EVENT 3 July , Brussels

How to reach carbon neutrality?

Insights from national pathways to net zero in large emitting countries

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Speakers

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Vidhee Avashia, IIMA

India

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Daniel Buira, TA

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Brazil

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South Africa

Alicia Zhao, UMD

USA

Christoph Bertram, UMD

USA

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Welcoming remarks

Speaker: **Antoine Oger,** Executive Director, Institute for European Environmental Policy (IEEP)

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Cross-country insights on long-term transformations and immediate actions required to achieve carbon neutrality

Speaker: **Henri Waisman**, Director of the Deep Decarbonization Pathways Initiative (DDP) at IDDRI

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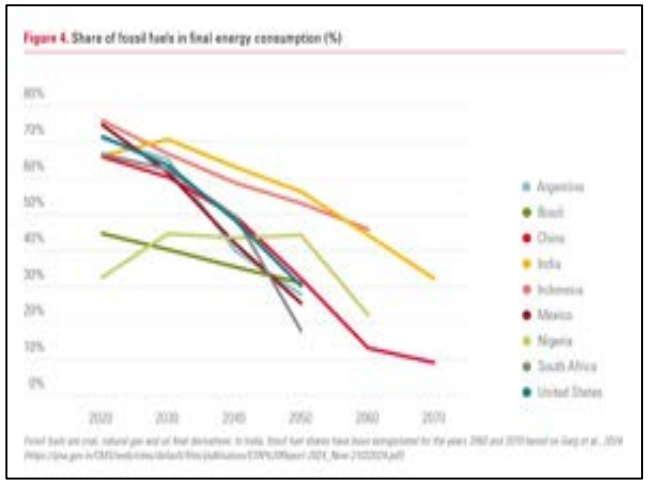
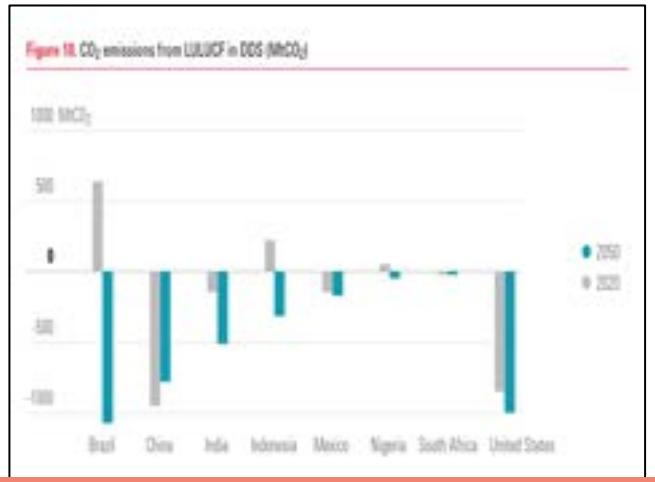
Cross -country lessons from national pathways to net zero - Long term transformations

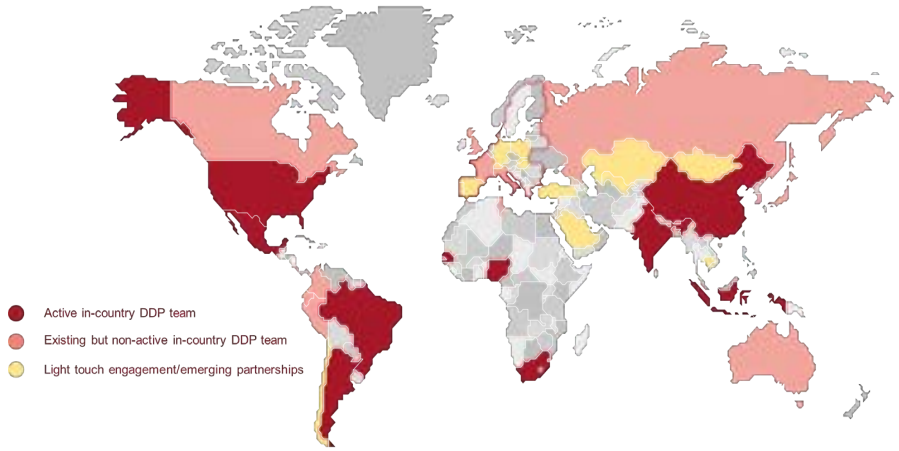
- ❑ Necessitate a relentless decrease in the direct use of fossil fuels by mid-century
- ➢ Can be aligned with development objectives, if country-driven shifts in infrastructure and organizations



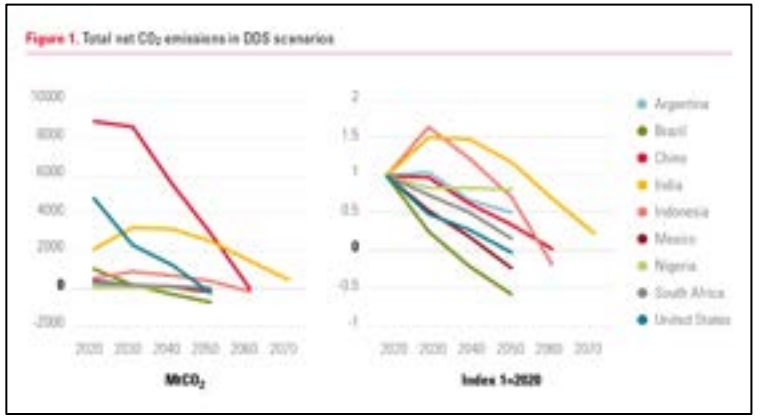
- ❑ Requires dedicated action on the land use and agriculture sector
- ➢ To be aligned with other functions of the sector through targeted and country-specific approaches



The Deep Decarbonization Pathways (DDP) initiative & DDP 2024 Annual Report



- A global network of in-country experts coordinated by IDDRI since 2013
- Explores carbon neutrality by 2050/2070 compatible with national development priorities
- **Guided the principles of being country-driven, country-led, country-owned.**



https://ddpinitiative.org/ddp-annual-report-2024/

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Cross -country lessons from national pathways to net zero

Short -term actions

- Triggering immediate emission reductions in power generation, passenger transport, land use
  - Technical solutions already exist in these sectors and the policies needed to accelerate their deployment are often well identified.

- Creating conditions to enable long-term deep emission reductions (even if they don't deliver immediate emission reductions)
  - Address inertias in infrastructure and technology, governance and institutions, and lifestyle and behaviour changes

- Addressing the socio-economic impacts
  - Manage the costs of the transition for vulnerable and disadvantaged populations through macroeconomic and/or sectoral measures
  - Prepare structural shifts in economic and industrial systems, including through new partnerships and international cooperation

Thank you!

Henri Waisman, IDDRI
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In-country perspectives from local experts

Speakers :

- Brazil: **Dr Emilio Lebre La Rovere**, Director, CentroClima, COPPE – University of Rio de Janeiro (COPPE-UFRJ)
- India: **Dr Vidhee Avashia**, Senior Researcher, Indian Institute of Management Ahmedabad (IIMA)
- Indonesia: **Dr Rizaldi Boer**, Director, International Research Institute for Environment and Climate Change, IPB University - **Retno Gumilang Dewi,** CREP-ITB
- Mexico: **Daniel Buira**, Co-founder and Scientific Director, Tempus Analitica (TA)
- South Africa: **Dr Bryce McCall,** Researcher at ESRG, University of Cape Town (UCT)
- United States: **Alicia Zhao,** Research Manager and **Christoph Bertram**, Associate Research Professor University of Maryland (UMD)

Facilitated by **Henri Waisman**

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Brazil

Prof. Emilio Lèbre La Rovere - Centro Clima / COPPE / UFRJ
Federal University of Rio de Janeiro

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National Modelling Approach

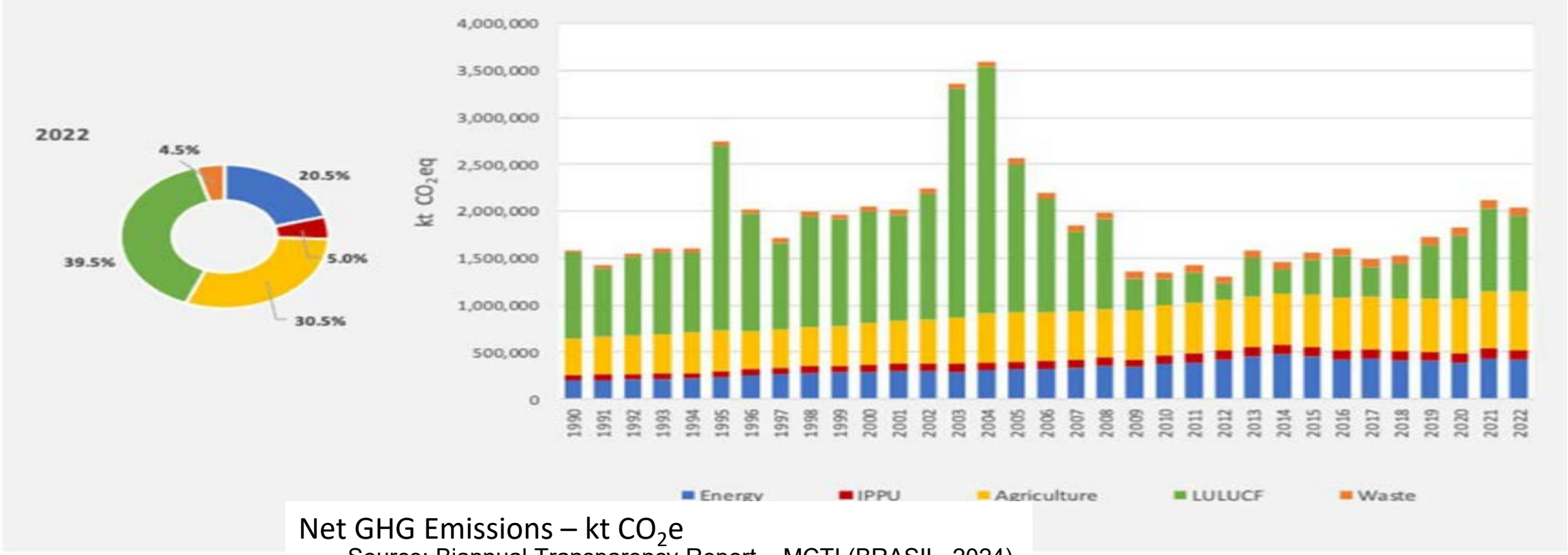
- Design of Deep Decarbonization Scenarios - DDS at the national level according to global narrative and national qualitative storylines translated into quantitative modelling assumptions with stakeholder involvement.

