

Renewable Energy (& Sustainable Development) Strategies for Developing/Emerging Economies

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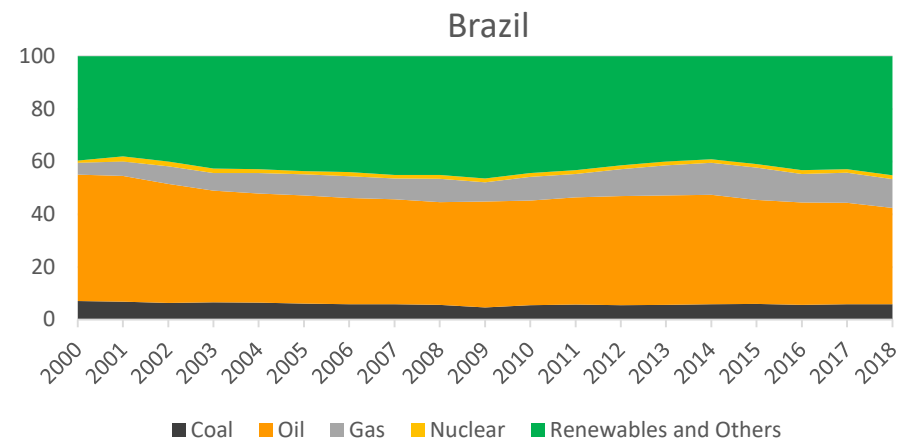
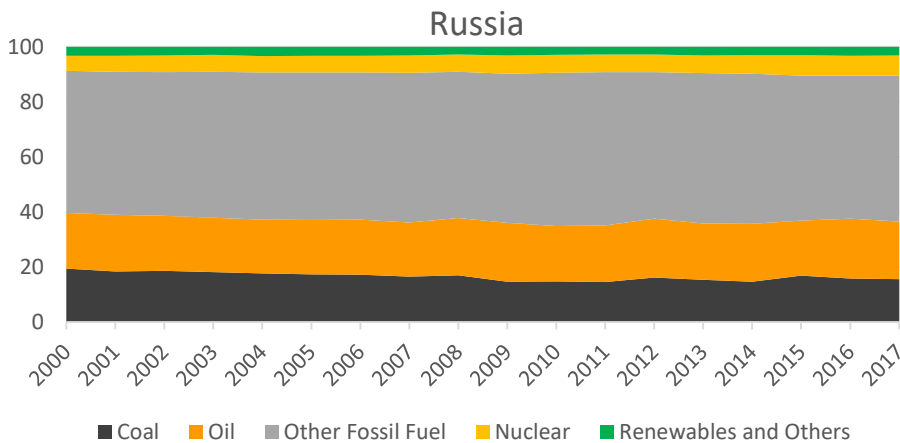
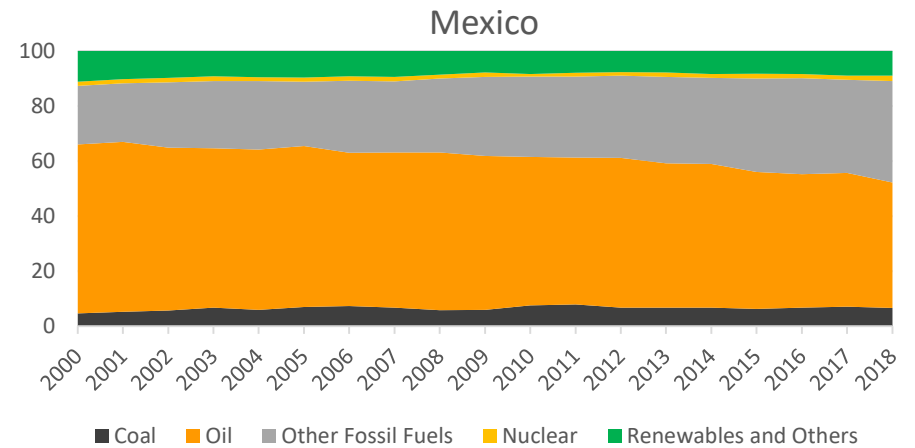
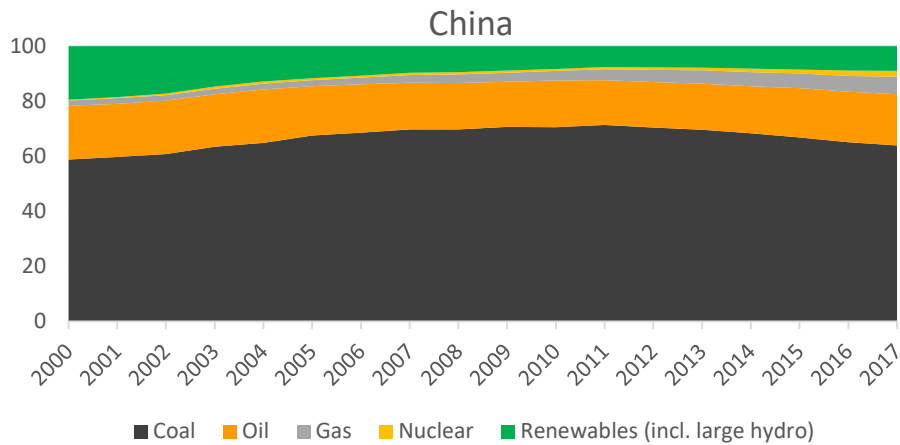
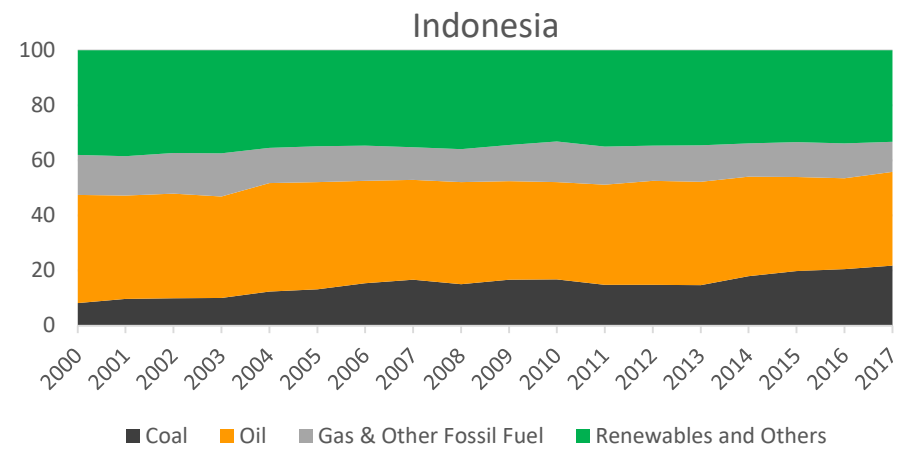
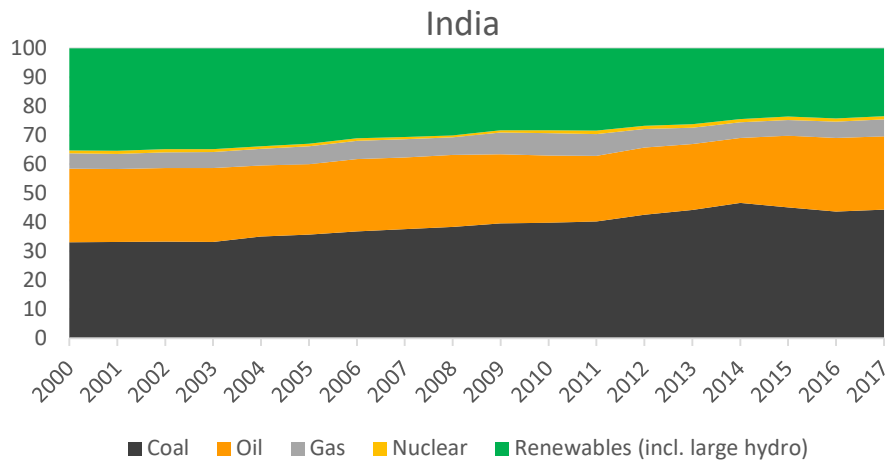
IGSA Labs

