TASK FORCE ON CLIMATE, DEVELOPMENT AND THE INTERNATIONAL MONETARY FUND

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Fiscal Impact Estimates of a Net-Zero Emissions Transition for Major Hydrocarbon Producers in Latin America and the Caribbean

THE PLURINATIONAL STATE OF BOLIVIA, BRAZIL, COLOMBIA, ECUADOR, MEXICO AND TRINIDAD AND TOBAGO[1]

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ABSTRACT

For major hydrocarbon producers in Latin America and the Caribbean (LAC) the net-zero emissions (NZE) transition will be particularly challenging as changes in energy production are also accompanied with falling fiscal revenues and additional investment needs to transform the productive structure and the energy matrix. Hydrocarbon producers with less diversified economies will face exceptionally large investment needs at a moment of increasing fiscal vulnerability. This paper examines the fiscal impacts of an NZE transition on major hydrocarbon producers in LAC6 countries—the Plurinational State of Bolivia, Brazil, Colombia, Ecuador, Mexico, and Trinidad and Tobago. It finds carbon taxes for most LAC6 countries would provide little relief from plummeting hydrocarbon revenues. To maintain a sustainable debt path in an NZE transition and achieve sustainable and inclusive development, it will be crucial to strengthen the capacity of hydrocarbon producers to mobilize domestic and external resources. At the national level, efforts need to be made to bolster tax revenues and strengthen fiscal frameworks for non-renewable natural resources. At the same time, these efforts must be accompanied by increased access to low-cost external financing from multilateral lending institutions, including the International Monetary Fund (IMF), with instruments that incorporate a medium- and long-term climate change and development perspective.

Keywords: Latin America and the Caribbean, Net-zero emissions scenarios, Fossil fuel exports, Hydrocarbon producers, Green transitions

TCD IMF

The Task Force on Climate, Development and the IMF is a consortium of experts from around the world utilizing rigorous, empirical research to advance a development-centered approach to climate change at the IMF. The Task Force believes it is imperative the global community support climate resilience and transitions to a low-carbon economy in a just manner, and the IMF's role in supporting a globally coordinated response is vital.

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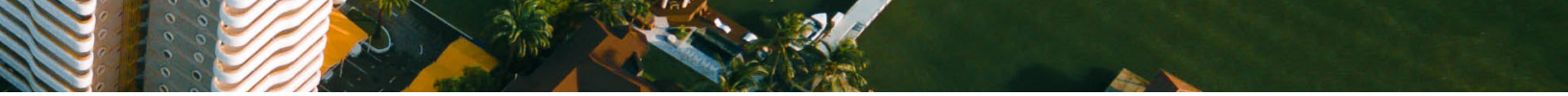
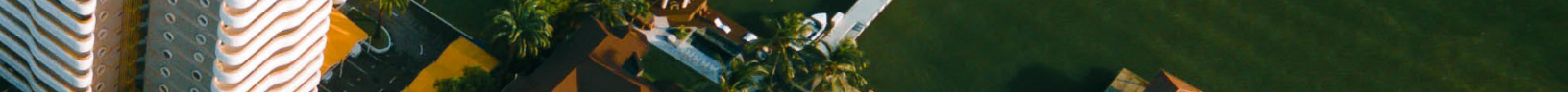


TABLE OF CONTENTS



INTRODUCTION

Hydrocarbon producing countries will face important fiscal challenges to reduce greenhouse gas emissions in line with the Paris Agreement on Climate Change and then move to an net-zero emission (NZE) scenario. Efforts taken to reduce these emissions will lower demand for fossil fuels globally and result in falling production volumes and decreased prices. This will lead to falling export volumes and values that may generate pressures on the balance of payments. On the fiscal side, revenues from hydrocarbon exploration and production (up-stream activities)—royalties, corporate income tax (CIT) and other revenues—will decline, as well as revenues from excises on the consumption of fossil fuels. This will result in tighter fiscal space, complicating efforts to finance public investment at a time when new investments are needed to adjust the energy matrix and productive structure. Thus, fossil fuel producing countries will face mounting pressures to increase public revenues in order to make up for lost hydrocarbon related revenues, finance their NZE transition and respond to growing social and investment needs.

However, the complexity of the NZE transition will be determined by the degree of fiscal dependence on hydrocarbons. While the International Energy Agency (IEA) (2021) and the International Monetary Fund (IMF) (2021a) suggest a transition to NZE characterized by a short-term potential boon for economic activity arising from the twin effects of green fiscal stimulus and carbon pricing, followed by relatively subdued negative impacts in the longer term, these assumptions may be hard to achieve. In the case of Latin America and the Caribbean, large hydrocarbon producing countries such as the Plurinational State of Bolivia, Brazil, Colombia, Ecuador, Mexico, and Trinidad and Tobago—from now referred as LAC6—face a macro-fiscal context that was exacerbated by the COVID-19 pandemic and is not necessarily conducive to the IEA and IMF central NZE transition scenario.

For LAC6 hydrocarbon producers, the impact of the energy transition on public revenues will be substantial and public investment requirements will increase substantially. Hydrocarbon related revenues range from 2.2 percent of gross domestic product (GDP) to 24.2 percent of GDP in these countries. While hydrocarbon related activities represent between 1.0 percent and 12.5 percent of economic activity and between 5.9 percent and 49.1 percent of exports by value. The NZE transition will require LAC6 countries to step up internal efforts to strengthen their fiscal frameworks, improve the level of revenue collection and its structure of their revenue collection and dedicate more public spending towards green and sustainable infrastructure to promote the decarbonization of its energy sector. However, this will be a fiscal challenge in a region marked by low investment levels, both public and private, and marked fiscal constraints.

A key challenge for LAC6 countries is building the fiscal capacity to support pro-growth development-centered fiscal policies. A strategic approach to public expenditure is key to ensuring that public resources are channeled to programs with high economic, social and environmental returns. Likewise, public investment must be aimed at appropriate and quality projects that are employment-intensive, gender-equitable and that support fundamental changes in the productive structure. Supporting such a fiscal policy framework will require efforts to improve domestic resource mobilization. There is ample room to improve

tax collection in the region. In the short-term, efforts should target reducing evasion and reviewing costly tax expenditure. Moving to the medium-term, a new generation of tax policies are needed, which strengthen direct taxation.

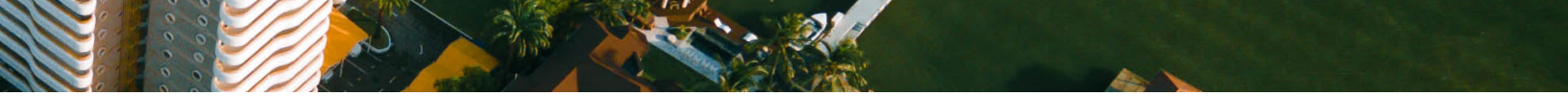
Efforts at the national level must be accompanied by further financing from multilateral institutions, such as the IMF, to ensure that LAC6 countries can accommodate fiscal demands and development needs during the NZE transition. Precautionary financing from the IMF will be particularly helpful for LAC6 countries as they potentially face strong fiscal distress during the NZE transition due to dual fiscal shocks as hydrocarbon related revenues fall and investment requirements increase. Furthermore, flexibility in the use of IMF resources, along with long-term financing programs, should be a key component of precautionary NZE financing for LAC6 and other fiscally distressed hydrocarbon producers. Hydrocarbon producing countries would be well served with access to IMF resources and programs that consider the uniqueness of their situation.

OVERVIEW OF THE PARIS AGREEMENT AND NATIONALLY DETERMINED CONTRIBUTIONS

In 2020, as the second commitment period of the Kyoto Protocol ended, the application of the Paris Agreement on Climate Change (PACC) began. The PACC's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century from reaching 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C. Following the PACC, the signatory countries announced their commitments for reducing carbon emissions. The PACC requires each nation to establish and communicate their own climate actions, known as Nationally Determined Contributions (NDCs), for the fulfillment of global goals. Such goals are ambitious and require funding. So far, the low flow of global investment available to achieve the commitments presents a complicated context for achieving the PACC goals.

The NDCs will define whether the world will achieve the goals for 2030 and 2050 set by the Paris Agreement. The actions established by the NDCs are based on the idea of equity and implemented through the lens of sustainable development. Every five years, the signatories submit an update of their NDCs to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat. With the purpose of enhancing the efforts to tackle climate change, the Paris Agreement states that successive NDCs need to represent a progression compared to the previous actions and must reflect the highest possible ambition (UNFCC, 2016). The 26th United Nations Conference on Climate Change (COP26) concluded with almost 200 countries supporting the Glasgow Climate Pact and committing to strengthen their efforts to limit the increase in global temperature to 1.5°C. COP26 was also incorporated a focus on reducing methane emissions, a powerful greenhouse gas associated with oil and gas, waste, and agricultural industries. As a result, over 100 countries signed the Global Methane Pledge to reduce global methane emissions by 30 percent by 2030.

Climate action focused on reducing the use of carbon intensive sources to produce energy, such as coal and hydrocarbons, is a key element to achieve the PACC goals. Today, the energy sector accounts for 73 percent of the total CO_2 emissions (Ritchie, H and Roser, M.,



2020). According to the Glasgow Climate Pact, "developed countries have made progress towards delivering the $100 billion climate finance goal and will reach it by 2023 at the latest." At COP26, 34 countries and five public finance institutions committed to ending new direct public support for international fossil fuel extraction and the unabated fossil fuel energy sector by the end of 2022. This will free up an estimated $24 billion a year to flow into clean energy and will avoid burdening countries with stranded assets.

NDCs submitted by LAC6 countries are mixed in their ambitions. Brazil, Colombia and Mexico have adopted unconditional targets that commit each to significant reductions in their emissions with respect to a business-as-usual (BAU) scenario, or in the case of Brazil, compared to a benchmark year (Table 1). Trinidad and Tobago has adopted an unconditional emissions target restricted to public transportation. In contrast, the Plurinational State of Bolivia and Ecuador have indicated their intention to improve the composition of the energy matrix, by increase the share attributable to renewable sources. Despite the variations in commitments, LAC6 countries that are principally oil producers also adopted the Global Methane Pledge, which marked a milestone as oil extraction activities are often accompanied by large methane emissions. Several LAC6 countries have also adopted climate change or carbon reduction strategies, for example the Low-Carbon Development Strategy in Colombia, the National Climate Change Strategy in Ecuador, the Climate Change Law in Mexico and the Carbon Reduction Strategy in Trinidad and Tobago.

TABLE 1 LAC6: NDC commitments and membership in the Global Methane Pledge

Country	NDC	Greenhouse gas (GHG) emissions target		Non-GHG target	Global Methane Pledge member
		Unconditional	Conditional		
Bolivia (Plurinational State of)	First submission, 10 May 2016	N/A	N/A	Increased participation of renewable energy to 79 percent by 2030 from 39 percent in 2010.	No
Brazil	Second submission, 12 August 2020	Reduce greenhouse gas emissions by 37 percent below 2005 levels in 2025, and by 43 percent below 2005 levels in 2030.	N/A	N/A	Yes
Colombia	Second submission, 29 December 2020	Cap emissions at a maximum of 169.44 MtCO2e in 2030 (equivalent to 51 percent reduction compared to BAU) and reduce black carbon emissions by 40 percent compared to 2014 in 2030.	N/A	N/A	Yes

(continued)

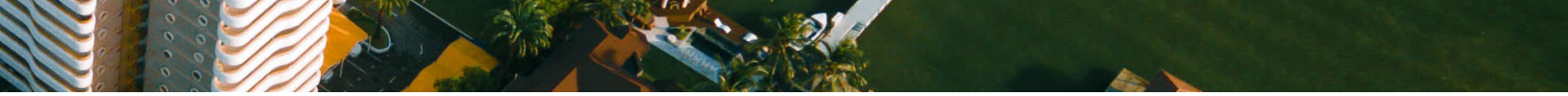
TABLE 1 LAC6: NDC commitments and membership in the Global Methane Pledge

Country	NDC	Greenhouse gas (GHG) emissions target		Non-GHG target	Global Methane Pledge member
		Unconditional	Conditional		
Ecuador	First submission, 29 March 2019	N/A	N/A	Aims to achieve 90 percent clean energy from hydropower in total electricity production by 2017 and increase the share of renewable energy in the energy matrix further until 2025.	Yes
Mexico	Second submission, 29 December 2020	Reduce GHG emissions by 22 percent and 51 percent of Black Carbon emissions by 2030, compared to BAU scenario.	Reduce GHG emissions by 36 percent and 70 percent of Black Carbon emissions depending on the availability of resources to finance implementation	N/A	Yes
Trinidad and Tobago	First submission, 22 February 2018	Reduce GHG emissions by the public transportation sector by 30 percent compared to a business as usual (BAU) scenario (reference year 2013) by December 31, 2030.	Reduce total GHG emissions by 15 percent compared to a BAU scenario (reference year 2013) by December 31, 2030, based on the availability of climate finance.	N/A	No

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on national NDC submissions (UNFCC), ClimateWatch and Climate and Clean Air Coalition Secretariat.

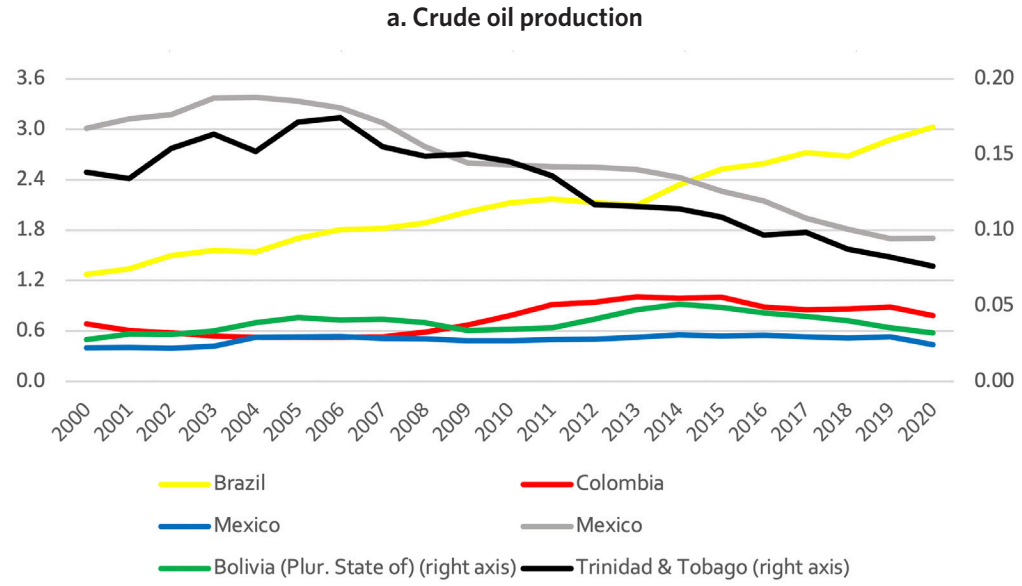
ECONOMIC IMPORTANCE OF HYDROCARBON RELATED ACTIVITIES IN LAC6 AND ONGOING FISCAL CHALLENGES

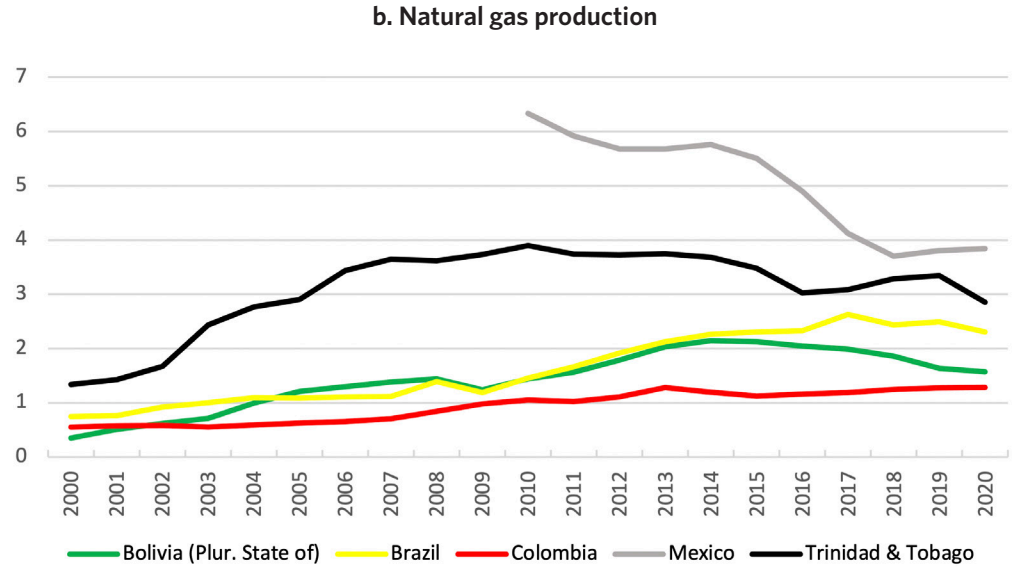
LAC6 countries account for a relevant share of global hydrocarbons production. For the period 2015 to 2019, production in Brazil accounted for 2.8 percent of total global output, followed by Mexico (2.3 percent), Colombia (1.4 percent) and Ecuador (0.9 percent). For context, the largest producers in the world, Saudi Arabia and the Russian Federation, accounted for 16.2 percent and 11.5 percent of oil output, respectively, during the same period. The relative weight of production of LAC6 countries has varied during the current century (Figure 1). Crude oil in production has registered a secular decline in Mexico since the early 2000s, principally due to maturing fields and relatively low levels of investment



in the sector. In contrast, output in Brazil has risen sharply, passing from roughly a third of Mexican production in 2000 to become the largest producer of the group in the mid-2010s. Natural gas production in LAC6 has a less significant weight on global production, with Mexico and Trinidad and Tobago both accounting for roughly 1.0 percent of the global total.

FIGURE 1 LAC6: Crude oil and natural gas production, 2000-2020
(Millions of barrels per day and millions of cubic feet)





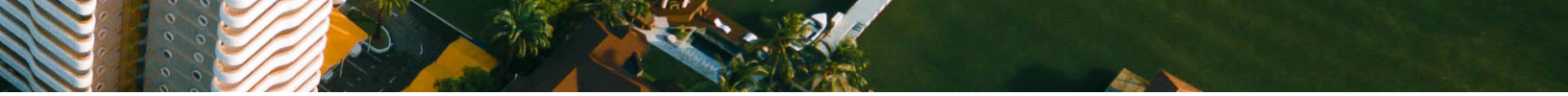
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official figures and BP Statistical Review of World Energy 2021 | 70th edition.

For LAC6, crude oil and natural gas exploration and production activities are highly significant in terms of national accounts, balance of payments and fiscal accounts. Hydrocarbon activities have a relatively modest weight in overall value-added in absolute terms, especially in the most recent period; however, these figures tend to understate their importance as they do not capture a wide range of support activities (Table 2). These figures notwithstanding, oil and gas production has an outsized impact on exports and fiscal revenues. Hydrocarbons are a major generator of foreign exchange, with exports accounting for a third or more of total exports in several countries. Similarly, fiscal revenues—including tax and non-tax receipts—from the exploration and production of oil and gas play a major role in public accounts, exceeding 15 percent of total revenues in the Plurinational State of Bolivia, Mexico and Trinidad and Tobago and reaching 24.2 percent in Ecuador. While this paper focuses on fiscal implications of a fossil fuel transition, the repercussions for other major macroeconomic indicators—such as the balance of payments—represent a significant vulnerability for some LAC6 countries.

TABLE 2 LAC6: Share of hydrocarbon activities in gross domestic product (GDP), exports and general government total revenues, 2000-2019 *(Percentages)*

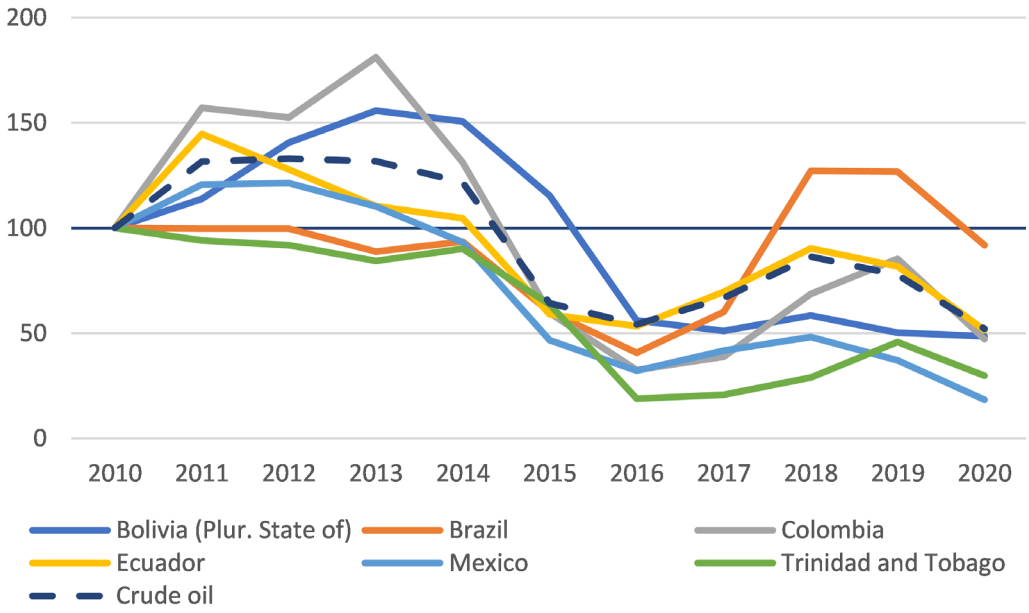
Concept	Period	Country					
		Bolivia (Plur. State of	Brazil	Colombia	Ecuador	Mexico	Trinidad and Tobago
GDP	2000-2004	4.0	1.2	3.8	4.3	5.3	18.0
	2005-2009	6.0	1.9	4.4	11.0	6.3	24.8
	2010-2014	6.7	2.2	7.6	12.1	5.9	22.2
	2015-2019	3.8	1.0	3.4	4.9	2.5	12.5
Exports	2000-2004	24.2	4.0	28.3	45.5	10.2	60.9
	2005-2009	45.7	8.1	28.1	57.5	15.4	71.1
	2010-2014	48.0	9.5	50.4	55.9	13.6	54.5
	2015-2019	33.9	9.6	38.0	37.0	5.9	49.1
Fiscal revenues	2000-2004	11.8	2.4	6.3	20.3	23.1	32.3
	2005-2009	27.7	3.1	9.6	28.8	35.2	49.5
	2010-2014	29.7	2.0	13.6	34.9	32.9	41.0
	2015-2019	16.7	2.2	5.6	24.2	11.7	16.7

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of figures of CEPALstat, Instituto Nacional de Bolivia, Departamento Administrativo Nacional de Estadística de Colombia (DANE), Banco de México, Central Bank of Trinidad and Tobago, WTO Statistics, and *Fiscal Revenues from Non-Renewable Natural Resources in Latin America and the Caribbean* database of the Fiscal Affairs Unit of the Economic Development Division of ECLAC.
Note: Figures for GDP and fiscal revenues refer to exploration and production activities (up-stream) and exclude refining and commercialization of hydrocarbon products (down-stream activities), which in some countries can be significant. In Ecuador and Trinidad and Tobago, the GDP data corresponds to the mining and quarrying sector.



The 2014-2016 collapse in crude oil prices highlighted the strong linkage between external markets and fiscal conditions in LAC6. As a result of the decline in market prices for crude oil, fiscal revenues from oil and gas production plummeted in the LAC6 (Figure 2). Countries with a higher participation of corporate income tax and dividend payments in overall hydrocarbons revenues, such as Colombia and Trinidad and Tobago, where particularly hard hit. While this situation eased somewhat in 2018 as prices rose and production ramped up in some countries, principally Brazil, hydrocarbon revenues were generally significantly lower than prior to mid-2014.

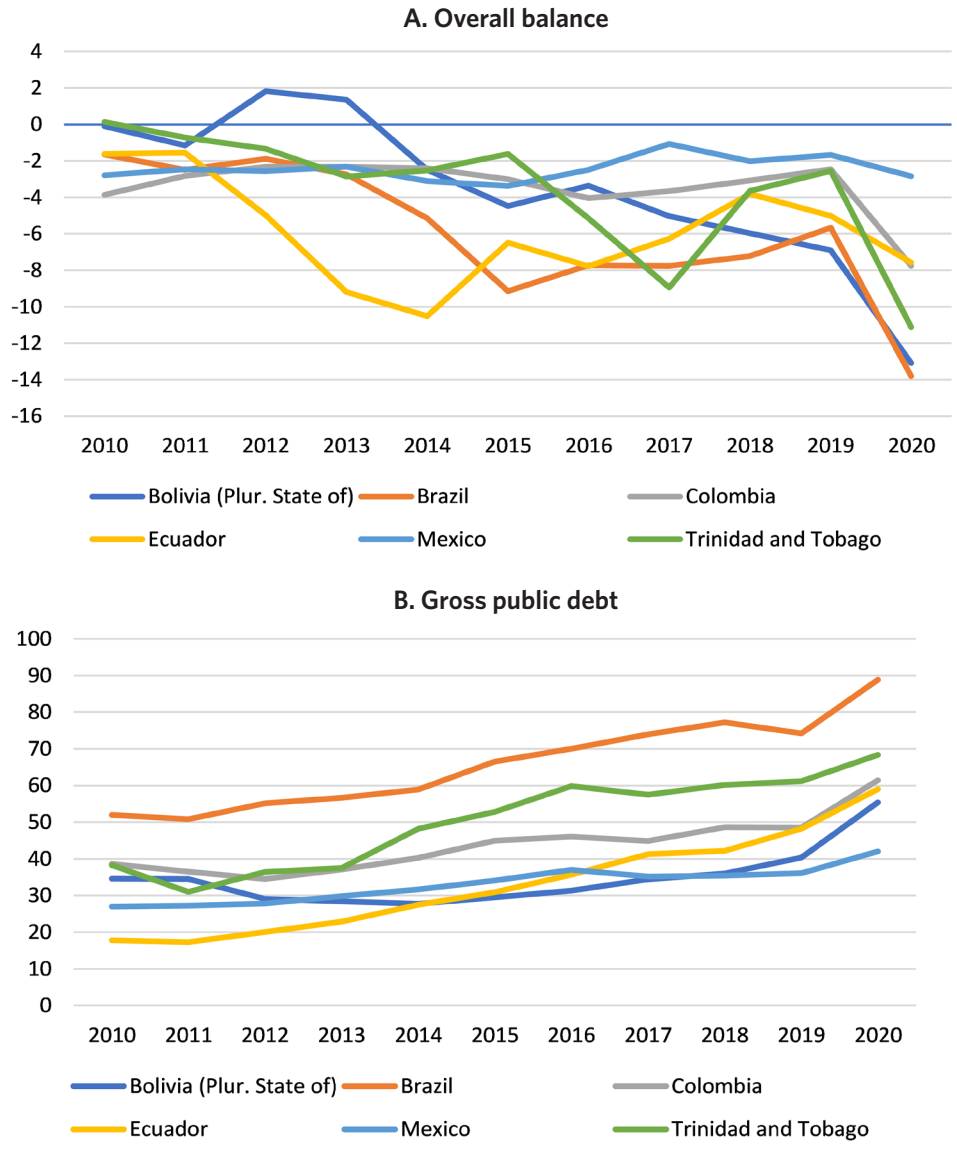
FIGURE 2 LAC6: general government tax revenues and property rents from oil and gas production, 2010-2020[a]
(Index 100=2010)



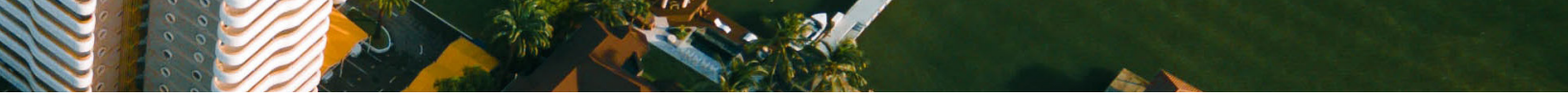
Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on data from ECLAC's *Fiscal Revenues from Non-Renewable Natural Resources in Latin America and the Caribbean* database.
[a] Values exclude other non-tax revenues such as signature bonuses and recurrent payments for land usage.

