Title: Building the Future: How Sustainable Infrastructure Will Power India's Net Zero 2070 Vision

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1. India's Commitment to Net Zero by 2070: A Developmental Imperative

At COP26 in Glasgow, India made a historic pledge to achieve **Net Zero carbon emissions by 2070**. As the fastest-growing large economy, India's sustainable growth trajectory will significantly influence global climate outcomes. Infrastructure is Central to this trajectory — the very foundation of economic development and a substantial contributor to emissions.

Today, infrastructure development (transport, construction, buildings, and energy-related works) contributes nearly **30% of India's total CO_2 emissions**. With the rollout of massive programs such as **PM Gati Shakti**, **National Infrastructure Pipeline**, and **Smart Cities Mission**, this share will increase unless sustainability is built into every brick, binder, and byte.

2. The Infrastructure Boom Ahead – and Its Carbon Risk

India plans to invest over **$1.4 trillion** in infrastructure in the coming decade. This includes:

- 50,000+ km of expressways and highways
- 100+ smart cities with green mobility systems
- Modern ports, airports, and rail systems
- Integrated agri-logistics and rural roads
- EV and green fuel-ready transport corridors

Without intervention, this growth could push infra-related emissions to **over 4 $GtCO_2$ per year by 2040**. But it also presents a unique opportunity: to embed sustainability at scale before irreversible damage is done.

3. Sustainable Design: Embedding Efficiency from the Start

Sustainability must begin at the design stage:

- **Life Cycle Cost Analysis (LCCA)** should be a standard component of all Detailed Project Reports (DPRs).
- Adoption of **climate-resilient road geometry**, **permeable pavements**, and **bio-swales** to manage water and heat stress.
- Urban road designs must integrate **multi-modal corridors** to minimize private vehicle use and emissions.
- Green infrastructure codes under IRC and BIS are being revised, and these need universal enforcement.

4. Materials Innovation: The Green Foundations of Infrastructure

New-age materials are drastically cutting embedded emissions:

Material	Benefit	Adoption
Bio-bitumen	Made from rice straw and sugarcane; carbon neutral	Pilot Projects
Plastic Waste in Roads	Diverts 8T plastic/km, enhances road life	>1,00,000 km built
Warm Mix Asphalt	30–40% lower energy vs hot mix	Expanding Rapidly
Geocells & Geotextiles	40% less aggregate needed; supports load redistribution	In PMGSY/NHAI
Fly Ash & GGBS in RCC	Reduces cement use, lowers emissions by 25%	CPWD standard

Indian Roads Congress (IRC) works closely with NHAI and MoRTH to update specifications and promote these materials.

5. AI & Digital Twins: Smart Infra for a Low-Carbon Future

Technology is revolutionizing infrastructure sustainability:

- **AI-based traffic simulations** help optimize highway alignments and reduce unnecessary cut-and-fill operations.
- **Digital twins** allow real-time tracking of embodied carbon across a project's lifecycle.
- India's **NHAI Data Lake**, initiated under my leadership, provides a blueprint for AI-led infrastructure governance.
- **ANPR systems** and **satellite tolling** are minimizing fuel wastage from traffic congestion.

Globally, AI-enabled traffic systems have reduced urban emissions by **20–30%** — India's ongoing pilots can mirror this success.

6. Construction Machinery: The Overlooked Carbon Source

Construction equipment contributes up to **10% of total infra-sector emissions**. Solutions include:

- Shift to **electric or hybrid construction equipment**
- Use of **biofuels and ethanol blends** in machinery
- **Fuel-monitoring systems** and **geo-fencing** for idle time reduction
- Smart machinery adoption has shown a **20–30% reduction in fuel usage** in pilot projects by CPWD and state PWDs

Policy incentives for contractors adopting green machines will accelerate this transition.

7. Sustainable Construction Practices

Besides materials and machinery, practices matter:

- **In-situ recycling** of bituminous layers using cold mix technology
- **Pre-cast components** to reduce site-level energy and waste
- **Batch mixing plants** with emissions filters
- **Lean construction scheduling** using BIM and AI for efficiency

These measures, when scaled, can reduce construction-phase emissions by **25–40%**.

