POLICY BRIEF

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REALISING INDIA'S EMISSIONS INTENSITY PLEDGE

Data Needs and Short-Term Actions

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Introduction

As a vulnerable developing country with a low per-capita historical contribution to climate change, India's climate commitments are situated within the context of its multiple development objectives, which highlights the need for adopting multiple co-benefits approaches to lowering its emissions trajectory.

In line with this, towards supporting international progress on reducing emissions within the framework of the Paris Agreement, at COP 26 Prime Minister Modi announced India's five 'Panchamrit' pledges for enhanced climate action relating to non-fossil and renewable energy (RE) capacity and emissions. Among these, the pledge to achieve emissions intensity reductions of 45% below 2005 levels by 2030 is noteworthy for its economy-wide scope and implications. Since it depends on both total emissions and GDP in 2030, it will reflect progress on overall mitigation actions – including the other 'Panchamrit' pledges – as well as India's growth pathway, and serves as a partial short-term indicator of emissions in the context of India's macroeconomic and development trajectory.

This paper offers suggestions for the data needs and immediate sector actions that can help realise this pledge, within the more comprehensive requirements to realise a longer-term low-carbon development transition.

Consistency of Pledge with Current Policy Framework

Although official 2005 emissions data is not publicly available (Subramanian 2019), 2005 emissions are estimated at 1.64 GtCO2e by interpolating 2000 and 2007 data from India's third biennial update report (BUR) to the United Nations Framework Convention on Climate Change (UNFCCC) (MoEFCC 2021). With 2005 GDP at INR 59.15 trillion[1] (MoSPI n.d.), this indicates India's emissions intensity in 2005 was approximately 27 gCO2e/₹.[2]

To contextualize the intensity pledge against India's possible emissions trajectories, we consider five recent exercises that have modelled India's growth and emissions pathways (Gupta et al. 2020; TERI and Shell 2021; IEA 2021; Chaturvedi 2021.; Energy Innovation 2021), estimate the 2030 emissions intensities indicated by their outputs, and compare these against the 2005 baseline.[3]

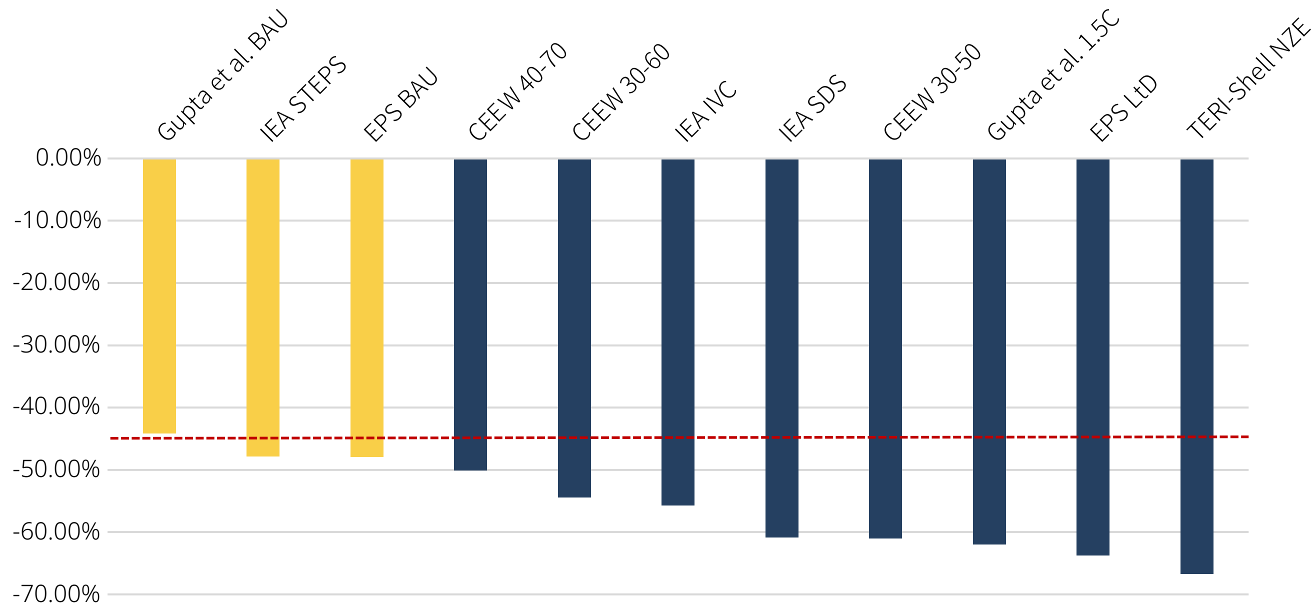
Figure 1 shows the estimated 2030 emissions intensity reductions for eleven scenarios within these five exercises, which are described in Appendix I. The red line in the figure represents the new 45% intensity pledge.

