

# Towards A Sustainable Energy Strategy for India

Montek Singh Ahluwalia

Himanshu Gupta

Nicholas Stern

# Overview

- We examine India's energy trajectory for 2012-47 based on IESS-2047, Version-2 of NITI Aayog, focusing on
  - Degree of import dependence
  - CO2 emissions
- Projections: **Business as Usual (BAU)** and **Low Carbon Alternative (LCA)**.
- The BAU is clearly not acceptable. LCA is much better both for import dependence and carbon emissions.
- We explore the policy implications of transiting to the LCA path.
- We also look at international aspects and compare China.

# Sectors

Demand	Supply
Transport( Passenger and Freight)	Fossil Fuel Production( Coal, Oil and Gas)
Buildings( Residential and Commercial)	Fossil Fuel Electricity( Coal, Oil and Gas and CCS)
Industry	Solar Energy ( PV, CSP and Water Heaters)
Agriculture	Wind Energy ( Onshore + Offshore)
Telecom	Hydro and Nuclear Energy
Cooking	Bio Energy( 2 <sup>nd</sup> Generation, and Advanced Biofuels)
	T&D losses and Storage
	Hydrogen and Cross Border Electricity Trade

# Levels of Effort

## Level 1

### Least Effort

- Offers projections assuming pessimistic or almost no improvements in energy efficiency levels in the demand sector and/or deployment of supply-side technologies.

## Level 2

### Determined Effort

- Effort which is deemed most achievable by the implementation of current policies and programmes of the government

## Level 3

### Aggressive Effort

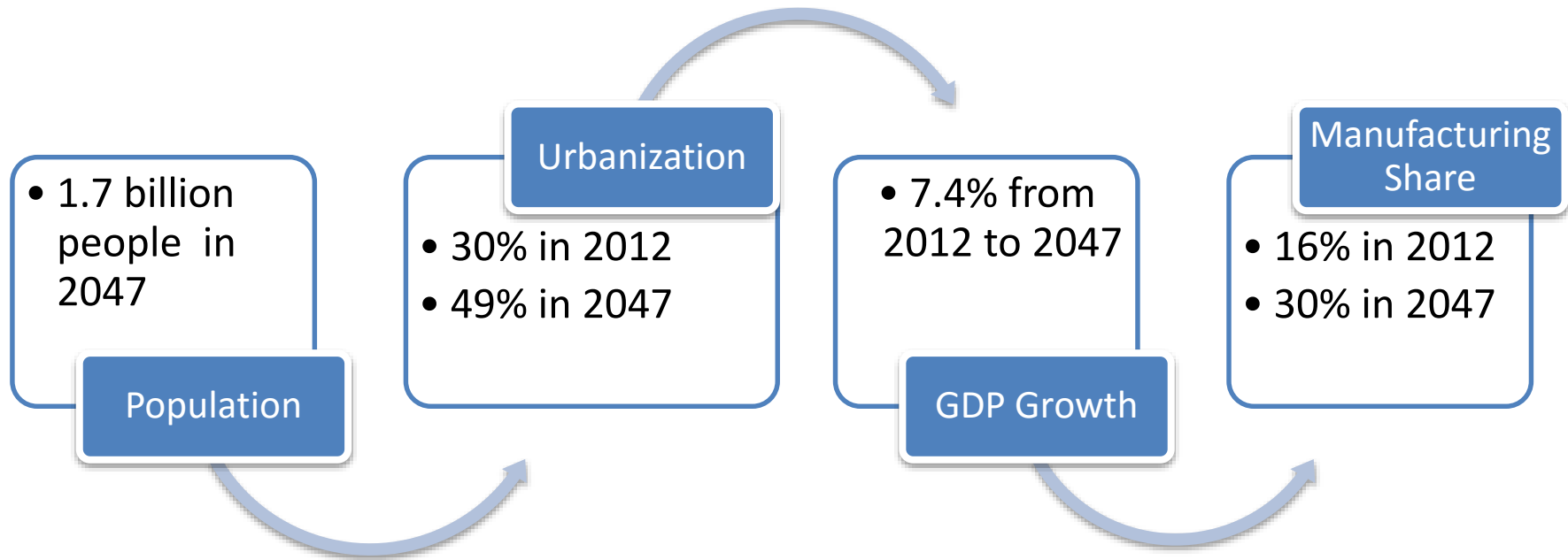
- Describes the level of effort needing significant change which is hard but deliverable.