The 2014-2016 price shock was one of the factors that contributed to a significant deterioration in fiscal accounts in several of the LAC6 countries. Fiscal balances in LAC6 in the period leading up to the shock were generally in deficit, although with significant variation between countries, in a context characterized by a generalized deceleration in economic activity (Figure 3). The price shock, combined with economic contraction in some countries, such as Brazil, undercut public revenues and contributed to an expansion in fiscal deficits. As a result of the interplay of these factors, public debt levels began to rise, with the largest increase observed in Trinidad and Tobago (+11.6 percentage points of GDP between 2014 and 2016).

FIGURE 3 LAC6: central government overall balance and gross public debt, 2010-2020[a]
(Percentages of GDP)

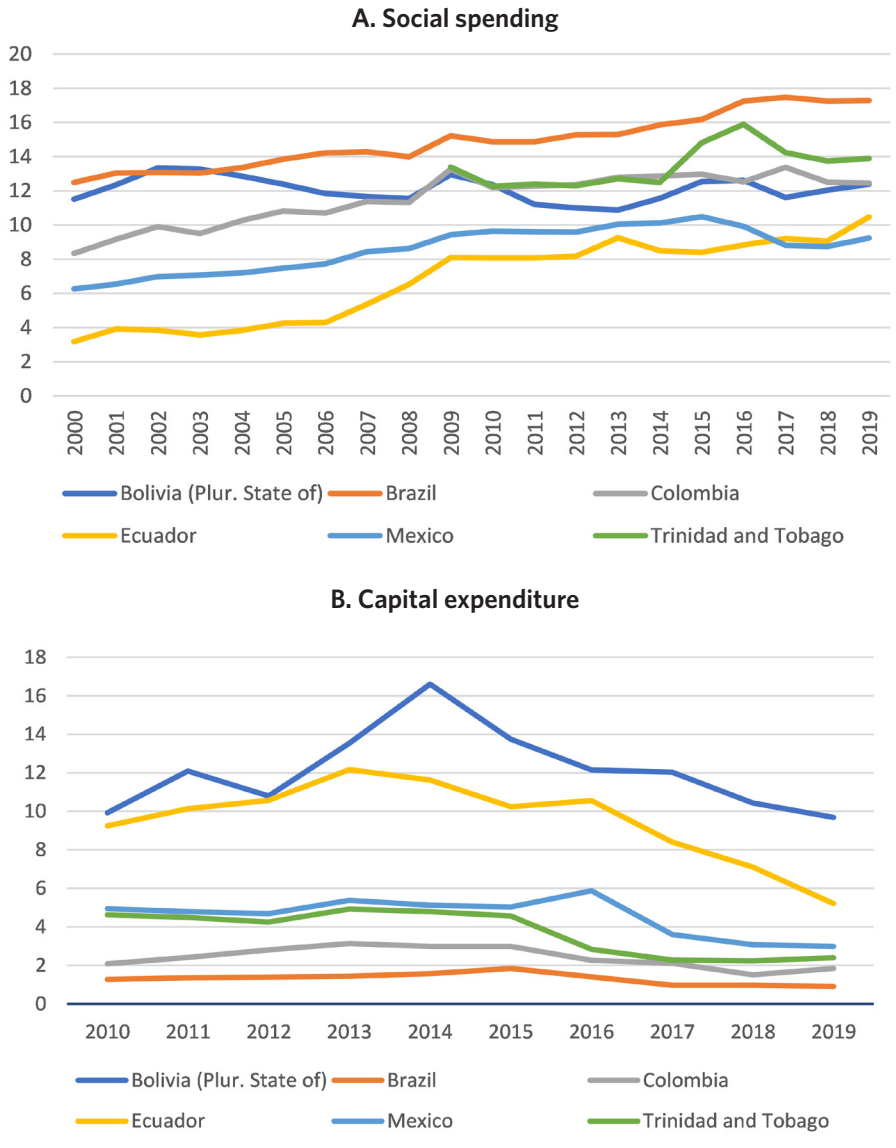


Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on data from official sources.
[a] Overall balance data for Bolivia (Plurinational State of) and Mexico correspond to the general government and federal public sector, respectively. Gross public debt data for Bolivia (Plurinational State of) and Brazil correspond to the general government.



Prior to the COVID-19 pandemic, LAC6 countries faced significant policy dilemmas, navigating both demands on public spending and the need to put public debt on a sustainable path. Overall public expenditure levels remained steady over during the period, reflecting the interplay of these objectives. Social spending rose during the 2008-2009 global economic and financial crisis as LAC6 countries implemented counter-cyclical policies that were largely successful in limiting economic dislocations. Countries largely maintained social spending at these levels, reflecting in large part the existing deficits in the provision of quality public goods and services (Figure 4). At the same time, interest payments were progressively increasing in line with higher public debt levels, generating a significant upward

FIGURE 4 LAC6: central government social spending and capital expenditure, 2000-2020[a]
(Percentages of GDP)



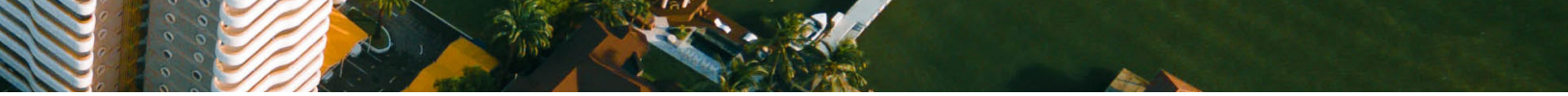
Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on data from official sources.

pressure on total expenditure. Faced with the need to maintain social spending and accommodate rising interest payments, governments turned to reductions in capital expenditures to cap the growth of total spending and in turn limit the expansion of overall fiscal deficits. These measures began to close primary balance deficits in several countries, but at the significant cost of reducing capital expenditure (ECLAC, 2020c). Public investment was a cornerstone of economic development in the Plurinational State of Bolivia and Ecuador in the period leading up to 2014 but was sharply cut in the following years.

The COVID-19 pandemic had a significant impact on economic and social indicators of LAC countries. The region experienced the largest contraction in economic activity (-6.8 percent) since 1900 (ECLAC, 2021a). Employment levels plunged as public health measures implemented to limit the spread of the COVID-19 virus generated dual supply and demand shocks of unprecedented magnitude. Poverty and inequality levels, already high compared to other regions in the world, rose sharply (ECLAC, 2022).

Faced with the magnitude of the crisis, governments in the region adopted significant fiscal policy packages—equivalent to 4.6 percent of GDP on average in Latin America—to strengthen overwhelmed public health systems, support families and workers, and protect the productive structure. While policymakers employed all fiscal instruments at their disposal—tax policies, public spending and State-backed credit—public spending emerged as the most important fiscal policy tool employed (ECLAC, 2020c). Spending levels in the region and in the LAC6 rose to historic levels. At the same time, public revenues contracted sharply because of the collapse of private spending and the negative shock to gross national income. In LAC6 countries, this was aggravated by a sharp decline in fiscal revenues from hydrocarbon activities. As a result, fiscal deficits ballooned, and public debt increased to its highest level during the current century (ECLAC, 2021b). In 2021, public revenues increased and total expenditure declined, but remained at a higher level than in 2019, as fiscal stimuli were withdrawn to reduce deficits and stabilize the growth of public debt.

Looking forward, LAC6 countries face the challenge of improving the sustainability of fiscal policy in order to drive economic recovery, reduce the social impacts of the pandemic and finance the investment requirements for the NZE transition. Fiscal sustainability implies increasing tax revenues and improving the progressivity of structures in order to finance an upward trajectory of spending demands. This will also require the strategic reorientation of public expenditure towards reducing social and development gaps and boosting green public investment. During this process, premature fiscal consolidation measures should be avoided to prevent derailing the recovery process.



REVIEW OF NET ZERO SCENARIO EXERCISES ELABORATED BY INTERNATIONAL AND POSSIBLE IMPLICATIONS FOR MAJOR HYDROCARBON PRODUCERS IN LAC [2]

According to IEA (2021), "the energy sector is the source of around three-quarters of greenhouse gas emissions today and holds the key to averting the worst effects of climate change, perhaps the greatest challenge humankind has faced. Reducing global carbon dioxide (CO_2) emissions to net zero by 2050 is consistent with efforts to limit the long-term increase in average global temperatures to 1.5°C. This calls for nothing less than a complete transformation of how we produce, transport and consume energy."

Reaching NZE requires governments to significantly strengthen and then successfully implement their energy and climate policies. IEA's path calls for scaling up solar and wind rapidly this decade and to use hydropower and nuclear, the two largest sources of low-carbon electricity today, as an essential foundation for transitions. As the electricity sector becomes cleaner, electrification emerges as a crucial economy-wide tool for reducing emissions. As mentioned in section A, most of the LAC6 have already made important commitments to adopt a net-zero emissions goal for 2050. However, in general, commitments made to date fall far short of what is required by the NZE pathway.

The path considered by IEA is designed to maximize technical feasibility, cost-effectiveness and social acceptance while ensuring continued economic growth and secure energy supplies. IEA highlights priority actions that are needed today to ensure the opportunity of net zero by 2050, narrow but still achievable. Further delay in acting to reverse that trend will put net zero by 2050 out of reach. Under this scenario, it is important for LAC6 to take measures to place their economies on a net-zero emissions trajectory by 2050.

It is evident that the path to net-zero emissions is narrow: staying on it requires immediate and massive deployment of all available clean and efficient energy technologies. IEA acknowledges that reaching net zero by 2050 requires further rapid deployment of available technologies as well as widespread use of technologies that are not on the market yet. According to the agency, major innovation efforts must occur over this decade in order to bring these new technologies to market in time. Most of the global reductions in CO_2 emissions through 2030 in their pathway come from technologies readily available today. But in 2050, almost half the reductions will come from technologies that are currently at the demonstration or prototype phase. In heavy industry and long-distance transport, the share of emissions reductions from technologies that are still under development today is even higher.

[2] This section is mainly based on the document: Net Zero by 2050 A Roadmap for the Global Energy Sector. International Energy Agency (July, 2021).

The transition to net zero brings substantial new opportunities for employment, thanks to new activities and investment in clean energy. Spending on more efficient appliances, electric and fuel cell vehicles, and building retrofits and energy-efficient construction would require more workers. Nevertheless, these job opportunities are often in different locations, skill sets and sectors than the jobs that will be lost as fossil fuels decline. In IEA's pathway, around 5 million jobs are lost. Most of those jobs are located close to fossil fuel resources. This requires careful policy attention to address the employment losses, especially in LAC6, where the exploitation of fossil fuels has been the main source of income for centuries.

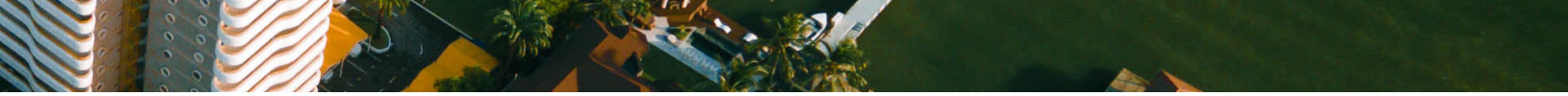
Net zero means a huge decline in the use of fossil fuels. Instead of fossil fuels, the energy sector in 2050 will be based largely on renewable energy. They fall from almost four-fifths of total energy supply today to slightly over one-fifth by 2050. Fossil fuels that remain in 2050 are used in goods where the carbon is embodied in the product such as plastics, in facilities fitted with carbon capture, utilization and storage infrastructure, and in sectors where low-emissions technology options are scarce. IEA estimates for 2050 that two-thirds of total energy supply will emerge from wind, solar, bioenergy, geothermal and hydro energy. Solar becomes the largest source, accounting for one-fifth of energy supplies.

The role of governments will be crucial to achieve NZE. Governments will need to provide credible step-by-step plans to reach their net zero goals, building confidence among investors, industry, citizens and other countries. Besides, governments must put in place long-term policy frameworks to allow all branches of government and stakeholders to plan for change and facilitate an orderly transition.

In the IEA NZE scenario, beyond projects already committed as of 2021, there are no new oil and gas fields approved for development, and no new coal mines or mine extensions are required. This assumption is considered for the analysis and estimation of the fiscal impact of the fossil fuel transition for LAC6 hydrocarbon producers.

The unwavering policy focus on climate change in the net zero pathway results in a sharp decline in fossil fuel demand, meaning that the focus for oil and gas producers switches entirely to output—and emissions reductions—from the operation of existing assets. Clean electricity generation, network infrastructure and end-use sectors are key areas for increased investment. Enabling infrastructure and technologies are vital for transforming the energy system. Electricity accounts for almost 50 percent of total energy consumption in 2050. It plays a key role across all sectors—from transport and buildings to industry—and is essential to produce low emissions fuels such as hydrogen. Emissions from industry, transport and buildings will need more time to be reduced. Cutting industry emissions by 95 percent by 2050 involves major efforts to build new infrastructure.

The investment towards clean energy will be one of the main pillars for achieving the transition towards NZE in 2050. Based on the IEA's joint analysis with the IMF, an unparalleled clean energy investment boom lifts global economic growth. Total annual energy investment surges to $5 trillion by 2030, adding an extra 0.4 percentage points a year to annual global GDP growth. IEA suggests the need of policies to be designed to send market signals that unlock new business models and mobilize private spending, especially in emerging economies.



As stated by IEA, governments have a key role in enabling investment-led growth and ensuring that the benefits are shared by all. There are large differences in macroeconomic impacts between regions. But government investment and public policies are essential to attract large amounts of private capital and to help offset the declines in fossil fuel income that many countries will experience. The major innovation efforts needed to bring new clean energy technologies to market could boost productivity and create entirely new industries, providing opportunities to locate them in areas that see job losses in incumbent industries.

The contraction of oil and natural gas production will have far-reaching implications for all the countries and companies that produce these fuels. One of the main assumptions of the NZE scenario by IEA, is that no new oil and natural gas fields are needed in the pathway, and oil and natural gas supplies become increasingly concentrated in a small number of low-cost producers.

The net zero pathway relies on unprecedented international cooperation among governments, especially on innovation and investment. Governments must work together in an effective and mutually beneficial manner to implement coherent measures that cross borders. The following actions proposed by IEA are fundamental for achieving the NZE objective: a) Managing domestic job creation and local commercial advantages with the collective global need for clean energy technology deployment; b) Accelerating innovation, developing international standards and coordinating to scale up clean technologies needs to be done in a way that links national markets; and c) Cooperation that recognizes differences in the stages of development of different countries and the varying situations of different parts of society.

Accelerated delivery of international public financing will also be critical to energy transitions, especially in developing economies, even if ultimately the private sector will need to finance most of the extra investment required. IEA considers the following aspects to finance the transition: a) Mobilizing capital for large-scale infrastructure calls for closer cooperation between developers, investors, public financial institutions and governments; b) Reducing risks for investors will be essential to ensure successful and affordable clean energy transitions; c) Many emerging market and developing economies, which rely mainly on public funding for new energy projects and industrial facilities, will need to reform their policy and regulatory frameworks to attract more private finance; and d) International flows of long-term capital to these economies will be needed to support the development of both existing and emerging clean energy technologies.

Multilateral technical support will also be necessary to ensure efficient and widespread deployment of key technologies and infrastructure. For many rich countries, achieving net-zero emissions will be more difficult and costlier without international co-operation. For many developing countries, the pathway to net zero without international assistance is even more uncertain. Large scale international cooperation is needed for global CO_2 emissions to fall to net zero by 2050. Through their technical expertise and signaling role to catalyze widespread financing and investment, multilateral institutions are uniquely placed to accompany countries as they step away from hydrocarbons.

ESTIMATED MACROECONOMIC AND FISCAL IMPACT OF THE FOSSIL FUEL TRANSITION AND POLICY OPTIONS FOR THE TRANSITION

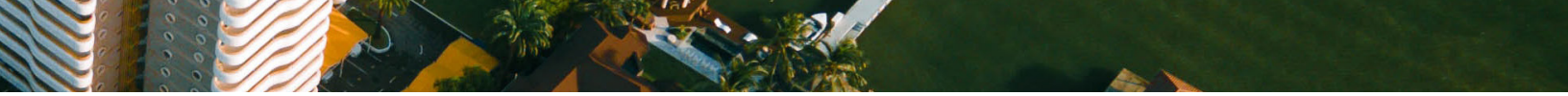
The transition to NZE will have a wide-ranging impact on practically every aspect of the economy. Achieving net zero will be undoubtedly positive in the long run, but the costs during the transition are potentially very significant. The impact of decarbonization is akin to an "adverse supply shock" in which equipment will lose economic value, plants will have to close and employees will lose jobs (Pisani-Ferry, 2021).

The overall cost of the transition will depend in large part on the policy frameworks put in place to take advantage of the positive aspects of NZE and to dampen its negative consequences. Like other countries, the LAC6 will need to adopt a broad range of policies and measures to minimize methane emissions and reduce CO_2 emissions to net-zero by 2050. The macroeconomic impact of these actions is evaluated assuming the LAC6 follow the policies and directives put forth in IEA (2021) for the energy sector as well as the mitigation strategies and policies to achieve a growth-friendly and inclusive transition recommended in IMF (2021a).[3]

However, irrespective of moving to NZE, LAC6 countries face growing pressures to increase public expenditure to close existing development gaps. Public social spending in the past decade has plateaued in the region, limiting the production of quality public goods and services, especially in the areas of education, healthcare and social protection. At the same time, public investment levels have fallen sharply as countries enacted fiscal consolidation measures to put their public debt on a sustainable trajectory. The COVID-19 pandemic has made it clear that the public sector must play a greater role in driving sustainable and inclusive development in the region, addressing persistent structural gaps and entrenched inequalities.

Reflecting the intersection of these important policy objectives, this section examines the impact of the NZE transition on fiscal accounts in LAC6 countries based on three scenarios. Two baseline BAU scenarios are constructed based on the macroeconomic and hydrocarbon assumptions outlined in IEA (2021) and country-specific information derived from other sources. The first BAU scenario—deficit anchor—assumes that policymakers will adopt a fiscal anchor strategy, adjusting public expenditure levels to maintain a fiscal deficit that matches historical levels. In the second BAU scenario—social and investment goals—total expenditure increases over the forecast horizon with the aim of closing existing structural development gaps in the region. The NZE scenario, which incorporates the social and investment goals policy objectives, is also constructed in line with IEA (2021) and country-specific information.

[3] There are different mitigation strategies that are consistent with emission reductions to limit global warming to 1.5°C (IPCC 2018). The policy envelope for this paper (IEA and IMF) is chosen for its consistency, comparability with other results and because the urgency of settling on one path of action is imminent. It is important to note that the IEA believes its pathway is "the most technically feasible, cost-effective and socially acceptable".



Each scenario was constructed using the IMF framework for designing fiscal strategies for resource-rich countries. The principal fiscal aggregates for the BAU and NZE scenarios were forecast based on the reduced form equations outlined in IMF (2021b). The underlying assumptions are reviewed in section D.1.

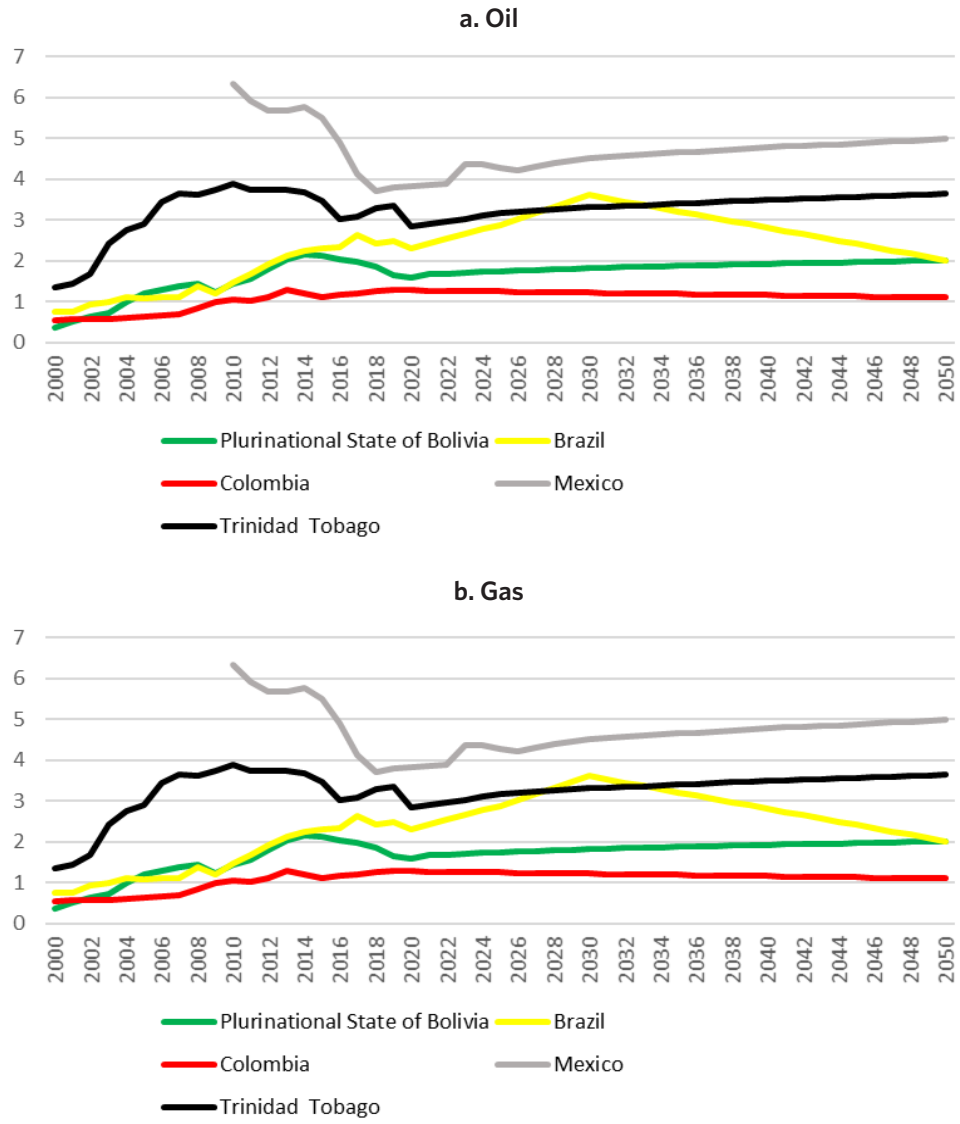
Fiscal dynamics under the BAU scenarios range from manageable to potentially unsustainable (section D.2). Assuming that countries adopt a deficit anchor — adjusting public expenditure levels to move in line with revenues to maintain fiscal balances — overall debt dynamics are generally manageable over the horizon leading to 2050. However, adopting more realistic assumptions that incorporates the growing demands on public expenditure, debt dynamics become potentially unsustainable, quickly surpassing 100 percent of GDP in some cases and nearing or exceeding 200 percent of GDP in some countries by 2050.

Debt dynamics under the NZE social and investment goals scenario would be unsustainable for several LAC6 countries, with debt levels upwards of 90 percentage points of GDP above those for the corresponding BAU scenario (section D.3). Only Brazil and Colombia would see their hydrocarbon revenues losses be fully offset by the implementation of carbon taxes. Other LAC6 countries would experience large revenue losses. Higher expenditure, due to social and investment spending and the need to compensate individuals for increases in energy costs, would lead to exceptionally large fiscal deficits. The rapid increase in public debt levels would provoke a concomitant increase in interest payments, which would significantly alter the composition of public expenditure.

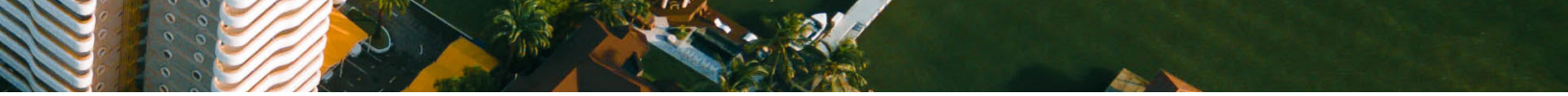
Underlying Assumptions for The BAU and NZE Scenarios

Under the BAU scenario, hydrocarbon production levels in LAC6 remain steady. With no changes to policies and regulation, hydrocarbon production is expected to remain close to current levels (Figure 5). Historical data on oil and gas production from 2021 onwards were obtained from official sources in countries with medium-term forecasts. For subsequent years, the hydrocarbon production was estimated considering the average of recent years and assuming a continuous and infinite availability of hydrocarbon reserves.

