Quality of Life for All:

A Sustainable Development Framework for India's Climate Policy

CSTEP

CENTER FOR STUDY OF SCIENCE, TECHNOLOGY & POLICY

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August 2015

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Executive Summary

India and other countries are expected to submit their Intended Nationally Determined Contributions (INDCs) for the Conference of Parties (COP-21) in December 2015. Keeping in mind the expectation that India will experience severe impacts from global warming and the fact that a large proportion of people still require basic needs and energy services, CSTEP conducted a study examining two scenarios for India's development by 2030: policy or Business as Usual (BAU) and Sustainable Development (SD) or quality of life.

The study builds on the India Energy Security Scenarios (IESS) 2047 tool developed by NITI Aayog by adding a 'quality of life' dimension to the energy and emissions pathways.

Impact of SD pathway on energy and emissions

When we considered improvements in quality of life using SD indicators such as fresh water, clean air, food security and energy services, we found that greenhouse gas emissions were reduced by close to 30% and energy use by 25% compared to BAU. The SD pathway reduced emissions intensity by 16% compared to 2012 and fossil free sources contributed to about a third of our electricity.

Renewable Energy (RE) generation and reduction in Transmission and Distribution losses offer significant scope for emission reductions in the power sector under an SD scenario. Industries and buildings also contribute to substantial reductions over BAU.

A significant increase in the demand of imported fuels is likely under BAU scenario (6.5 times increase in imported coal), which could threaten energy security in case of price volatilities and geopolitical uncertainty. Interventions to reduce service demands, improve energy efficiency and switch to cleaner fuels under the SD scenario can reduce the demand for imported coal and oil by 40% and 24% respectively and increase gas imports by 58%.

Impact of SD pathway on quality of life and sustainability metrics

Ambient air pollution reduces by 30% on average, on account of increased use of public transport, improved energy efficiency in industry, increase in RE generation and more stringent pollution control measures in thermal power plants. Aggressive penetration of modern cooking fuels more than halves the morbidity due to a reduction in indoor air pollution from traditional cooking.

Significant water savings are possible by rationalising water tariffs for large consumers, better water accounting practices, mandating green buildings by-laws, ensuring investment in the agricultural sector to improve water-use efficiencies and switching to RE generation options.

A switch to alternate materials in building and industry sectors and change in agricultural fertiliser practices can significantly reduce the material and resource requirement and improve soil health.

Therefore, we recommend that India make a commitment to a quality of life pathway for its INDC.

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List of Acronyms

AAP	Ambient Air Pollution
BAU	Business-as-Usual
BCM	Billion Cubic Meter
BEE	Bureau of Energy Efficiency
BPKM	Billion Passenger Kilometer
CAGR	Compounded Annual Growth Rate
CFL	Compact Fluorescent Lamp
CO	Carbon Monoxide
CO_2e	Carbon Dioxide Equivalent
COP	Conference of Parties
DALYs	Disability Adjusted Life Years
DRI	Direct Reduced Iron
EFOM	Energy Flow Optimization Model
ESP	Electrostatic Precipitate
EV	Electric Vehicle
FAR	Floor Area Ratio
FGD	Flue Gas Desulphurisers
FSA	Floor Space Area
GDP	Gross Domestic Product
GHG	Greenhouse Gas Emissions
GW	Gigawatt
GWP	Global Warming Potential
IAP	Indoor Air Pollution
ICS	Improved Cook Stoves
IESS	India Energy Security Scenarios
INDC	Intended Nationally Determined Contribution
INR	Indian Rupee
LPG	Liquefied Petroleum Gas
MCM	Million Cubic Metres
Mha	Million Hectares
Mt	Million Tons
MTPA	Million Tons Per Annum
NAPCC	National Action Plan on Climate Change
NMT	Non-motorised Transport
PM2.5	Particulate Matter
PNG	Piped Natural Gas
RWH	Rainwater Harvesting
SD	Sustainable Development
SEC	Specific Energy Consumption
SO2	Sulphur Dioxide
SPM	Suspended Particulate Matter
SWH	Solar Water Heater
T&D	Transmission and Distribution
TPES	Total Primary Energy Supply
TPP	Thermal Power Plant
TWh	Terawatt-hours
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile Organic Compounds

Introduction

India is soon expected to announce its Intended Nationally Determined Contribution (INDC) in preparation for the Conference of the Parties (COP-21) in December 2015. `

This study by CSTEP proposes an analytical framework to view India's growth and emissions trajectory through a 'people's lens'. The objective of our study is to examine a scenario in which we improve air quality, enhance availability of fresh water, provide cleaner cooking fuels, enhance energy services, promote efficiency in use of resources and facilitate food security. If we developed along a path that improved quality of life, what would be the implications for various sectors and for greenhouse gas emissions by 2030?

We argue that the central tenet of India's climate strategy should be the commitment towards a Quality of Life or Sustainable Development (SD) paradigm, rather than narrowly focussing on emissions. Our results suggest that such an approach can also reduce the intensity of GHG emissions and provide strategic opportunities for India's development path and climate policy.

Framework and Approach

The study builds on the India Energy Security Scenarios (IESS) 2047, a tool developed by NITI Aayog to evaluate the energy demand and supply scenario of various sectors such as agriculture, buildings, industries, power and transport. A bottom-up energy system model (TIMES- The Integrated MARKAL EFOM System) is used to examine several combinations of technology and policy options based on constrained optimisation (1). This ensures that the SD pathway is strictly relevant to national and international contexts. Figure 1 provides a diagrammatic representation of TIMES.

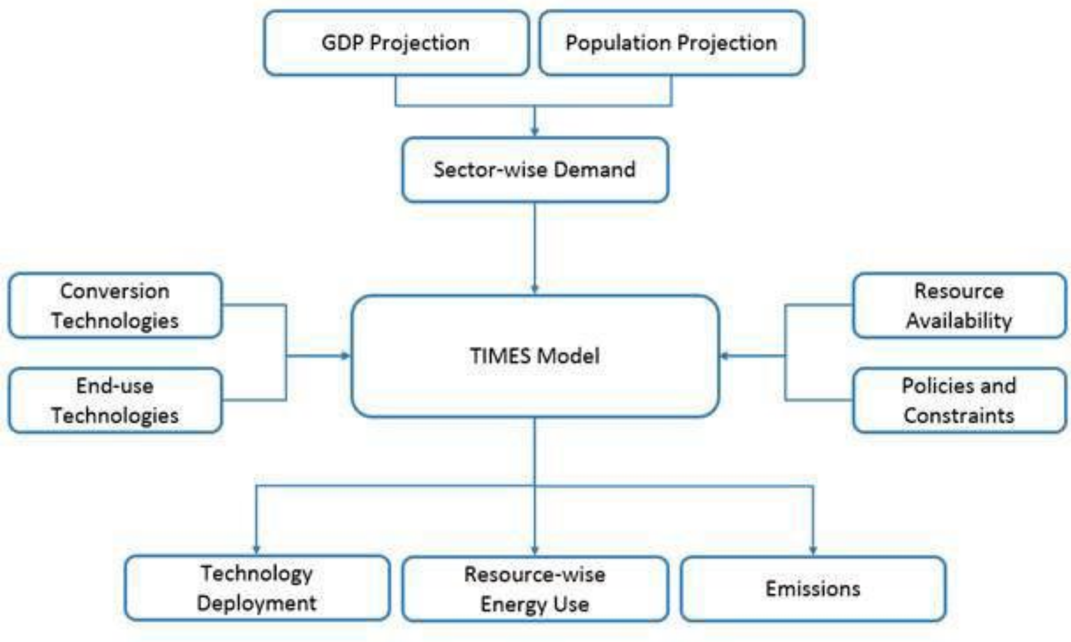

Figure 1: Representation of the India-Multi Region TIMES Model

In order for India to transition to a SD pathway, we outline the key sustainability challenges that need to be managed by identifying the following:

1) Drivers: Macroeconomic factors determining growth in demand of resource consuming goods and services

2) Pressures: Key sustainability challenges in the sector and sustainability indicators to measure the state of resource use or impact; and

3) Response: Interventions that reduce the pressure state of the indicators. Figure 2 illustrates the above approach followed by this study.

