



राष्ट्रीय ऊर्जा सुरक्षा परिदृश्य INDIA ENERGY SECURITY SCENARIOS 2047



सत्यमेव जयते

University of Melbourne
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*Views expressed by the Author are personal and don't represent the views of his organization



DISCLAIMER

The presentation examines various energy demand and supply scenarios as developed through the IESS, 2047 tool, and in no way offers the Indian Government's energy strategy. This is merely meant to inform the range of options and implications thereof on several fronts. The numbers do not present the likely scenario or the Government's projections or choices regarding the energy pathway of the country.

Structure of the Presentation

India's Energy Status

India's Developmental Ambitions

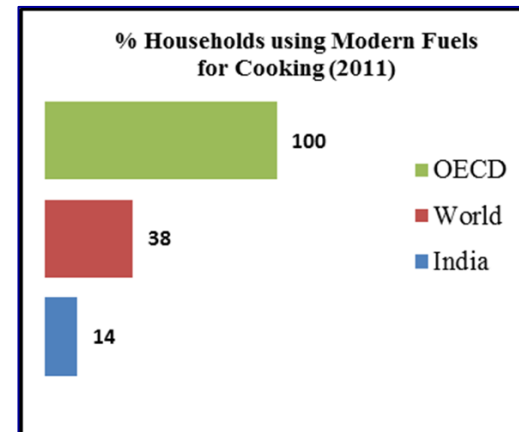
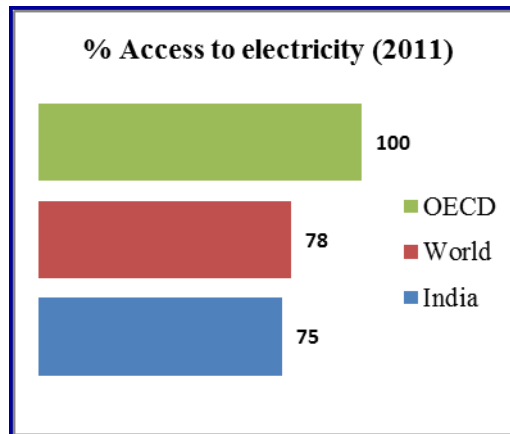
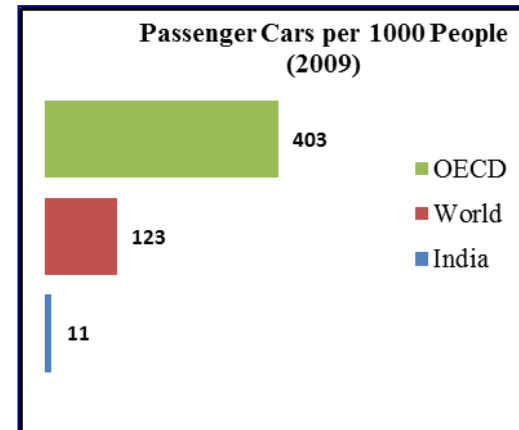
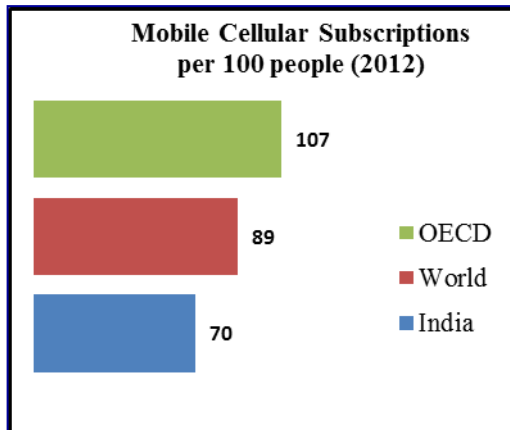
Demand Strategy for an Inclusive and Sustainable growth.

Supply Strategy for an Energy Secure and Sustainable Growth.

Utility of IESS for Energy Policy.