- Identification of national and global requirements for implementing DDS:
  - Barriers to decarbonization at the sectoral level in each country
  - Policy instruments at the national level to overcome the barriers
  - Enabling conditions at the global level

- Key findings:
  - Sharp reduction of annual deforestation rate and native vegetation restoration in public and private areas have a significant abatement potential allowing to offset other sectors' residual GHG emissions.
  - A pathway towards net-zero GHG emissions in 2050 can be reached with available technologies only and a carbon price going up to 50 USD/t CO_2e by 2050
  - DDS allows to reach carbon neutrality while keeping slightly better economic and social development results than in Current Policies Scenario (assuming a smart recycling of carbon pricing revenues).

Brazilian GHG Emissions (Historical Record)

AFOLU: main GHG emissions source in Brazil = 70% of economy-wide GHG emissions in 2022
Deforestation is the main source of LULUCF GHG emissions (CO2) = Around 40%
Enteric Fermentation is the main GHG emissions source (CH4) from Agriculture = 30% of total
49% of overall energy mix = renewables, 89% of power generation = non-fossil => Energy = 20% of total

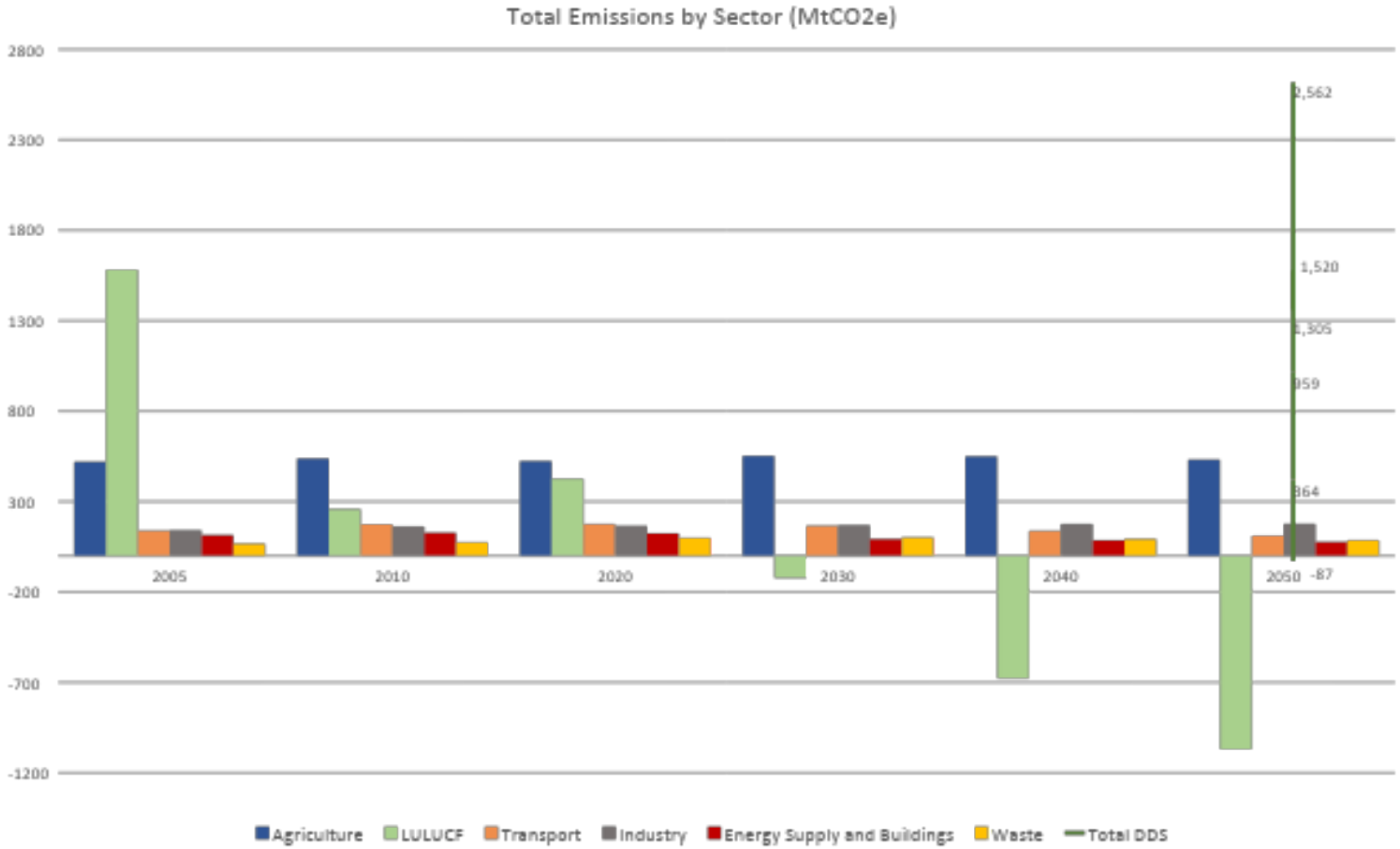


Net GHG Emissions – kt CO_2e

Source: Biannual Transparency Report – MCTI (BRASIL, 2024)

Figure 1.1. Net emissions by sector with LULUCF, in kt CO_2 eq.

Economy-wide GHG emissions - DDS



Priority Short-term policies to Enable Key Transformations

➢Resuming policies successfully adopted in the recent past (2004-2012) to sharply reduce annual deforestation rates: both command-and-control and economic instruments; reversing the 2019-2022 trend, reduction of annual deforested area was of 11.2% in 2023 and 32.4% in 2024 (combined figure of 40% reduction in 2022-2024).

➢Carbon Pricing: design the regulations and implement a well-structured cap-and-trade scheme. A significant share of avoided emissions can be obtained at negative or very low costs.

➢ Boosting the forestry sector to capture a large share of emissions to make it possible to achieve net-zero target by 2050 helps to lower costs and provides time for disruptive technologies to be economically viable.

➢Developing innovative financial mechanisms - IFMs to reduce capital costs, de-risk and foster the funding of investments in mitigation actions, and mainly in forest cover restoration and low-carbon infrastructure key enabler of de-risking low carbon projects allowing for Substantial support of key Annex I countries to foster financial flows targeted at mitigation actions in the global South, including both the climate finance tools within UNFCCC (GCF, article 6 of PA) and international financial initiatives to channel private capital to low-carbon investments:.

➢Design and start implementation of a LT-LEDS for Brazil, assessing the economic and social implications of decarbonization, and including policy tools to ensure a just transition.

India

Vidhee Avashia, Senior researcher
Indian Institute of Management Ahmedabad

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National Context and Priorities

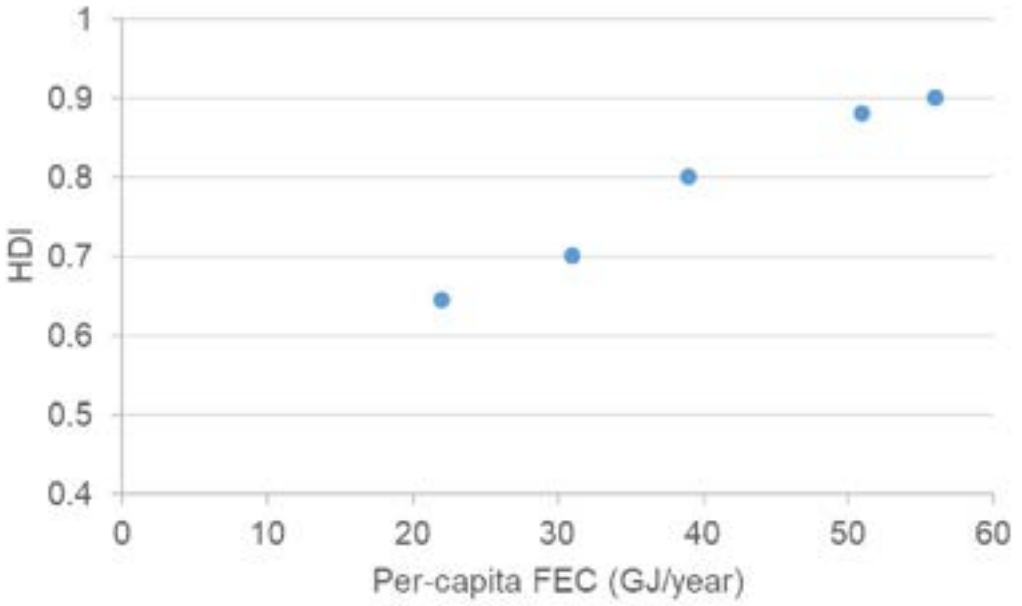
- **Most Populous country,** 4th largest economy in GDP (nominal), 3rd third largest GHGs emitter
  - Low gross domestic product (GDP) per capita (below global average)
  - Low FEC per capita(below global average)
  - Low power consumption per capita (below global average)
  - Low GHG emissions per capita among the G20 countries (below global average)

- NDC: reducing the GHG emission intensity of its **GDP by 45%** and about **50% cumulative electric power installed capacity from non-fossil fuel-based energy** resources by 2030
- **Net Zero 2070** target
- **Development-led transition**, not Transition led Development
- **Current Human Development Index (HDI):** India's current HDI is **0.633** (medium-HDI group)
- ***"Amrit Kaal"* Vision for "Vikshit Bharat 2047"**: India aims to become a developed country with HDI >0.8)

Energy Profile - How much energy do we need to become a developed country?

