Climate

p**O**licy assessment and

Mitigation

Modelling to

Integrate national and global

Transition pathways

Partners

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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 stock-take process to compare these policies to overall goal

Global transformation pathways

global stocktake

National low-carbon development pathways

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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

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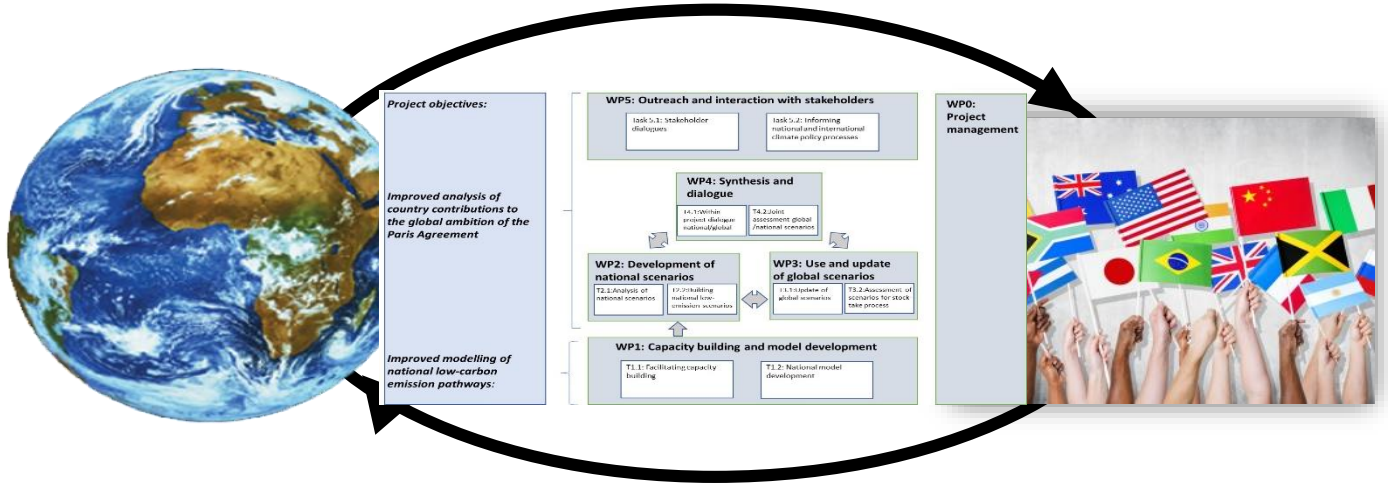
Global transformation pathways



National low-carbon development pathways

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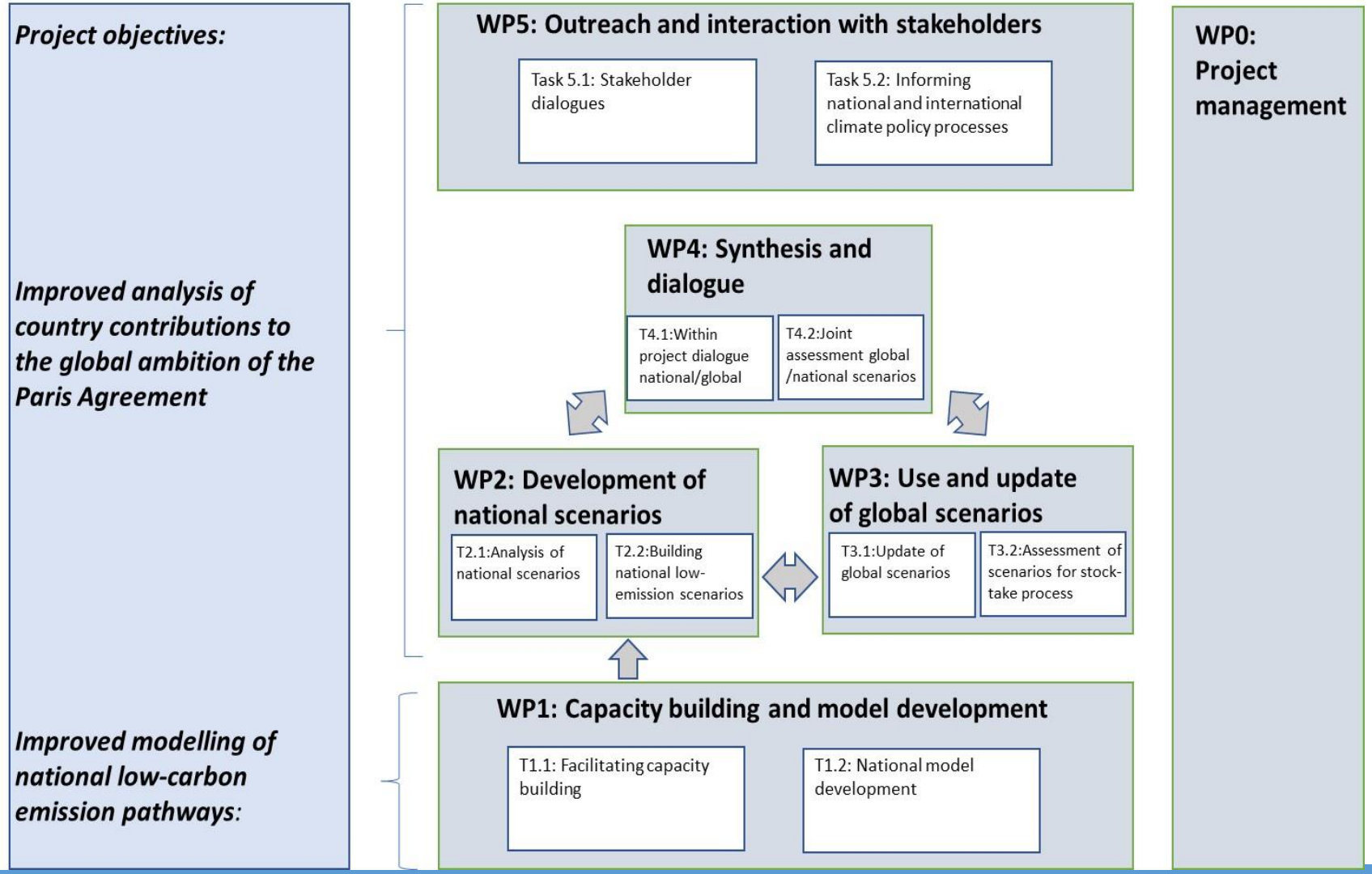
Project objectives:
Improved analysis of country contributions to the global ambition of the Paris Agreement
Improved modelling of national low-carbon emission pathways:
WP5: Outreach and interaction with stakeholders
Task 5.1: Stakeholder dialogues
Task 5.2: Informing national and international climate policy processes
WP4: Synthesis and dialogue
T4.1:Within project dialogue national/global
T4.2:Joint assessment global /national scenarios
WP2: Development of national scenarios
T2.1:Analysis of national scenarios
T2.2:Building national low-emission scenarios
WP3: Use and update of global scenarios
T3.1:Update of global scenarios
T3.2:Assessment of scenarios for stock-take process
WP1: Capacity building and model development
T1.1: Facilitating capacity building
T1.2: National model development
WP0: Project management