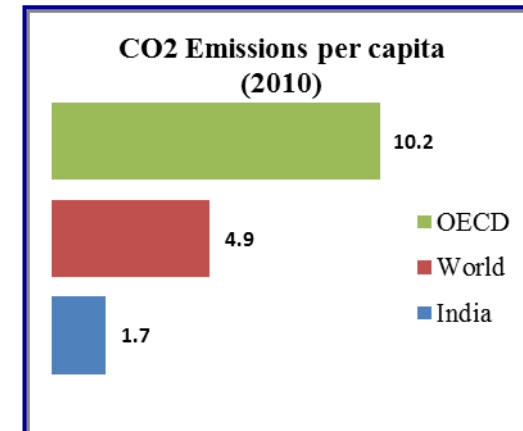
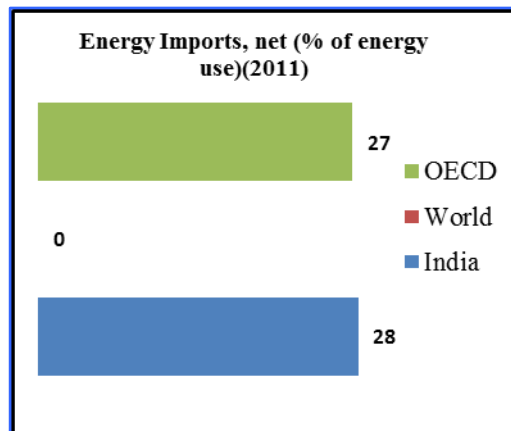
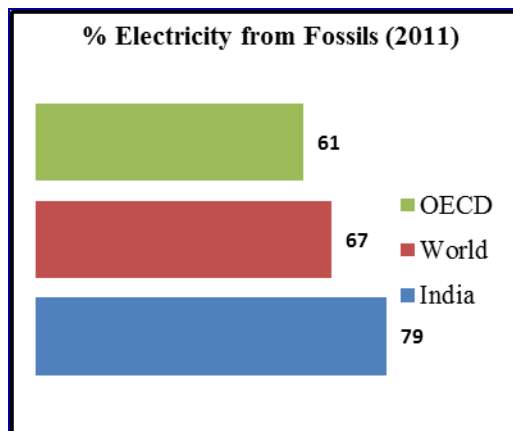
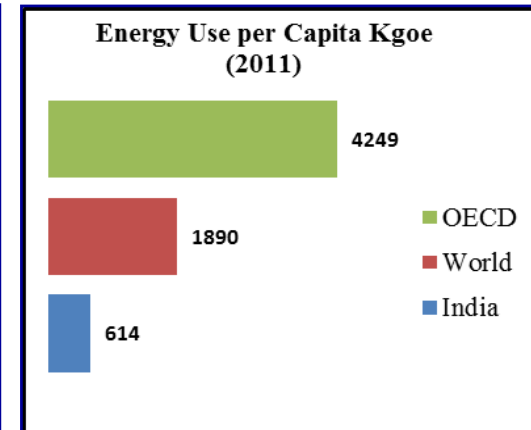
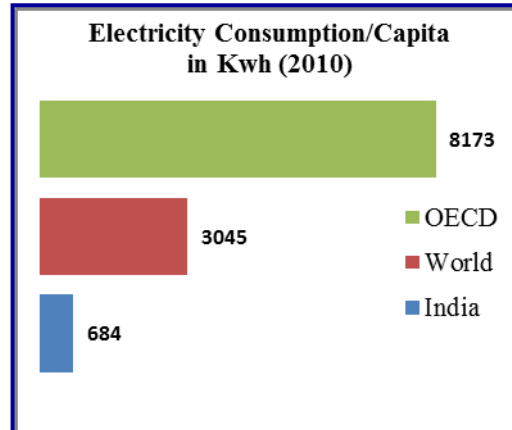
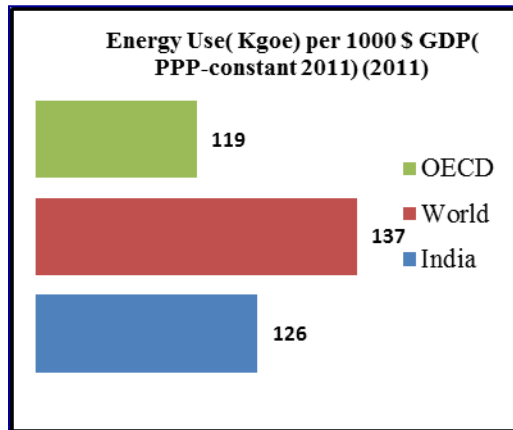
Coal Lock-in: A case Study