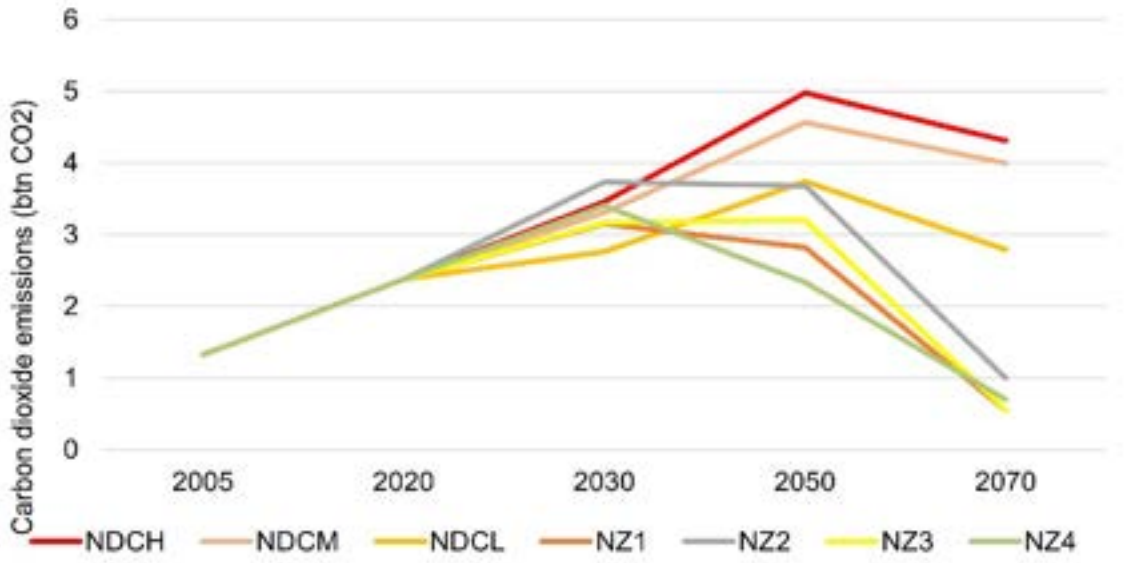
- India's per capita energy consumption is 1/3 of the global average in 2022
- Future Energy Demand: Global primary energy demand to grow from 14314 Mtoe (2018) to 17723 Mtoe (2040)
  - Per capita consumption still expected to remain 40% below world average
- Energy Mix: **Domestic coal is primary electricity source**
- Net importer of oil and natural gas
- **Electricity system will continue to rely on coal due to fast-growing economy and fossil fuel dependence**
- Currently, India's **FEC is at 21 GJ/capita/year (about 5,850 kWh)** (IEA, 2022), Electricity share in FEC at 18%

- HDI-Energy consumption linkages: India's total FEC could range from 14,000 to 18,000 TWh for an HDI of 0.8 and at least 19,000 – 23, 000 TWh for an HDI of 0.9 (Garg et al. 2024)



Net Zero Emissions 2070

- CO2 emissions could reach 0.5 billion tons in 2070, plus about a billion tons from other GHGs, requiring mitigation support from sequestration (AFOLU)
- CH4 and N2O emissions were about 18% of total GHG emissions in 2019
- India has already committed creating additional carbon sinks of 2.5-3 billion tons of CO2e by 2030 (NDC, 2015)



- Net Zero by 2070 is a challenging target, however, India is committed to achieving it
- Multiple transitions must happen almost simultaneously across fuels and end-use sectors.

Development and Net Zero Targets to go hand in hand

- There is no silver bullet to achieve NZ, myriad technologies must co-exist in our energy basket.
- **Coal is projected to continue until the next two decades as the backbone of the Indian energy system**. However slowly but surely non-fossil energy comes in (renewable and nuclear).
- To achieve NZ energy systems by 2070, the **electricity sector will need to decarbonize well before** that year.
- **For coal to continue due to energy security, India needs to explore Carbon dioxide removal technologies (CDRs), such as bioenergy with CO2 Capture and Storage (BECCS) and CCUS**.
- Relative costs and technological developments would determine their penetration levels.
- **Nuclear power and RE would be part of the NZ solution under all future scenarios**.
- Need for "**Just Sustainable Energy Transition**"
- **Agriculture** sector is critical for India's 'development-led transition
  - **~65% of population** directly involved in agriculture and allied activities
  - **67% of land holdings** are by marginal farmers (avg. 0.39 ha)
  - Significant indirect employment in the sector
- **Climate Adaptation & Resilience is a critical element**
  - High emphasis due to India's climate vulnerability and extreme weather events.
  - Large population in climate-risk zones impacts food security & livelihoods

Indonesia

Rizaldi Boer, Director, International Research Institute for Environment and Climate Change, IPB

Retno Gumilang Dewi, Head of Center for Research on Energy Policy, Bandung Institute of Technology

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The GHG Emissions

- FOLU sector in the last 20 years are the main source of GHG emission and energy sector (mainly from deforestation, peat fire emission)
- Significant decrease of emission in FOLU Sector in particularly in the last 5 years
- In 2022, more than 50% of national emission was from energy sector, while FOLU was about 23%
- In energy sector the main source if from power sectors

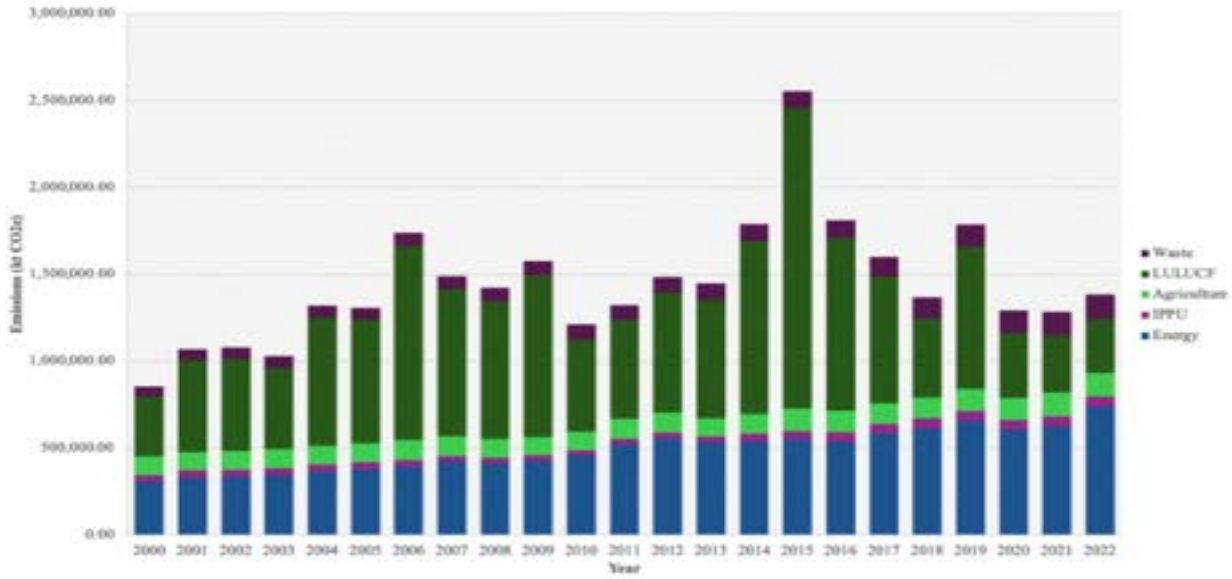
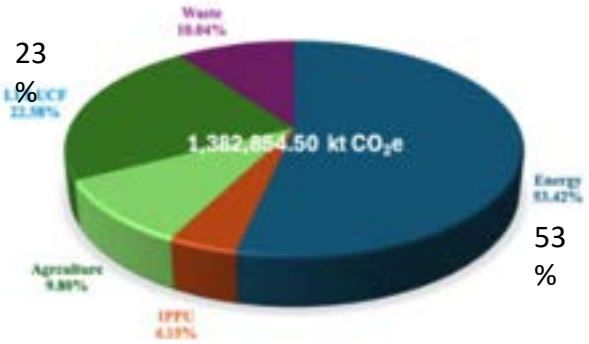
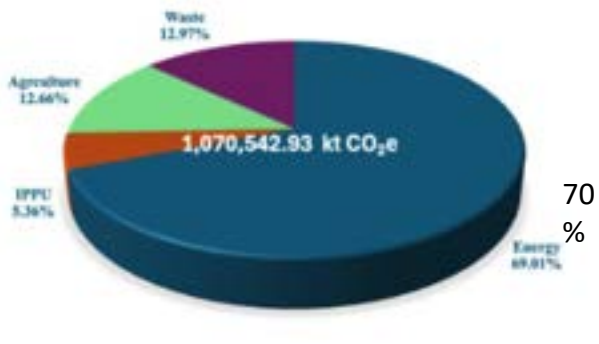


Figure 2 - 3 Trends in GHG emissions from 2000 - 2022 by sector (in kt CO_2e)



