number of 66 job roles will become obsolete, 93 new job roles will be created. Therefore, more new job opportunities will be created in the EV ecosystem.

However, an assessment of job roles as per the NSQF shows that the new jobs that will be created in the EV ecosystem are highly skilled jobs. For example, in Level 2 while over 10.6% of job roles will become obsolete, only 2% new job roles will be created. Most of the new job roles will be created at Level 5 and Level 6, which require higher levels of skills and education.

Table 10: Impact assessment on job roles as per education and skills

NSQF levels	Obsolete Job roles (% of total jobs at the NSQF level)	New job roles (% of total jobs at the NSQF level)
Level 2	10.6	2.1
Level 3	6.1	1.1
Level 3.5	1.5	5.4
Level 4	36.4	30.1
Level 4.5	12.1	7.5
Level 5	25.8	36.6
Level 5.5	6.1	2.1
Level 6	1.5	15.1
Total	**100**	**100**

Source: iFOREST analysis

PERSPECTIVE FROM INFORMAL SERVICE CENTERS

A key aspect of just transition of the workforce will be the informal workers engaged in servicing and repairing. As ground observations show, these workers are completely ill-prepared to adapt to the EV transition, as they do not have the necessary skills and resources.

iFOREST undertook consultations with 60 workers working in servicing and informal repair shops across three auto clusters to understand their perception of the EV transition and prospective impacts.

The workers expressed unease about adapting to the EV ecosystem considering the reliance on computerised components. Lack of familiarity with EV technology, along with inadequate capital for specialised equipment, emerged as key challenges. Most of them (about 85%) also said that they lack the necessary skills for EV maintenance.

The informal repair shop workers in two-wheeler repair shops also said that they have received fewer clients in recent times. Considering their low skill levels and limited opportunities to get absorbed in the EV ecosystem, they find the situation to be increasingly challenging. If things do not improve, they plan to move out of the auto sector to job opportunities in other sectors.

7. Impact on employment

To estimate the impact on employment, a detailed study was conducted on cars (passenger cars). The following methodology was adopted to estimate the number of jobs in OEMs and ACMs:

i. A primary survey was conducted at an OEM producing both ICE and EV cars of similar make to estimate the number of workers employed and develop a job factor (jobs per vehicle) at the OEM level.

ii. For ACM, job factors were developed separately for powertrain and non-powertrain components for an ICE vehicle and EV car.

   a. Firstly, the Annual Survey of Industries (ASI), 2021-22 was used to arrive at the jobs coefficient (jobs per INR crore output). NIC codes for the ACMs (29301, 29302, 29303, 29304, and 29104) and battery

manufacturing (27201 and 27202) were used to filter data from ASI and arrive jobs coefficient for the powertrain and non-powertrain of ICE and EV cars.

b. The jobs coefficient was then extrapolated with the cost of powertrain and non-powertrain components of ICE and EV cars to develop the job factors. Presently, the cost of the powertrain of an EV car, including the battery cost, is about 16% higher than an ICE car of similar make. Excluding the battery cost, the cost of the EV powertrain is less than half of ICE powertrain. Reduction in the battery cost, therefore, is the single most important factor in reducing the TCO of an EV car. The cost of the non-powertrain in an EV car is about 20% higher than its ICE counterpart. The higher cost is mainly due to expensive electrical, electronics and air-conditioning in an EV.[9]

iii. Estimating the number of jobs considering two scenarios, the Current Policy Scenario (CPS) and Aspirational Policy Scenario (APS)[10] till 2036-37. The CPS and APS scenarios were compared with a scenario in which it was assumed that only ICE cars were produced (ICE Scenario).

MODELLING SCENARIOS

iFOREST (2024) undertook a modelling study to forecast the production and sales of electric two-wheelers (2Ws), three-wheelers (3Ws), passenger cars, and commercial vehicles (CVs). The forecasting is done under two scenarios, viz., a Current Policy Scenario (CPS) and an Aspirational Policy Scenario (APS). The study makes projections for two timeframes — 2030 and 2036. The 2036 timeframe also marks 90 years of India's independence.

1. All vehicles: For all vehicles, multiple scenarios were modelled, including linear extrapolation (excluding the COVID years), Gross Domestic Product (GDP) elasticity, income elasticity and Compound Annual Growth Rate (CAGR), to arrive at the best fit for each vehicle segment.