Major Emitter Developing Countries

8 developing countries/emerging economies with 46% share of global GHG emissions, 74% of total developing country GHG emissions:

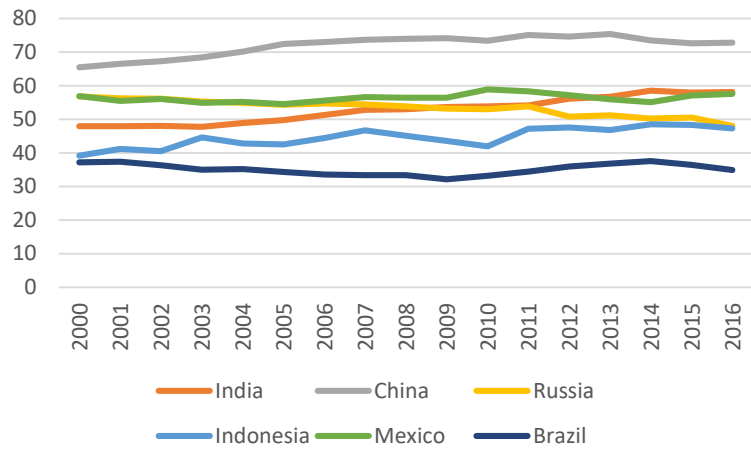
- China
- India
- Russia
- Iran
- Indonesia
- Mexico
- Brazil
- South Africa

Primary Energy Mix

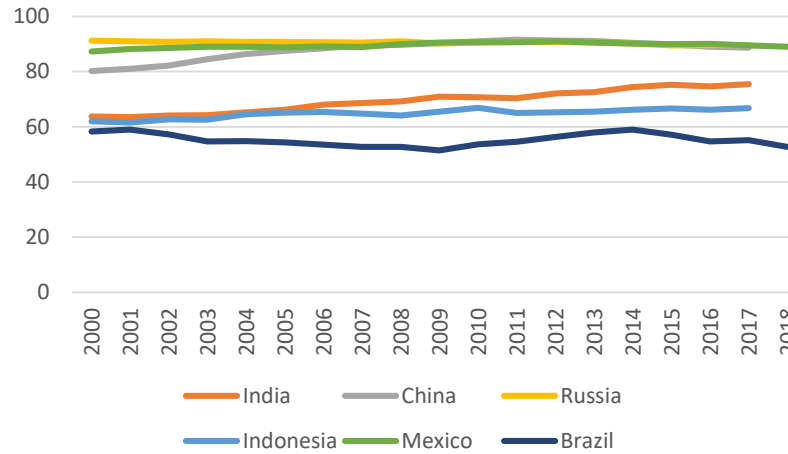


Comparisons

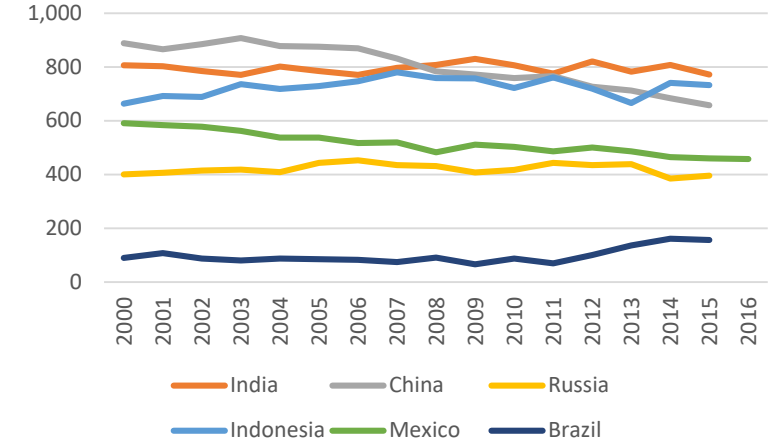
Emissions Intensity of Primary Energy [tCO₂ / TJ (primary)]



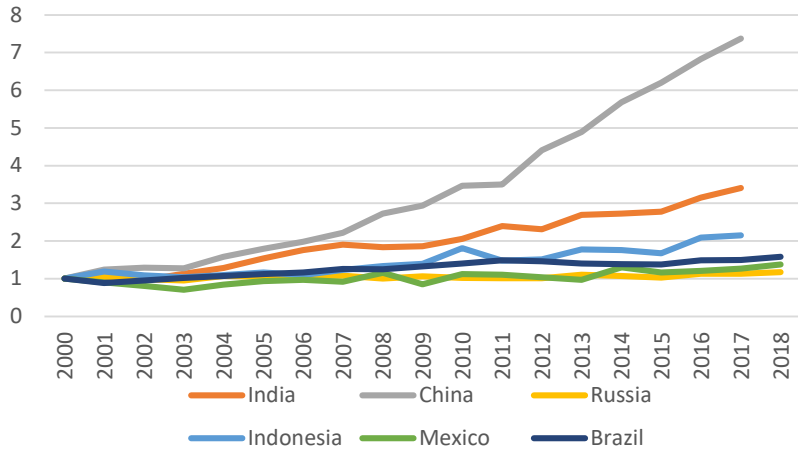
Fossil Fuel Share in Primary Energy [%]



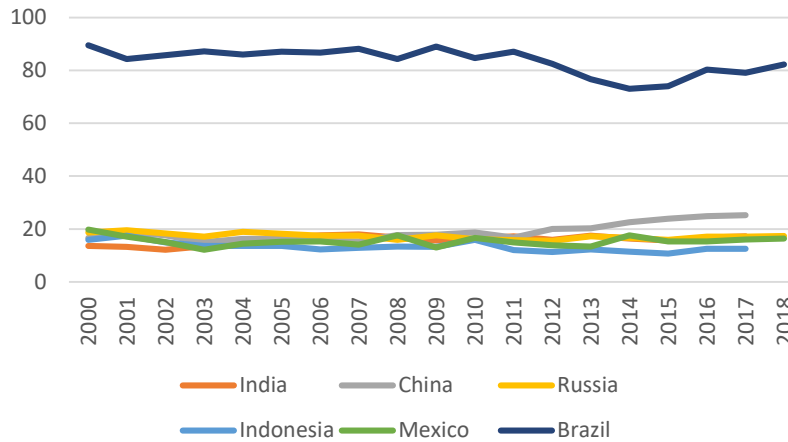
Electricity Emissions Intensity [gCO₂ / kWh]