India's Development Indicators



Source: World Bank

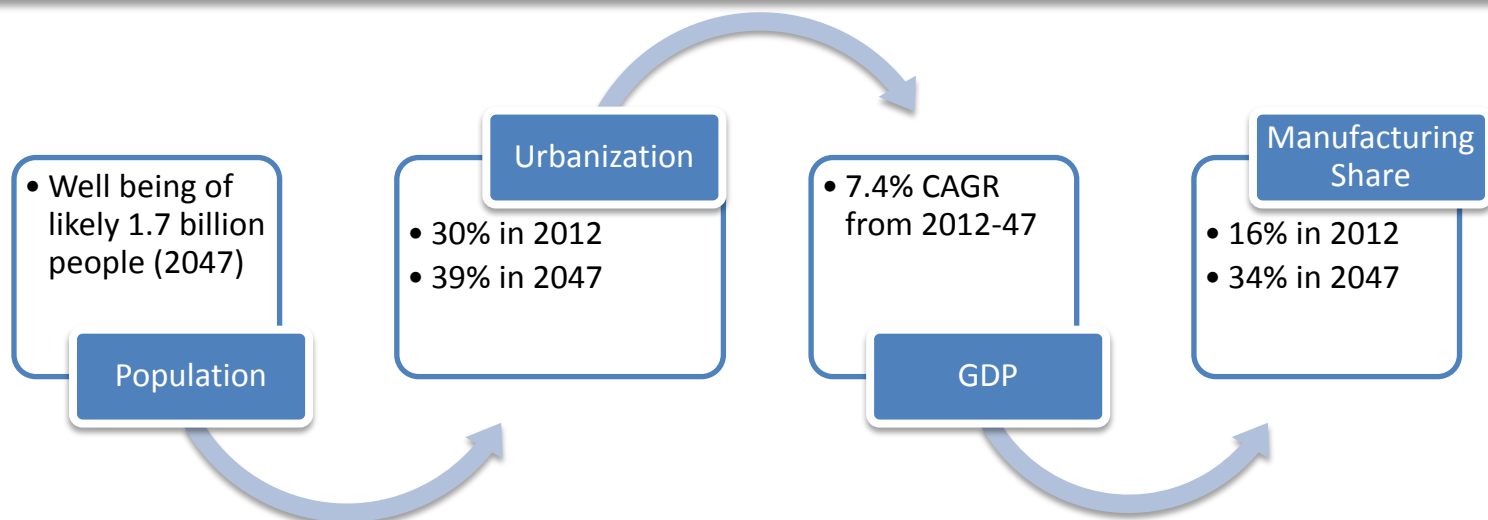
India's Energy Status



Energy and Low Carbon Strategy must support India's Developmental Goals

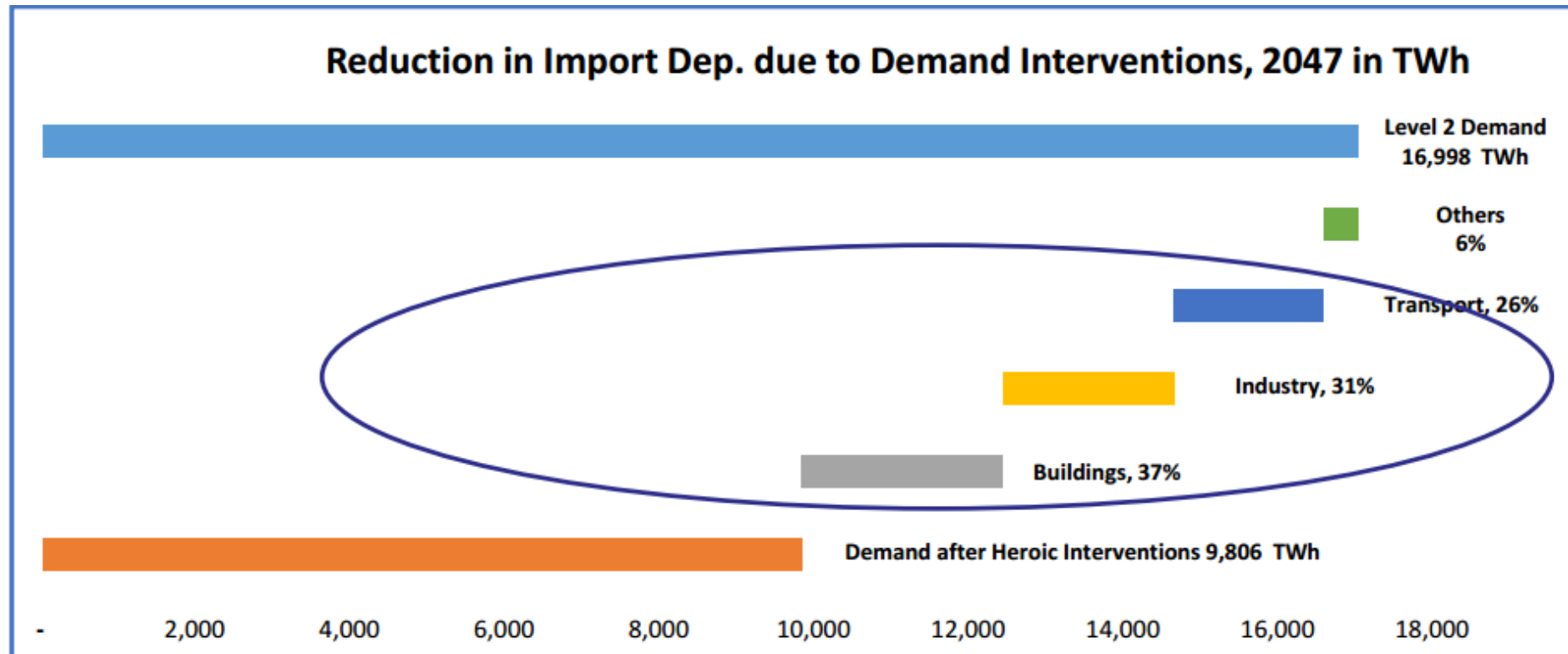
- Developmental Objectives can be met only at 7.4% CAGR in GDP from 2012-2047.
- Government committed to the following:
 - Affordable housing for all by 2022 (**Only 30% of the building stock in 2030, in existence in 2012**)
 - 24x7 power for all by 2019 (**Grid size to triple between 2012 and 2030**)
 - Modern Cooking Fuels for all by 2019 (**Nearly 800 million people use biomass for cooking**)
 - Share of manufacturing to rise from 16% to 25% of GDP by 2022 (China has 34%)

