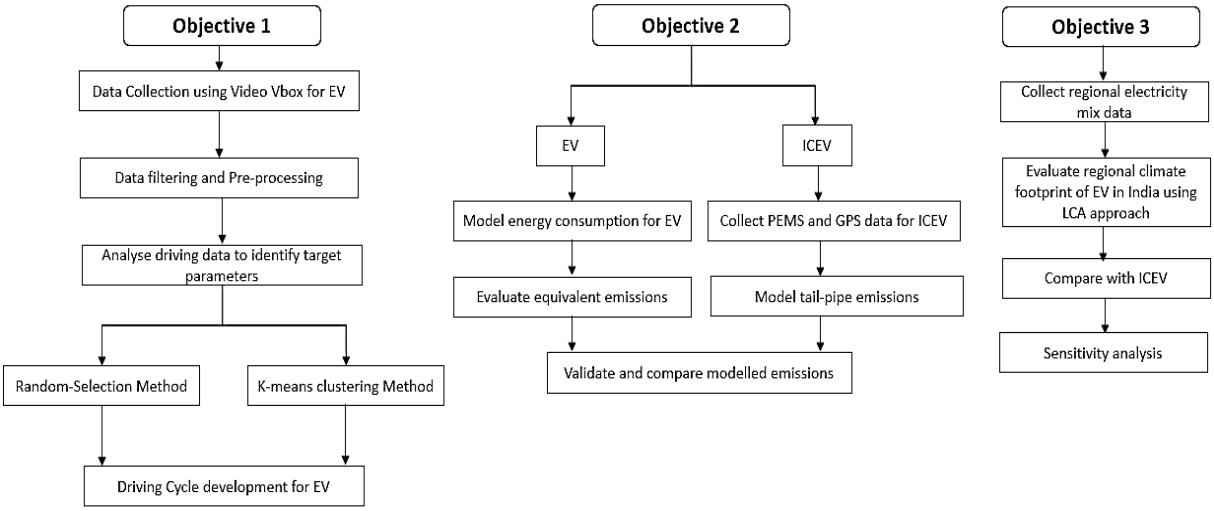
భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

RESEARCH PROPOSAL

1. **Title of the Project** – Emission Reduction and Energy economy by electric vehicle on Indian Roads- Driving cycle-based study
2. **PI details with Dept and Designation** –
   Dr. Pritha Chatterjee, Assistant Professor, Department of Civil Engineering, Head, Department of Climate Change
   Dr. Digvijay S. Pawar, Associate Professor, Department of Civil Engineering
3. **Origin /Background Problem** – The transportation industry has significantly contributed to the deterioration of air quality and the increase in greenhouse gas emissions (Dharmala et al., 2022). Electrification of the transportation sector can contribute to climate mitigation, reduce air pollution, and advance global climate goals (Shafique et al., 2022). Electric vehicles (EVs) offer a promising alternative, but their integration into the Indian traffic environment requires a tailored understanding of their performance and environmental impact (Moreira et al., 2022). A comprehensive emission modelling approach, considering factors such as vehicle characteristics, traffic characteristics and driving behaviour, can provide valuable insights into the environmental performance of vehicles (Chandrashekhar et al., 2022). In the context of India, a rapidly developing nation, the need to address the environmental challenges posed by transportation is paramount. The Indian traffic environment has unique characteristics, including congested road networks, diverse driving patterns, and varying climatic conditions across regions. Thus, it is essential to develop models specifically tailored for EVs in the Indian context to accurately capture the real-world driving behaviour and traffic conditions. Additionally, assessing the emissions of EVs based on a refined driving cycle, coupled with the regional electricity mix and climate data, enables a comprehensive evaluation of their contribution to regional climate change mitigation efforts.
4. **Aim and Objectives** –
   - To analyze and develop driving cycles for two-wheeler and four-wheeler battery electric vehicles in Indian road conditions
   - To model electric vehicle energy consumption and equivalent emissions from the developed driving cycle and tail-pipe emissions from ICEV
   - To evaluate the life-cycle carbon footprint of electric vehicles in India considering electricity generation sources and regional climate conditions
5. **Current Status of your work (including TRL)** – Significant progress has been achieved in the development of representative driving cycle for electric vehicles (EVs) in the dynamic Indian traffic environment and modelling the emissions for internal combustion engine vehicles (ICEVs), reaching a Technology Readiness Level of TRL 4.
6. **Proposed Work** –



7. **Thematic areas covered under SDGs**– The research aligns with SDGs 7 (Affordable and Clean Energy), 9 (Industry, Innovation, and Infrastructure), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), 13 (Climate Action), and 17 (Partnerships for the Goals). It estimates EV energy consumption and emissions (SDG 7), supports sustainable urban mobility (SDG 9 and 11), addresses environmental impact (SDG 12 and 13), and fosters collaborations for sustainable transportation (SDG 17).

8. **Budget Details**

Item	1st year	2nd year	3rd year	
Data Collection	150000	100000		
Personnel (1 JRF for one year to do data collection, we will use existing students for the rest of the work)	492000			
Digital Multimeter	120000			
Portable Flue Gas Analyzer	350000			
Software (LCA)	200000			
Contingency	50000	50000	50000	
Consumables	50000	50000		
Total	1412000	200000	50000	1662000

9. **Social Impact (*Qualitative and Quantitative*)** – This research work will bring qualitative impacts by promoting sustainable transportation and societal behaviour change. It also delivers quantitative benefits through climate change mitigation, emissions reductions, health cost savings, empowering individuals and policymakers, and contributing to a sustainable and healthier future.

10. **Reference**

Bhatti, A. H. U., Kazmi, S. A. A., Tariq, A., & Ali, G. (2021). Development and analysis of electric vehicle driving cycle for hilly urban areas. *Transportation Research Part D: Transport and Environment*, *99*, 103025. https://doi.org/10.1016/j.trd.2021.103025

Chandrashekar, C., Chatterjee, P., & Pawar, D. S. (2022). Estimation of CO2 and CO emissions from auto-rickshaws in Indian heterogeneous traffic. *Transportation Research Part D: Transport and Environment*, *104*, 103202.

Dharmala, N., Kholod, N., Chaturvedi, V., Ghosh, P.P., Mathur, R., Bali, S., Behera, A., Chamola, S., Clarke, L., Evans, M., Horowitz, R., Jain, A., Koti, P.N., Paladugula, A.L., Qamar, S., Shekhar, S., & Srinivasan, S. (2022). Win-win transportation strategies for India: Linking air pollution and climate mitigation. Energy Clim. Chang. 3, 100072. https://doi.org/10.1016/j.egycc.2022.10007

Moreira, J.R., Pacca, S.A., & Goldemberg, J. (2022). The reduction of CO2e emissions in the transportation sector: plug-in electric vehicles and biofuels. Renew. Sustain. Energy Transit. 100032. https://doi.org/10.1016/J.RSET.2022.100032

Shafique, M., Azam, A., Rafiq, M., Luo, X. (2022). Life cycle assessment of electric vehicles and internal combustion engine vehicles: A case study of Hong Kong. Res. Transp. Econ. 91. https://doi.org/10.1016/j.retrec.2021.101112