

Linking climate targets and development goals:
Macroeconomic and social aspects of INDC implementation in Brazil

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MILES project Final event

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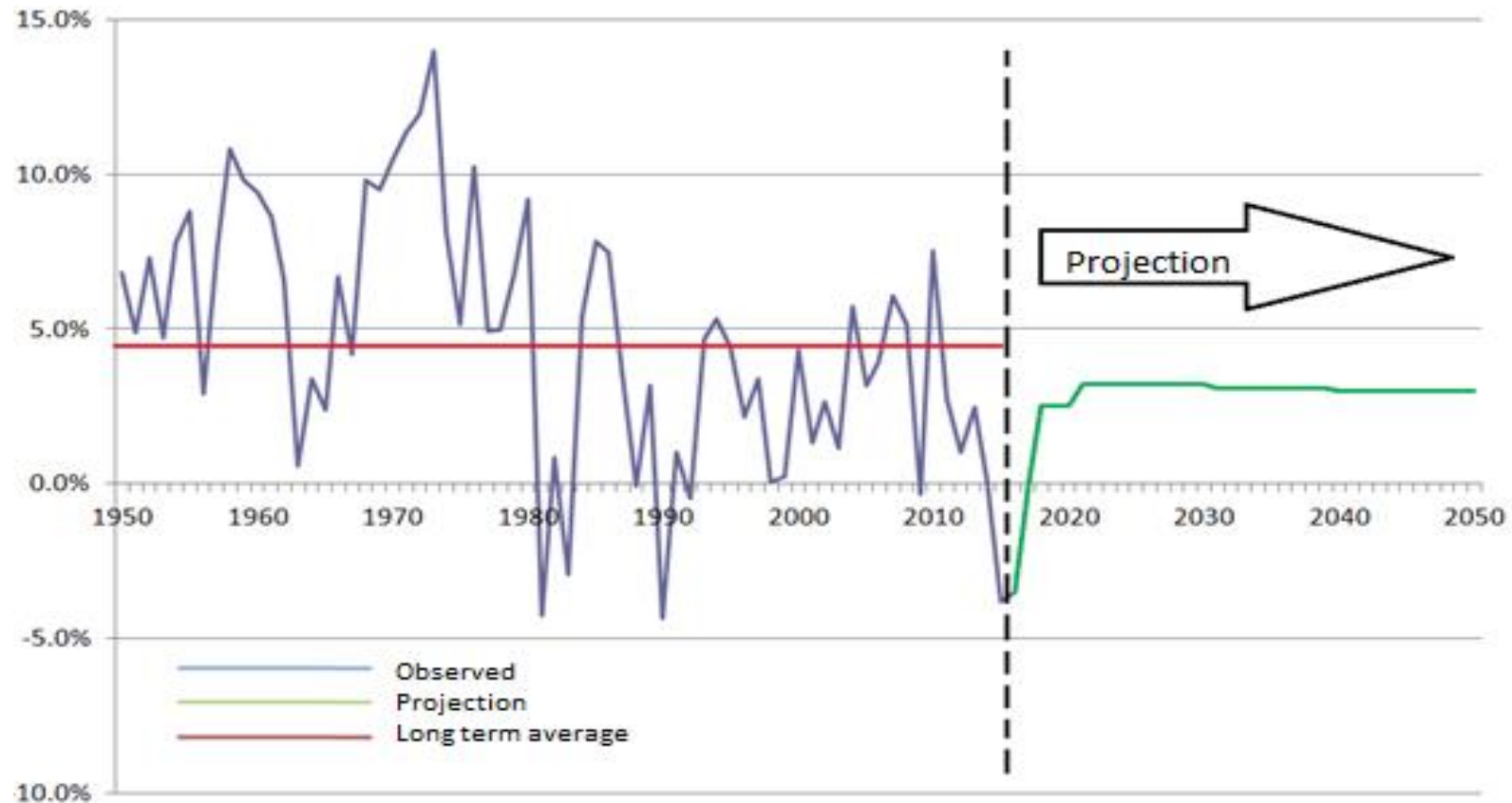
New Governmental Plan Scenario: NDC Implementation



