India Energy Security Pathways
Alternative Projections upto 2047

ICRIER

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The Key Questions

- What is the energy needed in 2047 for a GDP CAGR of 7.4%?
- To what extent can this be met by domestic sources of energy?
- What is the resulting **import dependence**?
- What does this mean for **per capita emission levels** in 2047?
- Can we reduce import dependence by reducing total energy demand for the same growth target ?
- Lower Demand means lower emissions. Can we reduce emissions further by altering the fuel mix?

What the India Energy Security Scenarios, 2047 Do?

The IESS, 2047 identifies **six major energy demanding sectors**

1) Transport 2) Industry 3) Building /Appliances
4) Agriculture 5) Cooking 6) Telecommunications

- In each sector there are 4 alternative levels of effort/choices at reducing demand through energy efficiency

There are **eleven primary energy supplying sectors**

1) Coal 2) Oil 3) Gas 4) Hydro Power
5) Nuclear 6) Onshore Wind 7) Offshore Wind 8) Solar P.V.
9) Solar CSF 10) Bio-energy 11) Municipal Solid Waste

- As in demand sectors, there are 4 levels of effort/choices in enhancing domestic supply to meet the demand

For each set of demand/supply choices (**Pathway),** it calculates the **import dependence, carbon intensity of GDP and emissions per capita**

What it Doesn't Do?

- The IESS, 2047 is ***not*** a model which might capture the effect of intervention in one area on other areas, its an accounting framework.
- The growth rate is exogenously set and the calculator estimates characteristic of each pathway
- The calculator doesn't optimize a pathway in context of costs, emissions or any other implication.
- The main use of the calculator is to indicate the kind and scale of change proposed in each area to achieve the desired levels of import dependence and carbon emissions.
- The calculator balances demand and supply for each year and hence is not reflective of the power and energy deficit scenarios for each year.

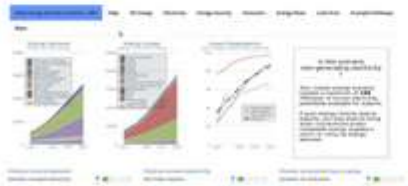
India Energy Security Scenarios-2047

The India Energy Security Scenarios 2047(IESS 2047)

The Planning Commission of India has developed an energy scenario building tool, the India Energy Security Scenarios 2047, which explores a range of potential future energy scenarios for India, for diverse energy demand and supply sectors leading upto 2047. The energy initiative is available to the public through an interactive, graphical web interface, as well as an excel-based model, and extensive sector-wise documentation.

The IESS 2047 explores India's possible energy futures across energy supply sectors such as solar, wind, biofuels, oil, gas, coal, and nuclear, and energy demand sectors such as transport, industry, agriculture, cooking, and lighting and appliances. The model allows users to interactively make energy choices, and explore a range of outcomes for the country – from carbon dioxide emissions and import dependence to land-use.

Explore the Interactive Web Version



New to the IESS 2047? Click Here

Get the Downloadable Excel Model

Quick Links

The IESS, 2047 enables the user to reflect on the implications of his chosen pathway on carbon dioxide emissions, as well as land-use and energy security

... Read more >>

Take a deeper look into the components of the IESS, 2047.

... Read more >>

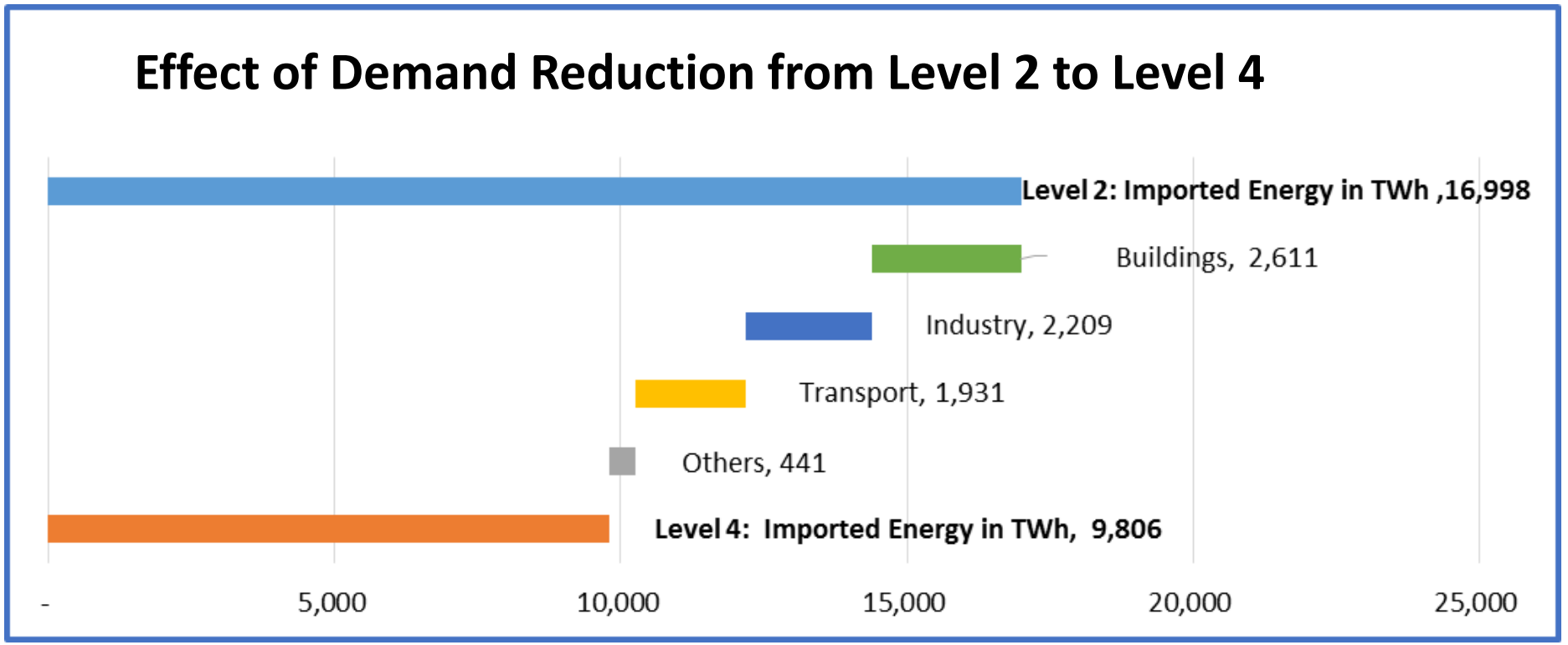
The IESS, 2047 allows the user to pick from a variety of supply options in order to meet his/her chosen levels of demand.

