



APPENDIX AVAILABLE ON THE HEI WEBSITE

Special Report 21

**Burden of Disease Attributable to Major Air Pollution Sources
in India**

GBD MAPS Working Group

**Appendix E. Assumed Technology Shifts and Growth Rates for
Sectoral Activity**

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E.1. Sectoral Growth Rates in Activity in Future Scenarios

Growth rates in periods of 2015–2030 and 2030–2050 for sectors including thermal power generation, industries, building construction, informal industry, and transport demand were derived from published sources and analysis of activity growth during 2005–2015. Growth in activity, estimated as the ratio of activity in 2050 to that in 2015, indicate factors of 1.6 and 2.2, respectively, in residential energy demand and in the burning of agricultural residues (in concert with food production changes), but indicate larger factors of 4 to 5 for electricity generation and heavy industry and of about 6 for the building sector. These numbers are in general agreement with published values of sectoral demand evolution in India (Anandarajah and Gambhir 2014; Chaturvedi and Shukla 2014; Parikh 2012; Shukla and Chaturvedi 2012).

Table E.1. Sectoral Growth Rates for 2015–2030 and 2030–2050^a

Sectors	Activity Name (unit)	Activity	Growth Rates (% per Year)							
			2015	2015–2030			2030–2050			
			2000-2015 Data	IESS ¹	Published Data	Current Study	IESS ¹	Published Data	Current Study	
Electricity generation	Installed capacity (GW)	270	6.89	6.31	6.7 ²	6.63	1.84	NIL	1.84	
Industry	Production (MT)									
	Cement	215	5.06	5.63	7.08 ³	6.07	2.86	NIL	3.1	
	Iron and steel	88	4.49	8.03	3.26 ⁴	4.5	2.93	NIL	2.5	
	Fertilizer	190	1.77	1.04	2.86 ⁵	2.32	0.02	NIL	0.04	
	Non-ferrous	4	6.65	9.74	11.3 ⁶	11.3	6.77	NIL	6.23	
Brick production	Number of bricks (in billions) (similar to construction growth)	250	NIL	NIL	6.6 ⁷	6.6	NIL	NIL	3.37	
Transport	Passenger-km (in billions)	9997	6.54 ^b	5.02	NIL	5.78	2.42	NIL	2.89	
	Freight-km (in billions)	2564	3.61	—	NIL	3.61	—	NIL	1.8	
Residential	Household number (in millions) (similar to population growth)	270	1.39	1.88	1.1 ⁸	1.25	1.57	0.47 ⁸	0.53	
Agriculture	Crop production (KT) (i.e., cereal produced)	578	1.02	NIL	~ 1 to 1.1 ⁹	1.02	NIL	NIL	1.02	

^a GW = gigawatt; KT = kiloton; MT = million tonnes; — = not available.

^b Growth rate calculated for data from 1996–2015.

Sources for Table E.1:

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Table E.2. Technology Fraction for Major Emissions Emitting Sectors^a