23 %

With LULUCF



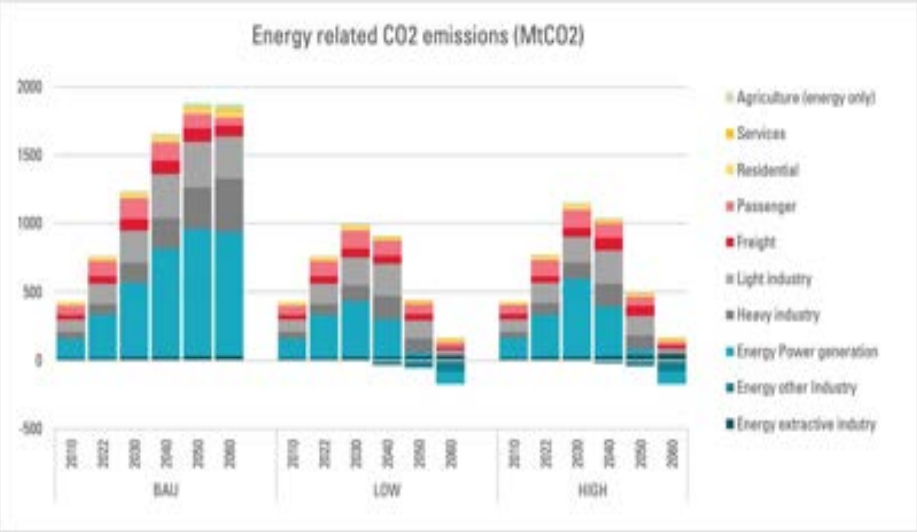
70 %

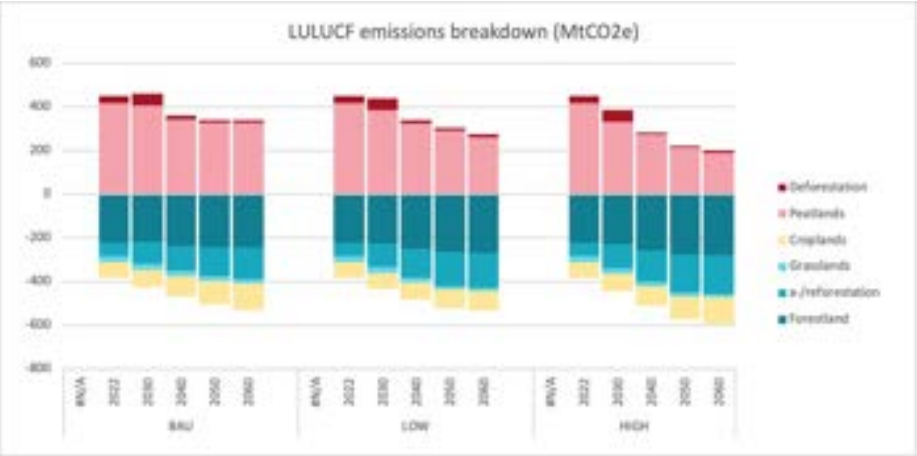
Without LULUCF

53 %

Source: 1st BTR

Developing a Paris-compatible Power and FOLU sector





- **Emission Scenario Pathways:**
  - **The Current Policy Scenario with Low Growth (CPS LOW):** this scenario represents the current policies in place and ongoing transformational trends which after the country reach ENDC in 2030 unconditional targets (2GtCO2) there is no additional policies and/or efforts to drive deep decarbonization transformations to reach long-term policy objective beyond 2060.
  - **The DDS LOW Scenario (DDS LOW):** this scenario follows the same socio-economic growth than the CPS but considers additional policies and/or efforts to drive deep decarbonization transformations reaching ENDC conditional target and net-zero GHG emissions by 2060.
  - **The DDS HIGH Scenario (DDS HIGH):** this scenarios considers a higher socio-economic growth for the country but considers additional policies and/or efforts to reach net-zero GHG emissions by 2060 and the ENDC conditional target by 2030.
- The key energy-related sectors for deep decarbonization are the power sector and the light industries
- The LULUCF sector plays a major role toward reaching the NZE target. The sector itself is CO2-neutral before 2030 (FOLU Net Sink 2030), and provides almost 130 MtCO2/yr by 2030 and almost 400 MtCO2/yr by 2060 in negative emissions.

Key Policies for Transformation

ENERGY

- Regulatory Measures
  - The government has enacted renewable-for-electric-power regulation (Energy Minister Regulation No.50/2017), then amended in Energy Minister Regulation No.4/2020, with more provisions that are expected to **attract investment in renewable power**.
  - To promote solar PV development, Energy Minister Regulation No 13/2019.
  - Electricity utility business plan for 2021-2030: **RE in power** generation is targeted to increase to **48%** in 2030
  - Presidential regulation No.55/2019 concerning acceleration of programs for BEV development and Government Regulation No. 73/ 2019 concerning taxation provisions that make BEV exempt from luxury goods taxation

FOLU

- Regulatory & Enforcement Measures (Permanent Moratorium on New Primary
  - Forest & Peatland Conversion, One Map Policy (Integrasi Peta Kawasan), Standardizes land-use (Still incomplete, with local governments sometimes issuing conflicting permits
  - Mandatory Sustainability Certification (ISPO (Indonesian Sustainable Palm Oil): Required for all palm oil companies by 2025; SVLK (Timber Legality Assurance System): Ensures legal timber trade
  - Multi business Permit: Corporate FOLU Commitments in RKUs (General Work Plans)
- Economic Incentives & Carbon Pricing
  - Carbon Trading & Tax (Presidential Regulation 98/2021, MOEF 21/2022)
  - Fiscal Incentives for Sustainable Practices (Tax breaks for reforestation, peatland restoration, Green bonds & sustainability-linked loans for FOLU-aligned projects)
  - International Climate Finance
  - Indonesian Environmental Fund (BPDLH): 1.7 billion USD and more than 50% for AFOLU

Mexico

Daniel Buira, Co-founder and Scientific Director
Tempus Analitica (TA)

TEMPUS ANALITICA

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CONTENT

- Mexico's climate change challenge
- The Pathway approach to planning our transition
- Results, challenges and opportunities

As a Higher Middle-Income Country, Mexico faces two structural challenges at the same time

- IPCC analysis shows the least developed nations must follow a very different path to low -emissions development than the most developed countries
- However, many of the large emerging economies here today must find a way to overcome *both* of these challenges:

  ensuring new opportunities for their populations to develop out of poverty while avoiding the traditional high-emissions path,

  also decarbonizing their existing industry, energy, and infrastructure.

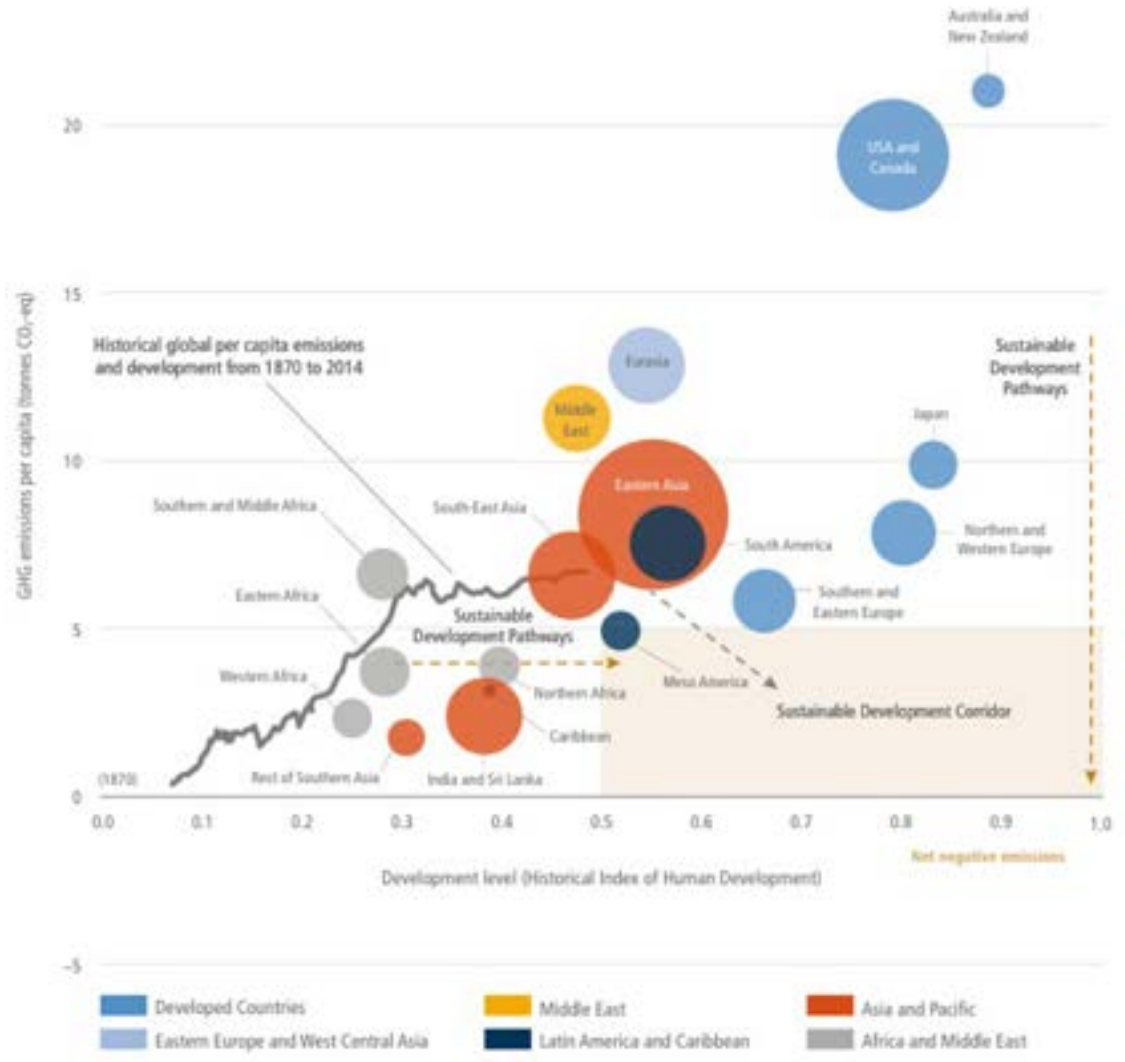
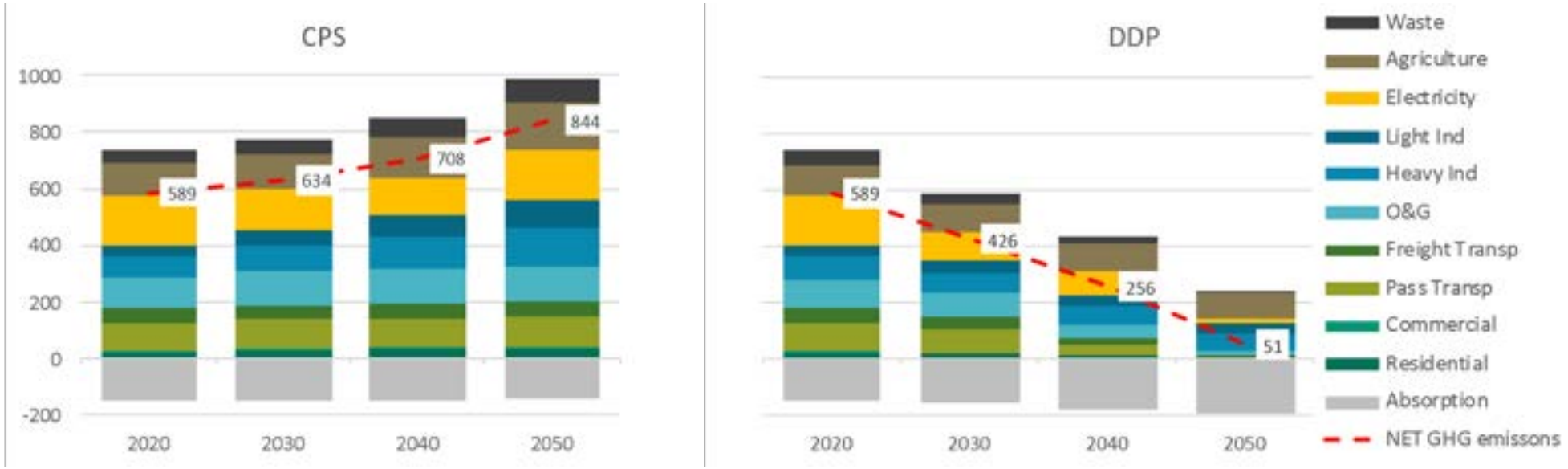