... Read more >>

Determined Effort Scenario in 2047

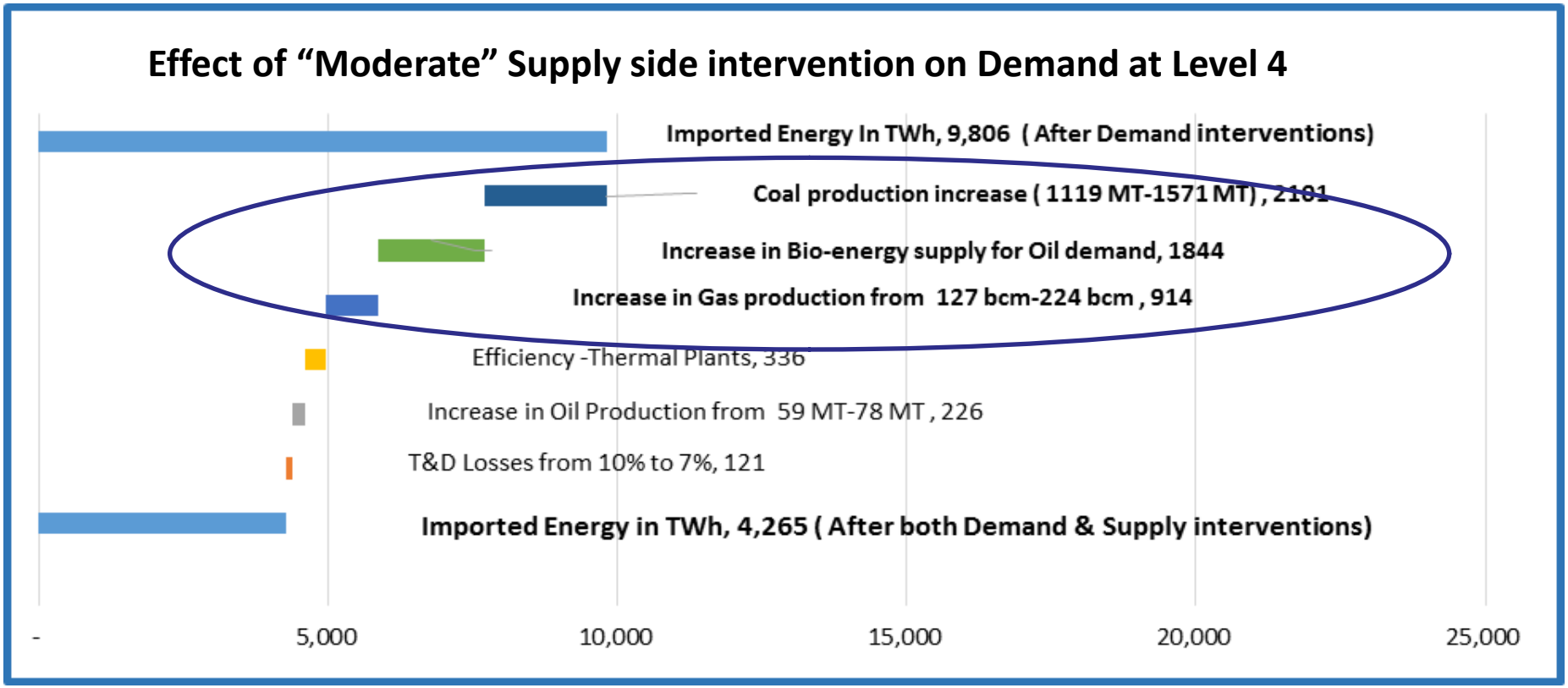
- Determined effort is approximately close to the present policy scenario.
- Demand for energy increases by 4 times compared to the base levels of 2012.
- Electricity demand will shoot up by 5 times.
- Renewable share in the grid will only be 12% in 2047 compared to 4% now.
- Consequently, overall import dependence will increase to 62 % as compared to 31% in 2012.
- Import bill will inflate by 8 times to approximately trillion dollars/annum.
- Emissions/capita will increase from 1.4 to 5.1 tons of CO2/capita.