Sector	Source Categories	Tech Mix	Scenario and Year							
			2015	REF		S2		S3		
				2030	2050	2030	2050	2030	2050	
Electricity generation	Electricity Generation	Fossil-fuel energy	0.70	0.70	0.60	0.60	0.40	0.25	0.2	
		Coal fraction	0.61	0.59	0.48	0.48	0.24	0.20	0.12	
		Gas fraction	0.09	0.11	0.12	0.12	0.16	0.05	0.08	
		Non-carbon energy	0.30	0.30	0.40	0.40	0.60	0.75	0.80	
		Sub-critical	1.00	0.90	0.70	0.65	0.55	0.40	0.30	
		Super-critical	0.00	0.10	0.15	0.15	0.20	0.15	0.15	
		Ultra-super-critical	0.00	0.00	0.10	0.12	0.15	0.20	0.20	
		IGCC	0.00	0.00	0.05	0.08	0.10	0.25	0.35	
Heavy industry	Cement	PAT	0.72	0.72	0.72	0.77	0.83	0.90	1.00	
		Non-PAT	0.28	0.28	0.28	0.23	0.17	0.10	0.00	
	Iron and steel	PAT	0.56	0.58	0.60	0.62	0.69	0.85	1.00	
		Non-PAT	0.44	0.42	0.40	0.38	0.31	0.15	0.00	
	Fertilizer	PAT	0.75	0.75	0.75	0.79	0.84	0.95	1.00	
		Non-PAT	0.25	0.25	0.25	0.21	0.16	0.05	0.00	
	Non-ferrous	PAT	0.69	0.69	0.70	0.76	0.83	0.90	1.00	
		Non-PAT	0.31	0.31	0.30	0.24	0.17	0.10	0.00	
Light industry		PAT	0.30	0.35	0.40	0.50	0.70	0.85	1.00	
		Non-PAT	0.70	0.65	0.60	0.50	0.30	0.15	0.00	
Brick and informal industry	Brick production	BTK	0.76	0.50	0.35	0.40	0.20	0.20	0.00	
		Clamps	0.21	0.20	0.05	0.15	0.05	0.05	0.00	
		Zig-zag firing	0.02	0.15	0.15	0.10	0.10	0.20	0.10	
		Hollow	0.01	0.05	0.20	0.05	0.20	0.15	0.20	
		Non-fired bricks	0.00	0.10	0.25	0.30	0.45	0.40	0.70	
	Informal industry	Traditional biofuel	1.00	0.90	0.75	0.80	0.65	0.35	0.20	
		Gasifier	0.00	0.10	0.25	0.20	0.35	0.65	0.80	
Transport	Passenger — Private	Private vehicles	0.81	0.81	0.81	0.75	0.70	0.60	0.40	
			Gasoline	0.97	0.94	0.87	0.88	0.70	0.62	0.30
		BS III	1.00	0.39	0.00	0.08	0.00	0.00	0.00	
		BS IV	0.00	0.39	0.00	0.30	0.00	0.30	0.00	
		BS V	0.00	0.22	0.71	0.47	0.41	0.30	0.25	
		BS VI	0.00	0.00	0.29	0.15	0.59	0.40	0.75	
		CNG	0.03	0.05	0.10	0.08	0.20	0.13	0.20	
		Electric	0.00	0.01	0.03	0.04	0.10	0.25	0.50	
		Passenger — Public	Public vehicles	0.19	0.19	0.19	0.25	0.30	0.40	0.60
	Diesel			0.98	0.90	0.90	0.82	0.70	0.60	0.40
	BS III		1.00	0.58	0.00	0.15	0.00	0.00	0.00	
	BS IV		0.00	0.24	0.00	0.25	0.00	0.12	0.00	
	BS V		0.00	0.18	0.59	0.35	0.29	0.38	0.21	
	BS VI		0.00	0.00	0.41	0.25	0.71	0.50	0.79	
	CNG		0.02	0.05	0.05	0.10	0.20	0.20	0.30	
	Electric		0.00	0.05	0.05	0.08	0.10	0.20	0.30	
	Freight		Diesel	BS-III	0.58	0.30	0.00	0.25	0.00	0.20
		BS-IV		0.00	0.23	0.12	0.20	0.02	0.15	0.00
BS-V		0.00		0.05	0.35	0.10	0.40	0.15	0.15	
BS-VI		0.00		0.00	0.08	0.00	0.08	0.00	0.30	
Residential	Cooking	Traditional biofuel	0.68	0.61	0.55	0.45	0.30	0.10	0.01	

	Gasifier	0.00	0.03	0.05	0.13	0.20	0.35	0.20	
	Kerosene	0.03	0.00	0.00	0.00	0.00	0.00	0.00	
	LPG	0.29	0.35	0.38	0.37	0.42	0.45	0.61	
	Electricity	0.00	0.01	0.02	0.05	0.08	0.10	0.18	
Lighting	Kerosene	0.42	0.34	0.26	0.10	0.05	0.00	0.00	
	Electricity and solar	0.58	0.66	0.74	0.90	0.95	1.00	1.00	
Space heating	Wood	1.00	0.95	0.85	0.90	0.80	0.85	0.70	
	Electric and solar	0.00	0.05	0.15	0.10	0.20	0.15	0.30	
Diesel genset	Diesel	1.00	0.95	0.85	0.90	0.80	0.85	0.75	
	Electric and solar	0.00	0.05	0.15	0.10	0.20	0.15	0.25	
Agriculture	Agricultural residue burn	Open residue burning	1.00	1.00	1.00	1.00	1.00	0.65	0.00
		Deep sowing mulching tech	0.00	0.00	0.00	0.00	0.00	0.35	1.00
	Agricultural pumps	Diesel	0.32	0.27	0.20	0.10	0.05	0.05	0.00
		Electric and solar	0.68	0.73	0.80	0.90	0.95	0.95	1.00
	Agricultural tractors	Diesel	1.00	1.00	1.00	1.00	1.00	1.00	1.00

