Climate Policy and Governance

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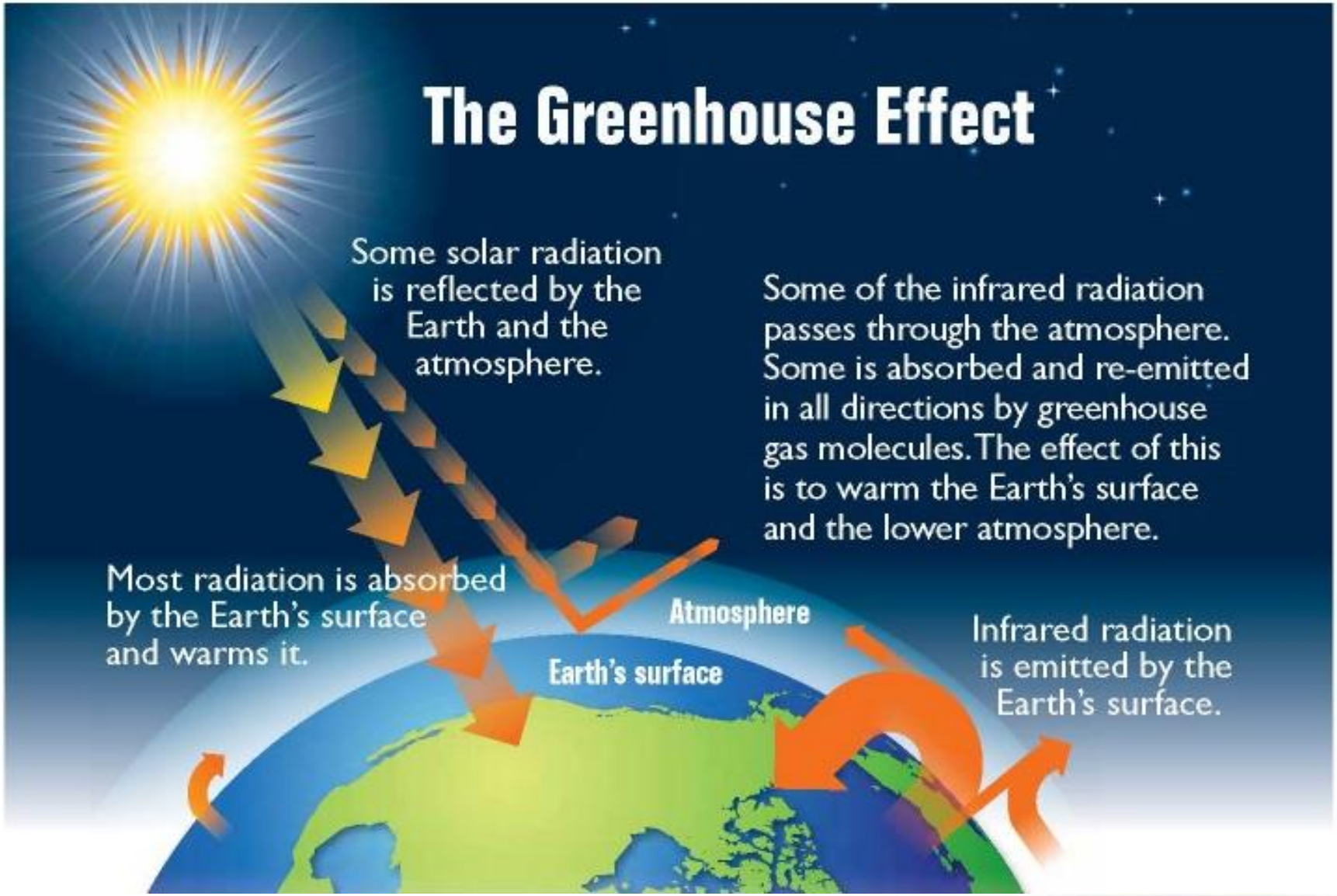
Radiative Forcing and the Greenhouse Gas effect



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What is the commodity ‘Carbon’?

- Carbon commodity operates in a counter-factual world. Absence of carbon gives it value.
- The price of carbon is the “scarcity value” (marginal cost) of emissions mitigation caused by the emissions limitations commitments
- Carbon is a regulatory market.
- Cap and trade, carbon tax, energy tax (indirect carbon tax) are some of the main instruments.

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Climate Policy and Governance: Key Elements

- Understanding your own region's circumstances
  - Exiting vulnerability, GHG emissions
  - Vulnerable populations, ecosystems and infrastructures
  - Variability and uncertainty of likely impacts, associated risks
- Long-term vision
- Policy options available
  - Near- to mid- to long-terms
  - Prioritization – align with national and global agreements, cost benefit analysis, optimization, key policy assessment
  - Target setting
- Political leadership
  - Bureaucratic leadership
  - Scientific leadership
  - Business and Industry leadership
- Governance
  - Monitoring implementation outcomes
  - Mid-course corrections
  - Societal engagement and public awareness

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Climate Policy and Governance at Various Levels

- Global
  - Institutions: UNFCCC, SDG
  - Process: Global negotiations, Protocols and Agreements
  - Mechanisms: e.g. CDM, ET, NDC, NAMA etc
- National
  - Institutions: Nodal ministry - MOEF&CC
  - Process: NAPCC, NDC targets, Development goals
  - Mechanisms: Missions and their targets, Financial (FiT, REC etc), Technology, Inter state
- State
  - Institutions: e.g. Climate Change Department, Gujarat
  - Process: SAPCC, state level targets and programmes
  - Mechanisms: Financial (e.g. incentives)
- Local: Implement, provide inputs and feedback

