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WORKING PAPER

A "just" transition in the downstream automotive segment: Evidence from Delhi

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HIGHLIGHTS

- India's automotive sector is at an early stage of an energy transition from internal combustion engine vehicles (ICEVs) to electric vehicles (EVs).
- Most employment in India's automotive sector is in the post-manufacturing, services-oriented "downstream" segment (e.g., commercial drivers, dealers, mechanics). New "green" (EV-related) jobs often require different skillsets and training that current ICEV workers may lack, potentially excluding them from the transition.
- We investigate whether this transition has been "just"—fair and inclusive to everyone, creating "decent" work opportunities and leaving no one behind—through a set of 106 interviews of downstream automotive workers (both ICEV and EV) in Delhi.
- We find that green job workers face challenges with the currently underdeveloped EV-supporting infrastructure. Inadequate training is also a challenge in higher-skill green jobs.
- ICEV workers, who are aware of these skilling and infrastructural challenges, perceive downstream green jobs negatively.
- We find that green jobs are associated with increased wages. However, they do not satisfy the other pillars of decent work—safe working conditions, job security, reasonable career prospects, and worker rights—or provide significantly better conditions than ICEV jobs.

EXECUTIVE SUMMARY

Context

India is in the early stages of a planned transition of its automotive sector to EVs. Most (86.38 percent) of India's 30.7-million-strong automotive workforce is employed in the sector's downstream segment (ASDC and EY 2019) rather than in automotive manufacturing. The downstream segment, which encompasses post-manufacturing processes, is a services-oriented segment including dealerships, after-sales parts and servicing, vehicle repairs, and commercial drivers. This segment overwhelmingly comprises informal and unorganized workers who face low wages, job precarity, exclusion from social protection, and inadequate training (Ramanayya and Nagadevara 2009).

Newer downstream EV-related jobs could both reduce emissions and provide employment opportunities to ICEV and other workers. These green jobs—which help preserve or restore the environment (ILO 2015)—tend to pay more (UNEP 2011; Valero et al. 2021), but may require different skills, education, and training (Bowen and Kuralbayeva 2015), making the transition challenging for current workers. These jobs vary in their transition challenge: some require minor task changes vis-à-vis existing jobs and may not entail major skill challenges (i.e., Green Increased Demand [ID] jobs—for example, commercial drivers transitioning to EVs). Certain green jobs may require significant task changes and specialized knowledge (i.e., Green Enhanced Skills [ES] jobs—for example, vehicle mechanics switching to EV repairs) (The National Center for O*NET Development 2013a; Bowen and Kuralbayeva 2015).

Currently, the transition's trajectory for workers is unclear. How are workers transitioning, and what are their challenges? Do ICEV workers perceive downstream green jobs positively (this can impact the number of workers applying for such jobs)? Finally, from an equity standpoint, do downstream green jobs provide workers decent work (Renner et al. 2008)?

About this working paper

This paper is an exploratory study focusing on workers in the downstream automotive segment. It draws from 106 semi-structured key informant interviews (KIIs) of workers from this segment in the NCR of Delhi, a major automotive hub with one of the country's highest EV adoption rates. It aims to understand

- the nature of the transition for downstream green job workers,
- the challenges faced by such workers, and
- ICEV workers' perceptions of such jobs, and whether such jobs qualify as decent work.

Snowball sampling was employed, and the respondents spanned four major downstream job roles. They were interviewed at their workplace with the permission of the enterprise. Because the focus is on understanding the challenges and quality of downstream green jobs, a larger number of EV workers were interviewed (Table ES-1).

Table ES-1 | **Interviewed downstream automotive segment workers**

JOB ROLE	INTERVIEWED ICEV WORKERS	INTERVIEWED EV (GREEN JOB) WORKERS
Vehicle dealership workers	0	9
Vehicle refueling workers (petrol pumps for ICEV workers, battery swapping/vehicle charging for EV workers)	5	17
Vehicle repair, servicing, and maintenance workers	8	19
Commercial drivers	12	36

Note: EV = electric vehicle. ICEV = internal combustion engine vehicle. NCR = National Capital Region.

Source: WRI India's authors' analysis based on interviews with key informants.

Respondents in green jobs were asked about how and why they transitioned to such jobs, their challenges and experiences in such jobs, and basic job details (wages, training, social protections, etc.). ICEV workers were asked about their awareness of green jobs, their perceptions of such jobs, and whether they would be willing to shift. Basic socioeconomic data were also elicited from both groups of respondents. Very little work has documented the nature of the automotive sector's transition in India and its large number of informal, unorganized workers. This paper provides important early-stage empirical evidence regarding the justness of the transition.

Key findings

Approximately half the green job workers in our sample had transitioned from ICEV jobs. The remaining workers were first-time job seekers and workers transitioning from other informal sectors, and most first-time job seekers were in a commercial driving green job (Figure ES-1). Workers involved in green dealership and repair jobs were more likely to have transitioned from ICEV jobs. Green job workers tended to have higher levels of education than their ICEV counterparts, though a majority (ICEV and EV) lacked college degrees. The majority had transitioned because downstream green jobs paid better than their existing jobs or alternatives they could have applied for.

Challenges faced by downstream green job workers include skilling, infrastructural, and EV-specific issues. In line with global findings, the challenges varied with the type of green job. For Green ES jobs such as vehicle servicing and charging, lack of adequate skills, training, and understanding of EVs emerged as the biggest challenge for the interviewed workers. For Green ID jobs such as commercial driving, the primary challenges included loss of working hours stemming from involuntary downtimes due to long vehicle-charging times, exacerbated by insufficient vehicle-charging facilities, which lead to longer driving distances or waits to access charging. Challenges also included systemic issues such as frequent breakdowns of battery-swapping machines and long wait times for spare parts (for mechanics), the latter exacerbated by underdeveloped EV supply chains.

Figure ES-1 | **Profile of green job workers in the sample**

Note: ICEV = internal combustion engine vehicle.

Source: WRI India's authors' analysis based on interviews with key informants.

ICEV workers either lack awareness of downstream green jobs or do not perceive them positively. Most ICEV workers in our sample were not aware of green job equivalents of ICEV jobs. Of those who were aware, ICEV repair and servicing workers perceived the upskilling required to transition to EV repairs excessive considering the low number of EVs in the market. Commercial drivers felt that the long charging times associated with EVs reduced their earnings flexibility.

Downstream green jobs appear to provide better wages, but do not satisfy the other criteria of decent work. Green job workers reported higher wages than the national average and higher income than from earlier work. However, structural issues inherent in informal work, such as lack of job security, long working hours, lack of social protections, and poor working environments, persist in the transition from ICEV jobs to downstream green jobs.

Four major sets of reforms could address transition challenges. Expanding charging infrastructure (including battery swapping, which currently lacks policy support); improving awareness, access, and funding for skilling programs; legislating social protections for the less organized downstream and gig economy segments; and instituting right-to-repair policies could address many of these challenges.

INTRODUCTION

India's automotive sector is at an early stage of a planned transition from internal combustion engine vehicles (ICEVs) to electric vehicles (EVs). Recent research has examined the considerable human impacts of such a transition: are the ongoing energy transitions "just" transitions, fair and inclusive to everyone, creating decent work opportunities, and leaving no one behind (ILO 2016)?

Work in the automotive sector is conventionally associated with automobile and component manufacturing, the industry's "upstream" segment. However, most workers (86.38 percent) in India's automotive sector are employed in the post-manufacturing ("downstream") segment (ASDC and EY 2019), a services-oriented segment encompassing employment at vehicle dealerships, fuel pumps and charging stations, vehicle repair shops, and as commercial drivers (Market Prospects 2022). Because most automotive workers are employed in the downstream segment, the majority informally and precariously (Damodaran 2010; Kerswell and Pratap 2019; Raveendran and Vanek 2020), it is crucial to understand this segment from the standpoint of India's automotive just transition.

This paper aims to contribute to the literature on just transitions, focusing on informal workers in India's downstream automotive segment. It draws from 106 semi-structured interviews of workers in this segment across the NCR in and around Delhi. We approach the overarching problem of whether the transition has been just, focusing on how workers are transitioning, the challenges they face in downstream green jobs involving EVs, ICEV workers' perceptions of green jobs, and whether these jobs provide decent work.

Background, focus areas, and research questions

Background

To reduce its transport-sector emissions and oil import dependency, India has accelerated an energy transition toward EVs through various policy and fiscal levers (PIB 2021). EV sales have increased considerably, from less than 200,000 in 2020 to over 1.2 million in 2023 (JMK 2023). As part of the EV30@30 campaign, India targets increasing the proportion of EVs sold to at least 30 percent of total vehicles by 2030 (IEA 2021), a more than fourfold increase from 2023.

India's automotive sector employs approximately 30.7 million workers (iFOREST 2024). Therefore, a transition can considerably impact workers and enterprises, especially because only a third of 35 EV-related employment areas in India require skills transferable from ICEV roles (Samantray and Banswal 2022). Currently, employment across the Indian automotive sector (both ICEV and EV) is projected to grow over the upcoming years (ASDC and EY 2019), with an estimated net increase in jobs (Soman et al. 2019; iFOREST 2024) resulting from the transition; that is, large-scale ICEV job losses in the sector are not imminent. However, when the transition gathers pace, its impact on workers needs careful consideration.

An early-stage understanding of the potential labor impacts and trajectories of India's EV transition could guide policies toward a just transition. Newer EV-related jobs can be classified as green jobs (Jarvis 2011): jobs that help preserve or restore the environment, both in traditional sectors such as manufacturing and construction and in new, emerging green sectors such as renewable energy and energy efficiency (ILO 2015). The global literature suggests that although green jobs pay better (Muro et al. 2011; Jackman and Moore 2021; Valero et al. 2021), they require higher levels of education and job training and involve non-routine analytical tasks (Bowen and Kuralbayeva 2015; Consoli et al. 2016). Thus, although workers could benefit by transitioning to green jobs, many current workers could eventually be left behind during the transition. However, the challenges in transitioning to such jobs in India are currently unknown.