^a BS = Bharat stage; BTK = Bull's trench kilns; CNG = compressed natural gas; IGCC = integrated gasification combined cycle; LPG = liquefied petroleum gas; PAT = Perform Achieve and Trade initiative.

Table E.3. Specific Energy (PJ)^a per Unit Activity for Each Technology

Sector	Source Categories	TechMix	Activity (units)	Scenario and Year						
				REF		S2		S3		
				2015	2030	2050	2030	2050	2030	2050
Thermal power	Thermal power	Sub-critical-coal	GW	68.24	68.24	68.24	61.41	58.00	61.41	58.00
		Super-critical-coal	GW	60.79	60.79	60.79	54.71	51.67	54.71	51.67
		Ultra-super-critical-coal	GW	54.05	54.05	54.05	48.65	45.94	48.65	45.94
		IGCC-coal	GW	52.01	52.01	52.01	46.81	44.21	46.81	44.21
		Sub-critical-gas	GW	39.00	39.00	39.00	35.10	33.15	35.10	33.15
		Super-critical-gas	GW	34.75	34.75	34.75	31.27	29.53	31.27	29.53
		Ultra-super-critical-gas	GW	30.89	30.89	30.89	27.81	26.26	27.81	26.26
		IGCC-gas	GW	29.73	29.73	29.73	26.75	25.27	26.75	25.27
Heavy industry	Cement	PAT	Million ton	4.47	4.47	4.47	4.02	3.80	4.02	3.80
		Non-PAT	Million ton	4.56	4.56	4.56	4.10	3.88	4.10	3.88
	Iron and steel	PAT	Million ton	25.62	25.62	25.62	23.06	21.78	23.06	21.78
		Non-PAT	Million ton	34.83	34.83	34.83	31.35	29.61	31.35	29.61
	Fertilizer	PAT	Million ton	1.30	1.30	1.30	1.17	1.10	1.17	1.10
		Non-PAT	Million ton	1.39	1.39	1.39	1.25	1.18	1.25	1.18
	Non-ferrous	PAT	Million ton	189.27	189.27	189.27	170.35	160.88	170.35	160.88
		Non-PAT	Million ton	280.24	280.24	280.24	252.21	238.20	252.21	238.20
Light industry ^b		PAT		NA	NA	NA	NA	NA	NA	NA
		Non-PAT		NA	NA	NA	NA	NA	NA	NA
Brick and informal industry	Brick production	BTK	Billion bricks	3.75	3.75	3.75	3.00	2.81	3.00	2.81
		Clamps	Billion bricks	7.91	7.91	7.91	6.33	5.93	6.33	5.93
		Zig-zag firing	Billion bricks	2.25	2.25	2.25	1.80	1.68	1.80	1.68
		Hollow	Billion bricks	1.67	1.67	1.67	1.34	1.25	1.34	1.25
		Non-fired bricks	Billion bricks	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Informal industry	Traditional biofuel	Million ton	14.65	14.65	14.65	11.72	10.98	11.72	10.98
		Gasifier	Million ton	8.79	8.79	8.79	7.03	6.59	7.03	6.59
Transport	Passenger — private	Gasoline BS III	Billion passenger-km	0.08	0.08	0.08	0.08	0.08	0.07	0.06
		BS IV	Billion passenger-km	0.08	0.08	0.08	0.08	0.08	0.07	0.06
		BS V	Billion passenger-km	0.08	0.08	0.08	0.08	0.08	0.07	0.06
		BS VI	Billion passenger-km	0.08	0.08	0.08	0.08	0.08	0.07	0.06
		CNG	Billion passenger-km	0.14	0.14	0.14	0.14	0.14	0.13	0.11
		Electric	Billion passenger-km	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Passenger — public	Diesel-BS III	Billion passenger-km	0.51	0.51	0.51	0.51	0.51	0.46	0.38

