



INTERNATIONAL CONFERENCE ON
**INFRASTRUCTURE DEVELOPMENT
& SUSTAINABILITY (ICIDS)**

Emerging Agenda in Sustainable Infrastructure
Development, Green Transition and Financing

BOOK OF ABSTRACTS



adani
University

Edited by
Dr. Rachna Gangwar
Dr. Anurima Mukherjee Basu



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2nd International Conference on Infrastructure Development and Sustainability 2024 (ICIDS 2024)

Emerging Agenda in Sustainable
Infrastructure Development, Green Transition
and Financing

December 11–12, 2024
Adani University, Ahmedabad



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Foreword

Dear community colleagues,

As the team of the International Conference on Infrastructure Development and Sustainability 2024 (ICIDS 2024), we are privileged to present this 'Book of Abstracts' for the 2nd International Conference on Infrastructure Development and Sustainability 2024, organized by Adani University, Ahmedabad, India. The theme this year is 'Emerging Agenda in Sustainable Infrastructure Development, Green Transition and Financing'. The ICIDS 2024 Global Advisory Board emphasized the importance of focusing on this theme, recognizing the critical role of transformative infrastructure in the world's fastest-growing economy. Thought leadership discussions and rigorous scientific research are essential for authentic progress in this field; this motivation inspired the creation of ICIDS 2024 as a unique blend of practical insights and academic scholarship.

This Book of Abstracts is a summary of research papers being presented in the conference. This collection represents the cutting-edge research and innovative ideas that will be discussed during the conference in the track themes Energy transition and zero carbon agenda; Emerging trends in transportation and mobility; Green Finance for new-age sustainable infrastructure; Sustainable cities and urban infrastructure; Realigning workforce diversity, equity and inclusion; Sustainability and CSR; and Sustainable Construction.

ICIDS 2024 received 92 extended abstracts in response to its call for research papers. After a rigorous review process and similarity checks, 68 contributions were accepted for submission of full research papers. Finally, 51 research papers are received for presentation at the conference. Since the conference mandates physical participation, we anticipate high scholarly engagement during the post-research presentations. To acknowledge the high-quality research papers, ICIDS 2024 has instituted six best research paper awards and one promising Doctoral Scholar Award. In addition, selected high-quality research papers will undergo a double-blind peer review for inclusion in an edited book. This book, edited by Dr. Rachna Gangwar and Dr. Anurima Mukherjee Basu, will be published by Routledge Taylor & Francis Group, UK.

I congratulate the conference chairs, Dr. Rachna Gangwar and Dr. Anurima Mukherjee Basu, for their commitment to shaping the conference. The support and

guidance of patrons and the Global Advisory Board have been unparalleled. Such a high-calibre conference cannot be achieved without the support of the technical and scientific committee and the faculty and staff team at Adani University.

With our continuous efforts, we hope to be successful in creating a global platform of practice and research in the infrastructure development and sustainability domain.

Sincerely,

Prof Rahul Singh

Dean and Professor

Faculty of Management Sciences, Adani University

About the Conference

Infrastructure connects people to opportunities, promotes economic growth, and improves quality of life. It also provides a pathway for countries to integrate their climate agenda by investing in projects that reduce carbon footprints. According to the World Economic Forum's (2020) Global Future Council on Infrastructure, leaders in the public and private sectors are becoming ever more aware of the importance of building a more economically, socially, and environmentally sustainable world. Yet, across much of the developing world, infrastructure remains inadequate. There is a need to identify the pressing issues, closing the growth loops, and designing new pathways to ensure a sustainable and equitable future for all.

In the context of national development goals and challenges, global focus on climate change, and mainstreaming of sustainable development goals (SDGs) with national policies and programs, policymakers around the world are grappling with the need for more resources to steer the global economy on to a more sustainable long-term development path. Globally, countries are also embracing the emergence of digital ecosystems and green finance to support the development process. The emerging trends in the world of infrastructure are that of sustainable, equitable, digital, and green finance.

Ensuring sustainability in infrastructure development is challenging due to the competing demands of economic growth and environmental conservation. Actions to mitigate and adapt to the new realities are required to be taken across infrastructure sectors, including energy systems, transport, urban and real estate development, digital strategies, financing, and policy ecosystems for development.

The new industrialization model embraces the understanding of circular economy applications to deliver lasting methods of innovation and sustainable solutions. Amidst these developments, countries are committed to the inclusive development agenda. Decision makers are often compelled to prioritize projects with short-term returns, making it challenging to allocate resources to initiatives that may not be commercially lucrative but are crucial for addressing social disparities.

The financing landscape for infrastructure is evolving to newer channels and instruments like responsible financing, green financing, and sustainable financing. There is still a requirement of standardized metrics and clear definitions for 'green' projects, helping investors to assess the environmental impact accurately. Green

financing often requires higher upfront costs and longer payback periods, deterring potential investors and project developers.

As we navigate to higher growth, new models of development, and a relatively uncertain path, the convergence of sustainability, technology, equity, and green financing is likely to reshape the landscape of infrastructure development, fostering inclusive and environmentally conscious economic growth.

Aim of the Conference

Against the aforementioned backdrop, the conference aims to delve into the issues surrounding the complex interplay in economic growth, environmental challenges, and social equity for ensuring that infrastructure development shapes the national and global sustainability agenda 2030. ICIDS provides a platform to discuss pursuits of infrastructure development that is sustainable, technologically advanced, equitable, and financed through green initiatives. Experts from academia, industry, and practice engaged in panel discussions addressing the following key questions:

- (1) What are the emerging trends of infrastructure development in developing economies?
- (2) How are these trends transforming the infrastructure ecosystem?
- (3) What challenges do policymakers encounter in aligning infrastructure development with sustainability and climate objectives?
- (4) How can infrastructure investments be effectively aligned with sustainable development goals?

ICIDS also provides a platform for academicians to share their research ideas before a diverse audience. Research paper presentations are organized across seven technical tracks.

Acknowledgements

This book of abstracts represents the collective efforts, intellectual rigor, and dedication of numerous individuals who contributed to the success of the 2nd Edition of the International Conference on Infrastructure Development and Sustainability (ICIDS) and the culmination of this book.

We would like to begin by extending our heartfelt gratitude to the esteemed conference patrons, Dr. Priti G. Adani, President, Prof. Dr. Arun Sharma (Royal Order of Australia), Vice President, and Prof. Ravi P Singh, Provost, for their visionary leadership and invaluable guidance throughout the course of this conference.

We are deeply grateful to the distinguished members of the Global Advisory Committee for their guidance and support in shaping this conference. Their expertise, insights, and commitment were instrumental in ensuring its success and impact.

We sincerely appreciate all the participants who submitted their research papers, contributing to the success of this conference. Their support has helped us establish it as an important academic conference in the field of infrastructure development—an objective that motivated its inception. We are thankful to the Track Chairs, the Technical Committee Members, and the Academic Review Committee Members for their diligent efforts in reviewing the papers and shortlisting those for awards.

We extend our sincere thanks to the keynote speakers, panel chairs, and panelists for their insightful contributions to the conference themes. Your leadership and expertise in the infrastructure domain greatly enriched the discussions on contemporary issues across various panels.

We greatly appreciate the support of our sponsors and partners—IRClass, Quality Austria, Adani Green, GIFT City, The Infravision Foundation, FPSB, and Routledge—for their contributions in bridging the gap between industry and academia.

We humbly acknowledge the support from Mr. Hiren Mandaliya, Dean Academics; Prof. Anupam Kumar Singh, Dean Faculty of Engineering Sciences and Technology; Prof. Hitesh Chhinkaniwala, Dean Research & Faculty of Sciences; and Prof. Sunil Kumar Jha for their cooperation and support.

Our sincere appreciation goes to the ICIDS Secretariat, support teams, backend teams, and student volunteers, who worked tirelessly to ensure the smooth organization of the conference. Your dedication and commitment played a key role in ensuring the seamless organization of the conference.

Thanks to Prof. Rahul Singh, Dean & Professor, Faculty of Management Sciences, the organising committee members, and other colleagues for walking an extra mile with us to make this conference a success.

Dr Rachna Gangwar

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Dr Anurima Mukherjee Basu

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Contents

Foreword

About the Conference

Aim of the Conference

Acknowledgements

T01: Energy Transition and Zero Carbon Agenda

- 1. Development of Optimal Strategy for Green Highway Construction** **3**
Hirenkumar Parmar, Harishkumar Varia and Sameer Patel
- 2. Estimating Potential of Municipal Waste Treatment to Earn Carbon Credits for Ahmedabad City** **4**
Nishra Shah and Dr. Devanshu Pandit
- 3. A Techno-Economic Evaluation of Solar Photo Voltaic Building Rooftop Installation for Ahmedabad, India** **5**
Shobhit Chaturvedi, Urvish Meghani, Elangovan Rajasekar and Naimish Bhatt
- 4. Assessing the Impact of Metro Projects on Air Pollution: A Comparative Analysis of Metro City and Nearby Low-Mobility Zones in India** **6**
Janki Pandya, Dr. Dayashankar Kaul and Prof. Debasis Sarkar
- 5. Sustainability Assessment of Green Hydrogen Production from Seawater by Alkaline Electrolysis Method** **7**
Meem Muhtasim Mahdi
- 6. Energy Harvesting Solutions for Smart Cities** **8**
Nutan Tanwar and Rajiv Dey
- 7. Comprehensive Strategies for Mitigating Greenhouse Gas Emissions in Coal-Based Thermal Power Stations** **9**
Ravi Patil and Suhas Patil
- 8. Exploring Emerging Battery Technology and Its Impact on Indian Electric Vehicle Manufacturers** **10**
Varunesh Singh

9. Hydrogen Blending in the Current Natural Gas Infrastructure: A Feasible Energy Security Option	11
<i>Debapriya Mukherjee, P L Srinivasa Rao and Sunil Jha</i>	
T02: Emerging Trends in Transportation and Mobility	
10. Transport in Africa: Challenges and Prospects for Sustainable Development	15
<i>Didier François</i>	
11. Sustainable Development of Bus Rapid Transit System (BRTS) Project in Ahmedabad Through Application of Clean and Green Technology	16
<i>Prof. (Dr.) Debasis Sarkar</i>	
12. Green Futures: Navigating the Policy Framework Towards the Promotion of the Net Zero Logistics Sector in the Emerging Economies	17
<i>Nikhil Roy and Dr. Smriti Asthana</i>	
13. Transit-Oriented Development as a Solution for Integrating Transportation Infrastructure and Land Use Planning: Global Insights and Applications for India	18
<i>Ashwin Prakash K, Thirumaran K, and Saikala L</i>	
14. Behavioral Insights and Patterns of Drivers, Pedestrians, and Cyclists: Integrating iRAP Software for Enhanced Road Safety	19
<i>Kumkum Bhattacharya and Debasis Sarkar</i>	
15. Environmental Benefits of Using Green Ammonia as an Alternative Fueling Option in Marine Vessels	20
<i>Meem Muhtasim Mahdi and Md. Minhazul Abedin</i>	
16. Inclusive Urban Development: Parking Management Strategy for Indian Cities Through Collaborative Governance	21
<i>Disha Pujara and Dr. Divi Sriram</i>	
17. Perception of Walkability Along the Existing Public Spaces: A Case Study of Bhubaneswar	22
<i>Amit Kumar Biswal and Dr. Preeti Onkar</i>	
18. Green Logistics and Green Training's Multiple Mediation Roles and Moderating Influence of Government's Green Policies on Sustainable Supply Chain Practices and Supply Chain Operation Excellence	23

Abhishek Shrivastav and Dr. Ankita Srivastava

19. An Alternative Model for Evaluating Sustainable Transition into Mobility as a Service (MaaS) 24

Aman Kumar and Kumar Abhishek

20. The Peri-Urban Interface: Transit-Oriented Development as a Tool for Sustainable Growth 25

Divya Susanna Ebin, Dr. Sanil Kumar, Dr. Amritha P. K.

21. EV Adoption Challenges in India: Identifying Barriers and Future Roadmap 26

Dr Kumar Shalender and Dr Naman Sharma

22. Walking in a Sustainable Environment: Assessing Walkability to Public Transport in Calicut, India 27

Rajina Rahiman V and Naseer M.A.