FIGURE 5 LAC6: Oil and Gas Production Paths in the BAU Scenario
(Millions of barrels per day and cubic feet per day)

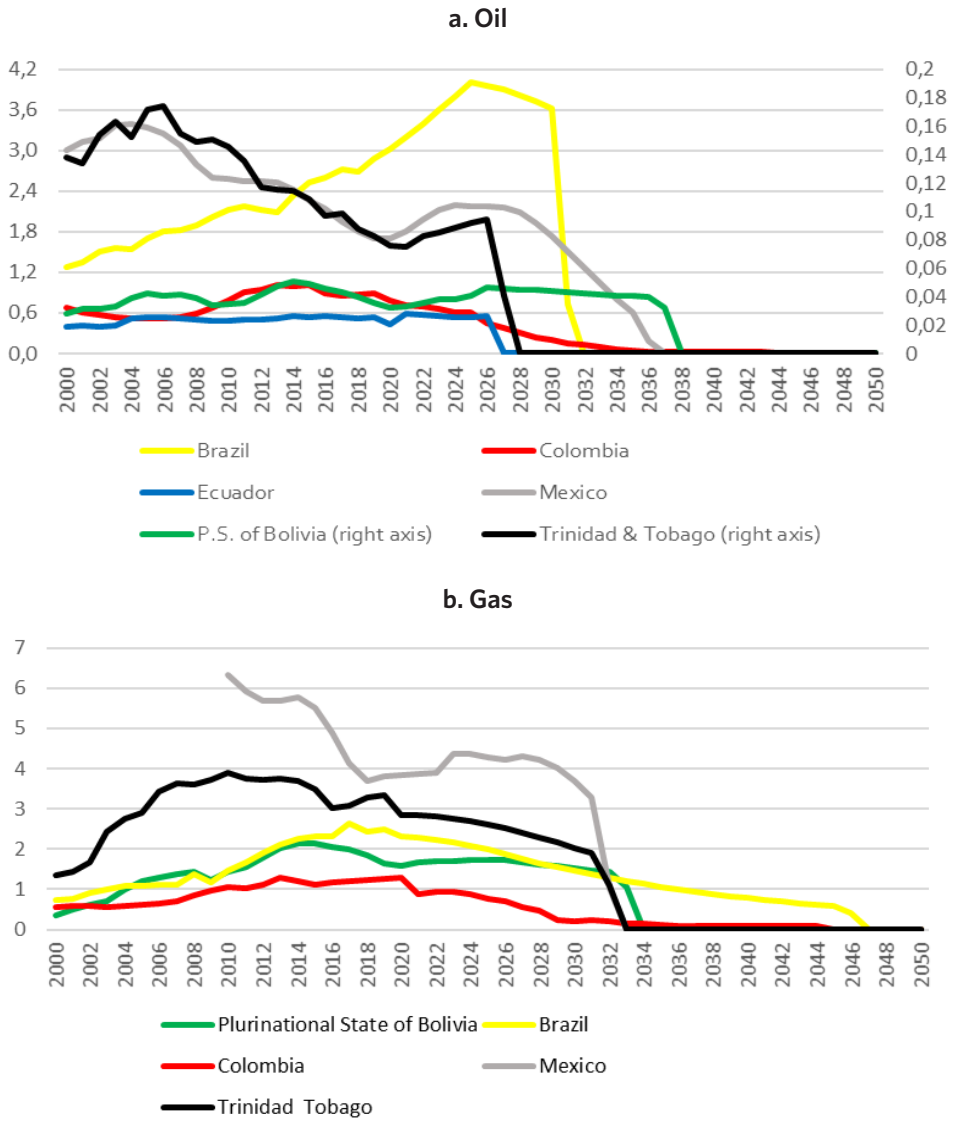


Source: Economic Commission for Latin America and the Caribbean (ECLAC).



The policy cornerstone for LAC6 NZE is assumed to be zero investment into new hydrocarbon fields. Following IEA (2021), in the NZE no new fossil fuel exploration is assumed to take place from 2022, no new oil and natural gas fields are approved for development, and no new coal mines or mine extensions are approved. Investment in upstream oil and natural gas is limited to supporting operations in existing fields. Refining and transport infrastructure investment fall less abruptly but also diminish. This production scenario is forecasted by modeling the natural depletion of all currently discovered oil and natural gas fields at the current rate of production (Figure 6), assuming that 90 percent of current proven reserves, 50 percent of probable reserves and 10 percent of possible reserves will be produced.

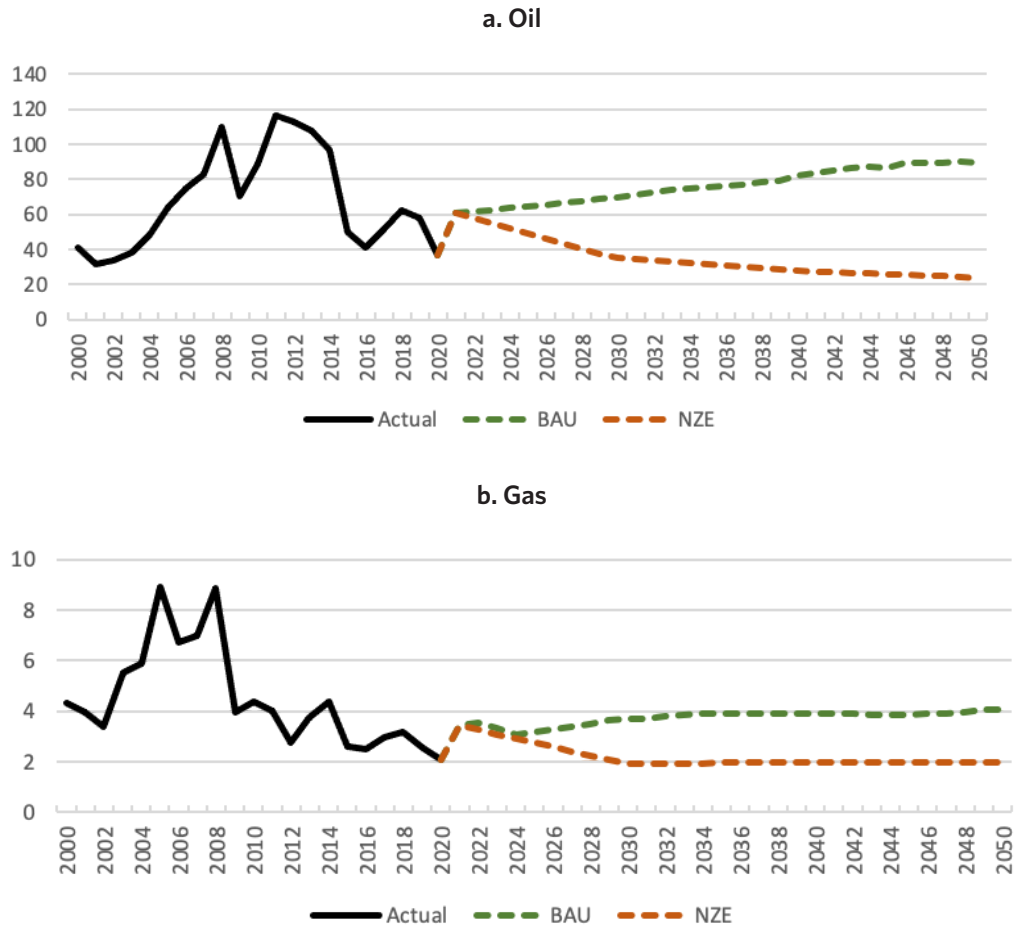
FIGURE 6 LAC6: Oil and Gas Production Paths in the NZE Scenario
(Millions of barrels per day and cubic feet per day)



Source: Economic Commission for Latin America and the Caribbean (ECLAC).

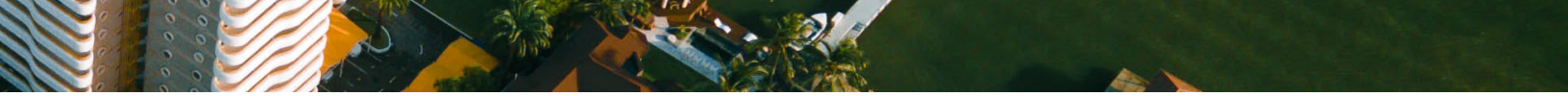
In the NZE, successful policies to curb hydrocarbon demand (through regulation and carbon pricing) should leave hydrocarbon prices near the relatively low levels observed in 2020. Because of carbon taxes and other regulatory measures, the price paid by consumers will be substantially higher than the one received by producers. For the BAU, prices out to 2050 are taken from the IEA's 2021 Reference Case (Figure 7). Oil and gas prices under an NZE scenario are taken from the same source.

FIGURE 7 Oil and Gas Prices in the NZE
(US dollars per barrel and US dollars per million BTU)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of IEA (2021).
Note: For the NZE the available IEA data are quinquennial, hence the data are extrapolated, following the fall in prices.

Prices for CO2 emissions will have to increase substantially to induce consumer and producer behavioral change. The IEA (2021) NZE scenario assumes that hydrocarbon prices for electricity generation rise in advanced economies from an average of $75 per ton in 2025 to $130 and $250 per ton in 2030 and 2050, respectively. For "selected" emerging market and developing economies (which include China, Russia, Brazil and South Africa) prices rise from $45 per ton in 2025 to $200 in 2050 and for other emerging market and developing



economies the rise is from $3 to $55 per ton. In LAC6, current available CO_2 prices are 5 and 0.4-3.2 US dollars per ton for Colombia and Mexico, respectively. In the fiscal model, carbon price forecasts for the Plurinational State of Bolivia, Ecuador and Trinidad and Tobago are taken from IEA (2021). For the cases of Brazil, Colombia and Mexico, projections come from Network of Central Banks and Supervisors for Greening the Financial System (NGFS, 2021)[4] (table D.1).

TABLE 3 LAC6: Carbon prices in the NZE
(US dollars per ton)

	2025	2030	2035	2040	2045	2050
Bolivia	5	15	25	35	45	55
Brazil	31	58	102	146	227	451
Colombia	31	58	102	146	227	451
Ecuador	5	15	25	35	45	55
Mexico	31	58	102	146	227	451
Trinidad and Tobago	5	15	25	35	45	55

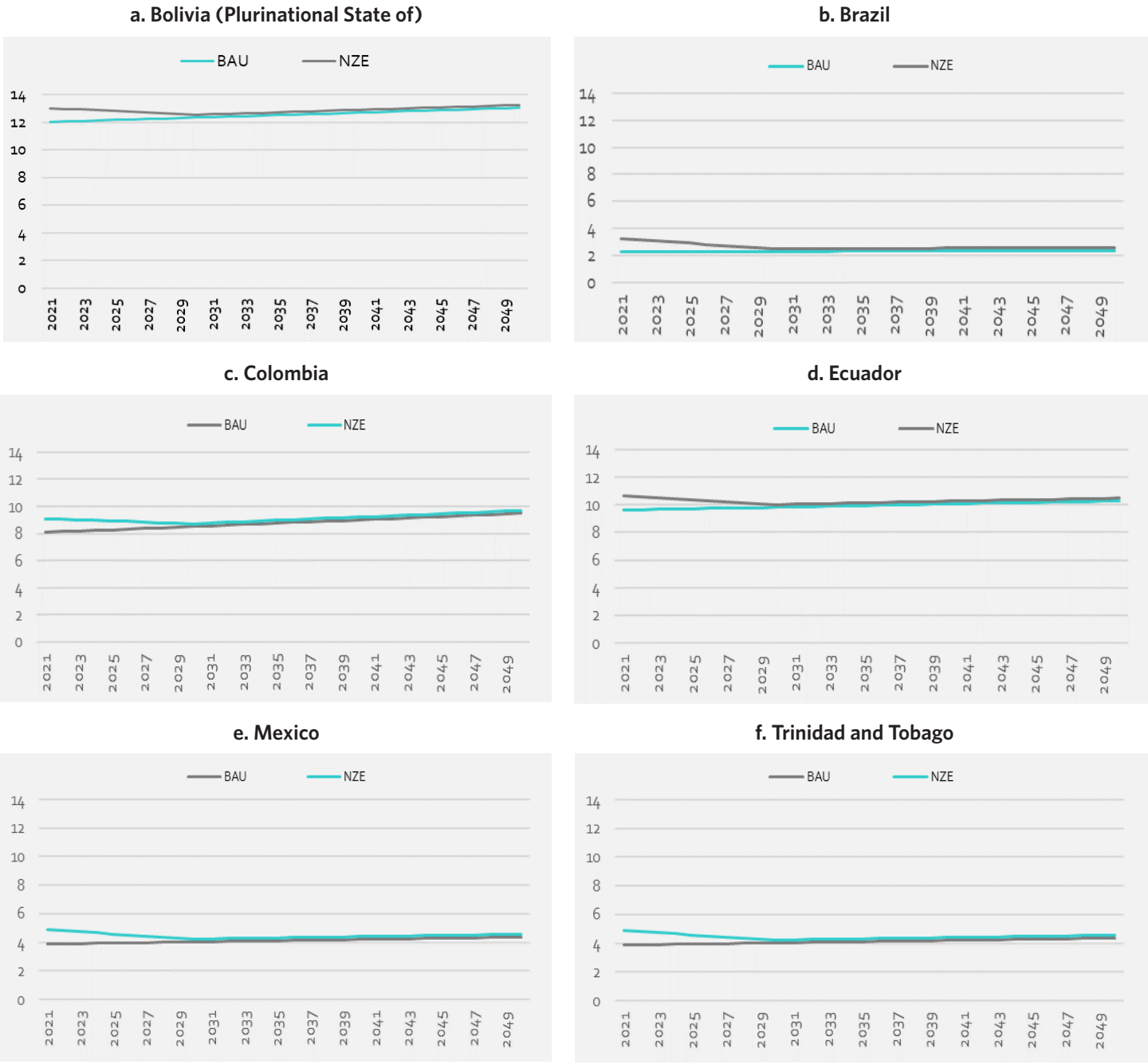
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of IEA (2021) and NGFS (2021).

Under the NZE, countries will experience a massive shift in investment from the hydrocarbon sector to alternative sources of energy production. In its central NZE scenario, the IEA (2021) assumes global energy capital investment rises from the current 2.5 percent of GDP to 4.5 percent by 2030 and then gradually declines again to 2.5 percent by 2050. Most of the increase in investment is financed through private sources but direct government financing is also necessary.

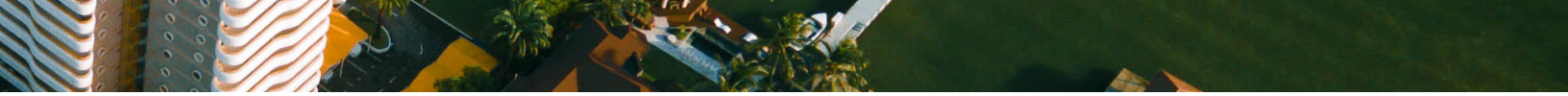
Public investment in the energy sector is assumed to follow the IMF's green public investment program, which may be difficult to sustain in the current fiscal environment. The working assumption is a 10-year additional investment push starting at 1 percent of GDP in 2022 and declining to zero by 2032. Thereafter, investment remains higher by 0.2 percent of GDP compared to the BAU baseline to offset depreciation for existing assets. Higher public investment is directed at the development of new clean energy fields and other projects with positive externalities (Figure 8). However, reaching this level of additional investment may be difficult as current fiscal trends in the region point to fiscal consolidation and, potentially, reductions in public investment.

[4] It is important to highlight that NGFS's forecasting for reaching a NZE scenario considers higher carbon prices than the IEA due to more stringent policies. This means that prices are more sensitive to the measure of overall policy intensity. According to the same source, governments are pursuing a range of fiscal and regulatory policies, which have varied costs and benefits and the level of ambition to mitigate climate is translated into higher emissions prices. Furthermore, the timing of policy implementation is linked to higher prices that are needed in the medium to long-term if action is delayed. Finally, emissions prices are sensitive to technology assumptions such as the availability and viability of carbon dioxide removal.

FIGURE 8 LAC6: Public Sector Investment in the NZE
(Percentage of GDP)



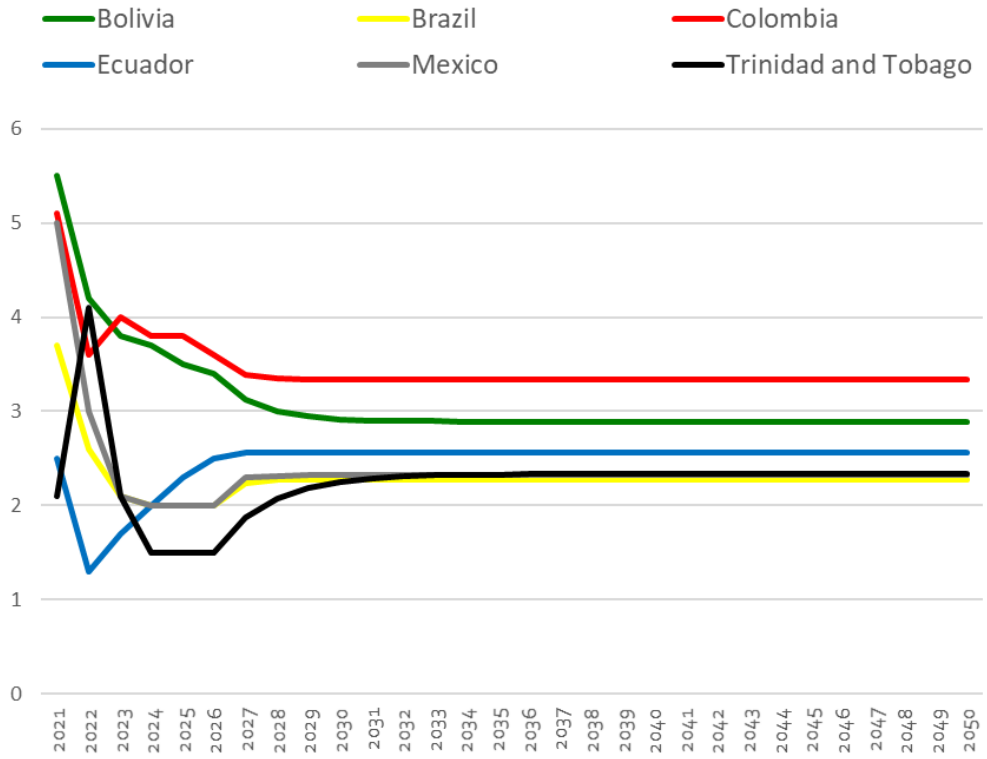
Source: Economic Commission for Latin America and the Caribbean (ECLAC).



Limiting global warming to 1.5°C will also require a host of additional policies, including land use, urban and infrastructure (including transport and buildings), and industrial systems. These include Carbon Dioxide Removal, Bioenergy with Carbon Capture and Storage and removals in the Agriculture, Forestry and Other Land Use sector. Research on the macroeconomic impact of these policies is limited and are not included in the macroeconomic impact projected in this study.[5]

Under the BAU scenario, economic growth for the LAC6 is assumed to remain relatively stable during the next thirty years. Projections out to 2026 are from the IMF's World Economic Outlook (WEO) database (April 2021). To forecast GDP growth for 2027-2050, a simple autoregressive model is used (Annex 1), implicitly assuming no large deviations from the growth rates observed in recent years (Figure 9).

FIGURE 9 LAC6: Gross Domestic Product
(Annual percent change)



Source: Economic Commission for Latin America and the Caribbean (ECLAC).

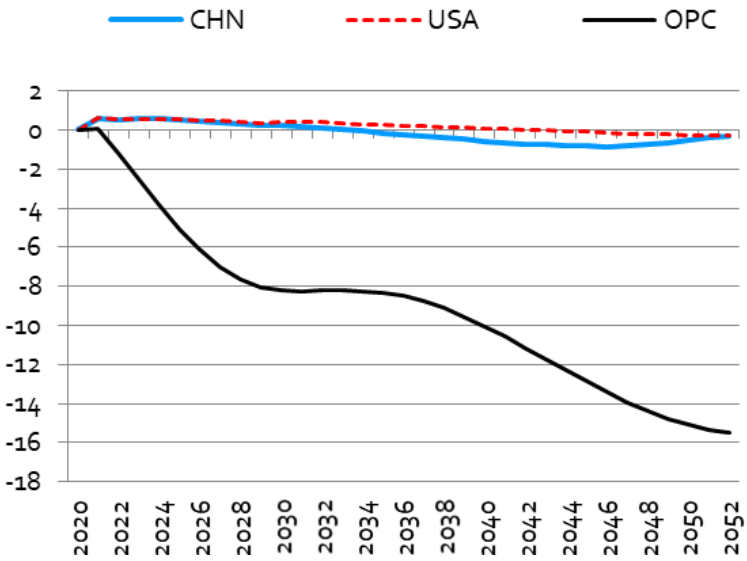
[5] Although it is important to consider the impact of these policies, modeling the impact of energy sector policies should capture a significant portion of the transition dynamics. The energy sector is responsible for around three-quarters of greenhouse gas emissions, according to IEA (2021).

For hydrocarbon producing countries, the impact of NZE on economic activity is potentially very negative during the transition. For example, Pisani-Ferry (2021) makes the case for short term declines in potential output due to the obsolescence of capital (in the energy, transportation, manufacturing and building sectors) and frictions in investment recalibration and in labor relocations. According to the IEA (2021), net income for hydrocarbon producer economies will drop to historic lows and be especially hurtful where revenues from oil and gas sales account for a large share of public spending.

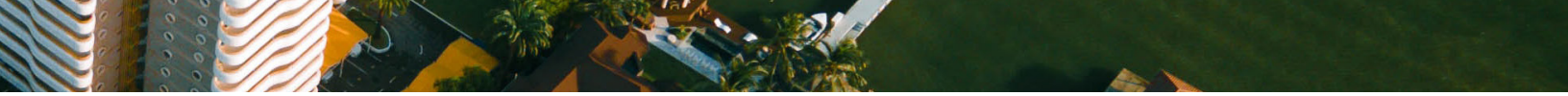
A first order approximation of the macroeconomic impact of NZE is inferred by analyzing its effect on economic growth and fiscal balances. The impact of the transition to carbon neutrality will of course be much broader, including on consumption, labor market conditions and terms of trade. These adjustments will, in turn, be reflected on financial variables (interest and exchange rates), relative prices and inflation. A general equilibrium model that considers these different interactions could deliver more precise forecasting scenarios but is beyond the scope of this study. To simplify the analysis, results from the IMF's (2021a) NZE general equilibrium model are used as a baseline.

Under the IMF (2021a) policy package, the aggregate economic costs of the transition are "moderate." Initially, global growth is higher given the net positive effect of the green fiscal stimulus and carbon pricing. The policy package rises global output 0.7 percent per year, on average, in the first 15 years. After this period the IMF anticipates that the negative impact of the carbon tax is larger, producing an average GDP drag of 0.7 percent per year between 2036 and 2050. Global GDP growth in the NZE is higher than under the current policies scenario but there are large differences between countries (Figure 10).

FIGURE 10 Gross Domestic Product in the NZE scenario
(Percent deviation from baseline, aggregated, selected countries)

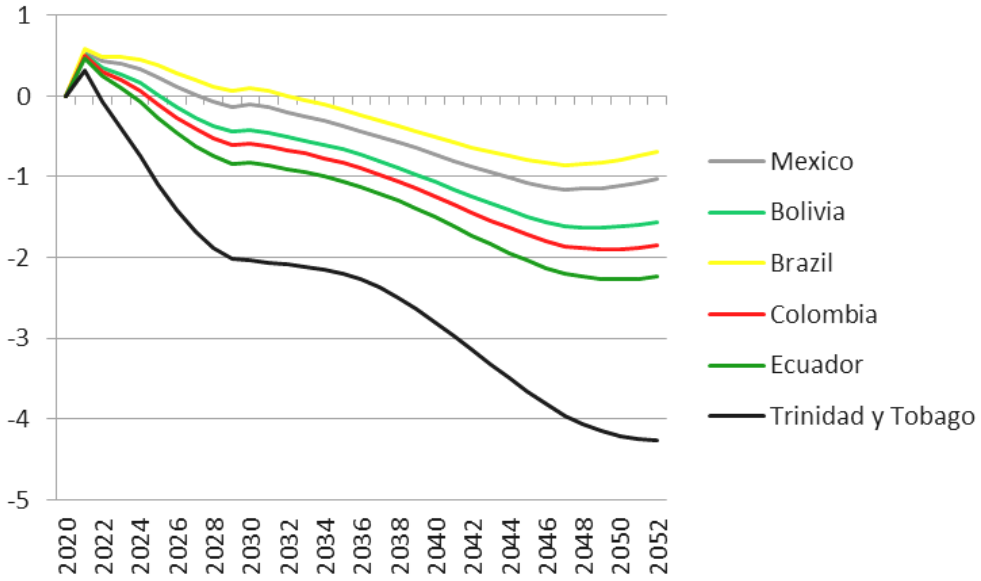


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of IMF (2021a).
Note: OPC represents a group of major oil producing countries and includes Ecuador.



For the LAC6, the impact on GDP growth in the NZE scenario will be significant, especially for less diversified economies. A simplifying assumption is that LAC6 economies will exhibit a trend between those estimated for non-hydrocarbon-intensive industrial and emerging countries (US and China) and selected oil-exporting countries in IMF (2021a). The results for each of the LAC6 countries are calibrated according to the relative weight of the gas and oil sectors in the economy (thus excluding the coal sector, including for Colombia where it is significant) (Figure 11). A key underlying assumption is that the LAC6 countries will be able to engage in green fiscal stimulus in the first period of the transition, which may be difficult to undertake in light of the current fiscal environment.

FIGURE 11 LAC6: Gross Domestic Product in the NZE scenario
(Percent deviation from baseline, aggregated)



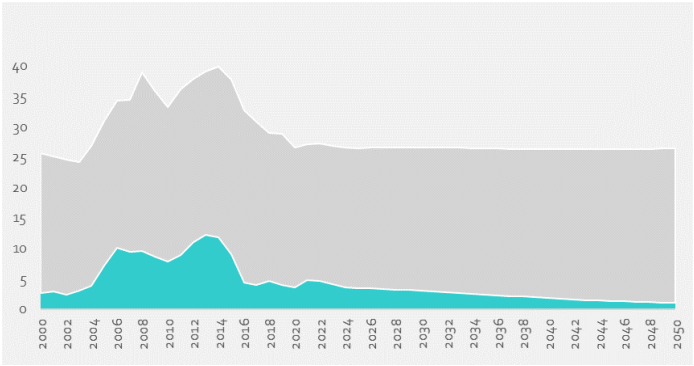
Source: Economic Commission for Latin America and the Caribbean (ECLAC).

Fiscal Dynamics Under the BAU Deficit Anchor and Social and Investment Goals Scenarios

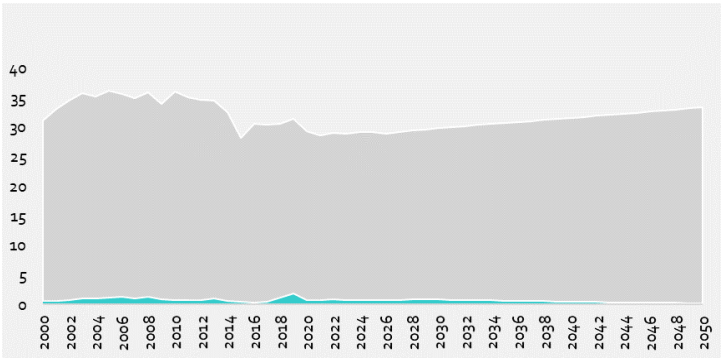
Total government revenues are projected to rise in most LAC6 countries in the BAU scenario, reflecting a continuation of previous efforts to strengthen non-hydrocarbon revenues. The projected increase in non-hydrocarbon revenues would more than compensate for the decline in hydrocarbon revenues—reflecting the projected stagnation in production levels—in Brazil, Colombia, Mexico and Trinidad and Tobago (Figure 12). However, in some cases it may be difficult to achieve these increases, as required structural tax reforms to generate substantial new revenues can be difficult to implement.

