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CENTER FOR INTEGRATED STUDIES ON CLIMATE CHANGE AND THE ENVIRONMENT - COPPE / UFRJ

COPPE UFRJ

Economic and Social Co-benefits and Costs of a Green Transformation in Brazil

Emilio Lèbre La Rovere
William Wills
Carolina Grottera

CentroClima/COPPE/UFRJ

Bonn

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Introduction

- Conventional thinking: low carbon pathways tend to jeopardize industrial competitiveness, reducing GDP and increasing unemployment

- The challenges:

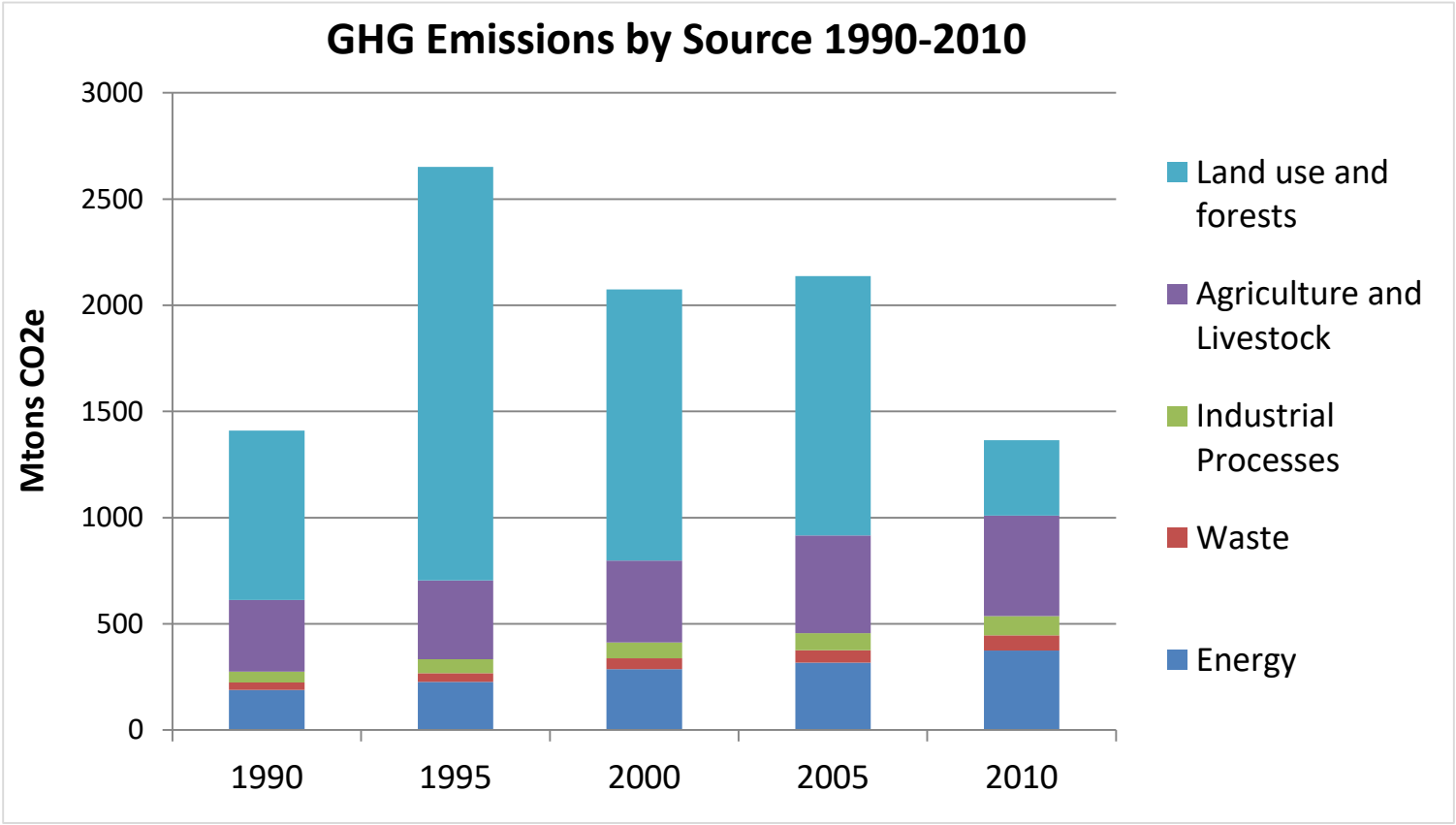
  - to illustrate the opportunity side of the transition to a low carbon economy