23. Gender-Responsive Urban Transport: Leveraging Mobility-as-a-Service and Emerging Technologies for Equitable Mobility 28

Meghna Verma and Silky Jain

T03: Green Finance for New-Age Sustainable Infrastructure

24. Public–Private Partnership: A Study of Sustainable Hybrid Annuity Models in India 31

Prof (Dr.) Debasis Sarkar

25. Deriving the Strategies for Sustainable Financing for Green Mobility Infrastructure in Indian Context 32

Sonia Chauhan and Chidambara

26. Analysing the Regulatory Framework and Implications of Small and Medium Real Estate Investment Trusts (SM REITs) in India 33

Siddhant Walia, Subhabaha Pal, Sankersan Sarkar, Birajit Mohanty

27. Examining the Dynamic Integration of India's Green Benchmark Indices: Global Peers or Traditional Crude 34

Vridhi Saini, Avni Tyagi, Rakesh Shahani

T04: Sustainable Cities and Urban Infrastructure

28. Integrating Green Building Practices for Eco-Urban Development 37

Ar. Kuntal Shah

29. The Silent Crisis: Understanding Shrinking Cities in Indian Context	38
<i>Ashly Augustine and Ankhi Banerjee</i>	
30. Urban Groundwater: An Underutilized Infrastructure of the City	39
<i>Shruti Pandit</i>	
31. Features of Age-Friendly Cities and Communities: A Comprehensive Analysis in the Indian Context	40
<i>Mrunalini Joshi and Ankhi Banerjee</i>	
32. Demand Side Factors Influencing Home-Ownership Patterns in Kolkata, India	41
<i>Sovan Biswas and Ankhi Banerjee</i>	
33. Sustainability Through Urban Green Infrastructure – Regulation of Ecosystem Service Valuation and Urban Heating: A Case Study of Kolkata City	42
<i>Jyotirmayee Sarkar and Amrita Dwivedi</i>	
34. Quantifying Urban Heat Island Mitigation Potential of Urban Green Spaces: A Case Study of Bhopal City	43
<i>Aishwarya Dwivedi and Dr. Rajat Soni</i>	
35. Town Planning Scheme Proposal Based on Predicted Spatial Growth of the City: A Case Study of Vadodara	44
<i>Hasmukh Chauhan, Nirali Patel, Saumya Patel, Ditsa Chaudhari, Chris Vaghela</i>	
36. Is Dholera Smart City a Sustainable Urban Space?	45
<i>Somayya Madakam and Kanu Patel</i>	
37. Comparative Analysis of Urban Civic Infrastructure Service Delivery: A Study of Two Indian Cities	46
<i>Ramakrishna Nallathiga</i>	
38. Green Building Price Premiums: Evidence from Ahmedabad	47
<i>Astha Agarwalla and Areeb Ahmad</i>	
39. Improving Livability as a Smart Solution for Cities and Urban Infrastructure	48
<i>Dhanyasree Dhanaraj, Dr. Shyni Anilkumar, Dr. Shraddha Bahirat</i>	
40. Spatiotemporal Analysis of Urban Heat Island and Change in Land Use at Gautam Budh Nagar	49

*Abhishek Kumar Srivastava, Shaleen Singhal, Dr. Deepty Jain,
Kamna Sachdeva*

- 41. Comparative Study of Carbon Emission for Different Aging Residential Buildings Using Household Survey and eQUEST Energy Simulation Software** 50
Mitali Shah
- 42. Villages and Urban Villages as Sustainable Infrastructure** 51
Anand Khatri, Hina Zia, Nisar Khan
- 43. Design of Smart Things for Rural and Urban Sustainable Digital Infrastructure Development in India** 52
Dr Vishvjit Thakar
- 44. Impact Fee as a Second Order Regulation: The Case of Unauthorized Properties in Ahmedabad** 53
Astha Agarwalla and Komal Mimani
- 45. Enabling Better Management of Public Expenditure Through Digital Infrastructures in Odisha** 54
Soumi Roy Chowdhury and Manisha Marulasiddappa
- T05: Realigning Workforce Diversity, Equity and Inclusion**
- 46. Interwoven Realities: A Holistic Inquiry into Pithampur Industrial Town's Socio-Economic Landscape** 57
Dr Pratyosh Madhavi, Dr Binayak Choudhury, Dr Ankit Kumar Singh
- 47. Impact Assessment of Indian Health Insurance Business Transition During COVID-19 Era** 58
Ruchita Verma, Dhanraj Sharma, Pranav Raghavan
- 48. Impact of Digital Transformation on Globalization of Small and Medium Enterprises in Oman** 59
Bipin Kuriakose and Sudepta Pradhan
- 49. Green Office Buildings and Employee Outcomes: A Literature Review** 60
Dr. Smita Kulkarni
- 50. Free Electricity Programme and Farmer's Attitude: A Study from Telangana State of India** 61
Dr. Mohammed Shameem P and Dr. Krishna Reddy Chittedi

51. Access to Safe Sanitation Facilities by Disabled People in Kolkata Sub-Urban Areas	62
<i>Mohan Kumar Bera</i>	
T06: Sustainability and CSR	
52. ESG and the Carbon Market Maze: Solutions and Opportunities in the Face of Climate Change and Sustainability Actions	65
<i>Soomrit Chattopadhyay, Utkarsh Singh, Yakabal Shaikh</i>	
53. Achieving Net Zero: Comprehensive Strategies and Implications for a Sustainable Future	66
<i>Swati Sinha and Sudarsan J. S.</i>	
54. Green Factory (Sustainable Organization) and Life Cycle Assessment	67
<i>Ajinkya Huddar and Dr. Sudepta Pradhan</i>	
55. Automated Detection of Greenwashing in Indian Corporate Sustainability Reports Using Natural Language Processing	68
<i>Ravi Shankar</i>	
T07: Sustainable Construction	
56. Experimental Assessment of Bio-Based Binders for 3D Printable Soil Composites	71
<i>Sagar Sanas, Karan Sanap, Karan Rathore, Avishkar Raskar, Chaitanya Rathod, Dr. Avadhoot Rajurkar, Dr. Rajkumar Bhagat</i>	
57. Comparative Study of Compressive Strength and Permeability of Pervious Concrete	72
<i>Sagar Shah and Bhargav Tewar</i>	
58. Integration of GIS and BIM for Thermal Comfort Through Passive Design Strategies in a School Building: A Case Study	73
<i>Damandeev Nagul and Neetu Kapoor</i>	
59. An Experimental Investigation on the Physico-Mechanical and Durability Properties of Cement-Stabilized Rammed Earth Blocks Incorporating Agro-Industrial Wastes	74
<i>Ranjeet Kumar and Abraham George</i>	
60. Advancing Refugee Shelters in India: A Comparative Study of 3D-Printed and Traditional Construction	75
<i>Adeesh Diwan</i>	

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T01

**Energy Transition and
Zero Carbon Agenda**

1

Development of Optimal Strategy for Green Highway Construction

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Abstract: India is a developing country. Current developments in construction activities have a significant influence on the economic growth of the nation. India possesses the second largest road network in the world. The road transportation is gradually increasing, and that has a great impact on the environment. The road construction activities generate greenhouse gas (GHG) emissions to a large extent, which are considerably responsible for climate change. Now a days, the government is focusing on sustainability to reduce carbon emissions and protect the environment. The green highway concept emphasizes reducing the carbon content, minimizing the impact on the environment, and reducing the use of natural resources. This study aims to develop a strategy that can reduce the carbon emission in the context of the use of alternative material or recycled material, along with satisfying the strength requirement at a reasonable cost. An approach for computing the overall carbon emission by use of only base or natural materials and with the replacement of alternative waste materials has been elaborated. This methodology is applied for the available data of a selected stretch of the "Dhrol-Amran-Maliya" road section of Gujarat, India. The present study is mainly focused on materials of rigid pavement sections, machinery, and energy generation units of selected road stretches, as these are the main sources of carbon emissions. The results of this study reveal that with the selected alternatives, overall saving in CO₂ emission can be achieved about 56313.01 MT (19.20%) and overall saving in cost can be achieved about 48.11 Rs. in crores (16.85%) for the selected road section data.

Keywords: Greenhouse gas, Green highway, Rigid pavement

2

Estimating Potential of Municipal Waste Treatment to Earn Carbon Credits for Ahmedabad City

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Abstract: Rising temperatures, frequent heat waves, and sea level rise are global impacts of climate change that are raising serious concerns. In response to this crisis, more than 2300 jurisdictions have declared a climate emergency. International agreements such as the Paris Agreement aim to limit temperature increases. As a signatory to this agreement, India has committed to achieving net zero emissions by 2070. As the 8th largest city in India, Ahmedabad has actively tackled climate change by promoting renewable energy and implementing effective waste segregation. However, the rapid population growth has resulted in a significant increase in waste generation, leading to open dumping in landfills. The Pirana landfill in Ahmedabad, where waste has been dumped since 1980, contains 8 million MT of legacy and fresh waste. Landfills are a significant source of GHG emissions (CH_4), primarily due to the decomposition of organic waste. Methane (CH_4) is approximately 25 times more potent than CO_2 in terms of its global warming potential over 100 years. In the present paper, we quantified the methane emissions for the legacy and fresh waste of the Pirana landfill using the FOD model. Over the next seven years, the GHG emissions from solid waste are estimated to be approximately 7.4 million tCO₂e. The paper has also reviewed the revenue generation potential through carbon credits. By reducing methane emissions with advanced waste treatment, India can reduce its environmental impact and generate revenue through carbon trading, proving the economic value of sustainable management.

Keywords: Carbon credit, GHG emission, Landfill, Legacy waste

3

A Techno-Economic Evaluation of Solar Photo Voltaic Building Rooftop Installation for Ahmedabad, India

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Abstract: Rooftop solar panels offer a cost-effective solution to reduce building energy expenses by utilizing solar radiation for electricity generation. This study provides a comprehensive techno-economic evaluation of solar photovoltaic (PV) rooftop installations on a two-story residential building in Ahmedabad, India. Using the EnergyPlus simulation program, a detailed energy model was developed to estimate monthly utility costs for lighting, appliances, and air conditioning. Twelve PV rooftop configurations were simulated, varying in panel types (ADANI Elan Shine, UNISOLAR US-64, and UNISOLAR US-128) and roof coverage (50% and 100%) on both ground and first floors. Among the configurations, the ADANI Elan Shine panels with full coverage on both floors performed best, generating 247,399 kWh annually and achieving a 3-year recovery period. Additionally, 50% ground floor coverage with ADANI Elan Shine panels resulted in a 4-year recovery period. UNISOLAR US-128 panels with 50% coverage on the ground floor produced 79,063 kWh annually with an 8-year recovery period. In contrast, configurations with lower roof coverage, especially those using UNISOLAR US-64 panels, exhibited poor performance. These setups had extended recovery periods of 18–29 years due to lower annual energy production relative to installation costs. This study's approach provides accurate energy modeling, performance evaluation, and financial analysis, offering valuable insights for stakeholders. By assessing various configurations and their economic implications, this research supports informed decision-making on sustainable building practices and solar energy investments, highlighting the importance of panel type and roof coverage in optimizing solar system performance and cost-effectiveness.

Keywords: Building energy simulation, EnergyPlus, Rooftop solar panel, Techno-economic evaluation

4

Assessing the Impact of Metro Projects on Air Pollution: A Comparative Analysis of Metro City and Nearby Low-Mobility Zones in India

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Abstract: India is on its path to sustainable development in transportation. In this way, the development of public transport in urban areas plays an important role in sustainability and improves the quality of life. Public transportation not only helps in efficient movement but also helps decrease the air quality index (AQI) by reducing the number of personal vehicles on the road. Metro rail in major Indian cities facilitates an eco-friendly alternative and a great option for transportation, even though development not only concerns the public facilities but also focuses on environmental health and sustainability; for this, improving air quality is also an agenda of this kind of big project. This study proposed to find the influence of metro rail projects on air quality during and after their construction phases in five metro cities of India: Ahmedabad, Pune, Jaipur, Lucknow, and Kochi. For this study, two main factors have been taken into consideration: one is air quality, which can give an idea about the particulate matter (PM) as well as gaseous pollutants, and the other is land surface temperature (LST), which can help to understand the activities on land. Air quality and LST data have been taken from the Google Earth Engine (GEE) platform. In this study, the buffer of active metro routes is used as a map to extract air quality and LST data, which will be compared with nearby low-mobility areas to assess and analyze the impact on air quality. This analysis has been performed using a machine learning algorithm. This study provides valuable perception that could guide future urban transportation planning and policy-making towards more sustainable solutions.

Keywords: Air quality, Machine learning, Metro-rail, Satellite data

5

Sustainability Assessment of Green Hydrogen Production from Seawater by Alkaline Electrolysis Method

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Abstract: The growing concern of the world community regarding carbon-neutral energy systems to facilitate industrial decarbonization and climate change mitigation has led to extensive research on developing alternate lower-carbon energy options for minimizing excess fossil fuel use and harmful emissions control. So far, green hydrogen has become a promising clean energy source to facilitate industrial decarbonization and sustainable energy development. Nevertheless, a significant challenge inhibits the widespread adoption of green hydrogen due to the requirement of adequate water and possible consequences of water scarcity in some regions. Hence, numerous efforts have been pledged to utilize seawater for large-scale green hydrogen production upon seawater desalination. In this context, this research aims to provide structured guidelines for quantifying different KPIs based on the key findings of secondary literature to evaluate the sustainability status of green hydrogen production plants or green hydrogen production policies aligning with seawater desalination. A mixed-method research approach was employed to develop a measurable list of KPIs and sustainability criteria for green hydrogen production systems from seawater desalination. The key findings have demonstrated a quantifiable guideline to assess salient impact categories of different sustainability aspects for policymakers and stakeholders in developing strategies for sustainable hydrogen production. The research showed that the inclusion of renewable energy grid connection will emphasize cleaner product yield within the total value chain, but solely the process is dependent on economic feasibility. Conversely, the social sustainability of the production method is highly related to public knowledge, employment generation, and infrastructural development, which will emerge from a smart energy grid system connection for equitable energy sharing and sustainable energy production for future generations.