2. EVs: For EVs two scenarios were modelled- Current Policy Scenario (CPS) and Aspirational Policy Scenario (APS).

Current Policy Scenario (CPS): The CPS is based on existing government policies and has been developed considering that the policies are implemented as per their intent (and not the informal targets). The implementation of FAME and the Production Linked Incentive (PLI) scheme has been able to help achieve an indigenisation level of 90% in all segments of EVs. Simultaneously charging and battery swapping infrastructure are also created. The Total Cost of Ownership (TCO) of ICE vehicles and EVs will reach parity by 2025. Overall, during the projection period (2023-2036), the average Gross Domestic Product (GDP) growth rate is 6.5%.

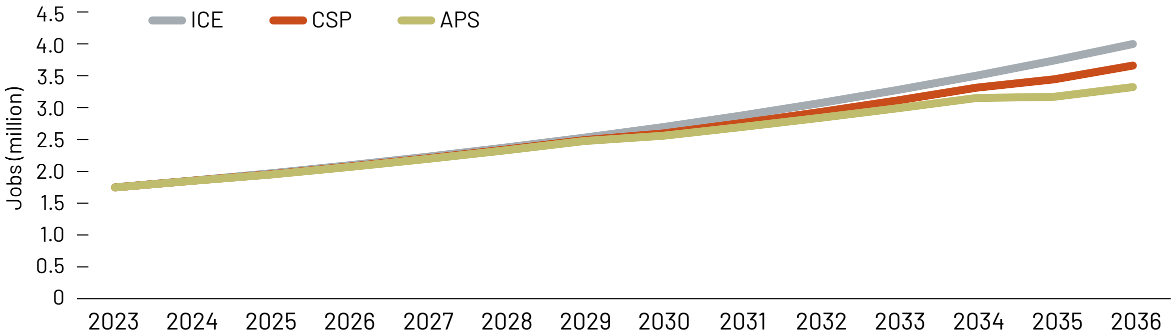
Aspirational Policy Scenario (APS): The APS is based on more ambitious government policies to accelerate the EV transition. It assumes that FAME III is implemented for EV adoption which will further incentivise domestic manufacturing. Further policies are introduced and implemented to restrict the entry/movement of ICE vehicles in certain parts of the city to control air pollution. The TOC of EVs will be 10-25% less than ICE vehicles by 2030 for various segments. Overall, during the projection period (2023-2036), the GDP grows at a higher rate of 8%.

The analysis brings out the following key observations:

- At the OEM level, the job factor in ICE is about 20% higher than EV.
- At the ACM level, the job factor in the powertrain of an ICE car is about 10% higher than that in the powertrain of an EV. The job factor in the powertrain of EVs is projected to reduce due to the economy of scale and automation.
- At the ACM level, the job factor in the non-powertrain of an ICE and an EV car is the same. However, the job factor in the non-powertrain of EVs is projected to reduce due to the economy of scale and automation.
- The total number of jobs in passenger car manufacturing is projected to grow from 1.7 million in 2023-24 to 2.6 million in 2030-31 and 3.3-3.7 million in 2036-37. Therefore, there is no job loss per se due to the transition from ICE to EV.

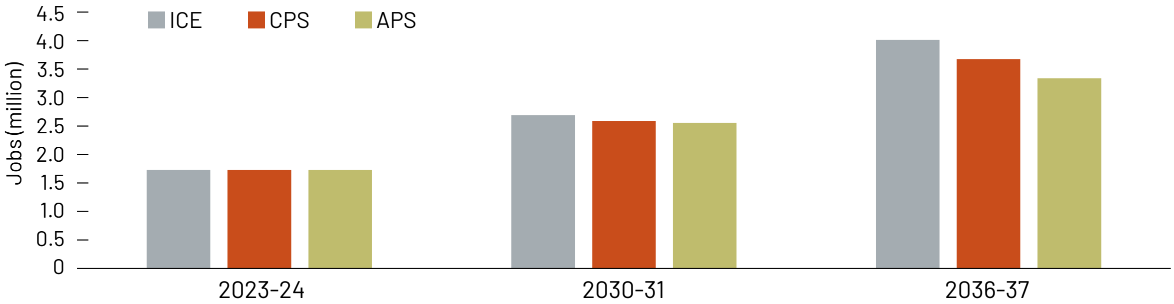
- However, the number of jobs created in CPS and APS scenarios is lower than those in the ICE scenario. In 2036-37, 8–17 percent fewer jobs would be created than in ICE. Thus, the number of jobs supported by EVs is relatively lesser than ICE.

