



Climate
policy assessment and
Mitigation
Modelling to
Integrate national and global
Transition pathways

Partners



Paris Agreement



The universal agreement's main aim is to keep a global temperature rise this century **well below 2 degrees Celsius** and to drive efforts to limit the temperature increase even further to **1.5 degrees Celsius** above pre-industrial levels



Countries need to formulate policies under the agreement. **Global stocktake** process to compare these policies to overall goal

Global transformation pathways



global stocktake



National low-carbon development pathways



- Global stock-taking process requires sufficient analytical capacity to ensure fair evaluation of country policies
- Requires good understanding of different outcomes and assumptions between the analytical teams that provide input into the negotiations

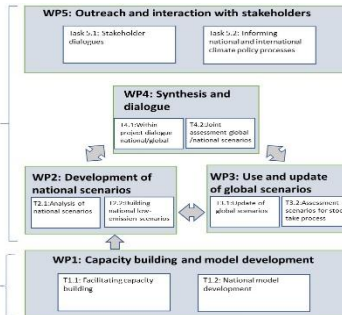
**Global
transformation
pathways**



Project objectives:

Improved analysis of country contributions to the global ambition of the Paris Agreement

Improved modelling of national low-carbon emission pathways:

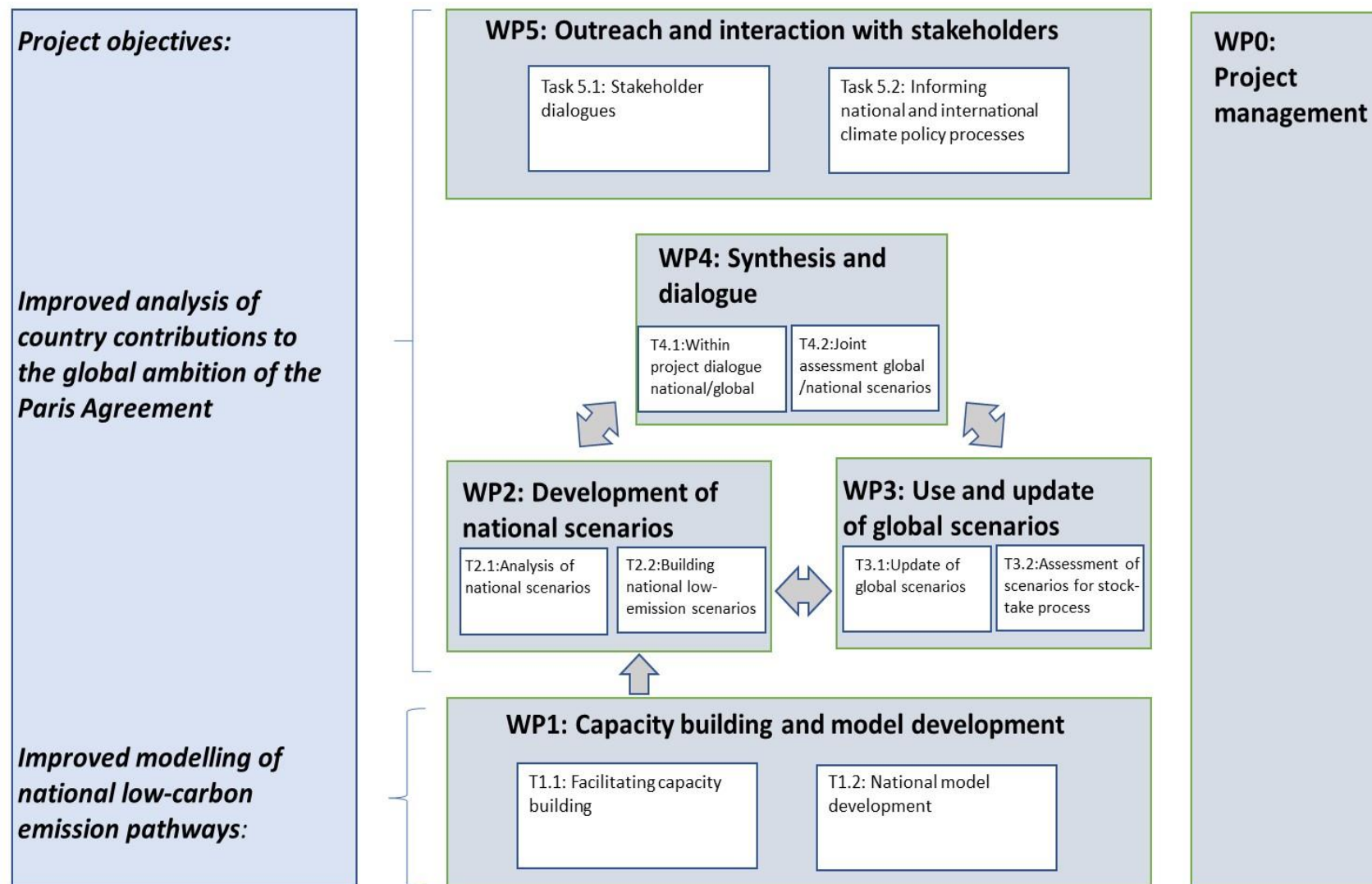


WP0: Project management



**National low-carbon
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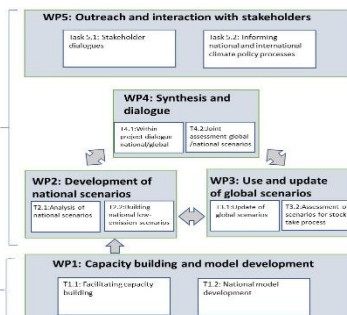
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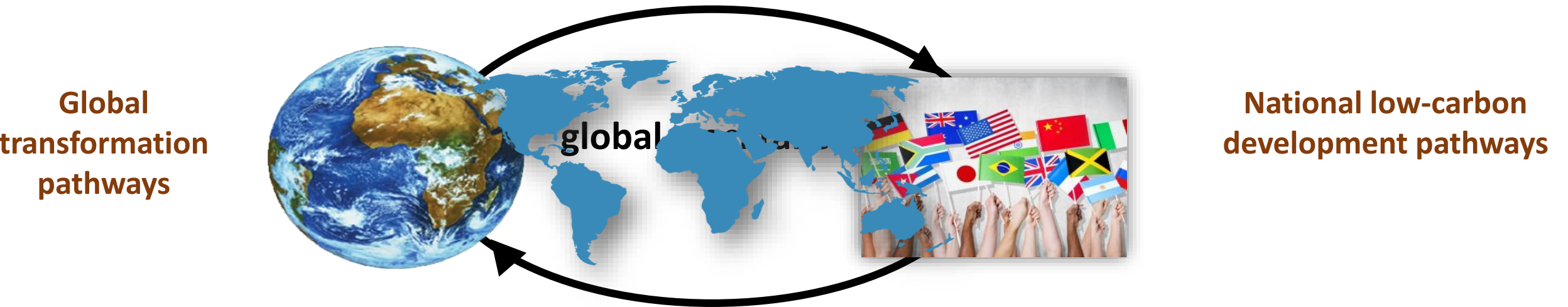


