

## Electric Vehicles: A Catalyst for Economic Growth in India

Dr. Deepika Saxena<sup>1</sup> Shivam Sharma<sup>2</sup> Surbhi Sharma<sup>2</sup> Vansh Jindal<sup>2</sup>

<sup>1</sup> Professor, Jagan Institute of Management Studies Technical Campus, Sector 5, Rohini, Delhi, India, saxenadrdeepika@gmail.com

<sup>2</sup> PGDM Students, Jagan Institute of Management Studies Technical Campus, Sector 5, Rohini, Delhi, India, shivam\_sharma\_pgdmib22@jimsindia.org, surbhi22658@gmail.com, v.jindal91@gmail.com

### Abstract

On a global level, environmental contamination is currently a big concern. Toxic emissions from internal gasoline engines, such as greenhouse gases, are the leading causes of air pollution. Both at National and international level, efforts are undertaken to mitigate the increase in greenhouse gas concentration, carbon credits and carbon markets are a part of the way forward. Electric vehicles (EVs) widely marketed around the worldwide to reduce carbon emissions and reduce the effect of fossil fuel emissions and solve environmental problems (EC) by trading carbon credits universally. Different governments are enticing individuals to switch to EV's by providing incentives for doing so. By reviewing past studies, electric vehicle infrastructure setup will initially charge high cost, the shortage of charging stations, and concerns about time and finances are obstacles to public acceptance. At the same, if it will be successfully set up then it will give better opportunities to the Indian economy. By 2030, the Indian government's goal is the majority of electric vehicles on the road. This paper aims to examine the carbon exchange market and the scenario of EVs in India. This review attempts to present an in-depth review of the methodologies, theories, and variables used in various peer-reviewed articles and papers published between 2010 and 2022 covering the main forms of Electric Vehicles acceptance, including government initiatives and economic development. The results of the study emphasize that India is now in a developing stage, where government rules play a vital role in promoting the preference for EVs by enabling policies to stimulate the development of the charging infrastructure network. This becomes necessary to adapt it to the unique Indian transportation environment and to build capacity among stakeholders in order to enable its on-the-ground expansion. To ensure the effective and timely deployment of EV charging infrastructure, a contextual strategy is required. As a result, individuals get used to driving electric cars more frequently and are able to provide significantly lower carbon emissions.

**Keywords:** Green Finance, Electric Vehicles (EVs), Carbon Credit Accounting (CCA), Carbon Credits Trading, Economic Growth & Development.

### Introduction:

Environmental deprivation and climate change are the two main challenges that are faced by the human race nowadays (UNESCO, Climate and Environment Survey 2030, 2021). To address these two challenges the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992 to bring all the world's nations together for negotiating actions and plans on establishing a world economy with a green sector (UNFCCC, Introduction to climate action, 1992) & (kaur, Sharma, & et al, 2023). International concern about climate change led to the Kyoto protocol, negotiated in 1997 and enacted on 16<sup>th</sup> February 2005 (UNFCCC, Introduction to climate action, 1992). It involves legally binding emission objectives for developed countries to restrict or reduce GHG emissions. The carbon market is the brainchild of the Kyoto Protocol for reducing GHG emissions (Maheshwari & Goyal, 2015). For both rich and developing countries, the convention established "caps or quotas on the maximum amount of GHG." (UNFCCC, 2005). The protocol makes it mandatory for the commercial entities emitted above the permitted limit of GHGs to cut down their emissions by prescribed levels or they should earn carbon credits certificates which can be transacted in the market or alternatively pay charge for the emissions which is termed as carbon tax (World Bank, 2020).

### Carbon Credits

Carbon credits, commonly similar to as carbon allowances, act as authorization forms for emissions. A corporation can produce one tonne of CO<sub>2</sub> emissions if it purchases a carbon credit, typically from the government (Investor Education Center, 2022). Each carbon credit represents one ton of CO<sub>2</sub> either removed from atmosphere or saved from being admitted (AS-26, 2007).

### Carbon Trading

The mechanism of purchasing and selling and selling of carbon credits is known as carbon trading. The environmental trading for carbon is based on the accumulation of carbon credits. These credits remain on track as electronic certification. In carbon markets two types of trading occurs; (a) cap and trade (emission trading), (b) offset trading (project-based carbon credits)

A market-driven approach known as the "Clean Development Mechanism" gives businesses the chance to both sustain the environment via their activities and make money by selling carbon credits (The Clean Development Mechanism, 2006). Under the United National Framework Convention on Climate Change (UNFCCC) charter, any company from a developed country can take up an emission reduction project activity with a company in a developing country that is a signatory to the Kyoto Protocol (UNFCCC, 2005). The cost of decreasing emissions through project activities is often much cheaper in developing countries. Companies in developed nations must implement new advanced technologies and fund these projects in order for undeveloped countries to obtain carbon credits. (UNIDO, 1994). The credit in CDM is termed as Certified Emission Reduction CERs. Such credits can only be certified by an appropriate authority under the protocol. After certification, only a part of CERs can be transferred of the companies to the developed countries to fulfil their emission reduction requirement (UNFCCC, 2007). India can accelerate projects for rural development so that the country's income growth strengthens as it provides food for local consumption while also producing an excess for the generating of additional earnings (Rekha & Pooja, 2020).

According to the World Bank report Global carbon pricing revenues increased by 60% over past year (Washington, 2022). Also, many countries, including India, pledged to contribute towards net-zero emissions, which shows it's a hot emerging topic, where the world is moving towards green finance (COP-26, 2021). Carbon credits can be generated from various projects and from various sectors including - Transport Improvement in Vehicle fuel efficiency with new technology with a switch to transport mode e.g. changing to less carbon-intensive means of transport like- EV Vehicle (IEA, . Energy and Climate Change: World Energy Outlook Special Report, 2015). In 2010, the transport sector contributed to 23% of total the energy associated CO2 emissions. (UN Climate Summit, 2014), thus making it a driver of climate change along with an agent for responses towards its mitigation. Electric vehicles (EVs) have been identified as one relatively low-cost solution to address climate change (cox 2014, Romm 2014), due to the reduced emissions intensity of their energy source compared to gasoline, and ongoing decarbonisation of electricity.

India has an opportunity to increase export of carbon credits and draw more FDI by earning carbon credits from the EV economic environment and through various green finance projects (SIRU, 2022). India on the global climate map with EV credits (Swain & Tekriwal, 2021). Due to ability to produce almost no emissions, electric vehicles (EVs) have been receiving a full-throttle push for widespread acceptance (Dabkara, 2022).