- Brazilian NDC is quite ambitious, targeting a 43% reduction of absolute GHG emissions level in 2030 compared to 2005.
- The development of new deep decarbonization scenarios for Brazil, beyond 2030 up to the middle of the century is key to keep the country's GHG emission pathway in line with the Paris agreement.
- The macroeconomic reference scenario was based on the long-term Governmental Energy Plan (PNE 2050), but with a less optimistic economic growth projection.
- This is not a baseline scenario, but already a mitigation scenario, which includes mitigation policies through the implementation of sectoral mitigation plans to achieve iNDC targets presented in Paris during COP21 up to 2030.
- From 2030 to 2050 no additional mitigation effort is assumed, just the extension of current policies up to 2050.



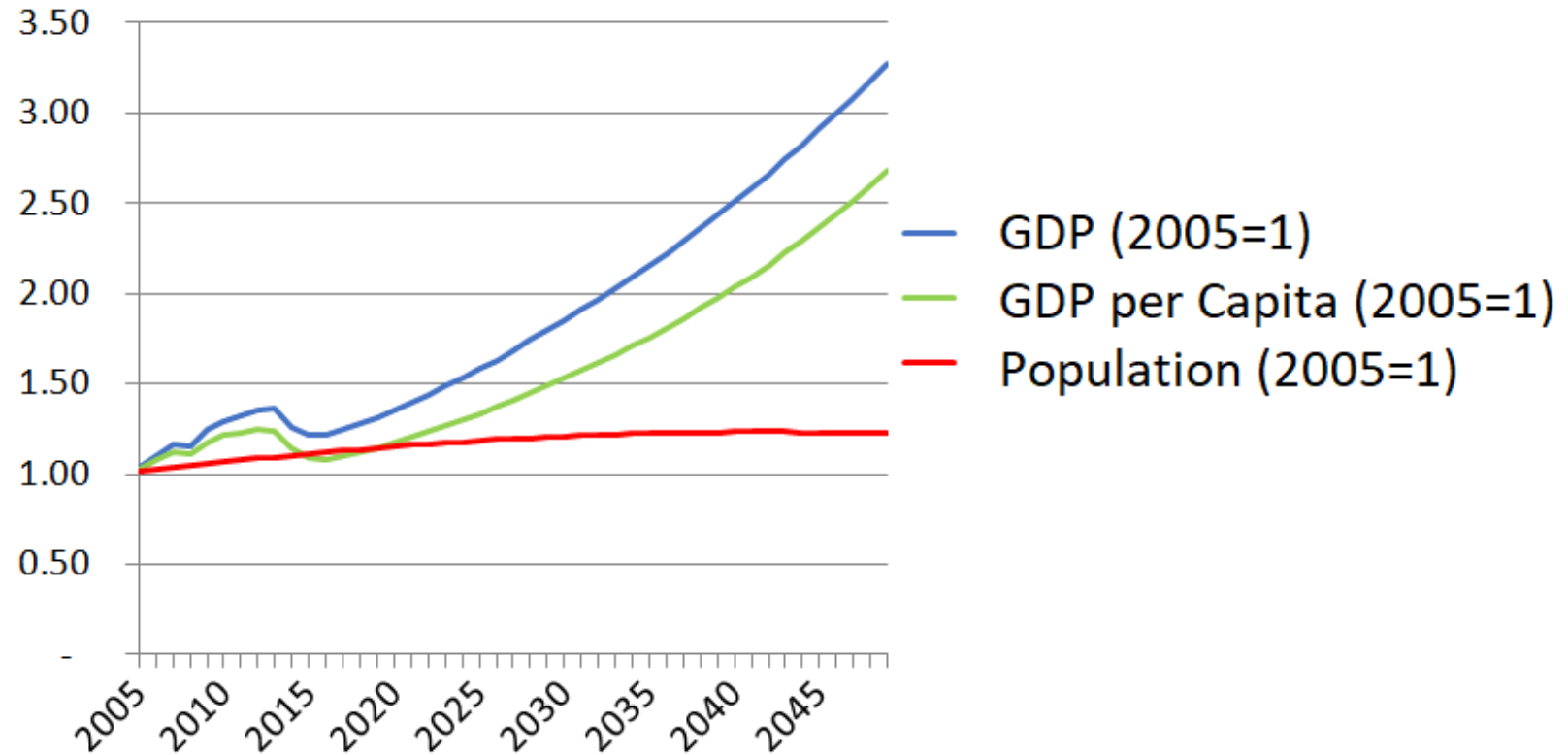
- GDP growth per year: Observed, long term average and projection