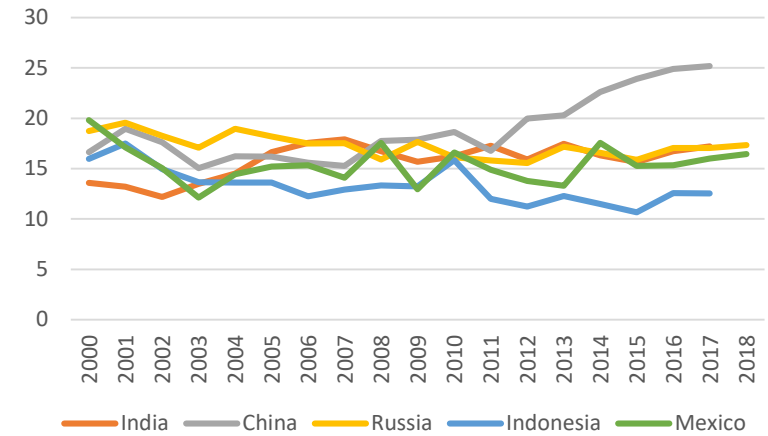
Renewable Electricity Generation Index (2000 value = 1)



Share of Renewables in Electricity Generation [%]

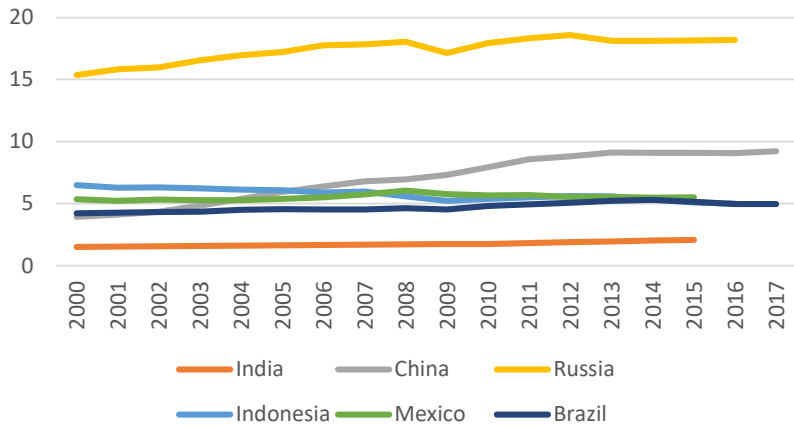


Share of Renewables in Electricity Generation [%]

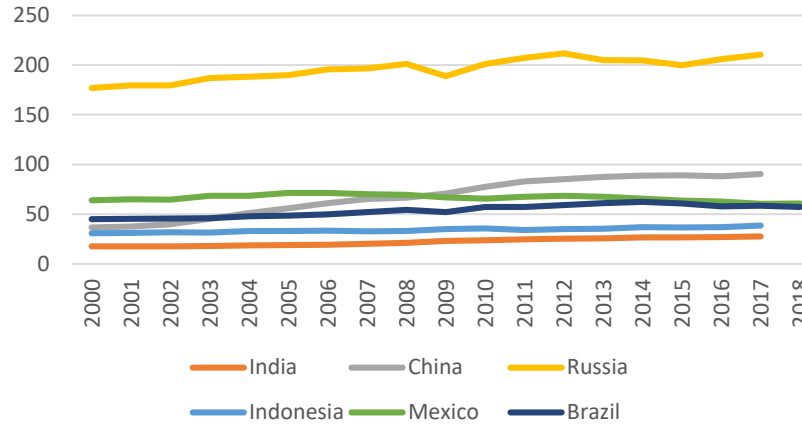


Comparisons

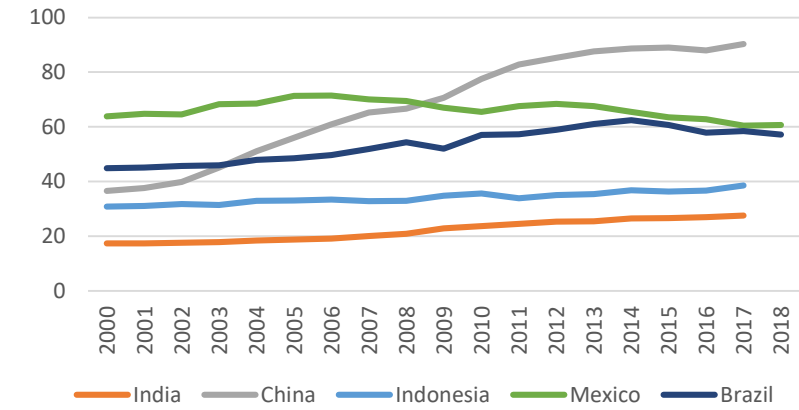
Emissions / Capita [tCO₂e / capita]



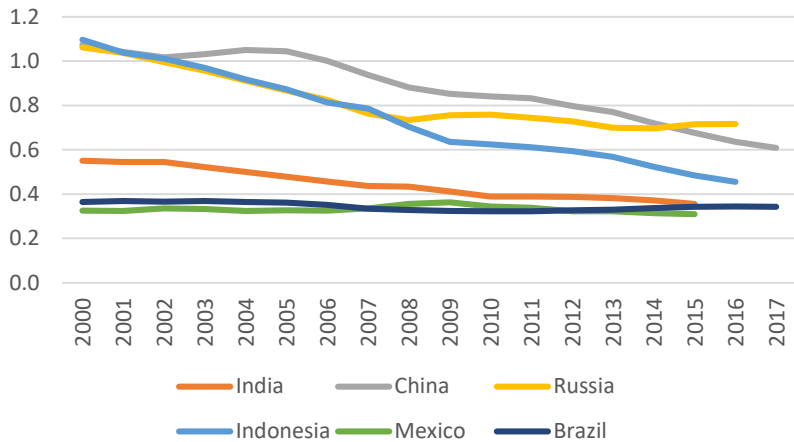
Primary Energy Demand per capita [GJ / capita]



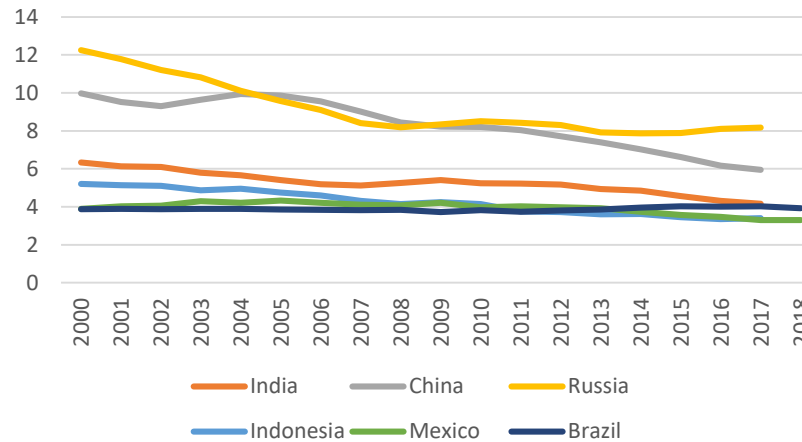
Primary Energy Demand per capita [GJ / capita]