**Literature Review**

S. No	Journal	Author	Name of Paper	Data Source	Variable Considered	Findings
1	Asian Journal of Agricultural Extension, Economics & Sociology	Subrata Gorain, Ayushman Malakar, Subhajit Chanda (2021)	An Analysis of Carbon Market and Carbon Credits in India	Secondary data, taken from 14 CDM projects under India's agricultural sectors by using EBCR (Emission from crop reside) Model, Econometric Model, Correlation and Regression.	Studies some economic factor beyond agriculture that impact the favorable and unfavourable to enter the agricultural sector. GHG gases, export of CO2, industrial output index, green index, price of coal, price of power and price of gold.	As result the research found from the regression 1 rupee rise in the price of gold results in a fall of carbon emission price by 0.21 rupee. Similarly, 1 rupee rise in the price of power leads to 0.46 rupee fall in carbon emission price. 1 percent increase in the industrial output index (IOI) leads to fall carbon emission price by 0.46 rupee.

2	SCMS Journal of Indian Management.	Praveen Kumar, Amit Mittal, Mohammad Firoz (2020)	Carbon credits issuance: Accounting based financial performance	Secondary data, taken from 44 organisation striving to protect the environment and making a contribution in that regard. Methodology used Econometric model, regression, Correlation and descriptive analysis.	Impact of agriculture biomass/crop stubble on carbon emission/climate.	Assessed the world's carbon exchange market and examined how much carbon credit India may have traded in the world carbon exchange market, if emission from the crop residue burning was stopped in the agricultural sector of India.
3	Search alerts and saved searches journal (SAGE)	Anil Khurana, V. V. Ravi Kumar, Manish Sidhpuria (2019)	A Study on the Adoption of Electric Vehicles in India: The Mediating Role of Attitude	Primary Data by using questionnaire method. From the 450 respondents from which we had collected the data, 214 are valid responses. The data were analysed using Structured Equation Modelling (SEM).	PEB: Perceived economic benefit; EC: environmental concern; IM: self-image; soc. In: social influence; ATT: attitude; BI: behavioural intention.	The acceptance of battery-powered automobiles was influenced by attitude (ATT), which became an influential mediator.
4	IOP Conference Series: Earth and Environmental Science	Jiping Zhou, Siqin Xiong, Yucheng Zhou, Zijian Zou and Xiaoming Ma (2017)	Research on the Development of Green Finance in Shenzhen to Boost the Carbon Trading Market	Secondary data, Discusses the major policy adopted by the government of Shenzhen	This paper analyze the current scenario of Shenzhen's carbon exchange market and China's financial market.	Shenzhen carbon trading market, Shenzhen should further deepen the carbon market mechanism construction, give full play to its advantage of rich local financial resources.
5	International Conference on Resources and Environment Sciences	Hao Wu1 and Chalotorn Kansuntisuk mongkol1 (2015)	What Drives the Carbon Price? - An Empirical Analysis Chinese Emission Trading Scheme	Secondary data, Econometric model FGSL, PVAR, bbai-Perron Breakpoint Test, DESCRIPTIVE, Pearson correlation matrix, STANDARD DEVIATION, REGRESSION	Dependent Variable: Carbon price& Independent Variables: Energy Prices, Weather Condition, Industrial Production etc.	Energy prices, extreme weather, industrial production and economic activity that represents market fundamental influential factors, among them, the coal price is significantly reduces carbon costs, while the expansion of the industrial sector and stock market significantly fluctuates in carbon prices.

6	International standard serial number Journal (ISSN)	Nicolas Kreibich & Lukas Hermwille (2021)	Caught in between: credibility and feasibility of the voluntary carbon market post-2020	Primary method. The subsequent analysis traces the discussion within and between organization ongoing through six stages without overlaps	Projects listed under funding ( Non- NDC crediting, NDC crediting, NDC support units)	Research deems that NDC crediting with corresponding adjustments is the only solution that strengthens and protects the legitimacy of using carbon emission for offsetting in relation to carbon neutrality targets while ensuring a high degree of environmental integrity.
7	IOP Conf. Series: Materials Science and Engineering	Weicheng Chen, Yuqing Wang, Shi Tian, Ming Zeng, Bin Zhu and Xingzhe Hou (2021)	Research on Carbon Accounting Method and Economy of Electric Vehicle Charging Facilities Participating in Carbon Emission Permits Trading.	Secondary method, A quantitative examination of the income from the construction of Electric vehicle setups.	Impact against EV Charging facilities on carbon emission trading. Construction cost (land, building, charging & equipment, monitoring system) and operational cost (electricity purchase cost, maintenance cost, labour cost.) / EV charging facility income (charging service income, carbon emission trading co, subsidy income, residual income)	The result shows that the economic benefits of EV charging facilities contributing in carbon trading increase, and with the increase of charging amount and carbon trading price, the economic benefits increase continuously.
8	Multidisciplinary digital publishing institute (MDPI) journal	Magaly Beltran-Siñani and Antonio Gil (2022)	Accounting Greenhouse Gas Emissions from Municipal Solid Waste Treatment by Composting: A Case of Study Bolivia	Secondary data	Study of Main problems being high biowaste content that has direct repercussions on greenhouse gases GHG emission.	The GHG emissions estimation results by open window composting process determined in the present study showing two scenarios: 38% of reduction when 50% of the bio-waste collected in 2019 was composted; and 12% of reduction when 20% of the bio-waste was composted.
9	Journal of Positive School Psychology (JPSP)	Mr. Monu Bhardwaj, Aditya Prakash, Namrata Prakash, Dr. Suruchi Sharma, Ms. Priya Sharma (2022)	Study the Impact of Carbon Credit on Accounting and Taxation of Companies' Profitability - An Indian perspective.	Secondary data sourced from books (with case histories of large companies related to CO2 discharge in India from 2016-2020)	Clean development mechanism (CDM), joint implementation (JI), emission trade (ET), carbon tax, carbon tariffs.	The research showed that India has a great opportunity to study the effect of carbon emissions on energy sector taxation and accounting.