- GDP Growth:
 - Short term: Recovery from major economic crisis
 - Long term: review of long term economic potential

Period	GDP growth per year(%)
2010-2014	2.2%
2015	-3.8%
2016	-3.5%
2017	0%
2018-2020	2.5%
2021-2030	3.2%
2031-2040	3.1%
2041-2050	3.0%

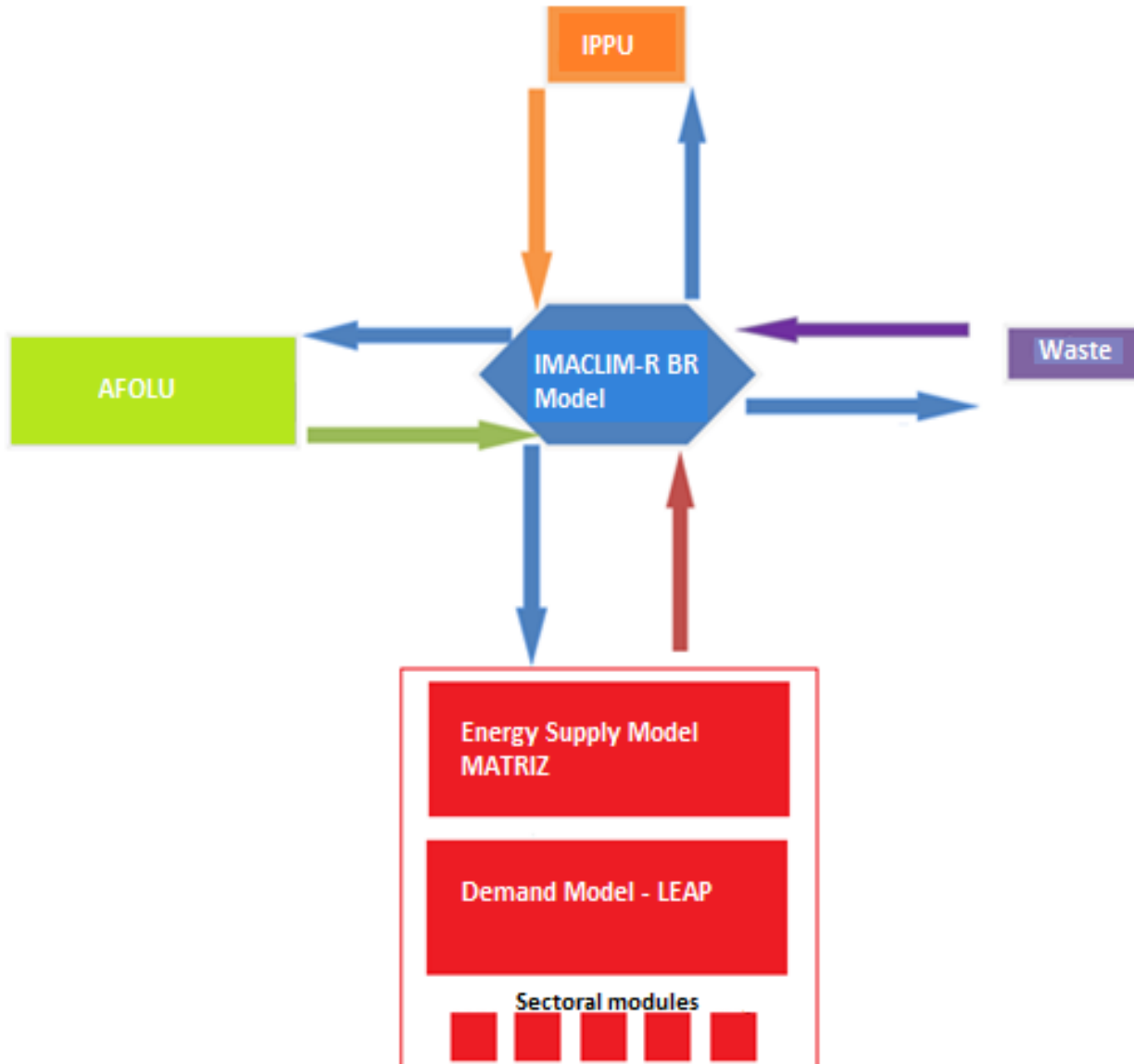




- According to the Emissions Gap Report (UNEP, 2016), a 50% probability to achieve a 1.5°C target requires global GHG emissions to be limited to 8 GtCO₂e in 2050, in a world with average GHG emissions per capita of 0.82 tons of CO₂e.
- As Brazilian population will reach 226 million people in 2050, hence in the New Brazil 1.5°C scenario Brazilian GHG emissions were limited at 186 MtCO₂e in 2050 to be consistent with this 1.5°C global GHG emissions pathway.
- With the same initial GDP growth assumption as in the GPS, we have added extensive additional mitigation measures along with a carbon tax :
 - High-efficiency biomass production and use, green electricity generation, electric vehicles, and modal shifts towards railways and waterways in the transportation sector.
 - Carbon tax values (fiscal neutrality assumed, recycling of tax revenues to reduce labour costs)

Year	2015	2020	2030	2040	2050
Carbon Tax (2015 US\$/tCO ₂ e)	0	33	100	150	200

Modelling Framework: IMACLIM-BR + sectoral modules



IMACLIM-R BR: Hybrid CGE model

MATRIZ: Energy optimizing model

LEAP: Puts together energy demands and build up an Energy Balance

AFOLU: Simulation model (spreadsheet)

WASTE: Simulation model (spreadsheet)

IPPU: LEAP

Transport: Simulation model (detailed spreadsheet)