FIGURE 12 LAC6: General Government Revenue in the BAU scenario
(Percentage of GDP)

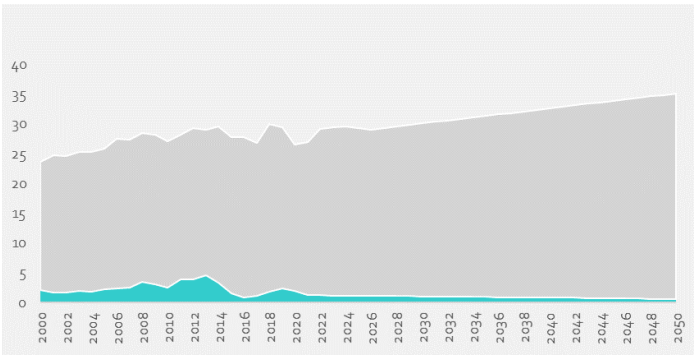
a. Bolivia (Plurinational State of)



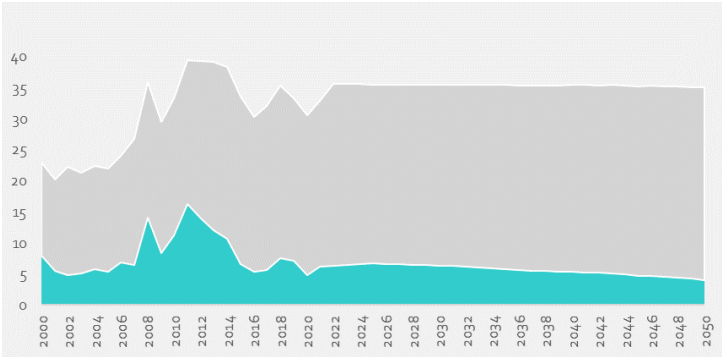
b. Brazil



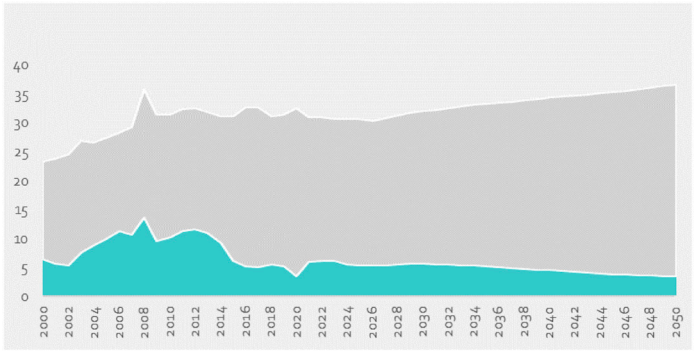
c. Colombia



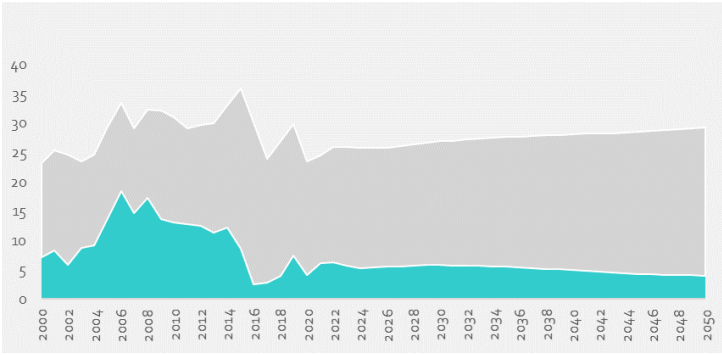
d. Ecuador



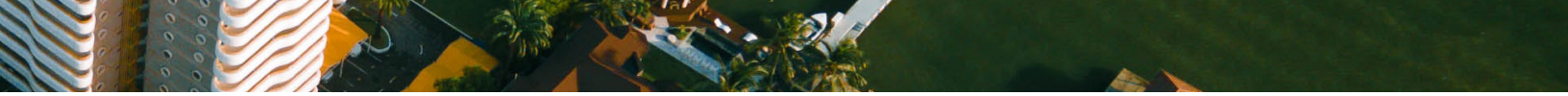
e. Mexico



f. Trinidad and Tobago

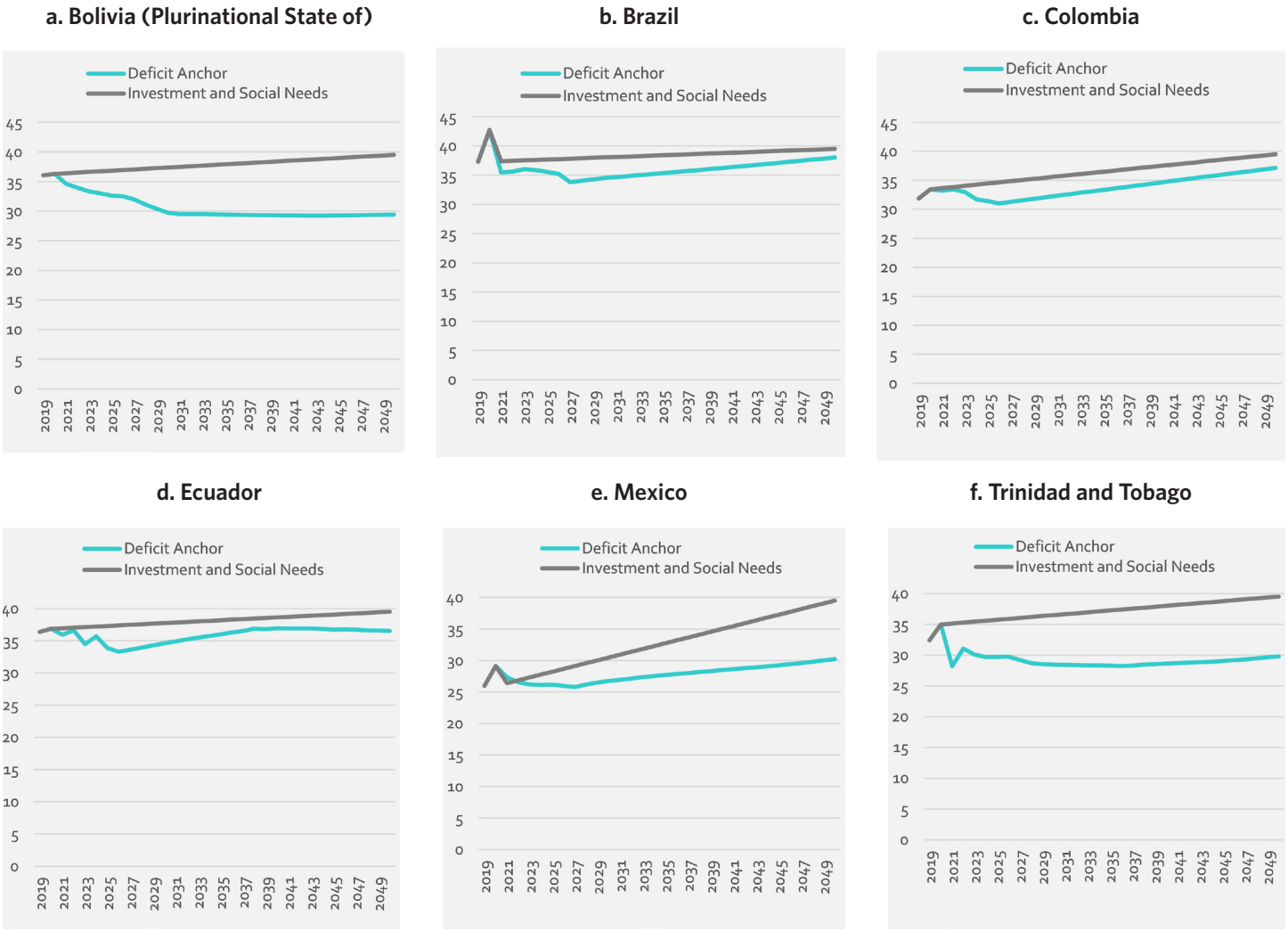


Source: Economic Commission for Latin America and the Caribbean (ECLAC).



LAC6 governments will face demands to increase public spending to meet investment and social needs under both the BAU and NZE scenarios. The working assumption is that these additional needs are met by increasing government expenditure in all countries to the level observed in 2019 at the 25th percentile of the Organisation for Economic Development and Co-operation (OECD) (39.5 percent of GDP) by 2050. To simplify the analysis, the increase in expenditure is assumed to grow linearly throughout the period (Figure 13). This expenditure scenario is labeled "Investment and Social Needs." For comparison purposes, an alternative scenario which anchors spending levels to maintain a stable fiscal balance throughout the transition period is also analyzed. This second scenario is labeled the "Deficit Anchor" scenario.

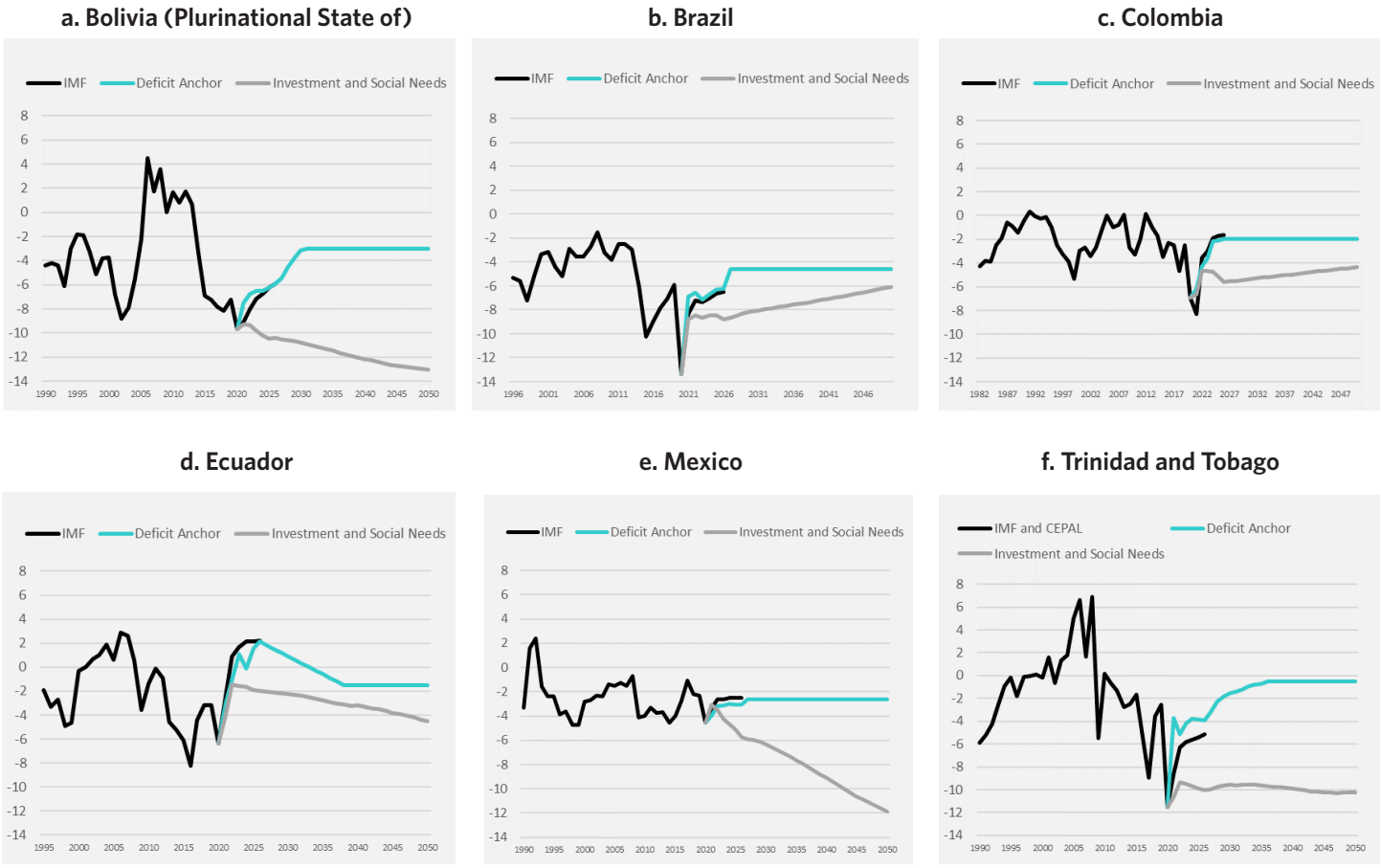
FIGURE 13 LAC6: General Government Total Expenditure in the BAU Scenarios
(Percentage of GDP)



Source: Economic Commission for Latin America and the Caribbean (ECLAC).
Note: In the "Deficit Anchor" scenario, expenditure for 2021-2026 is such that the debt path in this period equals that of the IMF's WEO; for the longer term, forecasts assume total expenditures are adjusted to maintain historical gap to income levels (stable fiscal balance). For the "Investment and Social Needs" scenario, total government expenditures (including interest payments) grow linearly to 39.5 percent of GDP.

Accommodating increased public spending to meet social and investment goals would create potentially unsustainable fiscal dynamics in some LAC6 countries under the BAU scenario. In the BAU "Deficit Anchor" scenario there is a gradual withdrawal of the fiscal stimulus put in place during the COVID crisis, with the deficit converging to historical averages (Figure 14). The stringent fiscal policy followed in the medium term would help keep debt anchored at "prudent" levels, but expenditure would remain below what is required to achieve the investment and social goals (Figure 15). In contrast, in the "Investment and Social Needs" scenario, fiscal deficits remain large or increase in size throughout the forecast period. As a result, all LAC6 countries would face mounting debt burdens that, by 2050, would be at least twice the ratio to GDP as in the BAU scenario.

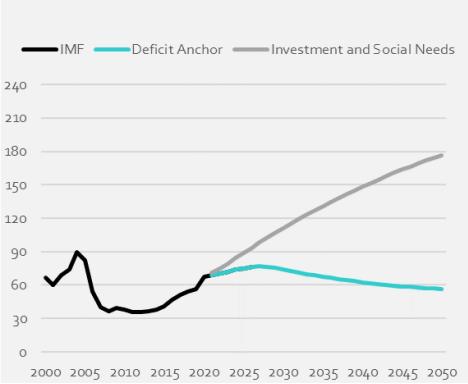
FIGURE 14 LAC6: General Government Total Balance in the BAU scenario
(Percentage of GDP)



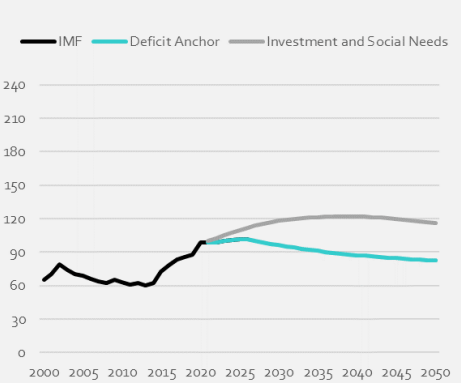
Source: Economic Commission for Latin America and the Caribbean (ECLAC).
Note: In the "Deficit Anchor" scenario, expenditure for 2021-2026 is such that the debt path in this period equals that of the IMF's April 2021 WEO; for the longer term, forecasts assume total expenditures are adjusted to maintain historical gap to income levels (stable fiscal balance). For the "Investment and Social Needs" scenario, total government expenditures grow linearly to 39.5 percent of GDP.

FIGURE 15 LAC6: General Government Gross Debt in the BAU scenario
(Percentage of GDP)

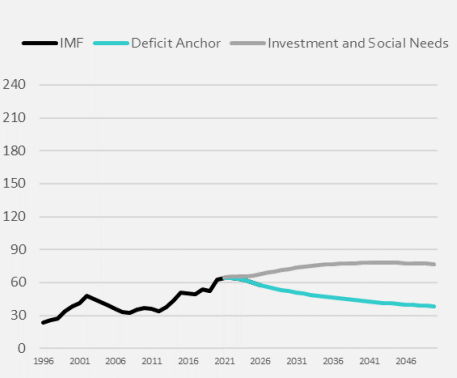
a. Bolivia (Plurinational State of)



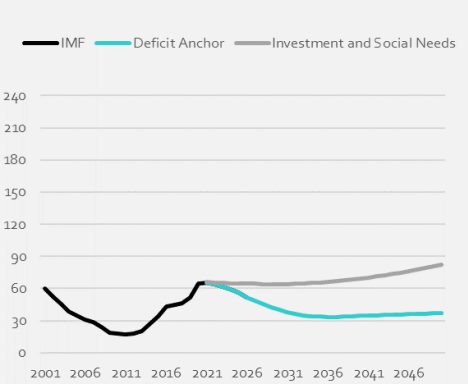
b. Brazil



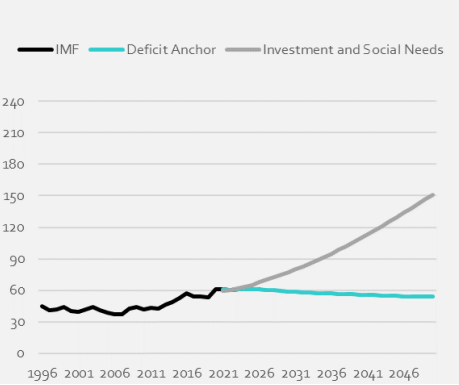
c. Colombia



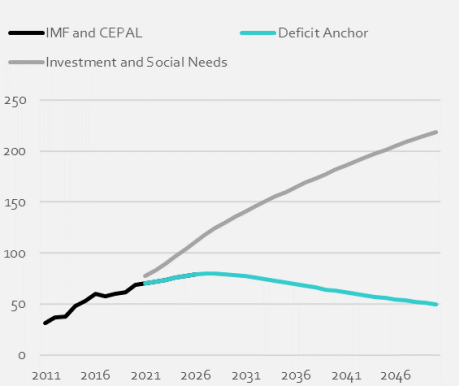
d. Ecuador



e. Mexico



f. Trinidad and Tobago



Source: Economic Commission for Latin America and the Caribbean (ECLAC).
Note: In the "Deficit Anchor" scenario, expenditure for 2021-2026 is such that the debt path in this period equals that of the IMF's April 2021 WEO; for the longer term, forecasts assume total expenditures are adjusted to maintain historical gap to income levels (stable fiscal balance). For the "Investment and Social Needs" scenario, total government expenditures grow linearly to 39.5 percent of GDP.

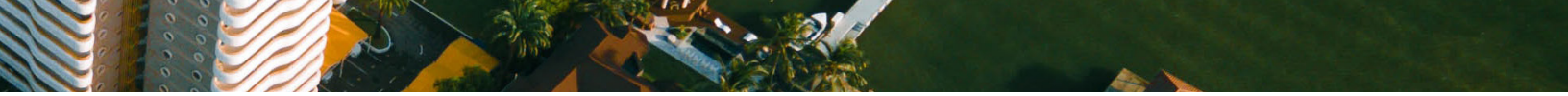
Fiscal Dynamics Under the NZE Social and Investment Goals Scenario

In the NZE scenario, implementing carbon taxes would generate additional revenues and may alleviate some of the projected fall in hydrocarbon revenues. However, these revenues would be small for countries that are relatively low consumers of energy (Plurinational State of Bolivia, Ecuador and Trinidad and Tobago), and would grow slowly for all the countries of the group (table D.2). Additionally, any relief provide by revenues from carbon taxes may be offset by the need for higher expenditure to cushion the impact on consumers.

TABLE 4 LAC6: Tax revenues from CO2 taxation
(Millions of US dollars)

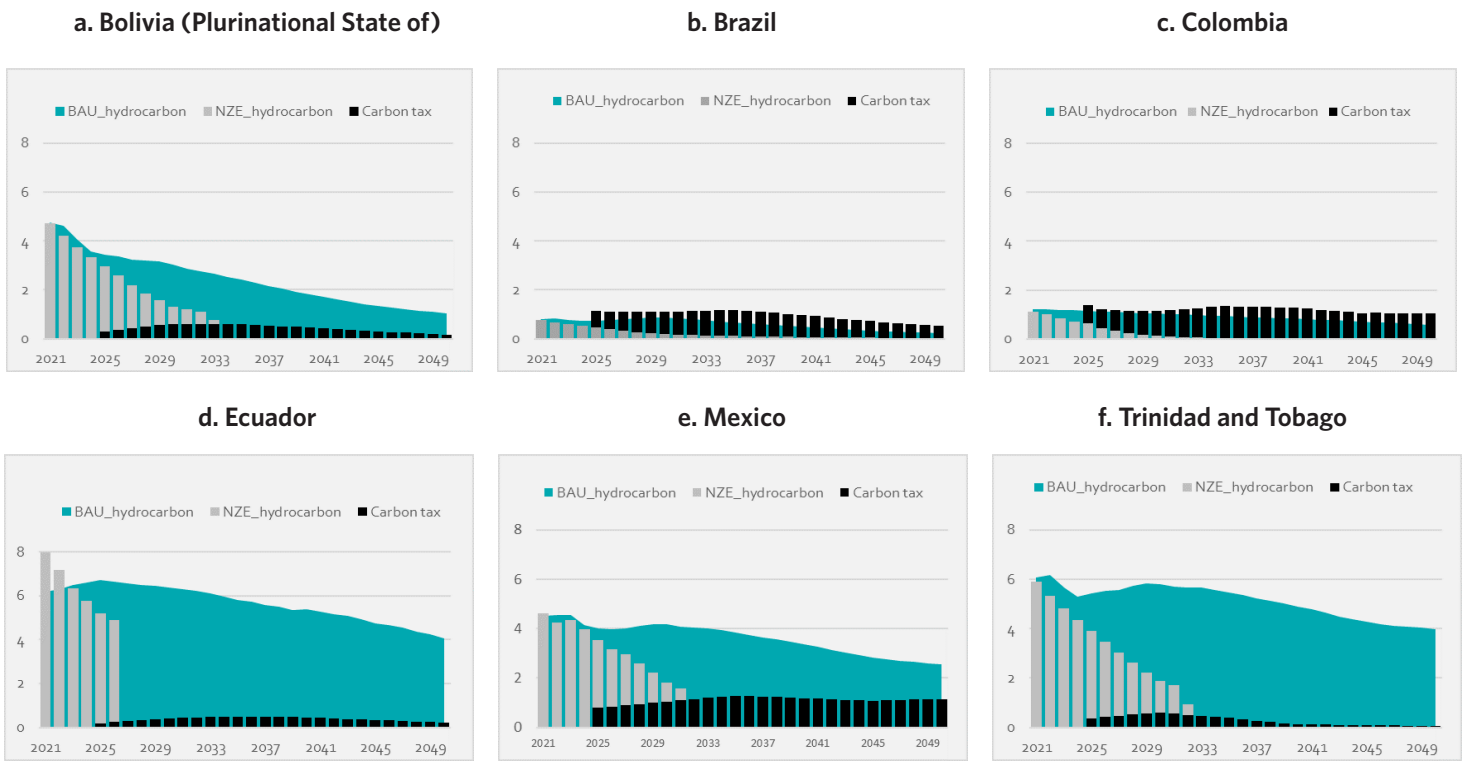
	2025	2030	2035	2040	2045	2050
Bolivia	162	461	631	677	603	462
Brazil	12,715	20,916	30,219	31,508	28,954	28,160
Colombia	2,445	4,132	6,567	7,773	8,028	9,923
Ecuador	201	555	786	862	764	573
Mexico	10,391	16,030	23,444	25,659	27,779	35,493
Trinidad and Tobago	88	167	119	44	36	27

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of IEA (2021) and NGFS (2021).



Despite revenues from CO2 taxation, in the NZE the loss in hydrocarbon related revenues would not be offset for most countries. According to the projections of the model, Brazil and Colombia are the only two countries in the LAC6 group that would experience a net revenue increase from carbon pricing. Mexico would eventually make up roughly half its revenue loss while the Plurinational State of Bolivia, Ecuador and Trinidad and Tobago would face substantial permanent shortfalls (Figure 16).

FIGURE 16 LAC6: General Government Hydrocarbon-related Revenue
(Percentage of GDP)



Source: Economic Commission for Latin America and the Caribbean (ECLAC).
Note: Revenue in the NZE scenario is the sum of hydrocarbon related revenue (gray bar) plus revenue from the carbon tax (black bar).

Even with an increase in economic activity in the first years of the transition of NZE, fiscal revenue losses are large for most countries. Revenue in the first 4 to 5 years of the transition would be lower in real terms in all countries bar Ecuador, where hydrocarbon production would decrease more slowly than for the others (Figure 17). At around half a percentage point of BAU GDP per year, in terms of resources available to the government, the losses would appear to be relatively manageable. As the investment-induced GDP boom fades, only Brazil and Colombia manage to increase revenue above the BAU scenario mainly through carbon taxation. All other countries in the group would face losses that follow the contraction of their economy relative to the baseline.