10	Ilkogretim Online - Elementary Education Online, 2021	Dr. Namrata Prakash, Mr. Monu Bhardwaj, Anuj Singh (2021)	An Analysis of The Effects of Green Business Activities, With an Emphasis on Carbon Credit Accounting.	Secondary data	Emissions of carbon credits and economic achievement.	India is the country that benefits the most from carbon trading, but it still lacks a solid policy for trading carbons on the market. Separate principles for financial accounting must be created in order for carbon markets to grow and function properly, along with carbon trading activities.
11	Multidisciplinary digital publishing institute (MDPI) journal	Rachana Vidhi and Prasanna Shrivastava (2018)	A Review of Electric Vehicle Lifecycle Emissions and Policy Recommendations to Increase EV Penetration in India	Secondary method, supports with various govt policies	Impact of natural resources, vehicle emission (4-wheeler 2-wheeler, auto, taxi, buses, goods vehicle), industrial impact, greenhouse gases from various vehicle (nox, fossils fuel, co2, so2, hc, pm, voc, pb)	It was found that the nox emissions caused by vehicles can be reduced by 7–25%, depending on charging energy source, while CO and CO2 can be reduced by up to 85%, if the charging energy were to come from comes from fossil fuels, SO2 emissions can increase by 11%.
12	Global Journal of Management and Business Research	Ms. Yuvika Gupta (2011)	A step toward green environment	Secondary method	Greenhouse gases and carbon offset.	One metric tone of CO2 or an identical greenhouse gas has been lowered with the worth of a carbon offset credit.
13	International Journal of Science and Research (IJSR)	S. N. Kotkar , Rashmi Bhadani (2016)	Carbon Credits - Most Value and Profit-Added Advantage to Business	Secondary data (Essay format)	Independent: HR Management techniques. Dependent: Carbon footprints	How human resource management can contribute in environmentally sustainable development.
14	Research scholar department of commerce	Ashini Paul (2011)	Carbon credit and carbon trading in India.	Secondary method.	carbon trading and earned profit	Sketching the present scenario of carbon credit in India and identifying the future prospect
15	Management Accounting quarterly winter journal	Kenton D. Swift, Ph.D., CPA (2019)	Accounting for greenhouse gas emissions.	Secondary data is taken from various financial reports of the organization and by using a regression technique.	Scope 1 (direct) emissions far exceed, scope 2 emissions because the dominant source of GHG emissions for airline companies is fuel. Information on scope 3 emissions is voluntary, and different airlines either do not report scope 3 emissions.	Airline varies dramatically from a total of 4,502,601 metric tonnes for the Alaska Air Group to 42,281,500 metric tonnes for the American Airlines Group.

16	Inspira- Journal of Modern Management & Entrepreneurship (JMME) 7	Dr. PC Saini (2020)	Carbon Credit Accounting In Indian Business Industries: Challenges	Secondary method.	Reduce of carbon by introducing the substitute	India is working on the substitute of petrol and diesel to reduce the carbon and also increasing the electric vehicle to reducing other vehicles from the road
17	Pacific Business Review International	Monika Soni, Dr. Shurveer S. Bhanawat (2018)	Accounting and Taxation Issues of Carbon Credit Transactions	Primary method, 200 question paper was distributed among them 148 had replied, technique applied to test null hypothesis is chi square test.	Opinion of the respondents, to accounting and taxation aspects of CERS.	Awareness is required to the accountant regarding how to book the CCA as the other income or in sales prospect. For which little change required to the accounting standards.
18	International Journal of Research in Finance and Marketing (IJRFM)	Dr. B.C.M. Patnaik, Dr. Ipseeta Satpathy, D. Litt, Dr. Chandrabhanu Das, Mr Sourav Mohanty (2016)	Carbon credit accounting - a study on finance students and professionals in Odisha.	Primary method. Direct and close ended question was asked from 450 students. Where 309 responses were suitable for study.	Awareness of CCA on students	There is no awareness in the market regarding the CCA. Need to take help of social media to get aware regarding the CCA to prevent the environment.
19	Researchgate, Department of management studies.	Abhinav Kumar (2019)	Potential and Impact of EVs in India	Secondary method.	This paper studies the obstacles and opportunities for EV in India. for EV in India. The contribution of the government and other parties to EV improvement scenerio has been explored.	The findings says that with an expansive landscape and population over 1.2 billion and booming every year mobility remains one major challenges of the country and it is expected to rise in the number of vehicles to 550 million units by 2030 form 160 million now.
20	Energy Economics	Tamara L. Sheldona,b , Rubal Duab, (2019)	Measuring the Cost-effectiveness of Electric Vehicle Subsidies.	Primary data are collected from 148 respondents. Six hypotheses are framed based on recognition of hypothesisers in book of accounts, valuations of CERS held for inventory, different methods of recognition of revenue from sale.	The paper studies the prevalence of plug-in electric vehicle (PEV) subsidies, research on improving their cost-effectiveness and impact remains limited.	Results suggest that existing federal incentives are expensive, \$36kper additional PEV, as every buyer gets the subsidy. By focusing incentives based on factors like income, geographic location, car disposal, and/or vehicle mileage, the cost-effectiveness can be increased by a factor of two.

21	Journal of Physics: Conference Series.	Colin J R Sheppard, Anand R Gopal, Andrew Harris and Arne Jacobson (2016)	Cost-effective electric vehicle charging infrastructure siting for Delhi	Primary method, by various models as applied to the National Capital Territory (NCT) of Delhi represents the region as divided into 53 travel analysis zones (tazs) along with a road network overlay.	Level 1: low power chargers, 1.5 kw. Level 2: medium power chargers, 6.6 kw. DC fast: direct current fast chargers, 50 kw. stations for switching batteries stations: where discharged batteries are replaced with pre-charged batteries	By placing 2764 chargers throughout the NCT of Delhi with a focus on the more densely populated and frequently visited areas of the city, charging services can be provided to drivers for an investment of \$4.4 M (or \$440/BEV) at 1% penetration in the passenger car fleet, or approximately 10,000 battery electric vehicles (bevs).
22	Environmental Research	Colin J R Sheppard, Anand R Gopal, Andrew Harris and Arne Jacobson (2016)	Environmental and economic impact of electric vehicle adoption	Secondary data by using various model framework like - Conceptual framework of the impact evaluation of BEV adoption, plug-in electric vehicle infrastructure (PEVI) model etc.	In order to address this inquiry, the study will undertake an extensive effect analysis of the adoption of battery electric vehicles (BEVs).	The paper findings states, Battery electric vehicle (BEV's) adoption are , tailpipe emissions are reduced. However, additional manufacturing activity brought on by productivity gains or subsidies might result in an increase in non-tailpipe emissions, negating part or all of the tailpipe emissions savings.
23	International standard serial number Journal (ISSN) Journal	Imran Khan, Mohammad Farooq, Arshe Azam (2023)	A Study on Carbon Credits Market and Its Accounting Implication in	Secondary data taken from many sources national and international with an interpretative approach.	Credit accounting with its born causes in India with the world and the impact of carbon credit accounting with its accounting standard in India.	The study found that most wealthy nations struggle with a lack of carbon credits, but India has sizable carbon credit markets and its accounting standards make it easier to account for carbon credits than it is in other nations. India should focus on many renewable energy or eco-friendly energy sources and more fund to provide and be less dependent on fossil oils also India should focus on further research in this area.
24	Advances in Applied Energy	Xu Hao, Zhen Hong Lin, Hewu Wang, Shiqi Ou, Minggao Ouyang (2017)	Range Cost-effectiveness of Plug-in Electric Vehicle for Heterogeneous Consumers: An Expanded Total	Secondary Data taken from many sources with an interpretative approach	The classic TCO approach was extended in this study by (1) completely taking into account the various driving behaviours of consumers, (2)	There is a huge difference between model results and the actual market sales data, the insights derived from the model offer valuable reference for the overall holding