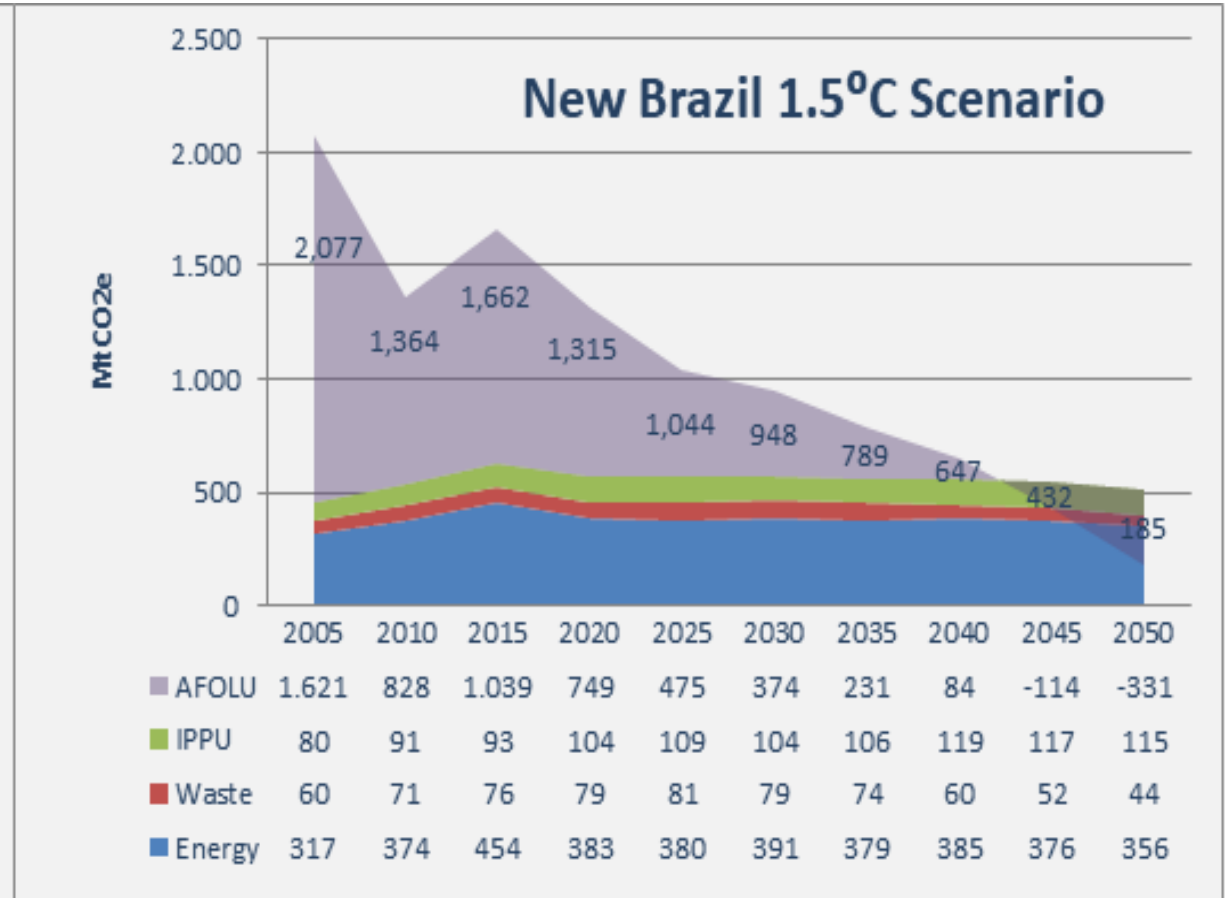