## Level 4

### Heroic Effort

- Indicates heightened efficiency numbers, leading up to the physically best attainable in due course.

## Projections for basic economic indicators : 2047



## Business as Usual ( BAU) Assumptions

- BAU assumptions imply extrapolation of past trends of effort in development, deployment and outcomes of current policy measures.
- Experts feel current efforts are sub-optimal in some sectors such as Transport, hence Level 1.
- Efforts are assumed to be just optimal in other sectors such as Industry and Renewables, hence Level 2.

## Low Carbon Pathway Assumptions

- Four ingredients of Low Carbon Pathway:
  - a) Minimize resource consumption in the demand sectors
  - b) Minimize energy consumption required to produce and consume resources.
  - c) Supplying the energy required through electricity rather than primary fuels.
  - d) Increasing renewables in the electricity mix
- Level 4 of demand sectors, Level 1 of coal based capacity, Level 3 of Solar and Wind and Level-4 of Bio Energy to make the above possible.
- 17 user choices in the 8 demand sectors in the IESS-V2 to realize components a,b,c of the low carbon pathway.

## Key Results - Import Dependence

	<i>2012</i>	<i>2047</i>	
	<i>Base Year</i>	<i>Business as Usual</i>	<i>Low Carbon Scenario</i>
<b>Import Dependence</b>			
(%)			
<b>Coal</b>	18	57	19
<b>Oil</b>	77	90	60
<b>Gas</b>	22	43	21
<b>All Energy</b>	31	59	22



# Energy-Emission-GDP equation

$$\left(\frac{EM}{GDP}\right) = \left(\frac{E}{GDP}\right) \times \left(\frac{EM}{E}\right)$$