  - Requirements for overcoming the barriers and taking advantage of the opportunities

The Brazilian context

- Among the largest economies in the world
- Mid-range average GDP per capita
- Poverty, high income inequality, regional disparities
- Low population growth, highly urbanized
- Large natural resources basis

The Brazilian context



Clean energy mix (hydropower, biomass, wind, incipient solar)

Decreasing emissions from deforestation

Increasing emissions from cattle raising, agriculture and energy

Implications of low carbon pathways

- Economic implications of low-carbon scenarios: impacts on GDP, inflation, public debt, trade balance, energy-intensive industry competitiveness

- Social implications of low-carbon scenarios: employment, consumption of low-income classes, income distribution

- IES-Brasil project: studies of economic and social implications for Brazil of adopting low carbon scenarios

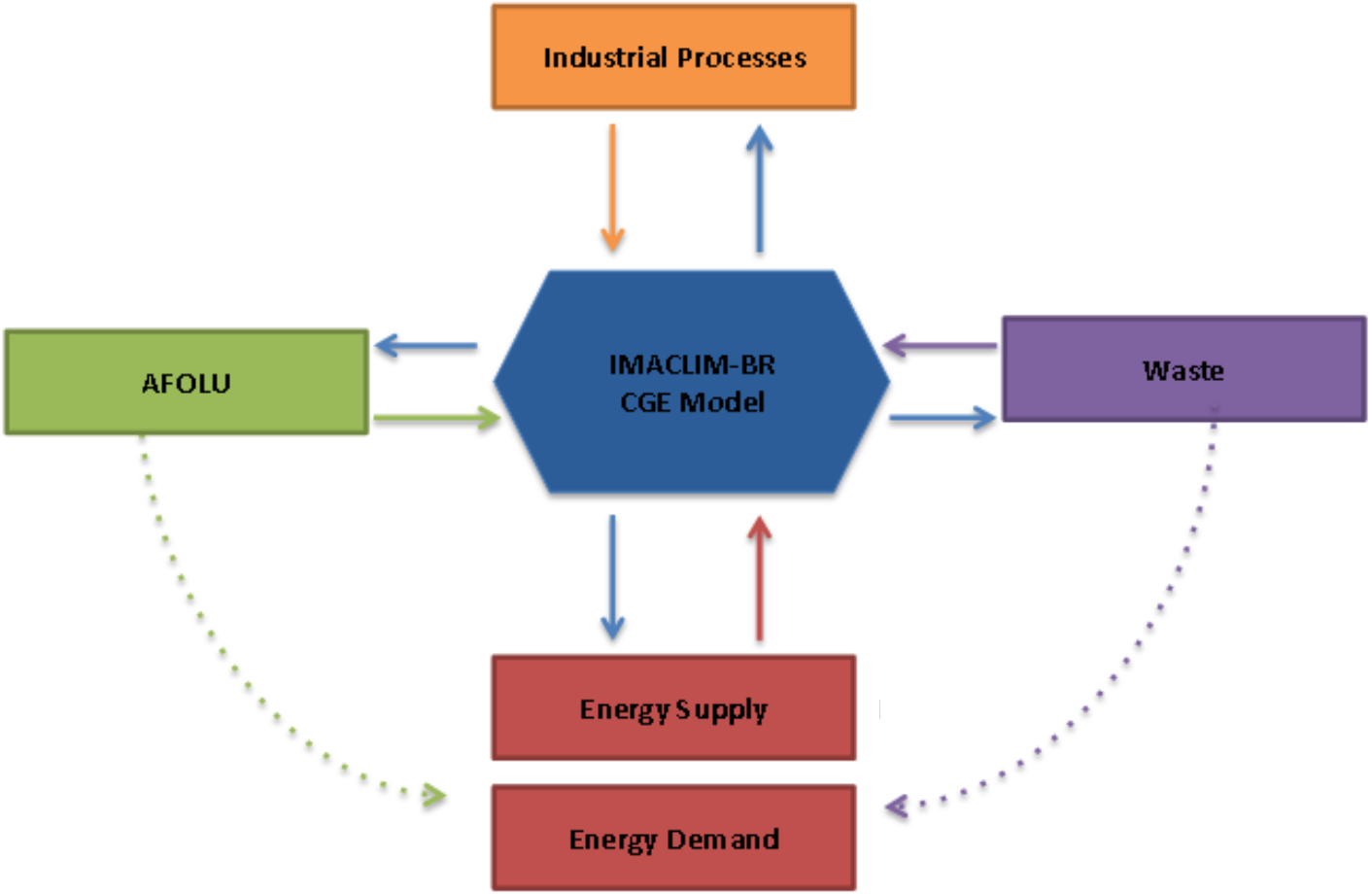
IES-Brasil Process: Dialogue with stakeholders