			Ownership Cost Approach		measuring the anxiety associated with charging battery-electric cars (BEVs), and (3) capitalising both tangible and intangible PEV policies.	cost and consumer choice preferences among different powertrain systems and different PEV ranges.
25	Energy Economics	Tamara L. Sheldon, Rubal Dua (2018)	Measuring the cost-effectiveness of electric vehicle subsidies	Primary method, by various models as applicable to the various factors which affects the purchasing power of customer	Depicting on the income and location of the consumer	Depending on whether the policy objective is to maximize PEV market share or reduce petrol use as a result of PEV adoption, cost-effective subsidy schemes vary somewhat.
26	Energy Policy	Marcello Contestabil, Mohammed Alajaji, Bader Almubarak (2017)	Will current electric vehicle policy lead to cost-effective electrification of passenger car transport?	Secondary data taken from many sources the domestic and international levels with an interpretative approach.	Schemes or subsidies given by the central government and state government in by different countries	An approach where bevs are limited to the relatively short-range, small vehicle segment, supported by mainly urban. One scenario that could significantly lower the risk of the financial burden of the EV transition is one where charging infrastructure networks are present and relatively long-all-electric range (AER) phevs are common in all other sectors.
27	Energy Policy	Craig Morton (2016)	Electric Vehicles: Will Consumers get Charged Up?	Secondary data is taken from many sources at the domestic and international levels with an interpretative approach.	Behaviour change, decision making	Cars are repositories of many high value meanings, some of which are important but not quantifiable nor can be allocated an equivalent monetary value.
28	International conference on recent advances in transport infrastructure (Rat Mani)	Sanjay Gupta, Pintu Saini (2018)	Electric Mobility in India: Potential and Policy Imperatives	Collected data from secondary resources as outlook	Policy consideration in India and in other country	City planners would have to evolve appropriate planning norms, standards and Building regulations that would facilitate the process simpler to develop a charging infrastructure, specifically in residential complexes, at the city, zone, and neighbourhood areas demand.



**Objectives**

Based on the literature review, following objectives are formulated.

- To identify the scenario of electric vehicles in India.
- To identify the effect of electric vehicles on Indian economy.
- To identify various policy initiatives taken by Indian Government towards adoption & promotion of EV in India

**Research Methodology**

The present study is exploratory in nature and uses secondary sources of data collection. Various domestic and international journals, research reports and articles of various organizations such as World Bank, UNESCO, UNEP etc. and various summits such as UN Climate Summit, UN Education Summit etc. have been used to arrive at the findings.

**Findings & Discussions**

**EV Market in India**

India is on the fifth position in terms of automobile industry in the world and expected to become third largest country by 2030 (IBEF, 2022). The market for electric vehicles (EVs) is expanding quickly on a global scale. According to EV volumes, there were 6.75 million electric vehicles on the road in 2021, up from 4.2% in 2020 and 8.3% from battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) (Almubarak, 2017). As of 2020, this represents an increase of 108%. It contributed to lowering emissions and the depletion of natural resources, thus EVs are gaining popularity around the world. Since close to 0.32 million vehicles were sold in 2021, an increase of 168% YoY, the Indian EV sector is likewise developing quickly. The Paris Agreement, which goals to reduce carbon emissions, improve the quality of the air in urban areas, and decrease oil imports, is the foundation for India's ongoing acceptance of electric vehicles (IBEF, 2022). The EV market in India is anticipated to increase at a CAGR of 36%. Environmental concerns have prompted consumers to select EVs over vehicles that use fossil fuels, experts say, and EV demand is rising more quickly than people had anticipated in line with population growth (IESA, 2022).

**Business opportunity**

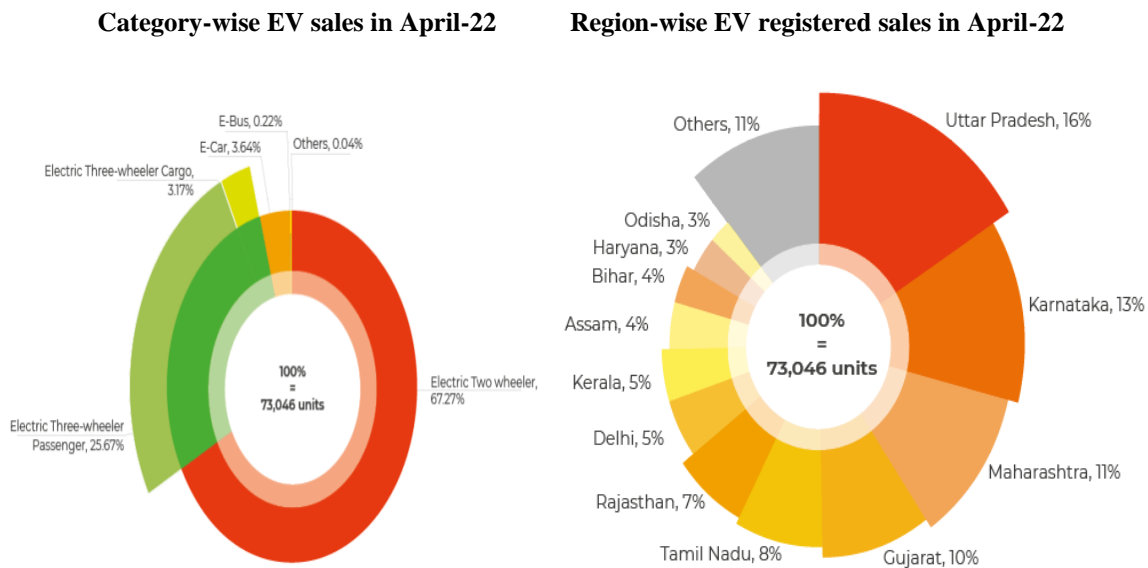
Numerous economic opportunities are made available by India's EV drive in the mobility, infrastructure, and energy sectors. Among these opportunities are those related to battery infrastructure, solar vehicle charging, the OEM market for EVs, EV franchising, and battery swapping technologies. The NITI Aayog predicts that a US\$ 267 billion (Rs. 19.7 trillion) in overall investment (Rs. 19.7 lakh crore) in EVs, battery infrastructure, and charging infrastructure is required to make the full transition to EVs (Niti Ayog, 2023). By 2030, the EV industry could add 10 million direct jobs, which would result in the creation of 50 million indirect jobs. (MSDE, 2022)