Energy Efficiency

Cleaner Energy

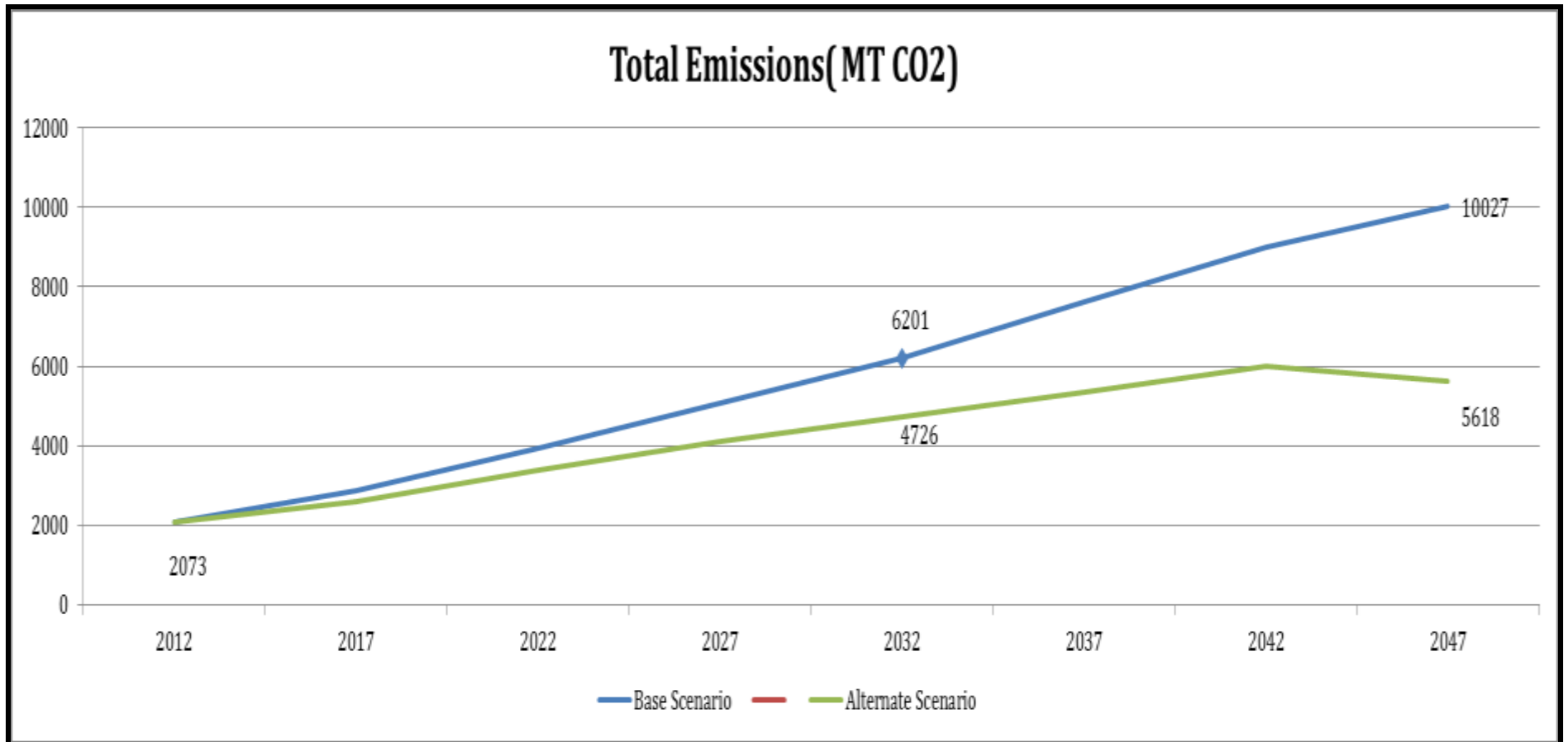
## Key Results-Emissions

	<i>2012</i>	<i>2047</i>	
	<i>Base Year</i>	<i>Business as Usual</i>	<i>Low Carbon Scenario</i>
Energy Intensity of GDP (kgoe/\$)	0.24	0.08	0.05
Emissions Intensity of GDP (Tonnes CO <sub>2</sub> /1000\$)	1.2	0.47	0.26