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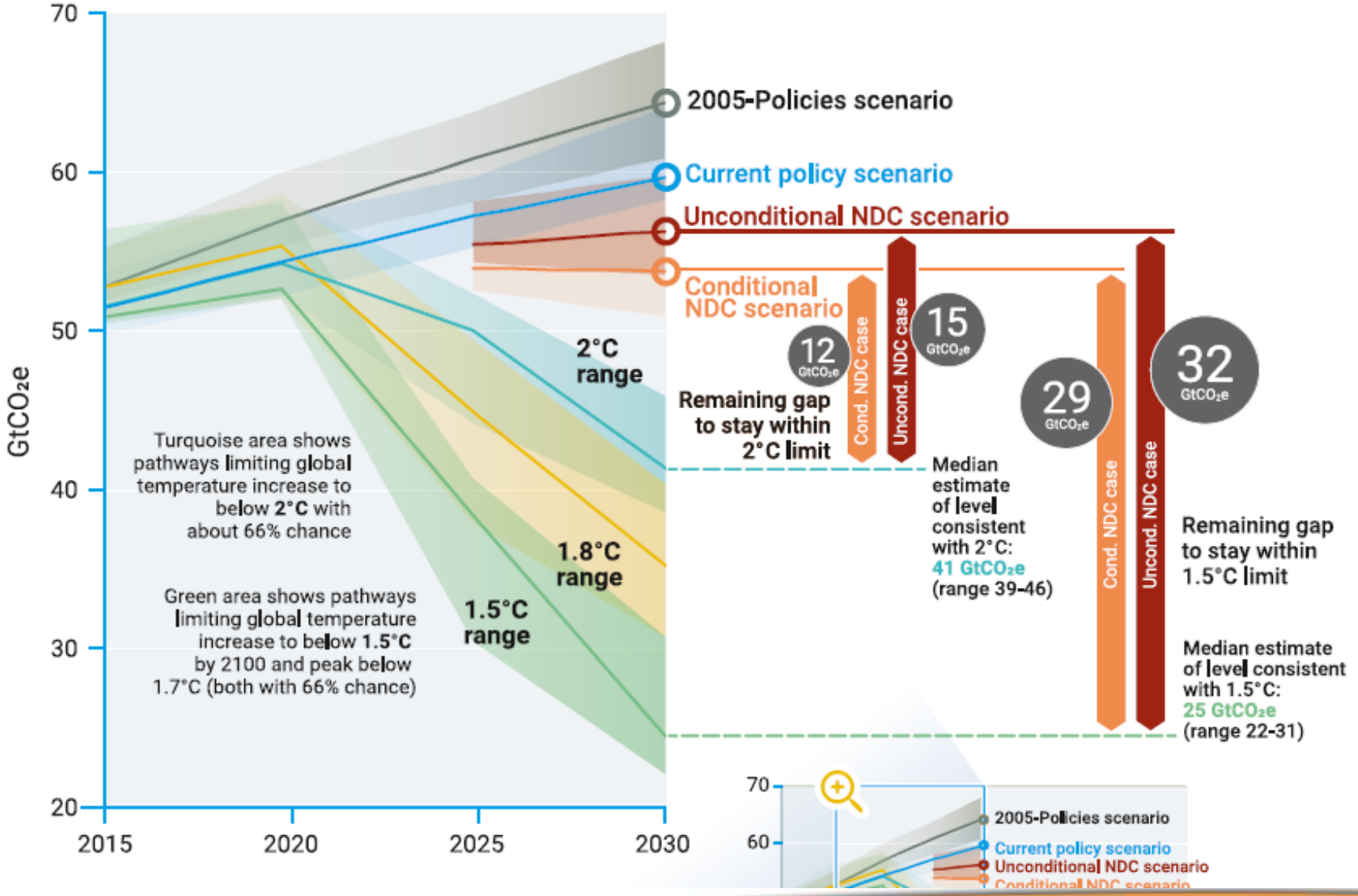
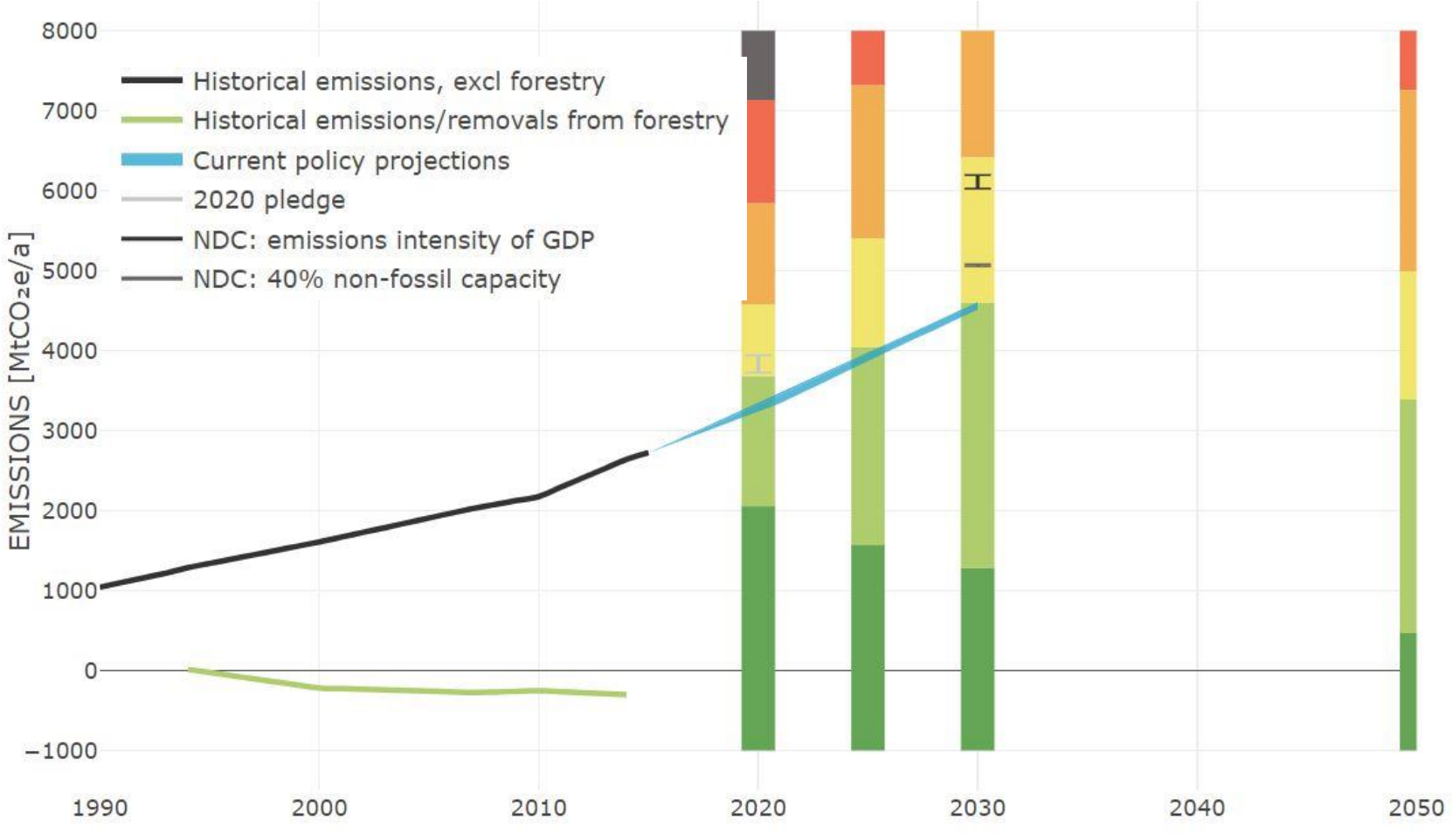
Global GHG Emissions and Emission Gap in 2030



Source: UNEP Emissions Gap Report, 2019

Economy wide Assessment

"India remains on track to overachieve its "2°C compatible" rated Paris Agreement NDC climate action targets"



Source: Climate Action Tracker

Global Climate Policy and Governance

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Origin of the commodity 'Carbon'?

- The Phenomenon: GHG emissions (to) concentrations (to) climate change (to) carbon mitigation (to) carbon markets and finance
- UNFCCC (1992)
- **Kyoto Protocol (1997)**
  - Emissions limitations on 41 Annex I countries (31 developed and 10 EIT parties)
  - About 5.2% reduction over 1990 and average of 2008-2012
  - Carbon Emissions trading markets and mechanisms (CDM, JI, ET) established
  - USA government walked away (under President George W. Bush).
- **Copenhagen Accord (2010)**
- **Paris Climate Change Agreement (2015):**
  - 2^{o}C and 1.5^{o}C temperature growth during 1850-2100 requires major carbon reductions by all.
  - NDC pledges.
  - USA government again walked away (under President Trump).