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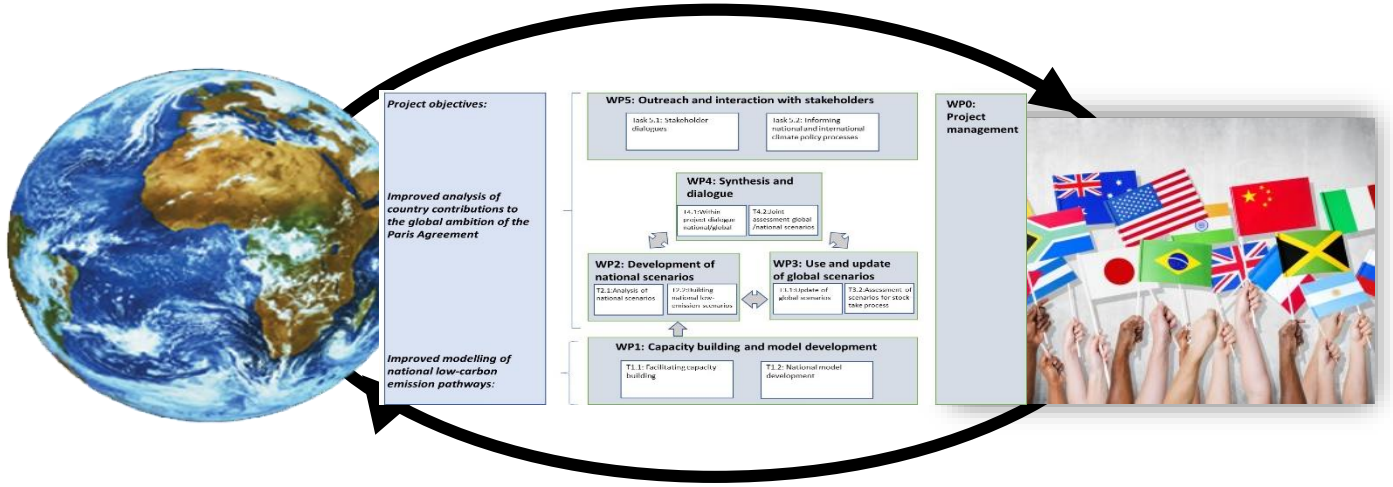
Global transformation pathways



National low-carbon development pathways

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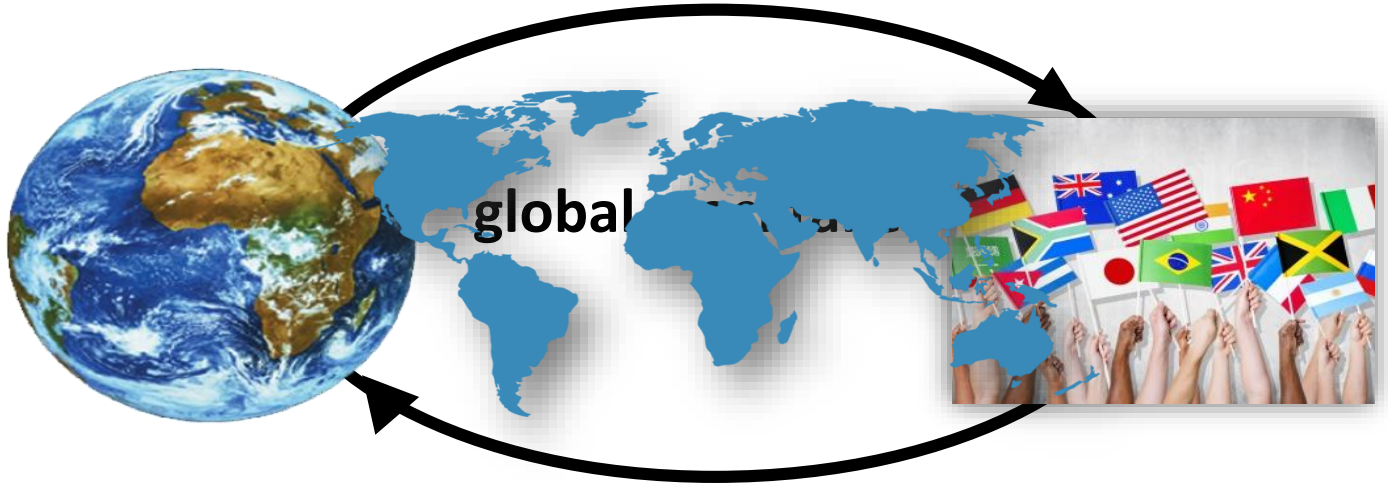

National low-carbon development pathways

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Environment and Climate Change Canada
Pacific Northwest National Laboratory
Netherlands Environmental Assessment Agency
PIK
International Institute for Applied Systems Analysis
IIASA
RFF CMCC
Modelling
NATIONAL RESEARCH UNIVERSITY HIGHER SCHOOL OF ECONOMICS SAINT PETERSBURG
NIES JAPAN
ENERGY RESEARCH INSTITUTE
NCSC
THE UNIVERSITY OF SEOUL
IGES
Institute for Global Environmental Strategies
teri
CCROM
Southeast Asia and Pacific
INSTITUT TEKNOLOGI BANDUNG
COPPE UFRJ
CSIRO

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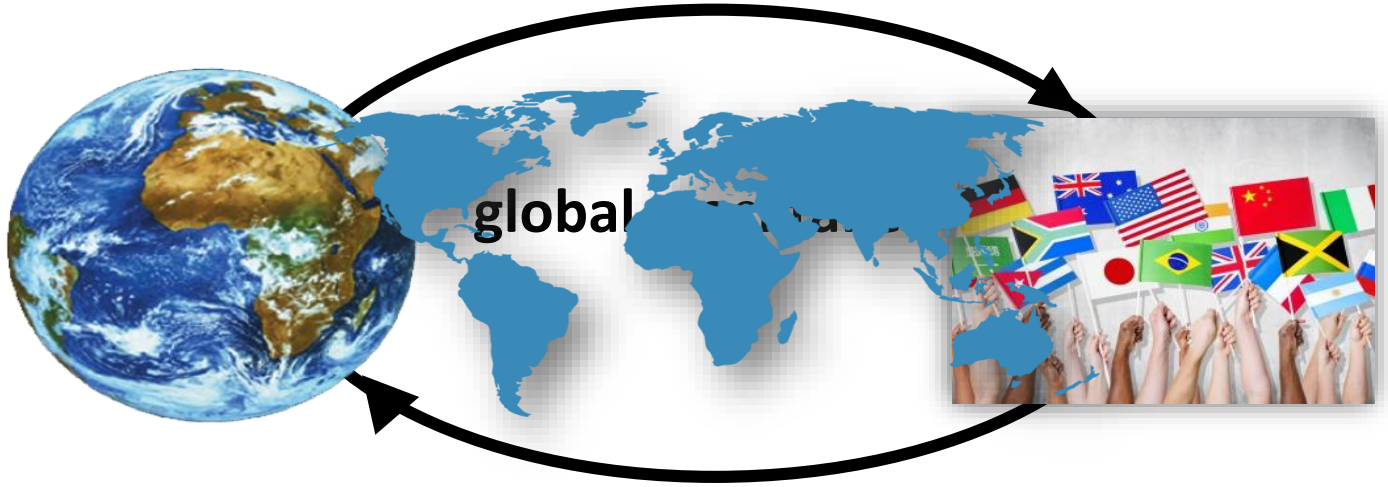
Global transformation pathways