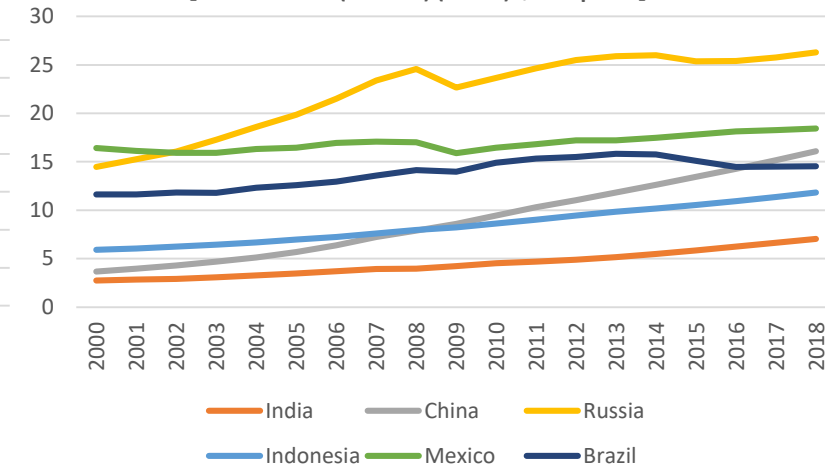
Emissions Intensity of GDP [tCO₂e / '000 USD(2012)(PPP)]



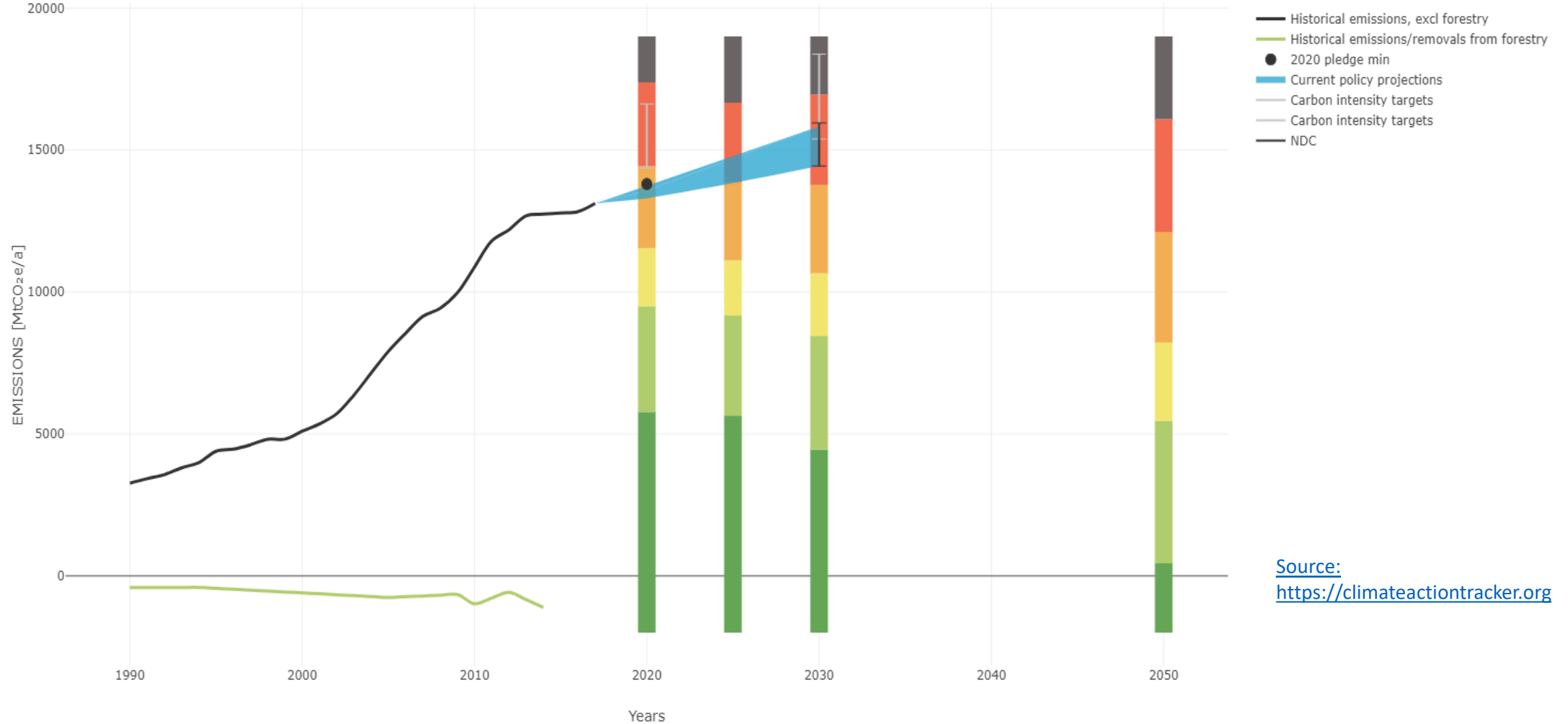
Primary Energy Intensity of GDP [TJ / Mill.USD(2012)(PPP)]



GDP / capita ['000 USD(2012)(PPP) / capita]



China









Source:
<https://climateactiontracker.org>

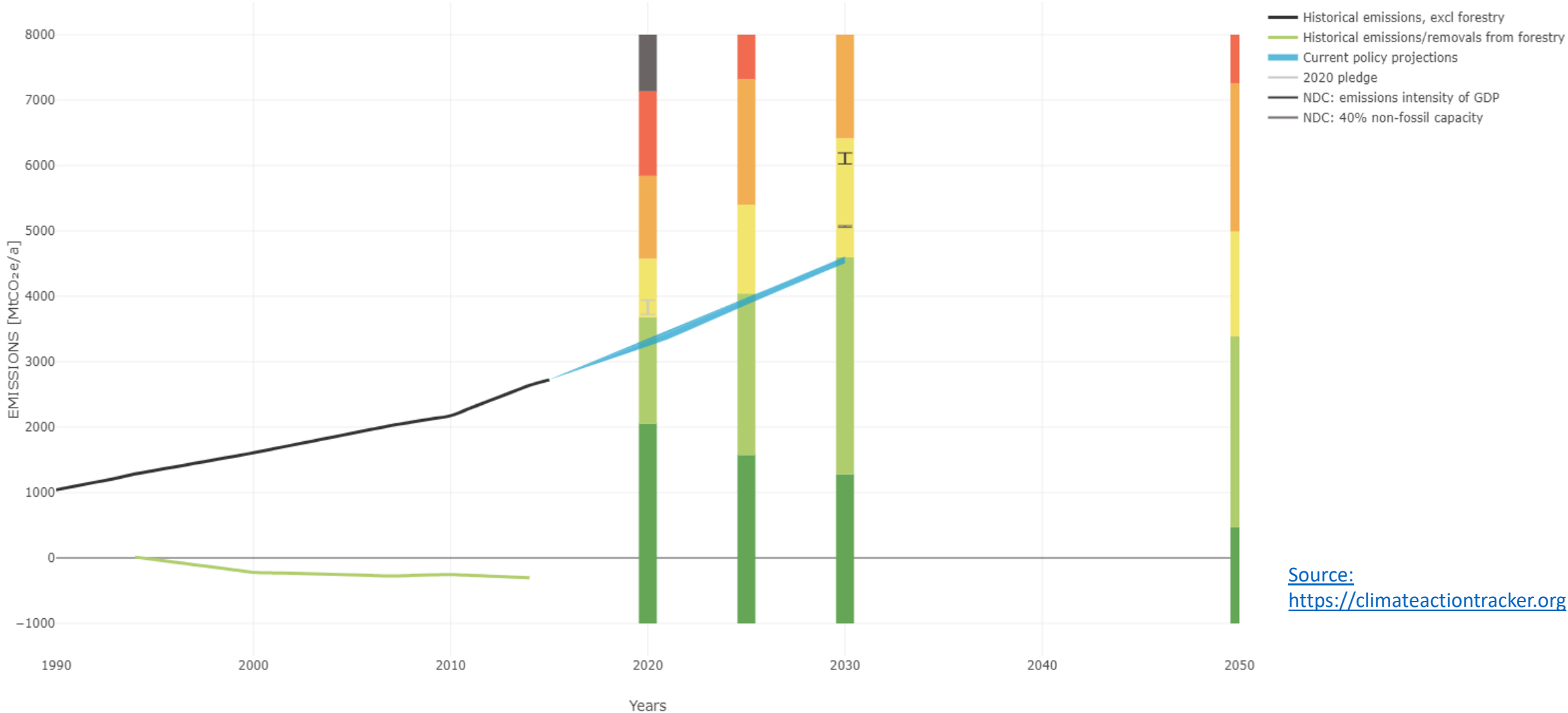
On track to meet NDC pledge but not adequate for 2-degree target