India's Developmental Ambitions at 100 years of India's Independence (2047)



Indicator	2012	2047
Per Capita Transport Demand (km)	5,970	18,700
Per Capita Steel Use(kg)	66	372
Per Capita Building Space (m ²)	1.8	36
Per Household Modern Energy Use for Cooking in Rural Areas (kgoe)	61	183
Per Household Electricity Use in Rural Areas (kWh)	500	3886

Reducing Import Dependence (by Demand Side Interventions)



	2012 Base Year	2047	
		BAU	Heroic
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

Efficiency Interventions in Passenger Transport



Heroic Effort in Transport, 1,226 TWh



Rail Road Share, 5%



Electric Vehicles, 5%



Better Urban Planning, 19%



Use of Public Road Transport, 19%



Level 2 transport demand, 2,428 TWh

- 500 1,000 1,500 2,000 2,500 3,000 3,500

Efficiency Interventions in Freight Transport

Heroic Effort in Freight, 1,809



DFCs & integrated logistic planning, 9%

freight Shift to rail to 45 % from 36%, 11%

Level 2 transport demand, 2,305 TWh

- 500 1,000 1,500 2,000 2,500 3,000 3,500 4,000

Efficiency Interventions in Residential Buildings

Heroic Effort in Buildings, 1,126 TWh