[1] 2011-12 prices

[2] gCO2e = grams of carbon dioxide-equivalent

[3] Each study used different inputs and assumptions relating to data sources, currencies, exchange rates, growth rates, base years, and other parameters. Although we attempted to harmonize estimates to a common baselines, insufficient clarity on modelling processes may limit the direct comparability of these studies.

Figure 1: Reductions in 2030 Emissions Intensity below 2005 Levels, across Scenarios



Notes: [1] TERI/Shell and IEA only model emissions from the energy sector. [2] Gupta et al. provide GDP estimates at 2011-12 prices; TERI-Shell GDP is based on MOSPI estimates at 2011-12 prices; IEA provides GDP estimates at 2019 prices. [3] Gupta et al.'s GDP is converted to INR using exchange rates on 31 March 2012; IEA GDP is converted using exchange rate in its Annex B. [4] An inflation adjustment is applied from base year to rescale IEA estimates to 2011-12 prices, based on a Ministry of Finance Cost Inflation Index.

Three of these eleven scenarios represent a continuation of trajectories that incorporate the substantial decarbonisation policies and targets already implemented and announced as of 2019 or 2020, and thus serve as reference scenarios. The remaining eight scenarios are designed to represent possible pathways towards mid-century decarbonisation, and imply greater emissions intensity reductions by 2030 compared with reference trajectories.

Notably, past reviews of scenario studies show that reference scenarios of successive studies show steadily declining intensity, as new policies are incorporated into reference baselines (Dubash et al. 2018). This suggests that what counts as 'reference' is itself a rapidly shifting baseline due to the rapidly changing policy environment, which represent material improvements in climate action over time. Based on recent policies, India is expected to reach intensity reductions of 35-50% by 2030 (Buckley et al. 2018; CSE 2021; Jaiswal 2019). The 45% intensity pledge thus appears to be consistent with the enhanced current policy framework, as represented in these reference scenarios. The additional eight scenarios point to various pathways to over-complying with this pledge.

Informing Progress: A System of Harmonized Data Management

India's emissions and development future will be shaped by multiple sectoral trends, relating to vehicle ownership, freight transport, electrification, urbanisation, and energy use in buildings, including cooking fuels, heating, cooling, and household appliances (IEA 2021; Dubash et al. 2018; Khosla et al. 2021). The planning for and assessment of these potential futures requires the consideration of a range of indicators – at the national, sector, and state levels – built upon the availability of suitable data.

A comprehensive understanding of sector trends is best achieved using a multi-criteria approach that takes into account development as well as emission metrics. Given data limitations and the limited scope of this exercise, it is useful to illustratively consider three basic indicators of low-carbon development by sector: energy use, economic output, and emissions. Tracking sector-level energy intensities and emissions intensities can indicate the abatement potentials and development synergies inherent in planning, and can enable a review of the results achieved by implementing specific policy and technology choices.

Figure 2: Sector Classifications within Emissions, Gross Value Added (GVA), and Energy Use Databases

EMISSIONS ACCOUNTING, MoEFCC

- Energy
  - Fuel combustion
    - Energy industries
    - Manufacturing and construction
    - Transport
    - Other (e.g., commercial, residential, agriculture)
  - Fugitive emissions
- IPPU
- Agriculture
- LULUCF
- Waste

GVA ACCOUNTING, MoSPI

- Agriculture
- Mining and quarrying
- Manufacturing
- Construction
- Electricity, gas, water, other utilities
- Trade, repair, hotels, restaurants
- Transport, storage, communication
- Financial services
- Real estate, professional services
- Public administration, defence
- Other services