National low-carbon development pathways

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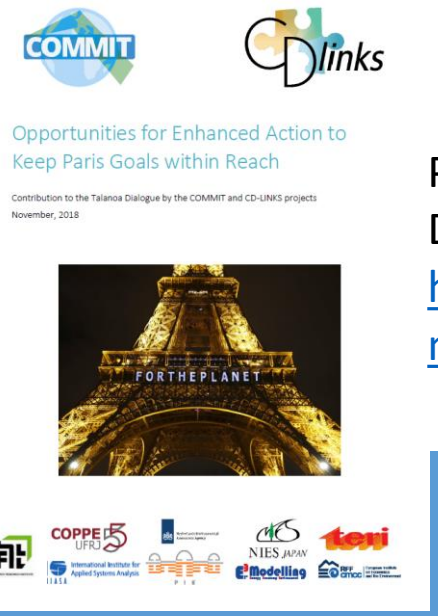
Global transformation pathways

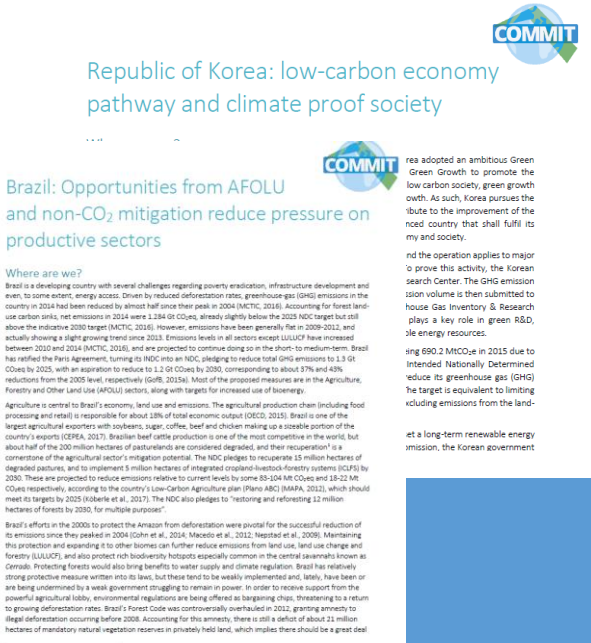
National low-carbon development pathways



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

National fact sheets:

https://themasites.pbl.nl/commit/products



Policy brief

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

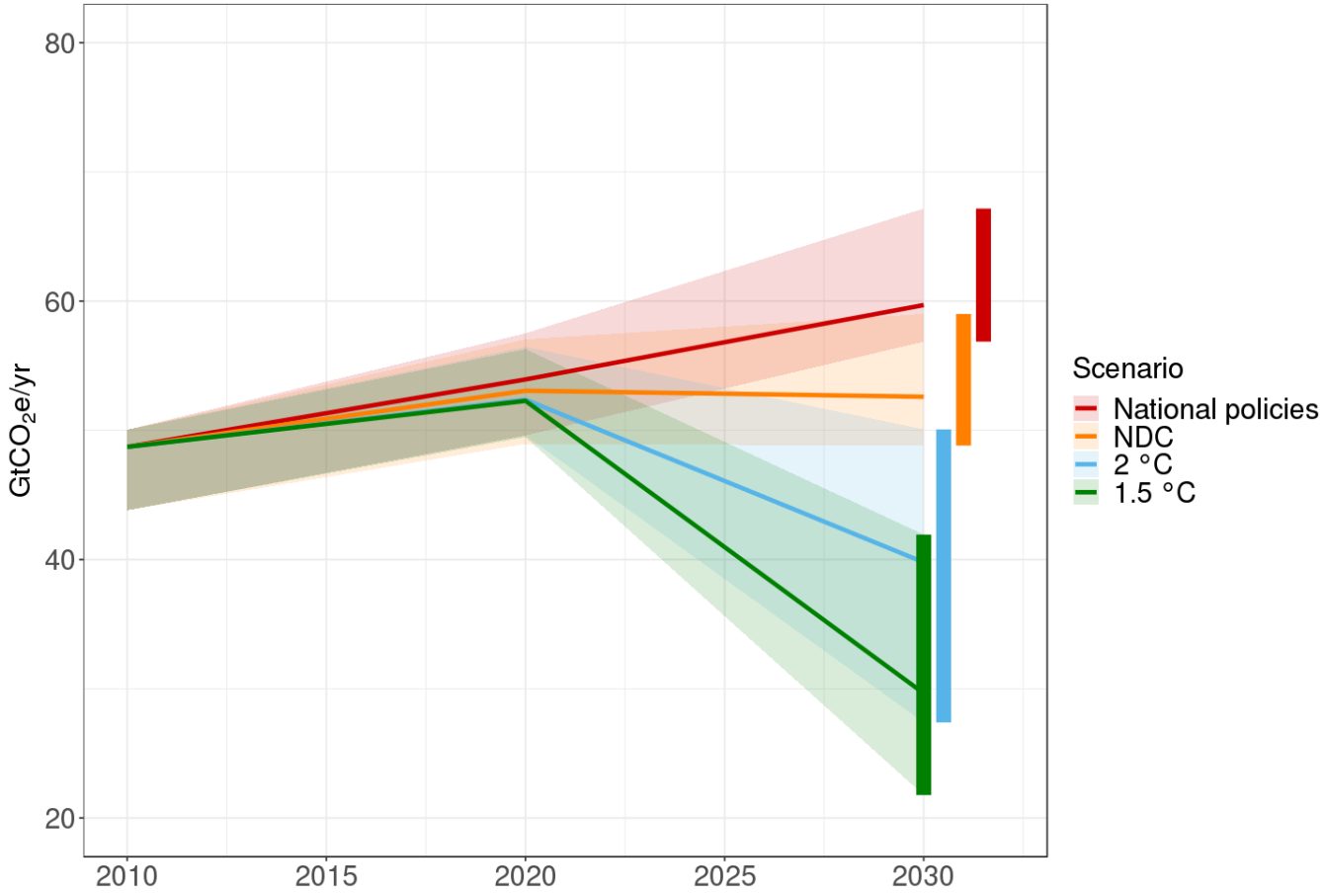
- Submitted to Talanoa Dialogue

https://unfccc.int/documents/184187

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 $GtCO_2e$ 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 $GtCO_2e$, 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.