Keywords: Alkaline electrolysis, Green hydrogen, Seawater desalination, Sustainable energy options

6

Energy Harvesting Solutions for Smart Cities

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Abstract: The most important problem is how to supply ubiquitous, long-lasting energy to the installed Internet of Things (IoT) units so that the optimization of smart cities can continue uninterrupted. This and other difficulties have kept the focus on energy harvesting research. The proposed energy collection system may enable Internet of Things hubs to search for renewable energy from environmentally significant sources. This paper examines the most practical urban power sources, drawing on descriptions provided by researchers in existing literature. We have also proposed that power sources can be different based on the application, given the plethora of no-cost resources in the city under investigation. Additionally, it implies that the power requirements for various Internet of Things and wireless sensor networks (WSNs) for the automation of smart cities should be located in close proximity to those requirements. Intelligent cities and society represent some of the significant smart, environmentally friendly, and energy-harvesting challenges that have emerged with the advent of smart urban computing. Gathering and distributing IoT devices and intelligent software to enhance people's quality of life is the key objective of the sustainable intelligent city. Management of energy harvesting is a crucial aspect of environmentally friendly urban computing, but it's being hampered by complicated populations, a proliferation of IoT sensors, and smart app proliferation. Among these challenges are the need to regulate environmental waste, save power, and lower related energy use. However, the idea of harvesting energy. Due to budgetary and legal constraints, the management of sustainable urban computing is currently expanding at a rapid pace and must be considered. This study examines several clean energy assembly approaches to produce cutting edge smart metropolitan computing tools for sustainable and smart cities. Technologically speaking, sustainable smart cities rely on evaluating current obstacles and unstudied study avenues in garbage collection and energy harvesting. These developments have boosted the amount of energy that individuals and smart apps utilize in complex metropolitan situations.

Keywords: Energy harvesting, Internet of things, Smart city, Sustainability

7 Comprehensive Strategies for Mitigating Greenhouse Gas Emissions in Coal-Based Thermal Power Stations

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Abstract: The objective of this study is to explore strategies to mitigate greenhouse gas emissions from coal-based power stations. This includes assessing current emission levels, identifying key sources of emissions, and implementing effective measures to achieve compliance with the 2015 Paris Agreement targets for India. The study employs the GHG protocol to measure emissions. Data were collected from a 2x300 MW thermal power plant, focusing on fuel usage, plant efficiency, and operational parameters. Various energy-saving projects, such as optimizing the heat rate, enhancing turbine efficiency, and reducing auxiliary power consumption, were discussed. The implementation of targeted energy-saving measures resulted in significant reductions in GHG emissions. Key projects, including the servicing of high-pressure turbines and renovation of air preheater baskets, improved the plant's heat rate by 50 kcal/kWh. Auxiliary power consumption was reduced by 0.807%. These improvements led to a reduction of 67,950 tons of CO₂. This paper introduces practical energy-saving measures that can be widely replicated in other thermal power plants to achieve significant reductions in GHG emissions.

Keywords: GHG, Scope, Heat rate, Emission

8

Exploring Emerging Battery Technology and Its Impact on Indian Electric Vehicle Manufacturers

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Abstract: Electric mobility is seen as a most promising pathway for decarbonizing the transportation sector. The sector is being supported and subsidized by the Indian government through schemes such as FAME-I and FAME-II, ACC, and PLI to build a sustainable ecosystem for faster adoption of electric vehicles. The next 6 years (2024-2030) will be the growth and sustenance years for the sector. Indian manufacturers must invest in their battery technologies so that the Total Cost of Ownership (TCO) is reduced and Range Anxiety can be minimized, respectively. This study explores novel battery technologies and their impact on the EV sector. The EV sector is projected to grow with a CAGR of 35% in the next decade under the Business-As-Usual (BAU) scenario (IESA, 2023). Thus, as the Indian EV market evolves, the need for batteries with higher energy density and cost rises. This paper analyzes the advantages and shortcomings of lithium-ion, solid-state, sodium-ion, and lithium-sulfur battery technologies. Through exploratory research, this study examines the potential benefits of these technologies, including their increased range, reduced charging times, safety improvements, and cost reductions. By addressing these challenges and investing in emerging battery technologies, Indian EV manufacturers will be able to enhance their competitiveness and sustainability, contributing to a cleaner and more energy-efficient future. Hence, this study is important for gaining insight into the emerging EV market in India.

Keywords: Battery-powered vehicles, Electric mobility, Emerging battery technology, Lithium-sulphur battery

9

Hydrogen Blending in the Current Natural Gas Infrastructure: A Feasible Energy Security Option

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Abstract: Zero-carbon initiatives are critical in addressing climate change and controlling global warming so that it stays below 1.5°C. India is the third-largest oil importer and heavily depends on fossil fuels for its energy needs. Oil is estimated to end by 2052, gas by 2060, and coal by 2090. On the other hand, the consumption of energy is increasing every day. This is the instance where renewable energy comes into play. Amidst global warming concerns, governments around the world are incentivizing a move towards renewable energy. Adhering to the Paris Agreement, India, also vowed to lower the carbon intensity and boost the proportion of renewable energy in its portfolio. It has quadrupled renewable capacity from 55 GW in 2010–11 to 190 GW in 2023–24 and set a goal to install 500 GW of renewable energy capacity by 2030. One of the most important pathways to reaching the zero-carbon agenda is the transition to a green hydrogen economy through integrating renewable energy sources. To start with, hydrogen blending offers a promising solution for reducing carbon emissions in the gas sector and facilitating a shift to a more sustainable energy system. Hydrogen has a higher energy density than fossil fuels, which can lead to more efficient combustion and reduced energy losses. However, hydrogen requires special safety precautions for handling and storage because of its high flammability and non-detectable fire. The present study explores the specifics of the technicalities of hydrogen blending in a natural gas network, focusing on emissions reduction, energy efficiency, and infrastructure compatibility within the framework of transitioning toward cleaner energy sources. For technical feasibility, the analysis was further broken down into existing infrastructure details, analysis of risk associated, the findings of earlier executed hydrogen blending projects, future research scope, and conclusion.

Keywords: Green hydrogen, Hydrogen blending, Natural gas infrastructure, Net zero

T02

**Emerging Trends in
Transportation and Mobility**

10 Transport in Africa: Challenges and Prospects for Sustainable Development

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Abstract: The detailed examination of such a subject will be carried out on the basis of a fundamental problem, which will thus serve as a guideline in the presentation of the ideas that should underlie the approach. This concerns the question of the links between the challenges of transport services in Africa and sustainable development. In other words, how can transport services in Africa contribute more easily to sustainable development to meet continental challenges?

Thus, the problem of method is at the heart of any scientific work. As it is true that the method sheds light on the hypotheses and determines the conclusions, our approach will be ordered with a few exceptions around the use of the analytical and exegetical but also comparative method. It is understood as the analysis, interpretation, and explanation of the rules of law, particularly those contained in the various legal texts of the GATT and the WTO.

As for the expected results, it will be a question of studying the standards and rules of the General Agreement on Trade in Services (GATS) of the WTO, which work for a progressive liberalization of the services sector, including, among others, transport.

Keywords: GATS, WHO, Transport

11

Sustainable Development of Bus Rapid Transit System (BRTS) Project in Ahmedabad Through Application of Clean and Green Technology

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Abstract: Bus Rapid Transit System (BRTS) projects can use clean and green technology to make their facilities last longer and be better for the environment. This paper aims at developing a sustainable clean and green technology like the Clean-Development-Mechanism (CDM) framework for a BRTS project launched in a city in western India. BRTS is characterized by an overarching goal to elevate the mass transit bus system, thereby elevating the general standard of end user experience. The BRT system also employs user information technology such as clear route maps and real time bus tracking display. Low emission buses conform to clean technology. The total carbon footprint of the BRTS project as computed is observed to be about 9266 tonnes per year. Additionally, it has been noted that the CO₂ emissions from BRTS buses can be reduced from 9015 tonnes per year to 5193 tonnes per year by utilizing alternative fuels, such as biodiesel. The entire carbon footprint of the BRTS buses and bus stations was computed in order to develop the proposed CDM model. Alternative fuels, such as biodiesel, have been suggested as a potential method of reducing CO₂ emissions. Additionally, it is advisable to reduce the use of energy-intensive materials such as steel and cement and to substitute fly ash for cement in a greater quantity. Fly ash can be employed as a partial replacement for cement, resulting in a 35% reduction in CO₂ emissions. Assuming a carbon credit of \$6 per metric ton of CO₂ emitted, the reduced CO₂ emission quantity would lead to cost savings of approximately INR 957515 (US\$14731). Additionally, it has been noted that the CO₂ emissions from BRTS buses can be reduced from 9015 tonnes per year to 5193 tonnes per year by utilizing alternative fuels, such as biodiesel.

Keywords: Clean and green technology, Clean Development Mechanism (CDM), Bus Rapid Transit System (BRTS), Sustainable projects

12 Green Futures: Navigating the Policy Framework Towards the Promotion of the Net Zero Logistics Sector in the Emerging Economies

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Abstract: Reducing carbon dioxide emissions and carbon particulates from logistics-related operations, which contribute to greenhouse gases (GHG) and climate change, referred to “carbon-free logistics,” is the need of the hour globally. By prioritizing the environmental impact of logistics activities, green logistics provides a comprehensive approach to carbon-free logistics. This includes minimizing carbon emissions, energy use, and overall environmental impact during the transportation of goods from producers to consumers, known as carbon-neutral logistics operations.

Experts have been laying emphasis on environmental sustainability (ES) in the Indian logistics sector, especially in the context of logistics 5.0. Achieving ES involves adopting various strategies (like carbon offset programs, eco-friendly packaging, collaborations, and alternative fuels) and technologies (such as energy-efficient transportation, route and network planning, and optimizing). The Paris Agreement accelerates India’s efforts to achieve a carbon-free logistics industry, aiming to limit global warming to well below 2 degrees Celsius above pre-industrial levels, with aspirations to keep the increase to 1.5 degrees Celsius.

As of 2021, India’s transportation sector accounted for 14–15% of the nation’s GHG emissions, with road transportation contributing over 85% of these emissions. Researchers for the purpose of this study have conducted a comprehensive literature review from the Scopus database of the past 20 years and collected data from both primary and secondary sources. The study explores the need for the Indian logistics industry to transition to more environment-friendly practices, examining the current state, policies, and practices within the industry, will contribute to the existing literature, and will provide practical recommendations for restructuring the Indian logistics industry based on successful strategies from other nations.

Keywords: Carbon neutral logistics, Emerging economies, Green House Gases (GHG), Sustainable logistics

13 Transit-Oriented Development as a Solution for Integrating Transportation Infrastructure and Land Use Planning: Global Insights and Applications for India

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Abstract: Urban sprawl, congestion, and resource depletion are significant global urban issues intensified by post-World War II zoning favoring automobile-centric development. The concept of Transit-Oriented Development (TOD) has risen as an essential method to tackle these issues, encouraging dense, mixed-use settings that favor public transit instead of individual vehicles. This methodology aims to enhance urban mobility, environmental quality, and social equity through cohesive planning and design. Globally, cities such as Singapore, Germany, Curitiba, and Japan have successfully adopted TOD principles, demonstrating various strategies and results in sustainable urban development. These case studies highlight TOD's effectiveness in reducing car dependency, encouraging active transportation, and fostering vibrant communities. In India, TOD presents a transformative strategy for sustainable urban growth amidst rapid urbanization and major transit projects in cities like Delhi, Chennai, and Bangalore. By synchronizing TOD principles with infrastructure investments, Indian cities can mitigate sprawl, congestion, and environmental issues while enhancing residents' quality of life. This research aims to investigate TOD as a catalyst for sustainable urban infrastructure development, utilizing international case studies to inform its application in Indian cities. Through comparative analysis and qualitative assessment of TOD's multifaceted impacts—such as economic viability, social inclusiveness, and environmental responsibility—the study intends to offer practical insights and policy guidance. By incorporating TOD into urban planning frameworks, this research contributes to the global discourse on infrastructure development and sustainability.

Keywords: Sustainable development, Sustainable urban infrastructure, Transit-Oriented Development

14 Behavioral Insights and Patterns of Drivers, Pedestrians, and Cyclists: Integrating iRAP Software for Enhanced Road Safety

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Abstract: In Ahmedabad, improper signage, deteriorating road conditions, and inadequate pedestrian facilities contributed to 24% of traffic incidents last year. Road usage causes several problems for the road, which in turn causes a variety of issues for road users. Using the International Road Assessment Programme (iRAP) software to improve road safety analysis, this study investigates the interactions and behavioral patterns between drivers, pedestrians, and other road users. The stretch area considered for the study involved around S.G. Highway connecting internal arterial roads from Pakwan char rasta to Keshav Bagh. Important conclusions include the prevalence of distracted driving among drivers, high risk-taking behaviors among pedestrians in places without proper crossing facilities, and variable traffic regulation compliance among cyclists based on perceptions of infrastructure safety. Using iRAP software to build safer and more effective urban settings, this research emphasizes the significance of a comprehensive approach to traffic management and urban planning.

Keywords: Behavioral insights, iRAP, Road safety, Urban planning

15 Environmental Benefits of Using Green Ammonia as an Alternative Fueling Option in Marine Vessels

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Abstract: This research aims to evaluate the technical feasibility of using green ammonia as an alternative marine fuel for marine vessels by determining its energy conversion and environmental performance. A general heavy fuel oil (HFO)-powered container ship, functioning in the North Atlantic Ocean, was selected as a reference ship to understand the emission status of the European Emission Control Area (EECA) and observe how ammonia usage can minimize harmful emissions in this region considering three case scenarios. The voyaging interfaces were developed in Seamatrix (v. 2.5.0.0), a navigation software based on the collected data from the global marine traffic database and annual reports of the port authorities. Finally, using a bottom-up integrated system approach, the environmental performance of the case scenarios was evaluated by the life cycle analysis (LCA) method for a given functional unit (1 ton-km). The well-to-wake LCA models for each scenario were developed in SimaPro (v. 9.2) using the Ecoinvent (v. 3.8) inventory database, and the environmental impact assessment was conducted by following the ReCiPe 2016 midpoint (H) methods for nine impact assessment categories. Based on the analyses, ammonia would become an emerging energy carrier for marine vessels to reduce embodied energy consumption and associated emissions from vessel operations compared to conventional marine fuel, and the use of ammonia in solid oxide fuel cells showed superior energy conversion potential and environmental performance.