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**National low-carbon
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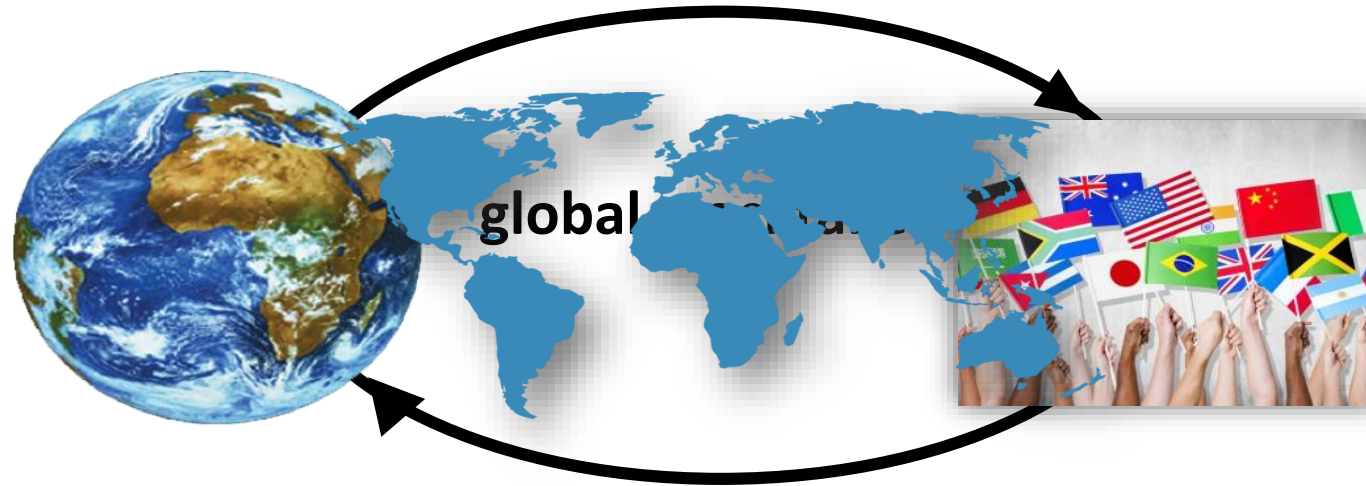
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**Global
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**National low-carbon
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Global transformation pathways



global stocktake



National low-carbon development pathways



Opportunities for Enhanced Action to Keep Paris Goals within Reach

Contribution to the Talanoa Dialogue by the COMMIT and CD-LINKS projects
November, 2018



Policy brief on Talanoa Dialogue Platform:
<https://unfccc.int/documents/184187>

National fact sheets:
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Republic of Korea: low-carbon economy pathway and climate proof society



Brazil: Opportunities from AFOLU and non-CO₂ mitigation reduce pressure on productive sectors



Where are we?

Brazil is a developing country with several challenges regarding poverty eradication, infrastructure development and even, to some extent, energy access. Driven by reduced deforestation rates, greenhouse-gas (GHG) emissions in the country in 2014 had been reduced by almost half since their peak in 2004 (MCTIC, 2016). Accounting for forest land-use carbon sinks, net emissions in 2014 were 1.284 Gt CO₂e, already slightly below the 2025 NDC target but still above the indicative 2030 target (MCTIC, 2016). However, emissions have been generally flat in 2009-2012, and actually showing a slight growing trend since 2013. Emissions levels in all sectors except LULUCF have increased between 2010 and 2014 (MCTIC, 2016), and are projected to continue doing so in the short- to medium-term. Brazil has reaffirmed the Paris Agreement, turning its NDC into an NDC, pledging to reduce total GHG emissions to 1.3 Gt CO₂e by 2025, with an aspiration to reduce to 1.2 Gt CO₂e by 2030, corresponding to about 37% and 43% reductions from the 2005 level, respectively (Gore, 2015a). Most of the proposed measures are in the Agriculture, Forestry and Other Land Use (AFOLU) sectors, along with targets for increased use of bioenergy.

Agriculture is central to Brazil's economy, land use and emissions. The agricultural production chain (including food processing and retail) is responsible for about 18% of total economic output (OECD, 2015). Brazil is one of the largest agricultural exporters with soybeans, sugar, coffee, beef and chicken making up a sizeable portion of the country's exports (CEPR, 2017). Brazilian beef cattle production is one of the most competitive in the world, but about half of the 200 million hectares of pastureslands are considered degraded, and their recuperation¹ is a cornerstone of the agricultural sector's mitigation potential. The NDC pledges to recuperate 15 million hectares of degraded pastures, and to implement 5 million hectares of integrated cropland-livestock-forestry systems (ICLFS) by 2030. These are projected to reduce emissions relative to current levels by some 85-104 Mt CO₂e and 18-22 Mt CO₂e respectively, according to the country's Low-Carbon Agriculture plan (Plano ABC (BAPA, 2012), which should meet its targets by 2025 (Silveira et al., 2017). The NDC also pledges to "restoring and reforesting 12 million hectares of forests by 2030, for multiple purposes".

Brazil's efforts in the 2000s to protect the Amazon from deforestation were pivotal for the successful reduction of its emissions since they peaked in 2004 (Gore et al., 2014; Macedo et al., 2012; Heipold et al., 2009). Maintaining this protection and expanding it to other biomes can further reduce emissions from land-use, land-use change and forestry (LULUCF), and also protect rich biodiversity hotspots especially common in the central savannahs known as Cerrado. Protecting forests would also bring benefits to water supply and climate regulation. Brazil has relatively strong protective measures written into its laws, but these tend to be weakly implemented and, lately, have been or are being undermined by a weak government struggling to remain in power. In order to receive support from the powerful agricultural lobby, environmental regulations are being offered as bargaining chips, threatening a return to growing deforestation rates. Brazil's Forest Code was controversially overhauled in 2012, granting amnesty to illegal deforestation occurring before 2008. Accounting for this amnesty, there is still a deficit of about 21 million hectares of mandatory natural vegetation reserves in privately held land, which implies there should be a great deal

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Policy brief

- Where are we?
- Where do we want to go?
- How do we get there?
- Submitted to Talanoa Dialogue

<https://unfccc.int/documents/184187>



Opportunities for Enhanced Action to Keep Paris Goals within Reach

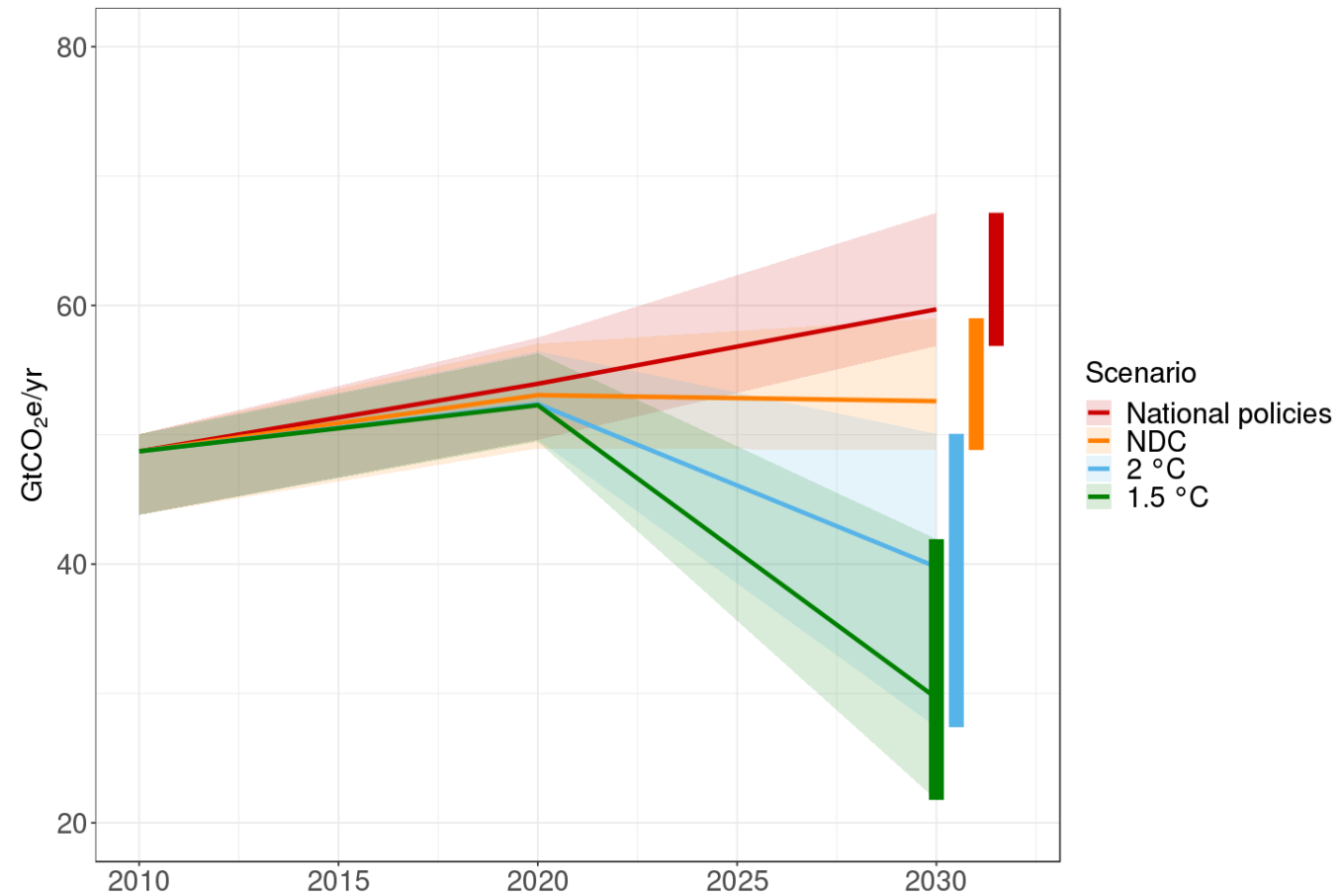
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Policy brief - Key findings: where are we?