Envelop Optmization, 0.3%

Televisions, 1%

Lighting, 1%

Refrigerators, 2%

Fans, 2%

Others, 10%

Air Conditioners, 19%

Level 2 Residential Buildings
demand, 1,764 TWh



500

1,000

1,500

2,000

2,500

Efficiency Interventions in Commercial Buildings

Heroic Effort in Buildings, 689 TWh



Others, 3%

HVAC, 4%

Envelope, 5%

Lighting, 6%

Level 2 Commercial Buildings demand, 846 TWh

200

400

600

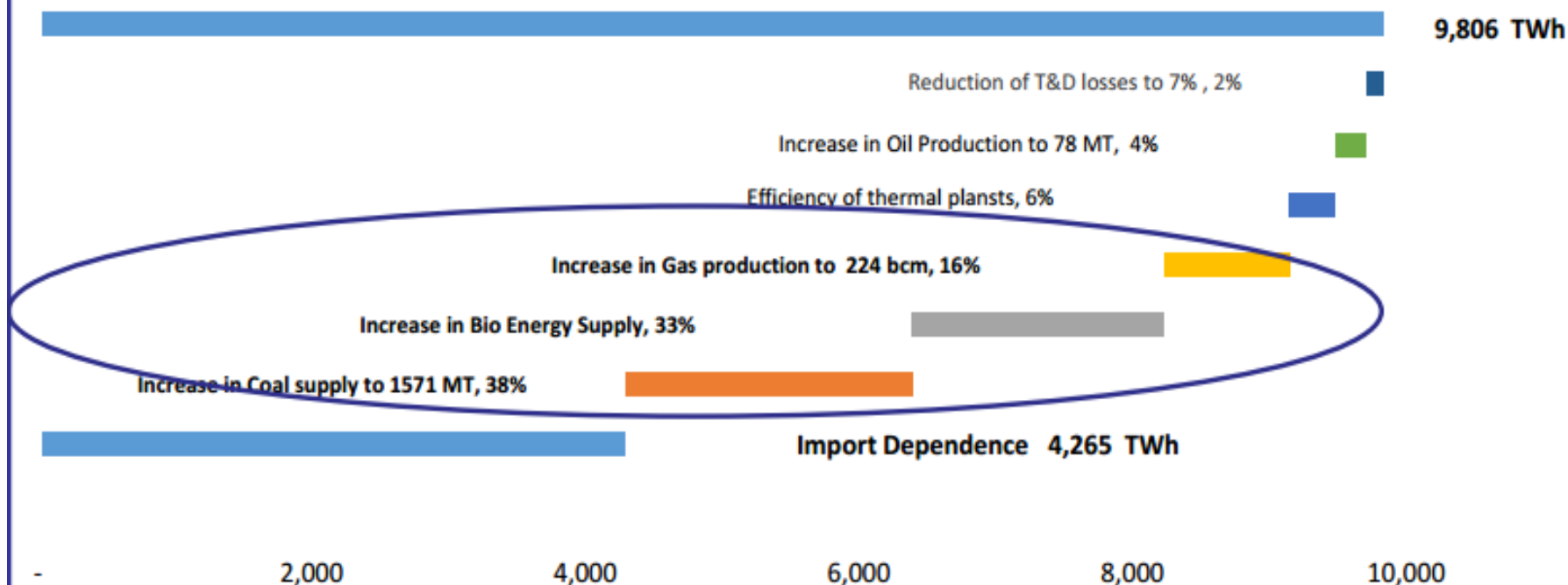
800

1,000

1,200

Moderate Carbon Intensive Energy Security (Supply side interventions)

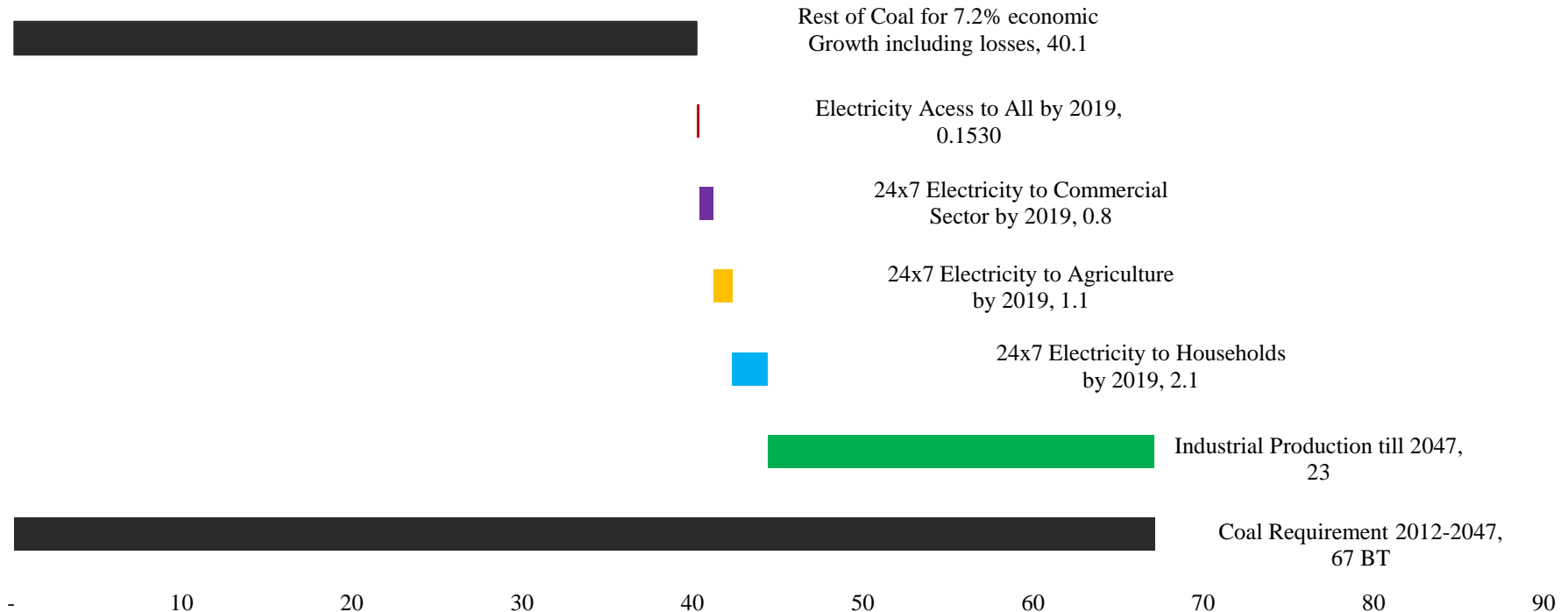
Decrease in Import Dependence due to Moderate Supply Side intervention in TWh & Demand at Level 4



	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 CO ₂ /INR Cr)	415	122	111

Coal Pathway Lock-In: A case study

Coal Requirement in BT in Reference Scenario from 2012-2047



24x7 power supply to all alone by 2019 will require coal worth 4.2 Billion Tones from 2012-2019, locking us into a coal mine development for the next 30 years(asset life) for new mines that will be in operation to meet this demand.