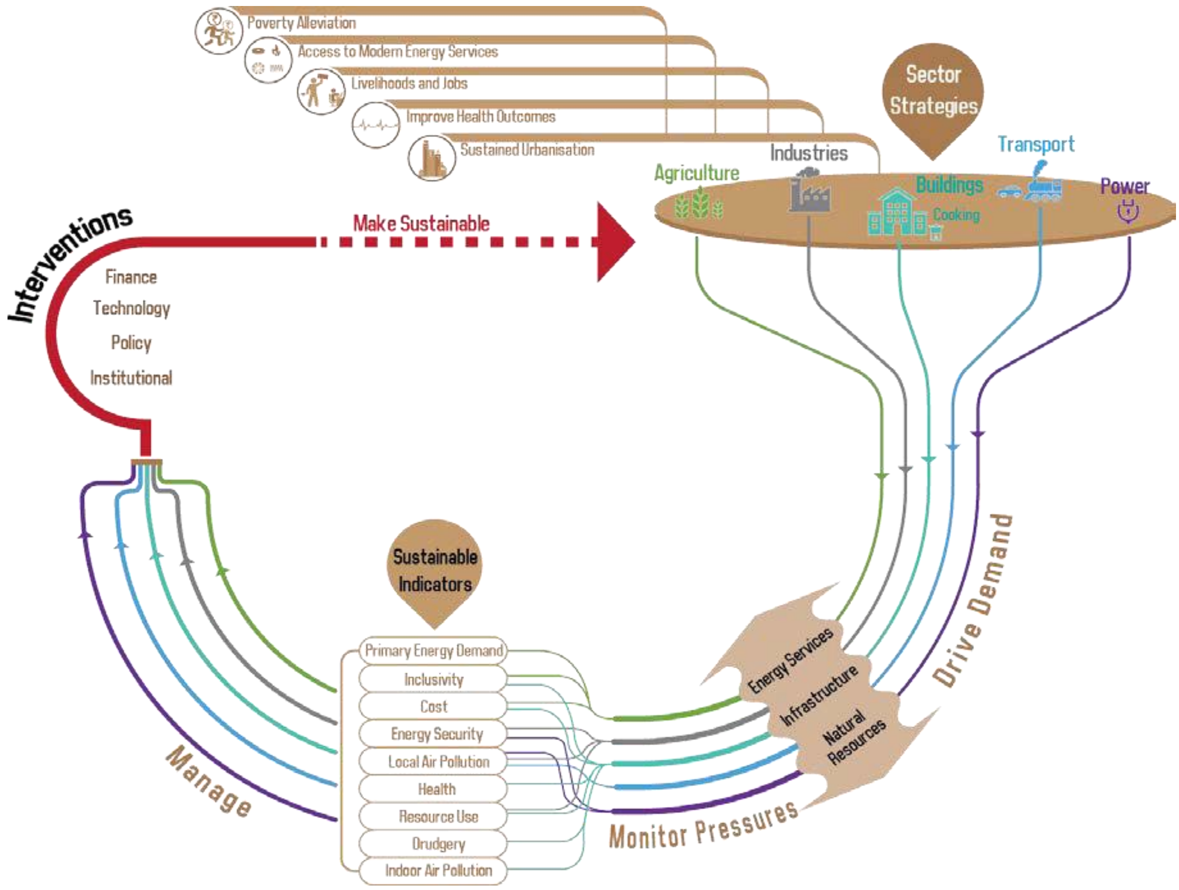

Figure 2: Approach to the Study

Two scenarios are constructed to compare the implications of business-as-usual (BAU) activities in various sectors versus an SD scenario that aims to significantly improve factors associated with improving the living conditions for people. Sector-wise details of interventions examined in the two scenarios are available in the Appendix.

Key Findings

This section outlines the key findings for sustainability across the BAU and SD scenarios for 2030.

Energy Demand

The total energy demand in 2012 was 4,696 TWh, of which the residential sector contributed 45% followed by industry at 29%. In BAU (2030), the demand is likely to more than double to 10,693 TWh with the industrial share increasing to 43% on account of robust manufacturing sector growth. Residential demand reduces on account of provision of cleaner cooking fuels and technologies with better efficiencies. Commercial sector grows at 12% primarily due to high growth in floor-space and high penetration of air-conditioners.

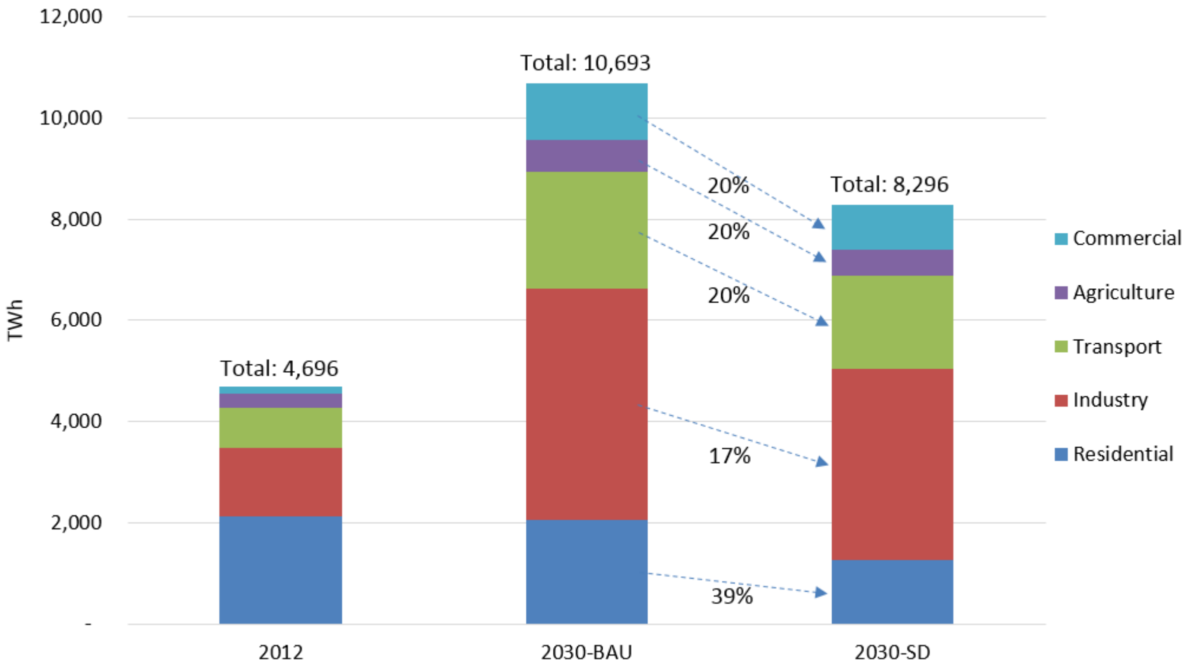

Figure 3: Final Energy Demand

The SD scenario indicates that over 22% of the BAU energy demand can be avoided through various interventions (refer to Appendix) across sectors. Energy demand thus grows in a manner that significantly alleviates pressures on the energy sector. Most sectors decrease their demand by about 20%, except the residential sector where aggressive penetration of modern cooking technologies and efficient appliances leads to about 40% reduction in energy demand.