Keywords: Alternative marine fuels, Green ammonia, Environmental impact assessment, Sustainable maritime transportation

16 Inclusive Urban Development: Parking Management Strategy for Indian Cities Through Collaborative Governance

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Abstract: Rapid urbanisation in Indian cities has led to a significant rise in the population of motor vehicles, leading to demand for parking spaces and causing issues related to traffic congestion and urban planning. This paper aims to examine parking management strategies adopted in Indian cities, focusing on the need for inclusive urban development through collaborative governance. In a vehicle's life cycle, it remains parked for 95% of the time, which happens to be a critical issue in Indian cities with limited parking infrastructure. The study highlights the ever-growing mismatch between demand and supply of parking facilities in Indian cities, which is further impacted due to the disjointed responsibilities of various authorities in Indian cities.

Drawing on the case study of various Indian cities, this paper explores existing policies, enforcement mechanisms, and the impact of inadequate regulations relating to parking. The study is based on a multi-method approach, which comprises policy reviews, direct field observations, and feedback from citizens as well as authorities. The findings of the study suggest that the major issues of parking in Indian cities are primarily because of ineffective policy enforcement and insufficient coordination between different agencies and authorities, which causes suboptimal outcomes, including revenue losses for local urban bodies and chaotic urban conditions.

The paper tries to advocate a collaborative governance model wherein various stakeholders, such as citizens, authorities, and enforcement bodies, work together in both policy formulation and implementation stages. Using the example of Indian Railways, the role of social media was also examined as a tool for fostering citizen engagement for service improvement. By integrating the various insights, the paper presents a framework for parking management that can enhance policy effectiveness, improve urban infrastructure utilization, and ensure more sustainable and inclusive urban development in Indian cities.

Keywords: Collaborative governance, Parking, Policy Implementation, Urbanization

17 Perception of Walkability Along the Existing Public Spaces: A Case Study of Bhubaneswar

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Abstract: With the developments in the Global South, the concept of walkability has taken an important role in creating a sustainable environment. The built-up growth and congestion have directly impacted the liveliness of city streets as well as the sustainability components of the cities. The SDG 11.7 suggests that people should have public spaces within walking distance. This study tries to analyze the existing condition of access to public spaces alongside people's perception of walkability within and surrounding streets adjacent to public spaces in Bhubaneswar city with three different approaches. To understand the spatial extent of access to public space within the city, the study conducts an isochrone assessment with QGIS-based QNEAT3 toolsets. Secondly, the study tried to develop an understanding of people's perspectives on walkability to reach a public space using a sample survey (N = 134). To understand the walkability aspect within these public spaces, the study has developed a Python-based tool to extract a sample of Google reviews and analyze the key interests of people within a public space. This three-step assessment allows us to visualize the gaps in current walkable access to public spaces in Bhubaneswar, the people's perception of walkability within the streets connecting to these public spaces, and the third step assesses the perception of public spaces by evaluating the reviews of the visitors. The study emphasizes the gap in existing public spaces while providing insights on how to approach the solution by understanding the public perception. This study can help in future studies on walkability within a city and the role of public spaces in walking practices.

Keywords: Perception, Public space, Sustainable transport, Walkability

18 Green Logistics and Green Training's Multiple Mediation Roles and Moderating Influence of Government's Green Policies on Sustainable Supply Chain Practices and Supply Chain Operation Excellence

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Abstract: This study focuses on Green Logistics (GL) and Green Training (GT)'s Multiple Mediation Roles and Moderating Influence of Government's Green Policies (GGP) on Sustainable Supply Chain Practices (SSCP) and Supply Chain Operation Excellence (SCOE). 138 Quick Commerce consumer responses were analyzed using Structure Equation Modeling in IBM SPSS AMOS and Jamovi Software. GGP moderates the relationship between SSCP and SCOE such that higher (either or lower) levels of GGP are associated with a strong (either or weaker) relationship between SSCP and SCOE, as moderator low level effect 0.012 is significant and high level effect 0.223 is not significant. SSCP and GGP as individual factors do not show statistically significant effects on outcomes when analyzed separately. The interaction effect signifies a meaningful relationship, implying that effective policies can influence sustainable practices to achieve better operational outcomes in the supply chain. GL mediates the relationship between SSCP and SCOE is supported, as indirect effect 36.6% mediation, direct effect 63.4% mediation, and total effect are not significant; hence, there exists a mediation relationship. A significant portion of the effect occurs through these mediators, and SSCP enhances operational excellence through improvements in GL. GT mediates the relationship between SSCP and SCOE is supported, as indirect effect 29.6% mediation, direct effect 70.4% mediation with significant 0.002 p-value at 95% confidence interval, and total effect are not significant; hence, there exists a mediation relationship. Organizations should focus on the regulatory environment when assessing improvement strategies, as well as focus on improving green logistics and green training as mediators to effectively translate SSCP into enhanced SCOE, and should prioritize adjustments to training programs to ensure alignment with SCOE sustainable goals. Future research should explore how changes in training impact operational metrics over time and factors of training that are associated with negative outcomes.

Keywords: Mediation role, Moderation effect, Structure Equation Modeling, Sustainable supply chain

19 An Alternative Model for Evaluating Sustainable Transition into Mobility as a Service (MaaS)

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Abstract: The concept of “sustainability” refers to meeting the needs of the present generation without compromising the needs and opportunities of future generations. This term is now being applied in various developmental sectors to maximize benefits without exceeding the carrying capacity of a system or degrading the environment, particularly in enhancing mobility. Since the industrial revolution, there has been a rapid pace of urbanization worldwide, though not uniformly across all regions. Currently, the process of rapid urbanization is a widespread reality, fostering economic and societal growth but often outpacing the carrying capacity of urban areas. Developing nations, including India, are significantly impacted by this unplanned rapid urban growth, leading to various infrastructural, social, and environmental issues. Hence, the concept of sustainability has been integrated into urbanization to harness the benefits of urban growth sustainably. This paper seeks to identify a method to evaluate the major challenges faced by urban areas in the development of MaaS and explore the potential of sustainable transition to bring about sustainable transition to MaaS, through innovative techniques and guidelines. This study will focus on Varanasi, Uttar Pradesh, and will undertake a qualitative assessment by reviewing existing literature. It will evaluate the prospects of the development of MaaS in urban transport by presenting cases from Varanasi towards achieving sustainable urban development.

Keywords: Mobility as a Service, Sustainability, Urban Transport

20 The Peri-Urban Interface: Transit-Oriented Development as a Tool for Sustainable Growth

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Abstract: As cities continue to rapidly grow worldwide, the expansion presents a unique challenge in the form of peri-urban areas. These zones exist between cities and rural areas and face significant issues such as unplanned growth, inadequate infrastructure, and environmental decline. To address this challenge, this paper delves into the concept of transit-oriented development (TOD) as a strategic solution for sustainable development in peri-urban interfaces. Through a thorough examination of existing literature, this research analyzes the various complexities and obstacles involved in implementing TOD in the context of peri-urban areas. The boundary between urban and rural, known as the peri-urban interface, is a dynamic and distinctive mix of urban and rural features. This intersection presents a range of possibilities and obstacles for promoting sustainable development. As the population quickly expands and resources are in high demand, it is crucial to implement forward-thinking planning and development methods that carefully weigh economic, social, and environmental factors. Fortunately, Transit-Oriented Development (TOD) provides a promising approach through prioritizing compact, diverse, and public transportation-focused progress. In conclusion, this research highlights the increasing significance of peri-urban areas in global urbanization. It suggests that the approach of transit-oriented development presents a viable and durable, and moreover, a sustainable solution for these regions to effectively handle growth while also maintaining the qualities of the region.

Keywords: Peri urban, Sustainable growth, Transit-Oriented Development

21 EV Adoption Challenges in India: Identifying Barriers and Future Roadmap

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Abstract: The adoption of electric vehicles (EVs) is going through turbulent times, and this study specifically aims to analyze the adoption barriers that electric mobility in India is facing. By drawing on the literature, the study develops a survey instrument to identify critical barriers that are hampering the adoption potential of EVs in the country. The findings of the data analysis suggest that range anxiety continues to remain the biggest obstruction to the adoption of EVs, followed by the high retail price, absence of charging infrastructure, higher maintenance cost, and lack of surety about the resale value. All these factors are keeping the EVs from realizing their true potential and need to be addressed by all stakeholders to reach an inflexion point for kick-starting the true EV revolution in India.

Keywords: Automobile, Barriers, Challenges, Customers

22 Walking in a Sustainable Environment: Assessing Walkability to Public Transport in Calicut, India

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Abstract: Walking, a simple and sustainable mode of transport, reduces carbon footprints and offers economic, safety, and health benefits. Integrating walking with public transport (PT) can transform cities, particularly in India, by reducing reliance on private vehicles and addressing issues like air and noise pollution, fuel costs, and pedestrian fatalities. The rise of automobiles has diminished pedestrian spaces, altering city character and reducing pedestrian visibility. Restoring these spaces can revitalize cities. Indian cities are diverse and mostly organically developed, with few planned exceptions like Bhubaneswar, New Delhi, and Chandigarh. Many lack dedicated sidewalks, and existing ones are often poorly designed or maintained, limiting pedestrian use to utilitarian trips. Economic constraints also force some residents to walk due to the high cost of other transport options. In Calicut, walkability was assessed in Bus Catchment Zones (BCZs) using qualitative factors like urban design qualities and pedestrian perceptions, and quantitative factors such as built environment characteristics and immediate walking. Environment. Walkability Assessment (WA) scores, ranging from 0 to 1, were calculated, with higher scores indicating better walkability. Scores below 0.5 suggest poorly performing streets. This methodology, suitable for cities with similar terrain and climate, identifies key factors that can be improved to enhance walkability and public transport access. By making minimal changes to walkways, cities can boost pedestrian use of public transport and reduce private vehicle dependency, and support sustainable development goals.

Keywords: Public transport, Sustainable transportation, Walkability, Walkability assessment

23 Gender-Responsive Urban Transport: Leveraging Mobility-as-a-Service and Emerging Technologies for Equitable Mobility

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Abstract: Transportation is crucial for providing women with autonomy in society through access to various opportunities and thereby empowering them. The literature review highlights gender differences in mobility patterns, role of transportation in women's empowerment, and factors affecting mode choices for different groups of women. Women are not a homogeneous section of society; they consist of various groups, each with unique needs and expectations from city transportation services. A comprehensive study of the similarities and differences in challenges faced by various women groups due to transport services is largely missing. To address this gap in the urban mobility context in developing economies, this study gives insight into the travel experiences, challenges, and aspirations of white-collar, entrepreneurs, students, homemakers, and marginalized sections of women in Bengaluru, India. To get deeper insights into how a city's transportation influences women's education, employability, and social life, a focus group discussion (FGD) method was adopted with a tailor-made set of questions followed by probing questions for each group to meet the objective. It was found that due to comfort, convenience, and better time management, working women and homemakers preferred personal vehicles, while students intended to shift to personal vehicles. Services like metros were preferred over buses for comfort and reliability, but the lack of first-and-last-mile connectivity discouraged women from using them. All groups expect better public transportation (PT) and non-motorized transport, safety while traveling, and better facilities at stops/ stations, such as clean toilets. Women in the marginalized groups were found to be the captive riders of public buses, albeit inconvenient and time-consuming. Poor mobility because of these factors affects the employability, health, and career progression of women. The insights from the FGD resulted in recommendations classified as policies related to transport infrastructure, services, technology integration and behaviour changes to aid governing bodies for inclusive city transportation that provides safer and seamless commutes to all.

Keywords: Urban Transport, Women Inclusive Policy, Focus Group Discussions (FGD), Mobility-as-a-Service, Technology integration

T03

**Green Finance for New-Age
Sustainable Infrastructure**

24 Public-Private Partnership: A Study of Sustainable Hybrid Annuity Models in India

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Abstract: Road projects in an emerging economy like India are typically implemented using Build Operate Transfer (BOT)-Toll, Build Operate Transfer-Annuity, and Engineering, Procurement, and Construction (EPC) models. The objective of this paper is to investigate the viability of implementing Hybrid Annuity Models (HAM) in the Indian context. HAM are relatively new in India, but they are gaining popularity, particularly in areas with low traffic density. Sustainable HAM models would create new hopes in the area of PPP. The conventional HAM models are a mix of 40% EPC and 60% BOT Annuity. In HAM, the NHAI will bear 40% of the project costs during the advancement period, while the remaining 60% is paid in annuity parcels during the action period close by the premium. The revised Model Concession Agreement (MCA), now known as the Hybrid Annuity Model (HAM), is a welcome departure from all previous Public Private Partnership Build Operate Transfer (BOT) models (PPP). Due to the poor performance of highway construction projects awarded under the existing model concession agreement, the issue of stalled BOT projects has been a top priority for the new unity government since it took office in May 2014. In a very short period of time, the government developed new HAM to address the various concerns expressed by stakeholders. This model is essentially the future of construction in order to accelerate the pace at which projects are completed. Use of sustainable and eco-friendly material like fly ash during the construction of the highway project would make this project sustainable.