Status/Performance of Developing Countries

- China:

- On track to meet NDC pledge; Targets not adequate for 2-degree C reduction
 - Renewables: largest manufacturer of solar technology 
 - 13th Five Yr Plan: Share of coal in primary energy: 58% (2020) 
 - Emissions Trading Scheme 
 - Mandatory renewable energy certification scheme
 - EV subsidy: 1.1 million EVs bought in 2018 
 - Emission standards for passenger & heavy duty vehicles from 2020
 - Largest consumer of coal; Coal use continues 
 - Finances coal power as well as renewable energy plants in other countries 
- Plans to replace coal with renewables
Solar electricity cost will be less than coal-fired cost by 2020
Cut solar subsidies in 2018
- Pilot from 2013, Launched in 2017, aim to cover 50% emissions eventually
Accurate MRV system will be required
- 4.2% market share in 2018, likely 12% in 2020
- Lifted construction ban on coal power
(coal cap under construction: 235 GW)
- 102 GW coal plants outside being funded from China

India



Even though its emissions are rising, India is on track to better its NDC pledge, will be 2-degree compatible, and may even not exceed 1.5-degree limit

Status/Performance of Developing Countries

- India:

- Will overachieve NDC pledge; 2-degree C compatible emissions reduction plan
- Electricity from renewables: 17.5% (now), 40% non-fossil (2030)
- Massive expansion of renewables: 175-228 GW (2022)
- Coal tax linked to National Clean Environment Fund
- Plan for EVs
- Biofuel blending mandate B5
- Coal power continues; New plants under construction

Will overachieve thanks to New Energy Policy (NEP)
But what if GDP growth increases?

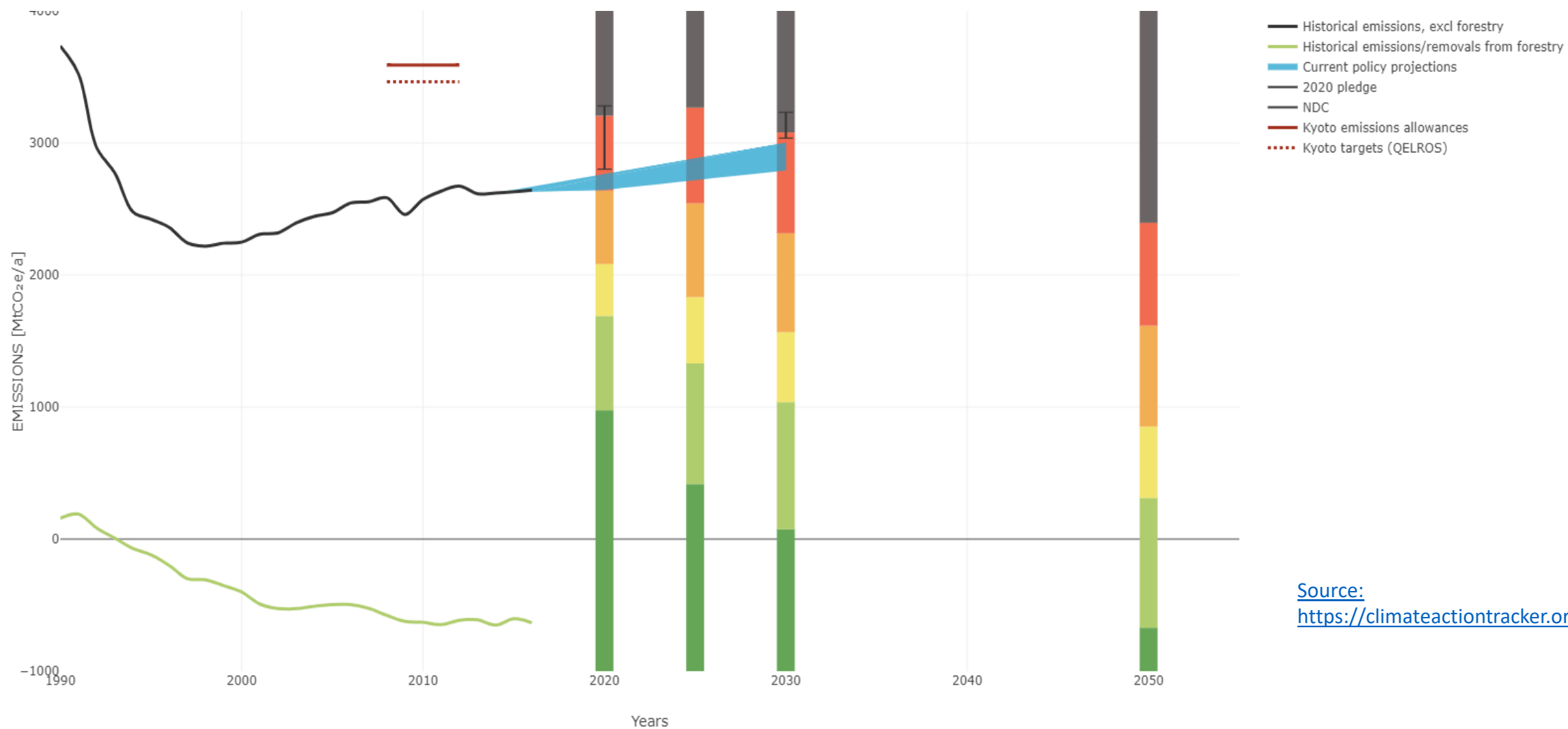
Will achieve much earlier!
In 2017-2019, renewable power
investments exceeded fossil fuel power
Rapid price drop for solar electricity
State govt policies + market effect

US\$ 12 bill. during 2010-2018

In a bit of limbo

Some coal subsidies continue
> 90 GW planned new coal power capacity
But several utilities shelving coal power plans
Env and health problems with coal power projects
(e.g. plant in Mundra with US\$ 450 mill. IFC/WB loan)