Figure 4 shows the electricity demand, which grows from 745 TWh in 2012 to 3,343 TWh in 2030 in the BAU scenario (at 9% CAGR). Industry remains the chief consumer of electricity (including captive generation).

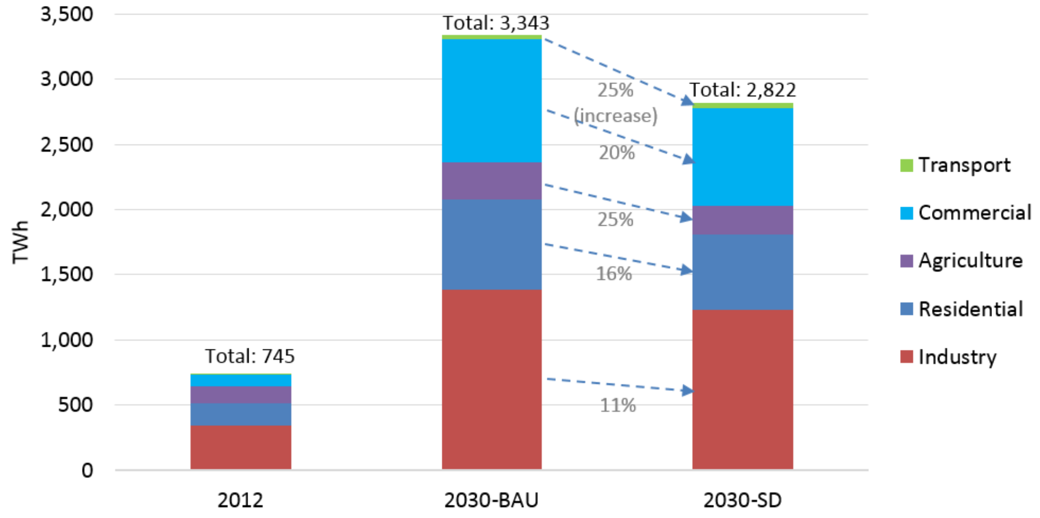

Figure 4: Electricity Demand

In the SD scenario, improved energy efficiency can reduce electricity demand by 521 TWh, or 16% compared to BAU. The transport sector's electricity consumption is likely to increase owing to higher penetration of Electric Vehicles (EVs).

Energy Supply

In the BAU scenario, Total Primary Energy Supply (TPES) grows almost three-fold from 6,355 TWh in 2012 to 17,538 TWh in 2030 (6% CAGR). TIMES model ensures that all energy demand is met based on technology, policy and resource constraints in the most cost-effective manner. Accordingly, the share of coal supplying this energy increases from 39% in 2012 to 62% in 2030. Based on the recent government announcements 1,500 MTPA of domestic coal mining capacity is assumed to be achieved by 2030.

The BAU scenario has 7% share of fossil-free energy that includes nuclear, hydro, wind, solar, and biomass used for electricity generation. Although a significant portion of biomass is procured commercially by households for cooking and heating applications, this is not considered as clean energy due to its negative effects on health.

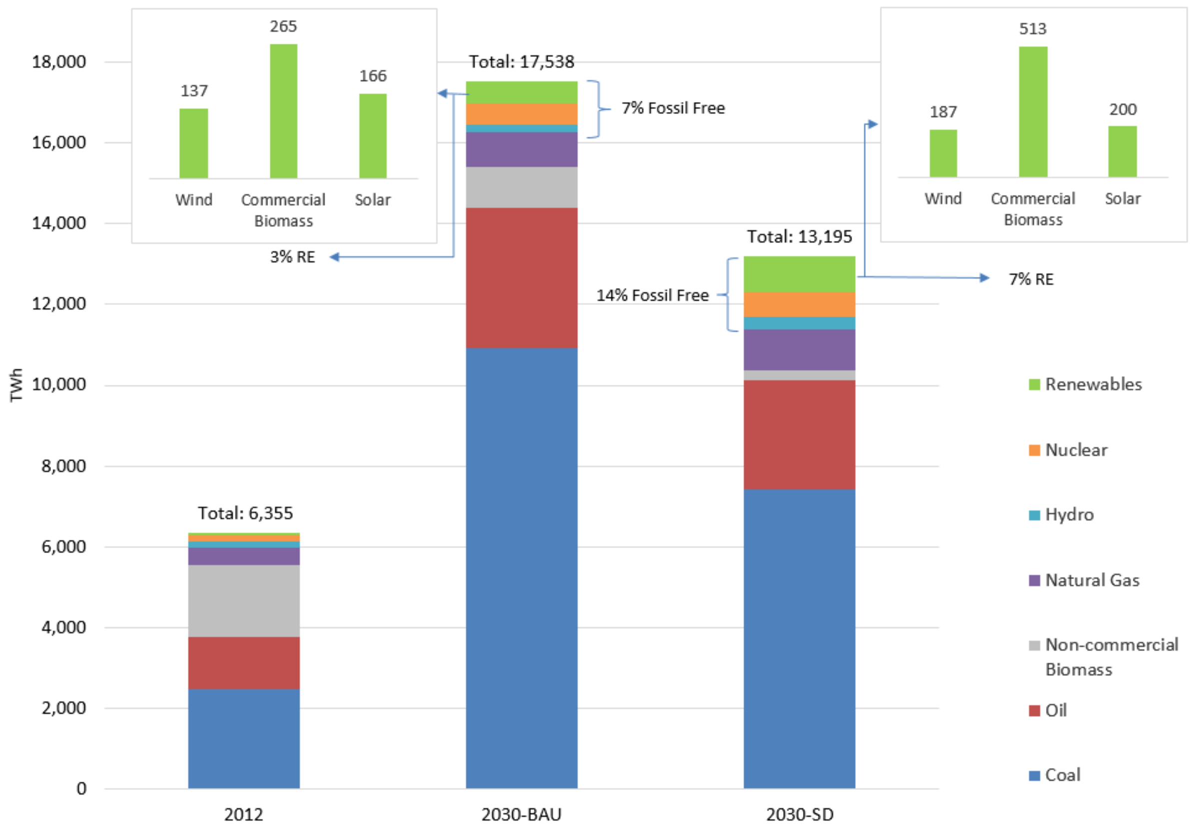

Figure 5: Total Primary Energy Supply

In the SD scenario, TPES reduces by 4,343 TWh (25%) compared to BAU owing to increased efficiency in energy use and in electricity transmission and distribution (T&D). The shift towards renewable energy across agriculture, industry and electricity sectors results in the share of fossil-free energy doubling to 14% compared to BAU.

Figure 6 shows that electricity (net) generation will need to grow over four times to accommodate the growing electricity demand in the BAU scenario. Reliance on coal-based electricity will increase from 70% in 2012 to 80% by 2030, despite the share of renewables doubling in the mix.