Following are the various Indian automakers intends to enter in the EV market:

<b>Company</b>	<b>EV related plans of Indian Automakers</b>
Kia	In 2025, Kia intends to start producing compact SUV EVs in India for export.
Maruti Suzuki	By 2025, Maruti Suzuki hopes to introduce its first electric vehicle in India.
Tata Motors	The government places an order with Tata Motors for electric buses costing US\$ 678 million (Rs 5,000 crore); the company intends to introduce 10 more EVs in India.
Hyundai	By the middle of 2022, Hyundai intends to introduce the IONIQ 5 EV in India.
Hopcharge	Hopcharge, a Gurgaon- based start-up has created the world's first demanding doorstep fast charge service.
MG Motors	MG Motors India has partnered with Bharath petroleum for expanding the EV charging infrastructure.

In view of the rising levels of carbon emissions in the atmosphere, the development that the electric car sector has seen in recent years is not only warmly welcomed but also desperately needed (IBEF, 2022).

**India’s electric vehicle sales data -April 2022 on the basis of report.** (info, 2022)



Source- e-vehicleinfo.com

According to the graph above, passenger-type electric three-wheelers and electric two-wheelers made up 92.92% of all EV registrations in April 2022, making them the most common type of EV. The next categories in order of share were e-Cars (3.64%), cargo-style electric three-wheelers (3.17%), and others.

The EV share among all the states and UTs is shown in the graph above. Uttar Pradesh maintained first place with 16% of total sales, followed by Karnataka with 13%. Maharashtra fell to third place, ahead of Gujarat (10%), Tamil Nadu (8%), Rajasthan (7%), and Delhi (5%), with an 11% share.

### The Effects of Electric Vehicle on Indian Economy

The over-a-century-old automobile industry is gearing up for transformation. Individual transportation procedures need to change as a result of the increase in the price of fossil fuels and the negative environmental effects of their combustion. Internal combustion engine-powered industry is gradually moving towards electric vehicles (EVs) (Khurana, Kumar, & Sidhpuria, 2019). The central Government of India has given a call for ‘only Electric Vehicles’ on Road by 2030 (Khurana, Kumar, & Sidhpuria, 2019). 30% EV revenues in future combined with a higher share of public transport would lead to a 31% reduction in oil imports. As a result of the predicted wide range of economic implications of the 30% EV transition in 2030, the government concentrates on changes in oil import, value-addition, employment, the influence on state finances, and the size of the EV market. environmental advantages as well as decreased greenhouse gas (GHG) emissions and local air pollution (Soman, Kaur, Jain, & Ganesan, 2020). The transportation sector contributes about a quarter of GHG emissions. Automobiles are the primary source of GHG emission world over with China emitting 25.9 per cent, the USA 13.87 per cent followed by India 7.45 per cent (Khurana, Kumar, & Sidhpuria, 2019). Being among in the top 10 automobile markets in the world, India has a steadily increasing middle class population and strong purchasing power.

Global trend such as urbanization and advances in the mobility over the past centuries which is transforming both people's and the nation's life. It is predicted that by 2050, there will be twice as many people living in cities as there are now, because of the world's anticipated 9 billion population and a doubling of the number of vehicles on the road from 1 million to roughly 2 million. As of now the transport facilities consumption of world energy is one fifth. (Kumar, March 2019) The electric vehicle (EV) market is estimated to reach Rs. 50,000 crore (US\$ 7.09 billion) in India by 2025. India might have a market for electric vehicles worth US\$206 billion by 2030, according to a CEEW Centre for Energy Finance

research. This will necessitate a US\$ 180 billion investment in India for vehicle manufacturing and charging infrastructure development. According to NITI Aayog and the Rocky Mountain Institute (RMI), India's EV finance industry is likely to reach Rs. 3.7 lakh crore (US\$ 50 billion) by 2030. According to a survey by the India Energy Storage Alliance, until 2026, the Indian market for EVs is anticipated to grow at a CAGR of 36%. In addition, projection for the EV battery market is expected to expand at a CAGR of 30% during the same period. In terms of market size, the India passenger car market was valued at US\$ 32.70 billion in 2021, and it is anticipated to achieve a value of US\$ 54.84 billion by 2027, while registering a CAGR of over 9% between 2022-27. (ibef.org, 2022)

India is currently shifting nucleus to electric cars to reduce emissions. Sales of electric vehicles (EVs) hit a new high of 5,592 units in Q3 FY22. Overall, in 2021, 329,190 EVs were sold in India, indicating a 168% YoY growth over last year's sales of 122,607 units. The market for EVs in India is predicted to grow at a CAGR of 36% until 2026, according to a report by the India Energy Storage Alliance (ibef.org, 2022). Shift towards electric vehicle would help the Indian economy in reducing their oil import which would directly affects the trade balance favourably. Electric vehicle penetration represents an enormous market growth opportunity. The demand for high value-add components in a scenario with the projected 30 per cent EV penetration amounts to about INR 2.1 lakh crore (USD 27.8 billion) in 2030 for batteries, electric powertrain, and facilities for charging. These activities may favour a significant boost for future investments in an environment with supportive policy measures. (Soman, Kaur, Jain, & Ganesan, 2020). The electric vehicles industry is likely to create five crore posts by 2030. The Indian cabinet is aiming to create an integrated electric vehicle (EV) mobility ecosystem with a low carbon footprint and high passenger density with an insistence on urban transportation reform. The Government of India forecasts the automobile sector to attract US\$ 8-10 billion in local and foreign investments. By 2030, India could emerge as a leader in shared transportation, opening up possibilities for electric and driverless cars. (ibef.org, 2022)