Focus areas

We focus on the downstream segment because it employs the most automotive workers. Figure 1 shows the ICEV automotive sector's segments.

The downstream segment comprises enterprises ranging from large-scale vehicle dealerships to small wayside mechanics. However, most employment in this segment is informal (Damodaran 2010; Kerswell and Pratap 2019; Raveendran and Vanek 2020). Informal work in India has been defined as follows: "All remunerative work (both self-employment and wage employment) that is not registered, regulated, or protected by existing legal or regulatory frameworks. ...Informal workers do not have secure employment contracts, workers' benefits, social protection, or workers' representation" (PLFS 2023).

Informal workers are often less educated, lack training, receive low wages, lack job security, work under poor conditions, and lack labor and social protection (Ramanayya and Nagadevara 2009). There is evidence of considerable job precarity even for workers on regular wages in the downstream segment, mainly due to uncertainty in contract renewals (Mamgain 2020).

It is unlikely that most downstream automotive jobs currently provide decent work—that is, work that provides adequate wages, safe working conditions, job security, reasonable career prospects, and worker rights (Renner et al. 2008). Transitioning to green jobs could potentially change this—if these jobs provide decent work. However, because many green jobs require higher training and education, the current informal downstream ICEV workers may become vulnerable later during the transition. Mitigating this risk requires understanding transition-related challenges and the required support measures. This understanding could also guide another dimension of a just transition: bringing more women into the workforce in a segment where women are highly underrepresented.

Research questions

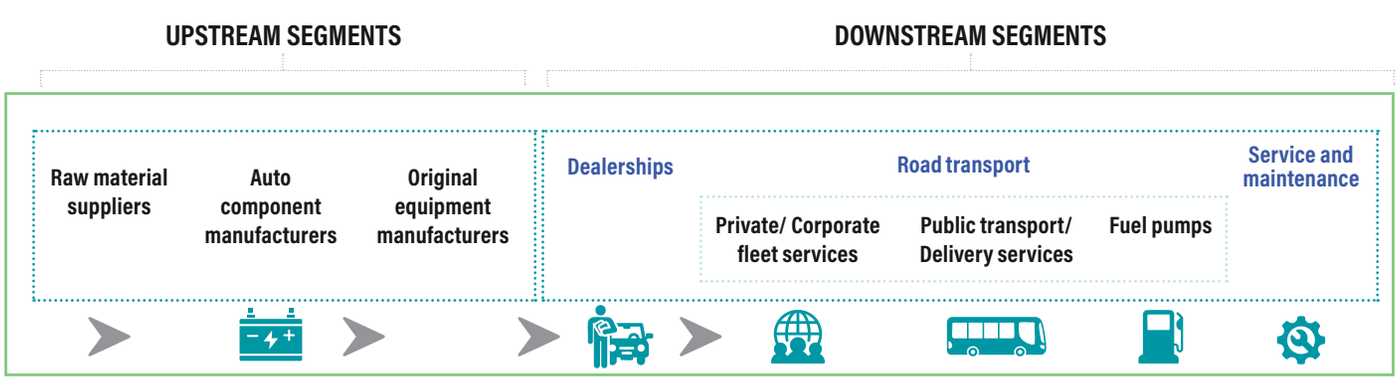
As mentioned earlier, the challenges associated with working in green jobs in the downstream automotive segment are not well known. ICEV workers' perceptions of downstream green jobs are poorly understood. If EV-related jobs are perceived as unattainable or undesirable, fewer workers may apply for such jobs, creating potential worker shortages. Finally, do downstream green jobs provide workers with decent work, or do they merely replicate the working conditions of existing ICEV jobs?

In this context, this study focuses on the challenges, perceptions, and benefits associated with working in downstream green jobs, based on interviews conducted across the NCR in Delhi. Our research questions include the following:

1. How are workers currently moving into green jobs in the downstream automotive segment (put more broadly, what is the current nature of the worker transition)?
2. What challenges do green job workers in this segment face?
3. How do ICEV workers perceive green jobs in this segment?
4. Do green jobs in this segment qualify as decent work?

We first discuss the research methodology and analytical frameworks, and then describe the paper's key concepts. Next, we present the interview findings, key insights, and recommendations. Finally, we discuss the potential way forward.

Figure 1 | **Indian ICEV automotive sector's segments**



Note: ICEV = internal combustion engine vehicle.

Source: WRI India.

METHODOLOGY, FRAMEWORKS, AND LIMITATIONS

To address the paper's research questions, we conducted 106 semi-structured key informant interviews (KIIs) with informal workers in the downstream automotive segment—both ICEV and EV—across the NCR in Delhi.

Study location

The NCR, primarily administered by the Government of the National Capital of Delhi, is a major automobile-manufacturing hub. More recently, Delhi introduced ambitious EV registration targets in India (EVs to comprise 25 percent of total vehicle registrations by the end of 2024) and has adopted numerous measures to encourage EV growth, specifically in the areas of upskilling and job creation: purchase subsidies, tax exemptions, lower electricity tariffs, and R&D support for EV manufacturers (Climate Trends 2023). Delhi outperforms almost all other Indian state capitals in EV growth, except for electric two-wheeler (e-2W) sales, where Bengaluru reported higher growth in 2023 (Vahan Dashboard 2024).

This EV growth will likely create green jobs in the downstream automotive segment. Delhi could thus be considered a "critical case" (Flyvbjerg 2006) for understanding how the transition impacts workers in a region supporting EV growth: do they face significant transition challenges, and do they perceive these new jobs to offer decent work?

KIIs

Key informants for this analysis included workers across major downstream job roles, both ICEV and EV. Because the broader focus of the study was to understand the challenges facing green job workers and the quality of these jobs, the larger sample was from the EV segment.

Other considerations influenced these job role selections:

- Commercial drivers: This is among the largest job group in the automotive sector, comprising many precarious jobs. In theory, a transition from driving ICEVs to EVs should not entail major changes; however, this requires empirical proof.
- Servicing and maintenance workers: This is a largely informal group in the ICEV ecosystem, with many self-employed mechanics. EVs require less maintenance, and because there are major differences between ICEV and EV repair processes (Albatanyeh 2024), lack of skills might hamper the ability of these workers to transition.
- Fuel pump station, EV-charging-station, and battery-swapping-station workers: Fuel pump workers will eventually face transition risks, and understanding their awareness of EV alternatives and the challenges of equivalent EV roles could inform the transition pathways in the downstream automotive segment.

Table 1 | **Sample distribution**

DOWNSTREAM ENTERPRISE	JOB ROLE	ICEV (SAMPLE SIZES)	EV (SAMPLE SIZES)	SAMPLING METHOD
Dealerships	Salespersons for e-2Ws, e-4Ws, and e-rickshaws	0	9	We contacted dealerships and requested interviews with workers. Workers in dealerships that granted permission were included.
Servicing/maintenance centers	Service mechanics, spare parts mechanics, and electricians	8	19	Identified through personal contacts. We then used snowball sampling to broaden the interview pool.
EV charging stations and battery-swapping shops	Charging-station assistants, battery-servicing mechanics, battery-swapping operators	0	17	
ICEV fuel pumps	Fuel pump assistants	5	0	
ICEV and EV commercial driving services	e-2W and ICEV-2W drivers working as last-mile delivery agents, e-4W and ICEV-4W cab drivers, e-rickshaw drivers, and ICEV-3W drivers	12	36	Identified through a mix of personal contacts, snowball sampling, and random intercept surveys (for example, women drivers of taxi services at the airport).
Total respondents		**25**	**81**	

Note: EV = electric vehicle. e-2W = electric two-wheeler. e-4W = electric four-wheeler. ICEV = internal combustion engine vehicle.

Source: Interview data.

- Dealership workers: This role could represent an easier transition pathway because it offers better employment security and existing ICEV workers in the segment might require less retraining.

Because workers in the automotive sector are not randomly distributed, large-scale intercept surveys could be inefficient, time-consuming, and expensive. Therefore, the current snowball sampling approach was preferred despite the possibly lower representativeness of the sample. Moreover, we believe this sampling strategy best addresses our research questions and provides a deeper qualitative understanding of how informal workers are negotiating the transition.

Frameworks and their application to the KII focus areas

Two primary frameworks, selected to address the nuances of this paper's research questions, guided our research design.

The first framework (hereinafter called the O*NET framework) is used by The National Center for O*NET Development (2013a) to classify green jobs. Although green jobs may require different skillsets, training, and education (Bowen and Kuralbayeva 2015; Consoli et al. 2016), treating green jobs as a monolith is problematic given the wide variations in their roles. Certain jobs may present low transition challenges, whereas others may require significant role changes (Table 2).

We apply the O*NET framework to classify green jobs in India's downstream automotive segment. Also, when assessing the challenges faced by downstream green job workers (Research Question 2), this framework allows for a better understanding of whether the observed trends align with global patterns.

The second framework we used evaluates the quality of the existing downstream ICEV jobs. Just as green job roles can vary widely, the existing ICEV job roles vary considerably in quality and precarity, an important consideration when evaluating whether equivalent green jobs offer decent work or better-quality work than existing ICEV jobs. This framework, which was used especially to answer Research Question 4 (i.e., do green jobs provide decent work?), is primarily derived from the existing literature (Table 3).

The KIIs drew from these frameworks and covered the focus areas shown in Table 4. Figure 2 shows the spatial distribution of the KIIs.