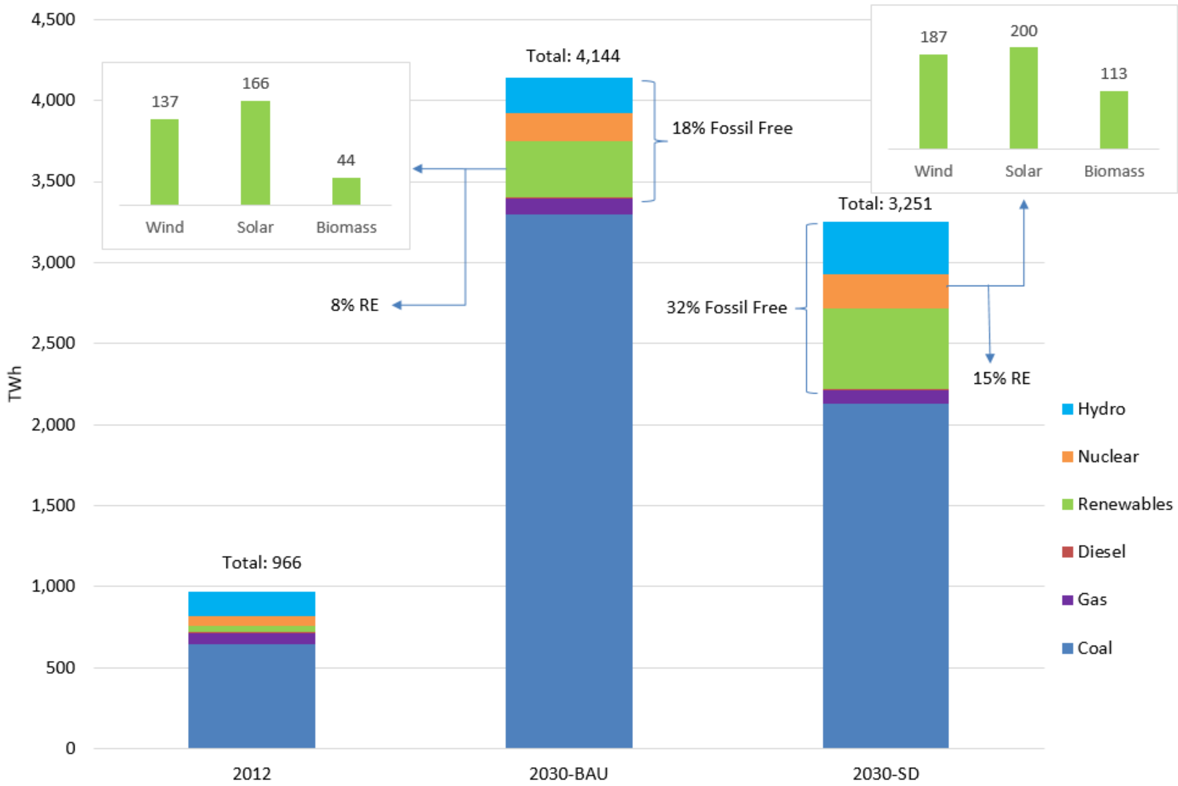

Figure 6: Fuel wise Electricity Generation

Electricity generation requirements reduce in the SD scenario by 893 TWh (27%). Figure 4 shows that 521 TWh of this reduction is on account of improved energy efficiency in demand sectors. Approximately 100 TWh is imported from neighbouring countries in the SD scenario. The balance of 272 TWh savings is due to aggressive T&D loss reductions across the country. While coal remains the primary source of supply, its contribution reduces to 66% of net generation in the SD scenario. Almost a third of electricity is supplied by fossil-free sources, and renewables contribute significantly (15%) to electricity supply.

Figure 7 provides the implications of the electricity generation scenarios on installed capacity. Installed capacity will need to increase from 251 GW in 2012 to 819 GW in 2030 in the BAU scenario. Renewables will contribute 180 GW in BAU.

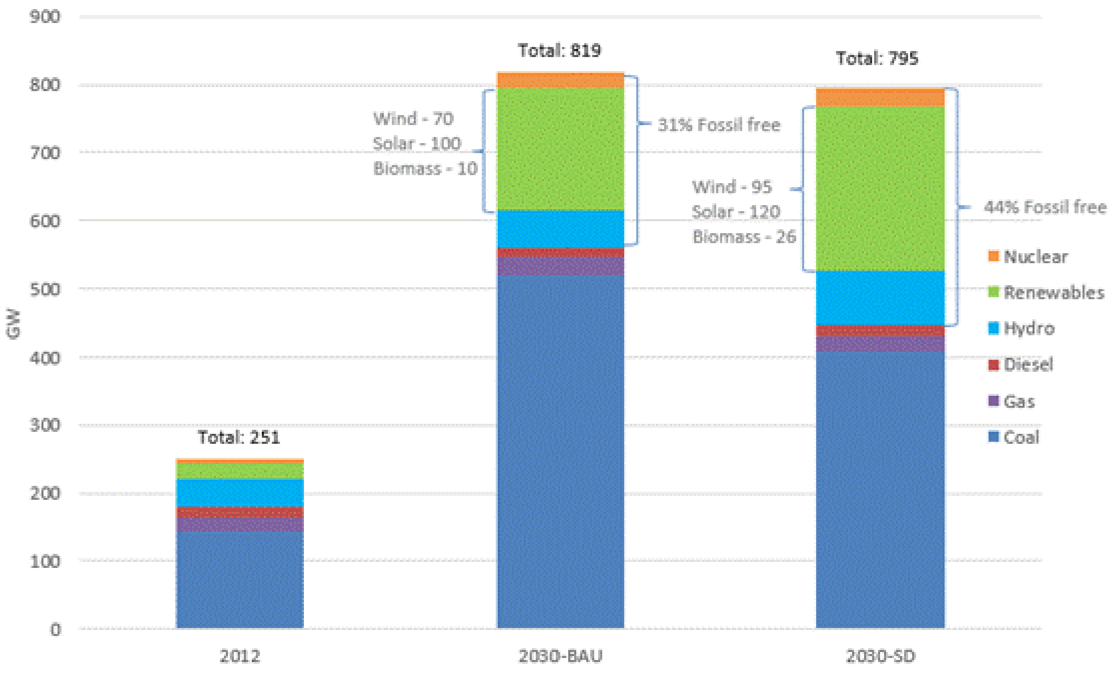

Figure 7: Installed Capacity

In the SD scenario the installed capacity reduces by 25 GW; most notably 112 GW of coal capacity is avoided. Installed capacity of renewables increases by 61 GW.

Import Dependence

Figure 8 provides the fossil fuels imported in 2012, and in 2030 in the BAU and SD scenarios. Coal imports increase by 6.5 times, oil by 1.5 times and gas imports double by 2030 in the BAU scenario. Securing supplies of fossil fuels amidst competing demand from other nations, price volatilities, and geopolitical uncertainties will prove to be a key challenge going forward.