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Conference of Parties (COP)

- The COP is the supreme decision-making body of the Convention.
- A key task for the COP is to review the national communications and emission inventories submitted by Parties.
- The COP assesses the effects of the measures taken by Parties and the progress made in achieving the ultimate objective of the Convention.
- “Convention” means the United Nations Framework Convention on Climate Change adopted in New York on 9th May, 1992.

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Major COP Meetings

- The first COP meeting was held in Berlin, Germany in March, 1995
- COP 3 (1997) Kyoto Protocol
- COP 8 (2002) Delhi Declaration
- COP 13 (2007) Bali Action Plan
- COP 15 (2009) Copenhagen Agreement
- COP 21 (2015) Paris Climate Change Agreement
- COP 25 (2019) was held on December 2019 in Madrid, Spain. Stalemate, no progress on modalities to implement Paris CCA
- COP 26 (2020) in UK has been cancelled

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Types of commitments under the Paris Agreement

- **Fixed-level targets** – specify the absolute emissions level in a target year or trajectory
- **Base year emissions targets** – as a percentage relative to a historic base year
- **Baseline scenario targets** – country provides information on projected level of emissions in the target year for a baseline scenario and commitment for an alternate scenario
- **Intensity targets** – commitment to reduce emissions intensity of GDP, energy use or similar variable – India and China

Non-State Actors – City, sub-national (states, provinces), regional and firm level commitments

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Various Trading Instruments (Carbon linked?)

- **Sectoral Instruments**
  - Aviation Sector Carbon Tax (operational in EU)
  - Feed-in Tariff for Renewable Technologies (e.g. Solar)
- **Energy vs. Carbon (Pollution) Tax**
  - Tax on energy content vs. tax on pollutants
  - Renewable Purchase Obligations (RPO) and Renewable Energy Certificate (REC) markets
  - Energy Saving Certificates (ESCerts) market
- **Carbon Tax on Production vs. Consumption**
  - Where to tax and who to tax?
  - Presently production based for countries (Carbon on as is where is basis, fuel sales based), consumption based for firms
- **Conjoint Instruments**
  - Conjoint Trading of CO_2 and SO_2 emissions
  - Technology Subsidy plus carbon tax (e.g. Solar/Wind)

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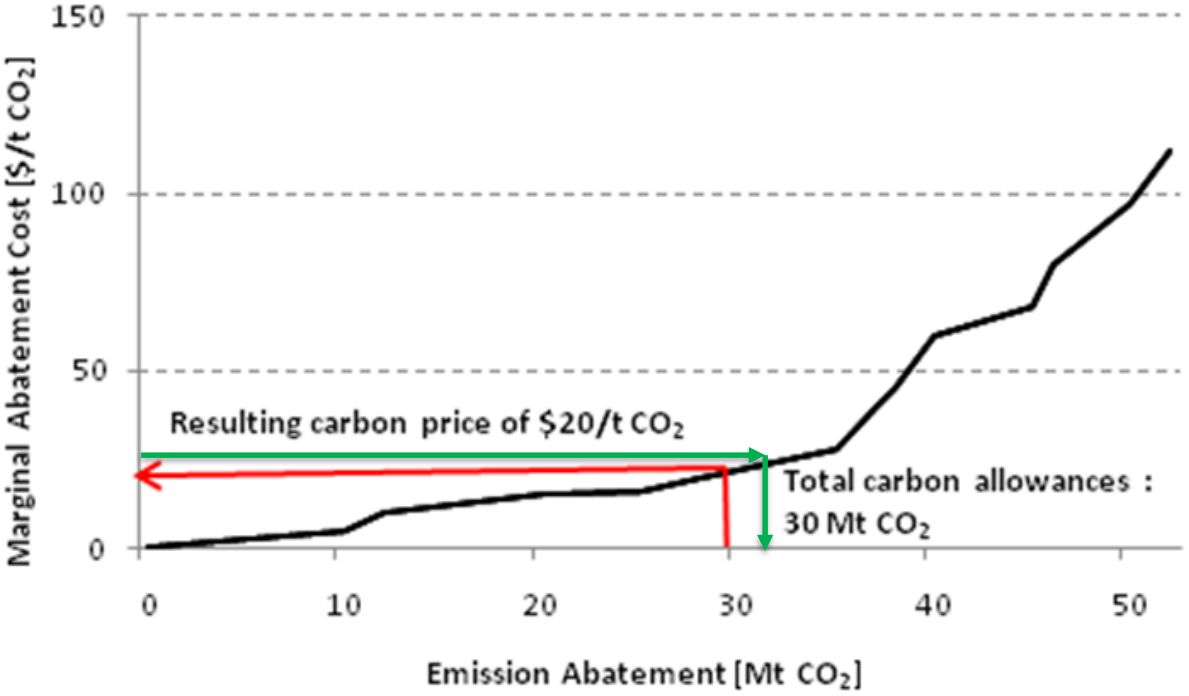
Carbon Pricing Instruments



- Cap allows price discovery through trade
- Tax allows determination of carbon to be mitigated
- Both P and Q are unknown for either approach

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National Climate Policy and Governance

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National Action Plan on Climate Change (NAPCC)

- NAPCC was launched in 2008 by the Prime Minister's Council on Climate Change.

- **Eight National Missions** forming the core of the NAPCC:
  1. National Solar Mission
  2. National Mission for Enhanced Energy Efficiency
  3. National Mission on Sustainable Habitat
  4. National Water Mission
  5. National Mission for Sustaining the Himalayan Ecosystem
  6. National Mission for A Green India
  7. National Mission for Sustainable Agriculture
  8. National Mission on Strategic Knowledge for Climate Change

Source: Websites of various Ministries of Government of India

National Solar Mission (NSM)

Implementing Ministry: Ministry of New and Renewable Energy

Targets of NSM:

i. Deployment of 20,000 MW of grid connected solar power by 2022;

ii. 2,000 MW of off-grid solar applications including 20 million solar lights by 2022;

iii. 20 million sq.m solar thermal collector area;

iv. To create favorable conditions for developing solar manufacturing capability in the country

v. Support R&D and capacity building activities to achieve grid parity by 2022.

Status (till 2018-19): Installed 9012.66 MW of grid-connected solar generation capacity and 382.01 MW equivalent of off-grid solar generation capacity.

National Mission for Enhanced Energy Efficiency

Implementing Ministry: Ministry of Power

Four initiatives to enhance energy efficiency in energy intensive industries are:

1. Perform Achieve and Trade Scheme (PAT)
2. Market Transformation for Energy Efficiency (MTEE)
3. Energy Efficiency Financing Platform (EEFP)
4. Framework for Energy Efficient Economic Development (FEEED)

Status (till 2018-19):

- Total of 10.49 mtoe energy savings would be achieved which corresponds to avoiding emission of 52.45 million tonnes of CO_2 under PAT Scheme.
- 29 million CFLs have been distributed and avoided generation capacity of 4115 MW has been achieved under Bachat Lamp Yojana (BLY) scheme during XI Plan.
- 20,00,120 CERs equivalent to as many tonnes of CO_2 reduction have been issued till now by UNFCCC under BLY.
- EESL has initiated action to procure and deploy super efficient ACs and fans under super efficient equipment programme.