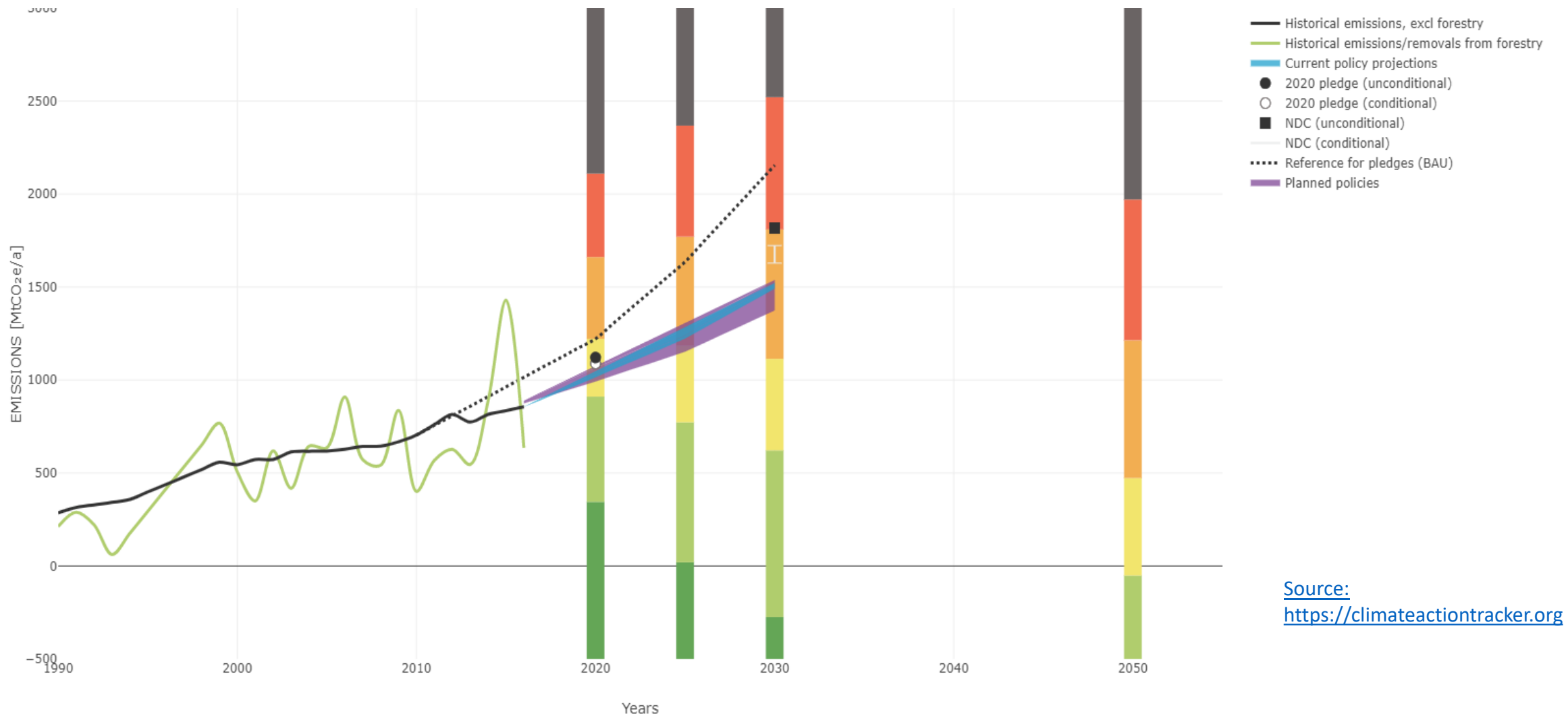
Russia



Source:
<https://climateactiontracker.org>

Might achieve NDC but grossly inadequate for 2-degree target

Indonesia



Source:
<https://climateactiontracker.org>

On track to achieve NDC but inadequate for 2-degree target

Status/Performance of Developing Countries

- Russia:

- Ratified Paris Agreement late! Pledged targets inadequate
- Forest restoration plan
- Energy strategy goal: 4.5% of electricity from renewables by 2020 (may not achieve!)
- Big wind power park near Murmansk: 57 wind turbines by 2021
- Oil, gas coal industries continue; 2nd largest oil exporter
- Lack of political support

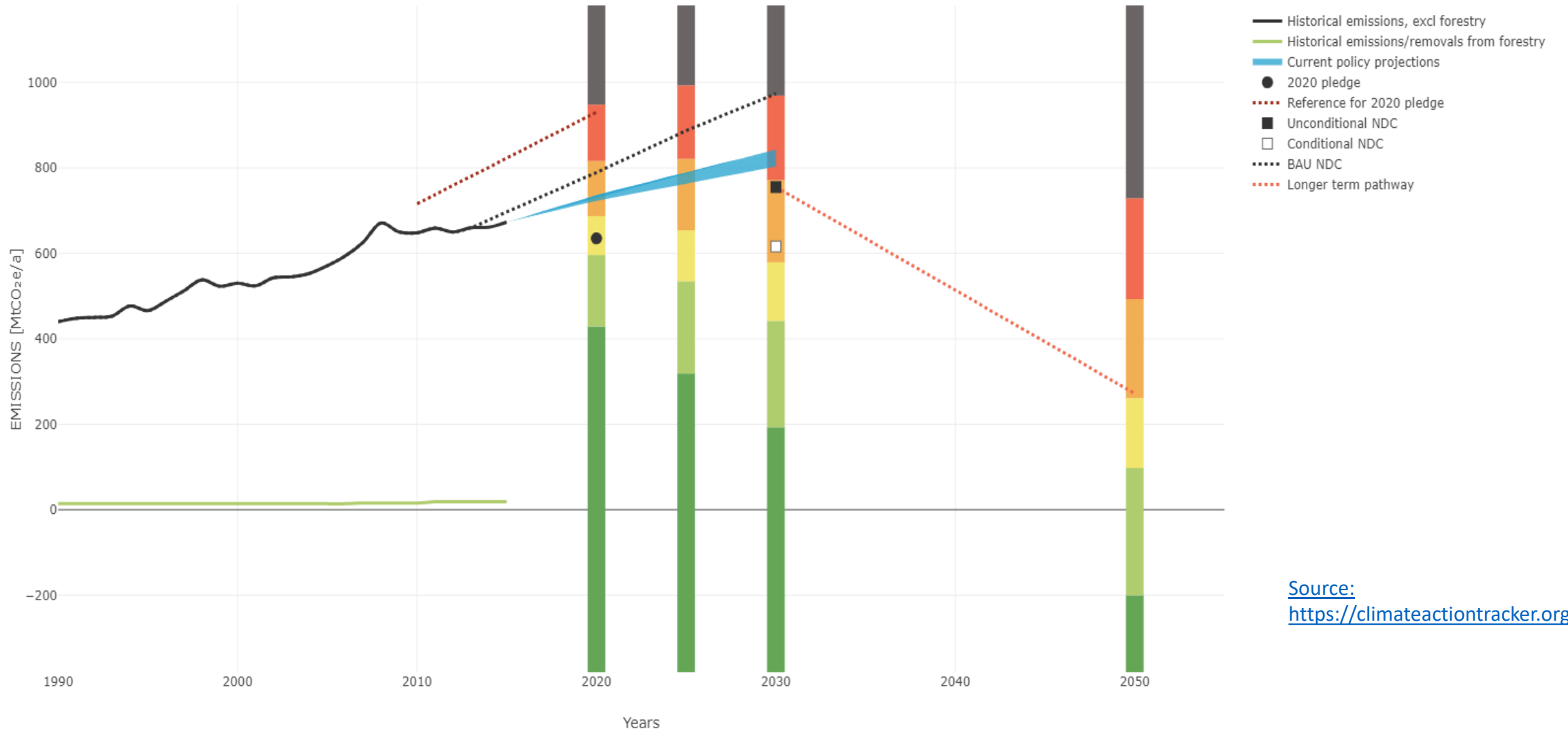
- Indonesia:

- Inadequate NDC targets (mainly through forestry)
- Regulation for rooftop solar
- NEP/Renewable energy target as share of primary energy: 12% (now), 23% (2025), 31% (2050)
- Renewable power capacity: Geothermal 1.95 GW, Bioenergy 1.85 GW
- Biofuel blending mandate: vehicles/rail/heavy machinery (B20/B30 in 2020), power plants (B30)
- 90% power generation from fossil fuels; New coal power capacity plan: 6 GW (by 2020), 27 GW (by 2028)
- Exports coal, oil, gas
- Forest cover reduced by 20% during 1990-2015; 7% of global tree cover loss during 2001-2017

May not achieve!
Weak renewable policy
Weak grid
Subsidy to coal
Large thermal power PSU, IPPs

Deforestation?