In India, there are very few EV charging stations available i.e., lack of infrastructure development for EVs. Main Cities in India like Delhi, Mumbai, Bangalore, and Hyderabad have charging stations. Some thousands of charging stations should be required all around the country to reduce the scarcity of recharging stations. India is entirely reliant on imports for essential minerals used in power unit manufacturing. Furthermore, the battery components are sustainable as well and their disposal requires careful and coordinated handling efforts. (Kumar, March 2019). Mobility is one of the country's greatest challenges due to the vast landscape and growing population of nearly 1.2 billion people, and it is anticipated that there will be 550 million automobiles on the road by 2030, up from 160 million at present (Kumar, March 2019). Several towns, states, and nations offer financial incentives for the purchase of electric cars (EVs) in an effort to uplift EV adoption and help the environment by reducing carbon dioxide emissions and local air pollution. Refunds, exemptions from sales tax, and tax benefits are just a few of the different ways that subsidies are provided. Despite the fact that EV endowment are widely used, policymakers rarely evaluate the performance of current regulations, and there is little data on the efficiency and cost-effectiveness of these subsidies. (Tamara L. Sheldon, 2019)

With the aim of lowering both local air pollution and greenhouse gas (GHG) emissions, governments all over the world have implemented a range of measures to encourage a cleaner fleet of vehicles. A 2009 "Cash for Clunkers" programme in the United States (formally known as the Car Allowance Rebate Scheme) provided \$3500 to \$4500 in subsidies for dumping old cars and switching to newer, cleaner cars. Owing to the fact that the bulk of the vehicles purchased through the programme were non-additional, numerous analyses show that this policy had little positive environmental impact. (Tamara L. Sheldon, 2019)

### **EV policy and its impact on various economies**

Several strategies have so far been employed owing the unique circumstances of each market, the vastly varied underlying taxes of conventional vehicles and fuels, and the absence of universally agreed best practises. Different deployment patterns for EVs and charging infrastructure framework have consequently started to develop in the most active nations and regions, namely China, Europe, Japan, and the U.S. (Almubarak, 2017) Different ratios of pure battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), as well as infrastructure for fast and slow charging, may be seen in advanced nations. (IEA, Global EV Outlook - Understanding the Electric Vehicle Landscape to 2020, 2013) (IEA, . Energy and Climate Change: World Energy Outlook Special Report, 2015)

Clarifying a future vision of self-sustaining buzz of passenger automobile transportation that does not only rely on the rapidly declining cost of EV power units has given very little attention. However, because the high levels of government incentives currently in place cannot be maintained indefinitely, we contend that policy should also be created with the need to direct the EV transition towards low cost and low technology risk pathways in mind. (Almubarak, 2017)

### **Recent policy initiative in India**

Indian cabinet has taken an initiative & declare the National Mission for Electric Mobility (NMEM2020). The National Mission for Electric Mobility (NMEM) has its two interrelated key objectives:

1. National energy security
2. Expansion of Domestic manufacturing capabilities in full range of electric vehicle technologies.

Expansion of indigenous production capacity for the complete spectrum of electric car technologies. The ambitious draught action plan for Electric Mobility 2020, which focus to have roughly six to seven million vehicles on the road by 2020, was released by the ministry of heavy industries in January 2012. With the goal of promoting XEVs (all types of electrical vehicles) that are dependable, affordable, and efficient and meet consumer expectations for performance and value through the government-industry collaboration for the advancement of indigenous manufacturing capabilities, necessary infrastructure, consumer awareness, and technology. The discovery of strategic incentives for electric vehicles will be another important aspect in the expansion of the XEV market. By lowering the cost of electric vehicles, the primary customer barrier, the adoption will be accelerated. The incentive might be an electric vehicle subsidy programme that closes the price gap between conventional and electric vehicles with comparable performance levels. (Pritam K. Gujarathi, 2018)

To further promote the sale of EVs, other benefits like VAT discounts, registration discounts, and toll plaza discounts can be considered.

The widening growth of the XEV market will coincide with the evolution of the charging infrastructure. The expansion of grid-connected charging stations with moderate tariffs, encouragement of standalone renewable (solar/wind) charging stations, addition of a facility for charging at gas stations and bus stops, state transportation charging stations, and allowing the enlargement of private renewable charging stations can all serve as sources of motivation. (Pritam K. Gujarathi, 2018)

### **Important Political Moves: Growth Levers**

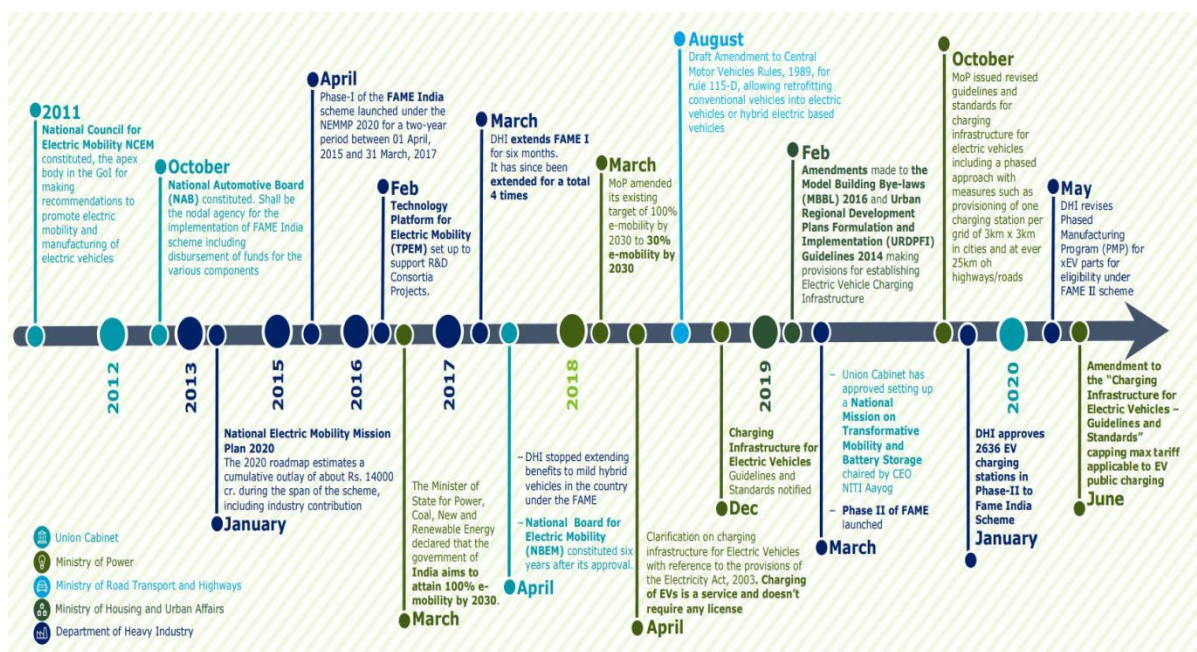
When it comes to developing national strategies for EV adoption, cabinet has always been at the forefront by giving some incentives and tax redemption.