Figure 2: Impact on jobs in various scenarios



Source: iFOREST analysis

Figure 3: Impact on number of jobs

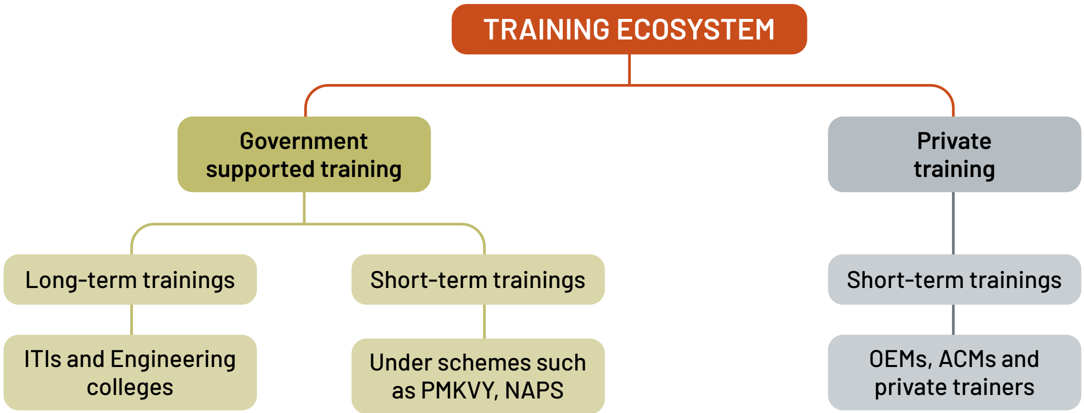


Source: iFOREST Analysis

8. Assessment of skilling ecosystem

Skilling and development of the future workforce is a key issue for the automobile sector considering its significance for India's manufacturing sector and the projected workforce requirement by the industry.

Figure 4: Skilling ecosystem



Source: iFOREST Analysis

Skill development training in auto sector is provided formally through two major sources of training by both government and Industry:

i. Government-supported training programmes:
   a. Long-term training: Through training institutes like ITIs, IITs, NITs and other government and private engineering universities and colleges teaching courses related to auto sector.
   b. Short-term training: Through Government schemes like Pradhan Mantri Kaushal Vikas Yojna (PMKVY) and National Apprenticeship Promotion Scheme (NAPS)

ii. Private-sector training programmes:
   a. Enterprise-based Training: Through OEMs, ACMs and private training providers.

i. Government-supported training programmes:

These programmes are under various ministries of Central Government like Ministry of Human Resource and Development (MHRD) and Ministry of Skill Development and Entrepreneurship (MSDE), and offer both long and short-term training programmes.

a. Long term training

Long-trem training programmes are provided by the ITIs and other engineering colleges. The ITIs have historically played a crucial role in supplying skilled labor to the auto industry. ITIs function under Directorate General of Education and Training (DGT) of the MSDE.

Auto sector and auto components related courses are among the most sought-after courses at ITIs. Of the total 15,020 ITI's, 78% have at least one auto sector related course. Overall, there are 37 auto sector related courses. However, as per information in public domain, Interestingly there is only one trade specific to EVs (Mechanic Electric Vehicle) which is currently taught at 163 ITIs (1.1% of the total it is in the country) with a seating capacity of only 4,584 students (0.3% of the total seating capacity).[11]

The engineering institutes under aegis of MHRD function under All India Council for Technical Education (AICTE). These institutes offer specialisations or courses within the broader field of engineering that focus on automotive manufacturing, technologies, R&D and including electric vehicles. Students undergo comprehensive training that includes understanding the intricacies of automobile design, manufacturing processes, and emerging technologies like electric propulsion.[12]

b. Short-term training

The MSDE is the central ministry overlooking most of the important schemes related to skilling and workforce development of the automobile sector. Two schemes are most significant in this regard- the Pradhan Mantri Kaushal Vikas Yojana (PMKVY), and the National Apprenticeship Promotion Scheme (NAPS).