Keywords: Hybrid Annuity Model, Infrastructure projects, Public-private partnership, Sustainable

25 Deriving the Strategies for Sustainable Financing for Green Mobility Infrastructure in Indian Context

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Abstract: Green mobility refers to eco-friendly transportation systems that minimize environmental impact and promote sustainability. Despite its importance, green mobility has been largely overlooked in infrastructure planning. Today, the world is looking forward to creating and adopting sustainable modes of transportation systems. In this regard, many researchers, planning authorities, and leaders are promoting environment-friendly transport and reducing reliance on fossil fuels, which helps mitigate climate change, improve public health, and enhance the quality of life in cities. Achieving this requires collaboration among government policies, private sector innovations, and public participation. However, there is no concrete institutional setup for funding of such infrastructure in developing countries. Hence, there is a need to explore sustainable financing mechanisms for green mobility by identifying strategies that address existing gaps.

To derive the strategies for sustainable financing for non-motorized transport (NMT) infrastructure, the methodology involves several steps. Firstly, a comprehensive literature review was conducted to understand the current practices of conventional funding mechanisms. Also, investigated three Indian metropolitan cities as case studies—Chennai, Bengaluru, and Pune—to assess their financial interventions for green mobility projects. From which, it is understood that NMT infrastructure in Indian cities remains underdeveloped and underfunded. Also, identified were the critical gaps and funding constraints. This paper also discussed the traditional as well as innovative funding mechanisms. Further, based on the gaps identified, prepare a comprehensive questionnaire with 30 questions for various stakeholders to conduct a stated preference survey. Based on the response from the stakeholders, a qualitative analysis was performed to identify key elements to formulate financing strategies.

In conclusion, strategies for sustainable financing of green mobility in India have been outlined, including strengthening of policy reforms, capacity building, monitoring, and public awareness efforts. These strategies would help the planning authorities formulate a sustainable financing system.

Keywords: Green mobility, Economic sustainability, NMT infrastructure, Sustainable financing

26 Analysing the Regulatory Framework and Implications of Small and Medium Real Estate Investment Trusts (SM REITs) in India

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Abstract: This paper examines the regulatory provisions and potential market impact of the recently introduced Small and Medium Real Estate Investment Trusts (SM REITs) in India. The study focuses on the guidelines set by Securities and Exchange Board of India (SEBI) for SM REITs (SEBI). These guidelines cover areas such as eligibility criteria, investment conditions, operational requirements, and governance structures. To understand SM REITs in an Indian context, a comparison is drawn between existing mainline REITs in India and their international counterparts from the United States, United Kingdom, and Australia. The research highlights the key differences between the SM REIT and the regular REIT provisions, such as lower minimum asset size requirements for SM REITs and comparatively more stringent investment conditions, like the requirement to invest 95% of asset value in completed, income-generating projects. The paper outlines potential benefits of SM REITs, such as increased funding opportunities for small and medium-sized enterprises in the real estate industry. It also highlights the enhanced market liquidity that will be created by it. The study also points towards diversified investment options and democratization of real estate investment by bringing new investment avenues to investors from across the spectrum. This paper also investigates the challenges for newly launched SM REITs, such as regulatory hurdles, market acceptance and response towards SM REITs, risk of economic conditions, and issues due to operational complexities. Overall, the SM REITs are a significant step towards the financialization of the Indian economy. This initiative helps to bring much-needed transparency to the real estate sector in India by increasing the net and covering even smaller projects that were earlier left out of the REIT mechanism. The success of this new avenue depends on effectively addressing identified challenges and implementing supportive policies. The paper emphasizes the need for further research to monitor SM REIT performance over time in the dynamic investment market of India.

Keywords: Market impact, Policy analysis, Real estate investment, SM REITs

27 Examining the Dynamic Integration of India's Green Benchmark Indices: Global Peers or Traditional Crude

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Abstract: The present study makes an attempt to examine the nature and strength of linkages amongst the sustainable peers asset classes, viz. India's green indices and Dow Jones World Sustainability Index. The study would further explore whether there has been any shift in linkages from India's Green Indices away from traditional crude to US Sustainability Index. The study collects data for a ten-year period (April 1, 2014 to March 31, 2024) and the analysis has been performed at log prices. To understand dynamics of linkages amongst the variables, the study has employed three methodologies, viz. causality, co-integration and spillover. Whereas causality amongst the variables has been tested by applying Toda and Yamamoto (1995) modified 'F' approach, the choice of this model (TY) being based upon level of integration of included variables, which was ascertained using powerful Dickey Fuller Generalized Least Squares (DF GLS) technique. For co-integration, the study applies the two-step Engle-Granger (1987) procedure, while for spillover, the study has adopted methodology of residuals and squared residuals as given by Masson (1998) and again improved by Dungey and Martin (2007). Both co-integration and spillover results obtained from the study could not provide any evidence of green Indices of India being more integrated towards major sustainability indices rather than crude. Thus the relation between crude movement and sustainability stock indices of India appears to be intact, and the study could identify three reasons for the same: first, the green initiative of the economy, which although has made substantial progress, the progression rate, however, appears to be rather slow. Second, although causality from the US Sustainability Indices towards Indian Green Indices was visible from results, this alone could not be regarded as evidence of changing dynamics as causality being primarily a short-run phenomenon may not translate into long-run dynamics as revealed under the present study; and finally there is a major composition mismatch between the nature of stocks included in India's Green Indices and US Sustainability Indices.

Keywords: Causality, Co-integration, Spillover, Sustainability Index

T04

**Sustainable Cities and
Urban Infrastructure**

28 Integrating Green Building Practices for Eco-Urban Development

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Abstract: Buildings are one of the most important emitters of CO₂, causing climate change. The growing demand for energy in the building sector drives the need for change from fossil fuels to environment-friendly power sources, which can also moderate the effect of global warming. Studies indicate that worldwide buildings consume up to 40% of the total global energy and 36% of carbon dioxide emissions. By the year 2030, the consumption is expected to increase up to 50%. In India, the building sector consumes a total of 70% of the electricity generated in the country. More than 50% of energy is used in buildings for occupants' comfort, like cooling and lighting. Together with the finiteness of conventional energy and recent developments in sustainability have drawn attention towards the Net-Zero Energy Building and Green Building definition system being future buildings.

Green building, also referred to as sustainable or eco-friendly building, is a transformative approach that aims to enhance the efficiency of resource utilization while minimizing the environmental impact of buildings throughout their life cycle. As India undergoes rapid urbanization, the integration of green building practices into urban development is becoming increasingly essential to ensure sustainable cities. Green buildings in India focus on optimizing energy and water use, utilizing sustainable materials, and creating healthier environments for occupants. This abstract explores the principles, methodologies, findings, and implications of green building practices in the Indian context, highlighting their role in fostering sustainable urban development.

Keywords: Green buildings, Sustainable development, Resource efficiency, Urban resilience

29 The Silent Crisis: Understanding Shrinking Cities in Indian Context

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Abstract: A city's size getting reduced is a complicated process that changes many things, from its physical structure to its people and communities. While shrinkage is a complex and ongoing process of urban transformation with which a significant population loss, economic decline, underutilised infrastructure and increased vacant land are seen, it's a crisis that is mostly not foreseen due to the high focus on the growth aspect and lag in data recognition. This crisis is driven by fundamental shifts in the factors driving urban development. It often takes several years and decades for these patterns or signs to emerge; by then it would be too late to turn it back. The main objective of this paper is to identify the possible urban shrinkage in Indian cities. For this, a population data set and spatiotemporal analysis are done. In addition, nighttime light data is used to validate the results obtained from the above-mentioned analysis. These analyses enabled us to precisely determine and recognize the urban shrinkage in the selected cities. The results show the size of cities changes over time. The correlation between urban growth and shrinkage corresponds closely to the fluctuations in demographic trends and patterns of internal migration within the region. It is essential to identify shrinking cities and understand their spatial and temporal patterns to develop effective policies and apply creative approaches to manage this. These findings suggest better recommendations for a city that might fall under the shrinkage anytime soon.

Keywords: India, Shrinking city, Spatiotemporal analysis, Urban shrinkage

30 Urban Groundwater: An Underutilized Infrastructure of the City

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Abstract: Mumbai once utilized its springs and shallow wells as its principal source of water but has now gone abandonment. With rapid urbanization, the dependence on traditional water systems has reduced. As water has reached individual homes, the city started depending on municipal-supplied piped waters. Urban wells, after losing their importance due to changing lifestyles, increasing density, space crunch, etc., were buried by subsequent construction or covered intentionally for health and safety reasons, resulting in depletion of the groundwater table, contamination, rise in salinity, spring flow dying, etc., making groundwater unfit for habitable use in most of the cases. The study explores the interrelationship between the current state of urban wells and urbanization patterns in Mumbai, using a qualitative research approach combining interviews, case studies, and focus groups.

However, the shallow hydrogeological system still operates under the city's concrete jungle of roads, parking lots, parks, and buildings. This buried geology and hydrology should be considered in the city's development plan, building guidelines, and regulations. This research highlights the importance of integrating urban springs and groundwater networks into development regulations, building bylaws, and city planning. By recognizing the value of hidden water heritage, Mumbai can move towards self-sufficiency in water management. Thus, it lays the foundation for the new era of integrating land infrastructure in city planning as an alternative water source during emergencies and secondary purposes. This study advocates for the inclusion of buried geology and hydrology in the city's development plan, ensuring resilient water management systems.

Keywords: Ecosystem services, Groundwater, Urban well, Water resilience

31 Features of Age-Friendly Cities and Communities: A Comprehensive Analysis in the Indian Context

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Abstract: Urbanisation and population ageing combined represent two of the world's most significant trends influencing this century. According to the WHO, there will be 1.4 billion persons over the age of 60 in 2030 globally, with the vast majority of these individuals residing in low- and middle-income nations like India. Therefore, it is imperative to address the physical and social changes associated with population ageing. This study focuses on the concept of Age-Friendly Cities and Communities (AFCC) in the Indian context, aiming to determine the features of AFCC relevant in the Indian context, to promote active ageing and improve the quality of life of older adults.

This research adopts a two-phase methodology: firstly, an extensive literature review was done to determine the key domains and features of AFCC from global studies, followed by a primary survey done among Indian experts. The survey employed a 5-point Likert scale to collect the data, and later, to validate the features in the Indian context, confirmatory factor analysis was done. The findings revealed multiple domains and features that are essential in creating age-friendly environments in India.

The study highlights the importance of context-specific approaches, particularly in developing countries like India, for better-suited development of age-friendly environments, where urban infrastructure level differs from developed countries along with the rate of ageing. By providing the perception of Indian experts, this study provides macro-level insights into AFCC features broadly applicable to India and similar countries. Further, the study sets a stage for future studies that examine age-friendly environments at the micro-level with a more diverse context.

Keywords: Age-friendly cities and communities, Built environment, Elder population, Quality of life

32 Demand Side Factors Influencing Home-Ownership Patterns in Kolkata, India

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Abstract: Home ownership is a significant measure of financial security and social status, and it is crucial for policymakers and urban planners to possess a comprehensive knowledge of the factors that influence it. The objective of this study is to examine and assess the factors that impact the home-ownership pattern in Kolkata, India, particularly in relation to housing, households, and neighbourhood aspects. The present study used a mixed-methods approach, integrating both quantitative and qualitative data collection and analysis. This study involves the collection of both primary and secondary data. A stratified random sampling method is employed for the collection of primary data. Secondary housing data is gathered from a variety of real estate listing websites and government websites, such as Census 2011 and NHB Residex. Calculated for the wards of Kolkata, the housing affordability index (HAI) reveals that the majority of the wards exhibit significant to very severe unaffordability. House price is identified as the primary determinant among housing and household characteristics when selecting a residential area, followed by the number of bedrooms and household size. The most significant accessibility aspect is noticed to be the distance to work, followed by the distance to other amenities and facilities. Remarkably, the distance to healthcare emerges as the least significant determinant among all other aspects of accessibility. When considering neighbourhood characteristics, the width of the road is the crucial aspect. The availability of green spaces takes precedence over infrastructural facilities such as street lighting quality, occurrence of waterlogging, and solid waste disposal, as people attach greater importance to green and open places during and after the Covid-19 pandemic. Equally, there is a growing acknowledgement of the significance of environmental and infrastructural excellence. These findings can provide valuable guidance for the formulation of urban planning and housing policy in Kolkata.

Keywords: Demand side factors, Home ownership, Mixed method approach

33 Sustainability Through Urban Green Infrastructure – Regulation of Ecosystem Service Valuation and Urban Heating: A Case Study of Kolkata City

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Abstract: In the field of sustainable development in urban areas, the significance of urban green infrastructure is highly acknowledged, as it has the potential to reduce environmental issues and increase the standard of living. The Urban Green-Blue Infrastructure provides a major beneficial effect as it integrates natural vegetation with human-made elements. The rapid urbanization exerts enormous pressure on the land uses in urban areas, which in turn deteriorates the environment. The assessment changes in land cover and uses in Kolkata as well as the effect over urban cooling and ecosystem services is the current focus of the study. The LULC map will be prepared from landsat images of 1994, 2004 and 2024 with the application of the Maximum Likelihood Classifier in a supervised learning approach. The Users Accuracy, Producers Accuracy and Kappa Coefficient would be calculated to evaluate the precision of the land cover and use maps. The Urban Green Space Change Intensity Index and Urban Expansion Intensity (UEI) Index would be calculated to measure the urban green infrastructure pattern. This study will also incorporate the changes in Ecosystem Service Valuation and Normalized Difference Vegetation Index. On the other hand, to quantify the urban heating, Land Surface Temperature map will also be analyzed. This research will try to identify the relationship between the normalized difference vegetation index (NDVI) and land surface temperature (LST) data. A detailed analysis of the alteration of urban green infrastructure and associated challenges would be helpful for policymakers and urban planners in the decision-making of climate resilience and sustainable urban development.