FIGURE 17 LAC6: General Government Revenue in the NZE scenario
(Percentage points of GDP difference relative to BAU scenario)

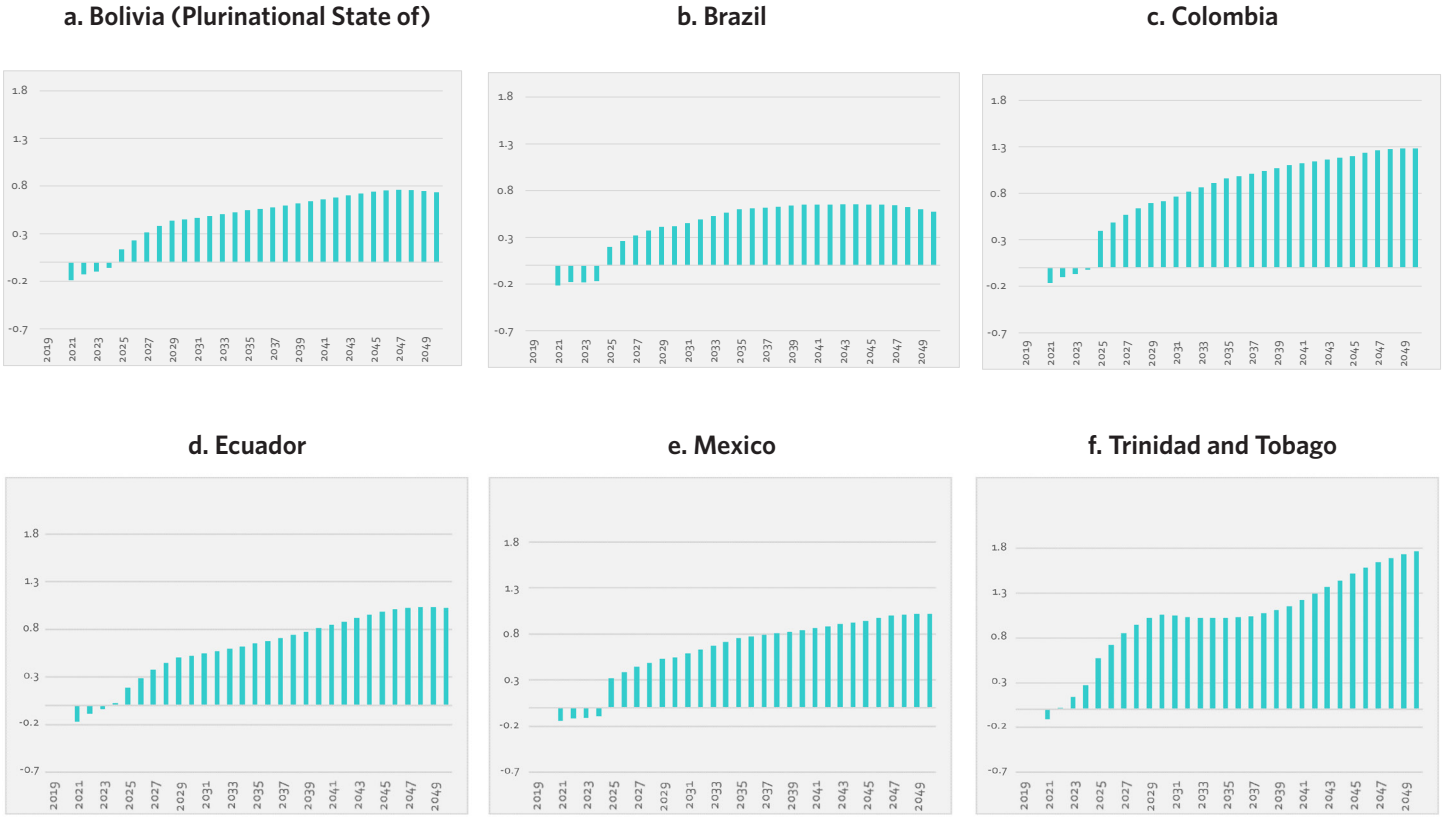
Source: Economic Commission for Latin America and the Caribbean (ECLAC).

In the NZE scenario, a crucial component of fiscal policy will be the size of carbon tax compensation schemes for vulnerable sectors. The transition to NZE will impact heavily some sectors of the economy and society, especially those for which energy consumption is relatively large. Governments will probably have to use a substantial part of their income from the carbon tax to smooth the transition of the large relative price changes that take place in the NZE. Some authors, for example Pisani-Ferry (2021), argue that "because carbon taxation is regressive, many governments will probably attempt to cushion its impacts

on the most vulnerable households." To simulate this policy element, the model considers a "partial compensation" scenario, where governments use 50 percent of carbon tax revenues as targeted expenditure through lump sum transfers to vulnerable households. **The rest of this section will compare the BAU investment and social needs (BAU-ISN) scenario and the NZE investment and social needs scenario incorporating the "partial compensation" mechanism (NZE-ISN-pc)**.

Expenditure levels to meet social and investment goals rise further in the NZE scenario because of additional outlays for the compensation of the carbon tax. Total expenditure, relative to the social and investment goals BAU scenario, would decline slightly at the beginning of the period as GDP rises as a result of green fiscal stimulus (Figure 18). While overall expenditure would exceed BAU-ISN levels going forward as the result of compensation payments. In some cases, the divergence between the NZE and BAU scenarios is significant, reaching 1.8 percentage points of GDP in Trinidad and Tobago by 2050.

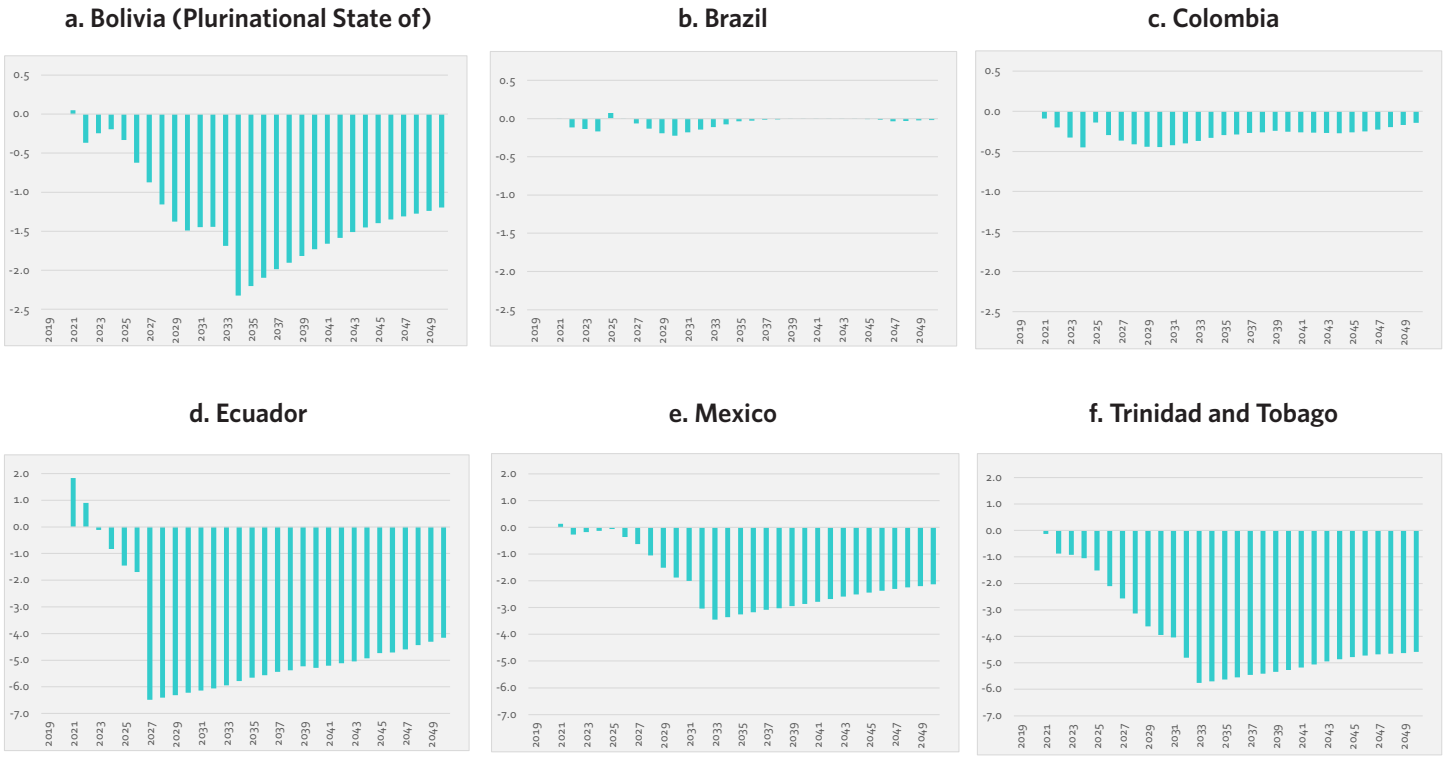
FIGURE 18 LAC6: General Government Total Expenditure in the NZE-ISN-pc scenario
(Percentage points of GDP difference relative to BAU ISN scenario)



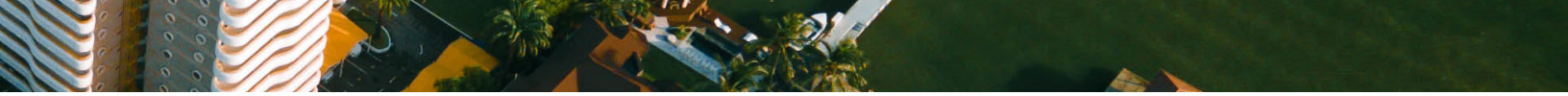
Source: Economic Commission for Latin America and the Caribbean (ECLAC).

The higher expenditure levels under the NZE-ISN-pc scenario would lead to much larger fiscal deficits in some LAC6 countries. Because of substantially lower revenue levels, governments aiming to maintain expenditure levels to meet social and investment needs would face higher fiscal deficits. Compared to the BAU-ISN scenario, fiscal deficits are larger in all countries for most periods of the transition, particular in the Plurinational State of Bolivia, Ecuador, Mexico and Trinidad and Tobago (Figure 19). However, in Brazil and Colombia the difference between the BAU-ISN and the NZE-ISN-pc scenarios is narrower, due to a net-increase in revenues due to the implementation of carbon taxes.

FIGURE 19 LAC6: General Government Fiscal Balance in the NZE-ISN-pc scenario
(Percentage points of GDP difference relative to BAU-ISN scenario)

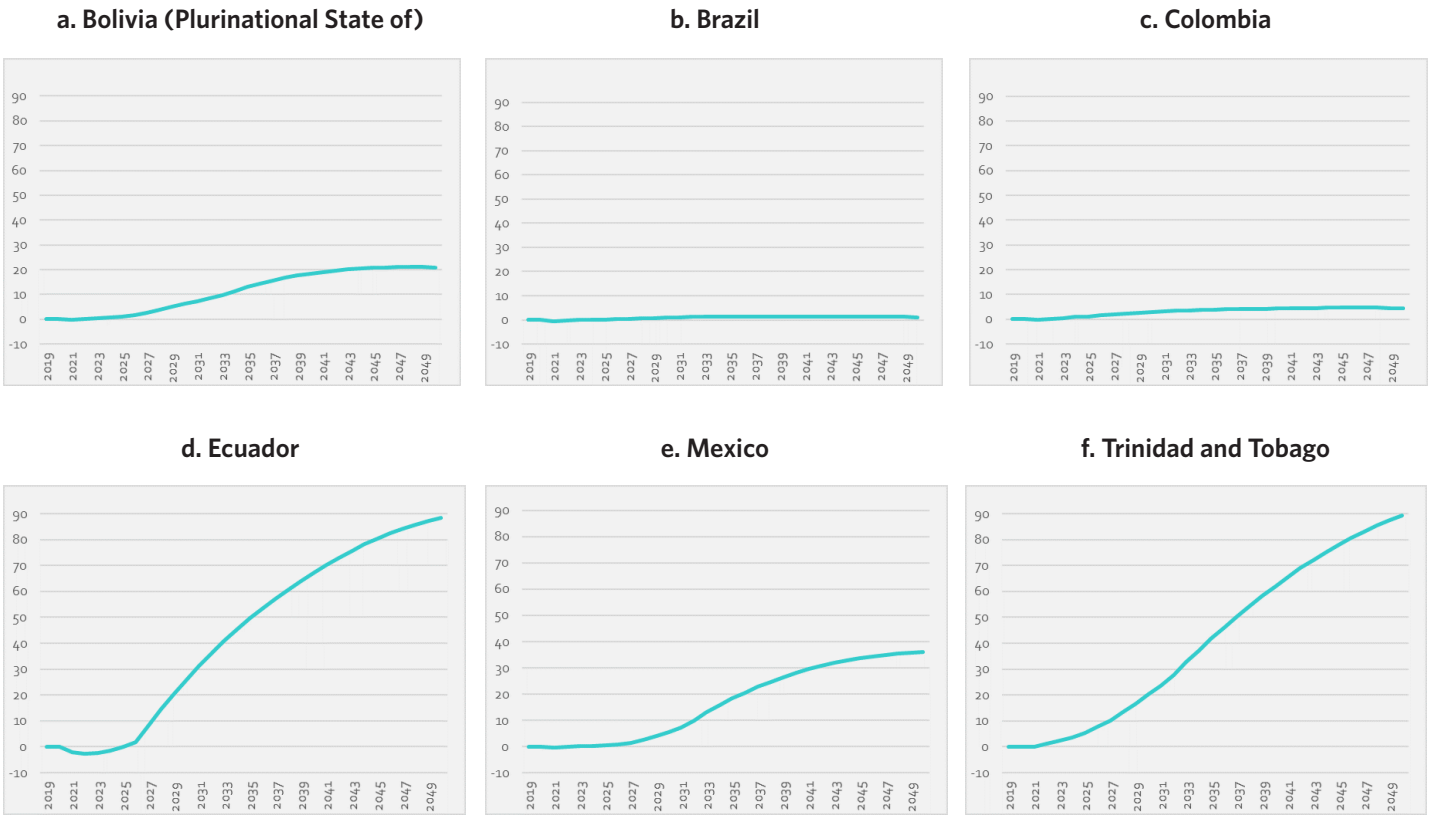


Source: Economic Commission for Latin America and the Caribbean (ECLAC).



Debt dynamics, already challenging under the BAU-ISN scenario, become unsustainable in some LAC6 countries in an NZE-ISN-pc scenario. For the hardest hit countries (Ecuador and Trinidad and Tobago), the transition would lead to debt levels that would be extremely hard to finance (Figure 20). This may be aggravated in some cases by existing debt issued by State-owned hydrocarbon producers (Box 1). In the absence of a clear commitment by the international community and the requisite support of multilateral institutions, governments would be hard pressed to find the required financing in private markets.

FIGURE 20 LAC6: General Government Debt in the NZE-ISN-pc scenario
(Percentage points of GDP difference relative to BAU-ISN scenario)



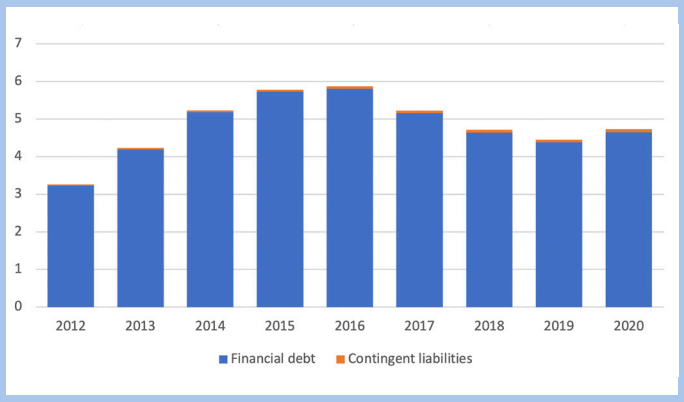
Source: Economic Commission for Latin America and the Caribbean (ECLAC).

BOX 1 Financial debt and liabilities of State-owned hydrocarbon producers

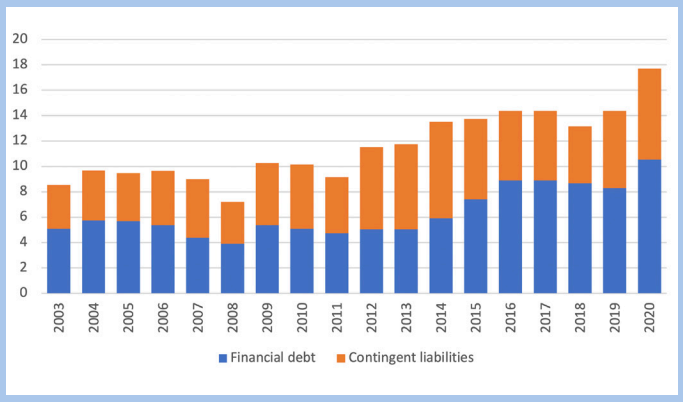
Beyond determining what will be the future for LAC6 countries once hydrocarbon fiscal revenues are diminished under the NZE transition, the debt and other contingent liabilities (such as pensions derived liabilities) of oil companies with national participation (YPFB, Petrobras, Ecopetrol and Pemex) should be in the LAC6 agenda por policy makers. As seen in the accompanying figure, Brazil and Mexico are the countries that may face the highest oil company financial burdens once hydrocarbon activity declines.

Financial Debt and Contingent Liabilities
(Percentage of GDP)

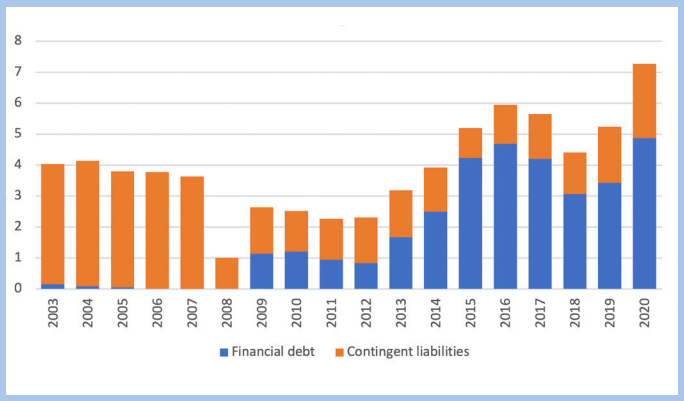
a. Bolivia (Plurinational State of): YPFB



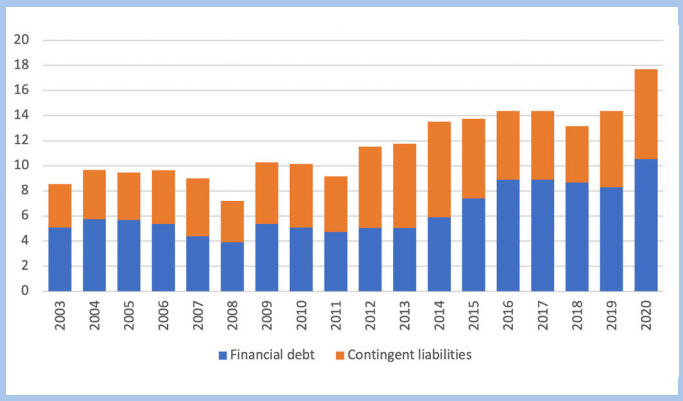
b. Brazil: PETROBRAS



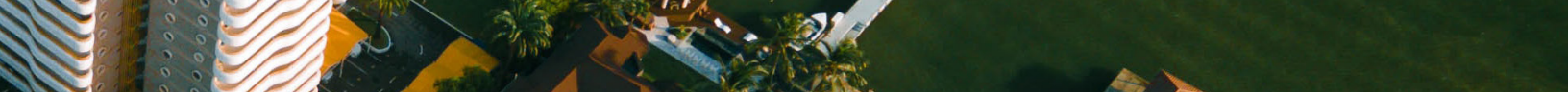
c. Colombia: ECOPETROL



d. Mexico: PEMEX



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of YPFB: Balance general comparativo formato MEFP [online] https://www.ypfb.gob.bo/en/; Petrobras: Consolidated Interim Financial Statements [online] https://www.investidorpetrobras.com.br/en/results-and-announcements/results-center/; Ecopetrol: Estados financieros no consolidados [online]: https://www.ecopetrol.com.co/wps/portal/Home/es/Inversionistas/InformacionFinanciera/Estadosfinancieros;PEMEX: Estados financieros no dictaminados [online]: https://www.pemex.com/en/investors/financial-information/Paginas/results.aspx



POLICY OPTIONS FOR LAC6 TO MITIGATE THE FISCAL IMPACT OF THE FOSSIL FUEL TRANSITION

Achieving net-zero emissions is key to combating climate change and will require a fundamental shift in the energy matrix. While efficiency gains and substitution for less carbon-intensive products and production processes will play an important role, decarbonizing energy production is fundamental to gaining leverage on global emissions. The magnitude of this shift cannot be understated, emissions-intensive fossil-fuel sources account for 80 percent of total energy supply at the global level in 2020, led principally by coal and oil (IEA, 2021).

Reconstituting the global energy matrix will require very substantial public and private investments, generating significant needs for financing. Winding down existing power facilities, ramping up electricity generation from renewables, improving energy infrastructure, and developing supporting technologies such as energy storage, among others, are highly capital intensive. The IEA (2021) estimates that global annual capital investment would need to increase sharply within a decade, rising from an average of $2 trillion (2.5 percent of GDP) annually between 2016 and 2020 to $5 trillion by 2030 (4.5 percent of GDP).

Latin America and the Caribbean and the LAC6 countries face significant financing constraints and public and private investment is weak. Public debt levels in the region increased in the past decade and rose sharply in 2020. Gross financing needs—covering fiscal deficits and the amortization of existing debt—will be large in the coming years, potentially curtailing the space for additional debt-financed investment. Public investment has been and may continue to be the principal variable for fiscal adjustment in the coming years. This would aggravate the already weak levels of overall investment in the region, which are among the lowest in the world.

The baseline BAU scenario that incorporates greater public spending to meet social and investment goals suggests that debt dynamics would be potentially unsustainable even before considering NZE. Fiscal dynamics under the BAU "deficit anchor" scenario, which presupposes continued growth in public revenues and spending restraint, are manageable but are not socially or economically sustainable in a region that faces severe structural development gaps. Despite the favorable assumptions for growth and public revenues in the BAU scenario, achieving social and investment objectives would lead to debt levels reaching upwards of 200 percent of GDP by 2050 in some LAC6 countries.

Under NZE, the efforts to achieve social and investment goals would lead to explosive public debt growth in some cases, well beyond any measure of debt sustainability. Total revenues would fall sharply, as the decline in hydrocarbon revenues are not offset by those from other sources, particularly from carbon taxes. This dynamic creates exceptionally large fiscal deficits and a concomitant massive increase in public debt. In addition, rising financing costs, in the form of higher interest payments would significantly alter the composition of overall expenditure.

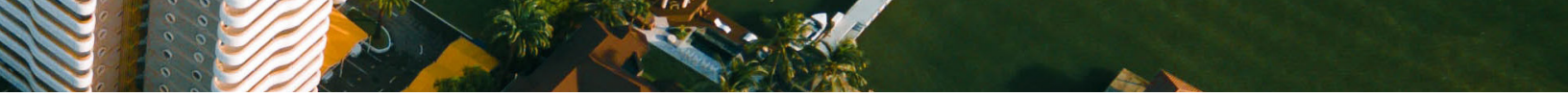
Long-run macroeconomic and fiscal simulations are by nature imperfect and may underestimate the impact of NZE on LAC6 countries. The models used in this study are based on the assumptions that underline the IEA (2021) baseline and NZE global scenarios, which may not be reflective of the macroeconomic and fiscal dynamics of LAC6 countries in the medium- and long-term. A simplifying assumption for the LAC6 NZE scenario is that countries can limit the long-term decline in GDP by implementing green fiscal stimulus in the first years of the transition, which may be exceptionally difficult given the current fiscal context. Country-specific data limitations, especially for future carbon prices, hinders the analysis of additional revenues from carbon taxes and outlays for compensation schemes.

Against this backdrop, a key challenge for LAC6 countries is maintaining an active fiscal policy that responds to both macroeconomic and development objectives. Countries in the region, including those of the LAC6, suffer from entrenched inequalities and structural development gaps—informality, productive structure, social protection systems, among others—that hinder economic growth (ECLAC, 2020a). Development-oriented fiscal policies, backstopped by a fiscal sustainability framework, are key for strengthening the region's capacity to successfully navigate the NZE transition.

A pro-growth and development-centred fiscal policy will require countries to adopt a strategic approach to public expenditure, especially as they face pressure on their public accounts. Public spending will need to be channelled to programs with high economic, social and sustainability returns. Closing structural development gaps requires an increase in public investment, which is low in the region and in LAC6. Capital outlays in appropriate and quality projects that are employment-intensive and gender-equitable in strategic sectors will play a key role in reshaping the productive structure and support sustainable and inclusive growth during the NZE transition.

Setting the appropriate conditions to bolster private investment will be one of the key determinants of the economic and fiscal conditions underlying the transition. In the scenario spelled out by the IEA, investment is a main buffer for global growth in the NZE. While the aggregate global scenario doesn't look particularly stressful, it masks the fact that countries will be competing for scarce resources that are in high demand practically everywhere. If the LAC6 where to be successful in increasing private investment in a continuous and consistent manner during the transition to NZE, the outlook would look much more benign.

A fiscal sustainability framework, based on greater domestic resource mobilization, will be required to support a pro-growth and development-centred fiscal policies. There is ample room to strengthen tax revenues in some LAC6 countries, for example, in Mexico (16.5 percent of GDP), Colombia (19.7 percent of GDP) and Ecuador (20.1 percent of GDP), which are well below the averages for Latin American and Caribbean as a whole (22.9 percent of GDP) and for the OECD (33.8 percent of GDP) (OECD-ECLAC-CIAT-BID, 2021). In the short-term, countries should take measures to tackle tax evasion and review costly tax expenditures. Towards the medium-term, tax revenues will need to be strengthened, with measures targeting greater use of direct taxes, including income, property and wealth taxes (ECLAC, 2021b).



As highlighted in the NZE scenario, carbon taxes may provide little support for lost hydrocarbon revenues. The assumption that carbon taxation is only partially returned to households is probably too optimistic. The projected magnitude of carbon taxation under the NZE will leave households footing large energy bills during the transition. Governments in the LAC6 have traditionally cushioned the direct impact of energy price increases through subsidies. A potentially more plausible scenario is that 100 percent of the tax intake from carbon pricing is returned to households, resulting in no net-improvement in fiscal accounts over the forecast period.

LAC6 countries must take advantage of the relatively favorable scenario for hydrocarbon prices during the rest of this decade to maximize their fiscal revenues from oil and gas production and create fiscal buffers. Although the magnitude and fiscal ramifications of NZE are very uncertain, the NZE shock is not unexpected. In contrast to periods of unexpected commodity price crashes, hydrocarbon producing countries have an advance warning of what NZE will entail and must therefore take preventative measures, including through the review of existing fiscal frameworks for the sector. Sovereign wealth funds could also be leveraged to provide long-term financing for green investment. These resources need to be well managed to prepare for the more stringent years of the transition.

Domestic resource mobilization efforts at the national level need to be accompanied by supportive measures by IFIs, such as the IMF, to ensure a successful NZE transition. Tackling climate change must be framed within a development perspective that recognizes that these investments are long-term in nature and that they must be accompanied by appropriate and quality social and productive projects to ensure their success. Financing support by IFIs should therefore be available to all countries, regardless of income-level, reflecting the global nature of the climate change challenge.

The IMF is in a unique position to help LAC6 countries smooth the path to NZE. LAC6 countries during the NZE transition will need to undertake significant public expenditures to address development needs and increase investment to rebuild their productive structure, while at the same time experiencing a sharp decline in revenues from hydrocarbons. Without recourse to additional resources, these countries could potentially face significant social and economic pressures. As in other complex global situations (e.g. most recently the COVID-19 pandemic), it is important that the IMF has the necessary instruments to respond to the evolving needs of its members.