The PMKVY was launched in 2015 and is implemented by the National Skill Development Corporation (NSDC). Under this scheme typically short-term trainings are offered. Currently, about 13% of the training centres established under the PMKVY offer training courses related to the automobile sector.

Table 11: Auto sector-related courses under PMKVY

Parameters	Number
Total centres	2640[13]
Total number of centres offering training on automobile-related job roles (40 job roles)	523 (training capacity of approximately 54,000 individuals)

Source: PMKVY Dashboard[14]

Another important component of the PMKVY is Recognition of Prior Learning (RPL), which is a form of a bridge course. Under this, individuals with prior learning experience or skills are assessed and certified. Implementing agencies for this component are the Sector Skill Councils (SSCs) or any other agencies designated by MSDE/NSDC.

The NAPS was launched in 2016, and is implemented by NSDC and the Directorate General of Training (DGT). Under the scheme, there are 34 apprenticeship courses, of which eight are related to EVs and electronics.[15] In the last five years (since 2018), 0.6 million apprentices have been trained under NAPS for the automobile sector.[16] The scheme also incentivizes enterprises to train their employees by providing 25% of the stipend that the apprentice receives from the company (with a cap of ₹1,500 per individual).

ii. Private Training

Skill training in automobile sector is usually is done through in-house training. To meet existing skill gap within the labour market and due to lack of practical training impartation at institutions, large OEMs and ACMs often resort to developing their own training centres.[17]

Many enterprises, especially large automotive companies, collaborate with training institutes or set up their own training centres. These centres focus on job-specific skills and are tailored to the needs of the enterprise, ensuring that the workforce is aligned with the company's goals and requirements. Maruti, Mahindra, Hyundai has tie ups with ITIs and Polytechnics for skill development.[18]

There are several short-term training courses also provided by Sector Skill Councils (SSCs). However, there are very limited number of prorammes/courses for EVs. For example, out of 137 Qualification Packs of courses on offer by the (Automotive Skill Development Council ASDC) only 13 are specific to EVs. Besides, some focused training related to EV charging stations is being conducted by the Power Skill Sector Council (PSSC).[19]

9. Overall observations

The assessment of the impact on workforce due to the transition from ICE vehicles to EVs shows the following:

About 31% of the job roles in the ICE ecosystem will be affected – 14% will become obsolete and 17% will require reskilling. About 66 job roles (14% of the ICE job roles) will ultimately become obsolete due to the shift to EVs. On the other hand, 92 new job roles (18% of the EV job roles) will be created due to EVs. Overall, the number job roles in EV ecosystem are about 5% higher than in ICE ecosystem. However, the new job roles are qualitatively different than the existing job roles, as they require high skills and education levels.

Even for job roles that will not become obsolete, new skill sets will be required to retain workers in those roles. Therefore, skilling and reskilling of the workforce will be one of the most important interventions for the EV transition.

The assessment of the skilling landscape shows that while there are various progarmmes and institutes related to skilling, however, there is a huge gap considering the required skills for the EV ecosystem. Therefore, redesigning of the skilling programmes and massive investments in skilling will be important for the transition of both formal and informal workers currently engaged in the ICE vehicle ecosystem, as well as for developing the new workforce considering the opportunities of the EV ecosystem.

10. Recommendations

A central issue of just transition of the automobile sector is the transition of the workforce currently engaged in the conventional auto sector. This is essential to ensure their adaptability and secure their employment in the EV value chain. Besides, it is also important to prepare the future workforce for the evolving industry requirements.

To address these, a comprehensive workforce transition policy in the automobile sector will be required. The workforce transition policy needs to address interventions required by the government, as well as the enterprises.