Reducing Import Dependence (by Demand Side Interventions)



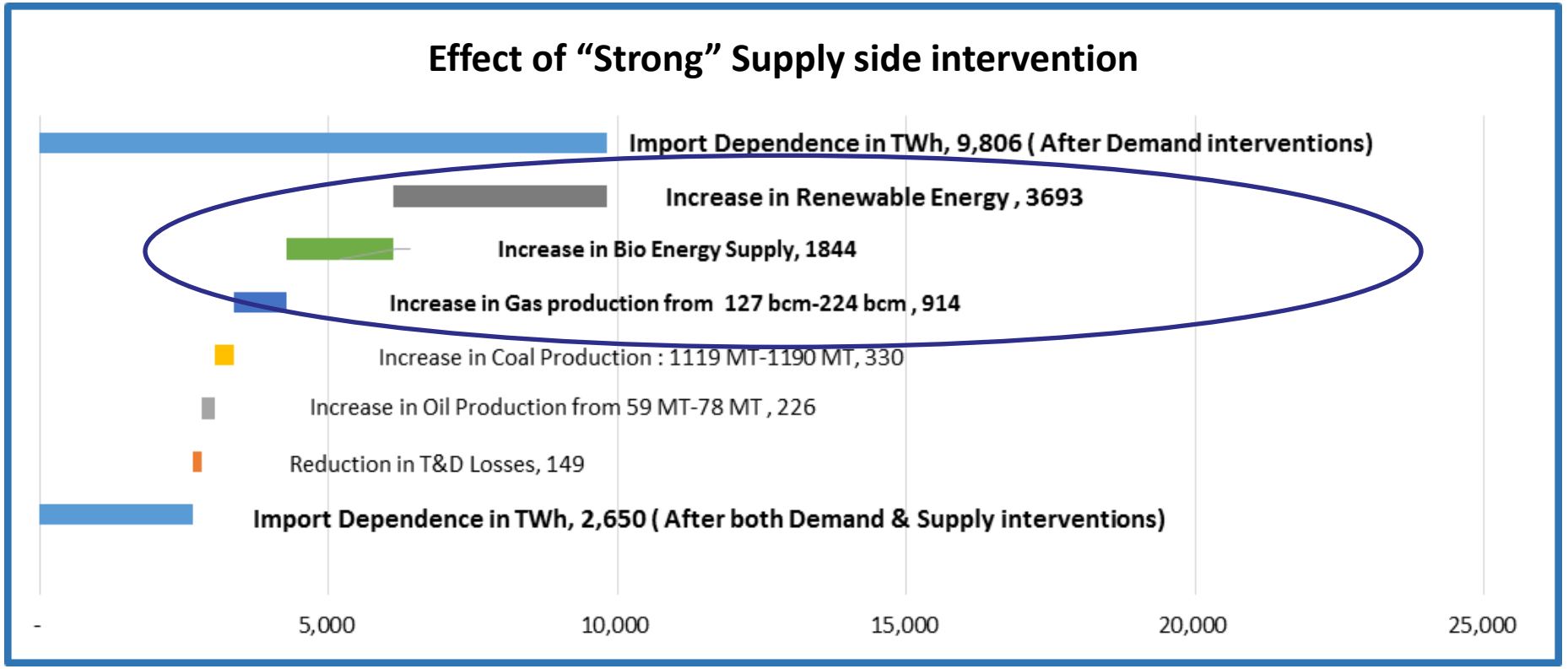
	2012 Base Year	2047	
		Level 2	Level 4
Import Dependence	31%	62.4%	49.5%
Emissions per Capita in (tons per capita)	1.4	5.1	4.2
Emission Intensity of GDP (tons CO2/INR Cr)	415	169	122

Moderate Carbon Intensive Energy Security (Supply side interventions)



	2012 Base Year	2047	
		After Demand Reduction	Moderate Carbon Energy Security
Import Dependence	31%	49.5%	21%
Emissions per Capita in (tons per capita)	1.4	4.2	3.3
Emission Intensity of GDP (tons CO2/INR Cr)	415	122	111

Low Carbon/ RE Intensive Energy Security



	2012 Base Year	2047	
		After Demand Reduction	Low Carbon Energy Security
Import Dependence	31%	49.5%	14.8%
Emissions per Capita in (tons per capita)	1.4	4.2	2.7
Emission Intensity of GDP (tons CO2/INR Cr)	415	122	89

Levels of Effort to reduce Demand

Efforts Level	2046-47 Demand (TWh/year)	Implicit Energy Elasticity*	Implicit Energy Intensity of GDP (Kgoe/US$)	Implicit Emissions Intensity of GDP (tons CO2/INR Cr)
Base Level (2011-12)	4,868	0.66 (2001-2012)	0.62	415
Level 1	24,016	0.63	0.24	218
Level 2	19,386	0.54	0.19	169
Level 3	16,763	0.49	0.17	141
Level 4	14,785	0.44	0.14	122