Source: Websites of various Ministries of Government of India

National Mission on Sustainable Habitat (1/2)

- **Implementing Ministry:** Ministry of Housing and Urban Affairs (MoHUA)

- It is implemented through four flagship missions/programmes:

1. Atal Mission on Rejuvenation and Urban Transformation (AMRUT)
2. Swachh Bharat Mission
3. Smart Cities Mission
4. Urban Transport Programme

- Successful implementation of these flagship missions has a potential to mitigate the GHG emission of 133 Mt CO2e by 2021 and 270Mt by year 2031.

Status: All programmes are under various stages of implementation in India.

Source: Websites of various Ministries of Government of India

National Mission on Sustainable Habitat (2/2)

Swachch Bharat Mission aims at making urban India free from open defecation and achieving 100% scientific management of municipal solid waste in 4041 statutory towns in the country to be achieved in five years, i.e. by 2nd October 2019.

Main Objectives of Swachch Bharat Mission

- Elimination of open defecation
- Eradication of manual scavenging
- Modern and scientific Municipal Solid Waste Management
- To effect behavioral change regarding healthy sanitation practices
- Generate awareness about sanitation and its linkage with public health
- Capacity Augmentation for Urban Local Bodies
- To create an enabling environment for private sector participation in Capex and Opex (operation and maintenance)

Source: Websites of various Ministries of Government of India

National Water Mission (1/2)

Implementing Ministry: Ministry of Water Resources, River Development & Ganga Rejuvenation

Five identified goals of the Mission are:

- Comprehensive water database in public domain and assessment of impact of climate change on water resource
- Promotion of citizen and state action for water conservation, augmentation and preservation
- Focused attention to vulnerable areas including over-exploited areas;
- Increasing water use efficiency by 20%; and
- Promotion of basin level integrated water resources management

Status (till 2018-19):

- 702 Hydrological Observation Stations and 65 Automatic Satellite based Telemetry system have been established during XII plan period
- Aquifier mapping of 6.31 lakh sq.km upto March 2017
- Delineation of Contamination -free aquifers in the Arsenic – affected States of UP, Bihar, Jharkhand & West Bengal.

Source: Websites of various Ministries of Government of India

National Water Mission (2/2)

Status (till 2018-19):

- Mega Recharge Project in Tapi River basin
- In drought affected areas of Latur district, 25 wells constructed on sites for tackling drinking water crisis.
- Max yield – 5.8 lps, all wells handed over to the state govt.
- Ground Water Management plan developed for reviving Rajgir hot springs.
- Through convergence with MGNREGA, 7.86 lakh water conservation structures have been made during 2016-17.

National Mission for Sustaining the Himalayan Ecosystem (1/2)

Implementing Ministry: Department of Science and Technology (DST), Ministry of Science and Technology

Aim: To understand the complex processes affecting Himalayan Ecosystem and evolve suitable management and policy measures for sustaining and safeguarding the Himalayan Ecosystem.

Status (till 2018-19):

Outcomes of the Centre for Himalayan Glaciology at Wadia Institute of Himalayan Geology, Dehradun

- Installation of six Automatic Weather Stations in the Upper Ganga Valley for real time weather data collection; installation of three Aethlometers in the Bhagirathi Valley to monitor black carbon and aerosols; establishment of Laser Isotope Laboratory to analyse stable isotopes of oxygen and carbon in water and establishment of Remote Sensing and GIS Lab.

- Monitoring of 8 glaciers namely Gangotri and Dokriani in Bhagirathi River basin, Chorabari and Companion in Mandakini River basin, Dunagiri and Bagni in Dhauliganga River basin and Pindari & Kafni in Pindar River basin in Uttarakhand region of Central Himalaya.

National Mission for Sustaining the Himalayan Ecosystem (2/2)

- **6 Thematic Task forces** anchored around lead institutions working in the areas of Himalayan ecosystem has been set up to undertake following technical work elements:
  - Establishing database
  - Designing monitoring systems
  - Modelling and simulation
  - Vulnerability assessment
  - Adaptation policy research
  - Pilot studies for revalidation.

Source: Websites of various Ministries of Government of India

National Mission on Strategic Knowledge for Climate Change

Implementing Ministry: DST, Ministry of Science and Technology

Aim:

- Seeks to build a vibrant and dynamic knowledge system that to support national action for ecologically sustainable development.
- Creating institutional capacity for research infrastructure including access to relevant data sets, technologies, computing and communication facilities and awareness to improve the quality and sector-specific scenarios of climate change over the Indian sub-continent.
- Seeks to build knowledge and research networks, develop national capacity for modelling the regional impact of climate change on different ecological zones within the country

Status (till 2018-19):

- Eight Centres of Excellence and 20 Major R&D Programmes
- 10 State Climate Change Centres
- Three National Network Programmes
- Seven Human Capacity Building Programmes
- Eight Global Technology Watch Groups (GTWGs)
- Indo-US Fulbright-Kalam Doctoral and Post-Doctoral Fellowships in Climate Change

Source: Websites of various Ministries of Government of India

National Mission for A Green India

Implementing Ministry: Ministry of Environment, Forest and Climate Change

Objectives:

- To increase forest/tree cover to the extent of 5 million hectares (mha) and improve quality of forest/tree cover on another 5 mha of forest/non-forest lands;
- To improve/enhance eco-system services like carbon sequestration and storage, hydrological services and biodiversity; along with provisioning services like fuel, fodder, and timber and non-timber forest produces (NTFPs)
- To increase forest-based livelihood income of about 3 million households.

Status/Outcome:

- Increase in forest cover by 32368.7 ha (2015-16)
- Promoting alternate fuel energy by 11015.1 ha
- Devices for households by 2500 ha
- Area afforested by 41266.12 ha (2016-17).

Source: Websites of various Ministries of Government of India

National Mission for Sustainable Agriculture (1/2)

Implementing Ministry: Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW), Ministry of Agriculture & Farmer Welfare

Objectives: Transforming agriculture into an ecologically sustainable climate resilient production system by devising appropriate adaptation strategies for ensuring food security, equitable access to food resources, enhancing livelihood opportunities and contributing to economic stability at the national level.

Status/Outcome during 2012-17:

- 18.70 lakh ha area has been brought under the organic farming as organic farming reduces of greenhouse gases, and sequestration of CO_2 in soil.
- Annual production of bio-fertilizers has increased up to 3.96 lakh MT.
- Coverage under Micro Irrigation System was 28.46 lakh ha to improve water use efficiency, reduce irrigation cost, reduce electricity consumption and decrease fertilizer usage.
- The coverage under System of Rice Intensification (SRI) was 7.42 lakh ha
- The coverage under crop diversification was about 2.6 lakh ha, led to reduction in water use.