ENERGY ACCOUNTING, MoSPI

- Industry
- Transport
- Others
  - Residential
  - Commercial and public services
  - Agriculture
  - Non-specified
- Non-energy use
  - Industry, transformation, energy
  - Transport
  - Others

However, estimating trends in sector energy and emissions intensities is challenged by missing – or intermittent – data points and frequent reclassifications of data. Detailed breakdowns of emissions data by sub-sector are only publicly available for the years 2000, 2010, 2014 and 2016 in India's BURs, restricting a meaningful analysis of trends. Reconciling emissions and economic data also presents a challenge, given uncertainties in the contents of the sub-categories, and differences in the way data is classified (overarching differences are shown in Figure 2, pointing at the difficulties in harmonizing data across indicators). At present, there is no clear, standardised framework that enables the estimation of sectoral emissions intensities in India and their potential contributions to the national emissions intensity.

Data challenges are prevalent not just in the direct assessment of emissions, but in other relevant sectors as well. In India's energy sector for instance, insufficient institutional capacity, a lack of coordination, and inadequate institutional processes to reconcile data have all been highlighted as challenges in data collection and management (Dukkipati at al. 2015; NITI n.d., Itkelwar et al. 2020)

Approaches that expand the focus of data collection to link development and emissions indicators, towards planning for more robust low-carbon development pathways, have yet to be institutionalised. In this context, accounting frameworks such as the System of Environmental-Economic Accounting (SEEA) – which provide systems to combine energy data collection with information on monetary flows and environmental costs and relationships – could be useful in enabling and monitoring progress, provided that these approaches are tailored to the Indian context (UN-DESA 2019).

Enabling Progress: Short-Term Sector Strategies

Although data limitations prevent a meaningful assessment of sector emissions intensities and their likely contributions to the overall pledge, it is useful to list historical patterns of energy use, GVA, and emissions, to further illustrate the challenges in data and to identify trends in these indicators. Future improvements to this data may better inform an understanding of sector potentials for meeting or exceeding the emissions intensity pledge, noting that a more robust and comprehensive approach to low-carbon development nevertheless requires consideration of and improvements to a broader set of development indicators.

Four sectors – electricity, industry, transport, and buildings – cumulatively account for nearly 79% of total gross value added (GVA), 81-83% of total emissions, and about 77% of total energy use.[4] The methods in which sub-sectoral data was classified under these four sectors is summarized in Appendix II. Supplementing summaries of historical trends in energy use, GVA, and emissions, the following sections list opportunities for near-term actions within these four sectors that can contribute towards meeting the emissions intensity pledge, while simultaneously laying the groundwork for a longer-term low-carbon development transition.

Electricity

Table 1 summarises India's emissions, GVA, and energy use from the electricity sector between 2000 and 2019.[5] Going forward, grid-based electricity demand is projected to grow at a 4.6-5.6% CAGR until 2030, with significant potential for employment creation from the sector (Ali and Tongia 2019, Kuldeep et al. 2019, Sinha 2022). Support to India's emissions intensity pledge from electricity will rely on greening the grid (IEA 2021; IEA & NITI Aayog 2021). With annual capacity additions of about 38 gigawatts (GW) required to meet the 2030 500 GW non-fossil capacity target, this will involve careful consideration of the near-term challenges around grid integration of variable generation, while simultaneously preparing strategies for a longer-term phase-down of coal and ensuring the financial viability of discoms (CEA n.d., CleanTechnica 2019).

Near-Term Considerations: Enabling Greener Generation by Balancing Variability

The Indian government is already taking steps towards a greener grid. In particular, interstate transmission charges are waived for both wind and solar energy as well as for storage energy (provided 70% is used for storing renewable power) (Ministry of Power 2021). In addition, it has announced production linked incentives for both solar panels and advanced chemistry cell battery production (PIB 2022). Both have attracted significant investor interest (Sharma 2022). Building on this, other specific near-term actions could include:

» Target a regulatory framework for, and investments in, storage solutions such as battery or pumped hydro storage (Pavarini 2020, Shah 2021, Buckley and Shah 2021, ET EnergyWorld 2021).