		BS IV	Billion passenger-km	0.51	0.51	0.51	0.51	0.51	0.46	0.38
		BS V	Billion passenger-km	0.51	0.51	0.51	0.51	0.51	0.46	0.38
		BS VI	Billion passenger-km	0.51	0.51	0.51	0.51	0.51	0.46	0.38
		CNG	Billion passenger-km	0.62	0.62	0.62	0.62	0.62	0.56	0.47
		Electric	Billion passenger-km	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Freight		Diesel BS-III	Billion ton km	1.19	1.19	1.19	1.19	1.19	1.07	0.89
		BS-IV	Billion ton km	1.19	1.19	1.19	1.19	1.19	1.07	0.89
		BS-V	Billion ton km	1.19	1.19	1.19	1.19	1.19	1.07	0.89
		BS-VI	Billion ton km	1.19	1.19	1.19	1.19	1.19	1.07	0.89
Residential	Cooking	Traditional biofuel	Million households	36.28	36.28	36.28	36.28	36.28	7.26	5.44
		Gasifier	Million households	21.77	21.77	21.77	21.77	21.77	4.35	3.27
		Kerosene	Million households	15.78	15.78	15.78	15.78	15.78	14.20	12.62
		LPG	Million households	8.04	8.04	8.04	8.04	8.04	7.23	6.43
		Electricity	Million households	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lighting	Kerosene	Million households	0.92	0.92	0.92	0.92	0.92	0.83	0.74
		Electricity and solar	Million households	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Space heating	Wood	Million ton	14.90	14.90	14.90	14.90	14.90	2.98	2.24
		Electric and solar	Million ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Diesel genset	Diesel	KT	0.04	0.04	0.04	0.04	0.04	0.04	0.03
	Electric and solar	KT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Agriculture	Agricultural residue burn	Open Residue Burning	Million ton	14.90	14.90	14.90	14.90	14.90	14.15	13.41
		Deep sowing mulching tech	Million ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Agricultural pumps	Diesel	Million units	67.57	67.57	67.57	67.57	67.57	60.81	50.68
		Electric & solar	Million units	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Agricultural tractors	Diesel	Million units	33.31	33.31	33.31	33.31	33.31	29.98	24.99

^a PJ = petajoule (10^{15} joules), IGCC = integrated gasification combined cycle, PAT = Perform Achieve and Trade initiative, BTK = Bull's trench kilns, BS = Bharat stage, CNG = compressed natural gas; NA = not applicable.

^b For light industry, the energy demand is directly projected using the activity growth rate.