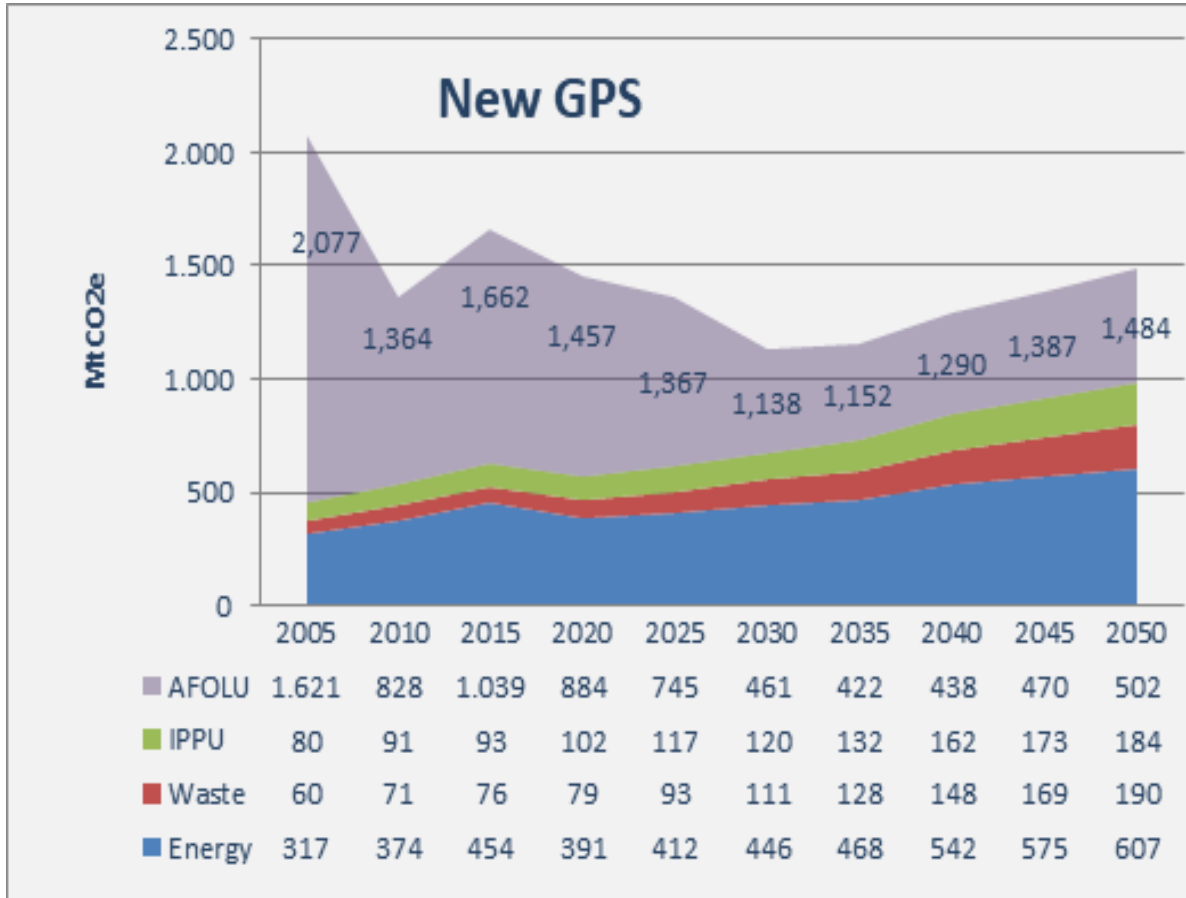
Other sectors: LEAP