- Current climate policies are inconsistent with the objectives of the Paris Agreement.
- NDCs are projected to lead to global greenhouse gas emissions in the range of 52–58 GtCO₂e by 2030.
- The differences between current policy trends and the emission levels consistent with the Paris Agreement to stay well below 2 °C and 1.5 °C, by 2030 will amount to a **global ‘emission gap’** from NDCs of approximately 15 and 22 GtCO₂e, respectively.
- Current gaps involve more than emissions
- Failing to ratchet up ambitions for 2030 would require an even faster **pace of decarbonisation** after 2030, and/or the deployment of more **carbon dioxide removal** (CDR) technologies, in the long term, in order to still meet the Paris temperature targets by the end of the century, after a significant overshoot.

Implementation and ambition gaps

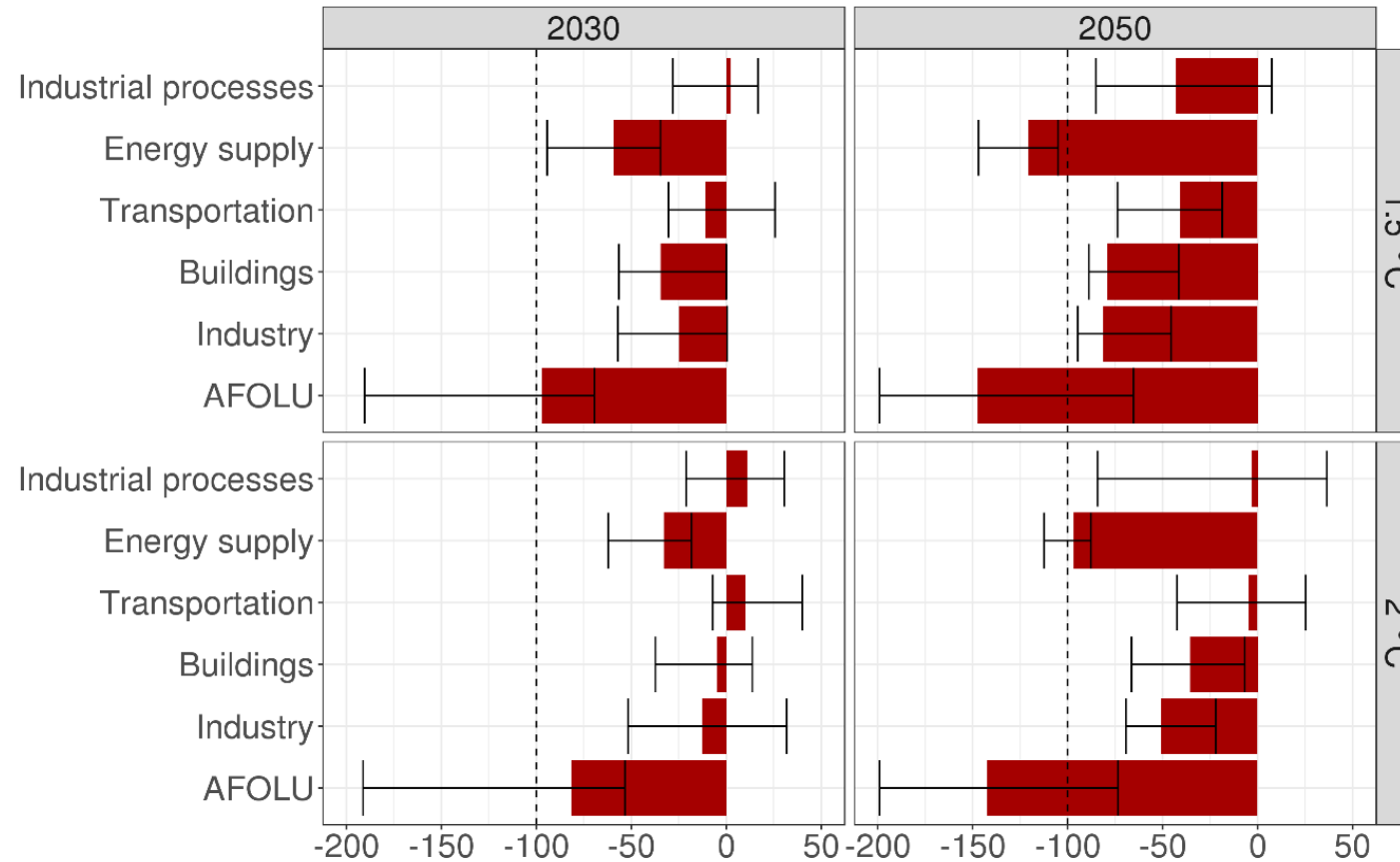


Policy brief - Key findings: where do we want to go?

- Scenarios limiting global warming to well below 2 °C or 1.5 °C project global emissions **peaking by 2020**, and declining rapidly afterwards, reaching **net zero CO₂ emissions between 2070 and 2090** (2 °C scenario) or between 2040 and 2060 (1.5 °C scenario).
- It is important to have a **near-zero emission ambition as an orientation for long-term planning**, for countries, regions and even for cities, as well as for individual sectors.
- A cost-optimal carbon-neutral global energy system may still imply that certain sectors or countries have residual CO₂ emissions that are compensated by net negative CO₂ emissions elsewhere. Net negative CO₂ emissions, however, are associated with several risks.
- Climate policies need to be combined with **broader sustainable development policies**.