- **Scenario Building Team (SBT): experts from the government, private sector, academia and civil society**
- **Modelling team coordinated by Centro Clima**
- **The SBT is responsible for:**
  - **agreeing upon the scenarios´ general assumptions and**
  - **identifying mitigation measures adopted in the scenario simulations; estimating their viability and costs**

Methodology: the Imaclim-BR model

- A hybrid computable general equilibrium model:
- Double accounting top-down framework
  - monetary values + physical values (toe, tons, pass.km, tons.km)
- Up to 19 productive sectors:
  - 6 energy: biomass, oil, coal, natural gas, petroleum refining products, electricity
  - 7 industrial (steel, non-ferrous, cement, paper and pulp, chemicals, mining, other industrial sectors)
  - 2 transportation (passenger, load)
  - 4 other (agriculture, livestock, construction, services)
- Six income classes
- Interaction with bottom-up sectoral models

Modelling framework



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IES-Brasil 2030:

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Designing an iNDC for Brazil under the assumption of fast economic growth

Government Plan Scenario (GPS)

Measures already being implemented under the National Climate Change Plan (Copenhagen pledges)

Additional Mitigation 1 (AM1+T)

Expansion of measures considered in the GPS, plus additional measures

Global carbon tax of US$ 20/tCO_2

Additional Mitigation 2 (AM2+T)