**Historical Energy Elasticity:*

1980-2001 : 0.73

2001-2012 : 0.66

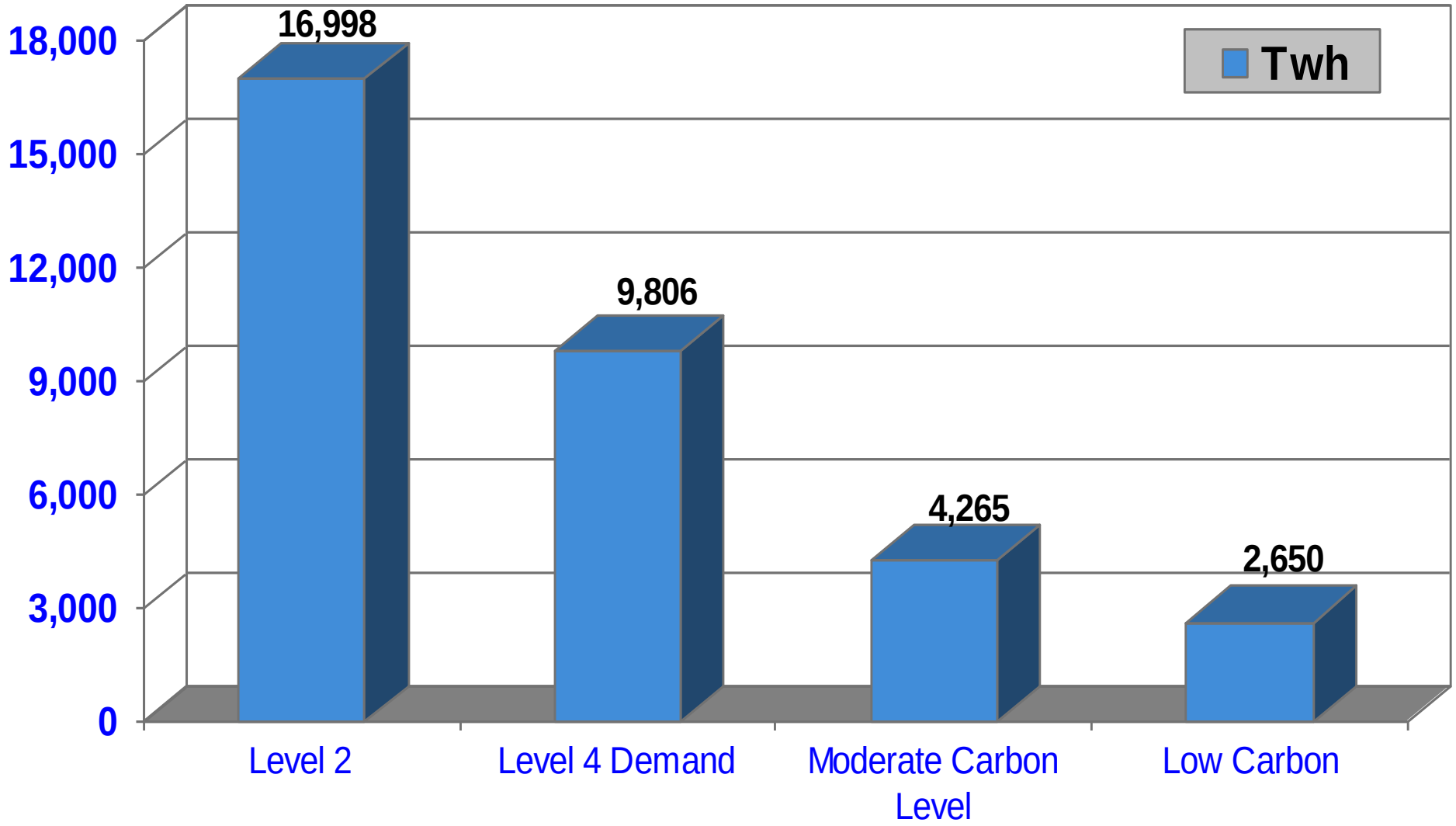
Historical Energy Intensity of GDP

1980 : 1.09

1991 : 0.99

2001 : 0.85

Potential to Reduce Energy Imports by adoption of Low Carbon



Per Capita Emission (tons)	**5.1**	**4.2**	**3.3**	**2.7**

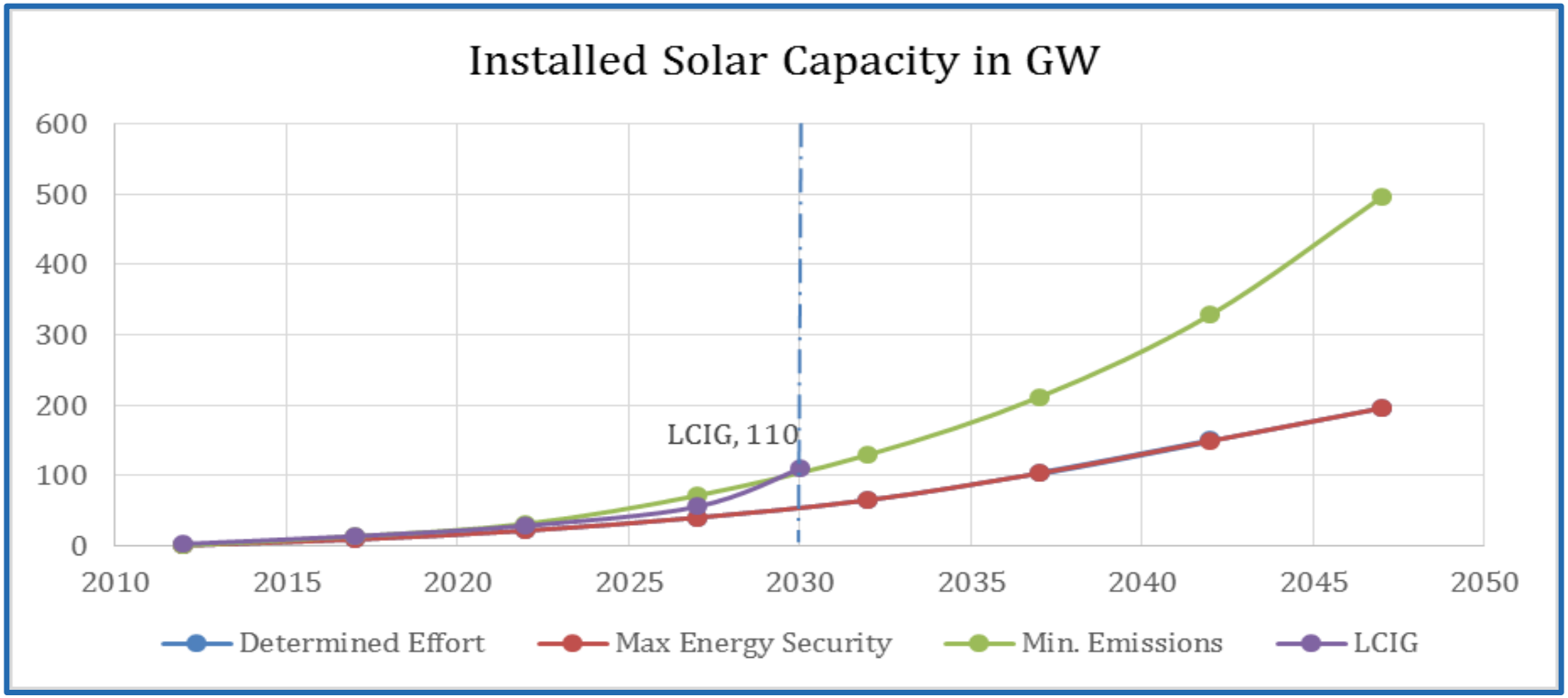
Policy Implications

- Each Pathway involves policy action in a number of areas. Policy coordination is therefore a critical element for achieving heroic effort.