Source: Websites of various Ministries of Government of India

National Mission for Sustainable Agriculture (2/2)

Status/Outcome during 2012-17:

- 8.01 lakh ha has been brought under plantation in arable land for CO_2 sequestration of in soil
- About 450 climate resilient varieties have been identified/released under National Innovation for Climate Resilient Agriculture.
- 50 lakh farmers are working on zero budget natural farming neither fertilizer nor pesticide is used and only 10 per cent of water is to be used for irrigation
- On December 10, 2015, the National Green Tribunal (NGT) banned crop residue burning in states of Rajasthan, Uttar Pradesh, Haryana and Punjab.

Source: Websites of various Ministries of Government of India

Latest Missions

- National Mission on Health
- National Mission on Coastal Zones
- National Mission on Waste to Energy

Source: As per some news articles, 2017 onwards

Major Commitments under India's NDCs

- To reduce the **emissions intensity of its GDP by 33 to 35 per cent** by 2030 from 2005 level
- To achieve about **40 per cent cumulative electric power installed capacity from non-fossil fuel energy** resources by 2030 with the help of transfer of technology and low-cost international finance including from Green Climate Fund (GCF)
- To create an additional **carbon sink of 2.5 to 3 billion tonnes** of CO_2 equivalent through additional forest and tree cover by 2030
- To better adapt to changing climate, mobilize climate finances from domestic and international sources and build capacities of relevant actors in the process

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Renewable Energy

- Rising share of non-fossil sources in installed capacity: 30.5% in March 2015 to 37.1% in October 2019 (NDC: 40% by 2030)
- Jump in Solar capacity addition: 12 times in last 5 years (2.63 GW in March 2014 to over 31.7 GW in October 2019), CAGR of 65% is way above average global growth rate of 25-30%
- Falling solar power tariffs: US$ 0.24/kWh in 2009 to US$ 0.034/kWh in May 2017 (levelized tariff in respect of Bhadla Solar Park, Rajasthan) following market forces.
- International partnerships: International Solar Alliance (ISA)
- Corporate voluntary commitments: Some Indian conglomerates have committed to 100% electricity consumption from renewables (TATA Motors and Infosys by 2030, Mahindra & Mahindra by 2040)

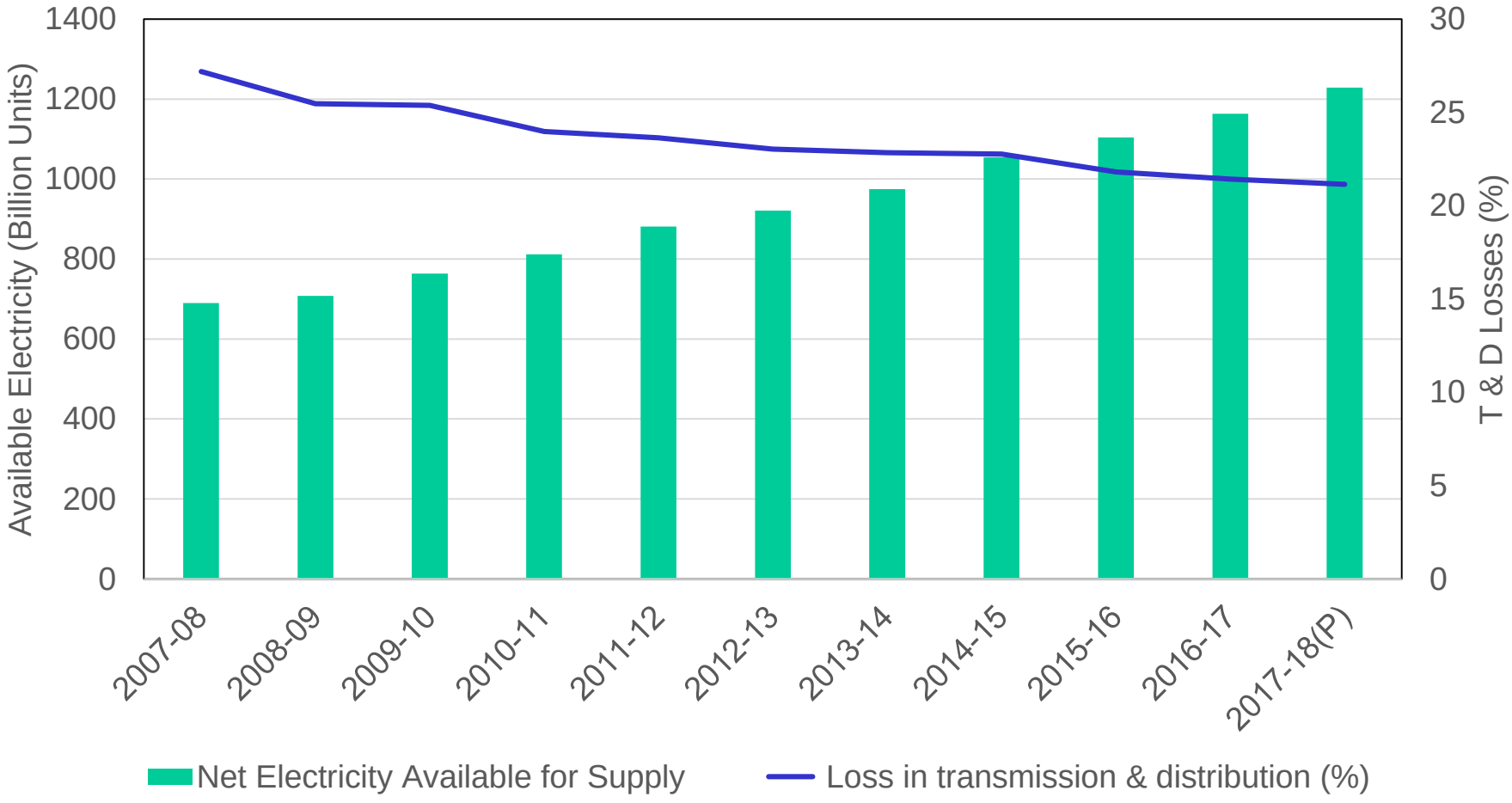
Source: MoEFCC; MoSPI, Government of India

Clean Coal Technologies

- **Coal Cess on every ton of coal used in India:** equal to around 30% of average pithead price of non-coking coal (Cess around US$ 5/tonne of coal)
- **Co-firing of biomass** pellets in coal power plants – target to reach 5-10% co-firing
- **Supercritical technology** has already been adopted to enhance the efficiency of coal fired thermal power plants
- Department of Science and Technology (DST) is exploring **Carbon Capture, Utilization and Storage (CCUS)** technologies
- Regulations to **reduce SO_2 emissions** using flue Gas Desulphurization (FGD) from coal plants in India since 2015

Source: MoSPI, Government of India

Electricity Transmission and Distribution (T&D) Losses



One percentage point reduction saves about 11 million ton CO_2 per year and can power almost a million electric cars for a year