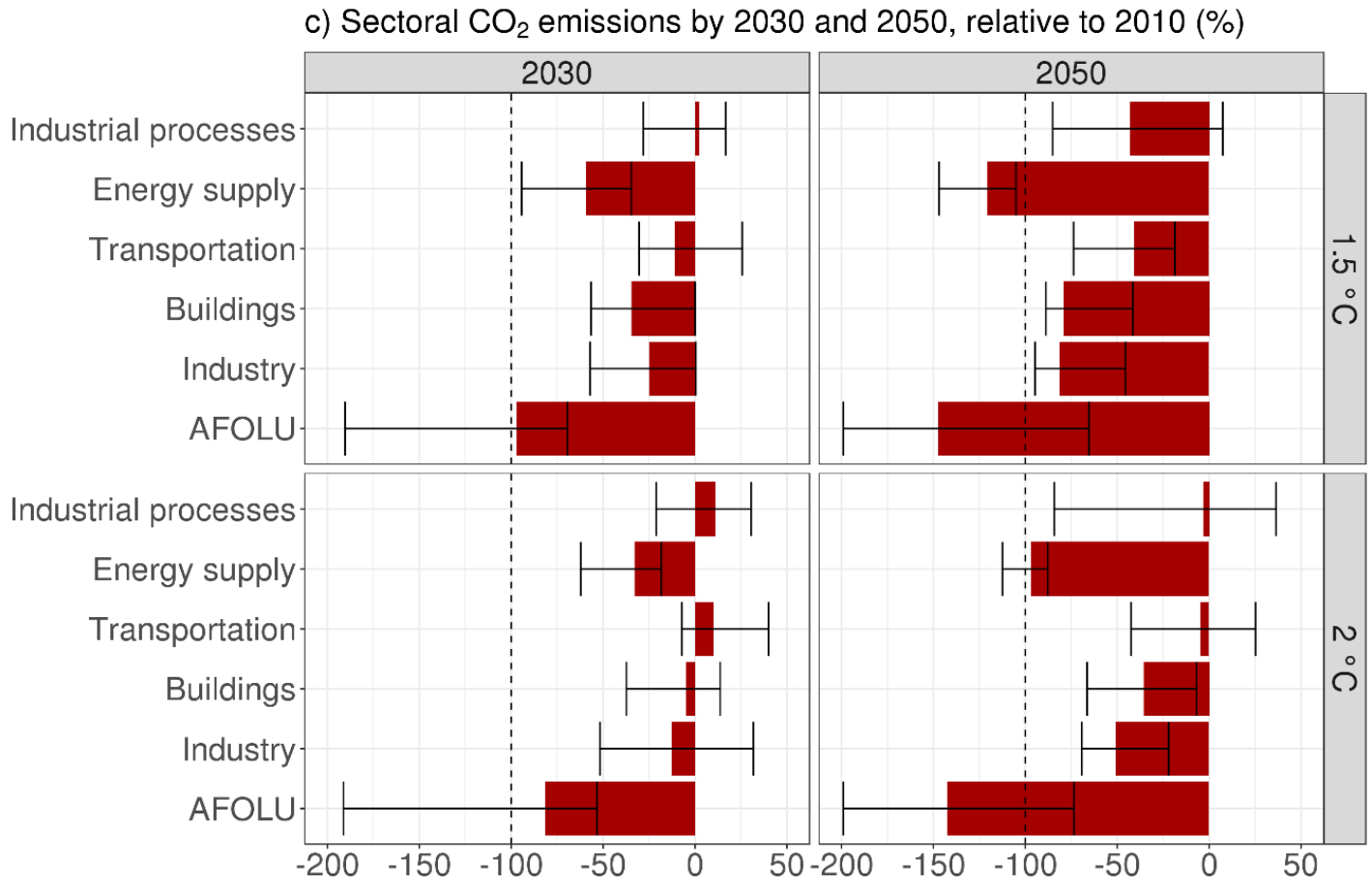
Implementation and ambition gaps



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 CO_2 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 CO_2 emissions that are compensated by net negative CO_2 emissions elsewhere. Net negative CO_2 emissions, however, are associated with several risks.
- Climate policies need to be combined with **broader sustainable development policies**.