» Promote efficient demand-side response (DR) services to boost flexibility (IEA 2021).

» Promote the banking of power to manage intermittency and encourage open-access RE (Gulia et al. 2021).

» Tailor incentives for scaling up rooftop solar PV installations, such as net metering, OPEX models, aggregation, or other subsidies (Climate Investment Funds and PwC. n.d.).

Table 1: Electricity Emissions, GVA, and Energy Use (2000-2019)

	2000	2010	2014	2016	2018	2019
Emissions (000 tCO2e)	525,023	819,690	1,083,437	1,127,732	-	-
GVA (crore, 2011-12 prices)	73,581	132,606	163,722	185,281	221,787	224,482
Energy (ktoe)	-	39,128	81,556	91,700	-	102,055.03

[4] Data on emissions was obtained from the National Communications and BURs to the UNFCCC (MoEFCC 2021). Data on energy use and GVA was sourced from the Ministry of Statistics and Programme Implementation (MoSPI) (MoSPI n.d; n.d).

[5] A summary of the methodology used to aggregate this data for each sector is provided in Appendix II

Table 2: Industrial Emissions, GVA, and Energy Use (2000-2019)

	2000	2010	2014	2016	2018	2019
Emissions (000 tCO2e)	364,809	581,526	649,788	740,177	-	-
GVA (crore, 2011-12 prices)	1,104,860	2,370,863	2,807,852	3,320,457	3,682,035	3,627,074
Energy (ktoe)	-	196,388	297,482	340,531	319,380	328,555

Industry

Table 2 summarises data on emissions, GVA, and energy use from the industrial sector between 2000 and 2019. The industrial sector is the second-highest emitting sector in India, and iron, steel, and cement – mainly powered by coal and oil – account for most of these emissions (IEA 2021). Indian industry is poised to replace the power sector as the highest-emitting sector in the economy, and become the largest driver of coal demand (IEA 2021). High-emissions growth in this sector could therefore risk undermining progress on India's emissions intensity pledge.

Near-term measures to improve energy and material efficiency have the potential to mitigate a significant proportion of short- to medium-term emissions (IEA 2021). Longer-term paths to low-carbon industrial development, however, will depend on whether and how different industries transition to hydrogen-based processes, and the potential for the deployment of CCUS at scale (IEA 2021).

Near-Term Considerations: Promote Greater Material and Energy Efficiency

High energy prices and elevated electricity tariffs for industry provide strong incentives for industry to be energy efficient in India. In addition, India has had a longstanding Perform-Achieve-Trade (PAT) scheme in place to encourage least cost energy efficiency gains. The Bureau of Energy Efficiency (BEE), which is in charge of implementation, has initiated six PAT cycles. So far, they include 1073 designated consumers (DCs) covering 13 sectors. The BEE projects total energy savings of "about 26 MTOE translating into avoiding of about 70 million tonnes of CO2" by March 2023 (BEE n.d.). Independently, Oak and Bansal (2019) "find that the PAT scheme was effective in improving energy intensity of firms in the cement and fertilizer industry, but not in the pulp & paper industry." It is noteworthy that this sector has over two-thirds of the capacity in MSMEs (Office of the PSA 2014). Other near-term actions in this sector include:

- Increase scrap-based secondary steel production, develop longer product and building life cycles, implement vehicle light-weighting, and make material efficiency process adjustments (Hall et al. 2020, IEA 2021, IEA 2019).
- Develop schemes to leverage and expand energy efficiency investments and savings in India's 64 million MSMEs (micro, small and medium enterprises) (Biswas et al. 2018, IEA 2021). One model for this could be the support provided to MSMEs by EXIM bank, which provides grant funding to obtain product/process certification. Improved energy efficiency would also make MSMEs more competitive (BEE n.d., AEEE 2021, Biswas et al. 2018).
- Successively update and expand the PAT scheme in accordance with global standards and low-carbon technologies aimed at improving the energy intensity of iron and steel (IEA 2021).