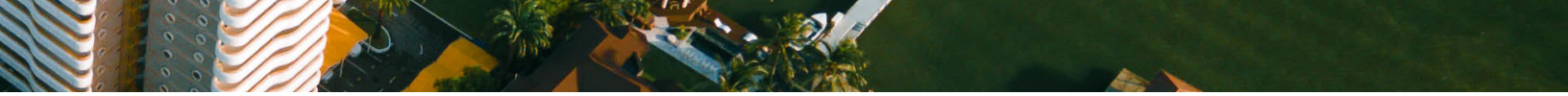
To be effective at identifying risks and needs, climate change and development considerations must be incorporated in every aspect of the IMF's work. The adoption of a climate change strategic plan is a good first step, building capacity to better assess climate change needs for member countries in its existing products (IMF, 2021c). However, a net-zero emissions transition will require a proactive approach, incorporating both a climate change and development perspective. This transition has profound implications for fiscal policy and macroeconomic policy more generally in developing and emerging economies. To that end, surveillance tools, such as the Article IV, Debt-Sustainability Assessments, Financial Sector Assessment Programs will need to be upgraded and expanded.

Expanding the IMF's lending toolkit will be key to ensuring that its member countries, in particular hydrocarbons producers, have access to long-term low-cost financing for green structural transformation and sustainable and inclusive development. The Fund's lending mandate allows it to extend financing to members facing a balance of payments problem, through tools such as the Rapid Credit Facility and the Rapid Financing Instrument, caused by climate-related economic needs. However, there is a need to create instruments that are aligned with the development and transition needs of member countries.

Access to precautionary financing will be particularly helpful for hydrocarbon producing countries as they adjust during the NZE transition. Potential debt distress and solvency issues call for the preemptive buildup of backstops. For hydrocarbon producing countries, there is a significant risk of "sudden stops" in market financing as hydrocarbon revenues diminish and the stock of debt increases, compounded in some cases by implicit or explicit guarantees on national energy companies. The substantive macroeconomic adjustments can trigger balance of payments problems, capital flow volatility and financial system vulnerabilities. At the same time, hydrocarbon producing countries will also need significant financial support to finance economy-wide investments to support a fundamental restructuring of the productive structure while at the same time ramping up social spending and public investment to close structural development gaps.

Flexibility in the use of Fund resources must be a key component of precautionary NZE financing. A successfully managed transition will require public investment to increase substantially. It will also need a full-fledged redesign of hydrocarbon taxation and subsidy policies. Hydrocarbon producing countries will be well served with access to Fund resources and programs that consider the uniqueness of their situation. Notably, for the LAC6, this implies the recognition that medium-term fiscal support will probably be needed if both the social expenditures and the NZE investment needs are to be met. The IMF will have to recognize that completing a fiscal consolidation policy path, which in many cases will requires a two- or three-decade effort, cannot be a precondition for NZE support.

In designing the duration and conditionality of a transition management facility, the IMF thus needs to consider the different horizons and policy choices facing hydrocarbon producing countries. For the NZE, the time frame attached to traditional Stand-By Arrangements (SBAs) seems to be too short (1 to 3 years) compared to the 30-plus years of the transition period. The conditionality attached to SBAs is also too stringent. At the other end of the spectrum, the ex-ante conditionality required for current precautionary credit lines (the Flexible Credit Line and Precautionary and Liquidity Line) will also be hard to meet for most members. Therefore, if conditionality measures are considered, they should balance the negative shock of NZE for hydrocarbon producing countries with the positive externalities it will bring for the rest of the world.



The proposed Resilience and Sustainability Trust (RST) could play a catalytic role in supporting countries to respond to climate change but may fall short of addressing the investments necessary to achieve green structural transformation. The RST's relatively small size—with an initial target size of $50 billion—may reduce its effectiveness. At the same time, overcoming the macroeconomic and social implications of climate change is fundamentally a development issue and as such the RST should expand access to financing at favorable terms for developing countries and emerging economies—including middle-income countries—particularly hydrocarbons producers, to invest in green structural transformation.

The resources required of the IMF to avert a balance of payments crisis for hydrocarbon producing countries will be substantial. These resources are likely much larger than the amounts currently envisaged for the RST. The LAC6 countries will together require substantial additional of financing. In the absence of conducive financial conditions, the willingness of hydrocarbon producing countries to implement the NZE policy framework will be limited. The Fund's membership must collectively work to ensure the needed resources are available to prevent this from being the case.

Achieving net-zero emissions is a global good which demands large adjustments carried out by all countries. All multilateral institutions must be up for the task. Giving its unique stature, the IMF must be at the forefront of this effort. Its financial support of NZE will likely catalyze additional financing from other multilateral institutions. It can also play an ex-ante role in the coordination of multilateral and private creditors. The IMF's macroeconomic updates and country monitoring, its experience in the assessment of debt sustainability and capacity building will all be a reference point in the transition.

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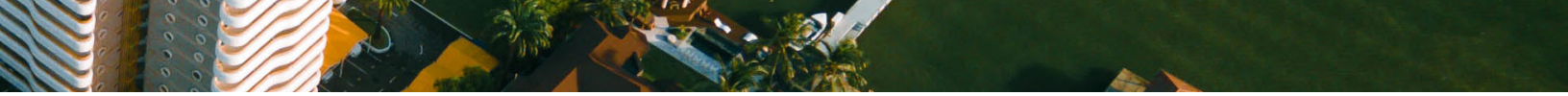

ANNEX 1

Public finance projections

The 2021-2050 projections for each country's public finance aggregates across the different scenarios are generated by a model based on the medium-term projections of the template by IMF (2021b):

$$REVENUE_t = NON\_HIDROCARBON\ REVENUE_t + HYDROCARBON\ REVENUE_t$$

$$EXPENDITURE_t = PRIMARY\ EXPENDITURE_t + INTEREST\ EXPENSE_t$$

$$PRIMARY\ EXPENDITURE_t = CURRENT\ EXPENDITURE_t + CAPITAL\ EXPENDITURE_t$$

$$BALANCE_t = REVENUE_t - EXPENDITURE_t$$

$$PRIMARY\ BALANCE_t = REVENUE_t - PRIMARY\ EXPENDITURE_t$$

$$DEBT_t = DEBT_{t-1} - BALANCE_t$$

$$INTEREST\ EXPENSE_t = DEBT_{t-1} * i$$

$$i = \frac{1}{(2020 - t_0 + 1)} \sum_{t=t_0}^{2020} i_t$$

$$i_t = \frac{interest\_expense_t}{debt_{t-1}}$$

Except for the debt implicit interest rate, the variables refer to nominal quantities in local currency. In the model, both balances, the debt and the interest expense are endogenous. The rest of the variables are calculated outside the model and fed into the system. The paths of these exogenous variables follow ad-hoc rules intended to portray the underlying assumptions of each scenario.

The model uses the IMF's General Government Revenue, Expenditure, Debt and GDP historical data and projections for 2021-2026.[6] It also builds on ECLAC's historical figures on hydrocarbon revenue, interest expense and capital expenditure up to 2020. [7] In the cases of Ecuador and Mexico, both IMF and ECLAC's data on public finance correspond to the non-financial public sector which includes state-owned enterprises.[8] For the Plurinational State of Bolivia, Brazil and Colombia, data from both sources refer to the usual definition of General Government which excludes such enterprises. For Trinidad & Tobago, both sources supply data on the Central Government which also excludes state-owned enterprises.[9]

[6] World Economic Outlook database, April 2021. All variables in local currency at current prices.

[7] Hydrocarbon revenue data was sourced from the *Fiscal Revenues from Non-Renewable Natural Resources in Latin America and the Caribbean* database of the Fiscal Affairs Unit of the Economic Development Division of ECLAC (available online at CEPALstat). In some cases, were calculated on the basis of data from ECLAC and the IMF to obtain chained series for INTEREST EXPENSE and CAPITAL EXPENDITURE in local currency at current prices.

[8] International Monetary Fund (2014). Government Finance Statistics Manual 2014. Available in https://www.imf.org/external/pubs/ft/gfs/manual/gfs.htm

[9] To rule out any discrepancies arising from the IMF's treatment of extraordinary revenue over the last years, the projections for Trinidad & Tobago use ECLAC's revenue, expenditure and debt statistics up to 2020 and the IMF's projections for these variables through 2021-2026.

Business-as-Usual Scenario (BAU)

HYDROCARBON REVENUE Historical data on hydrocarbon revenues in local currency up to 2020 was obtained from the Fiscal Affairs Unit (ECLAC). Hydrocarbon revenues, for the period 2021-2050, were projected considering the forecasting of prices, production, the percentage of royalties or other taxes and considering their share of total tax revenues. On one hand, the historical data and projections of oil and gas prices up to 2050 consider the Reference Case of the International Energy Agency (2021). A single oil price was considered for LAC6 (the weighted import price of oil in real terms), while for the gas price the Henry Hub was considered. On the other hand, historical data on oil and gas production from 2021 onwards were obtained from official sources in countries with medium-term forecasts. For subsequent years, the hydrocarbon production was estimated considering the average of recent years and assuming a continuous and infinite availability of hydrocarbon reserves.

NON-HYDROCARBON REVENUE It is the difference between REVENUE and HYDROCARBON REVENUE. For 2021-2026, it is calculated as the IMF's projected General Government Revenue less the projected HYDROCARBON REVENUE series. For 2027-2050, NON-HYDROCARBON REVENUE is such that

$$\Delta non\_hydrocarbon\ revenue_{2050-2026} = \Delta non\_hydrocarbon\ revenue_{2026-2000}$$

where lowercase refers to GDP ratios. In other words, *non_hydrocarbon revenue* grows linearly from 2026 and replicates its absolute increase observed over the previous two and a half decades.[10]

Debt implicit interest rate

It is the historical average ratio of INTEREST EXPENSE to DEBT. [11]

EXPENDITURE

Case: Deficit Anchor (DA)

For 2021-2026, EXPENDITURE is such that DEBT to GDP ratio delivered by the model reproduces the IMF's projected path for this ratio.[12] For 2027-2050, EXPENDITURE is such that BALANCE to GDP equals its average over the period 2000-2019.[13]

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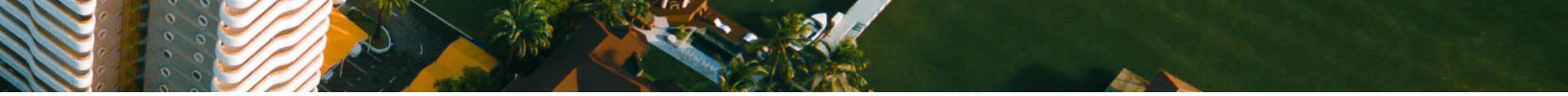
[10] For Brazil, it is the maximum increase observed over the 2000-2026 period. For a relevant debt trajectory, Ecuador's *non_hydrocarbon revenue* was capped at 30.94 percent in 2050. For the rest of the countries, the absolute increase of *non_hydrocarbon revenue* over the 2000-2026 period was calculated using suitable ends to control for the volatility of *non_hydrocarbon revenue.*

[11] For Bolivia, Brazil, Ecuador data on both INTEREST EXPENSE and DEBT are available since the early 2000s. For Colombia, since 2008. For Mexico, since 1997. For Trinidad & Tobago, since 2012.

[12] In this case, EXPENDITURE becomes endogenous by imposing the corresponding restriction on the model and its 2021-2026 path is solved numerically inside the system. In the case of Trinidad & Tobago, it replicates an adjusted IMF's projected path of DEBT to GDP projected path chained to ECLAC's.

[13] In the cases of the Plurinational State of Bolivia, Ecuador and Trinidad & Tobago smooth transition factors on EXPENDITURE to GDP were used to chain the 2021-2026 and 2027-5050 EXPENDITURE paths.



Case: Investment and social Needs (ISN)

For 2021-2050, EXPENDITURE is such that its ratio to GDP follows a linear path from 2020 to achieve 39.5 percent in 2050, a target equivalent to the OECD 25th percentile in 2019.[14]

CURRENT AND CAPITAL EXPENDITURE In the model, once EXPENDITURE has been settled by the respective condition above, the equation of the PRIMARY BALANCE becomes redundant and is no longer useful to shape the path of CAPITAL EXPENDITURE. In this context, CAPITAL EXPENDITURE is projected through the following restriction:

$$\frac{capital\ expenditure_t}{expenditure_t} = \overline{ce}$$

where lowercases refer to GDP ratios and $\overline{ce}$ is the historical average of the ratio of *capital expenditure* to *expenditure*.[15] In either EXPENDITURE case, *expenditure* is ever increasing and so is *capital expenditure*. As for the CURRENT EXPENDITURE, it is calculated as:

$$CURRENT\ EXPENDITURE_t = PRIMARY\ EXPENDITURE_t - CAPITAL\ EXPENDITURE_t$$

Net Zero Emissions scenario (NZE)

HYDROCARBON REVENUE For calculating the hydrocarbon revenues for the NZE scenario, the same methodology of considering production, prices and royalties and other taxes, was considered. it was considered the same methodology as the business-as-usual scenario. Nevertheless, in the NZE scenario, beyond projects already committed as of 2021, there are no new oil and gas fields approved for development, and no new coal mines or mine extensions are required. This scenario considers all oil and natural gas fields currently under production or discovered. Hydrocarbon production is dictated by the natural depletion of current sources and fields under development. In this case, future production evolves according to the following assumption:

- 90 percent of current proven reserves
- 50 percent of current probable reserves
- 10 percent of current possible reserves

With respect to prices, gas and oil prices follow the IEA's (2021) central scenario.

NON-HYDROCARBON REVENUE It equals the value of the BAU scenario NON-HYDROCARBON REVENUE plus the estimated amount collected from the CARBON TAX.

[14] Due to their atypical EXPENDITURE to GDP in 2020, for Brazil and Mexico the projected path for this aggregate starts in its value of 2019.

[15] Data on both expenditure and capital expenditure for Bolivia, Mexico and Trinidad & Tobago are available since 1990. For Brazil, since 2005. For Colombia, since 2008. For Ecuador, since 1995.

Debt implicit interest rate

Same values of the BAU scenario.

EXPENDITURE

Case: Deficit Anchor (DA)

Same EXPENDITURE values of the BAU Deficit Anchor case.

Case: Deficit Anchor plus compensation (DA+compensation)

It is the BAU Deficit Anchor scenario EXPENDITURE value plus a compensation component. The compensation component equals half of the amount of the carbon tax.

Case: Investment and social Needs (ISN)

Same EXPENDITURES values of the BAU Investment and social Needs case.

Case: Investment and social Needs (ISN) plus compensation (ISN+compensation)

It is the BAU Investment and Social Needs scenario EXPENDITURE value plus a compensation component. The compensation component equals half of the amount of the carbon tax.

CURRENT AND CAPITAL EXPENDITURE Capital and current expenditures are determined in the same fashion as in the BAU scenario.

Business as Usual Scenario (BAU)

GDP FORECAST Before 2027, public finance aggregates to GDP for each country are calculated using the IMF's nominal GDP series in local currency.[16] For 2027-2050, the path of the GDP series follows

$$GDP_t = RGDP_t * D_t$$

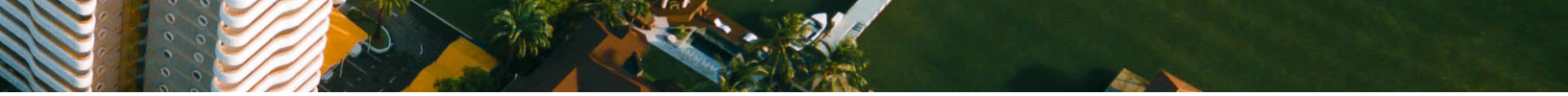
$$D_t = D_{t-1}(1 + \pi_D)$$

$$RGDP_t = RGDP_{t-1}(1 + g_t)$$

where $RGDP_t$ and D_t are, respectively, the GDP in local currency at constant prices and the GDP deflator. The GDP deflator inflation is given by π_D and g_t is the forecast series of the RGDP expansion rate. For a steady measure, the value of π_D is calculated as

$$\sum_{j=2020}^{2026} D_j$$

[16] World Economic Outlook database, April 2021.



where D_j are the last observed value of the variation of the real GDP and the available IMF's projections for this series. [17] The forecast series of the real GDP variation was generated by an AR(1) model with a constant as the deterministic component. The data used to fit the model is the percent change of the GDP in local currency at constant prices from the IMF's WEO database of April 2021.

TABLE 1A Real GDP growth AR(1) model estimation

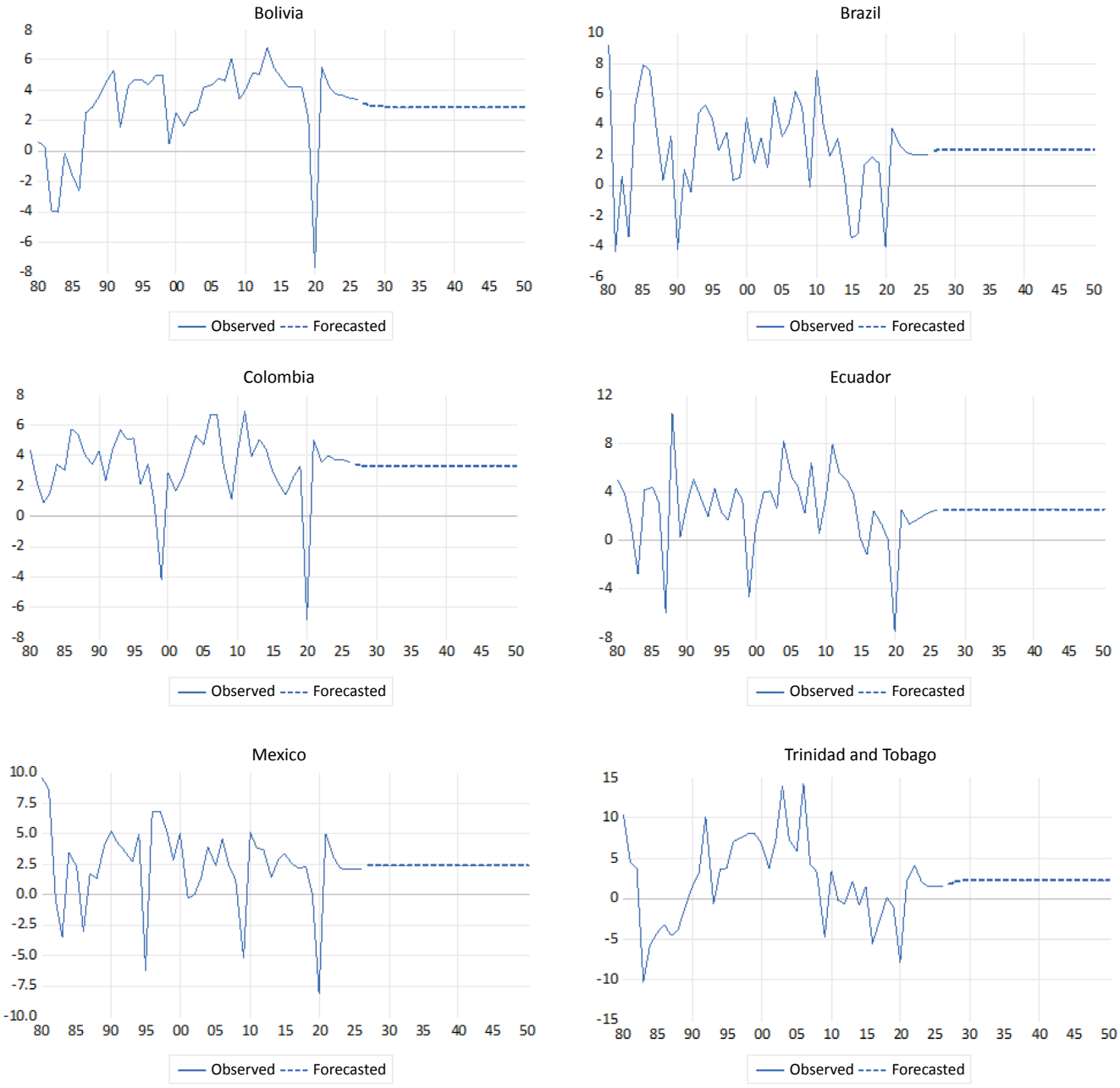
Country	Bolivia	Brazil	Colombia	Ecuador	Mexico	Trinidad & Tobago
Coefficients						
AR(1)	0.47 (0.12)***	0.15 (0.13)	0.20 (0.13)	0.00 (0.14)	0.04 (0.13)	0.56 (0.15)***
Constant	2.89 (1.21)**	2.23 (0.55)***	3.34 (0.64)***	2.57 (0.57)***	2.32 (0.59)***	2.33 (1.46)
R-squared	0.23	0.02	0.04	0.00	0.00	0.31
Adjusted R-squared	0.19	0.02	0.00	0.00	0.00	0.27
S. E. of regression	2.63	3.26	2.43	3.37	3.48	4.55
Log-likelihood	-110.7	-120.7	-106.9	-122.2	-123.8	-136.56
Durbin-Watson	2.13	1.95	2.02	1.99	1.90	2.20
Observations	1980:2026	1980:2026	1980:2026	1980:2026	1980:2026	1980:2026

Results obtained with Eviews 12. Standard errors in ().
*** significance at 1 percent level, ** significance at 5 percent level, & * significance at 10 percent level.

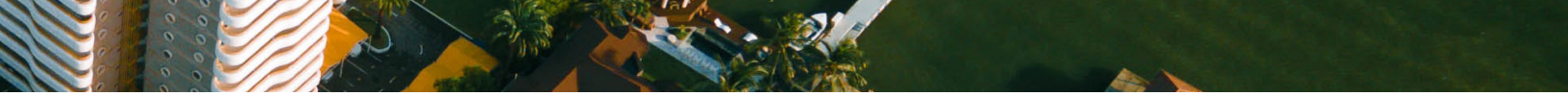
Table 1A, presents the results of the estimation of the AR(1) model for each country. As expected, in most of the cases, the constant has statistical significance at conventional levels. In the cases of Brazil, Colombia, Ecuador and Mexico, the estimated coefficient of the AR component has no statistical significance. This result suggests a *white noise* process around a constant for the annual economic growth that extends the historical average over the projection period. The historical data and the forecast series of the g_t for each country are presented in Figure 1A.

[17] International Monetary Fund, WEO April 2021. Bolivia: 3.6 percent. Brazil:.4.2 percent. Colombia: 3.0 percent. Ecuador: 0.7 percent. Mexico: 2.9 percent. Trinidad & Tobago: 1.1 percent. Except for Bolivia, calculations used numbers rounded to the nearest integer.

FIGURE 1A Real GDP growth
(Percent)



Source: IMF WEO April 2021 and projections.



EXCHANGE RATE FORECAST To convert quantities in U.S. Dollars to local currencies prior to 2021 historical exchange rates from the IMF's International Financial Statistics database were used.[18] Except for Bolivia and Ecuador, currency conversions after 2020 relied on exchange rate forecast series. Due to Bolivia's fixed exchange rate regime, it is assumed that the conversion rate is equal to its value of 2019 every year over the projection period (6.91 bolivianos per U.S. Dollar). In the case of Ecuador, its currency is the U. S. Dollar and no exchange rate is needed.

For Brazil, Colombia, Mexico and Trinidad & Tobago, each forecast series of the exchange rate was generated by an AR(1) model with a trend as the deterministic component. In Table 2A the results of the estimation of the AR(1) models are reported.[19] Overall, the estimated coefficients exhibit expected values with high statistical significance.

TABLE 2A Nominal exchange rate AR(1) model estimation

Country	Brazil	Colombia	Mexico	Trinidad & Tobago
Coefficients				
AR(1)	0.86 (0.11)***	0.92 (0.06)***	0.78 (0.17)***	1.00 (0.00)***
Trend	0.15 (0.03)***	118.10 (16.61)***	0.54 (0.12)***	0.03 (0.03)
R-squared	0.87	0.93	0.94	0.86
Adjusted R-squared	0.86	0.92	0.93	0.84
S. E. of regression	0.39	235.30	1.00	0.08
Log-likelihood	-12.21	-212.61	-33.765	24.94
Durbin-Watson	1.19	1.18	1.52	1.61
Observations	1994:2000	1990:2020	1996:2020	1995:2020

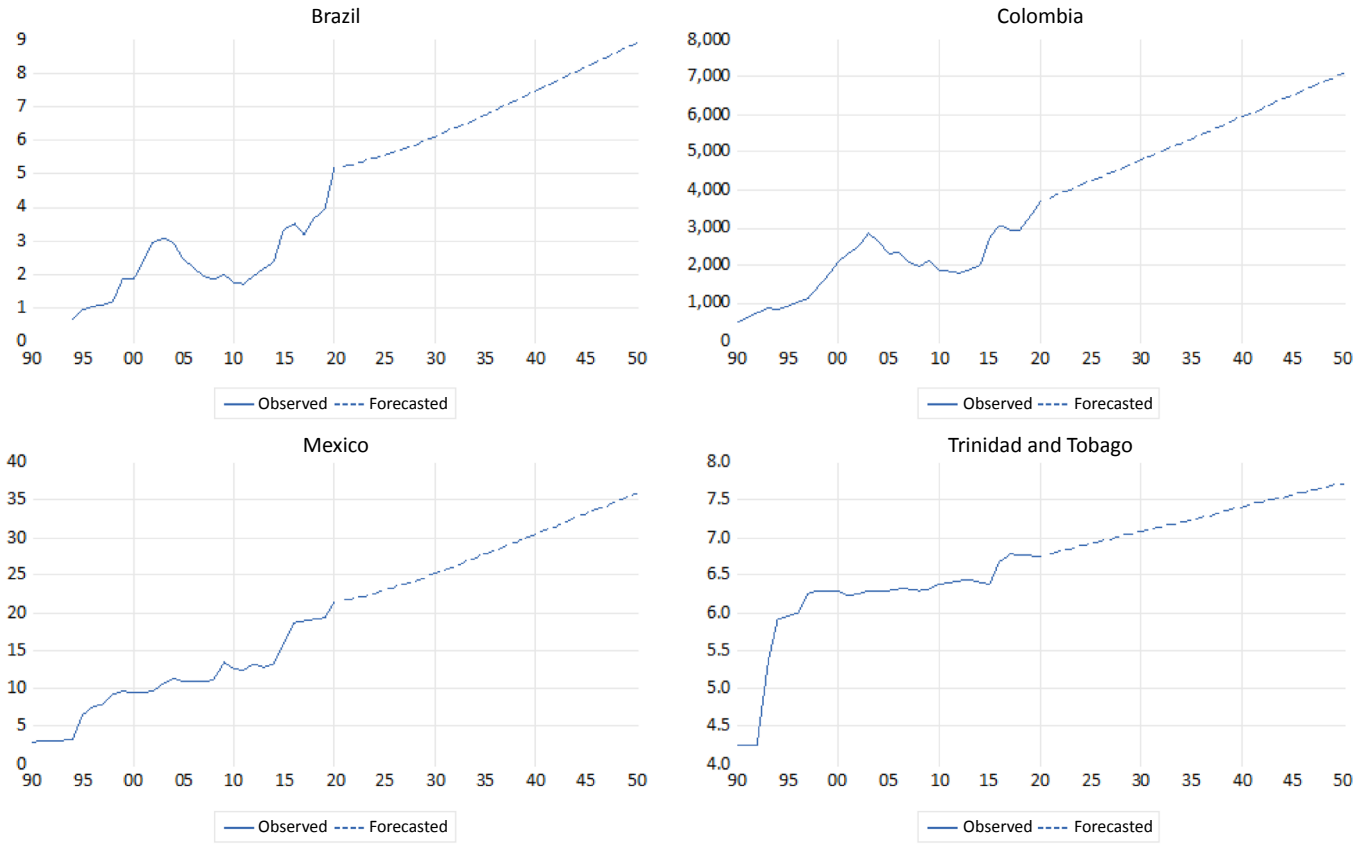
Results obtained with Eviews 12. Standard errors in ().
*** significance at 1 percent level, ** significance at 5 percent level, & * significance at 10 percent level.