1-Tax privilege of up to Rs.150,000 (US\$ 1,960) under section 80EEB of income tax while purchasing an EV (2W or 4W) on loan.

2-State- wise reduction of road tax and other incentives.

3-Reduction of custom duty on nickel ore (key component of lithium-ion battery) from 5% to 0%.

The following list highlights the timeline for various initiatives taken by policymakers and regulators on the national level:



Source- e-amrit.niti.gov.in

Some state-level policies towards different departments:

Nodal Agency	Year of release	Target's
Transport Department, Government of Delhi	2020	<ul style="list-style-type: none"> <li>•BEVs to contribute 25% of all vehicle's registration by 2024</li> <li>•1000 pure electric buses by 2020</li> <li>•Delivery service providers to covert 100% of their fleet operators to electric by 2025</li> </ul>
Energy and Petrochemicals Department, Government of Gujarat	2021	<ul style="list-style-type: none"> <li>•1,10,000 electric 2-wheelers by 2025</li> <li>•70,000 electric 3-wheelers by 2025</li> <li>•20,000 electric 4-wheelers by 2025</li> </ul>
Steering Committee, Government of Maharashtra	2021	<ul style="list-style-type: none"> <li>•BEVs to make for 10% of new vehicle registrations by 2025</li> <li>•10% electric 2-wheelers by 2025</li> <li>•20% electric 3-wheelers by 2025</li> <li>•5% electric 4-wheelers by 2025</li> <li>•15% electric buses by 2025 (25% for Urban Agglomerations)</li> <li>•25% electric fleet operators by 2025</li> </ul>
Department of Infrastructure and Industrial Development, Government of Uttar Pradesh	2019	<ul style="list-style-type: none"> <li>•10 lakhs EVs by 2024</li> <li>•1000 electric buses by 2030</li> </ul>

**Issue of Green bonds**

The Ministry of Finance approved the sovereign green bonds framework in 2022 towards India's commitment to achieving net-zero carbon ejections by 2030 (Sitharaman, 2022). The main objective behind the overall scheme is not to only encourage the energy industry but also to focus on raising finances for the country and making funds available for green infrastructure framework and renewable energy projects. India's sovereign bonds could bring in much-needed resources for green transition with the yields going to the project that could help reduce carbon emissions of the economy.

**Initiatives under Union budget 2023:**

While announcing the Union Budget 2023, Finance Minister Nirmala Sitharaman said that the endowment on electric car batteries would be extended for an additional year, making EVs more competitive in India. "I suggest extending the reduced tax on lithium-ion cells for batteries for an additional year," FM Nirmala Sitharaman stated. In May 2021, the cabinet introduced the Production Linked Incentive (PLI) programme for the production of batteries. The amount of money allocated by the cabinet to the FAME programme has also been tripled. (IBEF, 2022).

**Challenges of acquiring of EV and its implications.**

There would be a revenue hit of about INR 1.1 lakh crores to the government (both central and state) owed to the less consumption of fossil fuels. (Soman, Kaur, Jain, & Ganesan, 2020) A primary challenge that is yet to re-solve is the waste disposal challenge of batteries used in the EV. Cost is the main hindrance to the wide-scale adoption of electric-powered transportation, as gasoline and the vehicles that use it are more easily available, practical, and less expensive (IEA, . Energy and Climate Change: World Energy Outlook Special Report, 2015). To meet the requirement of cost which act as main barrier in the EV's project government has initiated many incentives to the EV's project businesses. But one should look for the long term benefits which the EV infrastructure would provide which include not importing crude oil from other countries which will relax the current account deficit of the country or better environmental climatic conditions. Barrier in the EV's project government has initiated many incentives to the EV's project businesses.

**Conclusion**

Everything has its pros and cons. The shift from traditionally running vehicles to newly innovated electric vehicle would have both positive and adverse impact on the Indian economy. The major key variables influencing the utilization of EVs would be the same, with a potential for the Indian economy to seize and build on. The factors are: familiarity with EVs, accessibility of charging points, cost of battery, cost of electric vehicle, driving range, running cost. The major hindrance that India is facing for a shift to happen from age old transport culture to the newly in culture of electric vehicle is the infrastructure development and the purchase cost of electric vehicle in today's time in comparison to the normal vehicle. There is no doubt that the cost of operation of the EV is significantly low as compare to the normal vehicles but it would take time to have psychological shift in the mind-set of the people. To get the success in EV model, it is essential to grow the adequate infrastructure first so that people gain confidence to buy the same. From the above findings and challenges, it is visible that the expenses of infrastructure is becoming a hindrance in the growth of EV infrastructure in the country. Government is trying to do their best in developing the same whether it is in the form of entering into joint ventures with the oil manufacturing companies to provide for the vehicle charging facilities, or forming policies related to it as discussed above. But one should look for the persisting benefits which the EV infrastructure would provide which include not importing crude oil from other countries which will relax the current account deficit of the nation or better environmental climatic conditions. The same would allow the existing business houses to trade in the CCA and offset their carbon footprints.