- The role of policy is therefore highlighted by analyzing some demand and supply sectors in further details:

Demand: 1. Transport 2. Industry

Supply: 1. Coal Thermal 2. Renewables

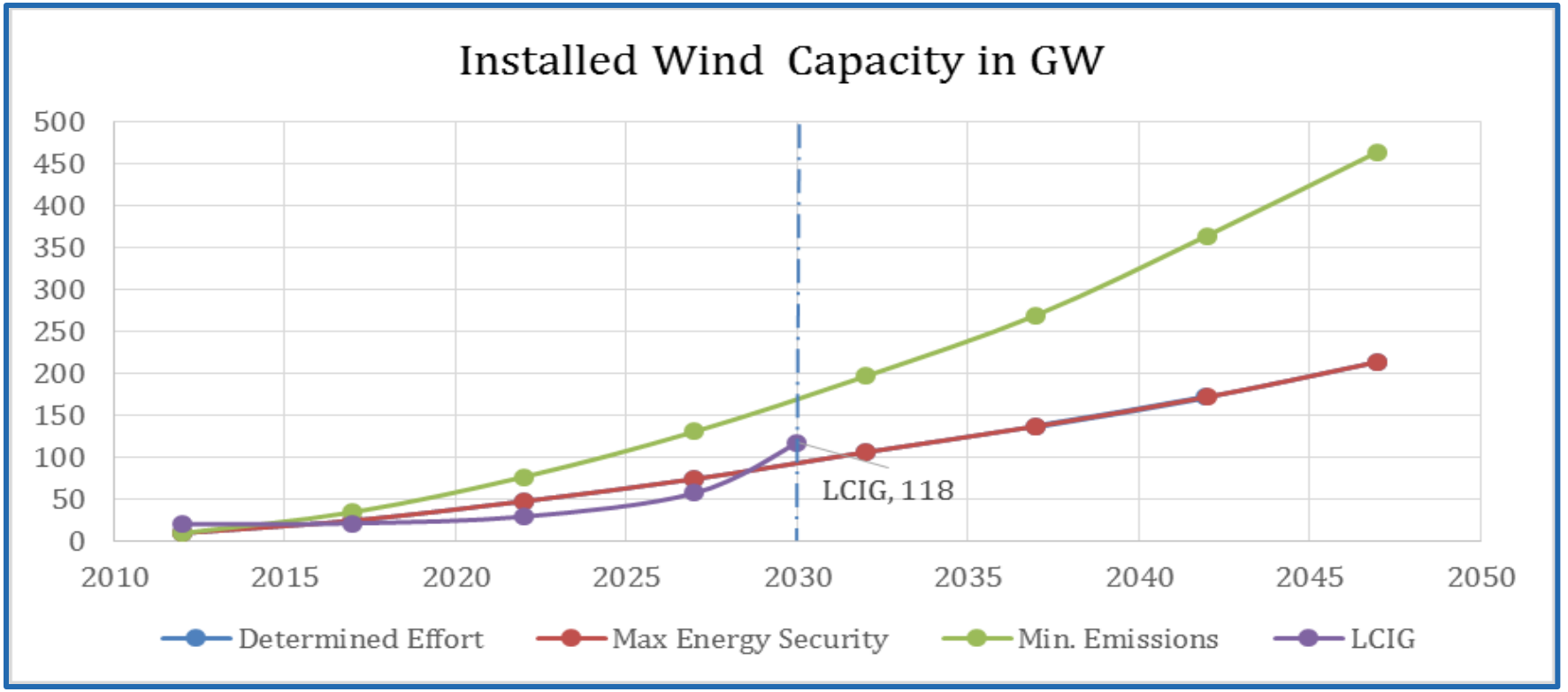
Example: Implications for Solar capacity



Key Interventions

1. Demand Response and Storage Technologies.
2. Compliance with the Solar RPO targets by all states.
3. Reliable Grid Integration.
4. Pricing of fossil fuel externalities.
5. Transmission infrastructure for Evacuation(Green Corridors)