Early implementation or expansion of measures from AM1, plus additional measures

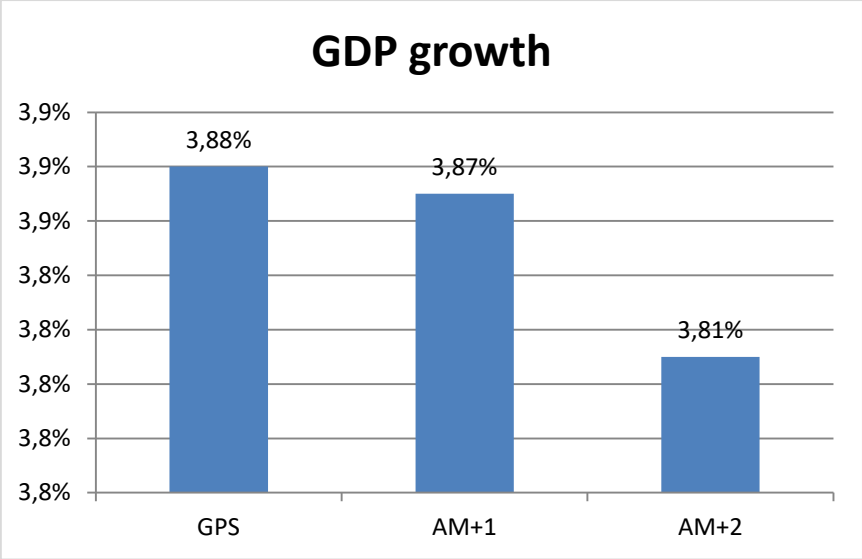
Global carbon tax of US$ 100/tCO_2

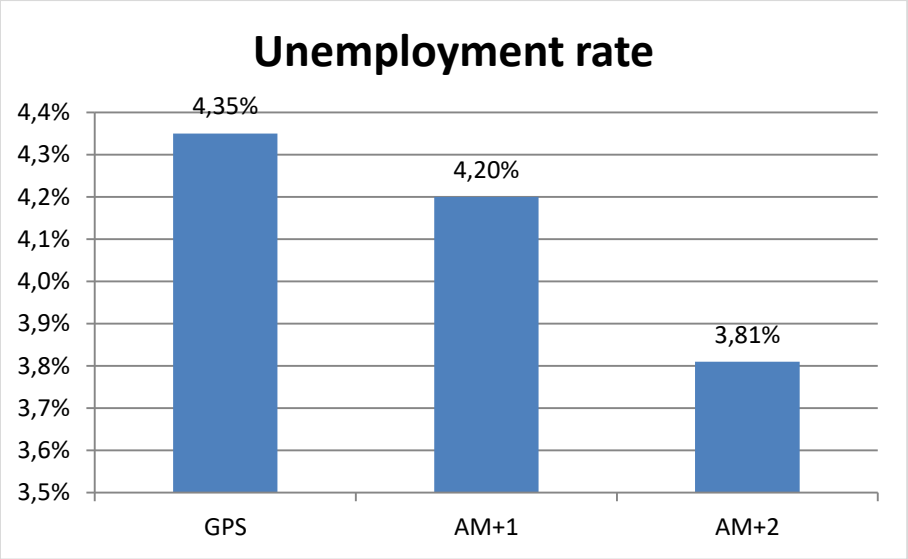
A domestic carbon tax on the combustion of fossil fuels starting at zero in 2005 and growing linearly until reaching 20 and 100 US$/ton of CO2e, in AM1+T and AM2+T, respectively, in 2030.

Carbon pricing schemes (taxes or cap&trade) adopted worldwide at similar levels