Figure TS.1 | Sustainable development pathways towards fulfilling the Sustainable Development Goals. The graph shows global average per-capita GHG emissions (vertical axis) and relative 'Historic Index of Human Development' (HIHD) levels (horizonal) have increased globally since the industrial revolution (grey line). The bubbles on the graph show regional per-capita GHG emissions and human development levels in the year 2015, illustrating large disparities. Pathways towards fulfilling the Paris Agreement (and SDG 13) involve global average per-capita GHG emissions below about 5 tCO_2-eq by 2030. Likewise, to fulfil SDGs 3, 4 and 8, HIHD levels (see footnote 7 in Chapter 1) need to be at least 0.5 or greater. This suggests a 'sustainable development zone' for year 2030 (in pale brown); the in-figure text also suggests a 'sustainable development corridor', where countries limit per-capita GHG emissions while improving levels of human development over time. The emphasis of pathways into the sustainable development zone differ (dashed brown arrows), but in each case transformations are needed in how human development is attained while limiting GHG emissions.

We have used the DDP pathway planning approach to guide our analysis the transition towards net zero emissions

- Climate change commitments made to date will reduce some emissions, but will not avoid continued growth
- By setting out targets for emissions reductions in line with the Paris Agreement requirements, we have developed a scenario to approach net zero emissions by 2050



The objective of phasing out of fossil fuels cannot be achieved on its own, but together with a set of systems changes

- Different system transformations must be achieved in parallel to enable our economy to continue growing while leaving behind fossil fuels
- Building the new economy is not enough, we also have to plan how we leave behind the old

1. Renewable electricity grid.
2. Sustainable urban infrastructure for low-carbon living.
3. Integrated transport electrification and zero-emission freight.
4. Solar heat & energy efficiency for industry and households.
5. Decarbonising heavy industry for future competitiveness.

Managed phase-down of fossil-fuel production & processing.

Achieving such a change is “unprecedented” bringing important challenges and opportunities

CHALLENGES

- Structural inertia in political economy
  - Oil production
  - Gas imports
  - Power infrastructure
- Changing expectations and behaviors for businesses and citizens will be crucial
- Additional capital to invest in new electrical system, new infrastructure, industrial assets
- Ensure new jobs compensate for job losses and communities are not left behind
- Trade balance and fiscal challenges re ramping down of oil exports

OPPORTUNITIES

- Abundant solar resource means we can achieve energy sovereignty and eventually lower energy costs
- Transitioning to green industry can create new jobs in growing export sectors (diversification)
- Better cities will improve quality of life for millions of people
- Electric vehicles and non -motorized transport will reduce pollution and improve health
- The industrial transition can also kick -start a green hydrogen economy for manufacturing, green fuels, fertilizers, and other applications

South Africa

Bryce McCall, Researcher at ESRG
University of Cape Town (UCT)

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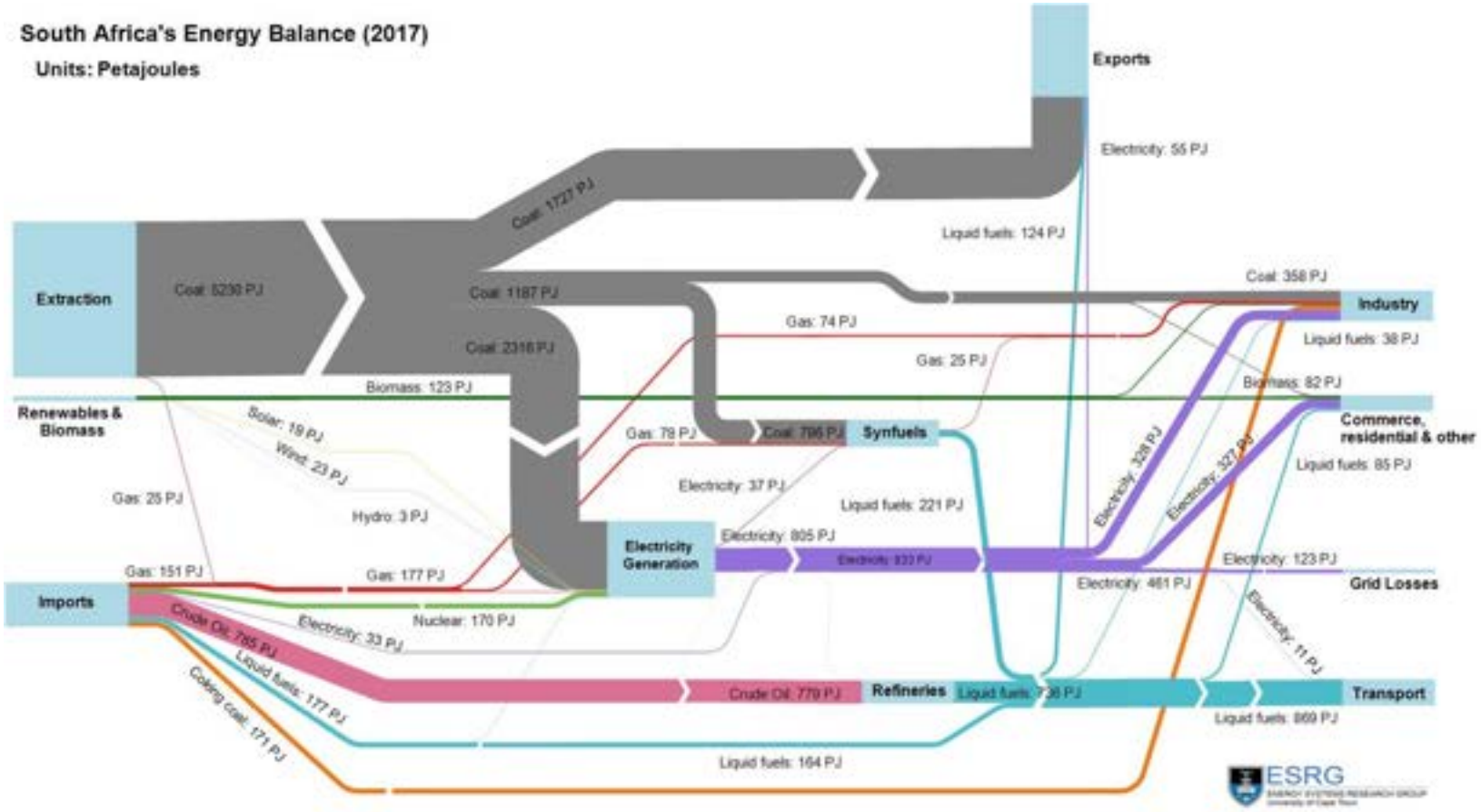
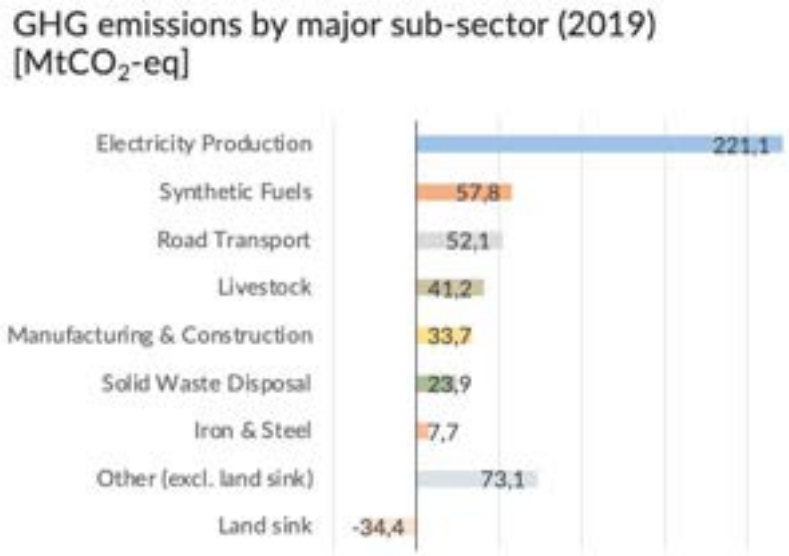
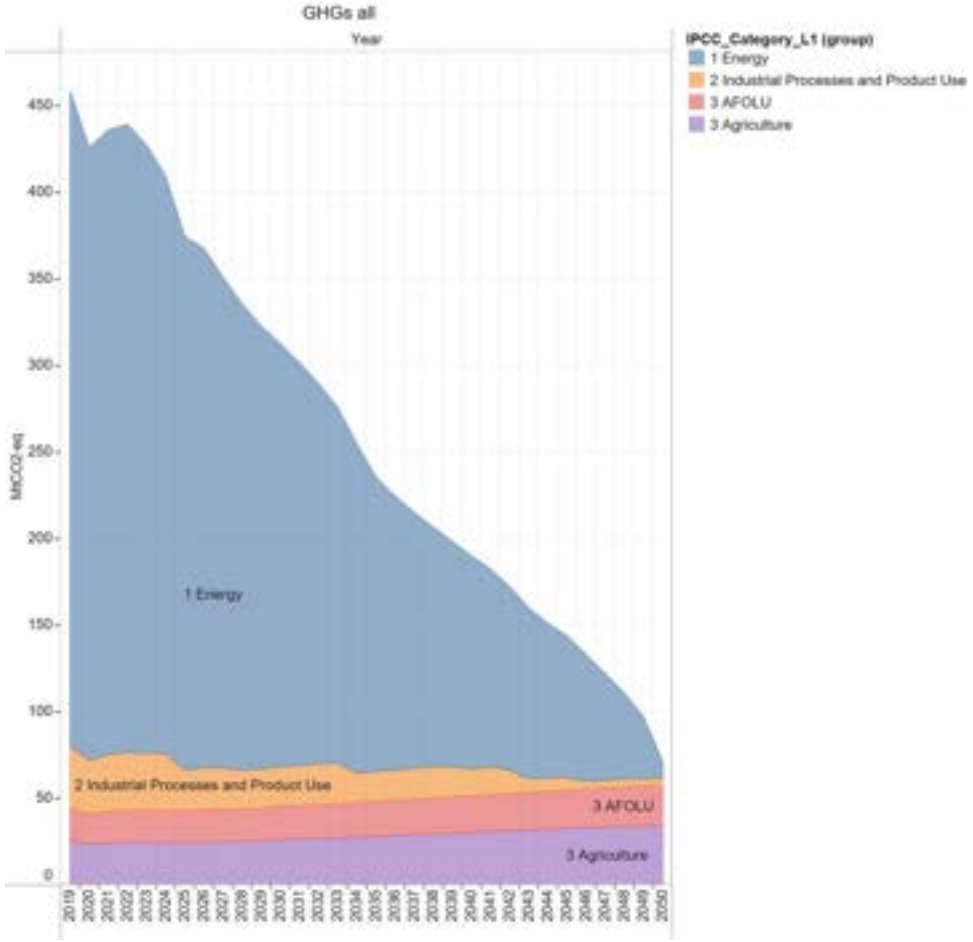
South Africa’s energy system