Sectoral emission reductions

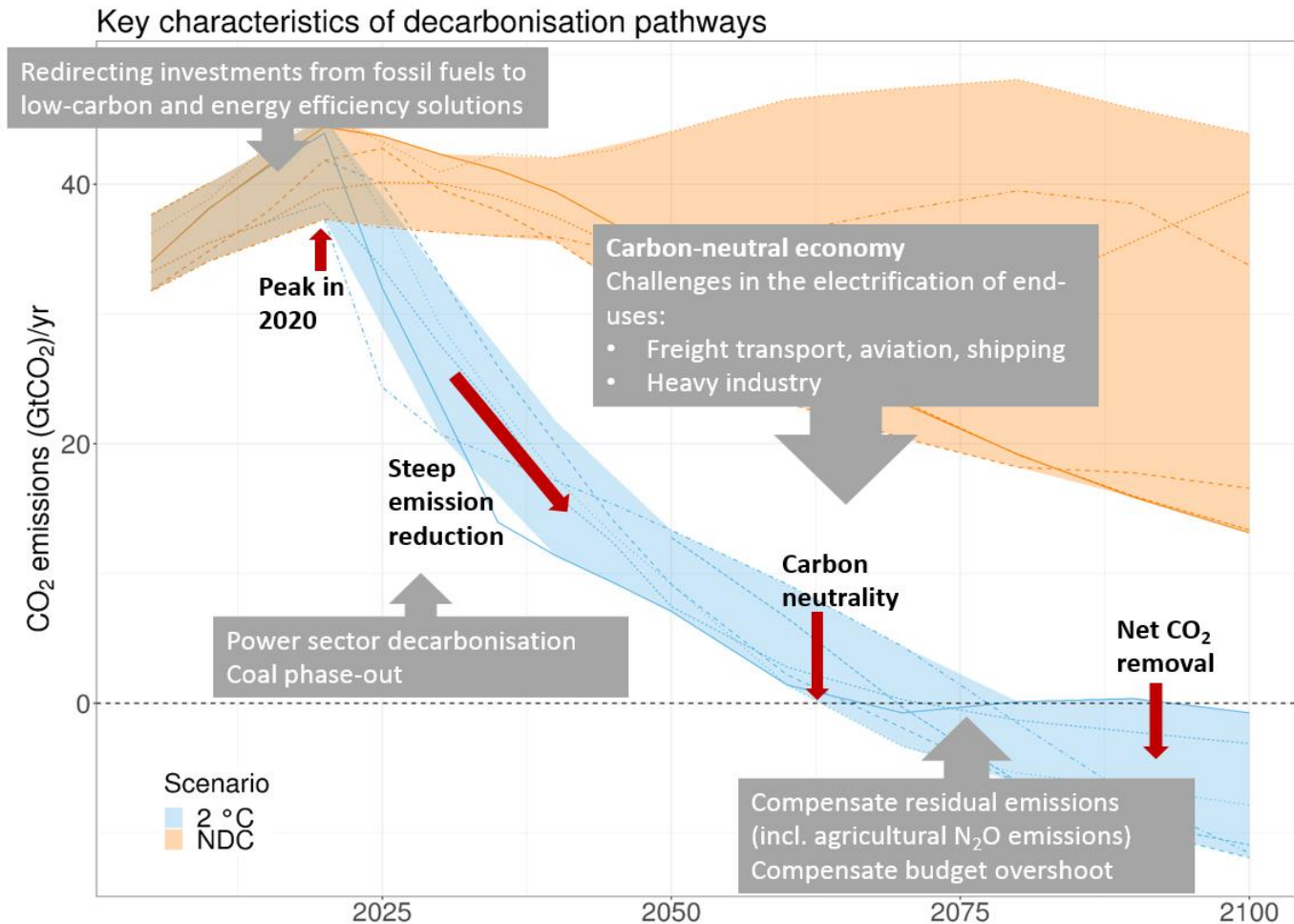
c) Sectoral CO₂ emissions by 2030 and 2050, relative to 2010 (%)



Policy brief - Key findings: how do we get there?

- Analysis shows that there are several **opportunities for strengthening current climate policies**.
- If all countries were to implement sectoral climate policies similar to successful examples as observed in certain countries (**good practice policies**), annual greenhouse gas emission levels could be reduced to approximately 50 GtCO₂e by 2030, compared to 60 GtCO₂e under the current policies scenario.
- The massive transformation of global energy, industry, and land-use systems required to achieve the 1.5 °C and well below 2 °C global warming goals depends critically on policies that incentivise **changes in investment patterns**, technology uptake and household/business and community behaviour.
- The 2 °C and 1.5 °C scenarios exhibit a shift **from fossil fuel** (especially coal) **to low-carbon and energy efficiency investments**.

Dynamics of the transformation



Introduction national fact sheets

- **The Paris Agreement**

- is a call for all Parties to strive to formulate and communicate long-term, low GHG emission strategies taking into account common but differentiated responsibilities and respective capabilities

- That is **why countries need long-term energy and climate strategies:**

- To set their directions and visions for economic and social development, helping them to manage the transition process, avoiding disruption for current systems and safeguarding their development targets from climate change risks

- And as such **the key contribution of this work is:**

- to present model-based scenarios assessing 11 major economies through national-level, low-carbon transition pathways, using national integrated assessment and energy-economy models

Methodological approach

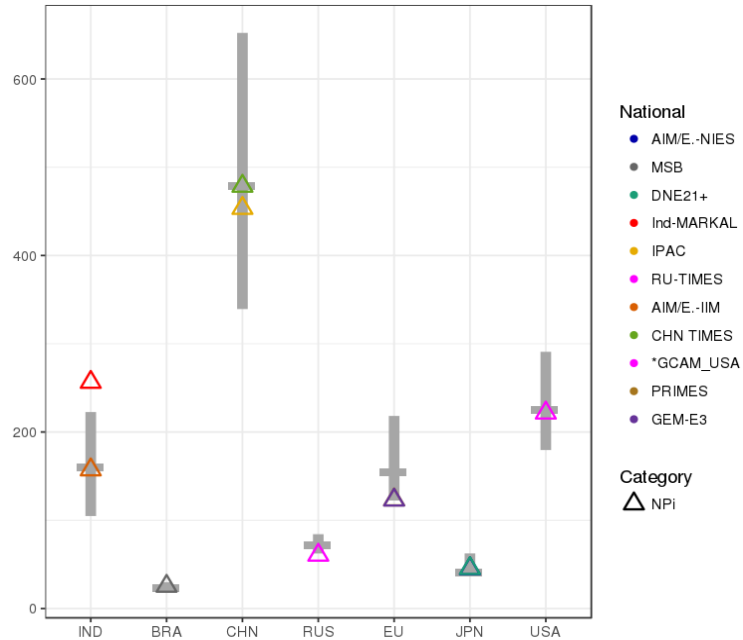
- Presentation includes **modelling from 11 G20 country teams** who:
 - **Regularly support domestic policymaking** in energy and climate policy
 - **Represent more than 87% of global CO₂ emissions in 2015**

National Team	Models	Country	Model type
CSIRO	TIMES-AUS	Australia	Energy system
COPPE	BLUES, COFFEE	Brazil	Integrated Assessment
ECCC	GCAM-Canada, EC-MSMR	Canada	Energy system, Macro-economy
NCSC, ERI	PECE	China	Integrated energy system
E3Modelling	PRIMES	EU-28	Energy system
TERI	MARKAL	India	Energy system
BAU, CREP-ITB	ExSS, AFOLU Dashboard	Indonesia	Energy system, AFOLU, waste
NIES	AIM/Enduse [JPN]	Japan	Energy system
HSE	TIMES-RUS, ROBUL/ CBS-CFS3	Russia	Energy system, Forestry
UOS	TIMES, AIM-Korea	South Korea	Energy system
PNNL	GCAM	USA	Integrated Assessment

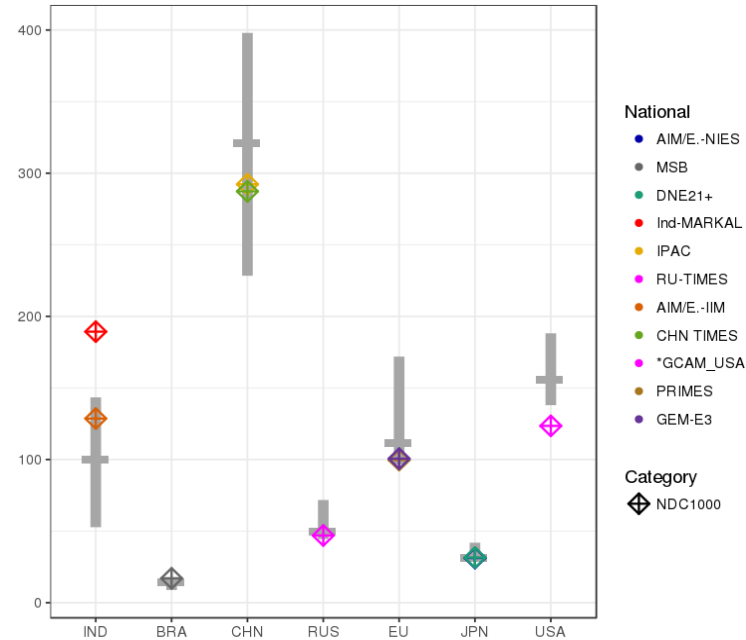
Methodological approach (cont.)