Example: Implications for Wind Capacity



Key Interventions

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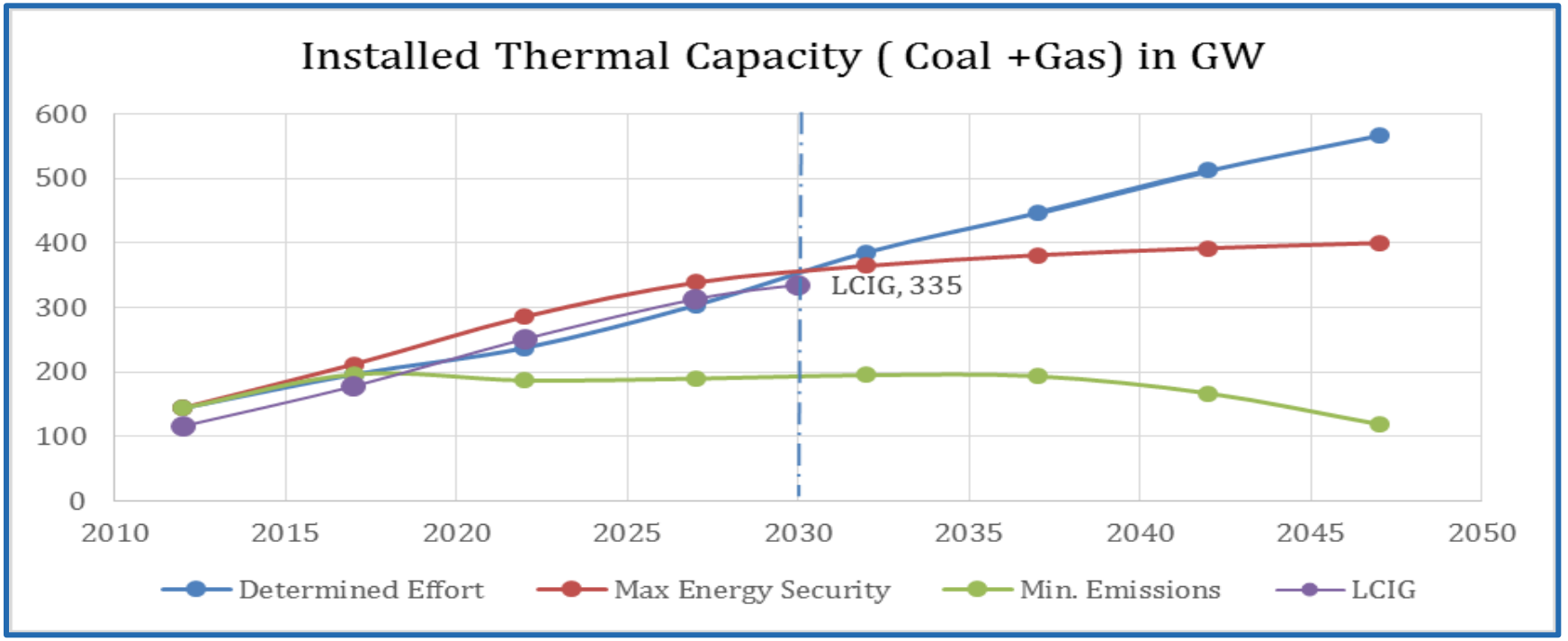
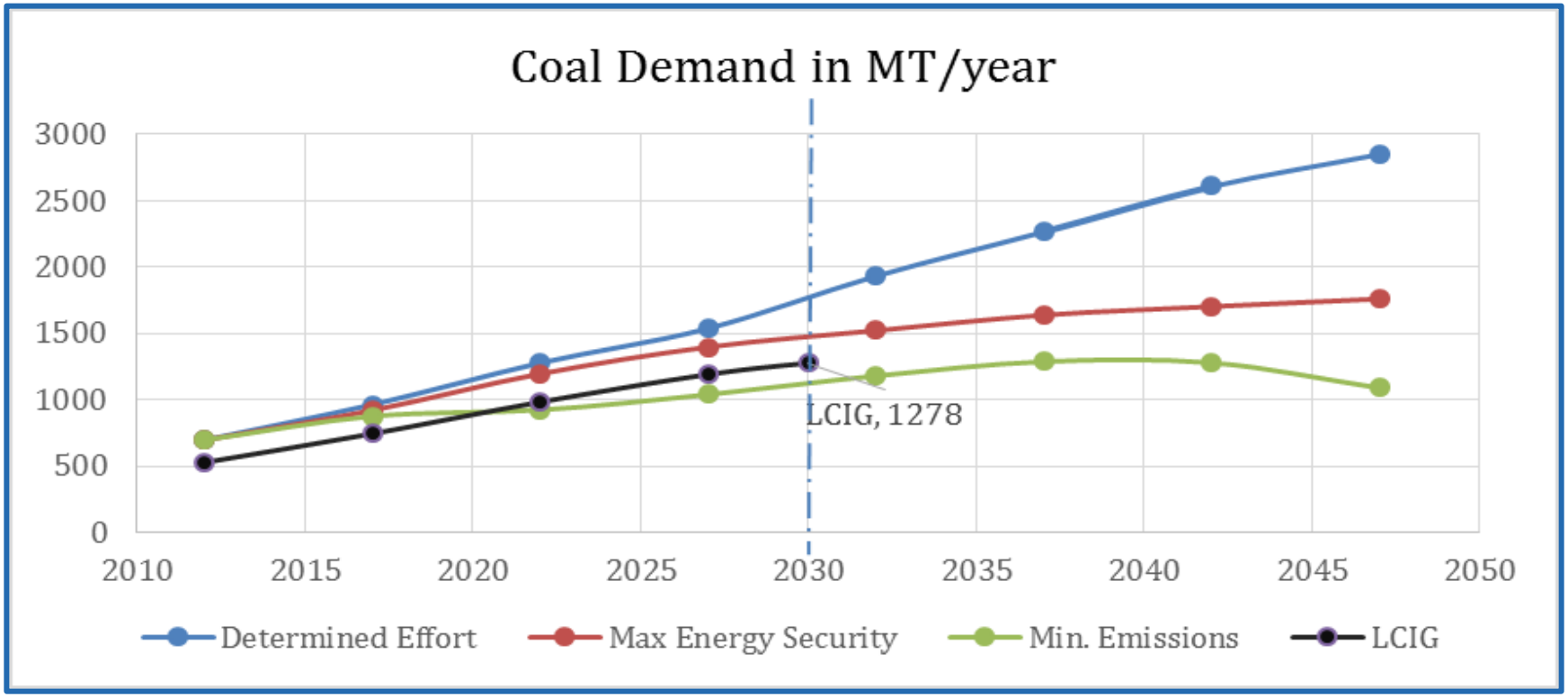
Example: Implications for Thermal Capacity