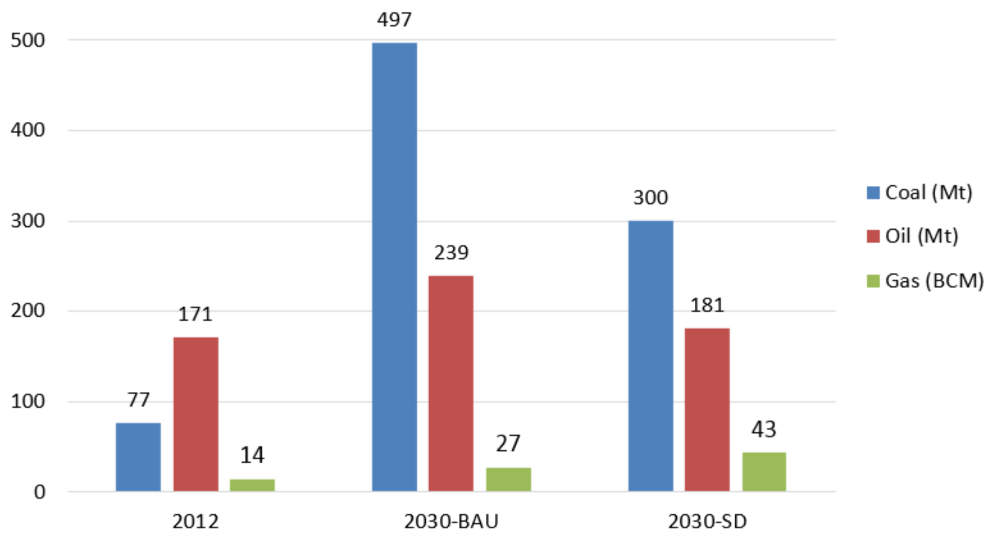

Figure 8: Energy Imports

Coal imports reduce by 40%, oil by 24% and gas imports increase by 58% in the SD scenario compared to BAU. The reduction in coal and oil can primarily be attributed to reduced coal-

based electricity generation, modal shift and compact city interventions (that reduce the share of motorised demand and average trip lengths in passenger transport), shift to rail-based freight movement, and process shifts, improved energy efficiency and alternate raw material use in industries. Increase in natural gas is attributable to meeting clean cooking demands, shift to entirely gas based nitrogenous fertiliser production, increased gas-based production of sponge iron, and enhanced CNG use in transport.

It is necessary to commensurately improve natural gas availability for the applications mentioned above, especially given the investments proposed in provisioning the distribution infrastructure for natural gas.

Air Pollution

Figure 9 provides ambient air pollution from combustion of fossil fuels in industrial, transport and electricity generation sectors. The pollution is represented as annual loads of Suspended Particulate Matter (SPM), Oxides of Nitrogen (NO_x), Sulphur Dioxide (SO_2), Carbon Monoxide (CO) and Volatile Organic Compounds (VOC). In the BAU scenario, these emissions almost double from 2012 due to enhanced activity in these sectors, and limited efforts at improving energy efficiency, pollution control and switching to cleaner fuels.

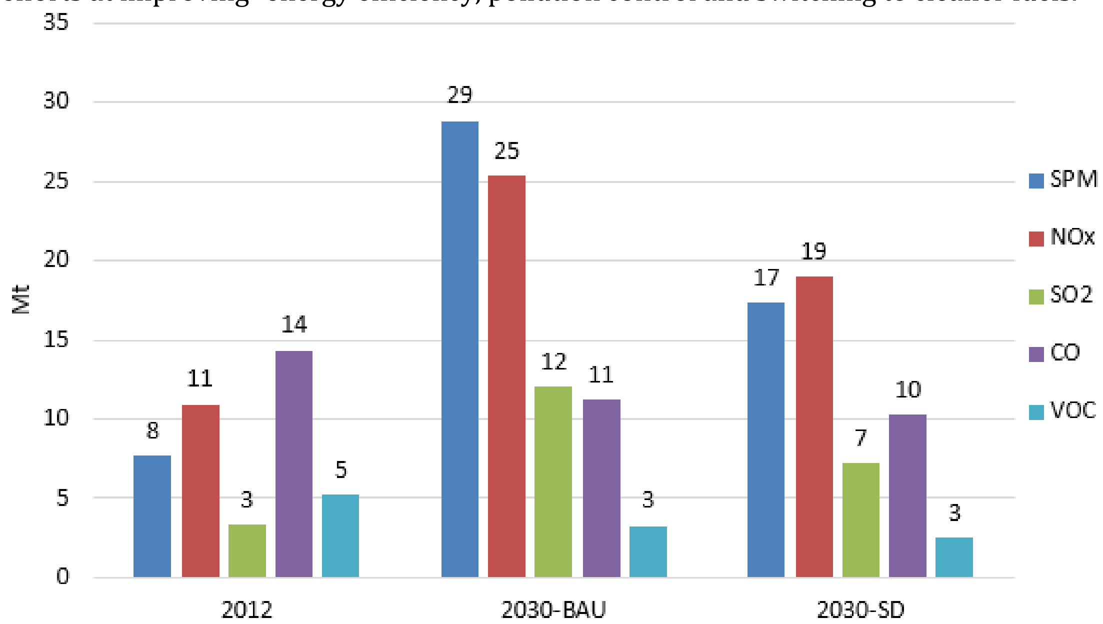

Figure 9: Ambient Air Pollution

In the SD scenario, air pollution reduces by 30% on average due to reduced vehicular activity through promotion of non-motorised transport and public transport, process upgradation and improved energy efficiency in industry, higher RE penetration in electricity, and pollution control measures in thermal power plants (TPPs). Electrostatic bag filters, flue gas desulphurisers, and Low NO_x burners are key interventions in thermal power plants that reduce PM, SO_2 and NO_x emissions by 10% in the SD scenario at an additional 10-15% of capital costs of these plants.

Indoor air pollution (IAP) from traditional cooking fuels in households is a premier contributor to mortality and morbidity in India. Improving access to cleaner cooking fuels and technologies can significantly mitigate these impacts. The onus of collecting fuel wood for cooking disproportionately falls on women and children. This also makes them vulnerable to back injuries and limb deformation, and prevents them from engaging in

other useful activities such as education and income generation. Figure 10 provides a summary of these outcomes in the two scenarios.

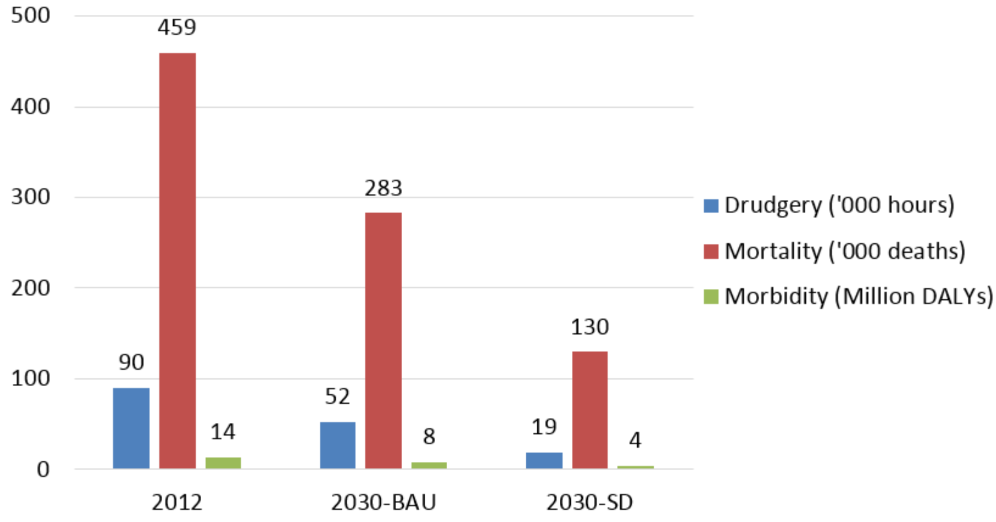

Figure 10: Drudgery, Deaths and DALYs due to Household Cooking

While there is progress in providing clean cooking fuels and technologies in the BAU scenario, (leading to reduction in indoor emissions of black carbon, carbon monoxide, and organic carbon), this effort is increased significantly in SD scenario. This is due to aggressive penetration of LPG in rural and PNG in urban sectors, which more than halves the negative impacts associated with traditional cooking fuels.