- All are **well-established, state-of-the-art models** that have been used extensively for domestic energy and policy advice
- These **models have been exposed to an interaction with global IAM teams**, so as **to get insights on national carbon budgets and GHG emissions projections** which are **globally consistent with respect to the Paris Agreement**
- The **CD-LINKS project** was used to provide national, cumulative CO₂ emissions **over 2011-2050, projected by a number of global IAMs**, assuming a global carbon budget of 1,000 GtCO₂ up to 2100, considered **equivalent to limiting global warming to below 2°C with >66% probability**

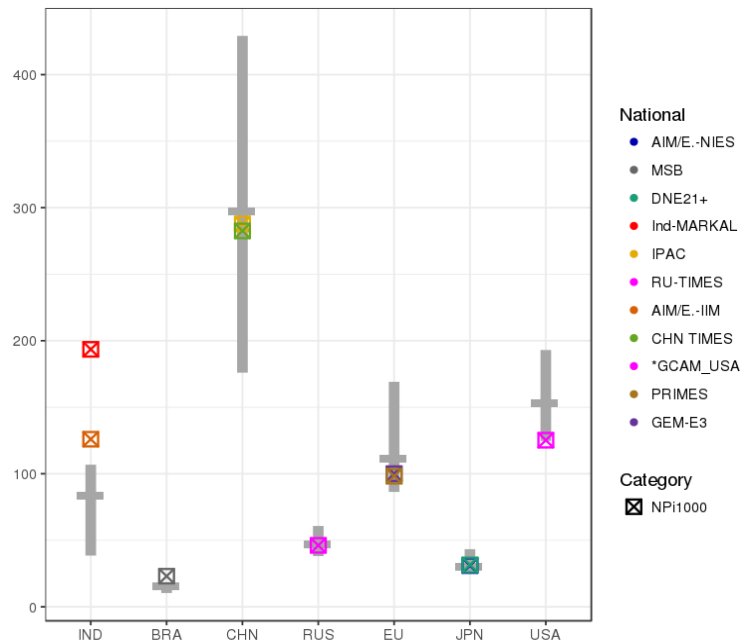
Carbon budget [GtCO₂] - NPi - 2050



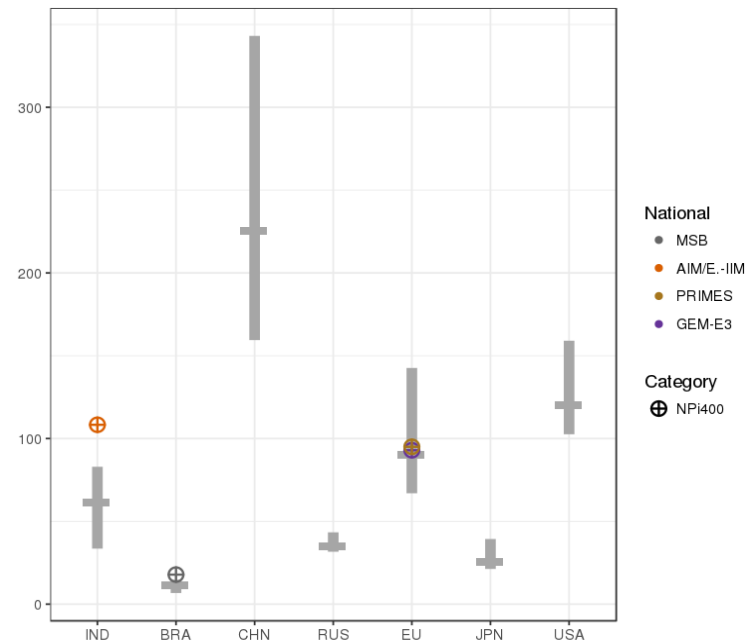
Carbon budget [GtCO₂] - NDC1000 - 2050



Carbon budget [GtCO₂] - NPi1000 - 2050



Carbon budget [GtCO₂] - NPi400 - 2050



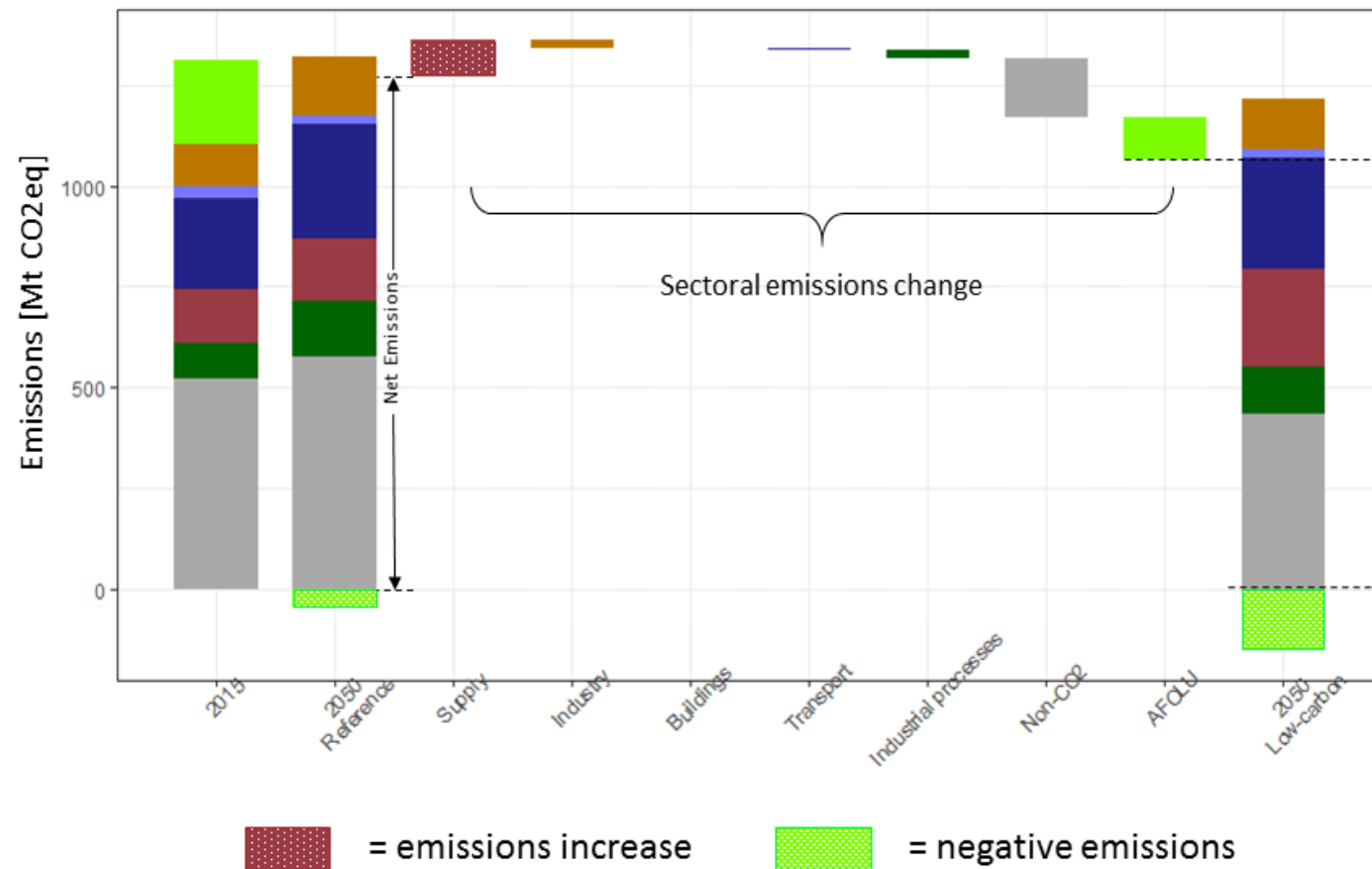
Carbon dioxide budgets (2011-2050) for the different countries and scenarios (NPi, NDC1000, NPi1000 and NPi400. Gray bars indicate the full range of global IAMs in the corresponding scenarios, and the color shapes the national/regional budgets from national models. BRA: Brazil, CHN: China, EU: European Union, IND: India, JPN: Japan, RUS: Russian Federation, USA: United States of America