Table 2 | **Green jobs classification framework**

CLASSIFICATION	DESCRIPTION	DIFFERENCE FOR WORKERS (FROM NON-GREEN JOBS)	EXAMPLE
Green Increased Demand (Green ID)	Existing jobs expected to be in high demand due to greening and requiring insignificant changes in tasks, skills, or knowledge. These jobs are considered indirectly green because they support green economic activity but do not involve any green tasks.	There are only a few specific skill differences between "indirectly" green jobs and non-green jobs, so transitions may require only on-the-job training.	Customer service representatives (in green firms), bus drivers (intra- and intercity).
Green Enhanced Skills (Green ES)	Existing jobs requiring significant changes in tasks, skills, and knowledge due to greening.	Green jobs require more on-the-job training, education, and experience than non-green jobs and also rely less on manual skills.	Automotive technicians, maintenance and repair workers.
Green New and Emerging	Unique jobs (as defined by worker requirements) created to meet the new needs of the green economy.	These jobs require considerable non-routine analytical tasks and high levels of education and training.	Energy auditors, chief sustainability officers.

Source: The National Center for O*NET Development 2013a; Bowen and Kuralbayeva 2015.

Table 3 | **Major categories of downstream mobility jobs (ICEV)**

DOWNSTREAM ICEV ENTERPRISE	EMPLOYMENT TYPE	QUALITATIVE ASPECTS OF EMPLOYMENT
Dealerships	Primarily regular wages and commissions from sales.	Permanent contracts are rare; however, this role is less precarious than other job roles examined in this analysis, with easier upward and horizontal job mobility because workers in this segment usually possess undergraduate degrees.
Fuel pumps	Regular or casual employment.	Larger number of casual workers in this segment indicate higher precarity. Social security nets are rare. Risks of injuries are higher due to insufficient training in handling inflammable material.
Vehicle repairs, services, and maintenance	Varies based on the service center type. Many local mechanics are self-employed. At small-to-larger repair/service centers, contracts may include regular or casual employment.	Self-employed mechanics and workers at wayside mechanic shops tend to work in unsafe conditions, are vulnerable to job disruptions, and tend to earn very low wages (INR 7,000/US$85 monthly). Workers are rarely financially supported by loans, salaries, health insurance, or pensions.
Commercial driving services	Many delivery executives and passenger vehicle drivers work in the gig economy, though some may work on regular wages or as casual workers for a fleet operator. Public transport drivers are usually on regular wages, though contract labor in this segment does exist. Freight vehicle drivers could be employed on regular wages, as casual workers, or they may be self-employed.	Gig economy workers (primarily last-mile delivery executives and auto-rickshaw/taxi drivers) in this segment grapple with numerous issues: income uncertainty, stress (due to strict deadlines for delivering goods or passengers) and the associated driving-related hazards, algorithmic discrimination, arbitrary suspensions from gig platforms, long working hours, unfair contracts, etc.[a] Although drivers with fleet operators have less precarious jobs, the working hours are often long, with inadequate social security nets.

Note: ICEV = internal combustion engine vehicle.
a. Choudhary and Shireshi 2022.

Source: ILO 2018, Soman et al. 2019, Raveendran and Vanek 2020, iFOREST 2024, supplemented by the authors' analysis.

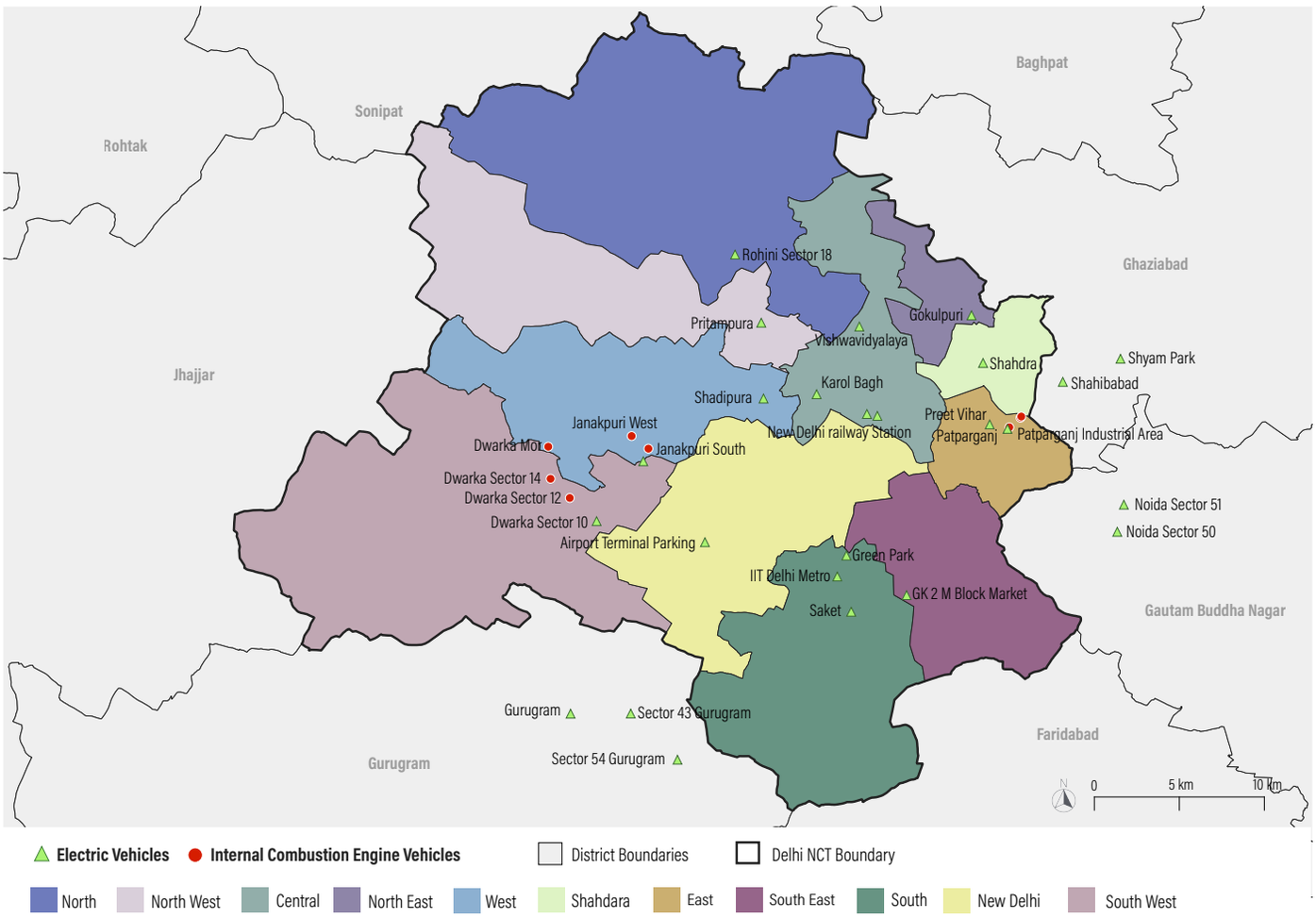
Table 4 | **KII focus areas**

SL.NO	FOCUS AREA	ASPECTS COVERED
1	Worker demographic information	Age, gender, social group (caste and religion), domicile (whether migrant worker), educational attainment.
2	Current job information	Larger number of casual workers in this segment indicate higher precarity. Social security nets are rare. Risks of injuries are higher due to insufficient training in handling inflammable material.
3	Current job quality	Average daily working hours, whether social security benefits were provided at work, type of work contract, whether income from the job was sufficient to meet household expenses, whether other sources of income complemented job wages, challenges faced in the present job, current job satisfaction.
4	Skilling and training	Whether any on-job training was received, participation in government skilling program, utility of such training/skilling, whether the respondent felt additional training might be useful (what and how)
5	Perceptions about green jobs (ICEV workers only)	Perceptions about green jobs in the downstream automotive segment (whether they are considered a potential transition pathway, whether it is difficult to transition to them and why).
6	Changes since transitioning to green jobs (EV workers only)	Previous job role; reasons for switching to green job; vis-à-vis the previous job, whether working conditions, job satisfaction, and income increased or decreased.

Note : EV = electric vehicle. ICEV = internal combustion engine vehicle. KII = key informant interview.

Source: Interview questionnaire.

Figure 2 | **Spatial distribution of KIIs**



DISCLAIMER: Maps used in this poster are for illustrative purposes and do not imply the expression of any opinion on the part of WRI India concerning the legal status of any country or territory or concerning the delimitation of frontiers or boundaries.

Note: KII = key informant interview.

Source: Data from interviews conducted for this paper.

Limitations

First, given the sampling strategy and sampling size, these results are designed to provide preliminary qualitative insights, especially because snowball sampling could exclude potential worker groups of interest. Second, many respondents were interviewed at their workplace, which may have made it difficult for some to express negative opinions about their job. Third, interviews with dealership workers were conducted with the prior employer permissions; it is thus likely that dealerships with track records of fair worker treatment granted permission for these interviews. Fourth, given the rapidly changing policy and working context of the automotive sector, longitudinal analyses may be needed to understand the temporal validity of this study's findings.

However, there is a clear gap in understanding the contours of the transition for this very substantial group of workers in India. By providing early-stage data on this topic, we believe this paper provides a useful foundation for further research and policy analysis.

We now introduce the paper's key concepts and apply the O*NET green job classification framework to the transition in India.

CONCEPTS AND CONTEXT: THE TRANSITION OF INDIA'S DOWNSTREAM AUTOMOTIVE SEGMENT

Key concepts: Just transition, green jobs, and decent work

The concept of a just transition is central and encompasses several dimensions. First, greening the economy should not cause widespread involuntary unemployment and a net reduction of jobs. Many studies estimate that low-carbon transitions and green investments result in net job creation (UNEP 2011; UNFCCC 2016; Montt et al. 2018; Unger et al. 2020; Jaeger et al. 2021; WEF 2022). Studies have forecast a net increase in jobs from India's planned EV transition as well (Soman et al. 2019; iFOREST 2024). However, importantly, state policy interventions may be necessary to ensure sufficient net job increases during transitions. For example, Saha et al. (2023), analyzing Michigan's EV transition, conclude that it "can" result in a net increase of 56,000 jobs but only if appropriate policies are introduced.