Mexico



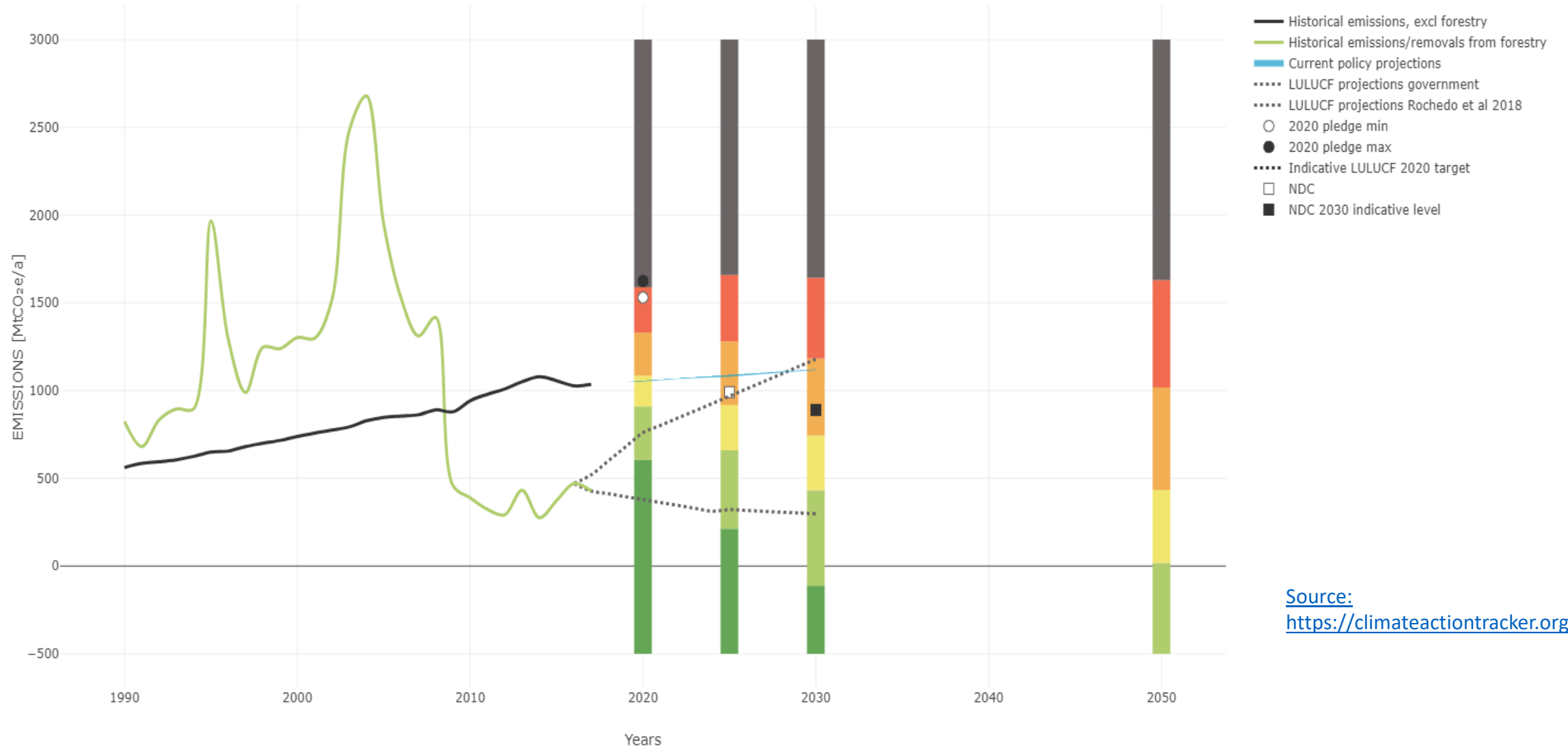
Source:
<https://climateactiontracker.org>

Not likely to achieve NDC which itself is inadequate for 2-degree target

Status/Performance of Developing Countries

- Mexico:
 - Inadequate NDC targets; Even those may not be met!
 - New budget allocations: 'modernize' coal, oil and gas power plants; geothermal, hydro; deprioritize other renewables
 - Good policy & institutional progress made earlier are being reversed
 - General Climate Change Law; Energy Transition Law (with targets)
 - Long-term electricity auctioning cancelled in 2018: clean energy targets in limbo!
 - Political support questionable with new government
- Iran:
 - Utterly inadequate emissions reduction pledge
 - Major oil and gas producer/exporter
 - 77% emissions due to energy
 - National plans and funds to promote renewable energy, but inadequate