Additional investment requirements – using a 8% p.y. discount rate

Sector	Mitigation options	2021-2030 (2021 present value)	2031-2050 (2031 present value)
AFOLU	<ul style="list-style-type: none"> - Commercial forests - Native forest restauration - Biological nitrogen fixation in crops - Zero-tillage systems - Improvements in cattle raising practices 	43.152	126.478
Renewable Energy	<ul style="list-style-type: none"> - Increased production of ethanol for light-duty vehicles - Increased production of biodiesel for heavy-duty vehicles - Increased production of biokerosene for air transportation - Increased production of biooil for water transportation - Expansion of renewable sources in power generation, reaching 100% in 2050 	(1.793)	(16.851)
Energy and Process Efficiency	<ul style="list-style-type: none"> - Efficiency gains in load transportation - Efficiency gains in passenger transportation (light-duty and heavy-duty vehicles) - Cross-cutting energy efficiency improvements in industry - Cross-cutting process efficiency improvements in industry - Reduction of fugitive emissions in the E&P sector 	55.218	400.211
Upgrades in Fleet and Infrastructure and Modal Shifts in Transportation	<ul style="list-style-type: none"> - Rail electrification - Expansion of rail passenger transportation - Increased penetration of electric and hybrid light-duty vehicles - Increased penetration of electric and hybrid heavy-duty vehicles in load transportation - Increased penetration of electric and hybrid heavy-duty vehicles in passenger transportation 	154.587	463.333
Waste	<ul style="list-style-type: none"> - Methane capture and destruction in solid waste treatment plants - Methane capture and destruction in sewage treatment plants - Methane capture and destruction in industrial waste treatment plants 	9.450	76.044
Total		260.614	1.049.214