Schaeffer et al., under review

National fact sheets

- **Eleven countries' fact sheets were produced** (Australia, Brazil, Canada, China, EU-28, India, Indonesia, Japan, Russia, South Korea and the USA) **based on a template** with 4 sections, 3 of which directly related to the Talanoa dialogue:
 - Where are we? Where do we want to go? How do we get there?
 - And one focusing on a specific key issue for each country
- **Common figures and indicators were developed for all countries:**
 - Energy-economy indicators (e.g. energy and carbon intensity of GDP)
 - GHG and CO2 emissions by major emitting sectors
 - Indicators for energy system restructuring (e.g. energy efficiency, electrification, share of RE)
 - Other national relevant issues (e.g. role of non-CO2, land-use)

National fact sheets (example of Brazil)



GHG emissions in 2015 and by 2050 in the reference scenario (NDC), emission reductions between the reference and the low-carbon scenario by sector (energy supply, industry, residential and commercial buildings, transport, industrial processes, non-CO₂, and AFOLU), and 2050 emissions in the low-carbon scenario (consistent with 2°C). Non-CO₂ emissions include emissions from AFOLU, energy use, waste treatment and industrial processes

National fact sheets (example of Brazil)

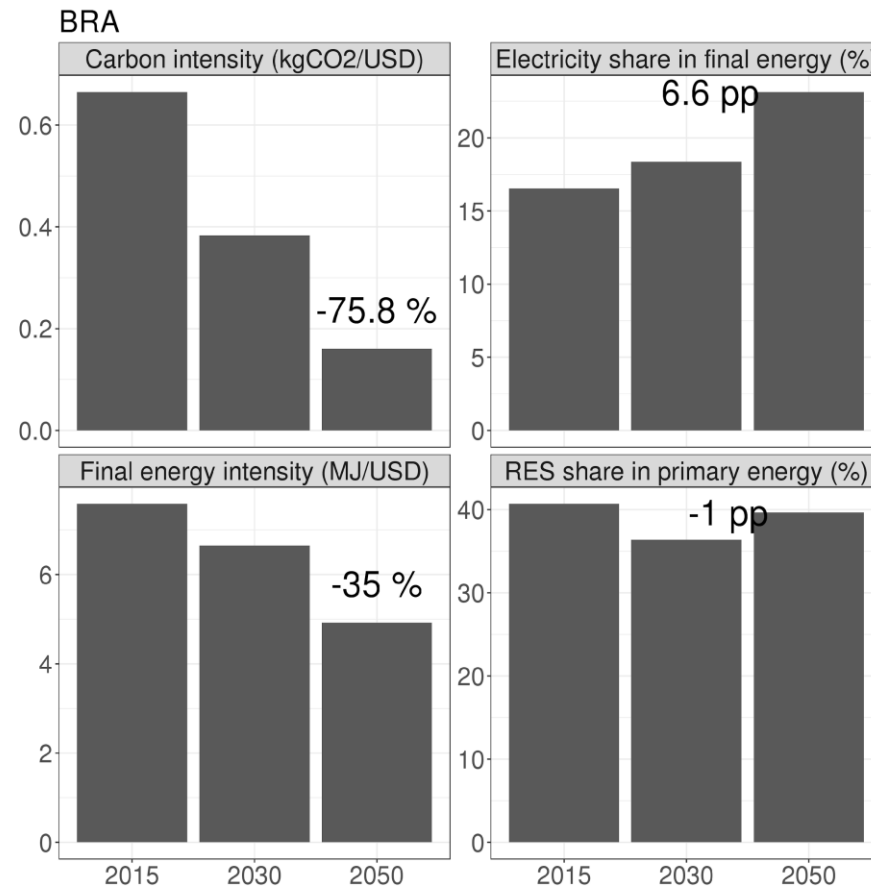
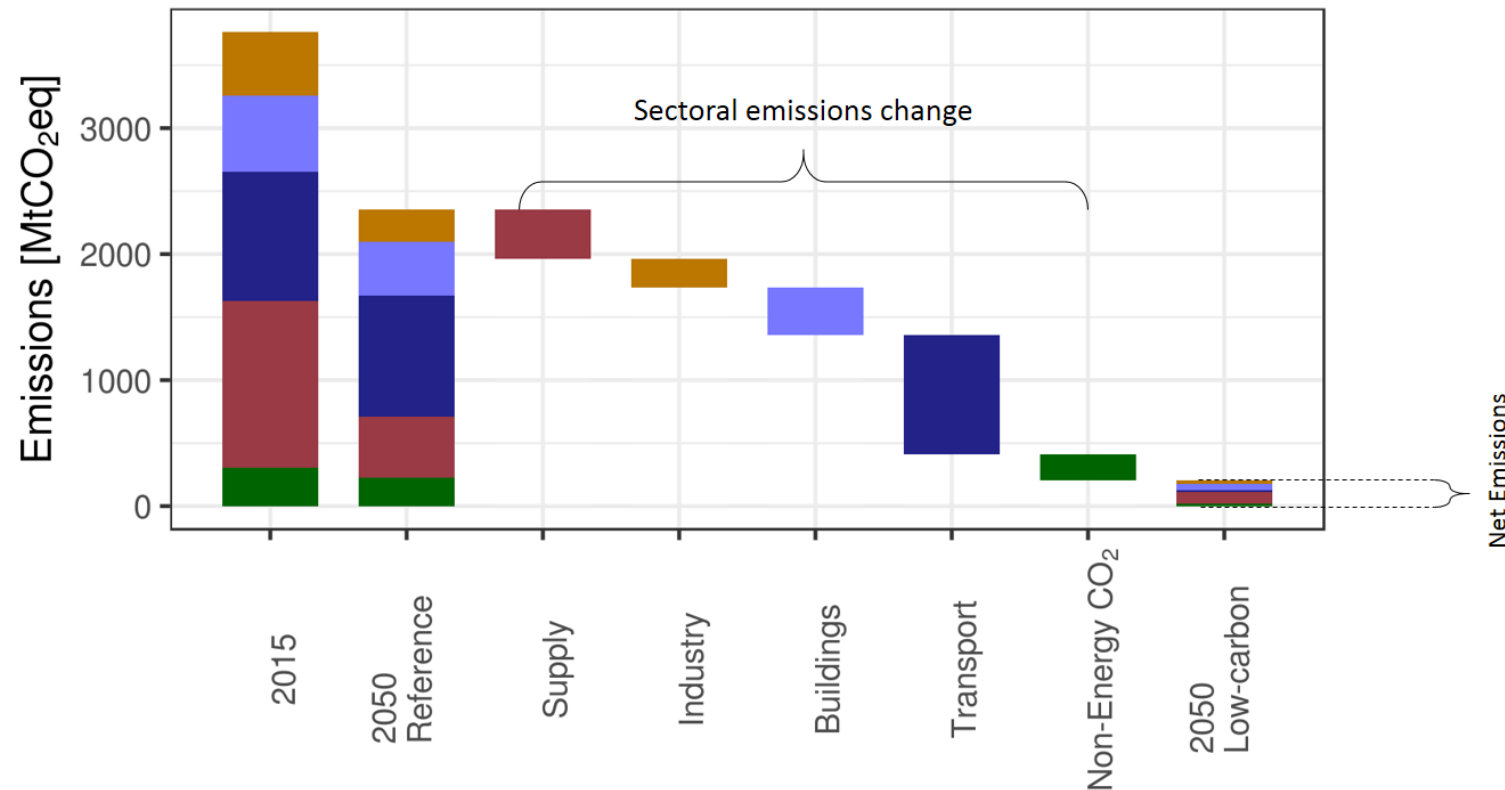