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The costs of not acting on energy security will increase proportionally every year.

The decisions we take today will determine our future for the next 60 years

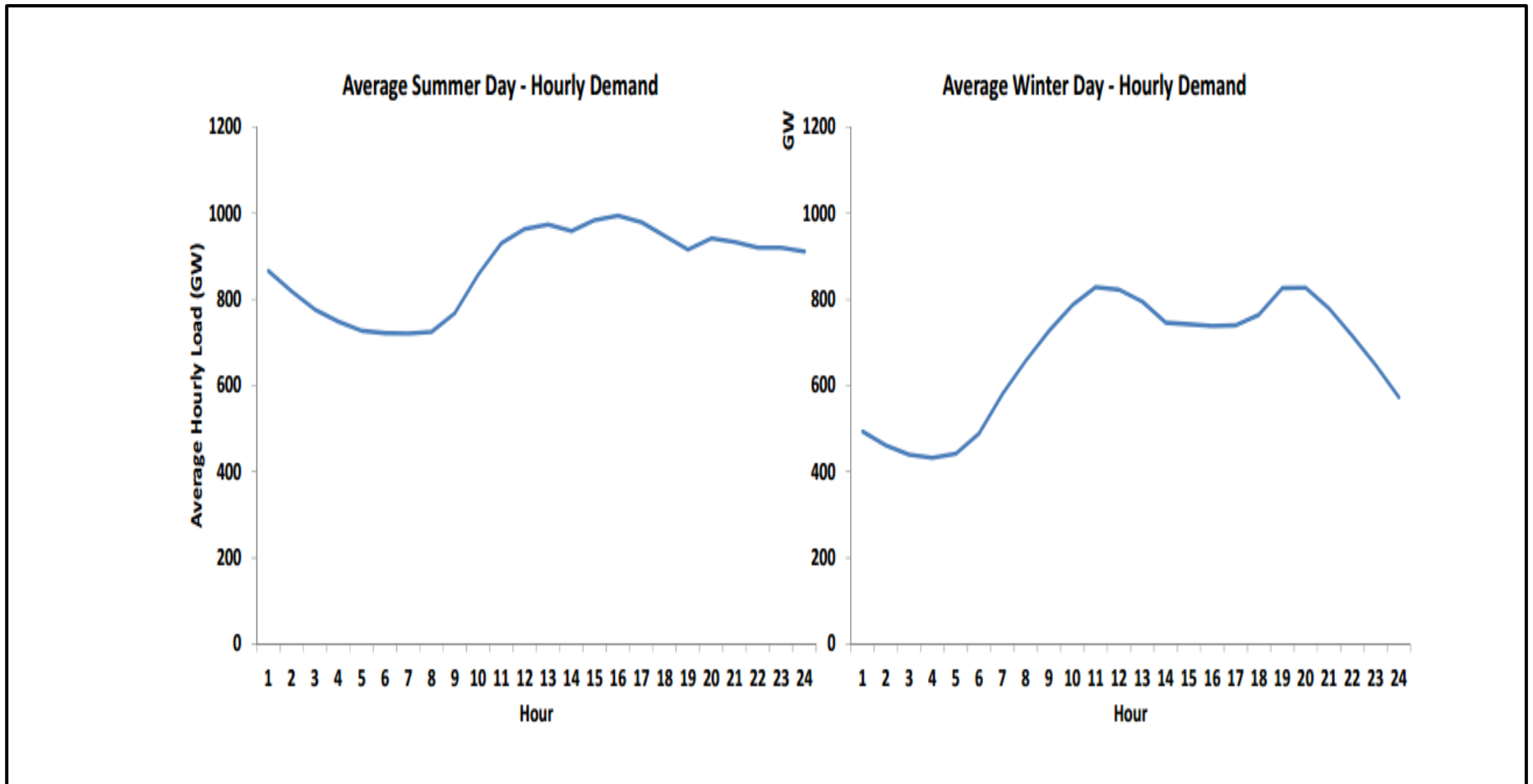
Ambitions for Version-2 of IESS

- Reliability indicator for Power Supply.
- GDP scenarios for the Indian Economy.
- Costs and Emissions implications for all pathways
- New Technologies such as Hydrogen to be included.
- Energy Access to be analyzed separately.
- Stress(Climate+ Water) Impacts On energy pathways to be analyzed.
- Manufacturing Scenarios for Indian Economy