Table E.4. Energy Demand for Each Technology (EJ)^a

Sector	Source Categories	TechMix	Energy Demand (EJ) by Scenario and Year						
			REF		S2		S3		
			2030	2050	2030	2050	2030	2050	
Electricity generation	Electricity generation	Non-carbon energy	5.35	10.92	6.42	13.92	12.04	18.56	
		Sub-critical-coal	8.76	23.35	4.65	7.80	1.19	2.13	
		Super-critical-coal	0.37	4.46	0.41	1.09	0.17	0.41	
		Ultra-super critical-coal	0.00	2.64	0.37	0.92	0.26	0.61	
		IGCC-coal	0.00	1.27	0.26	0.64	0.34	1.12	
		Sub-critical-gas	2.78	3.34	1.94	2.97	0.50	0.81	
		Super-critical-gas	0.12	0.64	0.17	0.42	0.07	0.16	
		Ultra-super critical-gas	0.00	0.38	0.15	0.35	0.11	0.23	
		IGCC-gas	0.00	0.18	0.11	0.24	0.14	0.43	
Heavy industry	Cement	PAT	1.67	3.08	1.61	3.02	1.88	3.64	
		Non-PAT	0.66	1.22	0.49	0.63	0.21	0.00	
	Iron and steel	PAT	2.54	4.31	2.45	4.21	3.35	6.10	
		Non-PAT	2.50	3.91	2.04	2.57	0.80	0.00	
	Fertilizer	PAT	0.26	0.26	0.25	0.25	0.30	0.30	
		Non-PAT	0.09	0.09	0.07	0.05	0.02	0.00	
	Non-ferrous	PAT	2.54	8.62	2.51	8.69	2.98	10.47	
Non-PAT		1.69	5.47	1.18	2.63	0.49	0.00		
Light industry		PAT	1.81	3.70	2.58	6.48	3.95	7.08	
		Non-PAT	3.35	5.56	2.58	2.78	0.70	0.00	
Brick and informal industry	Brick Production	BTK	1.22	1.66	0.78	0.71	0.39	0.00	
		Clamps	1.03	0.50	0.62	0.38	0.21	0.00	
		Zig-zag firing	0.22	0.43	0.12	0.21	0.23	0.21	
		Hollow	0.05	0.42	0.04	0.32	0.13	0.32	
	Informal industry	Non-fired bricks	0.00	0.00	0.00	0.00	0.00	0.00	
		Traditional biofuel	0.44	0.45	0.31	0.29	0.14	0.09	
Transport	Passenger - Private	Gasoline	BS III	0.56	0.00	0.09	0.00	0.00	0.00
			BS IV	0.56	0.00	0.37	0.00	0.18	0.00
			BS V	0.30	1.64	0.58	0.66	0.18	0.07
			BS VI	0.00	0.66	0.19	0.95	0.25	0.22
		CNG	0.13	0.51	0.20	0.82	0.24	0.35	
		Electric	0.00	0.00	0.00	0.00	0.00	0.00	
	Passenger - Public	Diesel	BS III	1.19	0.00	0.36	0.00	0.00	0.00
			BS IV	0.48	0.00	0.59	0.00	0.32	0.00
			BS V	0.36	2.10	0.83	1.26	0.96	0.79
			BS VI	0.00	1.47	0.59	3.15	1.28	2.99
		CNG	0.14	0.24	0.36	1.54	1.04	3.46	
		Electric	0.00	0.00	0.00	0.00	0.00	0.00	
	Freight	Diesel	BS-III	1.26	0.00	1.05	0.00	0.76	0.00
			BS-IV	0.97	0.72	0.84	0.12	0.57	0.00
			BS-V	0.21	2.10	0.42	2.41	0.57	0.68
			BS-VI	0.00	0.48	0.00	0.48	0.00	1.35
Residential	Cooking	Traditional biofuel	7.21	7.22	5.32	3.94	0.24	0.02	
		Gasifier	0.21	0.39	0.92	1.58	0.50	0.24	
		Kerosene	0.00	0.00	0.00	0.00	0.00	0.00	

		LPG	0.92	1.11	0.97	1.22	1.06	1.42
		Electricity	0.00	0.00	0.00	0.00	0.00	0.00
	Lighting	Kerosene	0.10	0.09	0.03	0.02	0.00	0.00
		Electricity and solar	0.00	0.00	0.00	0.00	0.00	0.00
	Space heating	Wood	1.36	1.35	1.29	1.27	0.24	0.17
		Electric and solar	0.00	0.00	0.00	0.00	0.00	0.00
	Diesel genset	Diesel	0.21	0.21	0.20	0.20	0.17	0.14
		Electric and solar	0.00	0.00	0.00	0.00	0.00	0.00
Agriculture	Agricultural residue burn	Open residue burning	2.55	3.12	2.55	3.12	1.58	0.00
		Deep sowing mulching tech	0.00	0.00	0.00	0.00	0.00	0.00
	Agricultural pumps	Diesel	0.19	0.18	0.07	0.04	0.03	0.00
		Electric and solar	0.00	0.00	0.00	0.00	0.00	0.00
	Agricultural tractors	Diesel	0.25	0.30	0.25	0.30	0.22	0.23
		Total	56.64	110.84	50.23	84.75	41.14	65.00

^a BTK = Bull's trench kilns; BS = Bharat stage; CNG = compressed natural gas; EJ = exajoule (10^{18} joules); IGCC = integrated gasification combined cycle; PAT = Perform Achieve and Trade initiative.