However, automotive-sector job increases alone may not ensure a just transition. Although new "green" jobs will doubtless be created during the transition, some existing job roles could eventually become less relevant, resulting in reduced job prospects (for example, small wayside ICEV mechanics in areas with high proportions of EVs). If displaced workers are unable to find green jobs, the transition would not be just.

Closely linked to a just transition is the concept of green jobs. Apart from their environmental aspects, the conceptualization of green jobs has expanded to subsume the concept of decent work, which comprises the following five pillars (Renner et al. 2008):

- Adequate wages
- Safe working conditions
- Job security
- Reasonable career prospects
- Worker rights

Whether or not green jobs qualify as decent work is a focus of this paper (Research Question 4). Although there is evidence for higher wages in green jobs (Muro et al. 2011; Jackman and Moore 2021; Valero et al. 2021), research on the other pillars of decent work lags.

Green job classification in India's downstream automotive segment

We apply the O*NET framework to the downstream automotive segment (Table 5).

Table 5 | **Downstream green jobs**

DOWNSTREAM ICEV ENTERPRISE	JOB ROLE	SKILLSET REQUIRED	O*NET GREEN JOB CLASSIFICATION
Dealership sales	▪ Sales executive	Clear understanding of EV features	Green Increased Demand (Green ID)
Servicing and maintenance	▪ EV technician ▪ Battery technician ▪ Other vehicle-related repair workers	Servicing requirements for EV components, especially batteries and electricals	Green Enhanced Skills (Green ES)
EV charging and battery-swapping stations	▪ Charging attendant ▪ Station supervisor ▪ Battery-swapping attendant	Diagnosing charging or swapping errors, charging/swapping batteries safely	Green ES
Commercial driving services	▪ Last-mile delivery executive ▪ Auto-rickshaw and taxi drivers ▪ Public transport driver ▪ Freight vehicle driver	GPS training, understanding how to drive EVs safely and efficiently	Green ID

Note: EV = electrical vehicle. GPS = Global Positioning System.

Source: ASDC and EY 2019; Samantray and Banswal 2022; The National Center for O*NET Development 2013b.

Based on this framework, we expect skilling challenges for workers transitioning into ES jobs (EV repair and maintenance jobs, EV charging or battery-swapping station jobs). EV technicians, for example, are more like electricians than mechanics (Tomatore 2023), requiring more specialized knowledge, especially of battery repairs. The increasing use of software and computer-based technology in EVs will require technicians to undergo significantly more training than their conventional, "mechanical" ICEV counterparts, and this disparity in skill sets may decide who can repair EVs. For Green ID jobs, the transition is less likely to require skilling, for example, moving from an ICEV to an EV dealership or from driving an ICEV to driving an EV.

DATA, FINDINGS, AND INSIGHTS

We first provide a broad demographic overview of our sample. We then discuss this paper's research questions: first, how the workers in our sample transitioned to EV jobs; second, the challenges faced by informal downstream green job workers; third, ICEV workers' perceptions of these green jobs; and finally, whether these green jobs could qualify as decent work. We then look at the key implications of these findings.

Profiles from our sample: Job and demographic characteristics of interviewees

Approximately half our respondents worked in ICEV and EV commercial driving jobs. Servicing and maintenance jobs were the second-most frequently cited roles, followed by fuel pump attendant roles (for ICEVs) and dealership roles (for EVs). Most of our sample consisted of young workers under 35; also, most were educated to matriculate levels. Green job workers tended to be more educated than ICEV workers, with all graduates from our sample working in green jobs. Most of our sample (63 percent) were from disadvantaged caste backgrounds (Other Backward Castes, Scheduled Castes, and Scheduled Tribes).

Approximately half the respondents were migrants, with most migrants hailing from Bihar or Uttar Pradesh. Trade union membership was not a prominent feature of this sample. Finally, only six respondents from our sample—all in green jobs—were women. This aligns with sectoral trends: Raveendran and Vanek (2020) also find that women comprise approximately 6 percent of informal transport workers in urban India.

Although basic socioeconomic data were collected—to understand the sample's representativeness—this paper does not examine the social discrimination aspects of the transition or provide detailed socioeconomic analyses of the studied job roles. These aspects are doubtless important and merit further research. However, this study focuses on the more technical aspects of the transition.

How are workers currently moving into green jobs in the downstream automotive segment?

Of the 81 respondents in green jobs, approximately half had transitioned from ICEV jobs, approximately 30 percent were first-time job seekers, with the remainder transitioning from other informal roles: street vendors, cleaners and helpers, and part-time jobs such as newspaper distribution and typists (Figure 3).

Table 6 | **Sample composition**

AGE GROUP	NUMBER (%) OF RESPONDENTS		EDUCATIONAL ATTAINMENT	NUMBER (%) OF RESPONDENTS		CASTE	NUMBER (%) OF RESPONDENTS	
	EV (green) workers	ICEV workers		EV (green) workers	ICEV workers		EV (green) workers	ICEV workers
18–25	29 (35.8)	1 (4)	Primary or secondary	16 (19.75)	11 (44)	General	32 (41.56)	6 (24)
25–35	28 (34.57)	11 (44)	Secondary (matriculated)	39 (48.15)	10 (40)	Scheduled Caste/Tribe	11 (14.29)	8 (32)
35–45	20 (24.69)	10 (40)	Senior secondary	14 (17.28)	4 (16)	Other Backward Caste	34 (44.16)	11 (44)
45 and above	4 (4.94)	3 (12)	Graduate	12 (14.81)	0			

Note: EV = electric vehicle. ICEV = internal combustion engine vehicle.

Source: Data from interviews conducted for this paper.

Within the various job roles, minor differences in transition pathways emerged: commercial driving attracted most first-time job seekers, whereas the other three roles saw most workers transitioning from ICEV jobs, with a lower number of first-time job seekers.

For most respondents, the primary reason for transitioning to downstream green jobs was because they paid better than their earlier job or equivalent jobs they could have obtained with their skillset.

For first-time job seekers, the need to earn ("avoid being unemployed") was the primary motivation for accepting these jobs. Supplementing family income (for example, driving a commercial EV when other family members were not driving it) was another prominent reason. The higher proportion of first-time job seekers in commercial driving jobs could be explained by the growth of low-speed EVs (LSEVs): e-2Ws and e-3Ws that have a maximum speed of 25 kmph. These vehicles can easily be rented and do not require a driving license. As one respondent put it: "By just paying INR 200–400 ($2.25–$4.5) daily [to rent an EV] we get jobs which pay INR 800–1,000 ($9–$11.25), without any prior qualifications, which is more than double the pay of an unskilled laborer in India."

Easier access to LSEVs than ICEVs indicates considerable employment opportunities for workers who lack specialized training. However, the low entry barriers may also present road safety issues, as discussed later.

Dissatisfaction with existing job incomes was a major motivating factor for workers transitioning from ICEV jobs. Several workers stated they had been forced to find new jobs after being released from existing jobs, though this involuntary unemployment was unrelated to the transition. Referrals from friends and family to downstream green jobs formed an important "discovery" channel for identifying and securing such jobs. A few ICEV workers mentioned that they had heard "EVs were the future" and were thus entering such work early to gain an advantage. However, as shown later, this view was far from universal.

Workers transitioning from other informal work broadly echoed the same reasons for shifting from ICEV jobs, though "poor working conditions" in previous jobs emerged as an additional factor for some.

Thus, multiple transition pathways emerged from our sample, with perceived higher incomes and involuntary unemployment being major reasons to shift to, or work in, downstream green jobs.

What challenges do downstream green job workers face?

By analyzing the challenges faced by downstream green job workers, we aim to better understand how easy it may be for future workers to make such transitions. If these jobs are too challenging, existing ICEV workers may be left behind as the transition gathers pace.

Figure 3 | **Transition pathways to green jobs**

Note: ICEV = internal combustion engine vehicle.

Source: WRI India's authors' analysis based on interviews with key informants.

The broad challenges fell into three major categories: inefficiencies related to EV operations and maintenance, inadequate training, and a lack of understanding of the "complex" mechanics of EVs.

Challenges faced by commercial drivers

Commercial drivers in our study primarily comprised e-rickshaw drivers (self-employed), taxi drivers (working for fleet owners), and last-mile delivery agents (primarily 2W drivers predominantly working in the gig economy).

The most common challenges faced were downtime and lost income due to vehicle charging (especially by e-4W drivers). One of the respondents stated that "charging time is more, and charging infrastructure is less. Two to three hours of daily charging time are wasted."

Another respondent expressed frustration with disruptions due to longer charging times and discharged batteries: "Major time goes in charging, as the battery gets discharged after 5 hours of driving and approximately 12 rides. I end up having to cancel many upcoming rides because of the discharged EV."

Charging problems also included inadequate charging infrastructure, which a delivery executive elaborated as follows: "Currently, there are fewer charging points, and we have to travel 20–25 km to charge our e-bikes. This takes a lot of time and affects the business."

Although the operating costs of an EV are lower—especially important for gig economy and other workers who pay for their own fuel—the perception of "unnecessary" downtime led to frustration and difficulty in following their "ideal" schedules.

For e-3W (e-rickshaw) drivers, lack of safety and quality in vehicle construction was a challenge. This unexpected complaint, which deviated from the broad challenges commonly associated with the just transition discourse, was expressed as follows: "Slow speed, high maintenance, less durability, unsafe."