Providing 24x7 power supply to Indians

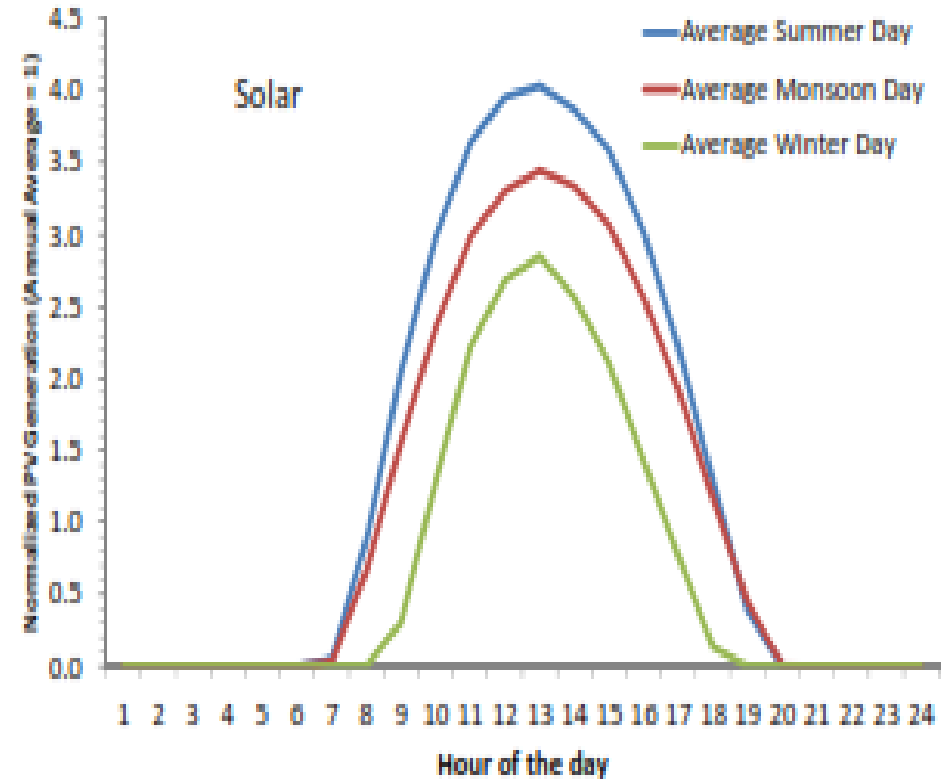
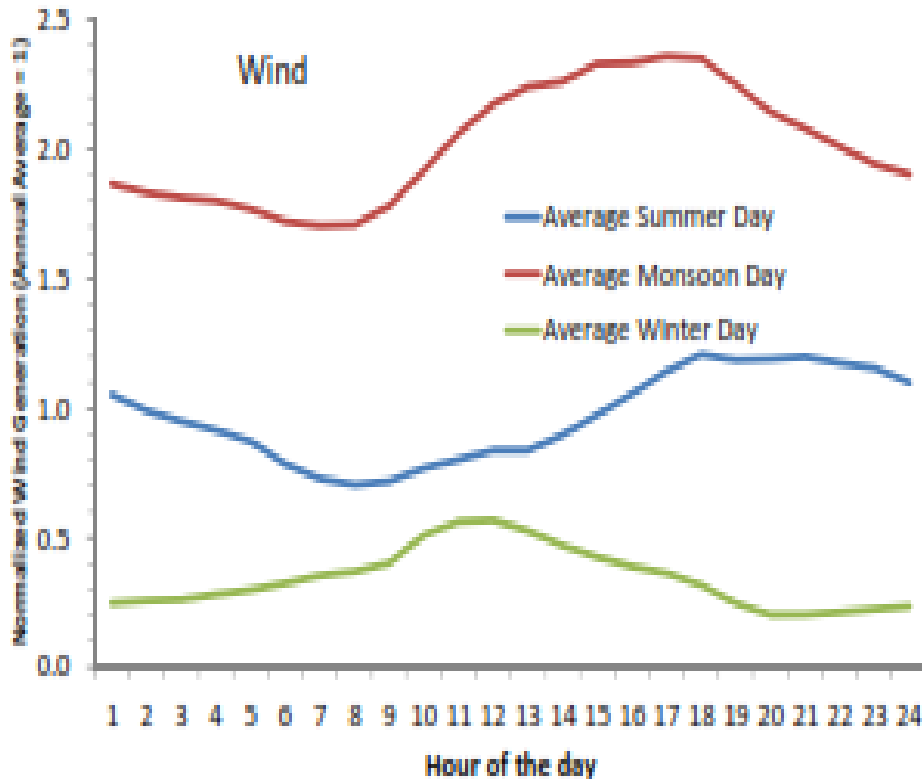
- Implementing 24x7 power for all vision will end up saving more than 240 MT of cumulative diesel consumption for the country between 2012-,2047 or 176 Billion dollar of forex outgo (at crude oil price of \$100/barrel).