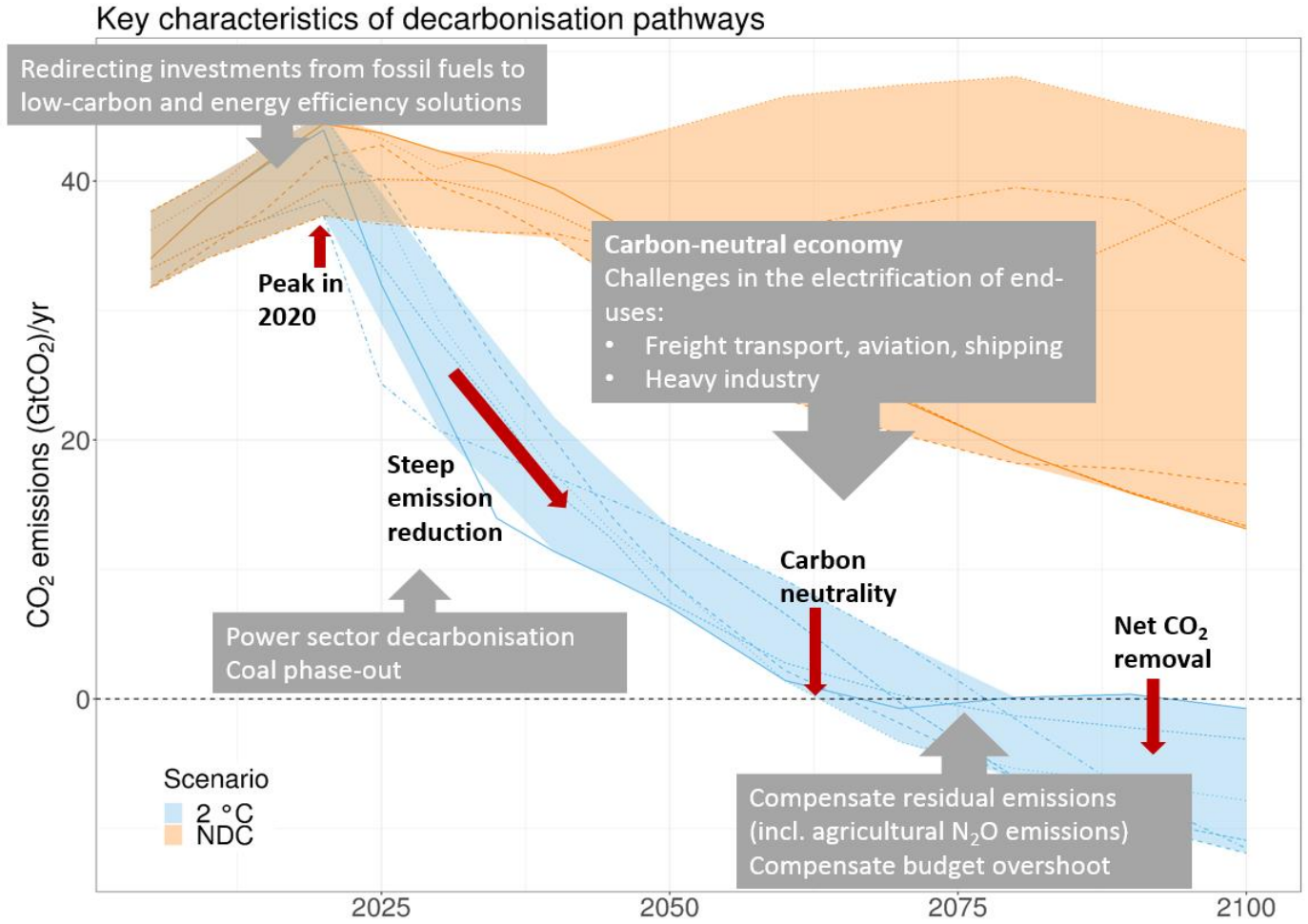
Sectoral emission reductions



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 $GtCO_2e$ by 2030, compared to 60 $GtCO_2e$ 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

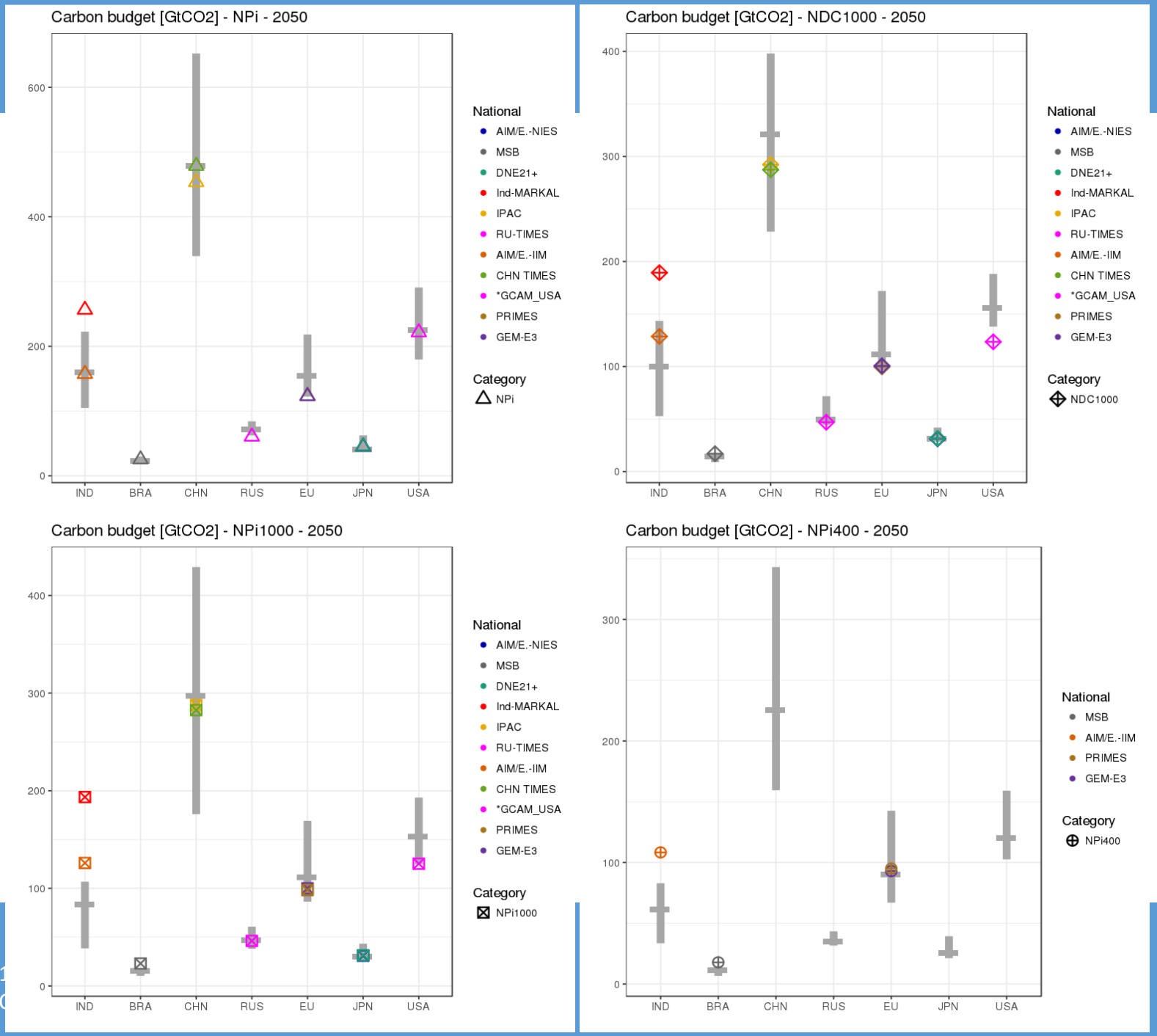
Methodological approach

- Presentation includes **modelling from 11 G20 country teams** who:
  - **Regularly support domestic policymaking** in energy and climate policy
  - **Represent more than 87% of global CO_2 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 CO_2 emissions over 2011-2050**, **projected by a number of global IAMs**, assuming a global carbon budget of 1,000 $GtCO_2$ up to 2100, considered **equivalent to limiting global warming to below 2°C with >66% probability**