Transport

Table 3 summarises the best available data on transport emissions, GVA, and energy use between 2000 and 2019. The Indian transport sector relies almost entirely on oil and petroleum products, with nearly half of the country's oil demand attributable to transport, and more than 80% of freight transport powered by diesel (IEA 2021). Freight transport is the highest contributor to energy consumption and emissions (45% in 2019) in the transport sector (IEA 2021). Going forward, the

Table 3: Transport Emissions, GVA, and Energy Use (2000-2019)

	2000	2010	2014	2016	2018	2019
Emissions (000 tCO2e)	98,104	188,009	250,172	274,433	-	-
GVA (crore, 2011-12 prices)	161,860	426,122	490,271	547,060	619,719	639,779
Energy (ktoe)	-	58,003	114,126	45,638	56,910	60,005

electrification of land-based transport, as envisioned by the FAME II (Faster Adoption and Manufacturing of (Hybrid) Electric Vehicles in India) Scheme, offers a promising near-term avenue for decarbonisation, but such decarbonisation will also require the simultaneous promotion of long-term urban planning approaches, multi-year modal shifts to normalise the use of public transport (TERI et al. 2019), and the development of alternative fuels for freight transport.

Near-Term Considerations: Support Greater Adoption of Electrified Public Transport

The government of India has announced its FAME II scheme, with significant incentives for consumers. In addition, it is directly tendering for public transport fleets in major cities. Recently, a Government of India entity tendered for 5,450 electric buses for Kolkata, Delhi, Bengaluru, Hyderabad and Surat (Gupta 2022). The bids received, including the cost of charging, compare very favourably to diesel powered buses, indicating that it may be possible to rapidly leap-frog to electric public transport, if electric bus production capacity issues were addressed. Concomitantly, battery-powered three-wheelers are becoming an increasingly common para-transit mode. These can also be thought of as a network based public transport, on a similar model to CNG fuelled auto-rickshaws in Kolkata (Anand, et al. 2016). To, inter alia, facilitate such initiatives, the NITI Aayog has recently announced a draft battery swapping policy (PIB 2022). These actions need to be built upon and scaled up, e.g. to more mid-sized cities.

» Further incentivise the increased uptake of electric public vehicles, including through subsidies, tax benefits, and fee reductions and exemptions (CAT 2020).

» Continued investments in public charging infrastructure; further incentives for domestic battery manufacturing for the large-scale deployment of electric vehicles under FAME-II and beyond (CAT 2020, TERI 2021).

» Progress on developing raw materials supply chains, end-of-life battery management processes, and supply-side incentives for automobile manufacturers to strengthen battery storage, innovation, and demand (ICCT 2021).

» Further direct budget allocations under centrally sponsored schemes towards bus procurement for public transport; increase subsidies for electric buses as part of the FAME-II scheme (TERI 2021).

Table 4: Commercial and Residential Emissions, GVA, and Energy Use (2000-2019)

	2000	2010	2014	2016	2018	2019
Emissions (000 tCO2e)	99,183	89,460	126,259	210,841	-	-
GVA (crore, 2011-12 prices)	1,390,250	2,909,644	4,050,395	4,874,029	5,538,568	5,961,156
Energy (ktoe)	-	178,610	50,796	57,520	60,511	64,042

Buildings

Table 4 summarises the best available data on residential and commercial emissions, GVA, and energy use. Buildings are assumed to constitute the bulk of these, based on the classification in Appendix II.

Buildings account for 40% of final energy demand in India, and as commercial infrastructure, housing demand and thermal comfort needs grow, buildings are expected to drive continued growth in demand (Vishwanathan et al. 2018, Khosla and Janda 2019). In particular, electricity demand for cooling is expected to increase six-fold in the next twenty years, and will potentially be a significant driver of emissions (Khosla et al 2021).

Near-Term Considerations: Lock in Sustainable Energy Consumption in Buildings

In addition to the inclusion of commercial buildings as one of six sectors under the PAT, the government also has an Energy Conservation Building Code (ECBC) in place (MoEFCC 2021). It is also mandatory for government buildings to achieve minimum standards under the GRIHA ratings system (PTI 2010). In addition, BEE has a Super-Efficient Equipment Programme (SEEP) project in place for ceiling fans as well as an energy labelling mandate for air conditioners, acting on both active and passive cooling aspects (BEE n.d., PIB 2020). Further actions could include:

» Incentivise on-site RE production in public and private housing and buildings (Gokarakonda et al. 2019, Malaviya and Shankar 2021).