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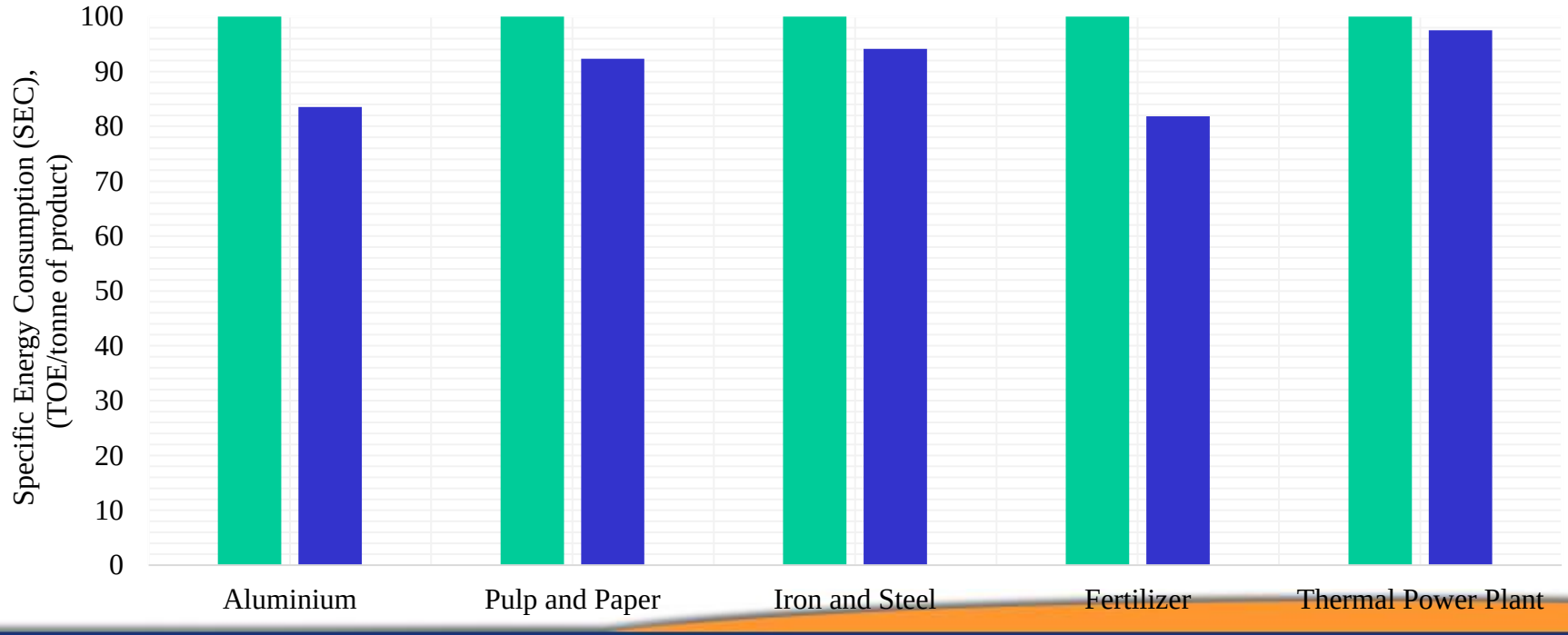
Sectoral Energy Efficiency Improvements

- Perform, Achieve and Trade (PAT) to improve industrial energy efficiency
- 31 $MtCO_2$ of emission reduction in PAT-I (2012-15), 60 $MtCO_2$ projected reductions in PAT-II (2016-19)
- Investment of US$ 3.5 and 4.3 billion by Indian industry in PAT-I and II, respectively

Note: Assuming SEC for 2014 = 100



Source: MoEFCC; BEE

Clean and Efficient Energy for All

- UJJWALA: Subsidized LPG connections to the poor for cooking. Provided to over 80 million poor households under PMUY. 86% of PMUY Beneficiaries who are at least one year old returned for the second refill
- SAUBHAGYA: 99.99% households electrified under Saubhagya Scheme
- UJALA: Over 361 million LED bulbs distributed till 30th November 2019, resulting in energy saving of about 47 billion kWh and reduction of 38 $MtCO_2$ per year
- Street Lighting National Programme: 10.55 million LED streetlights installed, leading to an annual emission reduction of 4.88 $MtCO_2e$
- Standards and Labelling (S&L) for efficient appliances continuously improves the appliance standards and implementation in the market
- Energy Conservation Building Codes (ECBC) for new and retrofitted buildings implemented.
- India achieved about 6 billion sq. ft. of Green Building footprints (about a third of total floor space), and with more than 5400 new green building projects it will touch 10 Billion sq. ft. by 2022.

Source: MoEFCC; BEE

Transport Sector

Biofuels Policy and Clean Fuel Standards

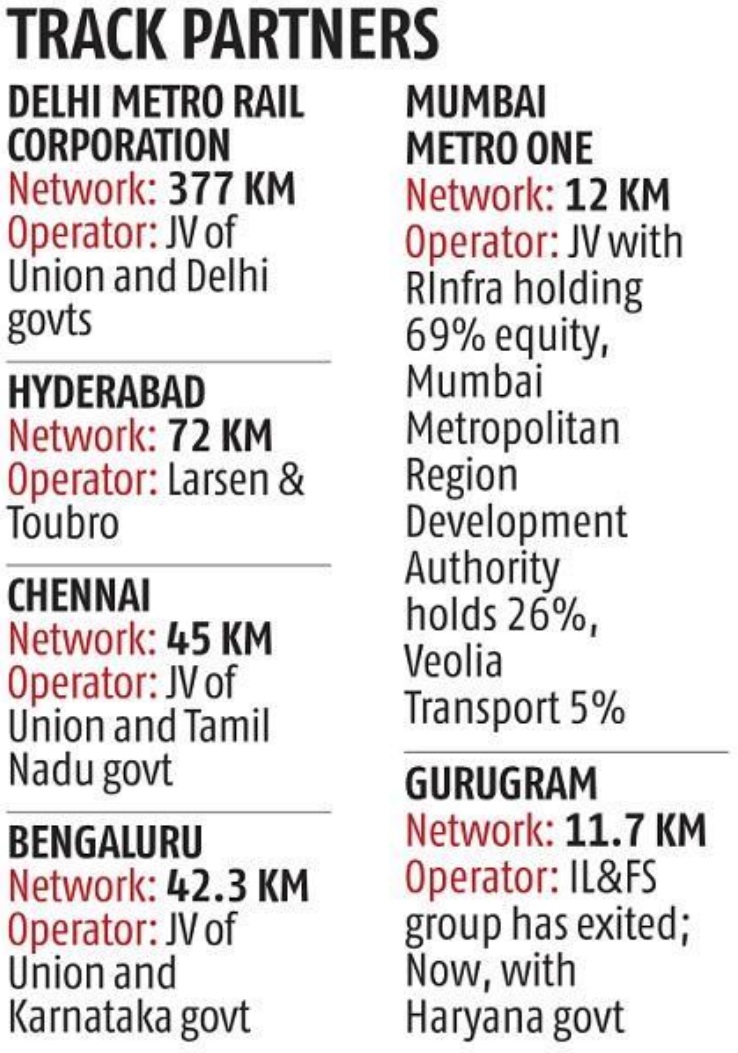
- Biofuel Policy 2018: 10 per cent of ethanol blending with petrol by 2022, 20 per cent ethanol blending with petrol by 2030,
- Ethanol blending with petrol expected to reach 7.2% soon (2.37 billion litre) as against 4.2% in 2017-18 (1.5 billion litre)
- Government has decided to leapfrog directly to Euro-6 equivalent (BS-VI) fuel efficiency norms from 1st April 2020 in the entire country