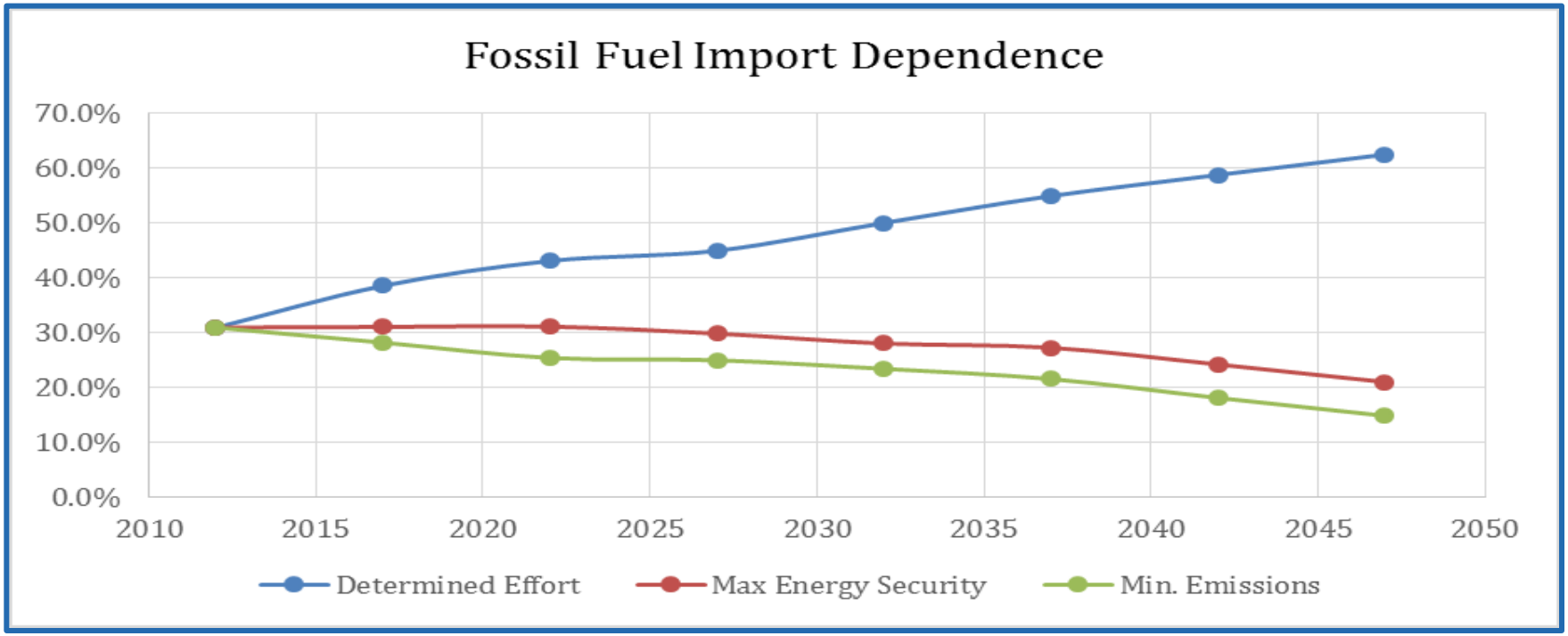
Key Interventions

1. Improved Domestic Coal & Gas Supply
2. Softening of Global Coal & Gas Prices
3. Integrated Planning on Water, Environment & Health
4. Availability of more carbon space for India.