As part of the government measures, the following are some of the key interventions that need to be considered:

- Establish a Skills Taskforce at the state level, consisting of members of OEMs, ACMs, skill sector councils, training institutes, and research institutions, to generate data on workforce profile, including their education and skills levels, to assess education and skill gaps to enable the design of training, academic and vocational programmes.
- Foster engagement between the implementation agencies of government training programmes, such as NSDC and ASDC, and the training institutes, such as the ITIs with the industry for designing curriculum, evaluating training outcomes, and providing certification, among others.
- Redesign the short and long-term training programmes considering the job roles and educational and technical requirements for the EV value chain. The training curriculum should include modules on advanced EV technologies, battery management systems, and sustainable manufacturing practices.
- Foster collaboration between the training institutes and educational institutions to design credit-based, continuous learning-oriented courses.
- Engage technology partners to design on-demand 'Phygital' learning courses for up-skilling existing workforce.
- Promote on-the-job quick capsule training while ensuring no reduction in wages for workers participating in such training.
- Support standardized certification criteria for EV-related skills.
- A key focus of workforce transition should be women. Equal employment opportunities should be ensured for women by adopting measures to improve their access to foundational skills and skilling programmes and increase employability.

Besides, interventions on skilling, one of the necessary policy interventions will be mandating the development of a 'workforce transition plan' by the OEMs.

WORKFORCE TRANSITION PLAN

Mandating the development of workforce transition plans by the OEMs can be an effective policy instrument for workforce transition at the enterprise level and complement government policies and transition measures.

The plan for workforce transition should be output-oriented, and include information regarding (but not limited to) the following aspects):

- The number of workers to be impacted by the transition at various levels, including their job roles.
- Assess the need for transition support necessary, including reskilling/skilling, temporary assistance, mobility assistance, etc.
- Outline a plan for providing transition support, including support on reskilling and skilling, to employees and workers of the enterprise.
- Outline a reskilling/skilling plan for ACM workers.
- Identify the scope of engagement with governments, institutions, or other skilling agencies, for support to workers, where OEMs will not be directly engaged.
- Outline a monitoring and evaluation strategy with key performance indicators (KPIs) to measure the success of the transition plan and monitor progress and success of implementation.

Overall, innovative and cooperative strategies will need to be designed to support workforce transition and workforce development for various categories of workers, including women, aligned with the technological changes and innovation in the automobile sector.

Annexures

Annexure1 : Job Roles that may become Obsolete

S.No	Job Role Title	NSQF LEVEL	Sub-sector/ process/Assembly/ stage
1	Chassis Welders (ICE-specific)	4	BODY & CHASSIS
2	Ignition System Engineers	6	BODY & CHASSIS
3	Automotive Engineering Technician/Testing Manager	5	Drive line
4	Drive Line Inspectors	5	Drive line
5	ECU Programmers (ICE-specific)	5.5	Electronics and control systems
6	Manager Heat Treatment /Metallurgist	5	Engine
7	Mechanical Engineering Technician/Supervisor R&D Testing	5	Engine
8	Maintenance Technician Assitant - Mechanical	5	Engine
9	Auto Engine Repair Technician	4	Engine
10	Engine Tester	4	engine
11	Engine Precision component technician	4	Engine
12	Carburettor Technicians	4	Engine
13	ICE Engine Testers	5	Engine
14	Engine Machine Parts Programmer	5	Engine
15	Exhaust System Machine Operator	4	Engine
16	Engine Quality Management Technicians	5	Engine
17	Automotive Flex Fuel Engine Designer	5.5	Engine
18	Drill Operator	4	Engine
19	Drill Press Operator	4	Engine
20	Driller	4	Engine
21	Automotive Additive Manufacturing Technician	5	Engine
22	Engine Quality Inspectors	5	Engine
23	Exhaust System Assemblers	2	Engine
24	Automotive Engine Electronics Diagnostic Technician (Petrol)	5	Engine
25	Fuel Injector Assemblers	2	Fuel System and Exhaust
26	Exhaust System Inspectors	5	Fuel System and Exhaust
27	Fuel System Assemblers	2	Fuel System and Exhaust
28	Fuel Tank Manufacturing technicians	5	Fuel System and Exhaust
29	Exhaust System Mounters	4	Fuel System and Exhaust
30	Fuel Tank Manufacturing operators	4	Fuel System and Exhaust
31	Axle Shaft operators	4	Fuel System and Exhaust
32	Manual Transmission Line Operators	4	General Purpose Components and Assembly Line Job Roles
33	ICE Engine Line Workers	3	General Purpose Components and Assembly Line Job Roles
34	Mechanical Engineer, Production	5.5	Plant And Equipment Maintenance
35	Mechanical Engineer, Automobile	5.5	Plant And Equipment Maintenance
36	Clutch Specialist	4	Transmission
37	Clutch System Specialists	5	Transmission
38	Engine Parts Assembly line workers	3	Transmission
39	Material Line Loading, Unloading	3.0	Engine
40	Associates	4	Engine