Carbon revenues of the domestic tax used to reduce payroll taxes, stimulating the creation of new jobs and offsetting the recessive effect of tax-induced price increases

IES-Brasil 2030: Results





In mitigation scenarios with a domestic carbon tax, GDP grows slightly less than in GPS

This is due to reduced economic activity: highest emitting sectors are affected by paying the carbon tax

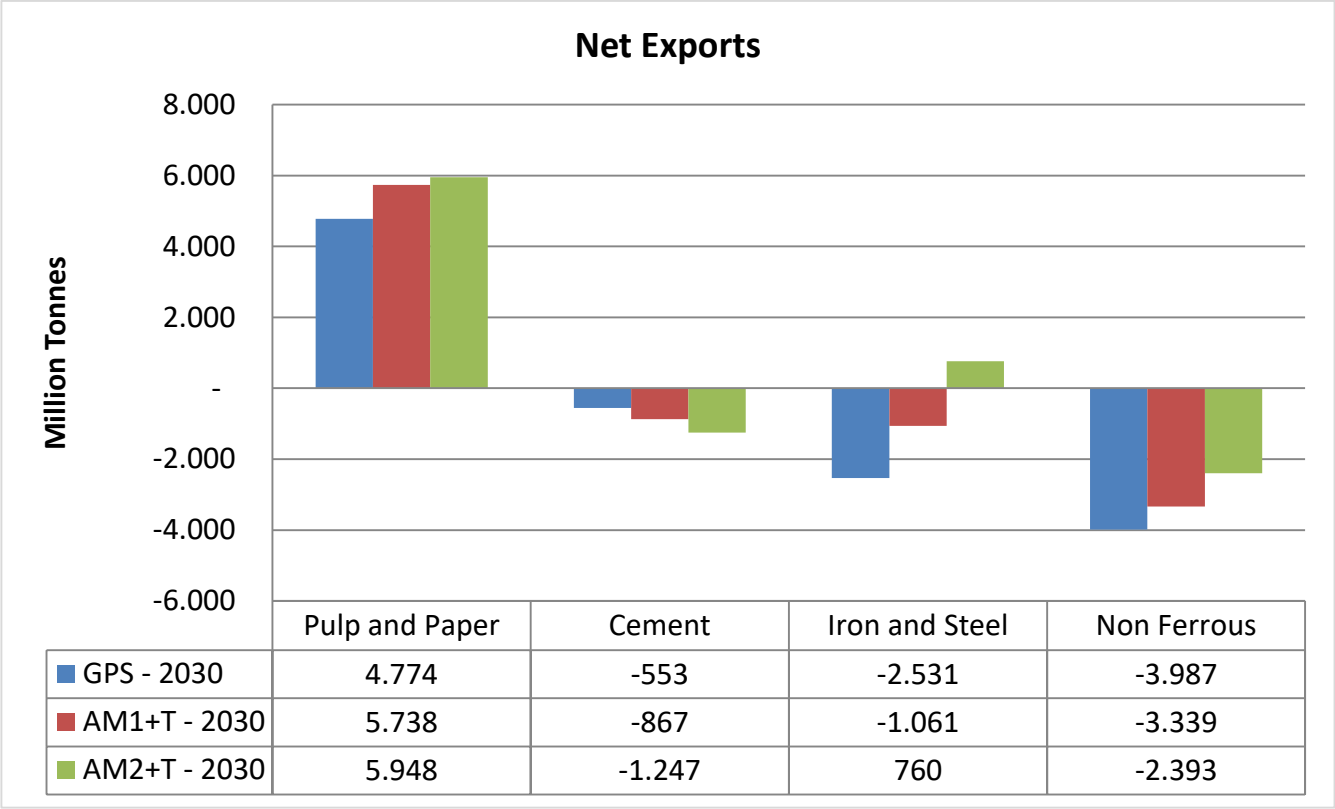
However, unemployment rates are slightly lower in scenarios with carbon tax