Land

Extraction of metals and minerals is known to cause significant damage to land and water bodies. This threatens ecosystems and livelihoods relying on this mineral rich land for their subsistence. The SD scenario envisages a shift towards alternate materials that reduce land footprint and the consequent waste generated from mining activities. Table 1 gives the land footprint from mining in 2012, and BAU and SD scenarios in hectares

Table 1: Land Footprint from mining (hectares)

	2012	2030-BAU	2030-SD	Saving
Coal	13,259	41,438	29,407	29%
Limestone	2,819	9,613	7,872	18%
Bauxite	57	201	158	21%
Iron Ore	1,198	4,463	3,308	26%
Total	17,332	55,715	40,745	27%

The story of Indian urbanisation also paints a stressful picture on land resources. The 100 largest cities in India account for 43% of GDP and 16% of the population using only 0.24% of the land area. Owing to competing use of land and rapidly increasing population densities in urban areas, land footprint of buildings will have a bearing on their supply and prices.

Improving Floor Area Ratio (FAR) of urban residential buildings and commercial establishments, and increasing the penetration of high-rise housing can reduce the land footprint of urban buildings from 10, 489 million sq. m. in BAU to 7, 316 million sq. m. in SD. This implies a saving of 43% or 3,173 million sq. m. in the SD scenario.

Water

Various estimates have shown that rising water demands from agriculture, industry and building sectors are likely to cause severe stress on water resources in the future. Ministry of Water Resources has indicated utilisable water of 1,123 BCM against an estimated demand of 710 BCM by 2025. Other studies have projected over 1,000 BCM of demand by 2025. Further, 17% of the population will face absolute water scarcity, with only 1,235 cm^3 per capita availability in 2050.

Table 2 highlights the water impact of various sustainability interventions across sectors. Enhanced micro irrigation provision, alternate wetting and drying for rice cultivation and appropriate measurement of soil moisture can enable significant water savings from agriculture. In the industrial sector, enhanced waste water recovery and reduced mining requirements in the SD scenario generate savings of water that can be recycled into industrial processes or contribute to groundwater recharge. Leaching of waste water from industries and ash dykes can significantly pollute fresh water bodies and contaminate water tables. Closed water cooling systems in thermal power plants consume up to $4m^3$ per MWh of electricity generated. Dry handling of Electrostatic Precipitate (ESP) and concentrating the ash slurry can significantly reduce the water requirement from TPPs. Dry cooling towers can also reduce water demand for cooling with an increase in 15% over capital costs of power plants.

Table 2: Water Impacts of Sustainability Interventions (MCM)

Water Sectors	2030-BAU	2030-SD	Improvement
Industrial Waste Water Recovery	2,700	4,724	74%
Rooftop Rainwater Harvesting	748	2,016	169%
Water Savings in Agriculture	69,000	146,000	111%
Water Demand from TPPs	9,209	6,519	29%
Water Footprint from Mining	25,967	18,669	28%

The key levers to achieve these water savings are rationalising water tariffs for large consumers, better water accounting practices, mandating green buildings in building by laws, investment in improving agricultural water-use efficiencies, and switching to RE options.

Waste and Material Use

A key indicator in the SD scenario is how much goods and resources are demanded for development activities. In agriculture, imbalanced application of chemical fertiliser and lack of organic manure is leading to nutrient deficiency and reduction of organic carbon in the soil. This negatively affects soil health, water retention, microbial activities, soil aeration and nutrient retention, leading to reduced agricultural productivity. Thus, integrated nutrient practises such as proportionately higher application of organic manure as well as bio-fertilisers are important to improve the nutrient balance in soils. In the SD scenario, fertiliser consumption reduces by 21% compared to the BAU scenario, resulting in 99 kg/ha of fertiliser consumption in SD compared to 122 kg/ha in BAU.

TPPs and industries such as, iron and steel, cement, aluminium and paper rely on materials that are financially and environmentally costly to extract. Moreover, there is a finite life for the known raw material reserves at current rates of extraction, beyond which it may become very challenging to secure their supplies. Table 5 provides the raw material requirements for various industries in the BAU and SD scenarios, and the years until expiry of known reserves (validity) based on current rates of extraction.

Table 3: Raw Material Requirements for Select Industries

Industry	Raw Material	Validity (years)	Raw Material Requirement (Mt)			
			2012	2030-BAU	2030-SD	Saving
TPPs/Industries	Coal		430	1,658	1,176	29%
Steel	Iron Ore	29	120	446	331	26%
Cement	Limestone	35	282	961	787	18%
Aluminum	Bauxite	46	6	20	16	21%
Paper	Wood		6	17	10	39%
	Trees (million nos.)		12	36	22	39%

In the industrial sector, this reduction in primary raw material demand in the SD scenario implies an increased demand for substitute materials. This is provided in Table 4.

Table 4: Alternate Material Requirements

Industry	Alternate Material	Alternate Material Requirement (Mt)			
		2012	2030-BAU	2030-SD	Increase
Steel	Scrap Steel	13	53	130	147%
Cement	Fly Ash	45	162	240	48%
	Blast Furnace Slag	6	28	40	44%
Aluminum	Scrap Aluminum	0.3	1	2	100%
Paper	Recycled Paper	4	7	9	21%

Overcoming the gap in affordable housing, and catering to increased demand for housing and commercial buildings will have profound impact on construction material requirements. Studies have indicated how vertical expansion leads to overall reduction in material requirements. Table 5 presents the cumulative material requirements in the BAU and SD scenarios, with the difference attributable to a greater vertical expansion of building floor-space in the SD scenario.

Table 5: Material Requirements for Buildings

Materials (units)	2012	2030-BAU	2030-SD	Saving
Bricks (Billion)	1,222	13,387	13,848	-3%
Cement (Mt)	106	1,215	1,276	-5%
Steel (Mt)	11	126	123	2%
Coarse aggregate (MCM)	211	2,412	2,261	6%
Brick aggregate (MCM)	48	565	588	-4%
Timber (MCM)	13	146	134	8%
Lime (Mt)	7	80	70	13%
Surkhi (MCM)	22	261	218	16%
Bitumen (kt)	890	10,263	8,984	12%
Glass (million m^2)	39	448	406	9%
Primer (million lit.)	43	494	449	9%
Paint (million lit.)	67	774	699	10%

Bricks, cement and steel are major contributors to cost and therefore offer the most significant potential for cost savings through recycling and use of alternate materials. Green buildings can further reduce demand for these materials by up to 25% by proper utilisation of construction waste.

Waste Generation

Mining activities are responsible for generating waste that affects land, and water bodies and tables. Table 6 accounts for the waste generated from mining activities in 2012 and BAU and SD scenarios.

Table 6: Waste Generated from Mining

Raw Material	Waste Generated (Mt)			
	2012	2030-BAU	2030-SD	Saving
Coal	1,945	6,080	4,315	29%
Limestone	295	1,006	824	18%
Bauxite	3	12	10	21%
Iron Ore	112	416	308	26%

Use of alternate materials such as fly ash in Portland Pozzolana Cement brings benefits to TPPs in terms of reduced resource requirement for fly ash ponds. Fly ash disposal accounts for 35% of the land (18 ha/Mt ash generated) and 40% (Ash: Water=1:10) requirement in TPPs where ash is handled in wet form. Fly ash utilisation in TTPs increases from 34% in BAU to 75% in SD (Table 4).