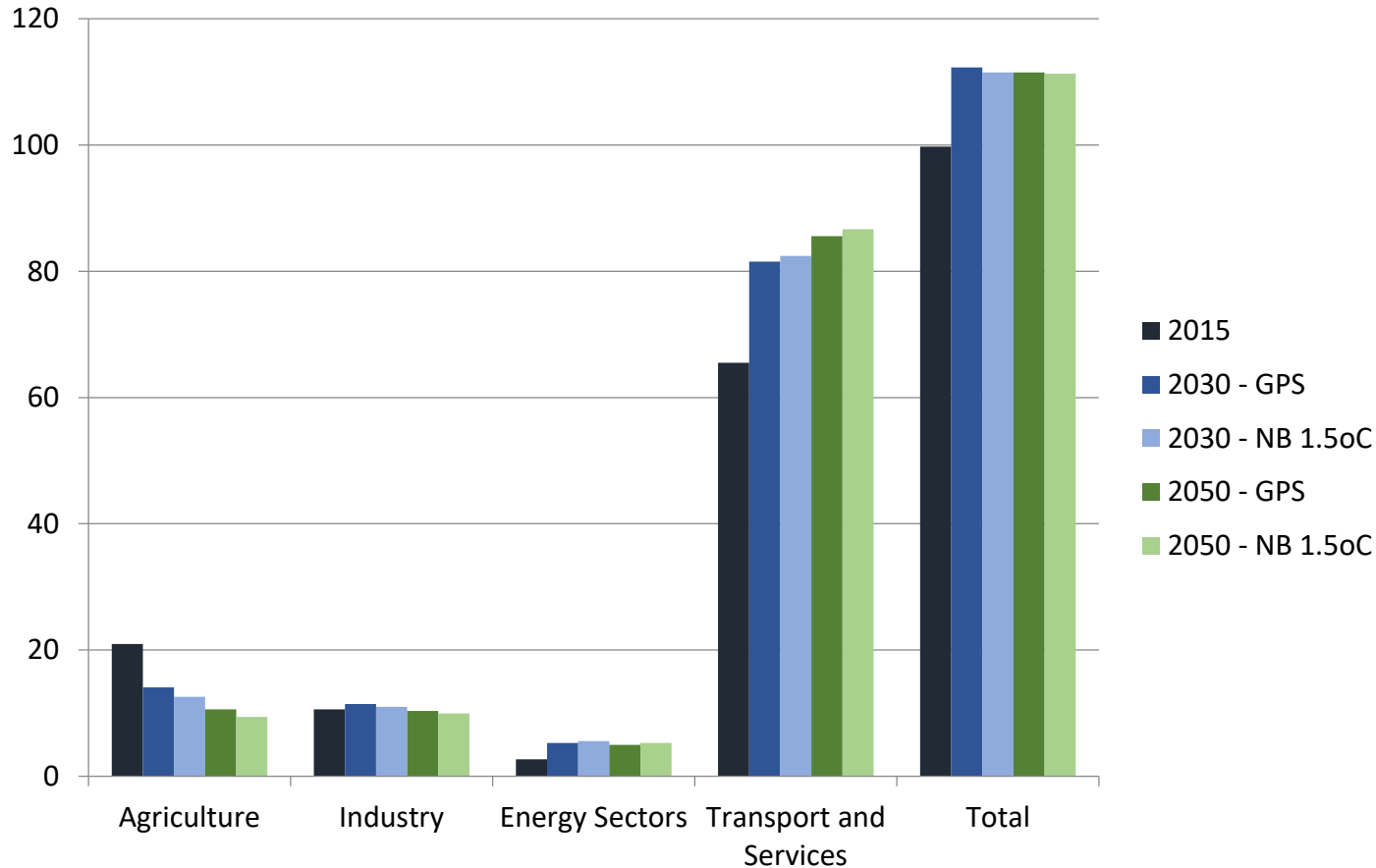
Scenarios Comparison: GHG Emissions





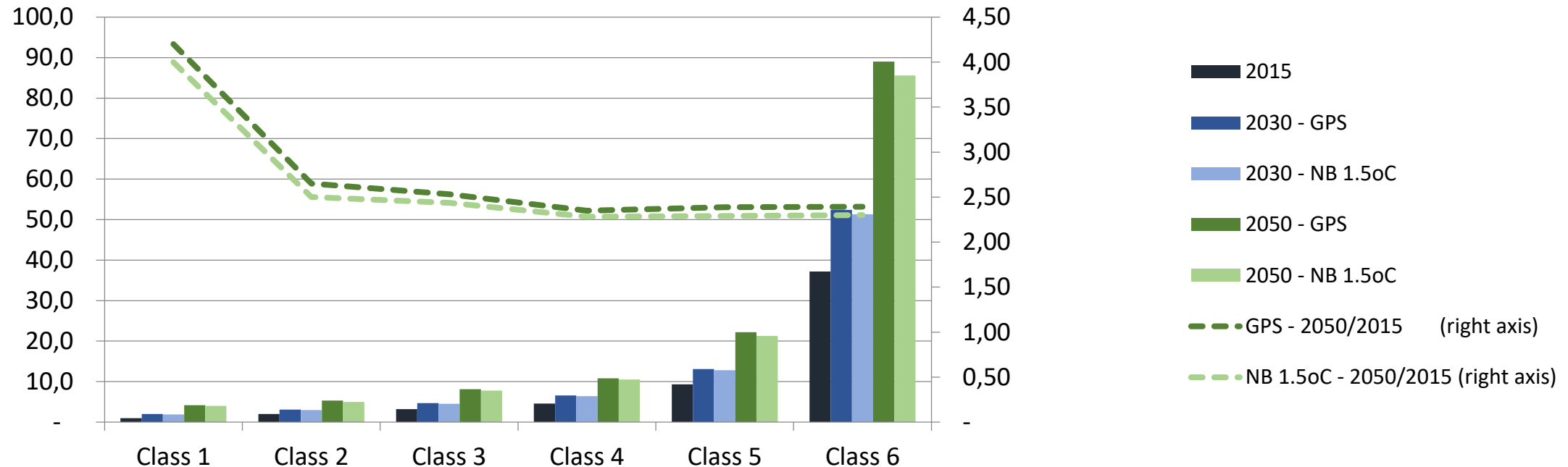
	Scenario	2005	2015	2030	2050
Population (million)		185	204	223	226
GDP (trillion 2015 USD)	GPS	1.43	1.78	2.75	4.72
	NB 1.5°C			2.69	4.54
GDP annual average growth (% per year, from 2005)	GPS	-	2.14%	2.95%	2.73%
	NB 1.5°C			2.72%	2.65%
GDP per capita (thousand 2015 USD)	GPS	7.75	8.70	12.32	20.89
	NB 1.5°C			12.06	20.10
Full time jobs (million)	GPS	91.2	99.8	112.3	111.5
	NB 1.5°C			111.5	111.3
Unemployment rate (%)	GPS	9.9%	8.5%	8.3%	7.3%
	NB 1.5°C			8.4%	7.4%
Total investment (trillion 2015 USD)	GPS	0.22	0.29	0.42	0.75
	NB 1.5°C			0.45	0.86
Investment rate (% of GDP)	GPS	15.5%	16.4%	15.2%	15.8%
	NB 1.5°C			16.8%	18.9%
Trade balance (billion 2015 USD)	GPS	52.70	76.83	71.75	146.35
	NB 1.5°C			0.83	70.79
Trade balance (% of GDP)	GPS	3.7%	4.3%	2.6%	3.1%
	NB 1.5°C			0.03%	1.50%
Total GHG emissions (Gt CO₂e)	GPS	2.08	1.66	1.14	1.48
	NB 1.5°C			0.95	0.19