» Create state-level 'green building centres' as capacity-building organisations, R&D partners, and recycled material banks to promote compliance with building codes (Gokarakonda et al. 2019).

» Develop finance mechanisms to promote energy-efficient air conditioners, 'smart' thermostats and demand-side technologies to nudge consumers (Graham and Rawal 2019, Khosla et al. 2021).

» Focus on passive cooling alternatives in and around buildings, such as transparent phase-changing windows or green roofs/vegetation to meet thermal comfort needs (Khosla et al. 2021a).

Way Forward

The new intensity pledge appears to be consistent with India's current climate policy framework, which itself represents improvements over time, as reflected in the reference scenarios of recent modelling studies. Additional scenarios in the context of future emission trajectories offer pathways to over-complying the 45% pledge. However, any such strategies need to be consistent with India's broader growth and development goals.

Improved Data Management

Planning for and reporting on emissions intensity strategies – as well as broader low-carbon development strategies – requires more systematic, disaggregated, and harmonized data collection practices across a range of indicators, including those on emissions, energy, and economic output. The capacity to do this could be built in organisations like NSO, which would need relatively small amounts of additional resources.

Sector-Focused Strategies

India has a host of low-carbon development policies already in place in various sectors. These include, *inter alia*, economic incentives for enhanced RE integration and investments in battery storage, progressive updates to the PAT scheme, public procurement of electric buses, and standards for energy efficiency and on-site RE-integration in buildings. Sector strategies to meet or over-comply with the emissions intensity pledge should build on these with complementary near-term actions, while simultaneously laying the groundwork for longer-term integrated transitions.

» Enable greener electricity generation by addressing issues of variability, through a focus on storage solutions, demand response services (DR), banking of power, and rooftop solar, while preparing for a long-term phase-down of coal, and supporting the financial viability of discoms.

» Promote greater material and energy efficiency in industries in the near-term, through process improvements and PAT, while supporting the development of hydrogen- and CCUS-based technologies for the long-term.

» Support greater adoption of electrified public transport, while improving long-term urban planning and developing alternative fuels for freight transport.

- Lock in sustainable energy consumption patterns in buildings, including a low-carbon approach to cooling using efficiency measures and passive approaches, with a longer-term focus on overall energy-efficiency.

Improved Cross-Sectoral Coordination

India's development trajectory requires a multi-criteria co-benefits approach. This implies that greater cooperation across government ministries, and the development of appropriate institutions to build consensus and coordinate action (Dubash et al. 2021) will have benefit individual sectoral strategies. For instance, approaches to address variability in RE production will involve increasing RE capacity, supporting the development of storage solutions, implementing demand response measures, and revisiting guidelines for the banking of power. These measures will be relevant to the Ministry of Power, Ministry of Heavy Industry, Ministry of Micro, Small, and Medium Enterprises, Ministry of Housing and Urban Affairs, Ministry of Finance, and state governments, among others. Going forward, building capacity and cross-ministerial linkages in climate 'cells', mainstreaming climate concerns into existing ministry mandates, and establishing collaborative platforms for ministries can be leveraged to improve overall coordination (Dubash et al 2021).

Conclusion

India's emissions intensity reduction pledge reinforces its commitment to its decarbonisation policies, and serves as an indicator of emissions in the context of India's macroeconomic trajectory. Within this broader context, it is important to understand the implications of the pledge on India's emissions and GDP, in order to develop additional policies to realise it without sacrificing on development objectives. This will also require ensuring close linkages between this and the other 'Panchamrit' pledges, as well as aligning low-carbon development-centred action in sectors that are not explicitly covered under the 'Panchamrit' announcement with this pledge.

Appendix I: Scenarios

1. IEA Stated Policies Scenario (STEPS): This scenario assumes that public health risks are gradually brought under control during 2021 and consequently, economic activity starts recovering steadily. India's announced or ratified policy ambitions and targets, per its 2015 NDC, have been incorporated under this scenario.

2. IEA India Vision Case (IVC): Under this optimistic scenario, the complete execution of India's stated policy aims is modelled, underpinned by a higher assumed economic growth rate (than under STEPS).