The increased uptake of Light Emitting Diode (LED) lighting in the SD scenario leads to Compact Fluorescent Lamp (CFL) stock displacement, which also checks mercury accumulation. Each CFL contains 5-6 milligram of mercury. Based on the difference in cumulative CFL retirements between BAU and SD scenario we estimate that around 10-12 tonnes of mercury waste will be avoided in the SD scenario.

Implications for India's INDC

The key insight for India's INDC is in terms of GHG emissions reduction along an SD pathway that significantly improves quality of life. Figure 11 demonstrates how different sectors contribute to emissions reduction in SD scenario versus the BAU. RE generation, industrial sector, T&D loss reduction, and residential and transport sectors contribute the most to emissions reductions in the SD pathway. The interventions described in the Appendix provide the necessary guidelines towards achieving these emission reductions.

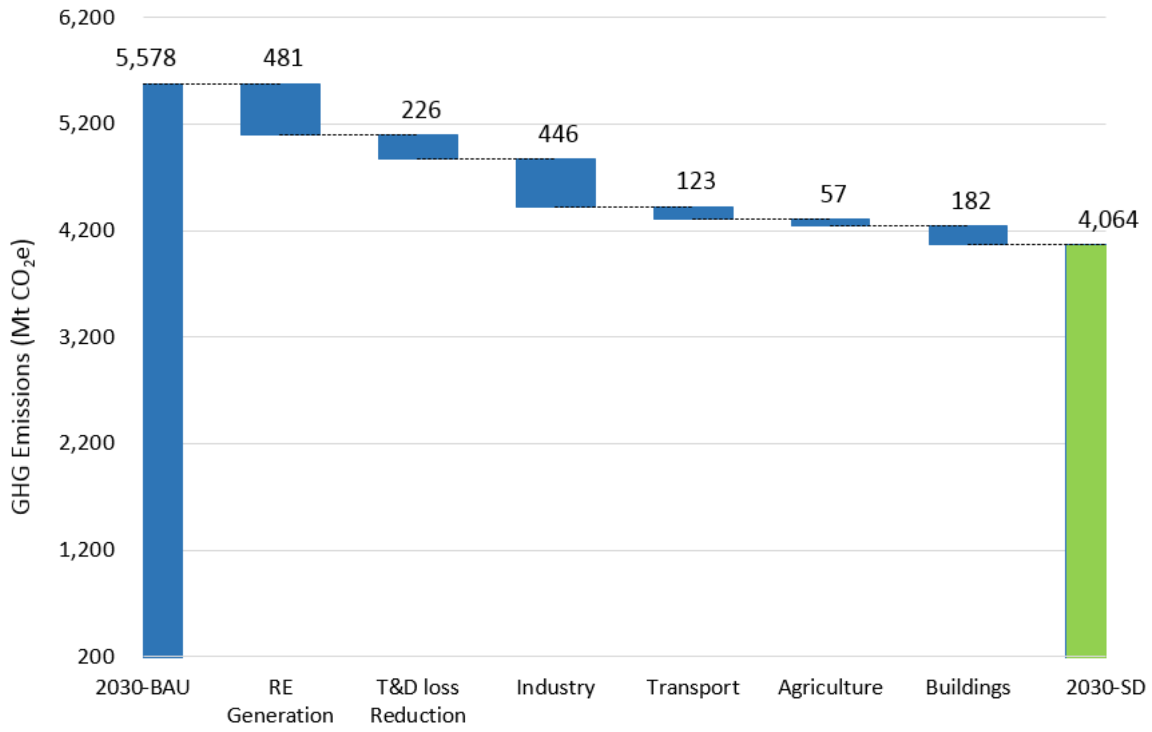

Figure 11: Emissions in BAU and SD Pathways

The scenarios are designed taking into account a 6.5% projected growth rate of the economy till 2030. Accordingly, energy and emissions intensity are obtained for 2012 and 2030 in both the scenarios. Figure 12 and Figure 13 provide these results.

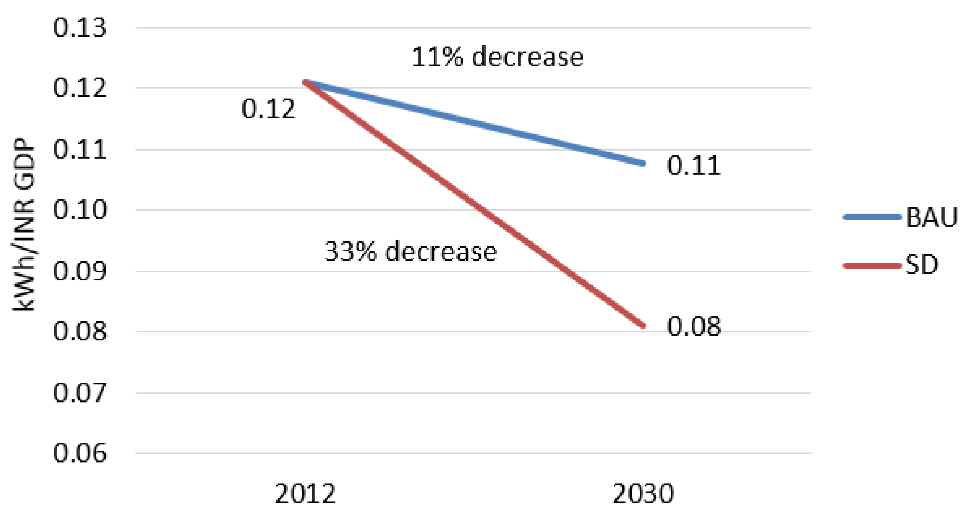

Figure 12: Energy Intensity in BAU and SD Pathways

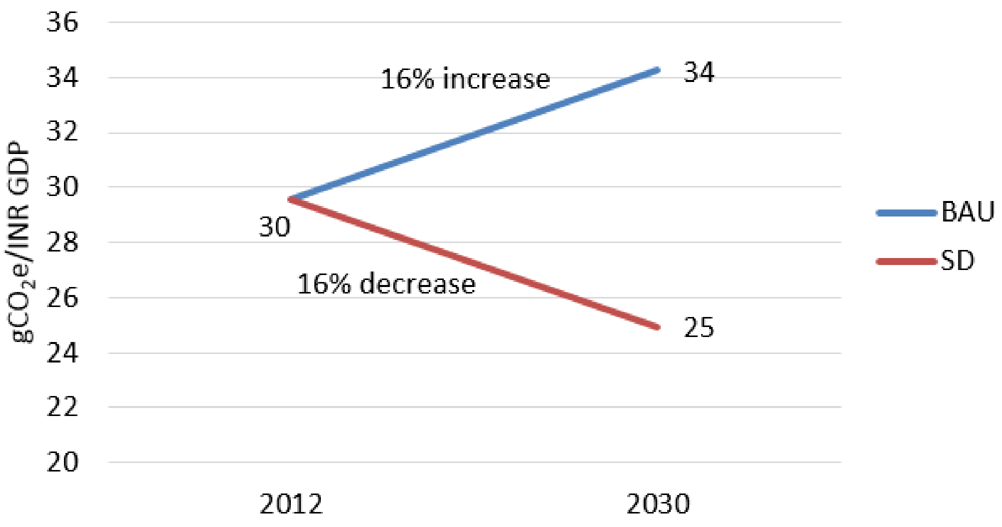

Figure 13: Emissions Intensity in BAU and SD Pathways

In the BAU scenario, the energy intensity improves to 0.11 kWh/ INR in 2030 compared to 0.12 kWh/INR in 2012, while the emissions intensity increases to 34 gCO2e/ INR from 30 gCO2e/ INR. On the other hand, the SD scenario offers additional reductions in energy and emissions intensities to 0.08 kWh/ INR and 25 gCO_2e/ INR, representing 33% and 16% decrease compared to 2012 respectively.