E.2. Technology-Linked Emission Factors

Technology-linked emission factors for more than 75 distinct technology types (Sadavarte and Venkataraman 2014; Pandey et al. 2014) were used. For thermal power, emission factors assumed a mean 38% ash content coal, typical of India, with electrostatic precipitators working at 99.98% while more efficient supercritical, ultra-super critical and IGCC technologies had emission reductions in proportion with increased energy efficiency. Particulate emission control was assumed to work effectively at different rates (90%, 95%, and 100%) in the three scenarios. In concert with no current controls on SO₂ emissions, low-to-modest flue gas desulfurization rates were assumed, reaching a maximum of 20% in 2050. In heavy industries, such as cement, iron and steel, fertilizer and non-ferrous production, 90% (REF and S2) and 100% (S3) operation of controls are considered. Emission factors for PAT technologies were reduced to below non-PAT values using their increase in efficiency.

In brick production, recently measured emission factors for PM_{2.5}, BC, and OC are used and for those of coal stokers are used for gases. It was assumed that non-fired brick, which uses cement and involves no use of fuel for firing or drying purposes, had zero emissions. In the case of informal industry, use of traditional biomass technologies for major thermal and drying operations would shift to cleaner gasifier or LPG technologies, hence, emission factors similar to those for residential cooking were considered. In the residential sector, available measurements (Pandey et al. 2014) were used to derive emission factors for combustion of wood, dung-cake, and crop residue in cookstoves, as also for kerosene and LPG cookstoves, which are also used for biomass-fired heating of water and space. For future emissions, emission factors of cleaner combustion technologies like biomass gasifiers were compiled. Diesel generator sets, for residential use and for mobile towers, have been included and their emission factors are set as similar to agricultural diesel pumps.

In the transport sector, emission factors were developed from earlier work that was based on seven categories of vehicles, across two vintage classes, applied to a modeled on-road vehicle age distribution (Pandey and Venkataraman 2014). Reduction in emissions for future BS-IV to BS-VI standards would rely on deployment of diesel particulate filters and gasoline catalytic converters (Auto Fuel Policy Vision 2025). The reduction in emission factors for BS-V as compared with BS-IV is not very significant (Table E.5).

In the agriculture sector, emissions from field burning of cereal and sugarcane residue were included, along with diesel use in tractors and pumps. Here, emission factors for cereal and sugarcane burning were used, with zero emissions allocated, in cases of future shifts to deep sowing and mulching technology (Gupta 2014). Similarly, emission factors for diesel pumps and tractors are used with zero emission allocation for a shift to electric or solar pumps.

Table E.5. Technology-Linked PM_{2.5} and Precursor Gases Emission Factors (g/kg)^a