Two women respondents reported feeling unsafe when driving an e-3W through certain areas of Delhi. Although it is unlikely that an ICEV would eliminate this risk, the relatively lower speeds of LSEVs may have contributed to this perception.

e-2W drivers often rented their vehicles from services such as Yulu. In this model, a vehicle with a depleted battery is swapped with a charged vehicle at designated zones; thus, charging is not a major concern. However, respondents expressed challenges with e-2Ws, especially in rainy weather: "There are too many wiring problems in the rainy season. It feels unsafe, and it slips. I need to visit the mechanic too often."

Lack of skills was thus not seen as the primary transition challenge. Some drivers found using platform apps and navigating with GPS challenging; however, this was not EV specific. For drivers transitioning from ICEVs to EVs, the switch was not considered a skill challenge: it was a "vehicle" change, not a "job" change.

Challenges faced by service center workers and mechanics

Among these workers, employment was equally divided between those receiving regular wages and those working as casual laborers, with no clear educational differences explaining the division. Two major challenges emerged: inadequate skilling and training, along with inefficiencies stemming from the nascency of the EV industry.

The transition to EV repairs was considered challenging: "I am currently working in this shop based on my previous work experience at [an ICEV] mechanic shop. I need adequate training to understand the mechanics of EVs."

Workers felt their existing training did not help them understand EV software, technicalities, and electrical components, and so they frequently got "stuck": "…EVs are regularly facing some technical problems here and there. If better training could be provided so that the repairs could last longer, it would be very helpful."

Even workers with more formal training lacked sufficient knowledge. A supervisor complained: "I have four junior mechanics who are working under my supervision. Though all of them hold an ITI [Industrial Training Institute] diploma, their understanding of the electrical parts of EVs such as wiring and battery maintenance is less. I would say they are partially skilled."

Another challenge was that EV-specific spare parts were difficult to obtain; workers needed to contact the manufacturer and wait 15–30 days to receive parts. This impacted both customer satisfaction and their daily working output.

Challenges faced by EV charging and battery-swapping station workers

The respondents were primarily employed on regular wages. Here, a lack of knowledge about charging systems remained a prominent challenge: "I have received no technical training, so sometimes I get stuck and have to call the supervisor. The charging gets stuck by the time the supervisor arrives."

Infrastructural challenges were also mentioned, with the following comment covering the gamut of a respondent's challenges: "Problems in learning [battery-swapping technicalities], frequent power cuts, Internet failures, overcrowding due to insufficient battery-swapping machines at the center."

These challenges highlight familiar themes: skill-related issues and issues dealing with newer, less well-developed EV infrastructure.

Challenges faced by dealership workers

The respondents were all employed on regular wages. Although a few felt they were not adequately compensated, these workers faced fewer work challenges.

One worker found it challenging to communicate effectively with customers: "Currently, at the showroom we are only given a manual to help understand the features of EVs. … However, if the customer has queries beyond that, we need to talk to our managers."

Charging infrastructure challenges, as discussed in the earlier section titled "Challenges faced by commercial drivers," also impacted dealership workers: "Sometimes it is difficult to convince customers about EVs. There is low acceptance of EVs due to lack of charging infrastructure and range anxiety."

However, the challenges dealership workers faced were relatively minor.

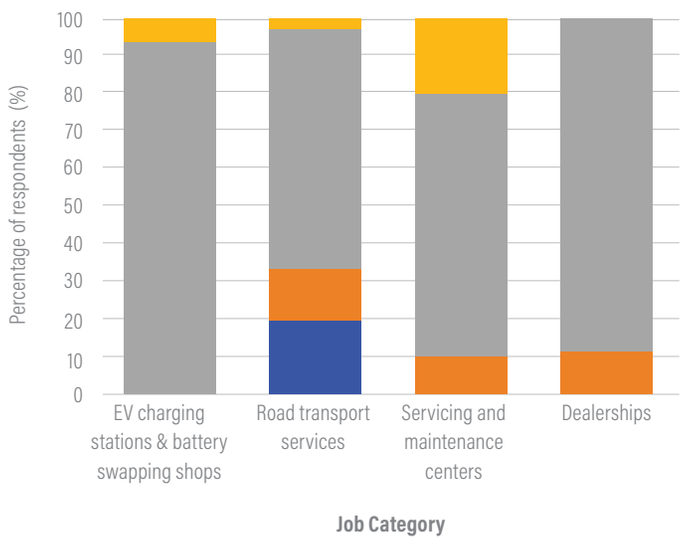
Challenge assessment

The results from our sample align with the O*NET green jobs classification framework: Green ID jobs (dealerships and commercial drivers) did not present skilling or training challenges; rather, the challenges stemmed from inadequate or inefficient EV infrastructure.

For Green ES jobs (servicing, maintenance, charging, and battery swapping), the more transient challenge was underdeveloped supply chains. This may ease as the transition gathers pace. More importantly, inadequate training left workers ill-equipped to perform their new roles well.

The type of training workers receive (Figure 4) is instructive. Most received "nonformal" training, defined by the Periodic Labor Force Survey (PLFS 2023) as training provided through community-based settings, the workplace, activities of civil society organizations, or any training organization, but without a formal curriculum, syllabus, or accreditation and certification. "Informal" training (acquired by a worker through family, community, or daily life experiences—i.e., outside the formal working environment)—was the second-most frequent type of training observed. Formal training (through an institution with a structured curriculum and learning requirement) was uncommon.

Figure 4 | **Training received by workers in the sample**



Note: EV = electric vehicle.
Source: Interview data.

When asked, most respondents found their training "sufficient." This was surprising given the number of respondents who had clearly voiced challenges stemming from insufficient training. This may indicate a disconnect between the quality of training and job performance ability.

The attitudes of supervisors regarding training indicated that short on-the-job training periods were considered sufficient; longer training would represent a "loss of income" because the trainee would not be able to "productively contribute" to work. The combination of these two factors—workers not considering sufficient training a prerequisite and employers primarily considering it a loss of income—requires further study, to understand how attitudes toward training can be changed.

How do ICEV workers perceive the quality of green jobs in the downstream automotive segment?

Of our sample of 25 ICEV workers, 5 perceived green downstream jobs positively. Of these, 3, who were involved in servicing and maintenance, were optimistic about the EV industry because they felt it could increase their business: "Yes [I foresee career prospects in the industry], EVs will come to our workshop for servicing."

For a mechanic who is mainly involved in priming and painting vehicles, the transition could offer additional business: "Yes, but the priming and painting of EVs should not be very different."

However, for most ICEV workers, the following observation summarized their perceptions, which also suggested a lack of imminent threats to their jobs due to the transition: "Not many [electric] vehicles in the market, and no training is available for EV servicing."

Training for battery-related repairs was specifically perceived as challenging: many EVs have unique battery pack systems that can only be changed by the original equipment manufacturers (OEMs). Similarly, the increasing digitization associated with EVs was perceived as a difficulty. An ICEV mechanic was up front about the challenge: "EV 3-W mechanics need proper training in servicing and repairing. Currently, we do not have any access to training programs. We are just aware that EVs in cargos and passengers are there."

The remaining workers in our sample either lacked awareness of downstream green jobs or saw no clear benefit in transitioning. For commercial drivers, although a few considered EVs "greener," concerns around charging times and repairs were repeated: "Getting vehicle services and charging at midday are huge problems with EVs."

The interviewed fuel pump workers had not considered related green jobs (such as battery-charging or battery-swapping attendants) a potential option; they also suggested there was no imminent threat to their existing ICEV jobs. Given that many charging stations are unstaffed, their job creation potential is admittedly lower. However, it appears that most ICEV workers are not considering alternative jobs, such as battery-swapping attendants.

It is notable how closely the perceptions of ICEV workers mirror the challenges faced by downstream green job workers. Additional research could identify steps to address such perceptions (and, more importantly, the underlying challenges in the downstream automotive segment that prompt such perceptions).

Do green jobs in the downstream automotive segment qualify as decent work?

As mentioned earlier, the concept of green jobs subsumes the concept of decent work, whose pillars are adequate wages, safe working conditions, job security, reasonable career prospects, and worker rights (Renner et al. 2008). We now evaluate findings from our study against these pillars.

Adequate wages

As discussed earlier, most respondents transitioning to green jobs did so because of a perceived increase in income. We now investigate this in more detail.

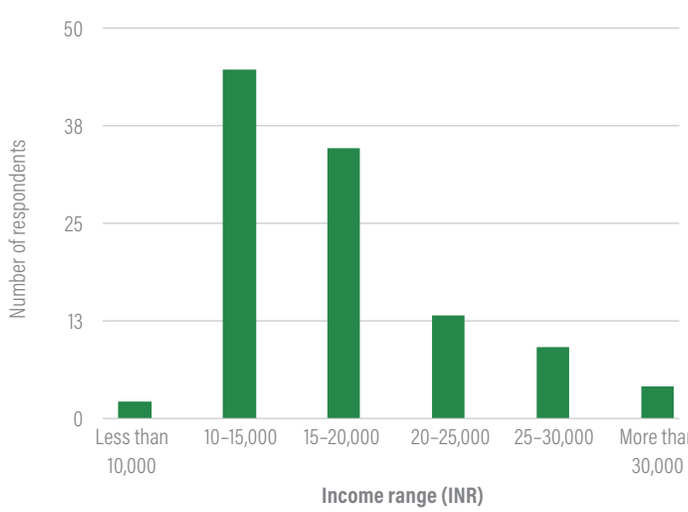
Most of the respondents in green jobs earned between INR 10,000–15,000 (US$120–180) per month, with the second-largest category earning INR 15,000–20,000 ($180–240) per month (Figure 5). The median income was INR 192,000 ($2,298) annually, higher than India's per capita income of INR 171,498 ($2,059) for 2022–23 (NSO 2023).