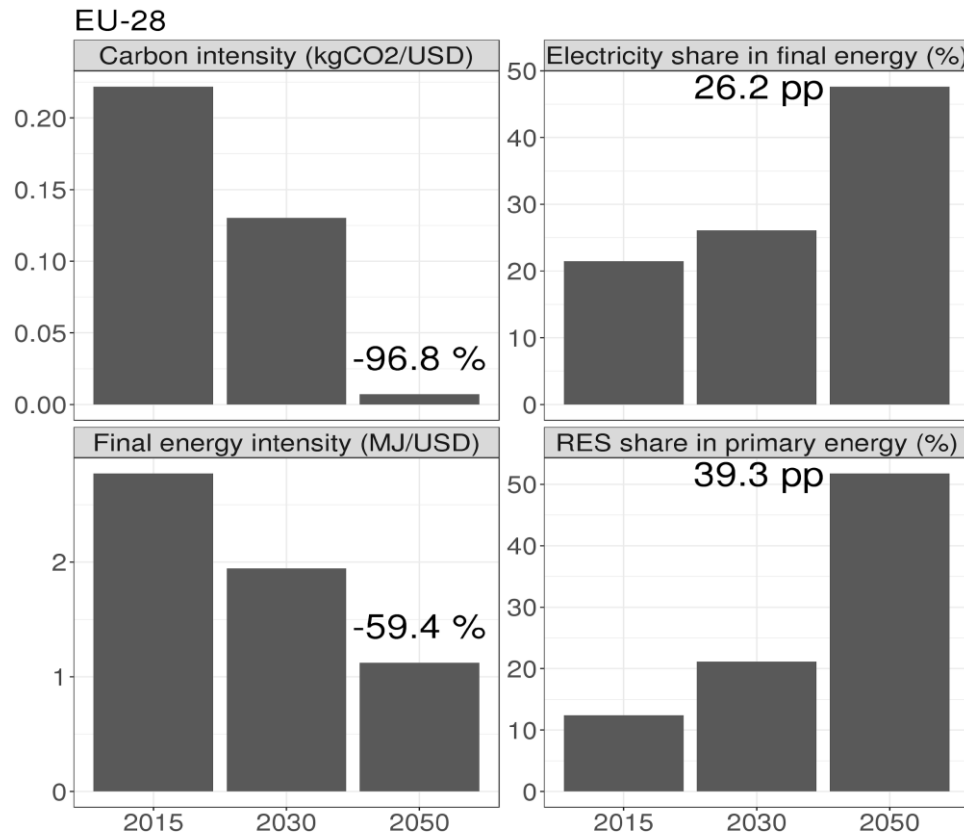
Illustration of the energy system transformation towards decarbonisation. Numbers in the graph indicate change between 2015 and 2050 (intensity indicators: %, share indicators: percentage points, pp)

National fact sheets (example of the EU-28)

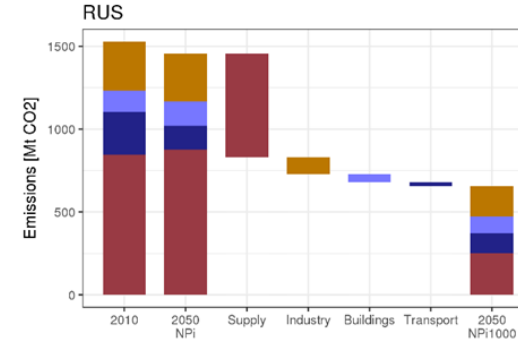
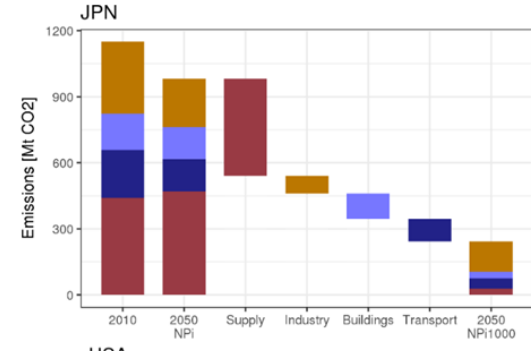
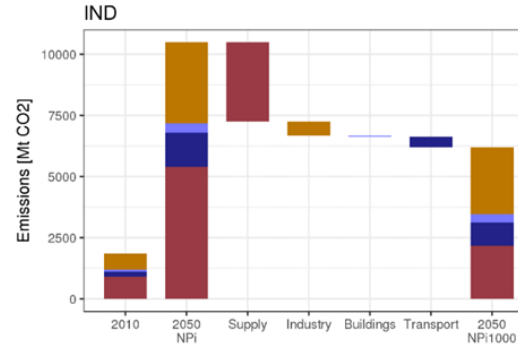
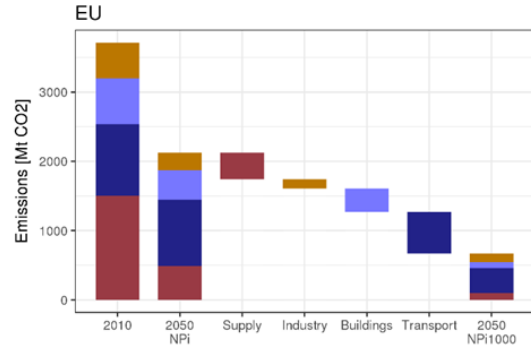
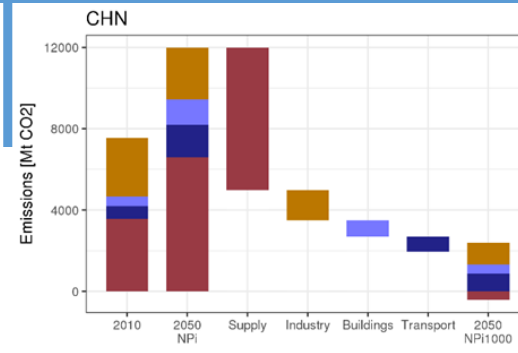
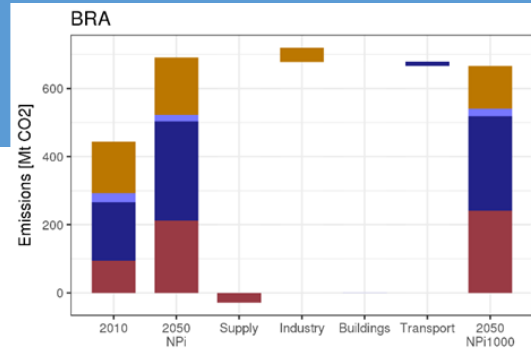


GHG emissions in 2015 and by 2050 in the reference scenario, emission reductions between the reference and low-carbon scenarios by sector (energy supply, industry, residential and commercial buildings, transport, non-energy CO₂), and 2050 emissions in the low-carbon scenario (consistent with 1000 GtCO₂, i.e. well-below 2 °C). Non-energy CO₂ includes emissions from industrial processes

National fact sheets (example of the EU-28)