Source: MoEFCC; MoPNG

Transport Sector

Mass Rapid Transport Systems

- As of February 2019, 585 km of Metro lines are operational
- There are about 600 km lines under construction which will be operational in next five years
- About 1000 km of metro line proposals under planning
- All cities above a million plus population to have Metro systems
- Modal shift is happening



Source: MoEFCC; Business Standard, websites of other Ministries as relevant

Transport Sector

Electric Vehicles

- National Electric Mobility Mission Plan (2020)
- Faster Adoption and Manufacturing of Hybrid and Electric vehicles (FAME)
- EV prioritization
  - ~ 61% of national petrol consumption is by 2 wheelers in India
  - ~ 18 million ton petrol/year (~100 million barrels of crude oil)
  - Forex of about US$ 4 billion/year for oil imports towards this
  - ~ 50 million ton CO2 emissions/year
  - Convert these to EV first (?). Solar charging - icing on the cake
- Electric buses, cars next in that order
- Installation of EV infrastructure

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- Agriculture Sector
  - National Mission on Sustainable Agriculture (NMSA)
  - Paramparagat Krishi Vikas Yojana (PKVY)
  - National Innovations in Climate Resilient Agriculture (NICRA)
  - Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)
  - Crop Diversification Programme
  - System of Rice Intensification (SRI)
  - Direct Seeded Rice (DSR) cultivation
  - Production of neem-coated urea
  - Avoiding crop residue burning
  - National Horticulture Mission
- Forestry Sector
  - Thrust on Forests, Trees outside forests, and Agroforestry (TFA)
  - Compensatory Afforestation Fund Act 2016
  - National Afforestation Programme
  - Green Highways (Plantation & Maintenance) Policy, 2015
  - National Mission for a Green India
  - National REDD+ Strategy

Source: Websites of various Ministries of Government of India

State Climate Policy

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Some Policies in Gujarat

Renewable Energy

1	Wind Power Policy 2007, 2009, 2013, 2016
2	Solar Power Policy 2009, 2015
3	Solar Roof Top Scheme, 2016
4	5 MW Gandhinagar Rooftop Programme
5	Green Solar Projects, 2010-11
6	Solar and Carbon Neutral City (Gandhinagar), 2010-11
7	Rooftop solar for 5 cities, 2012-2014
8	SKY Scheme, 2018
9	Gujarat Solar Park (Under solar power policy)
10	Installation of Solar Photovoltaic Power Pack for Anganwadis, 2013-14
11	Installation of Solar Pumps for small farmers in Gujarat
12	Solar Photovoltaic Power Plant at Gandhinagar Thermal Power Station
13	Solar plant on the premises of GNFC
14	Wind Solar Hybrid Policy, 2018
15	Wind Repowering Policy, 2018
16	Waste to Energy Policy, 2016
17	Mini Hydel Power Policy, 2016
18	Grid connected biomass based power projects in the state
19	Renewable Purchase Obligation (RPO)
20	Renewable Energy Certificates (RECs)

Source: Websites of various Departments of Government of Gujarat

Some Policies in Gujarat (2/4)

Energy Efficiency

1	LED lamps in APMCs spread in Gujarat
2	Perform Achieve Trade (PAT)
3	Domestic Efficient Lighting Programme (DELP)/ UJALA scheme

Industry

1	Industrial Policy, 2015
2	Greenhouse gas (GHG) reduction by implementing energy efficient plough share mixer (PSM)technology in soap manufacturing at Hindustan Lever Limited (HLL), India
3	Amine Circulation Pumps Energy Efficiency at Hazira works of ONGC
4	Demand side energy conservation &reduction measures at IPCL – Gandhar Complex
5	Efficient utilisation of waste heat and natural gas at Dahej complex of GACL
6	Energy efficiency and fuel switch project at Welspun India Limited

Source: Websites of various Departments of Government of Gujarat

Some Policies in Gujarat (3/4)

Urban Development

1	Urban Transport
2	Urban Waste Management
3	Street Light National Programme-MEEP
6	IGBC + GIHED
7	SJMMSVY
8	Smart Cities
9	AMRUT Cities
10	Waste Water Recycling in Rural Areas

Agriculture

1	Irrigation development through Micro Irrigation Systems
2	SAUNI Yojana (Saurashtra Narmada Avataran Irrigation Project)
3	Agro Industry- MOFPI schemes
4	Horticulture Mission
5	Biogas subsidy scheme - National Horticulture Board, Government of India (NHB)
6	NHB scheme on cold storage development
7	Agri-implements Subsidies
8	Soil Health Improvement through use of Bio fertilizers
9	National City Compost Policy, 2016
10	Climate Change Implications on Crop Growth in Gujarat

Source: Websites of various Departments of Government of Gujarat

Some Policies in Gujarat (4/4)

Forest and Wetlands

1	Joint Forest Management
2	Soil And Moisture Conservation
3	Social Forestry Programme
4	National Agroforestry Policy, 2014
5	Mangrove Conservation
6	State Bamboo Mission

Caveat: The policies mentioned here (4 slides) are just indicative and not exhaustive. There are over 150 such policies in Gujarat that have direct or indirect positive implications on climate change.