A closer look highlights considerable variations in salaries across different job roles, with charging-station and battery-swapping workers receiving the lowest wages. Variations also existed in the percentage of respondents stating that their incomes had increased on switching to such jobs. However, more than half the respondents indicated higher income in green jobs than in their previous employment (Table 7).

The low proportion of dealership workers indicating an income increase could be attributed to a shift by many of them from ICEV sales at dealerships to EV sales. However, these workers also reported the highest average income.

Most respondents also stated that they could meet household expenses with their current income, barring unforeseen medical issues. Because only a third of the respondents stated that they had other sources of household income, our findings suggest that downstream green jobs offer adequate, if unexceptional, wages.

Figure 5 | **Income distribution across the sample**



Source: Interview data.

Table 7 | **Median income across job categories, with wage perceptions**

JOB ROLE	MEDIAN ANNUAL WAGE (INR)	RESPONDENTS REPORTING INCOME INCREASES (%)
Charging and battery-swapping workers	168,000 ($2,010)	76.92
Commercial drivers	210,000 ($2,513)	91.3
Servicing and maintenance workers	192,000 ($2,298)	68.75
Dealership workers	240,000 ($2,873)	57.14

Source: Interview data.

Safe working conditions

Most respondents reported improved working conditions compared to their previous job (whether ICEV or other informal).

However, when asked "how" working conditions had changed compared to earlier work, the responses were mixed, especially for workers transitioning from other informal work, with 50 percent of them reporting no improvements, or even a deterioration, in working conditions.

For workers in commercial driving, green jobs presented no clear improvement over ICEV work. For e-2W users, many of whom work in the gig economy, the critiques of gig economy work apply: primarily, the pressure to meet tight delivery deadlines could lead to reckless driving. As a delivery executive pithily remarked: "It is the company that benefits—the delivery agent does not benefit by switching vehicles."

The increasing usage of LSEVs in this segment may improve safety due to their lower speeds. However, helmets are not mandatory. Because these vehicles are smaller and lighter than regular 2Ws, road collisions could result in serious injuries to their drivers.

No specific safety concerns were highlighted by the other respondents. However, the median number of daily hours worked across our sample was 9.83, above India's mandated 8 hours. From a health perspective, this is a safety concern, given that long working hours are associated with multiple negative health outcomes (Wong et al. 2019).

Thus, when analyzed against the job quality framework discussed earlier, it appears that green jobs (across job roles) replicate many of the safety issues observed with ICEV jobs, except the safety aspects associated with LSEV deliveries.

Job security

No major differences in job security were observed between ICEV workers and green job workers. Green job workers in dealerships and service centers were employed on regular wages without periodic contract renewals. Self-employed workers were primarily commercial drivers. Workers on regular wages in the commercial driving segment tended to work either as last-mile delivery agents or as e-cab drivers. Gig economy workers risk being arbitrarily removed from the service platform due to customer complaints. Further, the social security benefits are inadequate. From the standpoint of the job quality framework, there is little difference between existing ICEV jobs and green jobs.

Worker rights and career prospects

Except dealership workers and service center professionals, our sample provided little evidence that transitioning to green jobs in the downstream automotive segment has improved workers' rights and career prospects. As such, the picture here remains mixed: many job roles in this segment, either due to their informality or the working conditions of the gig economy, are not associated with clear career paths, career prospects, worker unions, or clearly spelled-out worker rights. Again, there is little difference between ICEV and EV jobs based on the job quality framework.

Of the five pillars of decent work, green jobs appear to meet just one—albeit important—pillar: wages. Therefore, most downstream green jobs cannot currently be classified as decent work.

Summary insights

In the context of India's EV transition, this paper aimed to provide a preliminary understanding of how workers transitioned to green jobs in the downstream automotive segment, the challenges workers faced in such jobs, ICEV workers' perceptions of green jobs, and whether downstream green jobs could provide decent work.

We find that workers are transitioning into green jobs in this segment in multiple ways: although half the sample had moved from ICEV jobs to green jobs, these jobs attract first-time job seekers (especially commercial driving jobs) along with workers from other informal industries. Commercial driving was particularly popular among first-time job seekers due to the very low entry barriers for driving low-speed EVs. Across all transition pathways, increased income in green jobs

(vis-à-vis previous jobs and alternative jobs) was the primary motivation for applicants and those transitioning to such jobs, supporting the broad hypothesis that "green jobs pay better."

From a worker challenge standpoint, we find that the transition is proceeding along expected lines. Application of the O*NET framework highlights that training and skilling challenges predominate for workers in Green ES jobs. For Green ID jobs—which are closer to existing ICEV job roles—the challenges include infrastructural issues stemming from the nascency of the EV ecosystem, especially inadequate access to charging points and vehicle spare parts. Some of these challenges could ease as the transition gathers pace, for example, the wider availability of charging points and EVs to repair. However, these are clear gaps that can be proactively addressed to smoothen the transition for workers.

Given these challenges—which were known to the ICEV respondents interviewed—many indicated that the transition to green jobs may not be justified given the relatively low number of EVs in the market and the insufficient supporting infrastructure. This again underscores the need to proactively address worker challenges in the downstream automotive segment.

Finally, in assessing whether green jobs provide decent work, the evidence from our sample indicates that green jobs do provide adequate wages to support everyday living. However, they do not provide the other pillars of decent work: safe working conditions, job security, worker rights, and clear career prospects. From the standpoint of the job quality framework, it is clear that green jobs currently do not provide better work quality than ICEV jobs (except for wages), in many cases replicating the same precarity seen in ICEV jobs.

RECOMMENDATIONS

Using the above insights, we suggest recommendations that span the broad areas of EV infrastructure, training, social security, and EV repairs.

Infrastructure

A common issue raised by road transport workers in our sample was the lack of charging infrastructure and long charging-related vehicle downtimes, which impacted their flexibility and income-earning potential. Several firms have already instituted ambitious fleet electrification targets; for example, Zomato targets 100 percent EV food deliveries by 2030 (ET Brand Equity 2024). These accelerated electrification targets will highlight the growing importance of fast, convenient charging for commercial drivers.

Charging infrastructure expansion needs to be accelerated: under the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles II (FAME-II) scheme, 2,877 EV charging stations were sanctioned across 68 cities in 2019, of which only 150 have been operationalized (*The Economic Times* 2024). Further, battery swapping (as opposed to charging vehicles at fixed charging points) is ideal for commercial drivers because it almost eliminates vehicle-charging downtimes; indeed, several respondents from our sample suggested it was "most suitable" for commercial drivers. However, it was not included in the earlier EV subsidy schemes, and swappable batteries attract higher taxes than "fixed" EV batteries. There is a need to ensure that workers can easily access appropriate charging infrastructure, reducing involuntary vehicle-charging-related work downtime.

In this context, the following two measures have potential:

- FAME-II earmarked INR 10 billion ($119.69 million) to expand the EV charging infrastructure; however, progress has been limited. In upcoming schemes, implementation mechanisms must address challenges such as land availability, seamless electricity connections, and financing of upstream grid infrastructure. This would ensure rapid scale-up of charging infrastructure, allowing commercial drivers to easily charge their vehicles.
- Mainstreaming battery swapping requires standardizing swappable batteries to enable open swapping networks (as opposed to the current closed-loop arrangements between battery-swapping operators and vehicle OEMs) by notifying appropriate policies such as NITI Aayog's 2022 Draft Battery Swapping Policy. Such measures, in conjunction with incentives for improving viability and promoting investments in battery-swapping networks, can significantly increase the scale of battery swapping.

Training

Transitioning the workforce, especially to Green ES jobs, requires significant investments in quality training. As our sample shows, training was often insufficient to allow workers to achieve competency. More concerningly, deficient training appeared to be normalized, in that workers perceived it to be sufficient. Additionally, unlike the upstream segment, the downstream automotive segment lacks rigorous in-house staff training, highlighting the need for workforce capacity-building (ASDC and EY 2019). Evaluating the precise training workers "should" receive is beyond this paper's scope. However, the following points may be made:

- There is a need to investigate how information about skilling programs can be effectively disseminated to workers, especially through informal social networks. Very few workers in our sample were aware of the existence or utility of skilling programs.
- There is a need to offer more need-based grants to workers seeking to attend formal skilling programs, and simplify application processes. Financial constraints deterred the workers in our sample who were aware of such programs.
- Establishments can attract unskilled workers by offering apprenticeships that include on-the-job training and a stipend. Programs such as the National Apprenticeship Promotion Scheme could prove a useful strategy for formally involving (and incentivizing) more semi-skilled workers in the downstream segment (Sachdev and Sengupta 2024). However, such schemes are more easily implemented in the upstream segment. There is a need to research how to include the downstream segment: schemes could be extended to large-scale fleet operators, garages, and dealerships, but smaller, more informal enterprises (such as small wayside mechanics) may be left out.
- There is a need to roll out new programs tailored to the downstream automotive segment's needs. Although the Automotive Skills Development Council has devised multiple qualification packs for EV-specific training, few have been operationalized.
- Enterprises need to be incentivized to initiate reskilling initiatives and improve the quality of in-house training. Hero Electric, for instance, undertook to reskill 8,000 small wayside mechanics to enable them to service EVs. It also aimed to reskill 10,000 such mechanics annually (WRI India 2022). However, because many enterprises are unlikely to adopt such initiatives voluntarily, they could be incentivized through appropriate tax incentives and mandates and as corporate social responsibility project inclusions.