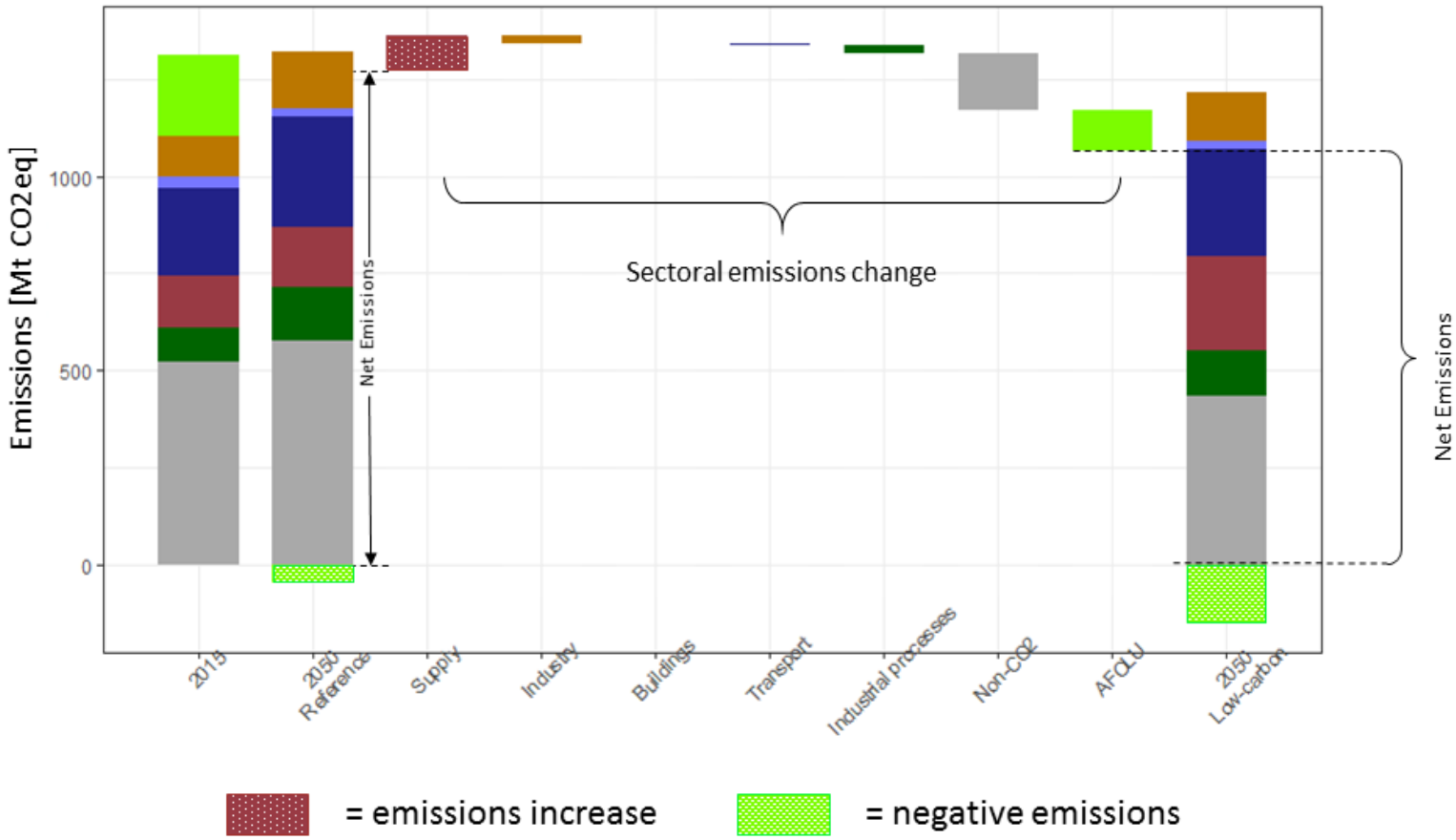
Carbon dioxide budgets (2011-2050) for the different countries and scenarios (NPi, NDC1000, NPi1000 and NPi400. Gray bars indicate the full range of global IAMs in the corresponding scenarios, and the color shapes the national/regional budgets from national models. BRA: Brazil, CHN: China, EU: European 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-CO_2, and AFOLU), and 2050 emissions in the low-carbon scenario (consistent with 2°C). Non-CO_2 emissions include emissions from AFOLU, energy use, waste treatment and industrial processes

National fact sheets (example of Brazil)

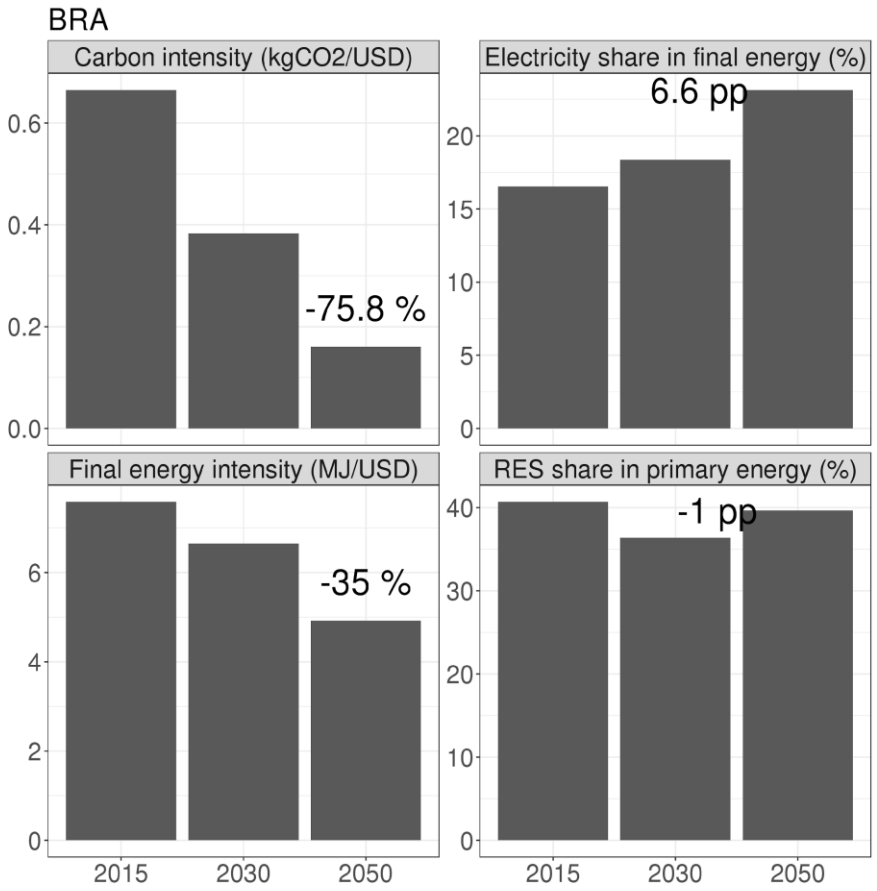
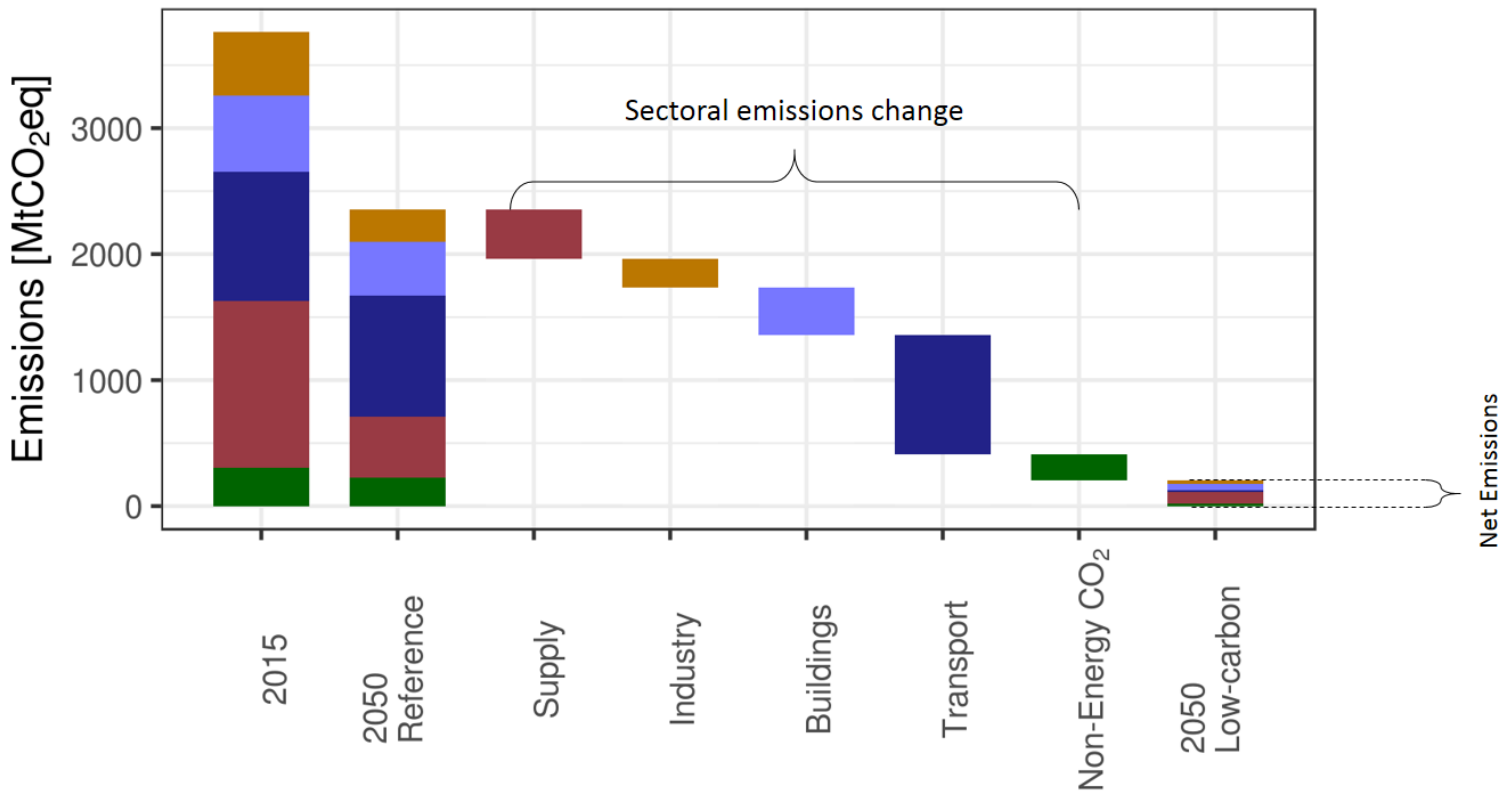