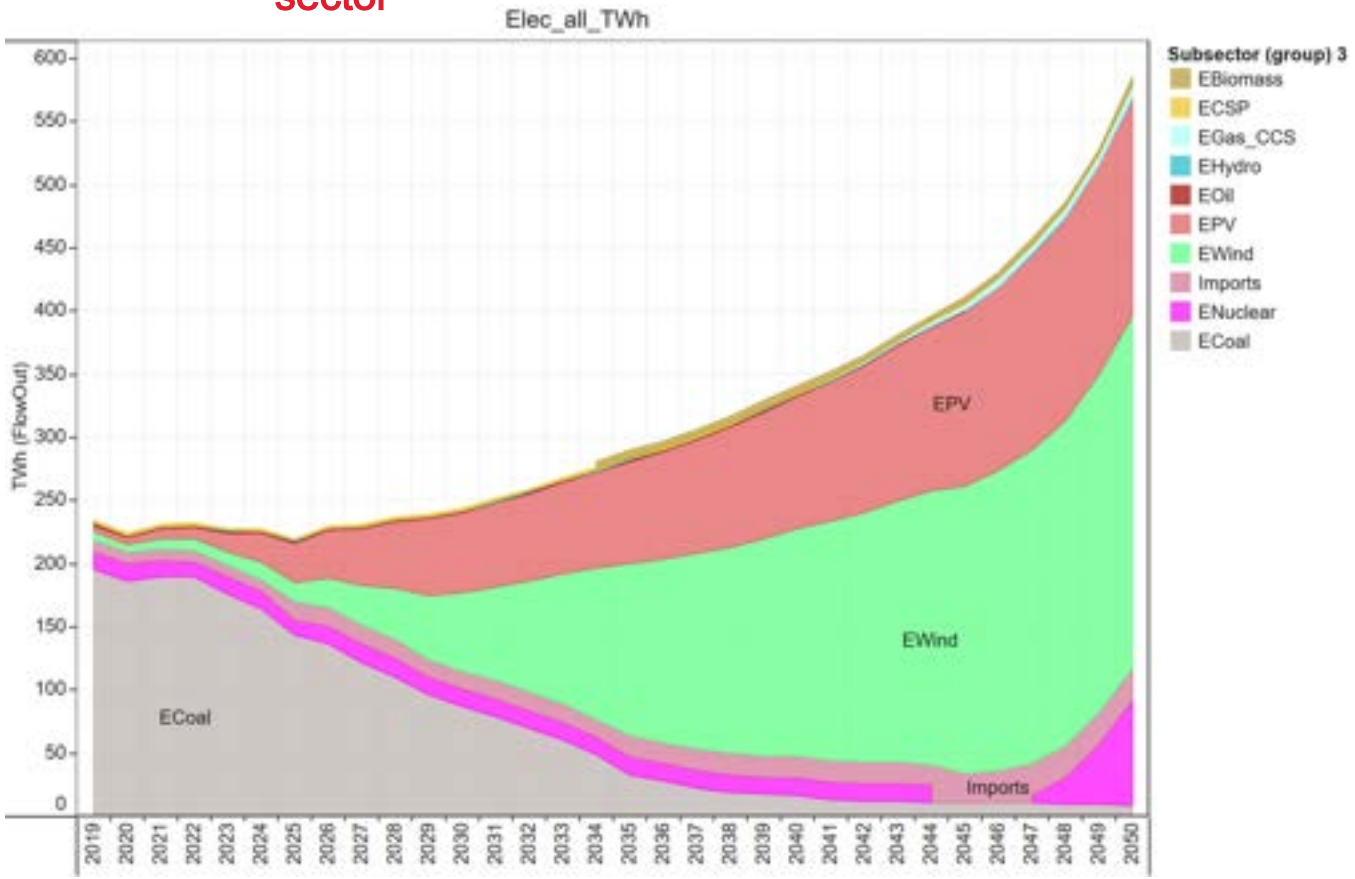


DDP:IMAGINE results for NZ South Africa using our energy-economy model

Emissions decline rapidly in Energy sector



Transition in Power sector



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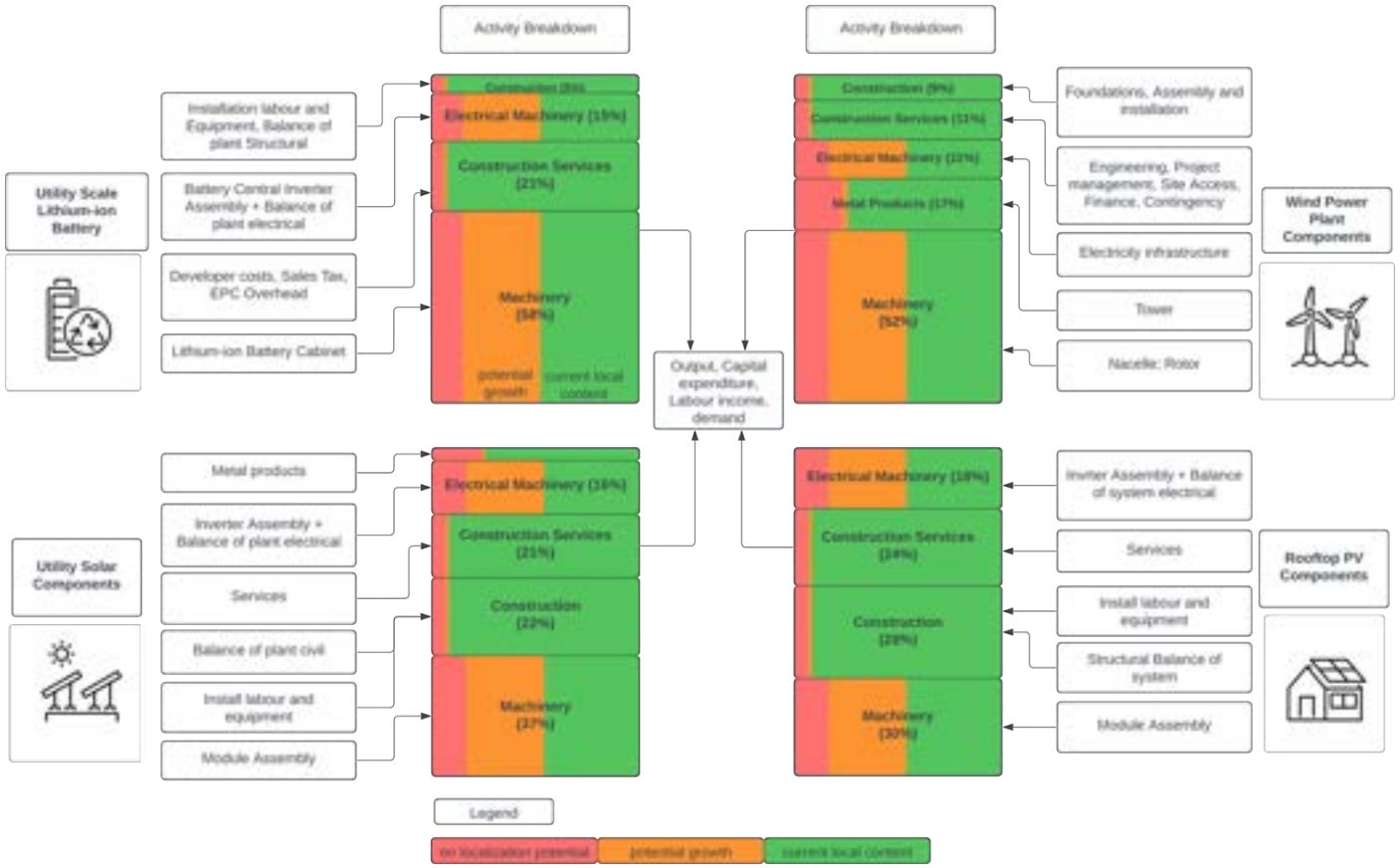
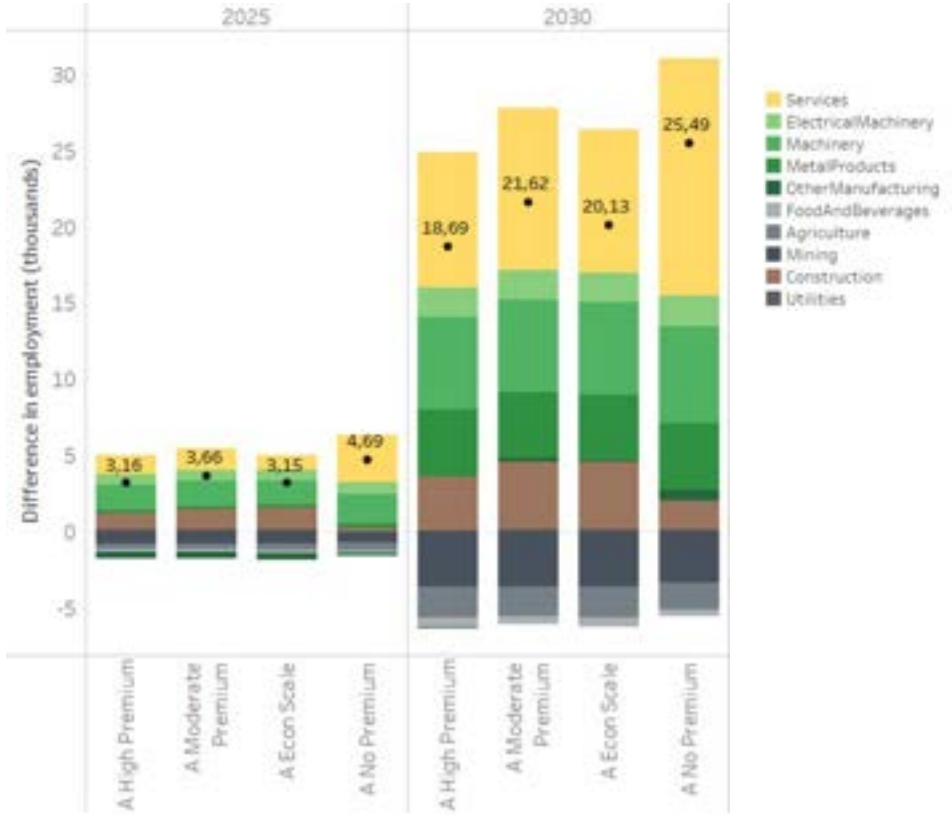
Local value chains: Renewables manufacturing

Components of wind, solar, battery tech represented



Result of localisation scenario:

net growth in jobs



Insights from modelling, and current trends in SA on the decarbonisation

- Solar and wind are the foundation of South Africa's future power supply – we have plenty of sunshine and wind.
- Need to invest heavily in upgrading and expanding our grid to accommodate all the additional RE capacity (currently bottlenecking >100GW of potential projects)
- Evidence that localisation can boost economy and create jobs: investment in manufacturing support required (transformers etc.)
- Just Transition Partnership: has been beneficial, some room for improvement for monitoring and evaluation and project selection for targeted funding,

USA

Alicia Zhao,
Research Manager

Christoph Bertram,
Associate Research Professor

University of Maryland

SCHOOL OF PUBLIC POLICY