- “No-regret” options include:
 - Expansion of RES
 - Energy efficiency improvement
 - Electrification of energy uses
- To move towards “carbon-neutrality” additional options are:
 - Advanced biofuels in transport
 - Hydrogen and clean e-fuels
 - Electricity storage
 - Deep building retrofits
 - Heat pumps
 - Material efficiency/circular economy
 - Sector coupling and market integration



Sectoral CO₂ emissions and contributions to mitigation in 2050, per region/country. Change between 2010 (first bar), 2050 NPI (second bar) and 2050 NPI1000 (seventh bar). Red: energy supply, yellow: industry, light blue: buildings, dark blue: transportation. BRA: Brazil, CHN: China, EU: European Union, IND: India, JPN: Japan, RUS: Russian Federation, USA: United States of America

Schaeffer et al., under review

Final considerations

- **National-level models capture country specificities** and show that different technological options can be used, based on policy priorities, domestic energy resources and broad socioeconomic considerations
- **Country specificities and policy priorities play a key role in designing nationally-relevant low-emission strategies** and have to be consistently integrated in the quantitative assessment of low-carbon transition pathways
- **Different starting points and divergent dynamics of economic growth and energy systems' evolutions lead to differentiated low-carbon transition pathways** by country

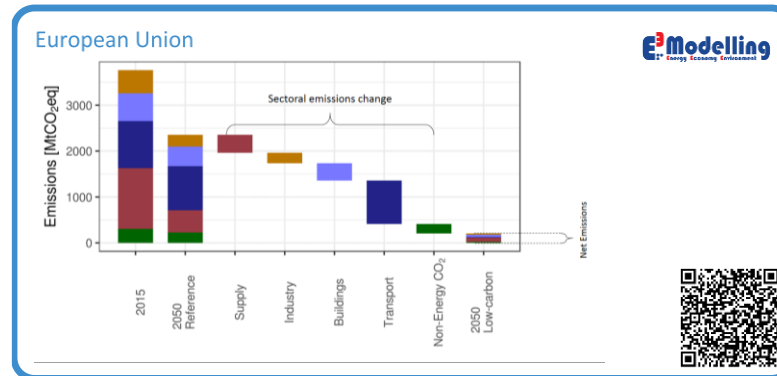
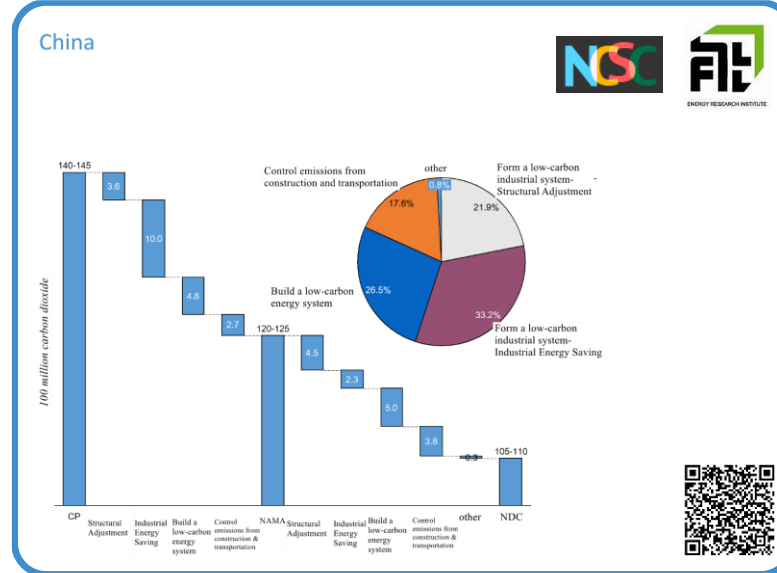
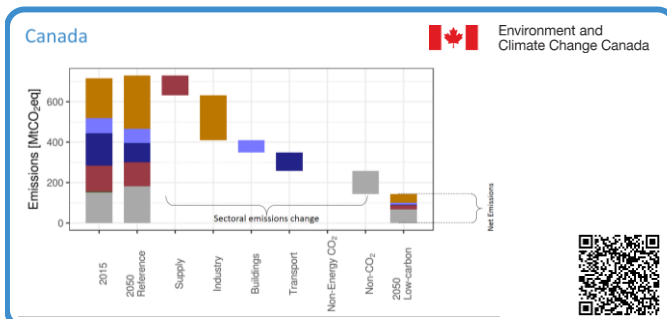
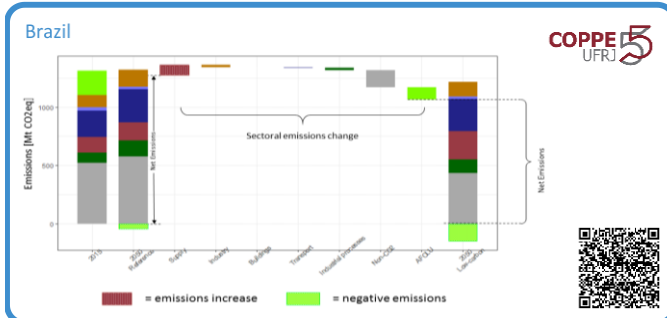
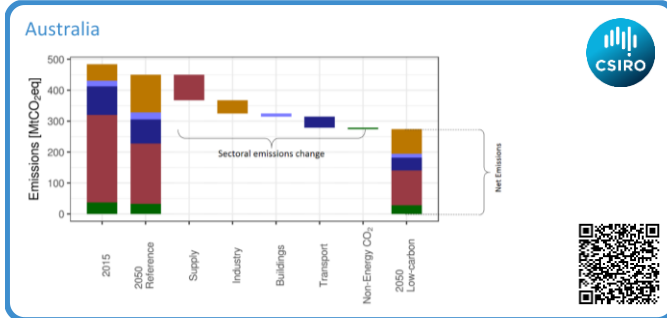
Final considerations (cont.)

- Results show that **low-carbon scenarios of all major economies are consistent with a pathway limiting global warming to “well-below” 2°C**
- National scenarios illustrate that, in a low-carbon context, **the major economies** explored here **are projected to:**
 - **Improve** the carbon intensities of their economies
 - **Diversify** their energy and power generation mix towards low-carbon sources
 - **Improve** their energy efficiencies in all end-use sectors
 - **Use a variety of mitigation options** across countries towards a low-carbon transition

Final considerations (cont.)

- The **key decarbonization pillars that are common to all countries** are:
 - **Expansion of RE sources** in both power (mainly PV and wind) and in the transport and heating uses (biofuels, RE-based electricity, bioenergy)
 - **Accelerated energy efficiency** improvements in all demand sectors (buildings, industry, transport)
 - **Electrification of final energy demand**, both in mobility and in heating end-uses (the share of electricity in final energy demand increases from the current global average of 20% to between 20-80% depending on the country)
- Our national-level analysis illustrates that the **deployment of other low-carbon options** (i.e. CCS, nuclear, advanced biofuels, hydrogen, synthetic fuels) **depends on national specificities**, policy considerations and priorities

How do we get there?



- Opportunities exist to strengthen existing climate policies
- Implementing these opportunities will require a massive **redirection of current investments** and using the possible **synergies between climate policies and national development objectives**

Key insights

- Paris requires reaching net zero emissions around the middle of the century (1.5 vs 2 °C)
- Current policies are not sufficient yet → Countries need to strengthen policies
- There is considerable potential in all countries (technically/economically)
- Synergies with other SDGs; trade-offs require side-policies

Thank you

Policy brief and national fact sheets:
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¹ Pasture recuperation is defined as the recovery of the carrying capacity of a given area of degraded pastureland

Global stocktake tool
<https://themasites.pbl.nl/global-stocktake-indicators/>

EMISSIONS BUDGET DECARBONISATION POLICY INNOVATION INVESTMENT SCENARIOS