3. IEA Sustainable Development Scenario (SDS): This scenario works backwards from specific international climate, clean air and energy access goals, including the Paris Agreement, and identifies combination of actions necessary to achieve them.

4. TERI Net-Zero Emissions (NZE): This scenario aims to assess a net-zero emissions strategy, pathways, and solutions for India's energy system. It is a normative and ambitious scenario that expects a rapid transition by 2050. The availability of required technology is assumed to be enabling to overcome all social, infrastructural and behavioural barriers

5. Gupta et al. Business-as-Usual (BAU): This scenario builds on the prolongation of current trends and provides the benchmark of the study's analyses

6. Gupta et al. 1.5C: This scenario considers Indian actions compatible with the cap of a 1.5°C increase in the global average temperature

7. EPS Long-term Decarbonization (LtD): This scenario explores sectoral decarbonisation policy levers that exhibit high potential for GHG abatement over the long term and sets ambitious targets for implementation by 2050

8. EPS Business-as-Usual (BAU): This scenario models an extension of current trends and provides a benchmark against which to compare decarbonisation scenarios

9. CEEW 30-50: This scenario assumes that India's emissions peak in 2030 and reach net-zero by 2050

10. CEEW 30-60: This scenario assumes that India's emissions peak in 2030 and reach net-zero by 2060

11. CEEW 40-70: This scenario assumes that India's emissions peak in 2040 and reach net-zero by 2070

Appendix II: Categorization of Emissions, Energy, and GVA

Emissions: India's BURs provide continuous emissions data for five key categories: energy, industrial processes and product use, agriculture, LULUCF, and waste (see Table 5). However, 'energy' is an umbrella category encompassing a variety of sources and sectors: energy and electricity production and fuel extraction; power generation from industries, manufacturing and construction; emissions from transport; emissions from commercial and institutional buildings; emissions from residential cooking, heating and lighting; emissions from power generation in agriculture and fisheries; and fugitive emissions from fuels. In this analysis, emissions from transport, electricity and commercial and residential sectors are extracted as sub-totals from within the broader energy category. Emissions from industry include those from industrial power and heat generation, petroleum refineries and solid fuel manufacturing, construction, industrial processes used to transform raw materials, and fugitive emissions from coal, oil and natural gas production. Emissions from agriculture represent energy use in the sector combined with emissions from enteric fermentation, cultivation, soils and residues.

Table 5: Categorization of Emissions in BUR

1. ENERGY

A. Fuel Combustion Activities

1. Energy Industries
   - a. Electricity production
   - b. Refinery
   - c. Manufacturing of solid fuel
2. Manufacturing Industries & Construction
   - a. Cement
   - b. Iron & steel
   - c. Nonferrous metals
   - d. Chemicals
   - e. Pulp & paper
   - f. Food & beverages
   - g. Nonmetallic minerals
   - h. Mining & quarrying
   - i. Textile/leather
   - j. Bricks
   - k. Fertilizer
   - l. Engineering Sector
   - m. Nonspecific Industries
   - n. Glass Ceramic
3. Transport
   - a. Road transport
   - b. Civil Aviation
   - c. Railways
   - d. Navigation
4. Other sectors
   - a. Commercials/Institutional
   - b. Residential
   - c. Agricultural/fisheries
   - d. Biomass burnt for energy

B. Fugitive Emission from fuels

1. Solid fuels
   - a. Above ground mining
   - b. Underground mining
2 .Oil and Natural gas
   - a. Oil
   - b. Natural gas
   - c. Venting and flaring