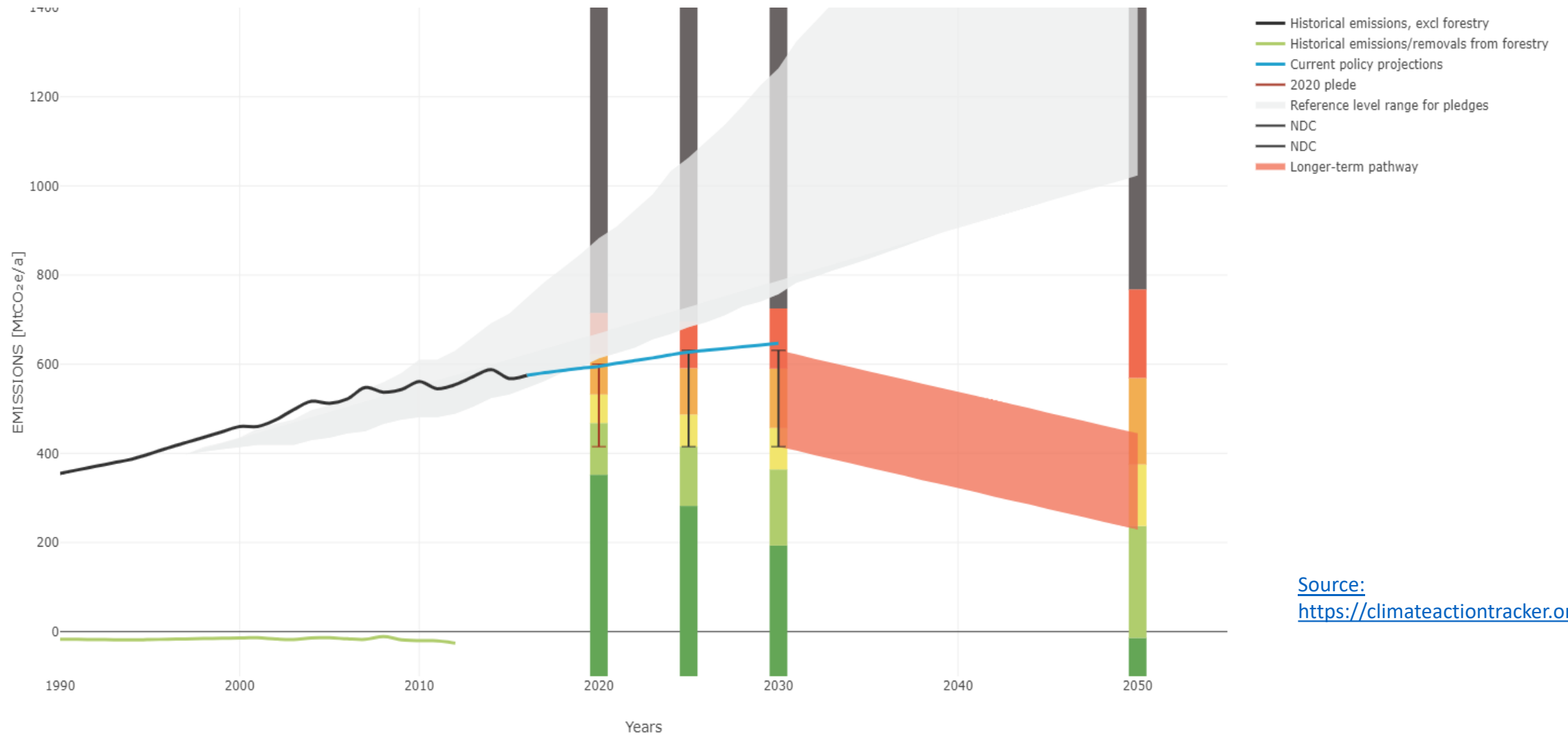
Brazil



Source:
<https://climateactiontracker.org>

Might not achieve NDC which itself is inadequate for 2-degree target

South Africa



Source:
<https://climateactiontracker.org>

Might barely meet NDC, inadequate for 2-degree target

Status/Performance of Developing Countries

- Brazil:

- Inadequate NDC targets (forestry, renewable energy)
- Good forestry emissions mitigation during 2005-2015; Now being reversed
- Renewables in primary energy: 47% (2027); Huge untapped potential
- National biofuels policy; Biofuel blending mandate B2 for transport
- Energy efficiency plans; Incentives for renewable energy
- Plans to expand fossil fuels
- Good policy, legal & institutional progress made earlier are being reversed
- Political support questionable with new government

7900 km² deforestation in 2018!
Target: zero illegal deforestation
in Amazonia by 2030

Min. of Env's climate change budget
Protection of deforestation
Long-term renewable energy goals
Participation of non-state actors

- South Africa:

- Inadequate NDC targets
- Biofuel blending mandate B5
- New Integrated Resource Plan (IRP) 2018: shift from coal to renewables and gas; halt nuclear
 - 35GW (of 42GW) coal power to be decommissioned by 2050; 6 GW ongoing construction to continue
 - Additional capacity by 2030: 14 GW solar & wind; 8 GW gas
- Natural gas on a rise
- Carbon tax too weak (doesn't apply to majority of emissions until 2022)

Might barely meet with new IRP and low economic growth
Higher economic growth will make it difficult

PSU grid operator's financial & operational
problems can create uncertainty

Status/Performance of Developing Countries

Top Performers (besides India) according to Climate Action Tracker ..

- Morocco:
 - 1.5-degree C compatible emissions reduction plan
 - Electricity from renewables: 35% (now), 42% (2020), 52% (2030)
 - Largest concentrated solar farm, can power 2 cities like Marrakesh
- Gambia:
 - 1.5-degree C compatible emissions reduction plan
 - Renewables: constructing one of largest PV plants in West Africa
 - Efficient cook-stoves
 - 10,000 ha forest restoration project
- Costa Rica:
 - Electricity from renewables: 98% (now), 100% (2021)
 - National Plan for Electric Transportation
 - Biofuel blending mandate B20
 - Moratorium on oil extraction until 2050 (but imports oil)

Status/Performance of Developing Countries

- Uruguay has already achieved 100% renewable electricity
- Countries that aim to achieve 100% renewable electricity by 2045 or 2050:
 - Bangladesh, Barbados, Cambodia, Colombia, Ethiopia, Ghana, Mongolia, Vietnam (REN21, 2018)
 - Cambodia began operating its 1st large solar power project (10 MW) in 2017
 - But is Cambodia's large Sambor hydropower dam on Mekong river sustainable?
- Thailand is investing US\$ 1.5 billion in 600 MW wind farm in Laos
- Ecuador, Tunisia and Cuba mention climate or climate change in their Constitution
- Several successful small-scale renewable energy implementation:
 - WISIONS/Sustainable Energy Project Support (SEPS), since 2004: variety of renewable sources, user needs, financing models
 - Community or NGO initiated solar, wind and biomass projects in several developing countries (e.g. India)
 - Mixed systems of small-scale renewable energy, storage and microgrids being piloted in Thailand (e.g. Mae Hong Son province)

Some observations from developing country trends

- Renewable energy additions so far have been inadequate
 - Policies didn't lead to decline of share of fossil fuels
 - High GDP growth → renewable energy provided additional capacity, didn't displace fossil fuels
 - Energy efficiency policies too were offset by GDP growth, didn't translate to emissions reduction
- Renewable energy policies (“schemes”) have been designed and implemented in isolation
- Weak policies

Should developing countries undertake unilateral and early actions towards ambitious emissions cuts?

- There's consensus that early and drastic actions, though costly, are necessary
- India, China and Brazil (besides USA, Saudi Arabia, UAE and others) are likely to incur the highest social costs of carbon of all countries (Ricke et al, 2018)
- High social cost of carbon at one place will result in costs at other places through globalization, trade, supply chain disruptions, large-scale migration
- Reducing GHG emissions will yield positive synergy on air quality/domestic environment, transformations in energy technology and operations capability, which will have large welfare impacts. Largest co-benefits are estimated for India, China and Middle East (Rao et al, 2016)
- Renewables also hold promise to address energy access/poverty
- Therefore, integrated, multi-sector policy to achieve SDGs and climate mitigation

Integrated, multi-sector policy

- Renewables-dominant energy systems need to combine all these factors in their design
 - Economic feasibility (of near-100% renewable transition)
 - Available resource potentials
 - Exchanging resources with neighbouring regions
 - Flexibility required for temporality, demand response solutions, supply-wise management of dispatchable renewables, sector coupling, grid extension & energy storage
 - Centralized-decentralized mix
 - Roles of consumers & prosumers
 - Renewables as part of integrated electricity/energy systems, includes transport, buildings, agriculture, industry feedstock, power-to-X technologies, CO2 removal options

(Breyer & Lund, 2019)
- Objectives of energy access, affordability, local pollution, local ecosystem/biodiversity, GHG emissions, local communities, livelihoods, and sustainable development must be addressed together
 - Decentralized vs. centralized projects
 - Integrated assessment of projects (e.g. large hydro power; even solar and wind projects)
 - Local economic opportunities through installation, delivery, repair/maintenance services

Integrated, multi-sector policy

- While financing for large-scale renewables is increasing, funding supports for small-scale renewable energy projects are still limited
- Measures to phase out fossil fuels
- Lifestyle & enduse changes
 - Air travel, household energy use, secondary consumption, motor vehicle use
 - Efficiency of energy service delivery and enduse devices
- Finance, technology support
- When new political government has a dim view of climate mitigation/renewables (e.g. Brazil, Mexico, Russia) or their policies are weak (e.g. Indonesia, South Africa), what is the alternative?
 - Role of non-national government and non-state actors (private sector, NGOs, sub-national governments)?