Sector	Source Categories	Tech. Mix	PM _{2.5}	BC	OC	SO ₂	NO _x	NMVOCs	CO ₂
Thermal power	TPP - coal	Sub-critical	1.84	0.01	0.03	7.26	4.45	0.03	1766.00
		Super-critical	1.64	0.01	0.03	6.46	3.96	0.03	1571.74
		Ultra-super critical	1.44	0.01	0.02	5.66	3.47	0.02	1377.48
		IGCC	1.23	0.01	0.02	4.86	2.98	0.02	1183.22
	TPP - oil and gas	Sub-critical	0.04	0.00	0.02	0.01	3.78	0.04	3120.00
		Super-critical	0.04	0.00	0.02	0.01	3.36	0.04	2776.80
		Ultra-super critical	0.03	0.00	0.02	0.01	2.95	0.03	2433.60
Heavy industry	Cement	PAT	2.34	0.01	0.11	1.20	2.09	0.07	770.00
		Non-PAT	2.39	0.01	0.11	1.22	2.13	0.08	786.00
	Iron and steel	PAT	1.23	0.25	0.18	5.22	1.93	0.44	1283.00
		Non-PAT	1.92	0.39	0.28	8.63	3.01	0.69	2004.00
	Fertilizer	PAT	0.28	0.05	0.01	2.66	1.08	3.71	1593.00
		Non-PAT	0.28	0.05	0.01	2.72	1.11	3.78	1625.00
Non-ferrous	PAT	0.28	0.05	0.01	2.66	1.08	3.71	1593.00	
	Non-PAT	0.28	0.05	0.01	2.72	1.11	3.78	1625.00	
Light industry		PAT	0.03	0.00	0.01	15.60	2.88	0.03	3149.22
		Non-PAT	2.45	0.46	0.11	13.51	6.95	0.65	2087.07
Brick and informal industry	Brick production	BTK	3.64	3.11	0.13	9.80	3.81	0.22	1714.10
		Clamps	4.18	1.59	0.58	9.80	3.81	0.22	1714.10
		Zig-zag firing	2.00	0.32	0.17	9.80	3.81	0.22	1714.10
		Vertical-shaft brick kiln	2.30	0.05	0.95	9.80	3.81	0.22	1714.10
		Non-fired bricks	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Informal industry	Traditional biofuel	5.61	0.67	2.24	0.43	0.72	11.21	13.14
		Gasifier	0.77	0.10	0.25	0.27	0.74	4.30	13.14
Transport	Passenger - private	Gasoline BS III	4.38	0.23	3.45	0.19	32.42	98.42	2810.25
		Gasoline BS IV	0.88	0.05	0.69	0.15	22.69	68.89	2810.25
		Gasoline BS V	0.88	0.05	0.69	0.15	12.97	68.89	2810.25
		Gasoline BS VI	0.44	0.02	0.35	0.15	2.59	19.68	2810.25
		CNG	0.00	0.00	0.00	0.00	10.79	1.80	2781.00
		Electric	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Passenger - public	Diesel BS III	6.78	1.18	0.38	0.54	39.23	5.99	2365.94
		Diesel BS IV	1.36	0.24	0.08	0.43	27.46	4.19	2365.94
		Diesel BS V	1.36	0.24	0.08	0.43	15.69	4.19	2365.94
		Diesel BS VI	0.68	0.12	0.04	0.43	3.14	1.20	2365.94
		CNG	0.00	0.00	0.00	0.00	17.37	0.01	3884.58
		Electric	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Freight	Diesel BS III	6.78	4.44	1.43	0.73	44.93	10.10	2590.35
		Diesel BS IV	1.36	0.89	0.29	0.58	31.45	7.07	2590.35
		Diesel BS V	1.36	0.89	0.29	0.58	17.97	7.07	2590.35
Diesel BS VI		0.68	0.44	0.14	0.58	3.59	2.02	2590.35	
Residential	Cooking	Traditional biofuel	5.61	0.67	2.24	0.43	0.72	11.21	13.14
		Gasifier	0.77	0.10	0.25	0.27	0.74	4.30	13.14
		Kerosene	0.61	0.17	0.33	0.02	0.00	17.03	2985.00
		LPG	0.32	0.01	0.05	0.32	0.00	18.80	3085.00
		Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lighting	Kerosene	93.00	90.00	0.40	0.02	0.00	0.00	2770.00
		Electricity and solar	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Space heating	Wood	4.10	0.70	1.90	0.10	0.00	6.90	135.80
		Electric and solar	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Diesel genset	Diesel	6.90	4.55	1.45	0.68	97.17	7.74	3186.12
		Electric and solar	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agriculture	Agricultural residue burning	Open residue burning	6.10	0.58	2.18	0.48	2.93	13.38	0.00
		Deep sowing mulching tech	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Agricultural pumps	Diesel	6.90	4.55	1.45	0.68	97.17	7.74	3186.12
		Electric and solar	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Agricultural tractors	Diesel	17.00	11.00	4.00	0.68	126.00	0	1.14

^a BTK = Bull's trench kilns; BS = Bharat stage; CNG = compressed natural gas; IGCC = integrated gasification combined cycle; LPG = liquefied petroleum gas; PAT = Perform Achieve and Trade Initiative; TPP = thermal power plant.

References for Appendix E

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