[18] Nominal exchange rates, local currency units for 1 U.S. Dollar. Annual averages.

[19] Preliminary AR(1) estimations included an intercept as an additional deterministic component but it failed to achieve a conventional statistical significance (1 percent, 5 percent or 10 percent). In the case of Mexico, the reported AR(1) estimation was carried out including an intercept as suggested by the visual inspection of the series, but it has no statistical significance at the conventional levels.

The graphs of the historical data and the forecast series of the exchange rate for each country are presented in Figure 2A. In the case of Trinidad and Tobago, the value of the coefficient of the AR(1) component is usually indicative of a *random walk*. Unfortunately, the small size of the sample (1995:2020) does not allow for a reliable unit root testing to shed light on the stationarity of the series. However, a visual inspection reveals a rather stationary behavior after the apparent one-time structural break of 1992-1994. As pointed out by Perron (1989), suck breaks masquerade underlying stationary processes by introducing a bias in the coefficient estimates.[20] The data from 1992-1994 has been removed from the estimation sample but the process behind the break is unknown and the presence of bias cannot be excluded. Since the largest part of the sudden adjustment of the exchange rate was precluded from the estimation sample, the size on any bias should be fairly small.

FIGURE 2A Exchange rate and forecast
(Local currency per U.S. Dollar)



Source: IMF, International Financial Statistics and own projections.

[20] Pierre Perron, (1989), The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis, Econometrica, 57, (6), 1361-1401.

Net Zero Emissions (NZE)

GDP PROJECTIONS For 2021-2050, each country's GDP projection is constructed on top of the BAU's as follows

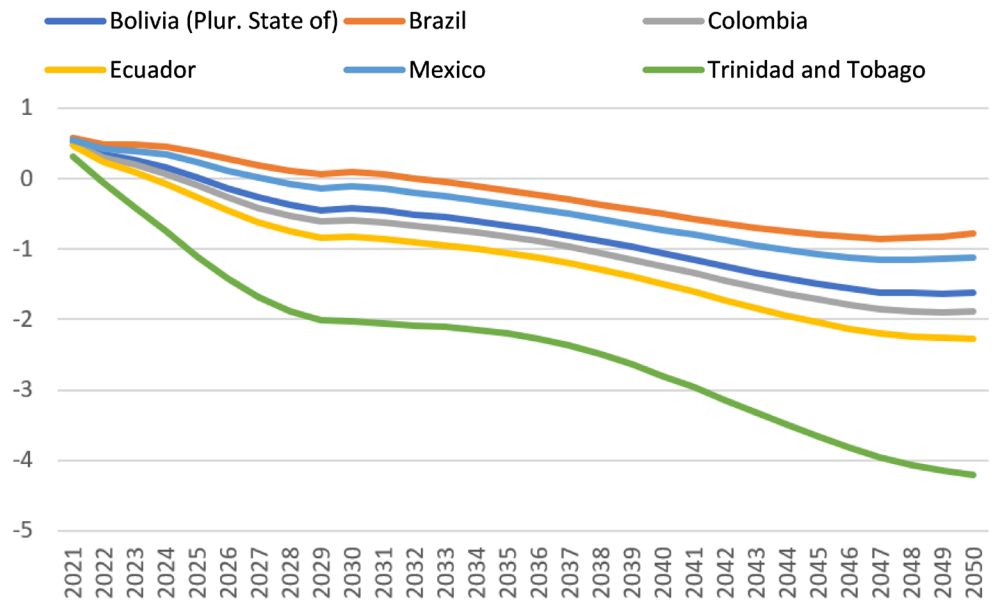
$$GDP_{NZE,t} = RGDP_{NZE,t} * D_t$$

$$D_t = D_{t-1}(1 + \pi_D)$$

$$RGDP_{NZE,t} = RGDP_t * (1 + \delta_t)$$

where $RGDP_t$, D_t, π_D and are the values of the Business-as-Usual scenario. The adjustment factor δ_t summarises the overall impact of the economic changes brought by the Net Zero Emissions framework on the real GDP as it unfolds through the horizon of the projection. We make the simplifying assumption that LAC6 economies will evolve between non-hydrocarbon-intensive industrial and emerging countries (US and China) and the selected oil-exporting countries in IMF (2021a). For each of the LAC6 countries we calibrate the results according to the relative weight of the hydrocarbon sectors in the economy. With the IMF (2021a) as background, δ_t follows a rough convex path over time to reflect the higher output from larger investment at the beginning of the transition (Figure 3A).

FIGURE 3A NZE real GDP gap
Percent of BAU real GDP



Source: Own calculations.

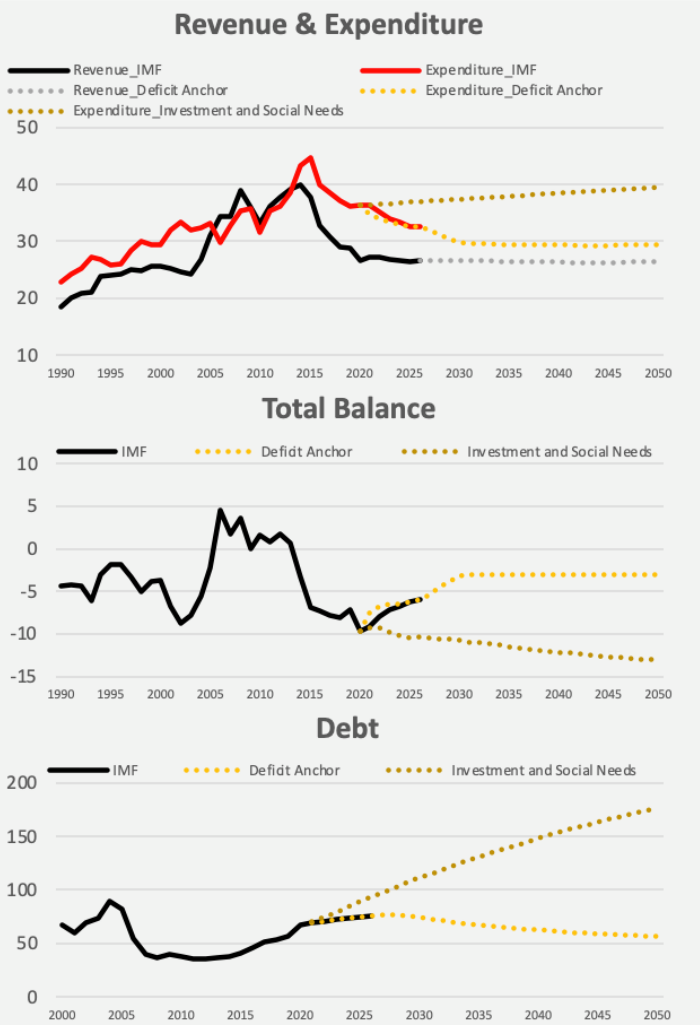
EXCHANGE RATE FORECAST Same exchange rates as in the BAU scenario.

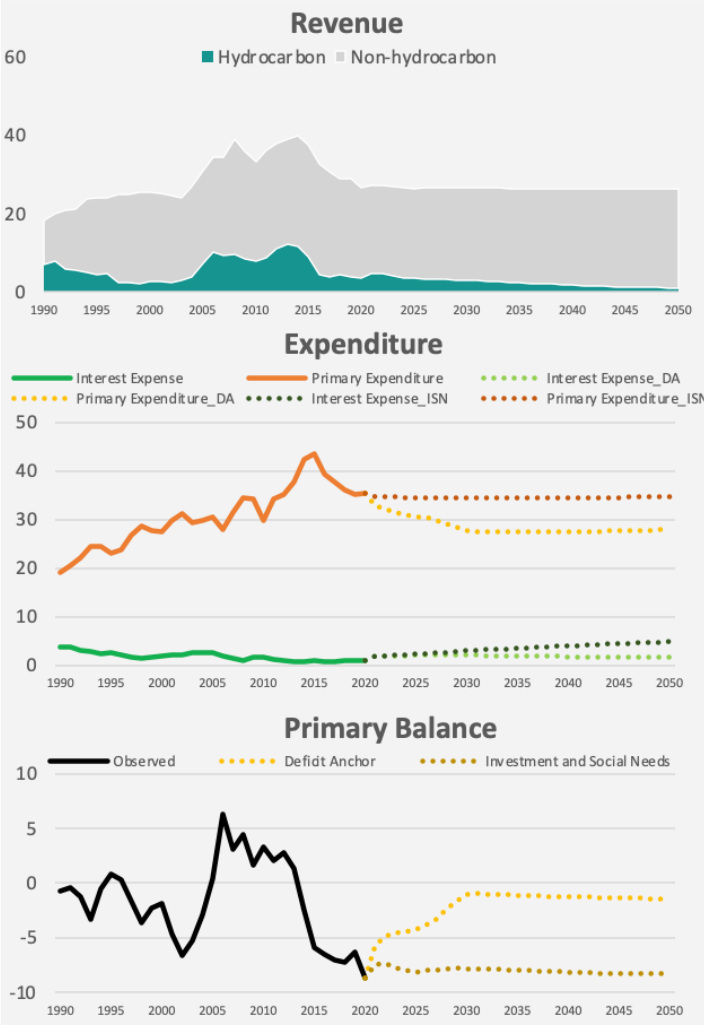
ANNEX 2

Revenue and expenditure in the BAU and NZE scenarios. All figures as percentage of GDP.

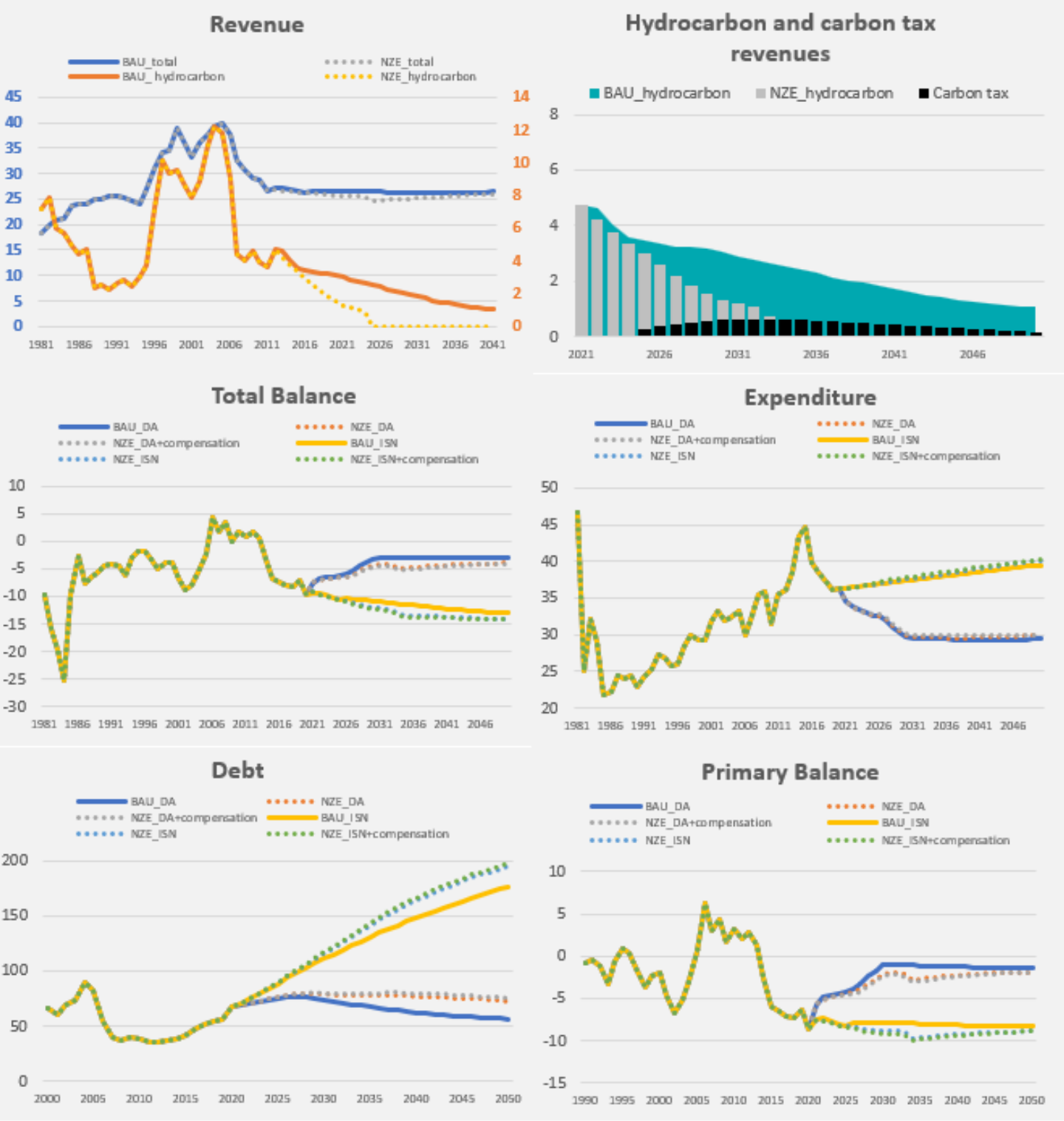
BOLIVIA-BAU

Revenue	Expenditure: Deficit Anchor	Expenditure: Investment and Social Needs
• 2021-2026: IMF • 2027-2050: non-hydrocarbon revenues increase by 2 ppts of GDP	• 2021-2026: Expenditure is such that the debt path in this period equals that of the IMF • 2027-2050: fiscal balance of -3 ppts of GDP	• 2021-2050 linear growth to 39.5 percent of GDP in 2050 • 2021-2050: fiscal balance of -11 ppts of GDP





BOLIVIA-BAU VS NZE



BRAZIL BAU

Revenue	Expenditure: Deficit Anchor	Expenditure: Investment and Social Needs
• 2021-2026: IMF • 2027-2050: non-hydrocarbon revenues increase by 5 ppts of GDP	• 2021-2026: Expenditure is such that the debt path in this period equals that of the IMF • 2027-2050: fiscal balance of -4.6 ppts of GDP	• 2021-2050 linear growth to 39.5 percent of GDP in 2050 • 2021-2050: fiscal balance of -8 ppts of GDP

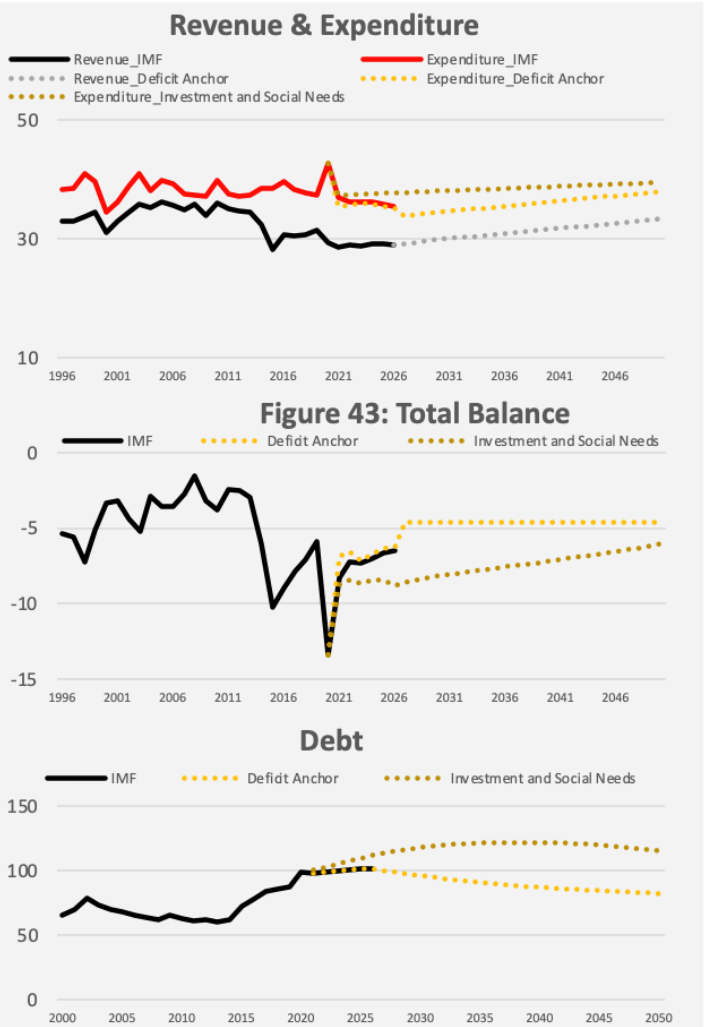
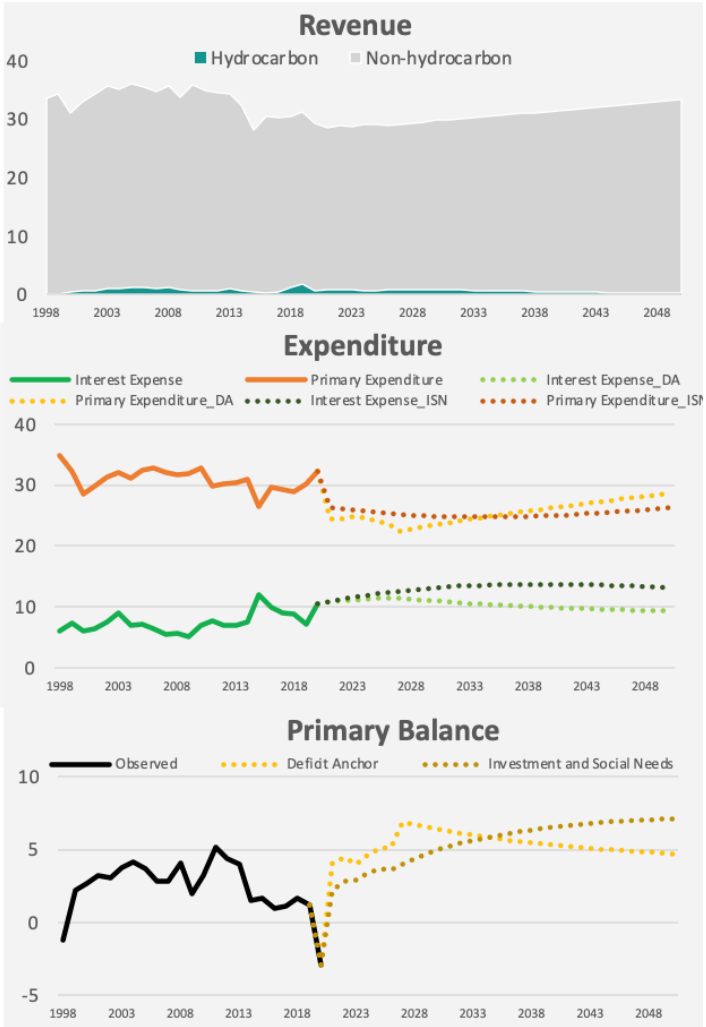
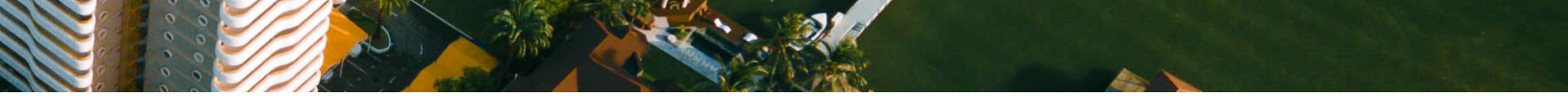
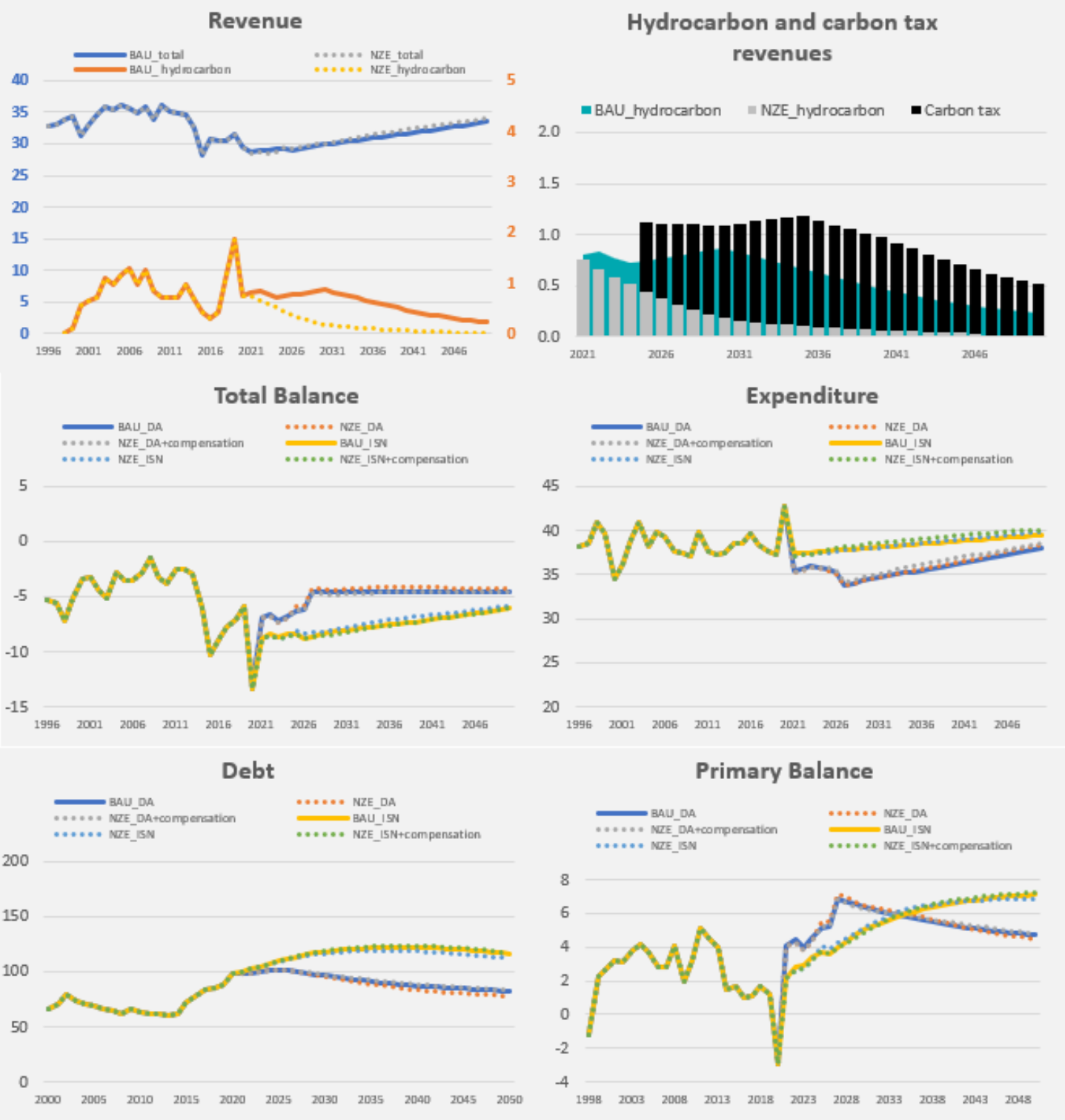