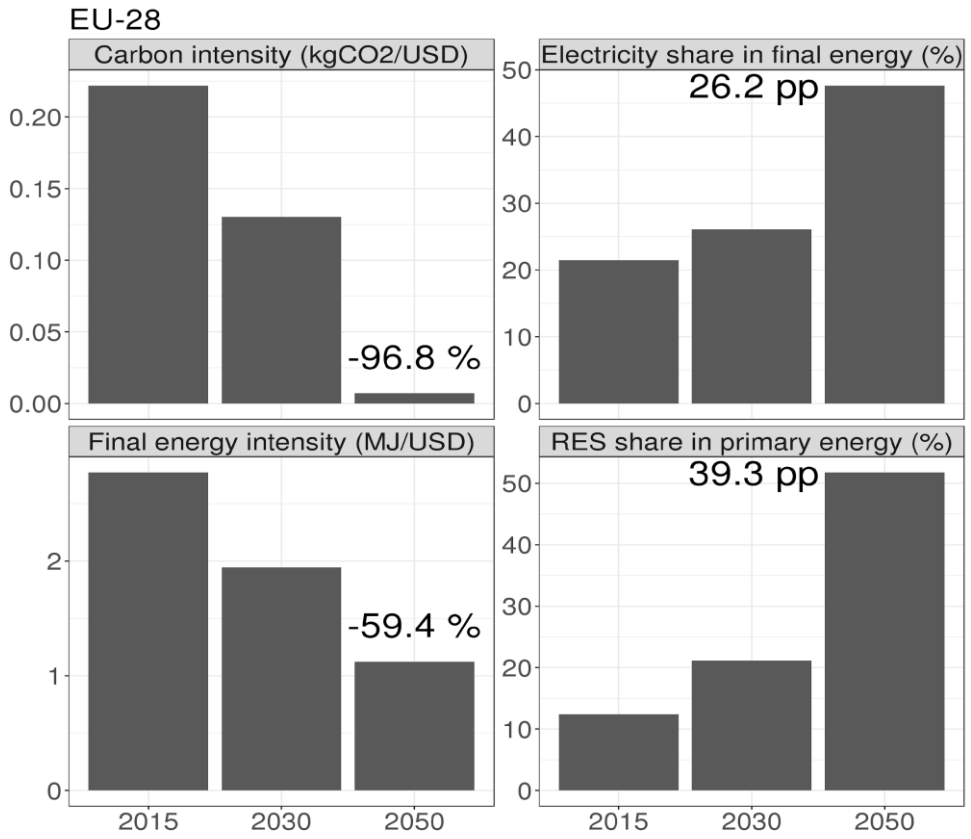
Illustration of the energy system transformation towards decarbonisation. Numbers in the graph indicate change between 2015 and 2050 (intensity indicators: %, share indicators: percentage points, pp)

National fact sheets (example of the EU-28)