8. Green Operation & Maintenance: The Long-Term Battle

Over **60% of infra-related CO_2 emissions** occur post-construction. Sustainable O&M strategies include:

- **Preventive maintenance** using micro-surfacing and fog seals to extend life and reduce reconstruction needs
- **Solar-powered lighting**, **IoT water pumps**, and **smart signals** to cut electricity consumption
- **Sensor-based asset monitoring** to detect faults early
- AI-assisted traffic management to improve fuel efficiency

Smart Roads in Pune, Surat, and Bhubaneswar already demonstrate **15–25% energy savings**.

9. Sustainable Agri-Infra: Green Growth in Rural India

The rural sector holds hidden potential for sustainable infra:

- **Agri-logistics parks** with solar cold chains and EV delivery systems
- **Green corridors** using agroforestry and carbon-sequestering trees
- **Climate-resilient rural roads** using geocells and stabilized soil
- **Solar-powered rural infrastructure,** such as grain dryers and irrigation pumps

Programs like **PM Gram Sadak Yojana – Green Edition** could become a flagship of climate-smart rural connectivity.

10. Infrastructure for EVs and Hydrogen Transition

While hydrogen and EVs are energy transitions, they rely on infrastructure readiness:

- **Multi-level EV charging hubs** along national highways
- **Hydrogen fueling depots** near logistics and industrial zones
- **Smart parking infrastructure** powered by solar microgrids
- **Integrated mobility corridors** enabling green freight transport

The success of FAME II, Green Hydrogen Mission, and NEMMP depends on how quickly we build this backbone.

11. Policy Frameworks Driving the Change

India has taken bold steps through enabling policy:

- **National Green Construction Code** (under finalization)
- **Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME)**
- **Energy Conservation Building Code (ECBC)**
- **NITI Aayog's push for Lifecycle Costing (LCC)**
- **MoRTH & NHAI mandates on the use of plastic waste, fly ash, and warm mix**

However, enforcement, state-level adoption, and monitoring remain gaps that must be urgently addressed.

12. Contractors as Change Agents

Contractors are no longer passive implementers but key to sustainability:

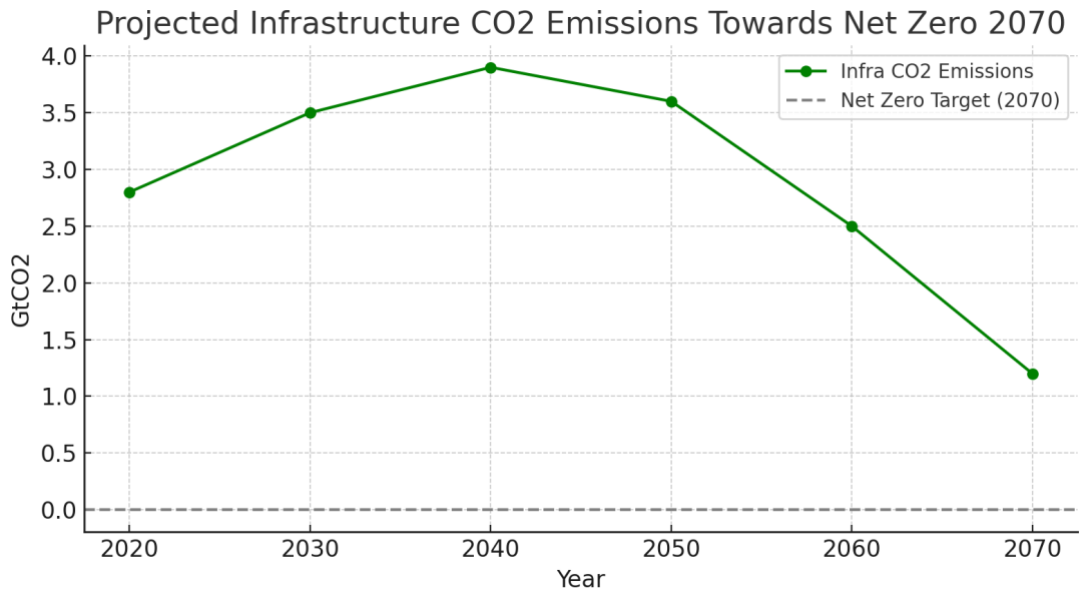
- Leading players are adopting **real-time carbon monitoring**, **electronic fuel logbooks**, and **digital quality audits**
- IRF is promoting **Green Contractor Ratings** based on emissions, material efficiency, and compliance
- Early adopters will benefit from **incentives and fast-track clearances**