Total Emissions (MT CO <sub>2</sub> )	2069	10,027	5618
<b>Emissions Per capita (Tonnes CO<sub>2</sub> per person)</b>	<b>1.7</b>	<b>5.9</b>	<b>3.3</b>

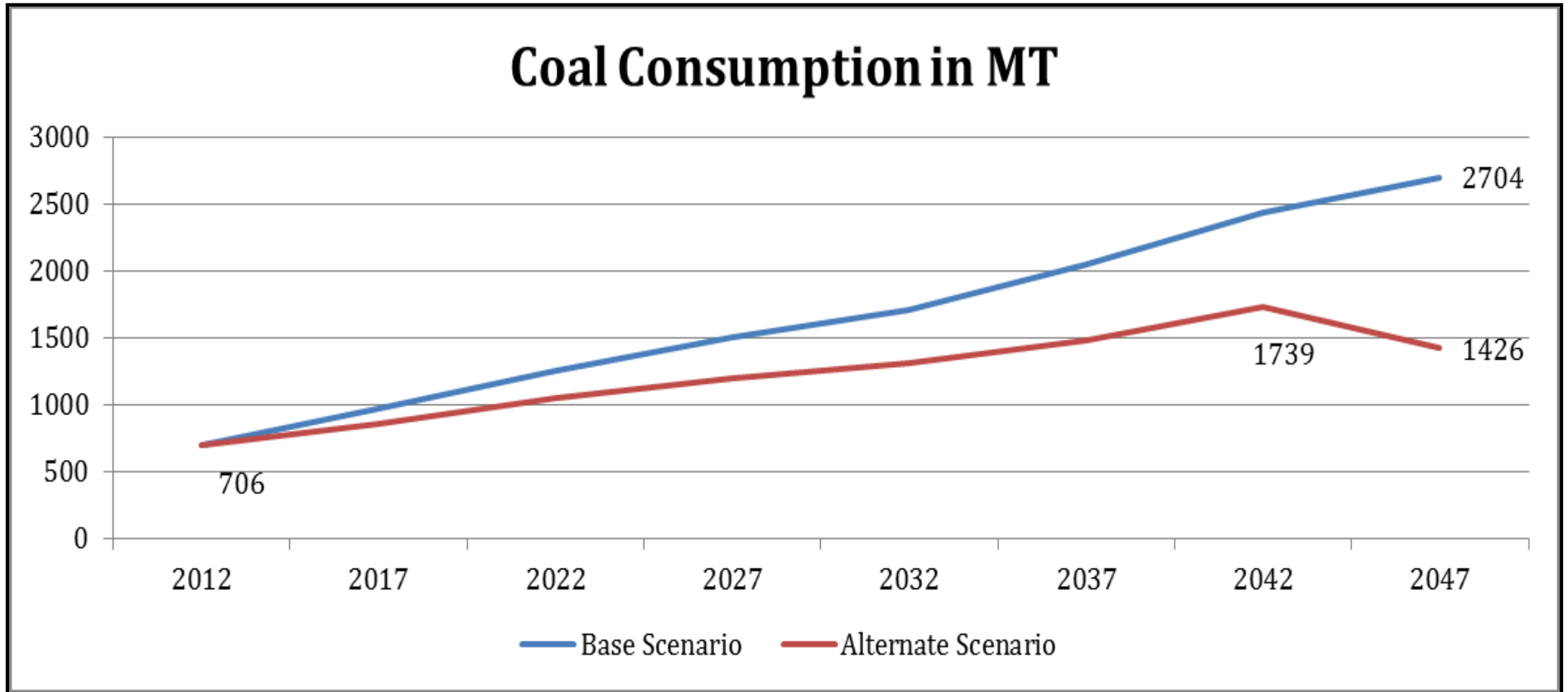
# Decomposition of Emissions Reduction From BAU to Low Carbon in 2047