Keywords: Ecosystem service value, Sustainability, Urban green infrastructure, Urban heat island

34 Quantifying Urban Heat Island Mitigation Potential of Urban Green Spaces: A Case Study of Bhopal City

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Abstract: Extreme heat events have become one of the significant climatic hazards in Indian cities for the past few years due to the Urban Heat Island (UHI) effect. The risk towards extreme heat hazards becomes more severe with consistently urbanizing populations and future climate change predictions. UHI impacts the well-being and efficiency of both the built infrastructure of the city and its residents. This makes UHI one of the major obstructions in developing sustainable and resilient urban forms. Nature-based solutions have been proposed to reduce the impacts of extreme heat events and increase the resiliency of the area towards such events. One of the major components of such solutions is the development of urban green spaces (UGS). UGS includes tree cover, parks, gardens, grasslands, urban forests, etc. UGS helps in limiting the thermal gains of built surfaces and reducing the surrounding temperature by creating a 'cooling effect'. This cooling effect varies with the landscape metrics of a UGA, surrounding morphology, and geological features of the city. The present study attempts to formulate a methodology for quantifying this variation in the cooling effect of UGS for the city of Bhopal. 89 UGS are identified for this study, showcasing variations in size, shape, vegetation, and location of UGS in urban areas. The cooling effect of each UGS is measured using land surface temperature derived from LANDSAT 8 imagery. 76% of the UGS showcased a cooling effect on their surroundings, while the rest of the UGS showed a park heating effect. The cooling effect is quantified in the form of maximum cooling distance (MCD) and cooling effect intensity (CEI). The mean MCD and CEI for studied UGS are 118 m and 10 C, respectively. The present study in this way presents a statistical measure for the UGS cooling effect and paves the way for effective UHI mitigation.

Keywords: Remote sensing, Urban green spaces, Urban heat island, Urban resilience

35 Town Planning Scheme Proposal Based on Predicted Spatial Growth of the City: A Case Study of Vadodara

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Abstract: Irregular and fragmented development has resulted in improper and irreversible land transformation and use, which results in many urban issues. The present study addresses the identification of spatial growth of Vadodara city, located in Gujarat state. Town planning scheme layers collected from VUDA and remotely sensed classified images were overlaid, and built-up area was calculated and compared. In comparison, it is found a mismatch between the actual spatial development and the TP scheme proposed. Also, large time gaps were observed between the dates proposed for the TP scheme and the dates approved for the TP scheme by the government.

In the end result, people are lacking in primary facilities such as water supply systems, storm water drainage, and wastewater collection systems where the TP scheme proposal and approval are delayed. To overcome this delay, a prediction of future urban growth is carried out by applying the Cellular Automata Markov Chain Model for the year 2024, which is derived from the land use to land cover classified remote sensing images of 2020. The predicted image is compared with the classified image of 2024, and an accuracy of 84.29% is achieved, which is very good; hence, the same method is applied to predict future growth of 2028 based on the input of classified remote sensing images of 2024.

Predicted data states that the future development will take place in Kumetha, Moralipura, Tatarpura, Bakrol, and Navi Jambuvai. This predicted Land Use Land cover image can be effectively used for the planning of primary facilities such as water supply systems, storm water drainage, and wastewater collection systems in advance and early management of other urban issues.

Keywords: Cellular Automata Markov Chain Model, Landuse Land Cover, Town planning schemes, Urban growth prediction

36 Is Dholera Smart City a Sustainable Urban Space?

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Abstract: The rapid pace of global urbanization, particularly in Africa and Asia, is expected to see urban populations in these regions reach 56% and 64%, respectively, by 2050. This growth brings numerous challenges, including overcrowding, rural migration, inadequate infrastructure, transportation issues, and security concerns. Studies highlight the complexity of urban problems, emphasizing the importance of understanding the various temporal, political, and social dynamics at play. As urban areas contribute over 60% of the global GDP, there is a critical need for municipalities to provide consistent, 24x7 civic services. In India, urbanization is expected to increase to 40% by 2030, contributing to 75% of the nation's GDP. This has prompted the Indian government to focus on developing smart cities to address urban challenges and improve the quality of life for its citizens. The Dholera Smart City in Gujarat, an ambitious project initiated by Prime Minister Narendra Modi, is an example of India's efforts to create sustainable, technologically advanced urban spaces. Such projects aim to mitigate urban problems and pave the way for efficient, future-ready cities.

Keywords: Dholera, Internet of Things, Smart Cities, Quality of Life, Sustainability

37 Comparative Analysis of Urban Civic Infrastructure Service Delivery: A Study of Two Indian Cities

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Abstract: Cities are important spaces wherein the economic activities concentrate due to the scale economies and the agglomeration advantages present in them. Urban local governments need to supply adequate civic infrastructure services so that the economic activities in cities flourish and cities continue to contribute to the economic development of the nation. Civic infrastructure service delivery is also essential for sustainable urban development. This paper reports the findings from a research study made to assess the status and performance of civic infrastructure service delivery in two large Indian cities – Hyderabad and Pune. The research study made use of the secondary data obtained from published documents and reports while focusing on six major/core civic infrastructure services rendered by these two cities. It used a comparative analytical framework in which the civic infrastructure service delivery status in the study cities is assessed on various service parameters and compared with reference to service delivery norms while also drawing a comparison with other service delivery benchmarks. The study finds that the civic infrastructure service delivery performance of both the study cities varies with references to respective service categories and parameters. Interestingly, the civic infrastructure service delivery performance of urban local government tends to be better than the corresponding public utility/parastatal, especially with reference to water supply and sewerage; there is a parity in the service delivery performance when it comes to other civic infrastructure services that are provided by urban local governments in both the study cities. The study also finds there is more scope for improvement on service quality.

Keywords: Civic service delivery, Service norms, Service parameters, Urban infrastructure

38 Green Building Price Premiums: Evidence from Ahmedabad, India

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Abstract: Green buildings are a derived imperative from the societal and business conscience for movement towards sustainable solutions. Unlike in many other sectors, real estate development does not have very strict compliance requirements towards the construction of green buildings. So far, incentive-based mechanisms have been used to encourage both the demand- and supply-side actors in the sector to move towards environmentally friendly practices. As a signaling mechanism, several certifications' programs are in place. The present paper attempts to measure the impact of such signaling on property prices in Ahmedabad. Using the sample of green-certified buildings in the city, the study finds a positive and significant price premium. We use the hedonic regression method for analysis. The results indicate that there is market traction for the idea of sustainability. Some of it can be attributed to the derived demand due to compliance requirements in other sectors, deriving high demand for green buildings for office spaces. Even in the case of residential properties, there is a positive price premium, indicating a growing awareness towards sustainability. We find a higher premium in cases of international standards, indicating more acceptability of those. Also, we find a positive price premium for the north and west zones in Ahmedabad. This result coincides with the property price data; these zones are seeing a high demand and rise in property prices. Transaction-level data is needed to take the study further to better understand the factors driving demand for green buildings. A policy push to green buildings, specifically in the case of redevelopment projects taken up on a procurement basis by the private sector, can increase the supply of green buildings and make the market more dynamic and competitive.

Keywords: Green buildings, Hedonic Model, Market demand, Price premium

39 Improving Livability as a Smart Solution for Cities and Urban Infrastructure

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Abstract: The current growth of cities needs smart solutions for urban development because of the rapid trend of uncontrolled and unplanned growth of urbanization. Smart solutions enhance the management of the urban environment by simultaneously capturing and analyzing the data captured with real-time monitoring for the efficient working of the city. The integration of smart solutions into urban infrastructure is a critical strategy for enhancing the livability of cities. Livability has a more localized approach and helps cities improve safety, health, environmental sustainability, and economic stability, thus creating a higher quality of life for residents. After all, livability makes a city desirable for citizens to live in. This study focuses on livability and its role in implementing smart solutions. There is a need to identify the aspects of livability that may be enhanced by the implementation of smart solutions. However, it is essential first to understand and define the various dimensions of livability, its impact on the city's evolution, and the research landscape on the subject. The present study uses bibliometric analysis to comprehensively evaluate the existing literature using Biblioshiny with the data retrieved from Scopus to identify and review the most influential literature. The bibliometric analysis helped in identifying the various dimensions of livability, research gap, future research themes, emerging trends, niche topics, and patterns of research development. It was observed that the implementation of smart solutions would have significant challenges, like high initial cost, data privacy, security, and even the dangers of data being misused while integrating them with various dimensions of livability. But the benefits of integrating smart solutions into urban infrastructure far outweigh the drawbacks. Smart solutions will help cities tackle the complex challenges faced as a result of urbanization, maintaining a livable, sustainable and resilient future growth of the city.

Keywords: Livability, Smart solution, Urban design, Urban infrastructure

40 Spatiotemporal Analysis of Urban Heat Island and Change in Land Use at Gautam Budh Nagar

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Abstract: Urban Heat Island (UHI) leads to higher temperatures in urban areas, which have several adverse effects on the environment, public health, and energy consumption. It is essential to address UHI to develop sustainable and livable urban environments. UHI is a variable phenomenon that varies across time and location, and its characteristics can vary based on several factors, such as local climate and weather conditions, wind patterns, vegetation and green spaces, urbanization and land use patterns, building density and height, surface materials, and anthropogenic heat dissipation. To mitigate the UHI effect, it is necessary to study the spatio-temporal properties of a specific location. This can help identify relevant strategies that would be needed to address the rising UHI effect. In this paper, we study the spatiotemporal pattern of UHI for the city of Gautam Budh Nagar. It is one of the fastest-growing cities in terms of population size, economy, and increasing built-up spaces within the National Capital Region of India. For this purpose, we have used land surface temperature (LST) estimates using LANDSAT images at 100 m spatial resolution. In this paper we have studied the area from 2001 to 2022 at each interval of five years. We have done data analysis on LANDSAT data and change in spatio-temporal variation pattern. The study shows that the LST is positively correlated with built-up index and negatively correlated with vegetation index. We have compared and done analysis with the respective year landuse pattern and urban geometrical morphology. We have found deviation in outcome correlation in some areas due to heterogeneous urban development attributes.

Keywords: Research publication, Spatio-temporal variation of LST, Urban heat island, Urban morphology

41 Comparative Study of Carbon Emission for Different Aging Residential Buildings Using Household Survey and eQUEST Energy Simulation Software

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Abstract: The two most important issues worldwide are energy security and environmental concerns due to urbanization and technological development. The residential sector is a leading contributor to emitting greenhouse gases. Buildings, construction materials, and components in their life cycle stages absorb global energy of forty percent annually, such as production, construction, and procurement of building materials, construction, use, and demolition. The objective of the study was to compare total carbon emissions from existing different aging residential buildings using household surveys and eQuest energy simulation software in the west zone of Surat city. Various sources of energy consumption like HVAC zoning, building components and their dimensions (doors, windows, ventilators, wall thickness), material type used (for building components), heights (floor to floor and floor to ceiling), occupancy duration details, electricity and fuel rates, and water storing capacities for the building Total energy consumption data was converted into carbon emissions using IPCC carbon emission guidelines. It was observed that older buildings emitted 10–20% more carbon emissions compared to younger buildings. Thirty-year-, twenty-year-, and ten-year-old buildings contributed 41.2602%, 32.1639%, and 26.5759% of carbon emissions, respectively, using eQuest software. And from the household survey, energy consumption for thirty-year-old, twenty-year-old, and ten-year-old buildings contributed 36.2437%, 32.8114% and 30.9449% of carbon emissions, respectively.

Keywords: Building Energy Consumption, Carbon emission, eQuest, IPCC carbon emission guidelines

42 Villages and Urban Villages as Sustainable Infrastructure

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Abstract: Urban villages (UVs) are sustainable infrastructure at the foundation of modern cities. They are essential to development functioning and house the contrast of urban and rural areas. Within the city, they are interdependent with the city and maintain contact with rural villages. Because of their presence, the city knows networks that run deep into the cultural hinterlands of the countryside, enabling the rooting of traditional functions within the developed city region. UVs house handicrafts, art communities, indigenous dwelling types, mixed-use development, city worker force, non-motorized transportation, craft-based economies, circular economies, local dialects, livestock, etc. It is crucial to comprehend and consider a process that allows urban dwellers to absorb rustic sensitivities. The slowness of village-based life addresses the sustainable development goals and brings in a circular economy. Much of the pre-modern world that is present in UVs contributes to reducing the harm brought about by modern living and reducing climate change. Using GIS, with a backdrop of several international policies written by the author and the urban transformation in the union budget 2024-25, this research establishes the recurrence of UVs in the city geography of historic cities of Delhi and Lucknow and modern cities of Amravati and Chandigarh. It proves their consistent presence as a sustainable infrastructure grid for urban transformation. Their presence suggests a pre-modern agro-urban grid below the city, which this research calls the Agrorobanization grid. This grid, with the non-motorized transport (NMT) culture inside the UVs, can act as a starting point to connect the city's NMT with sustainable infrastructure and walkability. A focus on UVs can lead the way to sustainability.