Social security

Lack of social security is a clear issue given the downstream automotive segment's informality and increasing contractualization of work. Another trend, overlapping with the EV transition, has been the exponential rise of gig work. A fair share of gig workers will thus be a part of the downstream EV ecosystem (OMI Foundation 2024). Because contractualization impacts working conditions and social security, these workers are at risk of losing out on the benefits of the technological transition (Damodaran 2010; Bajpai et al. 2018; Kerswell and Pratap 2019; Raveendran and Vanek 2020). Certain measures could help workers enjoy improved social security in downstream green jobs:

- The EV policies of some states incorporate job creation provisions designed to encourage employers to provide better-quality, formal-economy jobs; for example, by contributing to the Employee Provident Fund for new employees of EV companies. Such measures encourage permanent or fixed-term contracts rather than contractual hiring (Kanuri et al. 2021). There is a need to understand how such measures can include the less organized downstream segment.
- After the Code on Social Security 2020, which broadened the scope of social protection, was enacted, several gig platforms instituted social security measures for their partners, most commonly, accident insurance, skill development opportunities, and medical insurance (OMI Foundation 2024). However, the coverage varies. There are also concerns about the arbitrariness of such coverage at some major gig platforms. It is thus necessary to transparently extend protections to gig workers. Although lack of social security is not exclusive to green gig economy jobs, the transition presents a promising opportunity to leverage improved social security for gig workers.
- Certain states in India have recently taken measures to address these issues. Rajasthan passed the Platform Based Gig Workers (Registration and Welfare) Act in July 2023, aiming to formally register platform workers to provide social protections and other benefits to them through a common fund (Jeswant and Saggi 2023). Karnataka introduced legislation to address arbitrary dismissals and pay deductions, an increasingly common complaint among platform workers (Elizabeth 2024). Although the specifics of such legislation have invited debate—and may need further research and fine-tuning—they are a welcome step to improve social protections in the downstream automotive segment. There is a need for other states to introduce legislation to support platform workers.
- Finally, research is needed to understand how to bring informal workers in unorganized enterprises in this segment (such as small wayside mechanics) into social security nets.

Servicing EVs

The respondents highlighted numerous issues with EV repairs, some caused by nascent, underdeveloped EV supply chains, others due to the inherent characteristics of EV manufacturing and repairs. Delays in receiving EV spare parts, apart from reducing remunerative work hours for mechanics, also inconvenience commercial drivers who have purchased EVs, because their vehicles can be used only after spare parts arrive. Finally, there is a risk that small wayside mechanics might be left behind during the transition: EVs require less frequent repairs than ICEVs, and their components are more

complex than the mechanical components in an ICEV. This necessitates specialized handling techniques that informal mechanics may not know (Philip 2024).

The following measures could address some of the highlighted issues:

- Increasing localization of EV components and the spare-parts-manufacturing ecosystem could help reduce delays in receiving spare parts.
- An issue highlighted by the respondents was the need to get parts and repairs done exclusively from OEMs or at company garages. This impacts the ability of small wayside mechanics to transition to EV repairs. A "right-to-repair" policy allowing for a wider range of generic spare parts in EV repairs could alleviate this, as also highlighted by iFOREST (2024). This requires safeguards to ensure the quality of repair work even with non-OEM parts.
- There is a need to build strong countrywide EV repair and servicing networks that incorporate small wayside mechanics.

THE WAY FORWARD

Given the small-scale nature of this study, there is a need for further research to inform longer-term policies for the downstream automotive segment:

- Do the challenges, quality, and ICEV workers' perceptions of green jobs identified here prevail across India in this segment? If not, how do they vary?
- What are the broad labor shift trends in India in the EV transition context, and how do these trends vary?
- Which social networks influence the decisions of informal workers to opt for sectoral green jobs and training programs? How can these networks be leveraged to increase the salience of training programs?
- How can skilling and training programs be designed to better cater to the needs of informal workers in this segment?
- How can workers and employees be better incentivized to opt for (and employers be incentivized to offer) better training in this segment? How should such incentives be designed?
- How can legislation and social protections for the automotive and manufacturing sectors be extended to cover this segment, given its fragmented, unorganized nature?
- What strategies are being promoted to mainstream women's employment in this segment, and which have proved successful?

India's EV transition presents a great opportunity to leverage environmental and equity gains. Currently, the former gains are underway. However, the just transition challenges in the downstream automotive segment are not unique to India, as the literature and frameworks drawn on in this paper show. At this early stage of the transition, there is great scope to further research these challenges and deploy strategies to ensure that green jobs in this segment provide truly decent work.

REFERENCES

Albatayneh, Aiman. 2024. "The Electric Cars Era Transforming the Car Repairs and Services Landscape." *Advances in Mechanical Engineering* 16 (7): 16878132241266536. https://doi.org/10.1177/16878132241266536.

ASDC (Automotive Skills Development Council) and EY (Ernst & Young). 2019. *Human Resource and Skill Requirements in the Automotive Sector (2026).* New Delhi: ASDC, and Kolkata: EY. https://www.asdc.org.in/uploads/reports/109781093728052403073 6.pdf.

Bajpai, Harsh, Ambika Tandon, and Amber Sinha. 2018. *Future of Work in India's Automotive Sector: Perspectives from Ground.* Working Report. Bengaluru, India: The Centre for Internet and Society. https://cis-india.org/internet-governance/pdf-automotive-case-study.

Bowen, Alex, and Karlygash Kuralbayeva. 2015. *Looking for Green Jobs: The Impact of Green Growth on Employment.* Policy Brief. London: Grantham Research Institute on Climate Change and Environment and Seoul: Global Green Growth Institute. https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2015/03/Looking-for-green-jobs_the-impact-of-green-growth-on-employment.pdf.

Choudhary, Vedant, and Shambhulinganand S. Shireshi. 2022. "Analysing the Gig Economy in India and Exploring Various Effective Regulatory Methods to Improve the Plight of the Workers." *Journal of Asian and African Studies* 57 (7): 1343–56. https://doi.org/10.1177/00219096221082581.

Climate Trends. 2023. *Analysis of State Electric Vehicle Policies and Their Impact.* New Delhi: Climate Trends. https://imgs.mongabay.com/wp-content/uploads/sites/30/2023/03/09122500/Climate-trends-report.pdf.

Consoli, Davide, Giovanni Marin, Alberto Marzucchi, and Francesco Vona. 2016. "Do Green Jobs Differ from Non-green Jobs in Terms of Skills and Human Capital?" *Research Policy* 45 (5): 1046–60. https://doi.org/10.1016/j.respol.2016.02.007.

Damodaran, Sumangala. 2010. "Global Production, Employment Conditions and Decent Work: Evidence from India's Informal Sector." ILO Working Paper. New Delhi: International Labour Organization. https://webapps.ilo.org/static/english/protection/travail/pdf/rdwpaper27b.pdf.

Elizabeth, Shilpa. 2024. "What Does the Karnataka Bill Promise Gig Workers?" *The Hindu.* July 8. https://www.thehindu.com/news/national/karnataka/what-does-the-karnataka-bill-promise-gig-workers-explained/article68375781.ece.

ET Brand Equity. 2024. "Zomato Promises 100% EV Deliveries by 2030," June 5. ETBrandEquity.Com. https://brandequity.economictimes.indiatimes.com/news/advertising/zomato-promises-100-ev-deliveries-by-2030/110734736.

Flyvbjerg, Bent. 2006. "Five Misunderstandings about Case-Study Research." *Qualitative Inquiry* 12 (2): 219–45. https://doi.org/10.1177/1077800405284363.

IEA (International Energy Agency). 2021. "EV30@30 Campaign." Clean Energy Ministerial. https://iea.blob.core.windows.net/assets/0f695db4-14b0-4360-9c16-adccfde98536/CampaignDocumentupdate_2021.pdf.

iFOREST (International Forum for Environment, Sustainability and Technology). 2024. *ICE to EV: An Evaluation of Workforce Impact and Considerations for Just Transition.* iFOREST: New Delhi.

ILO (International Labour Organization). 2015. *Guidelines for a Just Transition towards Environmentally Sustainable Economies and Societies for All.* Geneva, Switzerland: International Labour Organization. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@ed_emp/@emp_ent/documents/publication/wcms_432859.pdf.

ILO. 2018. *India Wage Report: Wage Policies for Decent Work and Inclusive Growth.* New Delhi: ILO. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40asia/%40ro-bangkok/%40sro-new_delhi/documents/publication/wcms_638305.pdf.

Jackman, Mahalia, and Winston Moore. 2021. "Does It Pay to Be Green? An Exploratory Analysis of Wage Differentials between Green and Non-green Industries." *Journal of Economics and Development* 23 (3): 284–98. https://www.emerald.com/insight/content/doi/10.1108/jed-08-2020-0099/full/pdf?title=does-it-pay-to-be-green-an-exploratory-analysis-of-wage-differentials-between-green-and-non-green-industries.

Jaeger, J., G. Walls, E. Clarke, J.C. Altamirano, A. Harsono, H. Mountford, S. Burrow, S. Smith, and A. Tate. 2021. "The Green Jobs Advantage: How Climate Friendly Investments Are Better Job Creators." Working Paper. Washington, DC: World Resources Institute. https://doi.org/10.46830/wriwp.20.00142.

Jeswant, Bishen, and Luv Saggi. 2023. "Rajasthan Passes Rajasthan Platform Based Gig Workers (Registration and Welfare) Act, 2023" Blog. August 30. *Cyril Amarchand Mangaldas.* https://corporate.cyrilamarchandblogs.com/2023/08/rajasthan-passes-rajasthan-platform-based-gig-workers-registration-and-welfare-act-2023/.

Jarvis, Andrew, Adarsh Verma, and Justine Ram. 2011. *Assessing Green Jobs Potential in Developing Countries: A Practitioner's Guide.* Geneva: ILO. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40dgreports/%40dcomm/%40publ/documents/publication/wcms_153458.pdf.