2. INDUSTRIAL PROCESSES AND PRODUCT USE

A. Minerals

1. Cement production
2. Lime production
3. Limestone and dolomite use
5. Glass

6. Ceramics

B. Chemicals

1 Ammonia production

2 Nitric acid production

3. Carbide production

4. Titanium dioxide production

5. Soda ash production

6. Methanol production

7. Ethylene production

8. EDC & VCM production

9. Ethylene Oxide production

10. Acrylonitrile production

11.Carbon Black production

12. Caprolactam

C Metal Production

1 Iron & Steel production

2 Ferroalloys production

3 Aluminium production

4. Lead production

5. Zinc production

6. Magnesium production

D. Non-energy product use

1. Lubricant

2. Paraffin wax

E. Production of halocarbons and sulphur hexafluoride

H. Other

1. Pulp & paper

3. AGRICULTURE

A. Enteric fermentation

B. Manure management

C. Rice cultivation

D. Agricultural soils

Direct N2O Emissions

F. Field burning of agricultural residues

4. LULUCF

A. Forest Land

B. Cropland

C. Grassland

D. Settlement

F. Other land

5. WASTE

A. Solid waste disposal on land

1. Managed waste disposal on land

B. Waste-water handling

1. Industrial wastewater

2. Domestic and commercial wastewater

MEMO ITEM (NOT ACCOUNTED IN TOTAL EMISSIONS)

International Bunkers

Aviation

Marine

CO2 from Biomass

Gross Value Added (GVA): The economy is broadly divided into industry, services, and agriculture and allied activities, wherein services include transport and electricity (see Table 6). As India's emissions and GVA estimates categorise sources and sectors differently, there may be minor inaccuracies in harmonising these breakdowns for comparability on a sector-by-sector basis. For instance, it is not fully evident that the economic value of the MoEFCC's emissions sub-category of 'electricity' – itself a subset of under 'energy industries' in India's BURs – can be mapped onto MoSPI's GVA sub-category entitled 'electricity, gas, water supply & other utility services' – even if this appears to be the best possible match given current data. In future, more granular data, supported by in-depth descriptions of the sub-categories in this dataset, could enable robust calculations of sectoral emissions intensities.

Table 6: Categorization of GVA by MoSPI and Matching with Emissions Categories

Sector	Equivalence with Emissions Categories in Table 5
Agriculture, forestry and fishing	
Crops	1A4c + 3
Livestock	
Forestry and logging	-
Fishing and aquaculture	-
Mining and quarrying	
Manufacturing	
Food Products, Beverages and Tobacco	
Textiles, Apparel and Leather Products	1A1b,1A1c,1A2,1B + 2
Metal Products	
Machinery and Equipment	
Other Manufactured Goods	
Electricity, gas, water supply & other utility services	**1A1a**
Construction	**1A1b,1A1c,1A2,1B + 2**
Trade, repair, hotels and restaurants	
Trade & repair services	1A4a, 1A4b, 1A4d
Hotels & restaurants	
Transport, storage, communication & services related to broadcasting	-
Railways	
Road transport	
Water transport	1A3
Air transport	
Services incidental to transport	

Sector	Equivalence with Emissions Categories in Table 5
Storage	1A4a, 1A4b, 1A4d
Communication & services related to broadcasting	
Financial services	
Real estate, ownership of dwelling & professional services	
Public administration and defence	-
Other services	1A4a, 1A4b, 1A4d

Energy use: Data on final consumption of energy in different sectors is collected by MoSPI in an annual publication entitled Energy Statistics using the classification in Table 7 below.

Table 7: Categorization of Energy Use Data by MoSPI and Matching with Emissions Categories

Sector	Equivalence with Emissions Categories in Table 5
Electricity	**1A1a**
Industry	**1A1b,1A1c,1A2,1B + 2**
Transport	**1A3**
Others	
Residential	1A4a, 1A4b, 1A4d
Commercial and public services	
Agriculture/forestry	1A4c + 3
Non-Specified (other)	-
Non-energy use	
Non-energy use industry/transformation/energy	1A1b,1A1c,1A2,1B + 2
Non-energy use transport	-
Non-energy use others	-

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ABOUT THE PROJECT

India's continued economic growth and progress is integral to the bilateral relationship it shares with the United Kingdom, especially as the two explore deeper economic cooperation in finance and trade. The India-UK 2030 roadmap reaffirms this and outlines critical reform areas that will not only provide better opportunities for people in both countries, but also strengthen their partnership. In this context, the Centre for Policy Research, with support from the British High Commission, New Delhi, has produced four policy briefs on timely issues of mutual interest to both countries. These policy briefs help leverage mutual experience and suggest actions to chart more sustainable growth trajectories.

British High Commission New Delhi