Annexure 1 continued

S.No	Job Role Title	NSQF LEVEL	Sub-sector/ process/Assembly/ stage
41	Machine Job Engine Experts	4	Engine
42	Quality assurance engine	5	Engine
43	Machinists engine	4	Engine
44	Operator/assemble/associate	4	Engine
45	Maintenance engineer	4.5	Engine
46	Process Engineer	4.5	Engine
47	Repair Specialists	5	Engine
48	Fitter Engine	4	Engine
49	Tester	5	Engine
50	Production In charge	4.5	Engine
51	operator/Associates	4	Fuel System and Exhaust
52	Production In charge	4.5	Fuel System and Exhaust
53	Transmission Repair Specialists (ICE-specific)	4	Service/Repair
54	Automotive Engine Repair Technician	4	Service/Repair
55	Mechanic, Motorcycle	3	Service/Repair
56	Engine repair technician	4	Service/Repair
57	Carburettor Repair Technicians	4	Dealership
58	Fuel Attendant	2	EV Charging Stations/Fuel Pumps
59	Fuel dispensing attendant	2	EV Charging Stations/Fuel Pumps
60	Fuel Pump Sales Manager	5	EV Charging Stations/Fuel Pumps
61	Fuel Maintenance Technician	5	EV Charging Stations/Fuel Pumps
62	Petrol Pump Staff	2	EV Charging Stations/Fuel Pumps
63	Petrol Pump Manager	5	EV Charging Stations/Fuel Pumps
64	Petrol Pump Territory Manager	5	EV Charging Stations/Fuel Pumps
65	Petrol Pump Accounts Attendant	4	EV Charging Stations/Fuel Pumps
66	Petrol Pum loader/unloader	2	EV Charging Stations/Fuel Pumps

Source: iFOREST Analysis

Annexure 2: New job opportunities arising with transition from ICE to EV

S.No	Job Role Title	NSQF LEVEL	Sub-sector/ process/Assembly/ stage
1	Painting Supervisor	4	Battery
2	Battery Recycling design & testing	6	Battery
3	Wiring Harnesses Technicians	4	Battery
4	Thermal management Technicians	4	Battery
5	heat treatment technicians	5	Battery
6	Battery Management System Specialists	5	Battery
7	Battery Enclosure Fabricators	4	Battery
8	power usage Electrical Engineer	6	Battery
9	Drive train managers	5	Battery
10	Cell Technology Experts	5	Battery
11	Automotive Battery Management System (BMS) Design Engineer	5	Battery
12	Automotive Electric Vehicle BSS (Battery Swapping Station) Planning Engineer	6	Battery