JMK. 2023. "Electric Annual India EV Report Card: FY2023 Insights." *JMK Research & Analytics.* https://jmkresearch.com/annual-india-ev-report-card-fy2023/.

Kanuri, Chaitanya, Rohan Rao, and Pawan Mulukutla. 2021. A *Review of State Government Policies for Electric Mobility.* New Delhi: WRI. https://www.wricitiesindia.org/sites/default/files/Full_report_EV_State_Policy.pdf.

Kerswell, Timothy, and Surendra Pratap. 2019. "Informality in the Indian Automobile Industry." *In Globalization, Labour Market Institutions, Processes and Policies in India: Essays in Honour of Lalit K. Deshpande*, edited by K.R. Shyam Sundar, 187–209. Singapore: Springer Nature. https://www.springerprofessional.de/en/introduction-towards-an-understanding-of-informality-and-precari/16894060.

Mamgain, Rajendra P. 2020. "Wage Employment, Informality, and Social Networks in Indian Labor Market." In *Development Challenges of India After Twenty-Five Years of Economic Reforms: Inequality, Labour, Employment and Migration,* edited by Nripendra Kishore Mishra, 203–24. Singapore: Springer. https://ideas.repec.org/h/spr/isbchp/978-981-15-8265-3_11.html.

Market Prospects. 2022. "Introduction to the Automotive Industry Chain," May 24. *Market Prospects*. https://www.market-prospects.com/articles/introduction-to-the-automotive-industry-chain.

Montt, Guillermo, Kirsten S. Wiebe, Marek Harsdorff, Moana Simas, Antoine Bonnet, and Richard Wood. 2018. "Does Climate Action Destroy Jobs? An Assessment of the Employment Implications of the 2-Degree Goal." *International Labour Review* 157 (4). Wiley Online Library: 519–56. https://doi.org/10.1111/ilr.12118.

Muro, Mark, Jonathan Rothwell, and Devashree Saha. 2011. *Sizing the Clean Economy: A National and Regional Green Jobs Assessment.* Washington D C: Metropolitan Policy Program, The Brookings Institution. https://www.brookings.edu/wp-content/uploads/2016/06/0713_clean_economy.pdf.

NSO (National Statistical Office). 2023. "Statement 1.2: Per Capita Income, Product and Final Consumption." Spreadsheet. MoSPI (Ministry of Statistics and Programme Implementation), Government of India. https://www.mospi.gov.in/sites/default/files/reports_and_publication/statistical_publication/National_Accounts/NAS2023/1.2.xlsx.

OMI Foundation. 2024. *Social Protection in India's Platform Economy: Unpacking Supply Dynamics*. New Delhi: OMI Foundation. https://olawebcdn.com/ola-institute/social-protection-in-india-platform-economy.pdf.

PLFS (Periodic Labour Force Survey). 2023. *Annual Report July 2021–June 2022.* New Delhi: Ministry of Statistics and Programme Implementation. https://www.mospi.gov.in/sites/default/files/publication_reports/AnnualReportPLFS2021-22F1.pdf.

PIB (Press Information Bureau). 2021. "Round Table to Promote Electric Vehicles," December 4. Ministry of Heavy Industries, Government of India. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1776734.

Philip, Lijee. 2024. "Amid Booming EV Sales in India, a Nagging Issue: Who Will Service Your Car?" *The Economic Times.* March 16. https://economictimes.indiatimes.com/industry/renewables/amid-booming-ev-sales-in-india-a-nagging-issue-who-will-service-your-car/articleshow/108552067.cms.

Ramanayya, T.V., and V. Nagadevara. 2009. "Role of Unorganized Enterprises in Transportation Services in India." *International Journal of Business Research* 9 (2): 36–41. https://repository.iimb.ac.in/bitstream/2074/12091/1/Nagadevara_IJBR_2009_Vol.9_Iss.2.pdf.

Raveendran, Govindan, and Joan V. 2020. "Informal Workers in India: A Statistical Profile." (Women in Informal Employment: Globalizing and Organizing) WIEGO Statistical Brief no. 24. https://www.wiego.org/sites/default/files/publications/file/WIEGO_Statistical_Brief_N24_India.pdf.

Renner, Michael, Sean Sweeney, and Jill Kubit. 2008. *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World: Report for United Nations Environment Programme.* Nairobi, Kenya: United Nations Environment Programme (UNEP). https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_emp/%40emp_ent/documents/publication/wcms_158727.pdf.

Sachdev, Alisha, and Devina Sengupta. 2024. "Electronics, EV Makers Bank on Apprentices to Bridge Skill Gap; Boost Stipends." *Mint*. June 13. https://www.livemint.com/news/india/indian-ev-electronics-makers-bet-big-on-apprenticeships-to-bridge-skill-gaps-boost-stipends-by-up-to-70-11718184595048.html.

Saha, Devashree, Joel Jaeger, Sujata Rajpurohit, Evana Said, and John A. Laitner. 2023. *A Roadmap for Michigan's EV Future: An Assessment of the Employment Effects and Just Transition Needs.* Washington, DC: World Resources Institute. https://files.wri.org/d8/s3fs-public/2023-05/roadmap-michigan-ev-future.pdf?VersionId=v0C1QYM5LrUtDymSBYzR_PGHpKMUmRju.

Samantray, Shilpi, and Banswal, Chhavi. 2022. *Skilling Indians for an EV-Ready World.* New Delhi: Ola Mobility Institute. https://olawebcdn.com/ola-institute/skilling-indians.pdf.

Soman, Abhinav, Ganesan, Karthik, and Kaur, Harsimran. 2019. *India's Electric Vehicle Transition: Impact on Auto Industry and Building the EV Ecosystem.* CEEW: New Delhi. https://www.ceew.in/sites/default/files/CEEW-IndiaElectricVehicleTransitionReportPDF26Nov19.pdf.

The Economic Times. 2024. "Government EV Push, FAME II Ending March 31st 2024, FAME III Likely in Main Budget in July." March 31. https://economictimes.indiatimes.com/industry/renewables/government-ev-push-fame-ii-ending-march-31st-2024-fame-iii-likely-in-main-budget-in-july/articleshow/108911332.cms.

The National Center for O*NET Development. 2013a. "O*NET-SOC Code." Dataset. https://www.onetcenter.org/dl_files/database/db_22_0_excel/Green%20Occupations.xlsx.

The National Center for O*NET Development. 2013b. *Greening of the World of Work: O*NET® Project's Book of References.* Raleigh, North Caroina, United States: National Center for O*NET Development. https://www.onetcenter.org/dl_files/GreenRef.pdf.

Tomatore, Keith. 2023. "The True Ramifications of EV vs. ICE" Blog. April 5. *Perficient Blogs.* https://blogs.perficient.com/2023/04/05/the-true-ramifications-of-ev-vs-ice/.

UNEP (United Nations Environment Programme). 2008. *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World.* Nairobi, Kenya: UNEP. https://wedocs.unep.org/bitstream/handle/20.500.11822/8825/UNEPGreenJobs_report08.pdf?sequence=3&amp%3BisAllowed=.

UNEP. 2011. *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication—A Synthesis for Policy Makers.* Nairobi, Kenya: UNEP. https://sustainabledevelopment.un.org/content/documents/126GER_synthesis_en.pdf.

UNFCC (United Nations Framework Convention on Climate Change). 2016. *Just Transition of the Workforce, and the Creation of Decent Work and Quality Jobs.* https://unfccc.int/sites/default/files/resource/Just%20transition.pdf.

Ungar, Lowell, et.al. 2020. *Growing a Greener Economy: Job and Climate Impacts from Energy Efficiency Investments.* Washington D C: American Council for an Energy-Efficient Economy. https://www.ashb.com/wp-content/uploads/2020/10/IS-2020-141.pdf.

Vahan Dashboard. "Vehicle Class-Wise Fuel Data till March 2024." *Ministry of Road Transport and Highways.* https://vahan.parivahan.gov.in/vahan4dashboard/.

Valero, Anna, Li, Jiaqi Li, Sabrina Muller, Capucine Riom, Viet Nguyen, and Mirko Draca. 2021. *Are Green Jobs Good Jobs? How Lessons from the Experience to-Date Can Inform Labour Market Transitions of the Future.* London: Grantham Research Institute on Climate Change and the Environment and Centre for Economic Performance, LSE. https://cep.lse.ac.uk/pubs/download/special/cepsp39.pdf.

WEF (World Economic Forum). 2022. "How Many Jobs Could the Clean Energy Transition Create?" World Economic Forum. https://www.weforum.org/stories/2022/03/the-clean-energy-employment-shift-by-2030/.

Wong, Kapo, Alan H.S. Chan, and S.C. Ngan. 2019. "The Effect of Long Working Hours and Overtime on Occupational Health: A Meta-analysis of Evidence from 1998 to 2018." *International Journal of Environmental Research and Public Health* 16 (12): 2102. https://doi.org/10.3390/ijerph16122102.

WRI India. 2022. "Just Transition and Skill Development in the Electric Vehicle Industry: A Summary of Expert Perspectives on an Inclusive Transition and Workforce Development in the Electric Vehicle Industry." Webinar. *Forum for Decarbonizing Transport, NDC-Transport Initiative for Asia.* https://www.wri.org/research/just-transition-and-skill-development-electric-vehicle-industry.

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ABOUT WRI INDIA

WRI India, an independent charity legally registered as the India Resources Trust, provides objective information and practical proposals to foster environmentally sound and socially equitable development. Our work focuses on building sustainable and liveable cities and working towards a low carbon economy. Through research, analysis, and recommendations, WRI India puts ideas into action to build transformative solutions to protect the earth, promote livelihoods, and enhance human well-being. We are inspired by and associated with World Resources Institute (WRI), a global research organization. Know more: www.wri-india.org

Our challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to inform government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.