CENTER FOR GLOBAL SUSTAINABILITY

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Key transformations in the U.S. to achieve net zero

Context: Under the Biden Administration (2021-2025), the U.S. re-entered the Paris Agreement, pledging to **reduce GHG emissions 50-52% by 2030, 61-66% by 2035, and net zero by 2050.**

- The Inflation Reduction Act (IRA) and Bipartisan Infrastructure Law (BIL) provide over a trillion USD toward clean energy, energy efficiency, methane mitigation, etc.
- EPA regulations on oil and gas methane, fossil fuel power plants, tailpipe emissions.

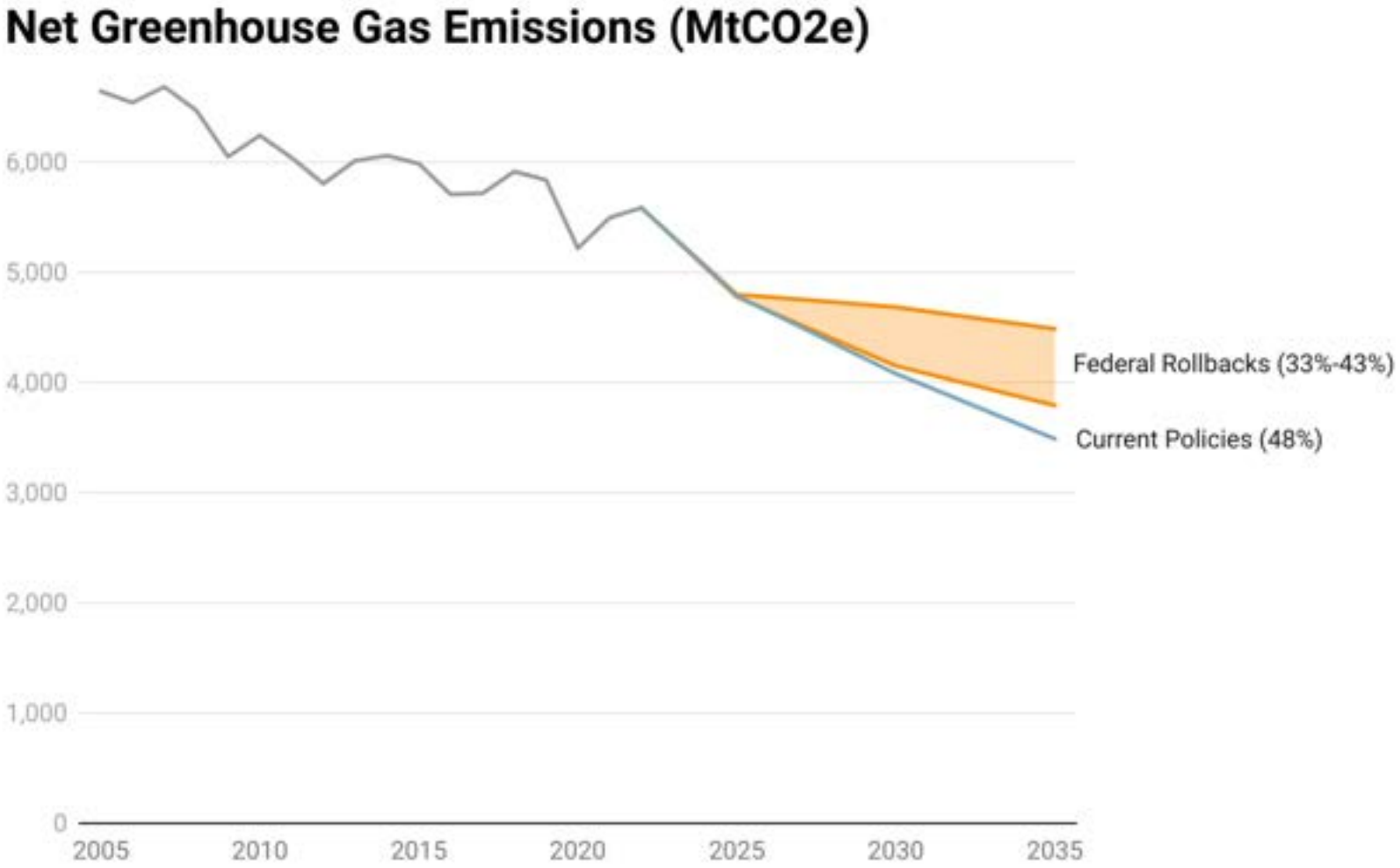
U.S. National Pathways: We used a field-leading modeling tool and a robust stakeholder engagement process to identify key policy levers at the federal and state levels.

- Current policies (as of December 2024) can achieve significant reductions in the **electricity and transport sectors,** through RE deployment, coal phasedown and road transport electrification.
- However, to achieve an ambitious 2035 NDC and set the table for net zero in 2050, **methane mitigation, electrification and efficiency improvements in the buildings and industry sectors, sequestration from CCS technologies, and enhanced land sink sequestration** will also be important.