Conclusions

The SD scenario demonstrates how various factors affecting quality of life- access to electricity services and clean cooking fuels, reduced natural resource extraction and associated impacts, reduced import dependence and waste generation- can be addressed whilst reducing overall energy production and use in the economy.

The study proposes a 16% emissions intensity reduction compared to 2012 levels based on a 33% reduction in energy intensity, and 14% contribution of fossil-free sources in energy supply and 32% in electricity generation by 2030.

We recommend such a 'quality of life' paradigm and associated emission intensity reduction as India's INDC for the upcoming COP.

Appendix: Sector-wise Sustainability Interventions

Interventions	BAU	Sustainable scenario
Agriculture		
Increase area under micro-irrigation schemes	Area under micro-irrigation increases from 1.5% of gross cropped area (~3 Mha) in 2012 to 6% (~13 Mha)	13% (~29 Mha) of gross cropped area under micro-irrigation
Water saving techniques for wheat and rice cultivation	Applied on 10% (~9 Mha) of gross cropped area of wheat and rice	Applied on 20% (~17 Mha) of gross cropped area of wheat and rice
Supplementing fertilizers with bio fertilizers	10% (~3 Mt) of chemical fertilizer use supplemented	15% (~5 Mt) of chemical fertilizer use supplemented
Organic farming	Area certified as organic increases from 4% (~5 Mha) of total net cropped area in 2012 to 10% (~15 Mha)	20% of total net cropped area(~30 Mha) certified as organic
Tractor efficiency improvement from 2012	11% improvement in fuel efficiency from 4.5 l/h in 2012 to 4.0 l/h	18% improvement in fuel efficiency to 3.7 l/h
Increase in deployment of solar pumps, reduction in diesel pumps	5% of penetration of solar pumping	15% penetration
Improvement in efficiency of pumps	10-15% improvement in input requirement of electric and diesel pumps	25-30% improvement in input requirement of electric and diesel pumps
Buildings		
Improvement in lighting efficiency	Residential: 30% LED penetration in point and linear lighting Commercial: 30% penetration of LEDs; 50% penetration of high efficiency CFLs	Residential: 80% penetration of LEDs in point and 70% in linear lighting Commercial: 60% penetration of LEDs; 35% penetration of high efficiency CFLs

Improvement in appliance efficiency	Residential: 5-20% penetration of highly efficient appliances Commercial: 30% penetration of highly efficient appliances	Residential: 50-60% penetration of highly efficiency appliances Commercial: 60% penetration of highly efficient appliances
Improvement in building design and equipment controls	Up to 30% penetration over different types urban residential buildings 10-20% penetration over commercial FSA	Up to 60% penetration over different types of urban residential buildings 40% penetration over commercial FSA
Setting AC Thermostat Temperature higher by 2%	Not applied	13% savings in energy consumption of Air Conditioners
Solar Water Heating (SWH)	16 million m^2 of residential and 4 million m^2 of commercial FSA under SWH	48 million m^2 of residential and 12 million m^2 of commercial FSA under SWH
Using Low GWP coolants in refrigerators and air-conditioners	85% penetration of R410-A in ACs 70% penetration of HFC- 134A in Refrigerators	35% penetration of R-32 and 23% penetration of R-290 33% penetration of HFC-600A
Increasing Floor Area Ratio of Buildings	45% penetration of High Rise Residential buildings (FAR- 7)	60% penetration of High Rise Buildings
Affordable Housing	Affordable Housing Gap met by 2030	Affordable Housing Gap met by 2022
Rainwater Harvesting (RWH)	10% of Residential and 15% of commercial rooftop area employed for RWH	25% of Residential and 40% of commercial rooftop area employed for RWH
Residential : Cooking		
Transition to ICS	25% of rural and 5% of urban households use ICS (58	36% of rural and no urban households use ICS (73 million

	million households)	households)
Improve PNG infrastructure with a focus on domestic supply	23% (33 million) of urban households use PNG	35% (50 million) of urban households use PNG
Biogas plant implementation	4% (8 million) rural households using biogas	8% (16 million) rural households using biogas
Increased use of electric cooking access due to improved electricity access	2% of rural and 2% of urban households use electricity for cooking (7 million households)	6% of rural and 5% of urban households use electricity for cooking (19 million households)
Improve access of LPG to rural areas	25% (51 million) of rural households use LPG as a primary cooking fuel	50% (101 million) of rural households use LPG as a primary cooking fuel
Industries		
Improving Energy Efficiency of Industries	5-8 % reduction in SECs	10-25% reduction in SECs
Process Switching	Steel- Increase in Gas DRI (9% to 12%) and COREX process (10%-12%) Aluminum- Shift to Pre-baked method (70%-75%) Fertilisers- Shift to Natural Gas Feedstock (80%)	Steel- Increase in Gas DRI (9% to 12%) and COREX process (10%-14%) Aluminum- Shift to Scrap (20%-40%) Fertilisers- Shift to Natural Gas Feedstock (100%)
Higher Recycling/ Use of Scrap	15% scrap use in steel 20% scrap use in aluminum 43% recycled fiber use in paper 80% share of blended cement	33% scrap use in steel 40% scrap use in aluminum 65% recycled fiber use in paper 92% share of blended cement

Industrial Waste Water Treatment	Increasing secondary and tertiary treatment by 14% 10% methane recovery	Doubling secondary and tertiary treatment over 2012 30% methane recovery
Transport : Passenger (Urban)		
a) Shift to NMT (walking and cycling) b)Development of compact cities	Reduction in NMT share from 30% in 2012 to 10% in 2030 No compact city intervention, city sprawl trend continues	Maintaining the share of NMT at 30% in 2030 Compact city intervention reduces trip length by 20%
Increase in public transport share	Reduces from the current 46% (road : 44% ; rail 2%) to about 33% (road : 29% and 4% rail)	Public transport ~ 67% share (road : 61% and 6% rail)
Promoting clean technologies (electric vehicles)	Negligible EV vehicles in 2012 to 2% of cars, 9% of 2W and 3% of buses in 2030	4% of cars, 15% of 2W and 5% of buses in 2030
Transport : Passenger (Non-urban)		
Increase the share of rail based transport	Current shares (Road :83%; rail:16%; air:1%) change in BAU to road: 81%; rail: 18% air: 1%	Increase in 2030 to 75% road share, 22% rail and 2% air
Increased Public Transport	Current bus share of 74% reduces to 62% in passenger kilometers travelled	About 71% share of buses in passenger kilometers travelled
Transport : Freight		

Increasing the share of freight transport by railways	61% road and 39% rail by 2030	50% rail and 50% road by 2030
Electricity Supply		
Reduce air emissions (SOx , NOx, PM2.5)	No restrictions of air pollution	SO_2 & PM 2.5emissions restricted to 40% of BAU
Reduce water use in thermal plants through	No water use standards imposed	Reduce water use in power sector by 40% of BAU
a) closed cooling b) fuel mix change	No restrictions	Specific water consumption in thermal plants in India adhere to global standards; share of renewables in power sector increases
Import dependence	Domestic Coal Mining Capacity at 1,500 Mtpa	Domestic Coal Mining Capacity at 1,500 Mtpa
Increase in access to electricity	75% of household access to electric lighting in rural areas in 2030	100% access to lighting in rural areas

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