Energy Efficiency	Reduction from 10002 MtCO <sub>2</sub> in BAU
Residential Buildings	622
Commercial Buildings	161
Passenger Transport	472
Freight Transport	231
Industry	2128
Agriculture	141
Telecom& Cooking	41
<b>Cleaner Energy</b>	<b>6231 MT</b>
Introducing efficiency in coal thermal generation	56
Reducing T&D losses	112
Deployment of Bio Energy	169
Deployment of Solar PV -Utility and Distributed	275
<b>Emissions in LCA</b>	<b>5618 MT</b>

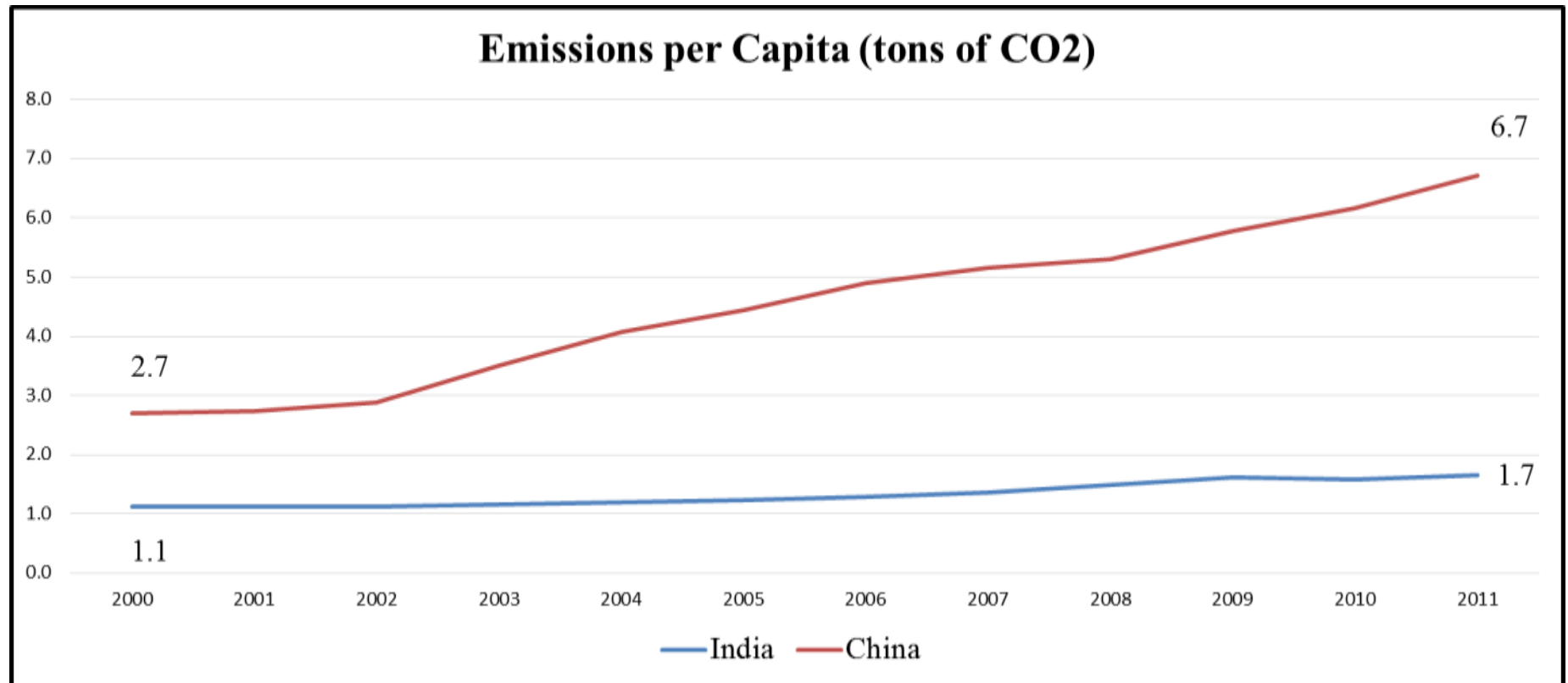
# Emissions Pathways



# Coal Consumption Pathways

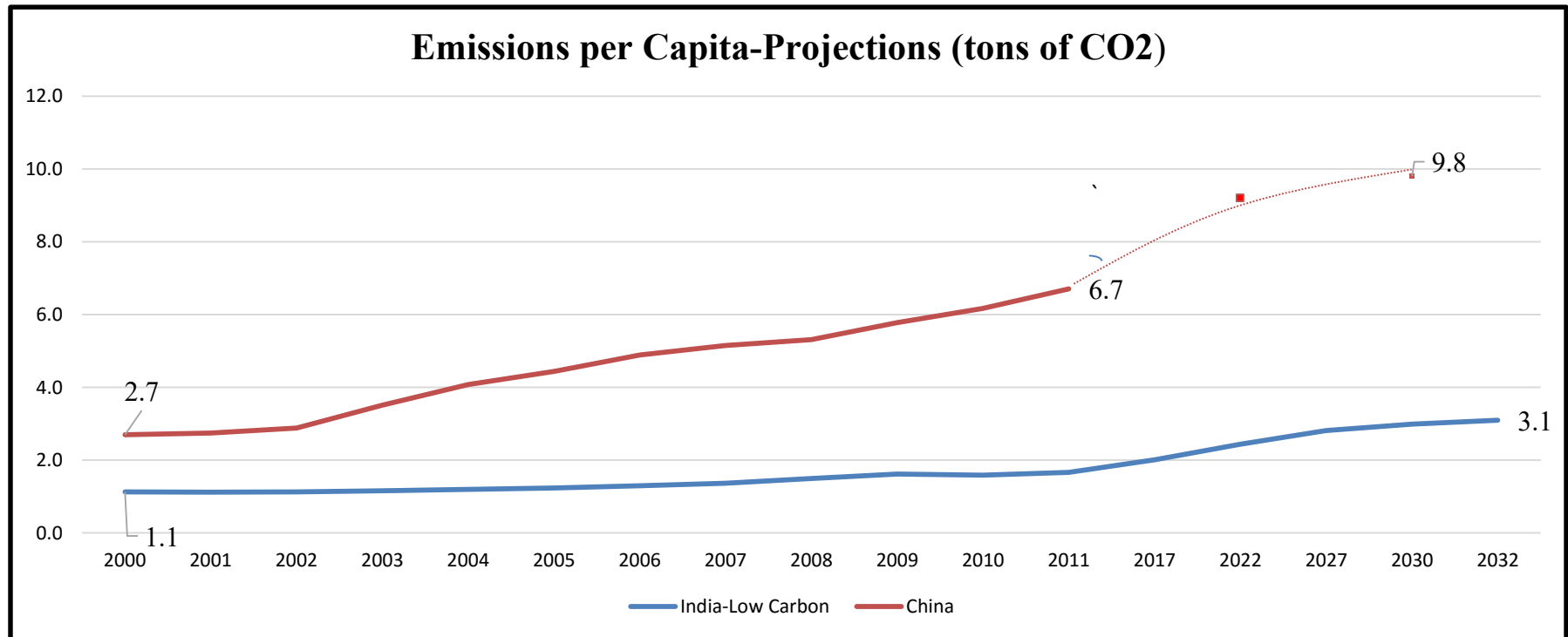


# Emissions-Historical Perspective



Source: World Bank

# Emissions-Future Perspective



Source: Green, Stern(2015) & Authors' calculations