Context on U.S. federal climate landscape

- Since January 2025, the new U.S. administration has initiated **a wide-ranging set of actions to reverse clean energy and climate policies.**
  - Withdrawal from the Paris Agreement
  - Rolling back regulations
  - Repealing climate legislation
  - Canceling/freezing federal funding
  - Blocking state climate policies
- Amidst policy and tax credit uncertainty, manufacturers have closed or downsized almost $8 billion worth of clean energy projects in the first three months of 2025.
- However, **the sustained engagement of subnational actors continues to serve as a cornerstone of U.S. climate governance** and international climate diplomacy (e.g. states, cities, businesses, coalitions like America Is All In and United States Climate Alliance, and more)
  - **America Is All In** is the largest coalition of non-federal actors assembled that remain committed to achieving Paris targets, representing almost 66% of US population and 75% of US GDP.

Non-federal leadership has the potential to counteract much of federal inaction or rollbacks and help achieve the U.S. NDC



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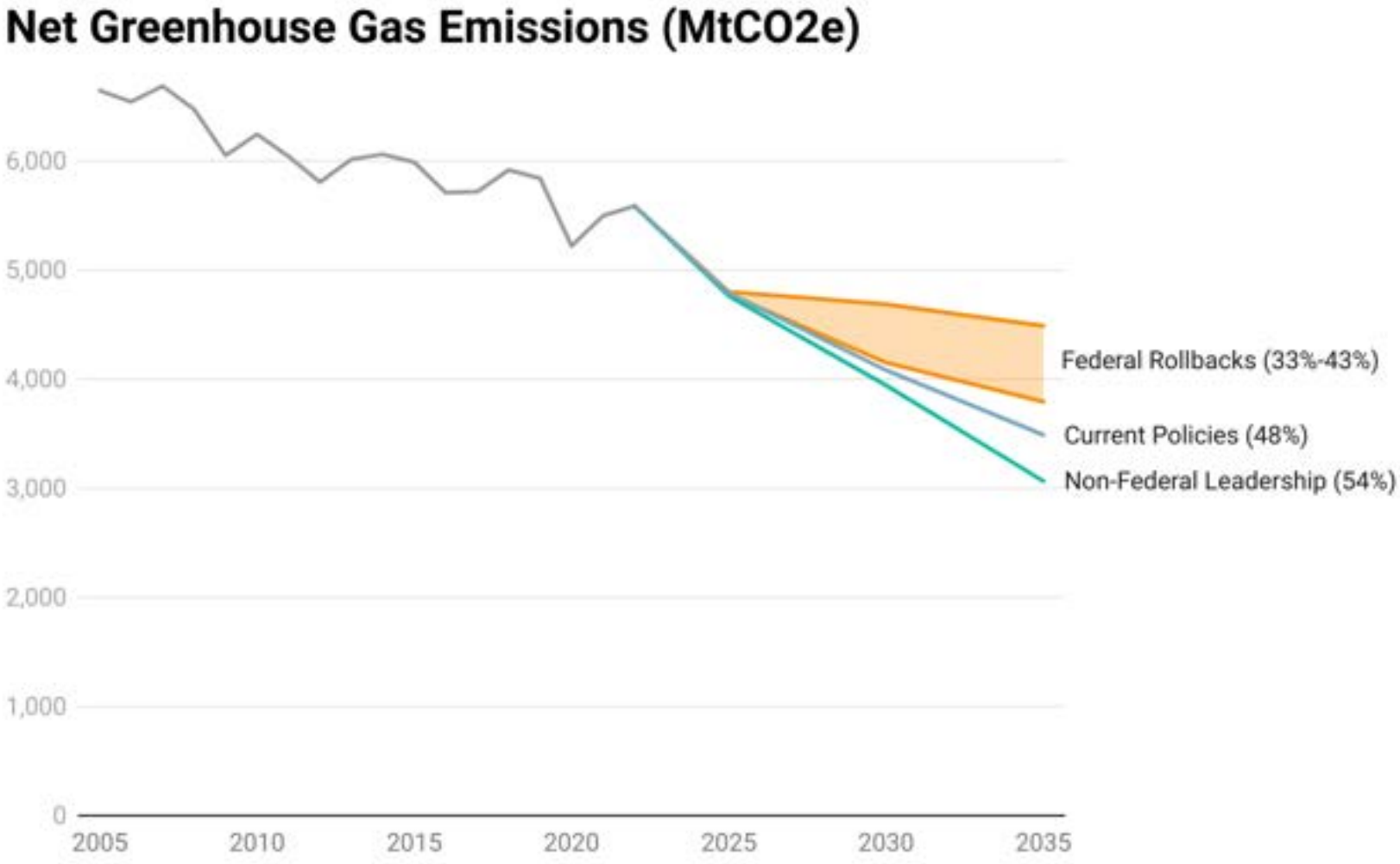

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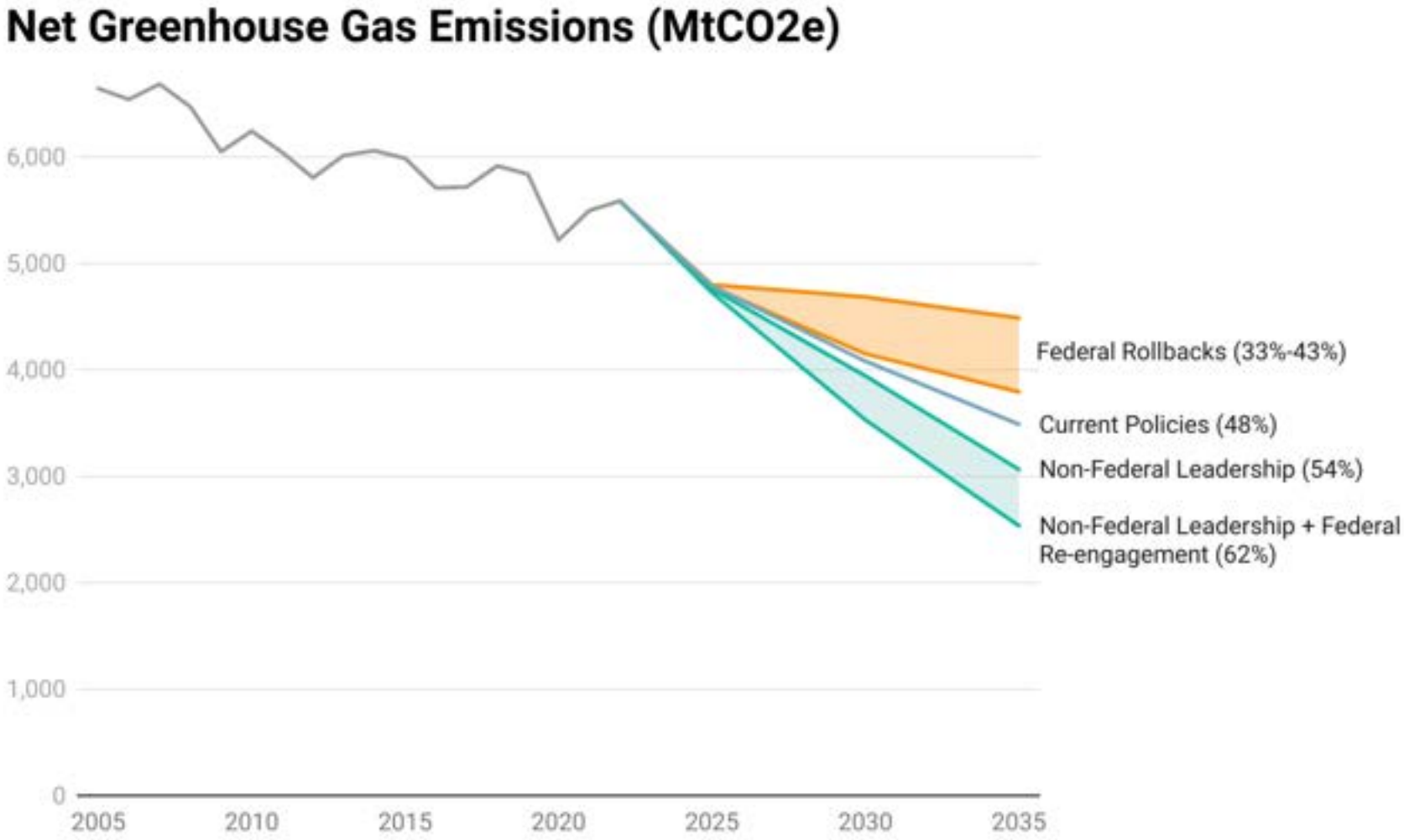

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Part 4: Reactions from the EU perspectives

Antoine Oger, IEEP

Johannes Schuler (DG CLIMA)

Thank you!

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Opportunities for EU-Brazil cooperation

- Potential for EU/Brazil cooperation on **financial mechanisms to fund decarbonization actions** in Brazil:

Amazon Fund, Tropical Forests Forever Fund – TFFF, Ecological Transformation Plan of the Ministry of Economy (Eco Invest hedging fund against exchange rate fluctuations, platform presenting the portfolio of investment opportunities in low-carbon projects, etc.)

- How to make the design of the **upcoming cap-and-trade Brazilian industry carbon market compatible with CBAM**? What mechanisms would be required to adjust the level of border taxes, at what disaggregation level, what methodologies to use?

- **Cooperation around certification programs compatible with EUDR:** a variety of deforestation free certification programmes exist internationally (eg RSPO, PNCCS and CBS/FSC in Brazil), and ensuring coherency among programmes and cooperation around the certification methodologies and the underlying technology

- Use the lessons learnt from the EU-Brazil dialogue on a **Taxonomy of Green Investments** applicable to CBAM and EUDR.