Annexure 2 continued

S.No	Job Role Title	NSQF LEVEL	Sub-sector/ process/Assembly/ stage
13	High Voltage system technicians	6	Battery
14	battery composition Electrical Engineer	5	Battery
15	battery systems Electrical Engineer	6	Battery
16	Battery Assembly Technicians	3	Battery
17	Chemical Engineers	5	Battery
18	Chemists for lithium testing	5	Battery
19	mechatronics Expert	5	Battery
20	Battery System Assembly Operator	3.5	Battery
21	Powerpack production In charge	4.5	Battery
22	Module Production In charge	4.5	Battery
23	Battery Pack In charge	4.5	Battery
24	QA Auditor	5	Battery
25	QA Manager	5	Battery
26	Battery Production Officer	5	Battery
27	Designer and BMS Tester	3.5	Battery
28	Thermal Desing	4	Battery
29	Battery Integration	4	Battery
30	BMS Hardware Engineer	3.5	Battery
31	Lead Mechanical Designer	4.5	Battery
32	Battery Testing and Validation Expert	5	Battery
33	Battery Certification and Testing	5	Battery
34	Cell Selection and Simulation and Design	5	Battery
35	Vehicle Testing and Validation	5	Battery
36	Vehicle Certification and Validation	5	Battery
37	Battery System and Productivity Expert	6	Battery
38	Battery System Design Engineer	6	Battery
39	Electric Vehicle Quality Control Inspector	5	BODY & CHASSIS
40	EV Sales and Retail EV Salespeople (with knowledge of automotive software), EV training instructors	5	Dealership
41	Data AI ML Expert	6	Design
42	Coding Expert	6	Design
43	Network and Computer System applications technicians	4	Design
44	Electric Vehicle Product Design Engineer	5	Design
45	Battery Pack Quality Control Inspectors	5	Drive line
46	Lightweight Material Specialists	4	Drive line
47	EV Systems Integrators	5.5	Electronics and control systems
48	Battery EV Ignition System Engineers	6	Electronics and control systems
49	Auto Electrical Maintenance Jr. Technician	4	Electronics and control systems
50	Battery Electric Vehicle Jr. Technician	4	Electronics and control systems
51	Charging operators	2	EV Charging Stations/Fuel Pumps
52	Charging station managers	4	EV Charging Stations/Fuel Pumps
53	Charging machine Installers	4	EV Charging Stations/Fuel Pumps
54	Repair and Maintenance technician	4	EV Charging Stations/Fuel Pumps
55	Charging Infrastructure Electricians	4	EV Charging Stations/Fuel Pumps
56	Maintenance Technician Electrical	5	EV Motor

Annexure 2 continued

S.No	Job Role Title	NSQF LEVEL	Sub-sector/ process/Assembly/ stage
57	Electric Motor Engineers	6	EV Motor
58	Motor control engineer	6	EV Motor
59	Electronic Hardware Assembly Operator	3.5	EV Motor
60	Thermal Engineer	4.5	EV Motor
61	Quality control Engineer	5	EV Motor
62	Traction/Invertor engineer	5	EV Motor
63	Motor and Controller Design Engineer	6	EV Motor
64	Electric Motor Assembly Line Workers	2	General Purpose Components and Assembly Line Job Roles
65	Electric Vehicle Assembly Technician	5	General Purpose Components and Assembly Line Job Roles
66	Electric Vehicle Maintenance Technician	5	Plant And Equipment Maintenance
67	Automotive Maintenance Lead Technician-Electrical	5	Plant And Equipment Maintenance
68	Battery Manufacturing operators	4	Plant And Equipment Maintenance
69	Transmission Repair Specialists transitioning to Electric Drivetrain Repair	4	Service/Repair
70	Battery swappers	4	Service/Repair
71	Auto expert technician	4	Service/Repair
72	Electric Vehicle Service Assistant (Two/Three-wheeler, Four Wheeler and Electric Truck/Bus)	4	Service/Repair
73	Electric Drivetrain Repair Specialists	4.5	Service/Repair
74	Battery technician	4	Service/Repair
75	EV Maintenance Battery Management Technicians	4	Service/Repair
76	Electric Vehicle Service technician	4	Service/Repair
77	Electric Vehicle Service Lead Technician	5	Service/Repair
78	Charging System Technicians	3.5	Service/Repair
79	Energy Storage System Inspectors	4	Service/Repair
80	Charging Infrastructure Logistics Managers	4	Service/Repair
81	Mechanic Auto Electrical and Electronics	5	Service/Repair
82	Supervisor - 2 and 3 Wheeler Electric Vehicle Services	5	Service/Repair
83	Battery repairer (ATS)	4	Service/Repair
84	Motor & Controller Repairing Technician	4	Service/Repair
85	Battery System Repair Technician	4	Service/Repair
86	Computer and Electronics engineers	5.5	Software
87	EV Salespeople (with knowledge of automotive software), EV training instructors	4	Supply chain and Logistics
88	Electric Drivetrain Technicians	5	Transmission
89	Electric Drivetrain Engineers	6	Transmission
90	Power Electronics Technicians	5	Transmission
91	Automotive Product Electrical Testing Technician	5	Vehicle Testing
92	Automotive Material Electrical Testing In charge	4.5	Vehicle Testing
93	Electric Drivetrain Testers	5	Vehicle Testing

Source: iFOREST Analysis

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