13. IRF's Role: Awareness, Standards, and Innovation

The **International Road Federation (India Chapter)** has been at the forefront of championing sustainability and safety through multi-stakeholder collaboration, technical advancement, and knowledge dissemination. Key initiatives include:

- **National consultations** on green roads, circular infrastructure, and carbon neutrality
- **Technical sessions and whitepapers** on topics like bio-bitumen, AI integration, and lifecycle costing
- **Pilot projects** demonstrating low-carbon materials, digital twins, and sustainable construction practices
- **Joint programs** with IITs, CRRI, MoRTH, NHAI, and global institutions to standardize innovation
- A nationwide skilling campaign through **"Green Roads, Green Skills"**, with the goal of training **10,000 professionals by 2027**
- The flagship annual event **GRIS – Global Road Infratech Summit 2026**, which will focus on **Vision Zero, climate-resilient road infrastructure**, and global best practices for reducing fatalities and emissions simultaneously

GRIS-2026 is positioned to be a catalytic platform for converging road safety and sustainability, two pillars of responsible infrastructure in the 21st century.



14. Public Awareness and Grassroots Engagement

People drive policy adoption. IRF and partner organizations are:

- Conducting **awareness campaigns** on plastic roads and bio-bitumen
- Promoting **community engagement** in green corridors and afforestation
- Launching **apps and gamified tools** to report fuel waste and sustainability violations
- Hosting **youth hackathons** on clean infrastructure innovation

15. India's Emissions Roadmap: The Green Curve

Year	Projected Infra CO_2 Emissions ($GtCO_2$)
2020	2.8
2030	3.5
2040	**3.9 (Peak)**
2050	3.6
2060	2.5
2070	1.2

Source: IRF India Sustainable Infra Model, 2024

This projection assumes the successful adoption of green materials, AI systems, electrification, and resilient policies. With sustained effort, it demonstrates the possibility of peaking by 2040 and achieving Net Zero by 2070.

Conclusion: Infrastructure Beyond Steel and Concrete

India’s journey to Net Zero 2070 is about reducing emissions and redefining development itself.

We must shift from **cost-centric to carbon-conscious**, from **short-term outputs to long-term impact**. Our infrastructure must not only serve today but also preserve tomorrow.

As President of the **International Road Federation (India Chapter)**, I see India's infrastructure future as **resilient, digital, inclusive, and climate-smart**. We have the technologies, the talent, and now the targets. What we need is unified execution.

Let this be India’s greenprint, not just for building infrastructure, but for building a better future.

About the Author

Akhilesh Srivastava is a globally recognized infrastructure and technology leader, currently serving as the **President of the International Road Federation (India Chapter)** and **President of the ITS India Forum**. With over three decades of distinguished service across government, multilateral, and private sectors, he is a pioneering force behind India's intelligent transport systems, road safety transformation, and sustainable infrastructure development.

Widely regarded as the architect of India’s **FASTag revolution**, Mr. Srivastava also spearheaded the creation of the **NHAI Data Lake**, one of the country’s first AI-powered project monitoring systems. His initiatives such as **Road Safety 2.0**, **Green Roads**, and **Safe Driving Score (SDS)** are now nationally adopted and influencing global mobility practices.

As a **Road Safety Ambassador** for the World Economic Forum and IRF Global, he has represented India at key international forums including the UN, ADB, World Bank, and ITS World Congress. A passionate advocate of Net Zero infrastructure, digital governance, and inclusive growth, Mr. Srivastava continues to mentor policymakers, engineers, and startups across domains.

His leadership at IRF India has brought together global innovation, national vision, and ground-level execution to build safe, smart, and sustainable infrastructure for future generations.