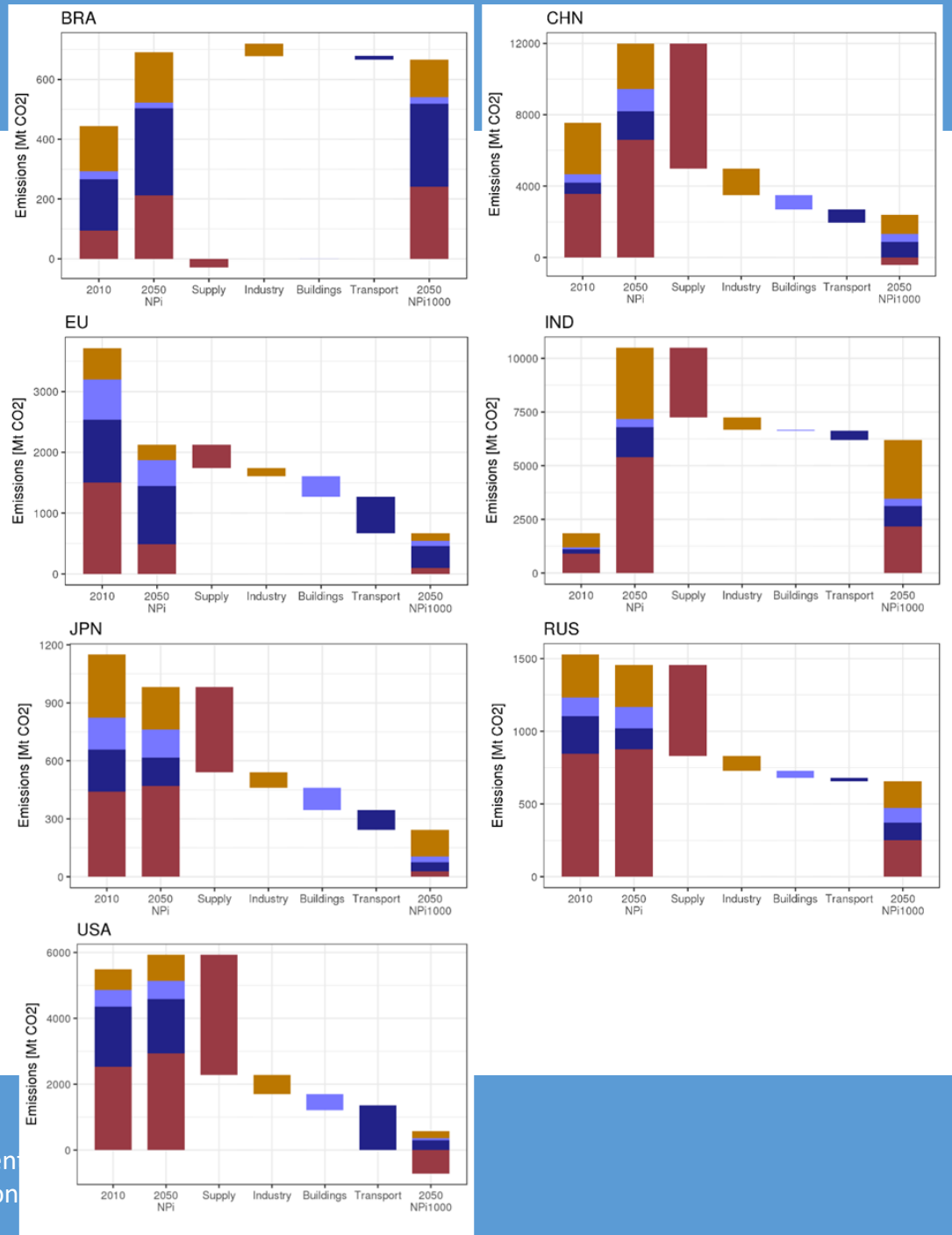


GHG emissions in 2015 and by 2050 in the reference scenario, emission reductions between the reference and low-carbon scenarios by sector (energy supply, industry, residential and commercial buildings, transport, non-energy CO_2), and 2050 emissions in the low-carbon scenario (consistent with 1000 $GtCO_2$, i.e. well-below 2 °C). Non-energy CO_2 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 CO_2 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.)

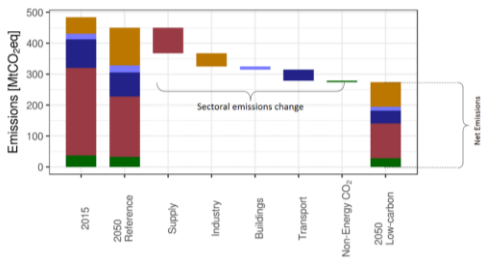
- Results show that **low-carbon scenarios of all major economies are consistent with a pathway limiting global warming to "well-below" 2°C**
- National scenarios illustrate that, in a low-carbon context, **the major economies** explored here **are projected to**:
  - **Improve** the carbon intensities 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.)

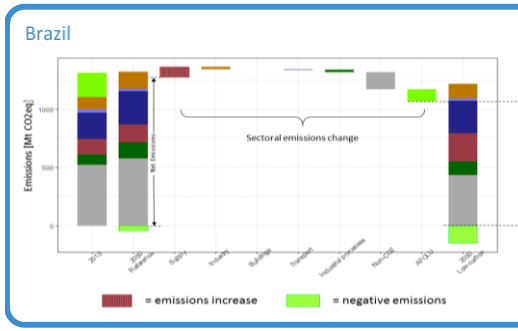
- The **key decarbonization pillars that are common to all countries** are:
  - **Expansion of RE sources** in both power (mainly PV and wind) and in the transport and heating uses (biofuels, RE-based electricity, bioenergy)
  - **Accelerated energy efficiency** improvements in all demand sectors (buildings, 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?

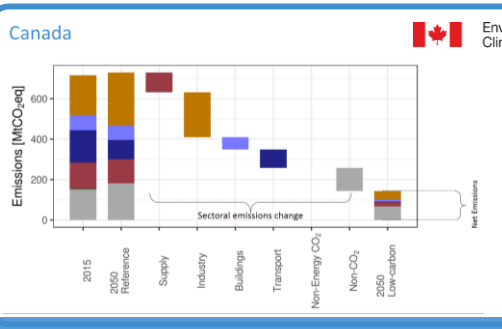
Australia



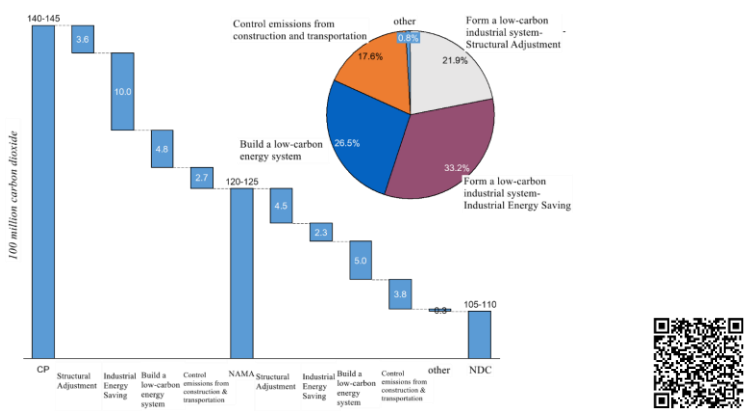
Brazil



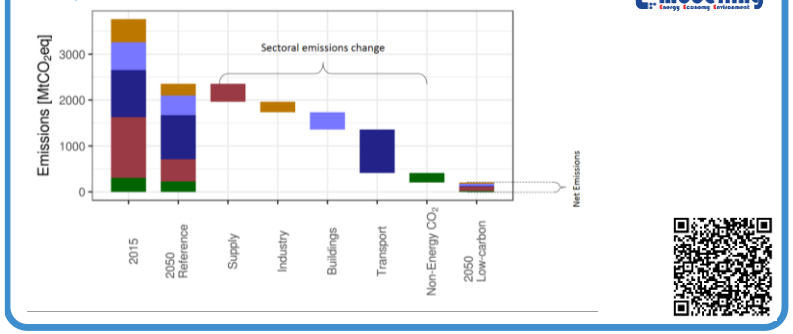
Canada



China



European Union



- 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:
https://themasites.pbl.nl/commit/products

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