Scenarios Comparison: Number of full time jobs by economic sector (Millions)



Sector		2005	2015	2030	2050
Agriculture and Livestock	GPS	19.0	21.0	14.1	10.5
	NB 1.5°C			12.6	9.5
Industry	GPS	9.7	10.6	11.4	10.3
	NB 1.5°C			11.0	10.3
Energy sector	GPS	2.8	2.7	5.3	5.0
	NB 1.5°C			5.5	5.3
Transport and services	GPS	59.7	65.5	81.6	85.6
	NB 1.5°C			82.4	86.6
Total	GPS	91.2	99.8	112.3	111.5
	NB 1.5°C			111.5	111.3

Scenarios Comparison: Household income, per income class, in GPS and New Brazil 1.5°C Scenario (in constant thousand USD of 2015)



	2015	2030 – GPS	2030 - NB 1.5oC	2050 – GPS	2050 - NB 1.5oC	GPS - 2050/2015 (right axis)	NB 1.5oC – 2050/2015 (right axis)
Class 1 (10% poorer)	1.0	2.0	1.9	4.2	4.0	4.20	4.00
Class 2 (20% next)	2.0	3.1	3.0	5.3	5.0	2.65	2.50
Class 3 (20% next)	3.2	4.7	4.5	8.1	7.8	2.53	2.44
Class 4 (20% next)	4.6	6.6	6.4	10.8	10.5	2.35	2.28
Class 5 (20% next)	9.3	13.1	12.8	22.2	21.3	2.39	2.29
Class 6 (10% richer)	37.2	52.4	51.3	89.0	85.6	2.39	2.30



- Evolution of selected indicators (2005=1)