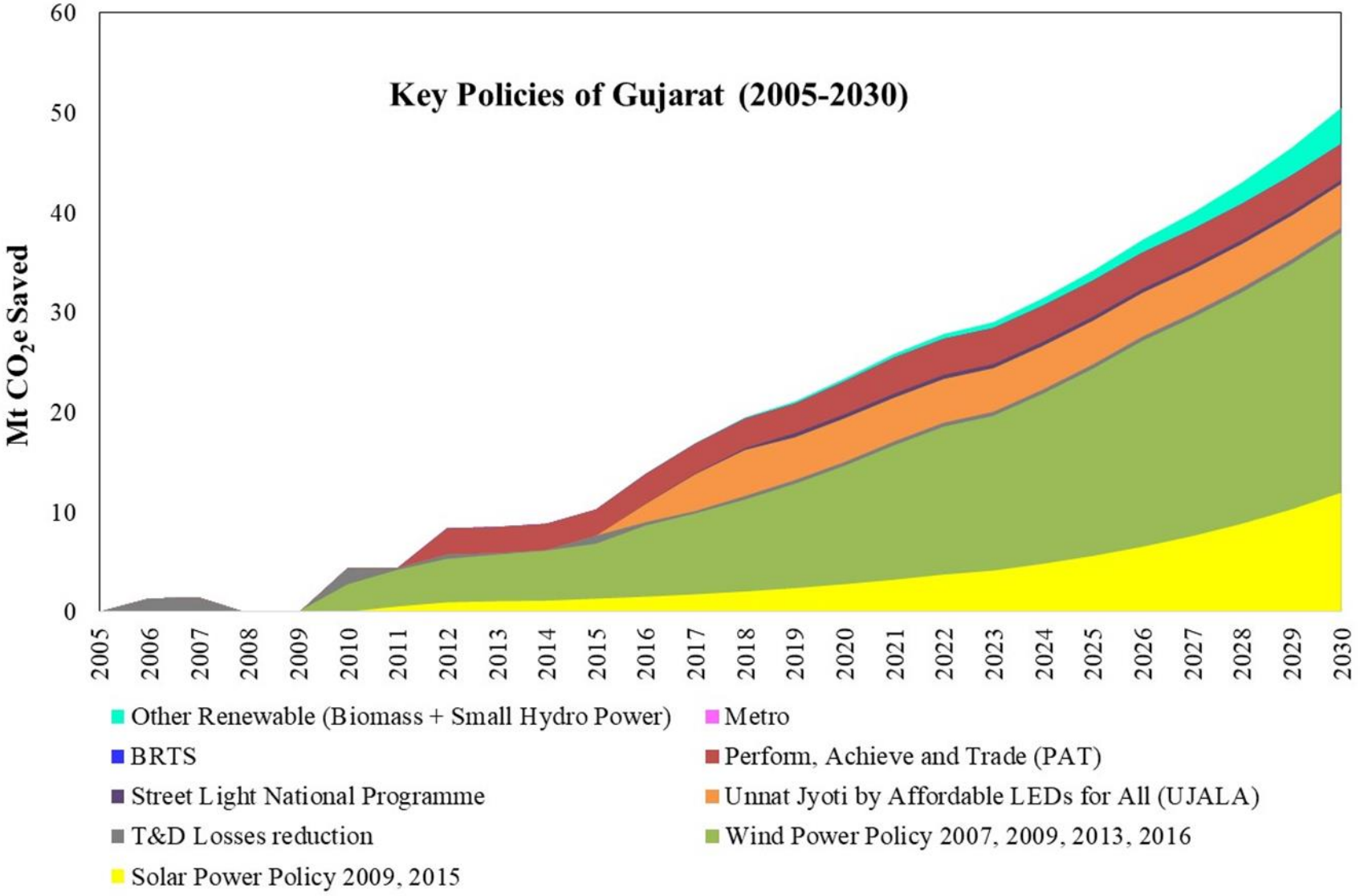
Source: Websites of various Departments of Government of Gujarat

Solar Policies of Government of Gujarat

- Solar Power Policy 2009
- Gujarat Solar Power Policy 2015
- Gujarat Solar Park (Under solar power policy)
- Residential Solar Rooftop Scheme (Grid connected)
- Jawaharlal Nehru National Solar Mission for development of long-term solar projects (Off-grid and Decentralized Solar PV)
- Gujarat Wind-Solar Hybrid Power Policy 2018-19
- 5 MW Gandhinagar Rooftop Programme
- Green Solar Projects 2010-11
- Solar and Carbon Neutral City (Gandhinagar) 2010-11
- Installation of Solar Photovoltaic Power Pack for Anganwadis 2013-14
- Installation of Solar Pumps for Small Farmers in Gujarat
- Solar Photovoltaic Power Plant at Gandhinagar Thermal Power Station
- Solar plant on the premises of GNFC

Source: Websites of various Departments of Government of Gujarat

GHG Mitigation Potential from Key Policies



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Future of Climate:
The Future is Today

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Climate Policy and Governance: Key Elements

- Leadership
  - Long-term vision important
  - Strong steps to implement
- Long-term vision for these transitions
- Policy options available
  - Key policies
  - Integrating low carbon and climate resilience into development
  - Target setting at micro level
- Governance
  - Monitoring implementation outcomes
  - Mid-course corrections (2022-23 and every 5 years)
  - Village, Taluka, City level engagement
  - Public awareness enhancement

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- Carbon and clean energy finance are linked. Both are large markets.
- A new division of capital
  - $44 trillion investment needed in global energy supply; $23 trillion required for energy efficiency. India $5 trillion until 2030.
  - 60% in oil, gas and coal extraction; 20% in renewable energies
- Climate pledges and climate goals
  - Countries on track; rise in CO_2 emissions can be slowed but its not enough. Expand carbon pricing initiatives and link them (?)
- Energy efficiency is the motor of change
- Electric vehicles ready to move
  - Electricity to account for 40% share of energy consumed by 2040
- Renewables break free
  - Nearly 60% of new power generated by 2040 to come from renewables; almost half of this from wind and solar PV.
  - Renewable energy competitive without any subsidies
  - Prosumer to Prosumer power trading

Source: World Energy Outlook (IEA, 2016)

- The policy focus shifts to integration
  - Structural changes to design and operation of power systems required
- The 2^{o}C pathway is very tough: the road to 1.5^{o}C goes through uncharted territory.
  - Fossil fuels: Make hay while the sun shines, risks from the low-carbon transition pressures, Covid-19 induced transitions
  - Oil markets are in for another bumpy ride
  - A truly global gas market is coming into view
  - Coal: a rock in a hard place
- Underlying commodity is Energy. Without transforming it, climate policy cannot meet the targets.
- Energy and water: one doesn't flow without the other

Source: World Energy Outlook (IEA, 2016)

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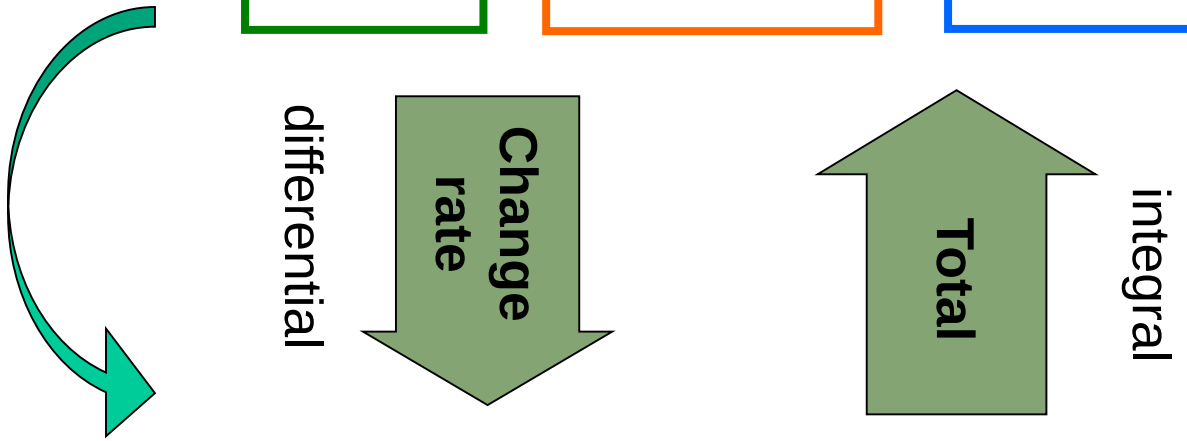
Economy, Energy and Carbon Dynamics

Per capita GDP | **Energy Intensity** | **Carbon Intensity**

Total amount

$$CO_2 \text{ emissions} = Pop \times \frac{GDP}{Pop} \times \frac{Energy}{GDP} \times \frac{CO_2}{Energy}$$



Rate of Change

$$CO_2 \text{emission change rate} = Pop \text{ Change rate} + \left(\frac{GDP}{Pop}\right) \text{change rate} + \left(\frac{Energy}{GDP}\right) \text{change rate} + \left(\frac{CO_2}{Energy}\right) \text{change rate}$$

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Thank You

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