Keywords: Inclusivity, Sustainable infrastructure, Urban transformation, Urban villages

43 Design of Smart Things for Rural and Urban Sustainable Digital Infrastructure Development in India

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Abstract: Smart things are appearing in everyday life. For example, smart phones and smart watches. They ease the task of the user in several ways. In a similar line, the design of smart things for rural and urban areas can contribute to sustainable development for society.

The term smart can be defined in this context as one that uses digital systems, information and communication technology, and automation. Such smart things can be smart water conservation and management systems, smart traffic lights, smart street lights, smart bus stops, smart railway system, smart tilt detection of poles, trees, and buildings, smart drainage management system, smart grid, smart post office, smart school, smart farming, and many more. These designs significantly affect the lives of the people and are required for sustainable development. The design of smart things requires systematic and organised efforts for deployment of the things in rural and urban areas, which requires support from local administration. The digital infrastructure thus set up would make the development sustainable and secure.

Keywords: Digital infrastructure, Rural and urban, Smart things, Sustainable development

44 Impact Fee as a Second Order Regulation: The Case of Unauthorized Properties in Ahmedabad

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Abstract: Compliance with Development Control Regulations (DCRs that serve as essential regulatory frameworks aimed at managing land use and building construction in urban areas) often incurs significant costs, leading to a conjecture that such financial burdens incentivize real estate developers to evade regulations, thereby fostering a market for unauthorized properties. The financial implications of adhering to DCRs were substantial, resulting in evasion. This situation creates an environment where unauthorized developments can proliferate without significant risk of penalties. To address the challenges posed by unauthorized properties, cities like Ahmedabad have begun implementing second-order regulatory instruments as a pigouvian tax. One such instrument is the impact fee, which aims to alleviate some of the financial burdens associated with compliance while also generating revenue for urban infrastructure improvements. We conjecture that the additional costs of compliance to DCRs act as an incentive to evade for real estate developers, and the interplay between compliance costs, weak enforcement, and unauthorised property markets presents significant challenges for urban governance. We discuss the case of Ahmedabad, which explores innovative regulatory instruments such as impact fees; they aim not only to enhance compliance but also to ensure sustainable urban development that meets the needs of their growing populations. On the contrary, addressing these issues requires a comprehensive approach that balances regulatory rigour with practical incentives for developers.

Keywords: Development control regulation, Externalities, Impact fee, Second order regulation

45 Enabling Better Management of Public Expenditure Through Digital Infrastructures in Odisha

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Abstract: The paper aimed at analyzing the role of different digital public financial management systems in mapping the fund flow processes of different types of government schemes. It argues that the ability to track expenditures of government schemes till the last mile strengthens the public financial management practices of the local governments; it also brings in accountability and transparency in public spending. By taking Odisha as a case study, three major digital reforms in the public finance space—PFMS, IFMS, and SBMS—have been discussed. A combination of field visits to different ULBs, in-depth interviews with state officials from multiple departments of Odisha, and secondary data collection helped in arriving at these findings. We looked closer at the PFMS- and the IFMS-generated reports with respect to three types of schemes: centrally sponsored schemes, Central Finance Commission grants, and state schemes, and showed that these digital systems have enabled better tracking of crucial public finance management parameters like agency-wise expenditures, unspent balances, real-time bank balances, and data on the release of funds to implementing agencies, among others. While acknowledging that tracking has been made more effective, reconciliation exercises with selected implementing agencies have shown that discrepancies in actual expenditures being incurred by them versus reported expenditures in the PFMS/IFMS portals still exist. The paper has called out the gaps in each of these digital PFM architectures and highlighted the implications of such gaps in the tracking process. To our understanding, this is the first paper that brings a direct account of the administrators and provides a narrative on the challenges they are facing in navigating through these digital systems. The paper hopes to generate more dialogues and discussions in academia and among industry experts on matters related to effective management of public finance in the country.

Keywords: Digital PFM architecture, Fund flows, Public financial management, Urban local bodies

T05

**Realigning Workforce Diversity,
Equity and Inclusion**

46 Interwoven Realities: A Holistic Inquiry into Pithampur Industrial Town's Socio-Economic Landscape

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Abstract: The pivotal role of industries in driving economic growth is well-recognised, often leading to strategic development in economically disadvantaged regions to uplift local economies. This research focuses on the case of Pithampur, an industrial town in Madhya Pradesh consciously developed by the government through a growth centre approach. It explores various factors influencing the economic growth of an emerging industrial town, including the proximity of a large city, the inflow of migrant workers, industrial policies related to contractual labour and local engagement, and the interface between industrial agencies and government bodies. Employing a comprehensive methodology encompassing secondary data analysis and primary surveys among workers and residents, the research unravels the intricate dynamics of planned industrial towns. Despite significant industrial growth, Pithampur grapples with challenges in establishing a resilient and thriving economic neighbourhood. The study illuminates the complex interplay of factors shaping Pithampur's socio-economic landscape, notably the preference for migrant workers over locals within industry practices, leading to palpable discontent and social divisions. Furthermore, while the initial reliance on services from neighbouring Indore facilitated industrial growth, it now impedes Pithampur's independent socio-economic development, underscoring the necessity for further research to validate these findings. The study highlights the pressing need for urban regeneration initiatives in Pithampur, emphasising the importance of addressing socioeconomic disparities and fostering inclusive development. These insights are crucial for policymakers, urban planners, and stakeholders aiming to align industrial growth with the well-being of local populations. By implementing holistic approaches prioritising infrastructure development, job creation, affordable housing, and social amenities, Pithampur can pave the way for a more resilient, inclusive, and prosperous future.

Keywords: Backward regions, Industrial towns, Migrant workers, Socio-economic profile

47 Impact Assessment of Indian Health Insurance Business Transition During COVID-19 Era

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Abstract: This study aims to assess the financial performance of Indian health insurance companies, focusing on the period before and after the COVID-19 pandemic. Utilising data from the IRDAI Handbook, IRDAI annual reports, and the annual reports of individual companies, this study spans a duration of six years, ranging from 2017–2018 to 2022–2023. The study employs descriptive statistics and paired sample t-tests to scrutinise a range of financial metrics, including the Net Premium Ratio, Net Claims Ratio, Expense Ratio, Commission Ratio, Loss Ratio, Combined Ratio, Incurred Claims Ratio, Solvency Ratio, Net Retention Ratio, Gross Direct Premium Growth Rate, and Underwriting Balance Ratio. Through a comparative analysis of these indicators, the study aims to furnish a comprehensive insight into the financial well-being and operational efficiency of health insurance entities in the Indian context. The findings of the analysis demonstrate notable differences in financial performance metrics pre- and post-commencement of the pandemic. Data from the pre-COVID-19 era reveals higher variability and skewness in key ratios, reflecting diverse management strategies and operational challenges among companies. Post-COVID-19 data illustrates a more consistent financial performance, with improvements in expense and combined ratios indicative of enhanced cost control measures and operational effectiveness. These findings present valuable implications for various stakeholders, encompassing policymakers, investors, government, and industry experts, fostering opportunities to elevate the strategic and operational prowess of the health insurance domain within India.

Keywords: Covid-19, Health Insurance Companies, Paired Sample T-Test, Performance

48 Impact of Digital Transformation on Globalization of Small and Medium Enterprises in Oman

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Abstract: Oman is in the midst of a sweeping digital transformation, and SMEs, vital to the country's economy, stand at the forefront of this transition. This study assesses the current digitalization status of Omani SMEs, the drivers behind their digital transformation, the challenges they face, and the opportunities they can leverage. SMEs have historically been significant contributors to Oman's economic landscape, driving employment and GDP growth. This research paper examines the profound impact of digital transformation on small and medium enterprises (SMEs) in Oman and its implications for their global competitiveness.

With an understanding of the global digital transformation landscape, the research begins with an analysis of Omani SMEs' digital readiness, encompassing their adoption of digital technologies and online presence. Findings reveal a growing interest in digital tools, although adoption varies among sectors and regions.

Key drivers fueling the digital transformation of Omani SMEs are examined. Government initiatives, market dynamics, and technological advancements converge to steer SMEs toward digitalization. The "Digital Oman Strategy" is a notable example of government-led programs fostering a conducive ecosystem for digital innovation and investment. A central theme explored is how digital transformation impacts SMEs' daily operations. Digital channels open new avenues for SMEs to engage with customers, offering personalized experiences. This aligns with dynamic capabilities, emphasizing the importance of adapting to shifting customer preferences and market dynamics. Digital tools enhance operational efficiency and productivity, aligning with dynamic capabilities, where firms adapt and reconfigure resources in response to changing environments. For Omani SMEs, digitalization equips them with dynamic capabilities to thrive in a rapidly changing business landscape. Digital transformation also fosters innovation and competitiveness. Digital technologies expedite the development of innovative products, services, and business models. The rise of platform-based businesses and e-commerce ventures exemplifies the transformative potential of digitalization, underpinned by dynamic capabilities enabling rapid adaptation. Omani SMEs are navigating the complexities of globalization as digital transformation breaks geographical barriers.

Keywords: Digital transformation, Globalization, Infrastructure, SMEs

49 Green Office Buildings and Employee Outcomes: A Literature Review

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Abstract: The modern workplace is evolving with an increased focus on employee wellbeing and environmental sustainability. Green office buildings, designed to reduce environmental impact while enhancing occupant health and comfort, have emerged as pivotal in advancing these goals. These buildings integrate sustainable practices such as energy-efficient systems, environmentally friendly materials, and advanced indoor air quality (IAQ) management. Certification programs like BREEAM, LEED, and IGBC set standards ensuring that these structures not only meet environmental benchmarks but also prioritize occupant health. This review examines the impact of green office buildings on employee outcomes, with a focus on IAQ, lighting, thermal comfort, noise control, and biophilic design. The literature reveals that improved IAQ in green buildings significantly reduces health issues and boosts cognitive function, productivity, and overall job satisfaction. Natural lighting, a hallmark of green design, enhances mood, sleep quality, and productivity. Thermal comfort, achieved through advanced HVAC systems, minimizes distractions and improves focus. Acoustic comfort and biophilic design further contribute to reduced stress, enhanced creativity, and increased job satisfaction. Studies consistently show that green buildings foster a healthier work environment and support higher productivity levels compared to traditional office spaces. This review underscores the multifaceted benefits of green office buildings, advocating for continued investment in sustainable building practices to improve both environmental and employee outcomes. Future research should further explore these relationships to optimize green building design and functionality for better work environments.

Keywords: Comfort, Green building/office, Satisfaction, Well-being

50 Free Electricity Programme and Farmer's Attitude: A Study from Telangana State of India

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Abstract: The preconceived notions on Indian farmers' attitudes towards the habituated production input subsidies are revisited. The 24-hour free electricity program in Telangana state of southern India is analysed from the perspective of farmers at the receiving end. The study is based on a field survey conducted in the Nalgonda district of the state after the completion of three years of the program. The primary survey result shows that farmers are driven by the promises of the government of free electricity supply and replacing their automatic motor pumps with manual motor pumps. The farmers' attitude and consumption behaviour toward free electricity endorses the success of government awareness drives and the possible sustainability of the program in the state in which they are satisfied. Even after three years of the program, the prevalence of motor pumps with the power of 5 HP and usage for 6 hours or less inscribes the sensibility of farmers in Telangana state. The willingness to accept usage-based tariffs and concern for electricity conservation in the absence of any incentive indicates a drastic change in the attitude of Indian farmers towards freebies.

Keywords: Freebies, Indian farmers, Subsidies, Telangana

51 Access to Safe Sanitation Facilities by Disabled People in Kolkata Sub-Urban Areas

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Abstract: Life with dignity for every citizen cannot be fully realized without addressing the issue of sanitation and hygiene. Persons with disabilities face major challenges in resolving accessibility issues in basic sanitation facilities due to socio-economic, physical, cultural, and attitudinal factors. The government of India has been dealing with the issue by raising the budget for sanitation by 135% in the past decade (Gol, 2019), but there is not much visible change happening in the provision of accessibility of safe sanitation and hygiene facilities among persons with disabilities, who are the 2.21% of the total population in the country (Gol, 2011). A qualitative study has been conducted among locomotors and visually challenged respondents between the age group of 11–59 years and has revealed challenges to access and afford safe sanitation facilities at home, in public places, and also at work. Since disabled-friendly sanitation facilities are not available, they accept and try to cope with common sanitation facilities. While they compromise the common facility, they experience unhygiene and sometimes meet with accidents. The family members are aware of the challenges experienced by disabled members but are unable to spend an extra budget to change the facility. Access to sanitation becomes more challenging due to the unavailability and inaccessibility of water. In many cases, they are forced to have open defecation. The challenges become more complicated while travelling because of the lack of sanitation facilities. The accessibility to sanitation facilities also varies with age and gender depending on the nature of required help from family members. Public safe sanitation has been a priority in public health to accommodate the growth of a city, city infrastructure, and city life, but the special needs of safe sanitation are overlooked in the policy.