Implications on Grid Balancing



There are two winter peaks and one summer peak.

Implications on Grid Balancing



Solar: The intra-day profile doesn't change during the seasons.

Wind: Winter profile drops sharply and hence requires some complimentary generation to balance the grid.

- Monsoon, wind generation is significant for 24 hours .
- Solar and Wind show complementarity during seasons.

Key Messages: Adding 200 GW of Solar/Wind into the Grid by 2022.

- Inter-regional transmission capacity Transmission capacities required (MW) under the scenarios:

Line	RE Missions
ER-NR	12,000 MW
ER-SR	20,000 MW
ER-WR	7,000 MW
NR-WR	16,000 MW
WR-SR	16,000 MW

- Additional flexible capacity is key for integrating large amounts of RE capacity by 2022. Key options include:
 - Additional Gas CT capacity for RE (2022) = ~24GW in addition to all other Hydro plants(66 GW) for 12th and 13th plan.
 - Operating current CCGT plants on open cycle (need local gas storage)
 - Optimizing hydro dispatch and sharing flexible resources across states
 - Summer wind starts late during the evening as compared to monsoon wind and hence no balancing capacity required for evening peak.
 - Some Evening Support during winters will be required with Gas

Utility of a Scenario Modelling Exercise



MORTON STREET, CORNER OF BEDFORD, LOOKING TOWARD BLEECKER STREET,
MARCH 17, 1893.

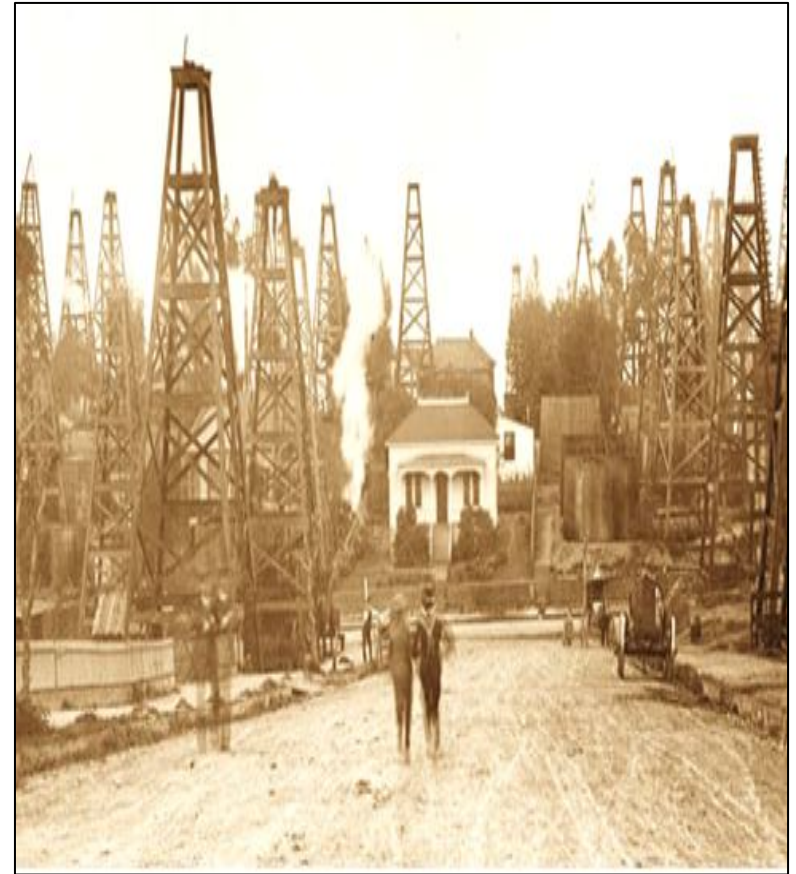
By 1950 every street in the city
would be buried nine feet deep
in horse manure....

Times of London, 1894

By 1930, it was predicted that
horse manure would reach the
level of Manhattan's third-story
windows...

Quoted by New Yorker

World would have been so much better..



Models are always wrong, but they help us think about the future

Questions ??