**Bibliography**

1. Almubarak, M. C. (2017). Will current electric vehicle policy lead to cost-effective electrification of. Energy Policy.
2. Arya, S., Garg, A., & Mudgal, R. K. (2017). Benefits and Challenges of Carbon Credit Trading practices in Organizations.
3. AS-26. (2007). Accounting of carbon credit. Cleartax.
4. COP-26. (2021). World contribute towards net zero emission. COP-26. Retrieved from <https://www.un.org/en/climatechange/cop26>
5. cox 2014, Romm 2014. (n.d.). CCA Awareness.
6. Dabkara, M. (2022, march 12). Towards net-zero: How EV industry can earn carbon credits. Drives Express.
7. Framework, U. F. (2022, november 9). Ministry of Finance. Retrieved from [pib.gov.in](http://pib.gov.in).
8. IBEF. (2022). EV Market in India. IBEF. Retrieved from [www.ibef.org](http://www.ibef.org)
9. ibef.org. (2022). Retrieved March 12th, 2023, from <https://www.ibef.org/industry/india-automobiles>

10. IEA. (2013). Global EV Outlook - Understanding the Electric Vehicle Landscape to 2020. International Energy Agency.
11. IEA. (2015). . Energy and Climate Change: World Energy Outlook Special Report. International Energy Agency.
12. IESA. (2022). EV Charger Market Report 2022. India Enery Storage Alliance. IESA.
13. info, e. v. (2022). India's Electric Vehicle Sales Data | April 2022. EV News. Retrieved from [www.e-vehicleinfo.com](http://www.e-vehicleinfo.com)
14. Investor Education Center. (2022). The Ultimate Guide to Understanding Carbon Credits. Retrieved from [carboncredits.com](http://carboncredits.com)
15. kaur, B., Sharma, S., & et al. (2023). Carbon Credit Accounting perception among chartered accountant with special reference to India. European Chemical Bulletin. Retrieved from <https://www.eurchembull.com/uploads/paper/0a8e95a255da93b0d8dc19cff34a595c.pdf>
16. Khurana, A., Kumar, V. R., & Sidhpuria, M. (2019). A Study on the Adoption of Electric Vehicles in India: The Mediating Role of Attitude. SAGE Journals, 23-34.
17. Kumar, A. (March 2019). Potential and Impact of EVs in India. Researchgate.
18. Maheshwari, M., & Goyal, N. (2015, September 3). Carbon Credit Accounting : A Case Study of Delhi Metro Rail Corporation. Pacific Business Review International.
19. MSDE. (2022). EV Market in INDIA. Ministry of skill Development and Enterprenurship.
20. Nations, U. (2014). Secretary-General, at Climate Summit Finance Session, Endorses Call for World Bank, Global Compact Carbon Tax Initiative. United Nations - Meeting and press releases. United Nation.
21. Neunuebel, Carolyn; Sidner, Lauren; Thawaites, Joe;. (2021, july 28). Climate Finance Multilateral Development Banks Climate Change Cop-26.
22. News, U. (2021). The World Climate and Environment survey 2030. UN Educational, Scientific and Cultural Organization (UNESCO), 2021. Retrieved from <https://news.un.org/en/story/2021/03/1088812>
23. Niti Ayog. (2023). State level policies for ev adoption. Retrieved from [www.e-amrit.niti.gov.in](http://www.e-amrit.niti.gov.in).
24. Pritam K. Gujarathi, V. A. (2018). Electric Vehicles in India: Market Analysis with Consumer Perspective, Policies and Issues. Journal of Green Engineering.
25. Rekha, & Pooja. (2020). mpact of Modern ICTs" usage on Agricultural Productivity: An Application of Modified TAM. TEST Engineering and management. Retrieved from <http://www.testmagzine.biz/index.php/testmagzine/article/view/1744>
26. SIRU. (2022). Straregic investment research unit.
27. Sitharaman, N. (2022). Sovereign Green Bonds framework of India. Union Finance Minister and Corporate Affair's. ibef.org.
28. Soman, A., Kaur, H., Jain, H., & Ganesan, H. (2020). India's Electric Vehicle Transition: Can Electric Mobility Support India's Sustainable Economic Recovery Post COVID-19? CEEW.
29. Swain, D. L., & Tekriwal, T. (2021, july 7). India's 2030 EV roadmap - on course or not? Business Today.
30. Tamara L. Sheldon, R. D. (2019). Measuring the cost-effectiveness of electric vehicle subsidies. Energy Economics, 1.
31. Technical, F. a. (2000). BUILDING INTERNATIONAL PUBLIC-PRIVATE PARTNERSHIPS UNDER THE KYOTO PROTOCOL. Technical, Financial and Institutional Issues. United Nations Foundation.
32. The Clean Development Mechanism. (2006). United Nations. Retrieved from <https://unfccc.int/process-and-meetings/the-kyoto-protocol/mechanisms-under-the-kyoto-protocol/the-clean-development-mechanism>
33. UN Climate Summit. (2014).
34. UNEP. (2022, Oct 27). Emissions Gap report 2022. United Nation Environmental Program.
35. UNEP. (2022). The fifth UN Environment Assembly. UNEP.
36. UNESCO. (2021). United Nation: UNESCO. Retrieved from <https://news.un.org/en/story/2021/03/1088812>
37. UNESCO. (2021). Climate and Environment Survey 2030. United Nations: UN Educational, Scientific and Cultural Organization (UNESCO). Retrieved from <https://news.un.org/en/story/2021/03/1088812>
38. UNESCO. (2021). The world in 2030. the United Nations Educational, Scientific and Cultural Organization.
39. UNESCO. (2021). UNESCO DAR ES SALAAM: ANNUAL REPORT | 2021. DAR ES SALAAM OFFICE.
40. UNFCCC. (2007). Clean Development Mechanism.
41. UNFCCC. (1992). Introduction to climate action. Retrieved from <https://unfccc.int/climate-action/introduction-climate-action>
42. UNFCCC. (2005).
43. UNFCCC. (2006). Report of the Conference of the Parties on its eleventh session, held at Montreal from 28 November to 10 December 2005 . United Nation.
44. UNFCCC. (n.d.). An Introduction to Climate Change and the International Community's response (1990 - 1994). Queen Marry, University of London, Global policy institute.
45. UNIDO. (1994). CDM Project Activities. Article-12.

46. Washington. (2022). Global Carbon Pricing Generates Record \$84 Billion in Revenue. IBRD.IDA. world bank report. Retrieved May 22, 2022, from [www.worldbank.org](http://www.worldbank.org)
47. World Bank. (2020, June 22). Carbon pricing. Retrieved from [www.worldbank.org](http://www.worldbank.org)
48. Raparathi, M., Dodda, S. B., & Maruthi, S. H. (2020). Examining the use of Artificial Intelligence to Enhance Security Measures in Computer Hardware, including the Detection of Hardware-based Vulnerabilities and Attacks. *European Economic Letters*, 10(1), <https://doi.org/10.52783/eel.v10i1.991>