Revenues from the carbon tax offset the reduction of labour taxes, stimulating job creation

IES-Brasil 2030: Implications for industrial competitiveness

- If other G-20 countries also adopt a carbon price at the same level as Brazil, the competitiveness of the Brazilian energy-intensive industry would increase
- This is mainly due to the low carbon intensity of energy produced in Brazil compared to its main competitors
- Lower labour costs due to the exemption of payroll taxes also play a role
- This would cause a slowdown in the structural shift of Brazilian economy from industry to services as compared to GPS

IES-Brasil 2030: Implications for industrial competitiveness



	Pulp and Paper	Cement	Iron and Steel	Non Ferrous
GPS - 2030	4.774	-553	-2.531	-3.987
AM1+T - 2030	5.738	-867	-1.061	-3.339
AM2+T - 2030	5.948	-1.247	760	-2.393

- **Energy intensive industries have a competitive advantage over their international competitors**
- **Reduced imports of some sectors (e.g. non-ferrous metals) and increased exports of others (such as pulp and paper)**

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IES-Brasil 2050:

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Designing a new scenario for Brazil up to 2050 compatible with a 1.5°C target

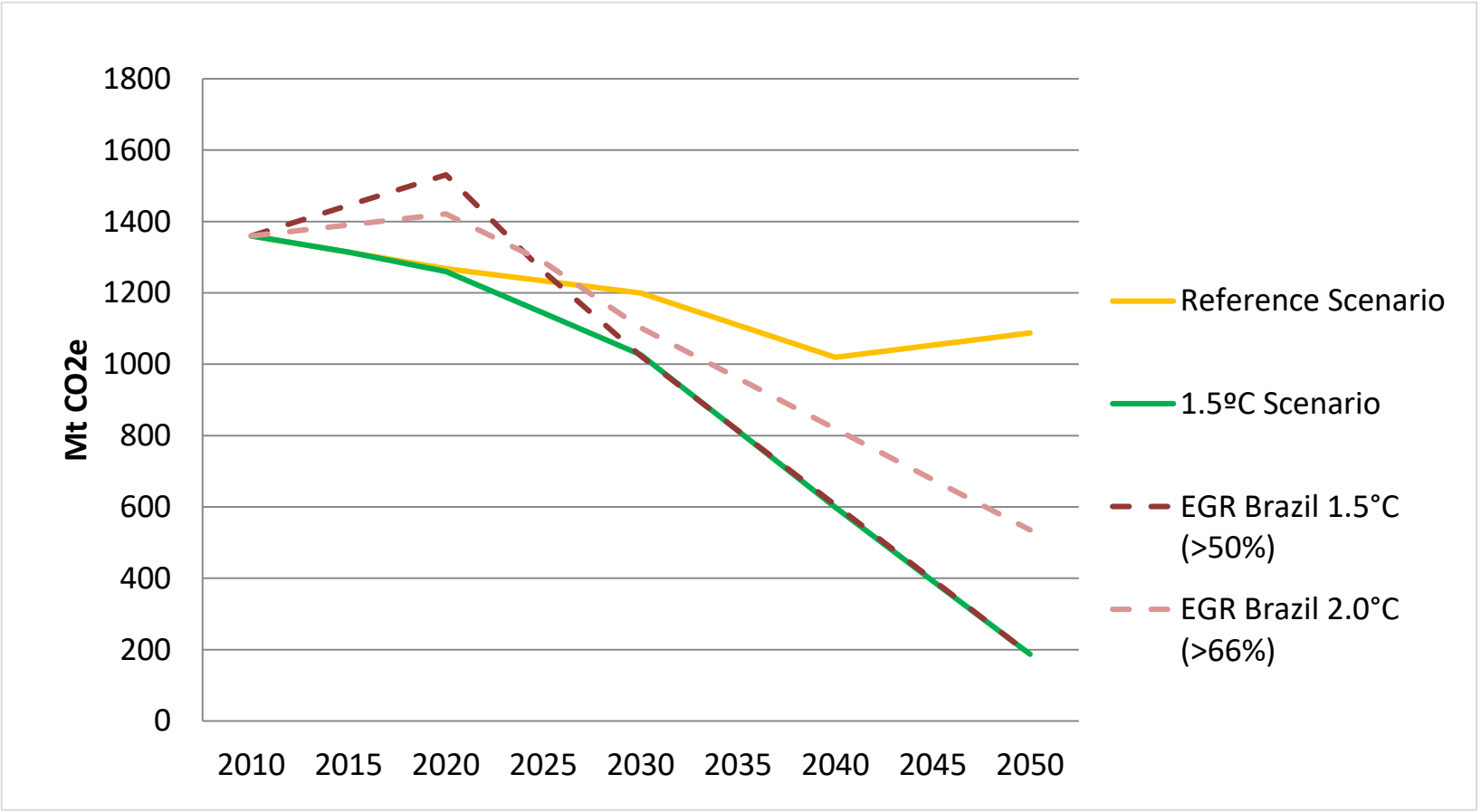
- Analogous to IES-Brasil 2030 regarding methodology and stakeholder engagement
- Extended timeframe up to 2050
- New Reference Scenario → significantly lower growth rates due to political economic crisis
- Not a business-as-usual scenario → incorporates the full implementation of Brazilian NDC up to 2030, and the continuity of mitigation policies from 2030 to 2050 with no further increase in ambition

IES-Brasil 2050:
The 1.5°C emissions pathway

		2030	2050
	World Population (millions)	8,501	9,725
	Brazilian Population (millions)	223	226
1.5°C target	World Emissions ($GtCO_2e$)	39	8
	World Emissions per capita (tCO_2e)	4.6	0.8
	Brazilian Emissions ($GtCO_2e$)	1.024	0.186

Source: Emissions Gap Report (UNEP, 2017)

IES-Brasil 2050:
The 1.5°C emissions pathway



IES-Brasil 2050:
The 1.5°C emissions pathway

- **Extensive additional mitigation measures:**
  - **High-efficiency biomass production and use**
  - **Renewable electricity generation**
  - **Electric vehicles and modal shifts towards railways and waterways in the transportation sector**
  - **Among others**

- **Along with a domestic carbon tax and recycling of tax revenues to reduce labour costs ensuring fiscal neutrality, but no similar carbon pricing schemes are assumed for trade competitors**