Keywords: Disability, Disabled-friendly sanitation, Sanitation, Urban

T06

Sustainability and CSR

52 ESG and the Carbon Market Maze: Solutions and Opportunities in the Face of Climate Change and Sustainability Actions

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Abstract: In the face of rising climate change and global consensus on sustainable development and sustainable actions, this research looks at some particular practical aspects of sustainability reporting. The Environment, Social, and Governance Indicators (ESG) reports have become a mandatory annual filing, and there are several different frameworks and guidelines for filing the same. Our current research looks at the filings of the top 50 companies listed on the NSE and BSE through a descending order market capitalisation order, and a qualitative analysis of the filings is done. The results show the dearth of data available even among big companies while filing ESG disclosures and the need for more robust data collection and upskilling and expansion, as well as integrating pro-sustainability action with the nascent carbon market. This will incentivize sustainable actions as well as bring in much-needed climate finance in India.

Keywords: Carbon market, Carbon credit, ESG, Sustainability

53 Achieving Net Zero: Comprehensive Strategies and Implications for a Sustainable Future

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Abstract: The concept of net zero is being recognized as an urgent goal in the global effort to counter climate change. Achieving net zero emissions is crucial for a sustainable future, considering the earth's environmental challenges. The goal is to achieve a scenario where greenhouse gas emissions are offset by a reduction in greenhouse gases (GHGs), which ultimately will result in no net increase in their concentrations. This study aims to provide a comprehensive and detailed understanding of the concept of net zero. The analysis will examine various net zero initiatives, each focusing on distinct aspects of resource utilization and environmental impact. The categories mentioned include net zero energy, net zero carbon, net zero waste, and net zero water. Each type has unique strategies and consequences for minimizing environmental impacts. The article will highlight the advantages of pursuing net zero goals and analyze various categories of these goals. The benefits of sustainable practices extend to the environment, economy, and society, including reduced carbon emissions, financial savings, job creation, and improved public health. The study proposes strategies to achieve net zero, including legislative aid, research funding, public awareness campaigns, and industry collaboration, despite high initial costs and regulatory hurdles. This study examines India's net zero efforts and the global path towards it, emphasizing the need for a comprehensive strategy involving technical innovation, policies, public involvement, and international collaboration.

Keywords: Net zero carbon, Net zero energy, Net zero waste, Net zero water

54 Green Factory (Sustainable Organization) and Life Cycle Assessment

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Abstract: Green Factory or sustainable organisation reflect the balance of economic, social, and environmental responsibility. They exist as business entities but are a part of a system that relies on a healthy dynamic of man-made and natural elements. At their most basic level, businesses take inputs, process them, add value, and generate outputs. That gives us the real picture of a sustainable organisation or green factory.

Qualities of a Green Factory or sustainable organization are as follows: Uses the waste of other processes and minimizes or eliminates the use of materials extracted from the earth; creates output that can be used by other processes or returned to a natural state, and eliminates waste that can't be used or returned to a natural state; uses the least amount of energy to achieve the desired outcome, and uses energy ultimately derived from renewable resources.

Advantages of Green Factory or sustainable organization: Green Factory emphasis on: Reducing the use of hazardous chemicals; reduction in carbon footprints; reduction in air acidification or decreasing pollution at its source and water eutrophication.

Design for the environment helps to reduce pollution and human environmental issues. It recognizes consumer and industrial institutional products believed to be safer for human health and the environment. One more application for design for environment with respect to industrial products and processes should be designed to the highest level of hierarchy and helps to be cost-competitive in the market. It helps in reducing the following applications: Source reduction/prevention of environmental hazards; reuse or recycle; treat wastewater to render it less hazardous and reuse; dispose of plastic products, e-waste, chemicals, etc.

Sustainability represents a balanced interaction between the built and natural worlds. This interaction is often expressed in three components: environment, social equity, and economy. The relationship between each of these elements shown in the diagram, with sustainability at the intersection, or as concentric circles, reflecting a layering of domains, second case reflects the more realistic perspective that a healthy economy depends on a healthy society, both of which rely on a healthy environment. Sustainability occurs when all three are present.

Keywords: Green factory, environment, Sustainable organization, Innovation

55 Automated Detection of Greenwashing in Indian Corporate Sustainability Reports Using Natural Language Processing

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Abstract: Greenwashing, the practice of making misleading or false claims about the environmental benefits of a company's products or practices, has become increasingly prevalent as companies seek to capitalize on growing consumer interest in sustainability. This paper presents a novel approach for automatically detecting instances of greenwashing in Indian corporate sustainability reports using natural language processing (NLP) and machine learning techniques.

A dataset of sustainability reports from Indian companies across industries was collected and analyzed. Expert human raters manually labelled a subset of the reports for greenwashing at the sentence level. This data was used to train a greenwashing detection model using bidirectional encoder representations from transformers (BERT). The trained model was then applied to automatically detect and quantify greenwashing in the full dataset of reports.

Results show the model achieved strong performance, with a 92% accuracy in detecting greenwashing sentences compared to the human-labelled sentences. Applying the model to the full corpus revealed that 24% of companies had significant levels of greenwashing in their reports, with the consumer goods and energy sectors exhibiting the highest rates. The types of greenwashing claims detected ranged from vague and unsubstantiated environmental promises to selective disclosure that omitted key negative information.

This work provides an automated and scalable method for regulators, investors, and consumers to assess the level of greenwashing in corporate communications. It has the potential to facilitate greater accountability and transparency in corporate sustainability practices in India and globally.

Keywords: ESG disclosure, Greenwashing detection, Natural language processing, Sustainability reporting

T07

Sustainable Construction

56 Experimental Assessment of Bio-Based Binders for 3D Printable Soil Composites

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Abstract: The application of bio-based composites in 3D printing for sustainable building is examined in this research. A thorough study was conducted to create composites reinforced with jute fiber utilizing various combinations. The study investigated different weight percentages of coir/jute fibers (2, 4, 6, and 8 wt%) and natural lime (3, 6, 9, and 12 wt%). Additionally, the water content—a crucial component of printability—was carefully altered between 20% and 50% based on the dry weight of the soil. The amount of natural gum content was varied (10%, 16%, 20%, and 25%) to assess its impact. The goal was to strike the ideal balance between increasing the material's printability and mechanical strength. A common compression testing apparatus was used to assess the composites' printability and compressive strength. The findings demonstrated a direct correlation between the rise in natural gum and lime content and compressive strength. 2.01 kN/mm² was the highest compressive strength ever measured, and it was attained using a particular material mixture and water content that were determined to be optimal for extrusion-based 3D printing. These results demonstrate the bio-composites' great potential for 3D printing and provide new avenues for environmentally friendly, sustainable, and low-impact building. The development of environment-friendly printable materials for 3D printing in the building industry is greatly advanced by this study.

Keywords: 3D printing, Bio-based composites, Jute fiber composites, Sustainable construction

57 Comparative Study of Compressive Strength and Permeability of Pervious Concrete

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Abstract: Pervious concrete provides an innovative solution to the problems and issues that arise from the increasing impervious stratum. This has led to a decline in infiltration of water into the ground, leading to issues of water logging and flash floods. Pervious concrete is a special type of concrete designed in such a way to contain a porous structure, thus allowing water from precipitation to pass through the pores and thus increasing the water table, thus resulting in a reduction of storm water runoff. The compressive strength of the pervious concrete is hindered due to the porous structure, which is essential for the permeability. The research aimed at modifying the mix design with silica fume and Styrene Butadiene Rubber, aiming to improve the mechanical strength of pervious concrete in proportions of 2%, 5%, and 10% and 5% and 10%, respectively, of cement in addition to cement. The addition of 5% of silica fume in the concrete produced optimum results when the mechanical properties and permeability were considered simultaneously. The flexural properties of the concrete were tested with beams reinforced with geogrid and FRP bars. The beams containing 5% silica fume in addition to cement and FRP bar reinforcement had the highest flexural strength. The beams with 5% of silica fume in addition to cement and FRP bar reinforcement produced the optimum results in terms of flexural strength. The concrete modified with 5% of silica fume in addition to cement showed an improvement of 28% in terms of compressive strength at 28 days, while the flexural strength increased by 4.6 times on using the same mix with FRP reinforcement. The result of the optimised mix with 5% SF was the best, as the mix provided optimum strength and permeability and can be recommended for use in pavement construction.

Keywords: Compressive strength, Permeability, Silica fume, Styrene butadiene rubber

58 Integration of GIS and BIM for Thermal Comfort Through Passive Design Strategies in a School Building: A Case Study

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Abstract: This study looks at the integration of Geographic Information System (GIS) and Building Information Modeling (BIM) for enhancing thermal comfort of existing school buildings in the composite climate region of Himachal Pradesh, India, through passive design strategies. A field study survey was performed, and based on the students' thermal perceptions, acceptability, preferences, feeling of humidity, sweating-shivering, and visual comfort, the study calculated the percentage level of comfort they experienced. GIS provides help in analyzing the spatial data and environmental information for understanding the impacts of the surroundings on the school building. BIM was used to make a 3D model of the existing school building and surrounding building blocks shapes and materials for simulating passive design strategies. Regression analysis was conducted to compare the simulated and real-time values in order to further simulate the passive design strategies ($R^2 = 0.8607$) based on real-time results. The results showed that in comparison to the base case condition, the minimum average daylighting lux value with passive design strategies increased by up to 357.294 percent. Additionally, building indoor temperatures decreased by up to 2.0°C in summer, while humidity levels increased by 7 percent from mid-November to mid-March (in the cold and dry seasons) and April to June (in the hot and dry seasons). In addition to this, these passive strategies save lighting load by up to 6.63 percent and cooling load by up to 14.84 percent annually. These passive strategies could give up to 15.58 percent more comfortable hours in the existing school building based on the ASHRAE-55 method.

Keywords: Energy efficiency, GIS, Passive design, Thermal Comfort

59 An Experimental Investigation on the Physico-Mechanical and Durability Properties of Cement-Stabilized Rammed Earth Blocks Incorporating Agro-Industrial Wastes

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Abstract: Fired Clay Bricks (FCBs) and Concrete Blocks (CBs) are majorly used masonry units for housing construction. Brick consumption is expected to expand at an exceptional rate since over half of India's projected building stock for 2030 is yet unbuilt. The production of FCBs and CBs is associated with high energy consumption and CO₂ emissions, whereas earth construction is notably more cost-effective and eco-friendly. However, earthen buildings exhibit certain limitations, including inadequate dimensional stability, a reduction in strength when exposed to moisture, and susceptibility to erosion caused by wind and rain. Lime and cement serve as common chemical stabilizers for earthen construction, but their extensive use is prohibited due to environmental concerns. Groundnut Shell Ash (GSA) is a very promising agro-industrial discard material that has the potential to be used as a replacement to cement in the production of Cement Stabilized Rammed Earth Blocks (CSREBs). This research study involves an experimental probe of the physico-mechanical and durability characteristics (such as particle size distribution of soil and GSA, Atterberg Limits of soil, density, water absorption, compressive strength, splitting tensile strength, and durability) of CSREB when GSA is used as a replacement for cement. Rammed earth blocks measuring (100 x 100 x 100) mm³ were manufactured using a steel rammer and a steel mold. This was done to identify and validate the equipment and methods suitable for constructing rammed earth structures. The developed CSRE blocks will be compared with the design criteria outlined in various standards. Since the current study's objective is to determine whether it is feasible to use GSA in lieu of cement in CSREB, it is advised to use four different GSA replacements, equal to 0, 10, 20, and 30% by wt. of cement, and cement content in the proportions of 0, 6, 8, and 10% of dry soil weight.

Keywords: Agricultural waste stabilization, GSA, Mechanical properties, Rammed earth

60 Advancing Refugee Shelters in India: A Comparative Study of 3D-Printed and Traditional Construction

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Abstract: The increasing demand for sustainable and disaster-resilient refugee shelters in India underscores the need for innovative housing solutions. This paper explores the potential of 3D-printed shelters as an alternative to traditional construction methods where focus on the technical, commercial, and environmental advantages has been taken into account. Through a literature review, the study evaluates the performance metrics, construction speed, seismic resilience, thermal insulation, and material longevity. Findings reveal that 3D-printed shelters can be constructed in just 1–2 days and offer a lifespan exceeding 50 years and provide superior insulation, which makes them particularly suitable for India’s diverse climatic zones. The integration of Building Information Modelling (BIM) enhances design efficiency and material optimization which is able to reduce construction waste up to 60%. Cost analysis shows that while initial setup expenses for 3D printers are high, the long-term affordability of these shelters—₹1.5–2.5 lakhs per unit compared to ₹3.5–4.5 lakhs for traditional shelters—offers a compelling case for adoption. Environmental benefits include a 50% reduction in carbon emissions, and the use of recyclable materials such as fly ash aligns with India’s sustainability goals. This paper advocates for pilot projects to evaluate the scalability and cultural adaptability of 3D-printed shelters in high-demand regions. By focusing on states with urgent refugee needs and leveraging India’s growing expertise in construction technologies, policymakers and humanitarian organizations can drive a paradigm shift in refugee housing. The integration of BIM and advanced material science holds promise for creating resilient, cost-effective and sustainable shelters that are able to meet India’s unique sociological and environmental challenges.

In conclusion, the research underscores the transformative potential of 3D-printed shelters to address India’s refugee crisis. Despite initial challenges in adoption, the long-term benefits in cost savings, disaster resilience, environmental sustainability and rapid deployment are huge as compared to traditional construction techniques. This study offers actionable insights for stakeholders aiming to enhance refugee housing and advocates for a strategic roadmap to implement these technologies in India’s humanitarian landscape.

Keywords: 3D printing, Construction technology, Refugee shelters, Sustainable housing