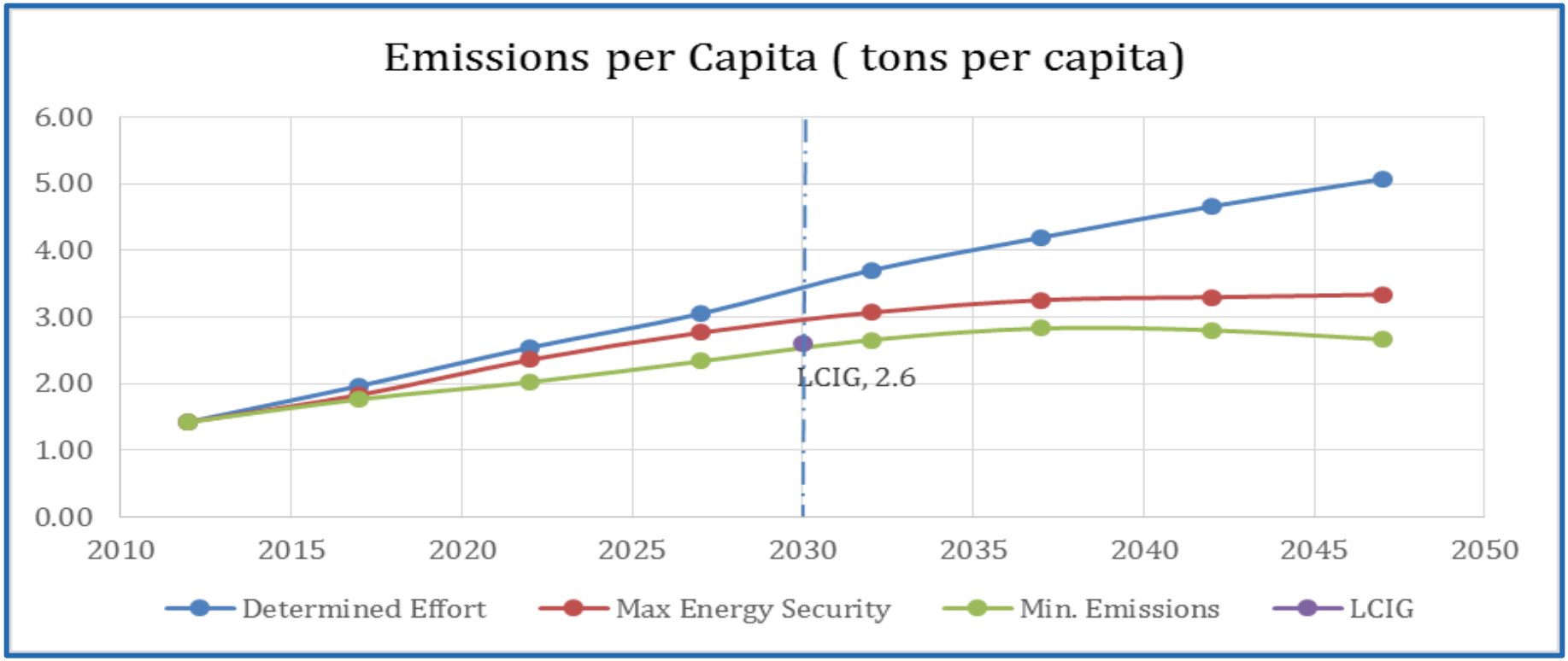
Example: Implications for Coal Demand



Implications for Import Dependence



Implications for Emissions per capita



Example : Reducing Energy Demand in Transport

Transport Demand	2011-12	2047	
	Base Year	Level 2	Level 4
Passenger transport in BPKM	7,255	17,312	13,979 (19% lower)
Freight Transport in BTKM	1,604	15,190	13,728 (9.6% lower)

Share of Passenger Transport : Mode	2011-12	2047	
	Base Year	Level 2	Level 4
Road	85%	83%	79%
Rail	14%	15%	20%
Air	1%	2%	1%

Shift in Passenger Road Transport	2011-12	2047	
	Base Year	Level 2	Level 4
Bus/ Omni Bus	42%	57%	79%
Cars/2W/3W/Taxi	58%	43%	21%

Reducing Energy Demand in Transport (Contd.)

Share of Electric Vehicles	2011-12	2047	
	Base Year	Level 2	Level 4
Cars	0%	18%	44%
2W	1%	26%	70%
Buses	0%	4%	13%

Modal Share in Freight Transport	2011-12	2047	
	Base Year	Level 2	Level 4
Road	58%	64%	55%
Rail	42%	36%	45%

Key Interventions

Passenger

1.Urban development oriented to minimum transport.
2.Metros in Tier-II
3.Rapid Rail Transport Systems.
4. Creating Charging Infrastructure for Electric Vehicles (Evs).

Freight

1.Dedicated Freight Corridors..
2.Tariff Rationalization.
3.Logistics Hubs to minimize Transport
4.IT integration in Freight.

Example : Reducing Energy Demand in Industry

Specific Energy Consumption(SEC) (TWh/MT)	2011-12		2047, Level 2		2047, Level 4	
	SEC	PAT Share	SEC	PAT Share	SEC	PAT Share
Cement (PAT DCs)	1.00	72%	0.93	72%	0.93	83%
Cement(PAT Non-DCs)	1.05		0.94		0.94	
Fertilizer (PAT DCs)	6.35	75%	5.82	75%	3.76	84%
Fertilizer (PAT Non-DCs)	6.47		5.82		3.76	
Aluminum(PAT DCs)	19.8	69%	8.80	70%	8.80	83%
Aluminum(PAT Non-DCs)	20.2		18.7		14.4	
Steel(PAT DCs)	7.30	56%	3.90	60%	3.90	69%
Steel(PAT Non-DCs)	7.50		7.00		5.60	
Paper(PAT DCs)	7.80	29%	3.96	30%	3.96	48%
Paper(PAT Non-DCs)	8.20		7.47		6.50	
Textile(PAT DCs)	4.19	93%	3.57	65%	3.57	69%
Textile(PAT Non-DCs)	3.95		3.57		3.57	
Chlor Alkali(PAT DCs)	3.84	89%	2.56	89%	1.36	94%
Chlor Alkali(PAT Non DCs)	3.61		3.29		2.57	
Others(TWh/INR m)	1.20		0.22		0.17	

Demand, Level 2: 9318 TWh **Demand, Level 4**: 7960 TWh (15% Lower)

Change in Composition of Electricity Supply in GW

Source In GW	Base Year		2047, Least Effort		2047, Determined Effort		2047, Max Energy Security		2047, Minimum Emissions	
	GW	% Share in Electricity	GW	% Share in Electricity	GW	% Share in Electricity	GW	% Share in Electricity	GW	% Share in Electricity
Thermal Capacity	144	78%	956	91%	629	70%	407	58%	154	18%
Solar Capacity	1	0%	47	2%	196	8%	196	11%	496	31%
Wind Capacity	10	2%	64	2%	215	10%	215	14%	465	28%
Hydro Capacity	41	14%	49	3%	75	5%	75	7%	105	10%
Nuclear Capacity**		3%	8	1%	25	3%	25	4%	42	8%

** 12th five year plan projects the share of Nuclear in the electricity mix to be around 4% in 2017 and 12% in 2030, by which standards the calculators projections are a bit conservative.

Thank You