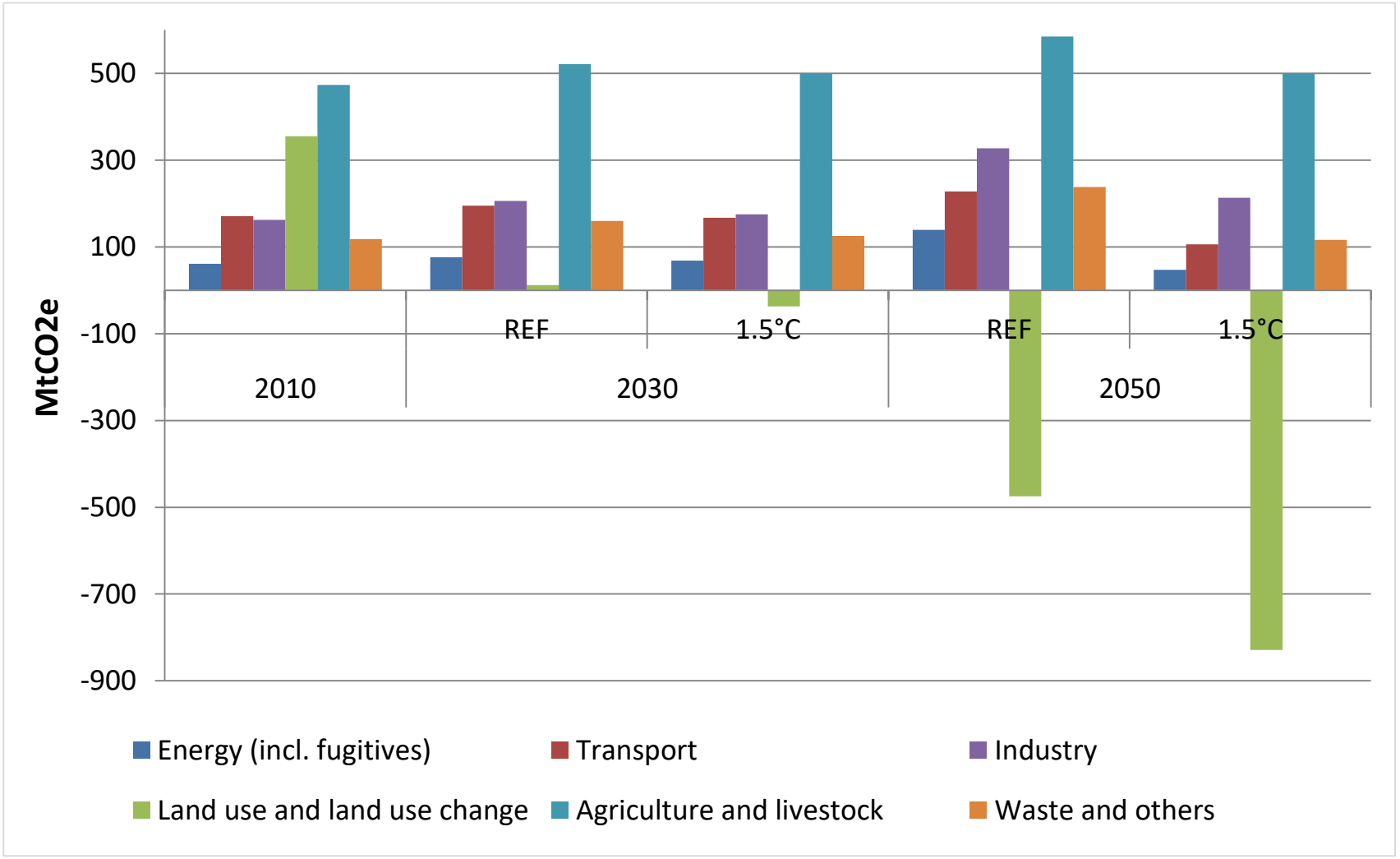
Year	2015	2030	2050
Carbon Tax (2015 US$/tCO2e)	0	100	100

IES-Brasil 2050: The 1.5°C emissions pathway

Cumulative GHG avoided emissions from 2021 to 2050

	2021-2030	2031-2050
AFOLU	**335.4**	**2,985.90**
Agriculture – low carbon practices	37.4	73.7
Cattle raising – efficiency gains	138.4	1,230.4
Expansion of economic planted forests (pellets included)	78.6	437.2
Native forest restoration	81	1,244.7
TRANSPORT	**46.8**	**653.5**
Modal shifts	15.6	157.4
Electric vehicles	18.1	393.3
Biofuels use	13.1	102.8
INDUSTRY	**123.9**	**855.3**
Processes and energy efficiency gains	107.3	734.7
Fuel shifts	16.6	120.7
WASTE	**195.9**	**1,493.9**
Solid waste management improvements	136.3	1,138.8
Waste water treatment improvements	59.6	355.1
ENERGY SUPPLY	**39**	**818.2**
Expansion of renewable sources	33.3	806.6
Reduction of fugitive emissions	5.7	11.6
TOTAL	**741**	**6,807**

GHG Emissions by Source in the 1.5°C emissions pathway



IES-Brasil 2050: Main economic implications

	Scenario	2005	2015	2030	2050
GDP (trillion 2015 USD)	REF	1.43	1.78	2.85	4.67
	1.5°C			2.82	4.62
Annual average GDP growth since 2005 (%)	REF	-	2.14%	2.79%	2.66%
	1.5°C			2.74%	2.64%
Total investments (trillion 2015 USD)	REF	0.22	0.29	0.50	0.87
	1.5°C			0.53	0.94
Full time jobs (millions)	REF	91.2	99.8	112.3	111.5
	1.5°C			111.2	110.7
Unemployment rate (%)	REF	9.9%	8.5%	8.3%	7.3%
	1.5°C			8.5%	7.4%
GDP per capita (thousand 2015 USD)	REF	7.75	8.71	12.80	20.67
	1.5°C			12.65	20.45
Accumulated price index since 2015 (%)	REF			8.8%	15.1%
	1.5°C			46.9%	42.0%
Cumulative investment in additional mitigation measures in 2021-2030 and 2031-2050 (billion 2015 USD)	REF			-	-
	1.5°C			35.9	634.9
Total GHG Emissions ($MtCO_2e$)	REF	2,838	1,662	1,200	1,088
	1.5°C			1,027	187
GHG Emissions per capita (tCO_2e/capita)	REF	15.3	8.1	5.4	4.8
	1.5°C			4.6	0.8
GHG Emissions per GDP unit (tCO_2e/million2015USD)	REF	1,979	936	420	233
	1.5°C			364	40

IES-Brasil 2050: Social impplications

Annual average per capita income per class (thousand 2015 USD)

	Scenario	2005	2015	2030	2050
Class 1 (10% poorest households)	REF	0.63	0.76	1.21	4.06
	1.5°C			1.21	4.03
	Variation to REF (%)			(-2.1%)	(-0.8%)
Class 2 (20% next)	REF	1.59	1.84	2.76	4.76
	1.5°C			2.73	4.73
	Variation to REF (%)			(-2.0%)	(-0.8%)
Class 3 (20% next)	REF	2.63	3.21	4.44	7.75
	1.5°C			4.35	7.68
	Variation to REF (%)			(-2.0%)	(-0.8%)
Class 4 (20% next)	REF	3.68	4.92	7.37	12.76
	1.5°C			7.21	12.67
	Variation to REF (%)			(-2.0%)	(-0.8%)
Class 5 (20% next)	REF	8.25	10.22	14.10	21.37
	1.5°C			13.84	21.21
	Variation to REF (%)			(-1.9%)	(-0.8%)
Class 6 (10% richest households)	REF	33.81	38.89	52.67	84.06
	1.5°C			51.87	83.43
	Variation to REF (%)			(-1.5%)	(-0.7%)

IES-Brasil 2050:
Implications for industrial competitiveness

- In 1.5°C scenario, additional costs from mitigation measures and carbon pricing lead to high increase in the price index
  - If other G-20 countries don't strongly commit to mitigation with similar ambition, price index in Brazil would grow faster than in G-20 countries
  - Brazilian competitiveness would be strongly jeopardized

- Under a strong global commitment to reduce emissions, price index in Brazil is expected to grow less than in other countries
  - Brazil has great mitigation potential at low costs
  - High share of renewable energy compared to main competitors, especially in industrial sector
  - Brazilian economy would become more competitive

Conclusions

- The transition to a low carbon economy can be done with only minor negative economic and social implications in the Brazilian case if appropriate policies are pursued (e.g. ensuring the fiscal neutrality of carbon taxes through recycling of its revenues to reduce labor costs)

- Under low GDP growth rates and with a long period of a high carbon price the negative social impacts may be slightly regressive, requiring appropriate compensation measures to protect the poor

- Even with a great mitigation potential at low costs the challenge of financing the additional investment required in low carbon scenarios is huge due to much higher upfront costs, requiring: appropriate regulatory framework to reduce risks of investing in low carbon infrastructure; and access to capital markets at fair conditions

- International cooperation is required to stimulate emerging economies like Brazil to embark on the transition to a low carbon economy