Figure 43: Total Balance



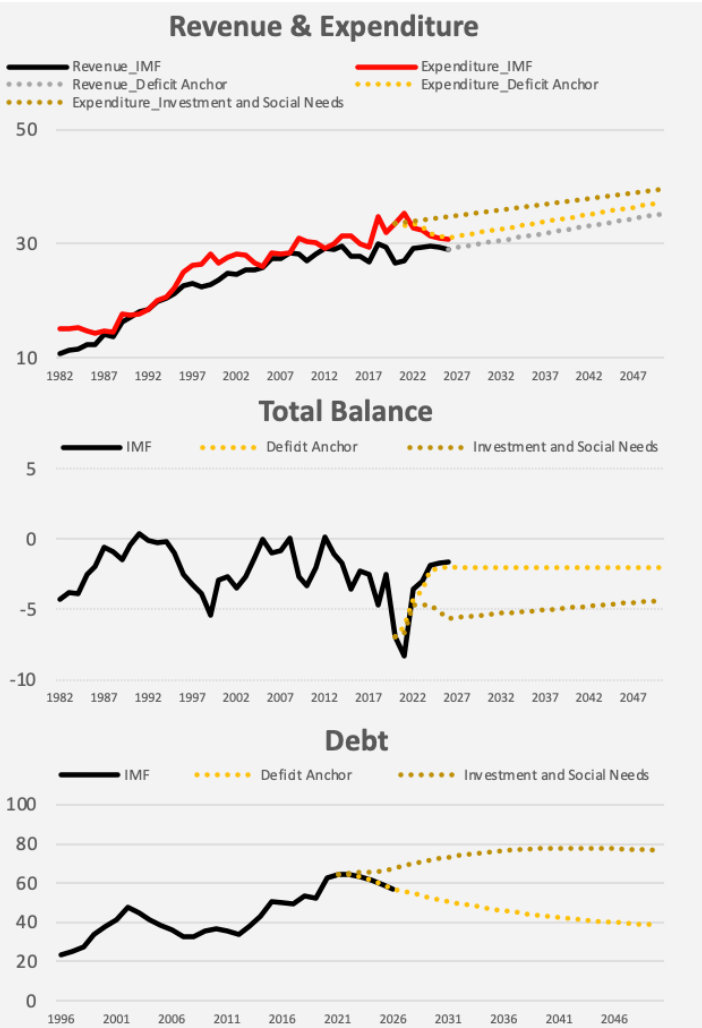


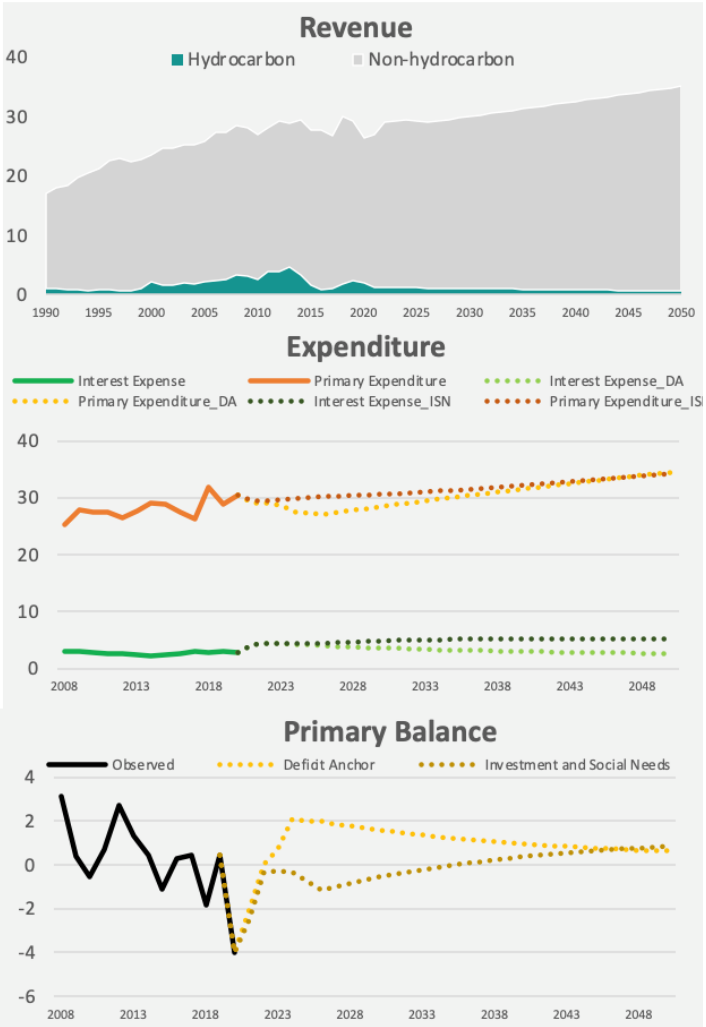
BRAZIL-BAU VS NZE

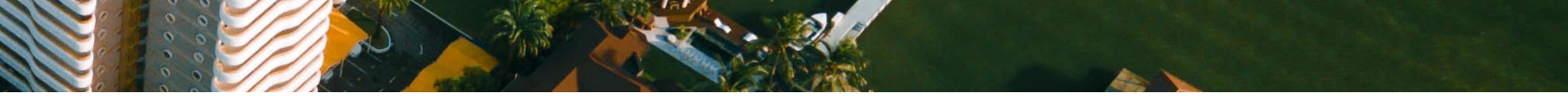


COLOMBIA BAU

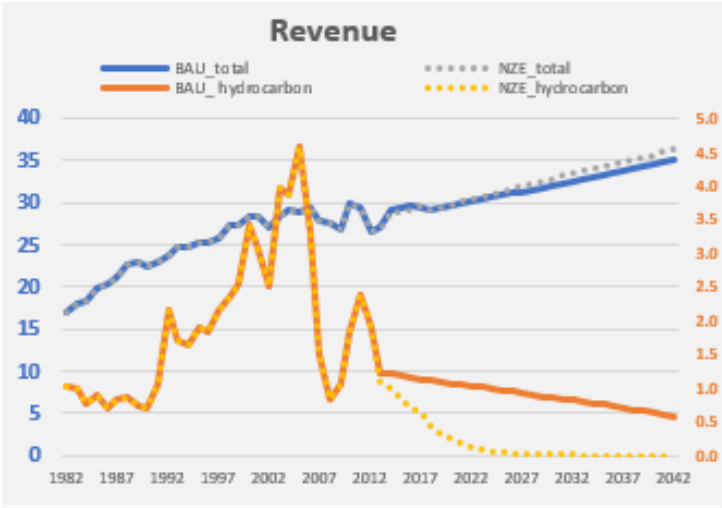
Revenue	Expenditure: Deficit Anchor	Expenditure: Investment and Social Needs
• 2021-2026: IMF • 2027-2050: non-hydrocarbon revenues increase by 7 ppts of GDP	• 2021-2026: Expenditure is such that the debt path in this period equals that of the IMF • 2027-2050: fiscal balance of -2 ppts of GDP	• 2021-2050 linear growth to 39.5 percent of GDP in 2050 • 2021-2050: fiscal balance of -5 ppts of GDP

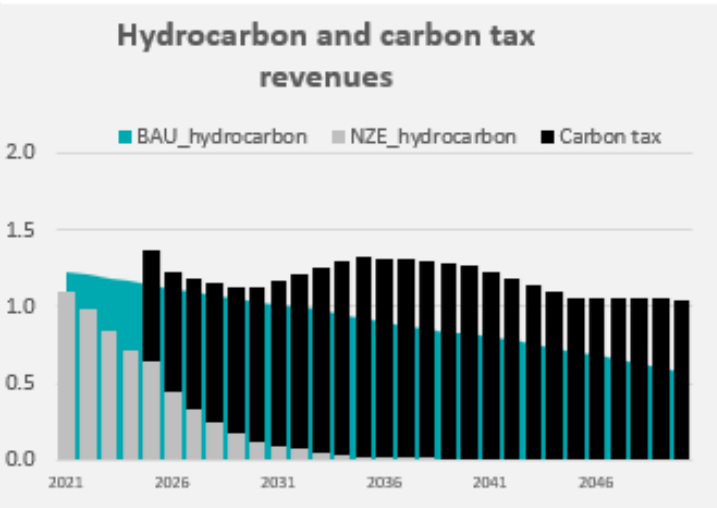


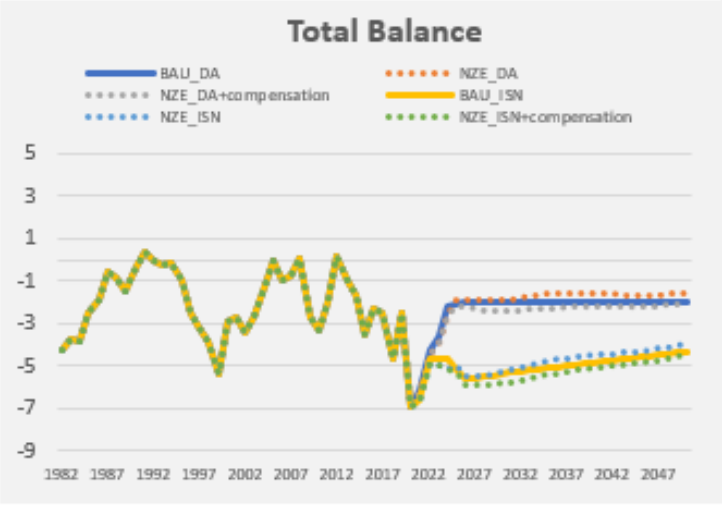


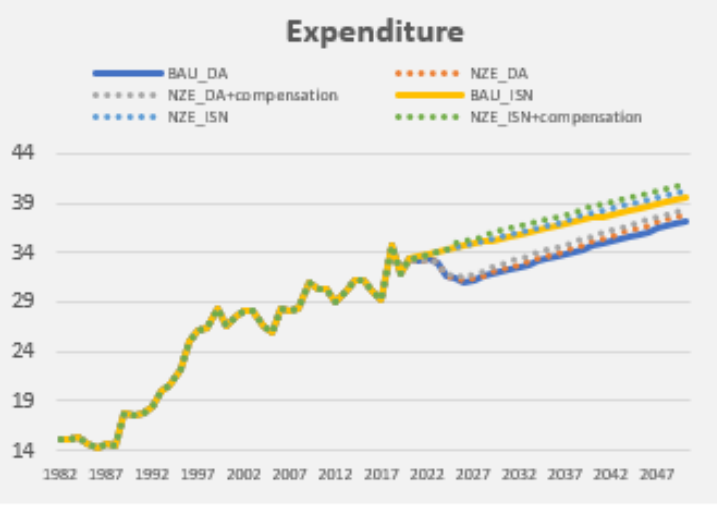


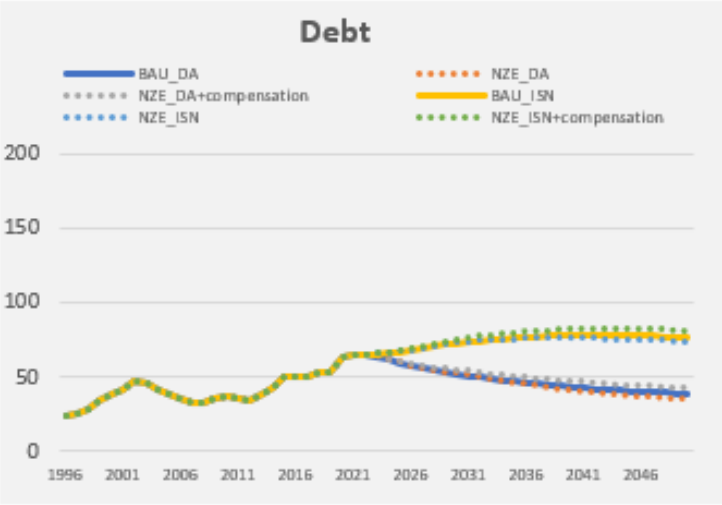
COLOMBIA BAU VS NZE

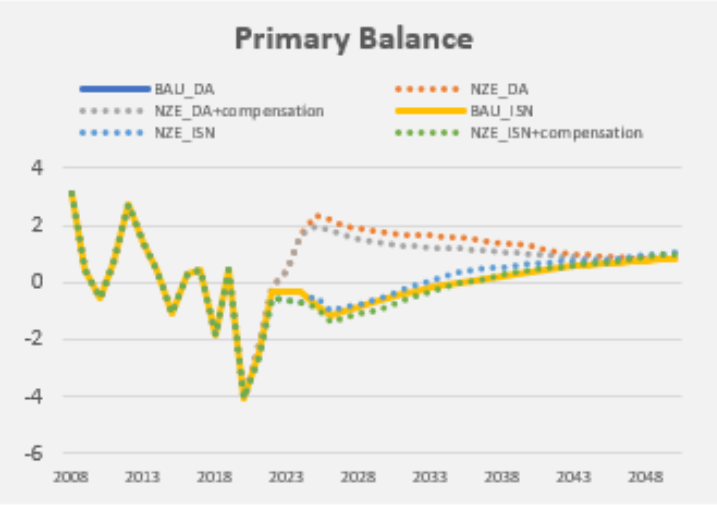






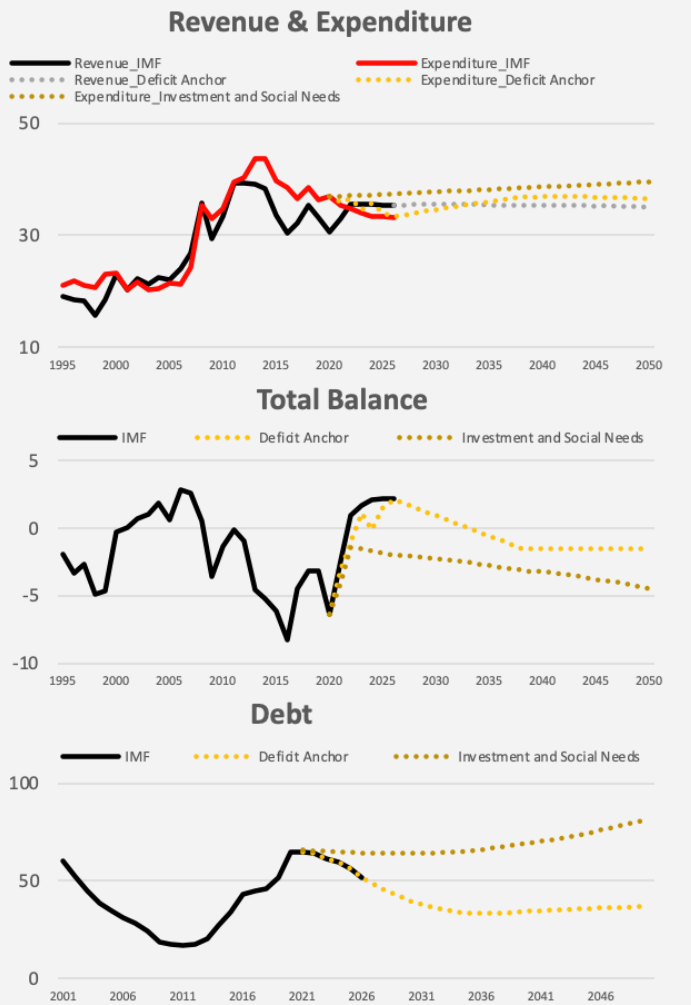


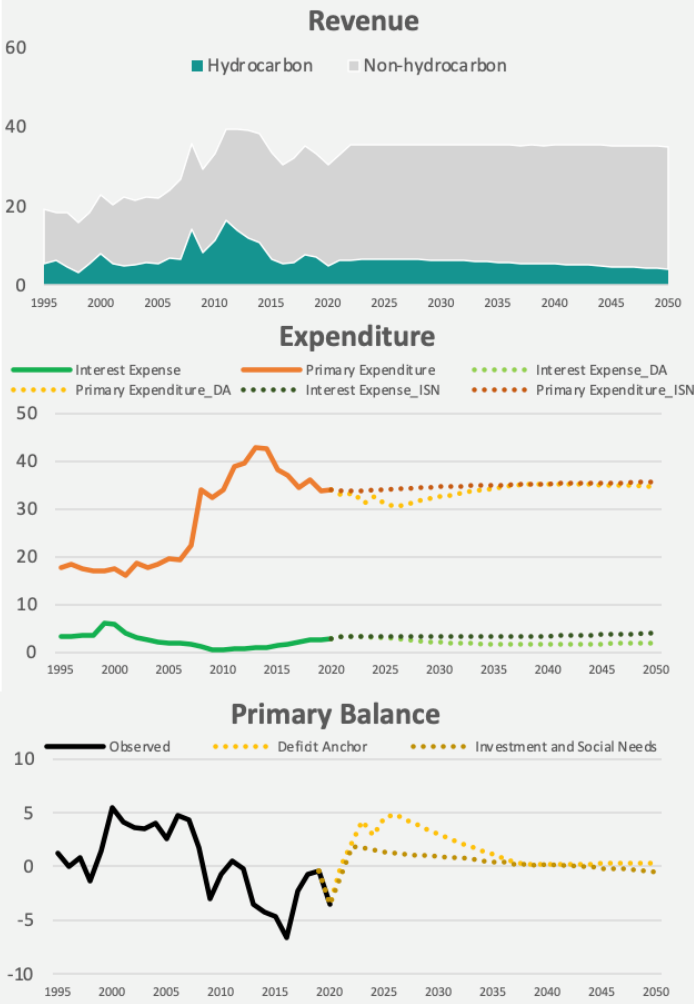


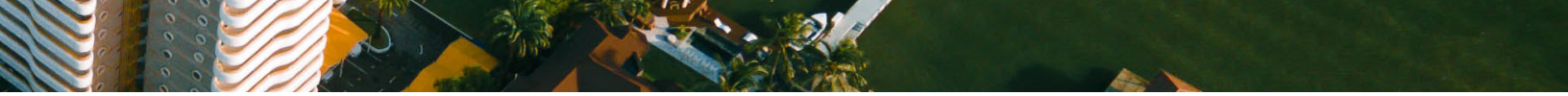


ECUADOR BAU

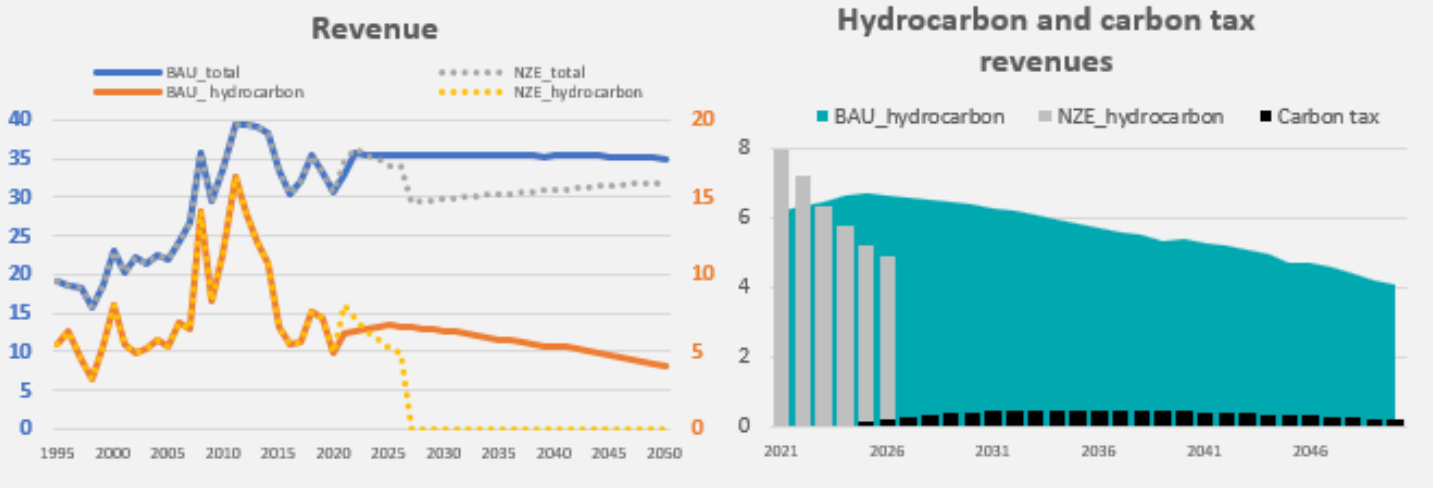
Revenue	Expenditure: Deficit Anchor	Expenditure: Investment and Social Needs
• 2021-2026: IMF • 2027-2050: non-hydrocarbon revenues increase by 2 ppts of GDP	• 2021-2026: Expenditure is such that the debt path in this period equals that of the IMF • 2027-2050: fiscal balance of -1.5 ppts of GDP	• 2021-2050 linear growth to 39.5 percent of GDP in 2050 • 2021-2050: average fiscal balance of -3 ppts of GDP

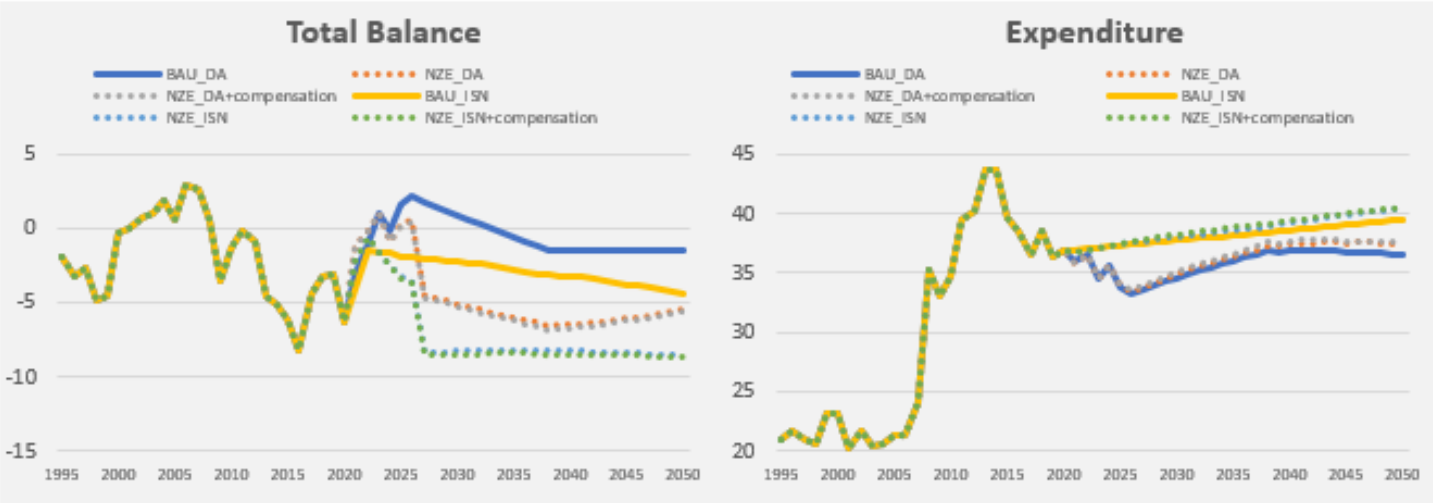


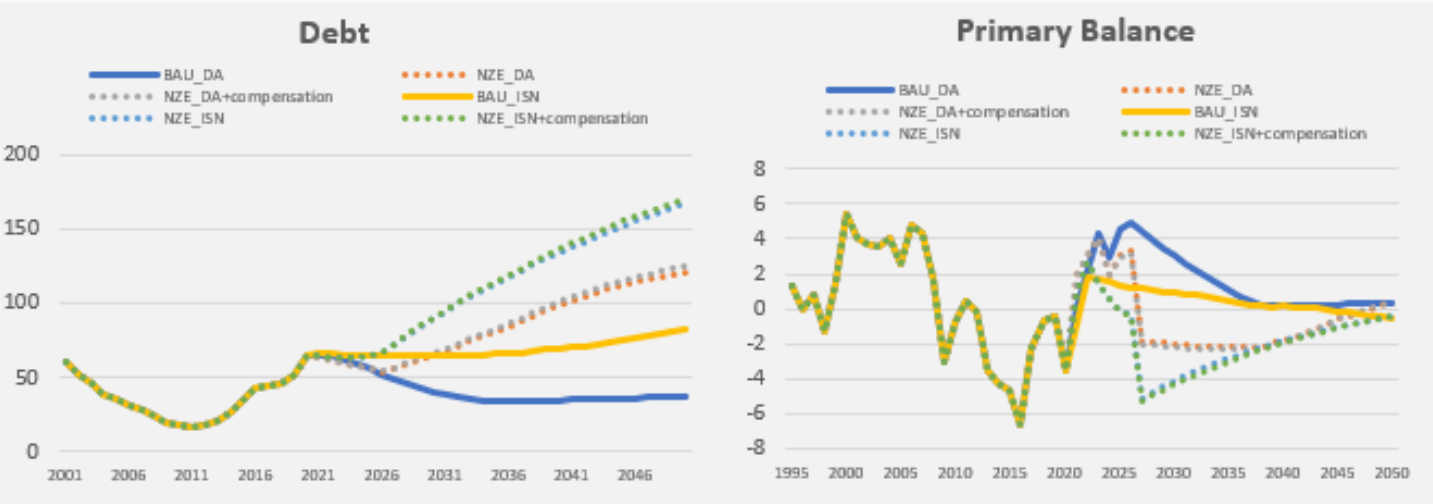




ECUADOR BAU VS NZE

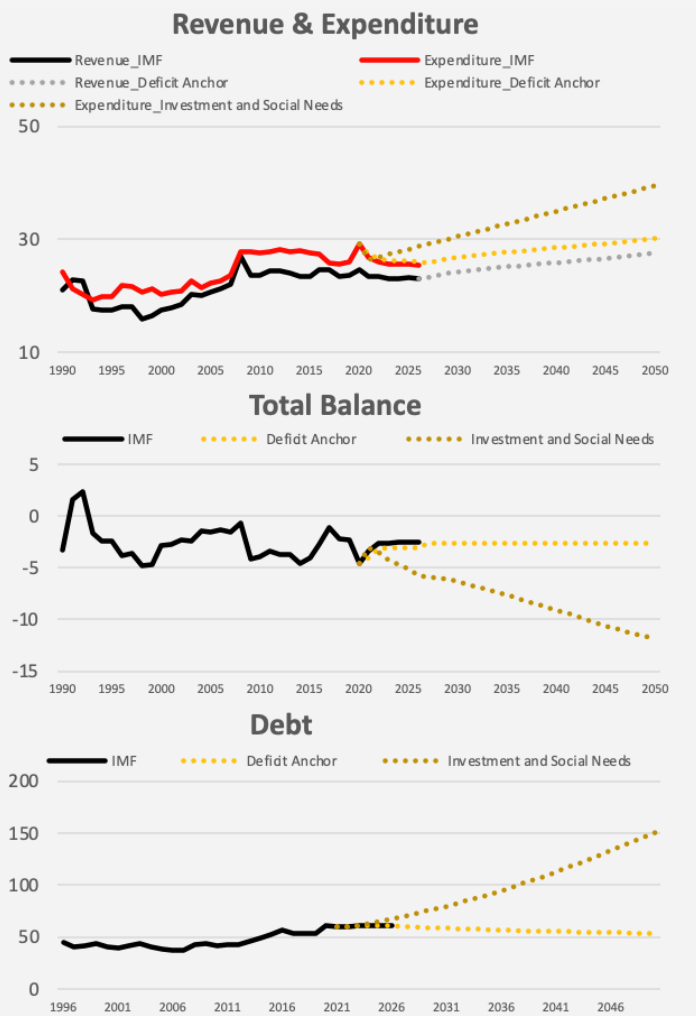


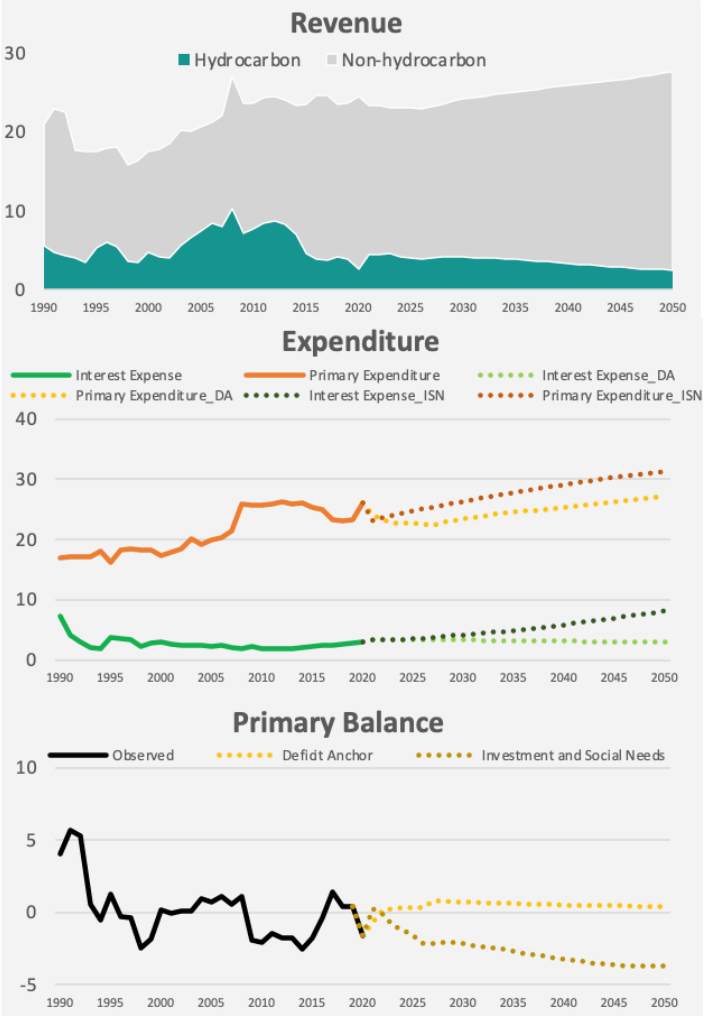




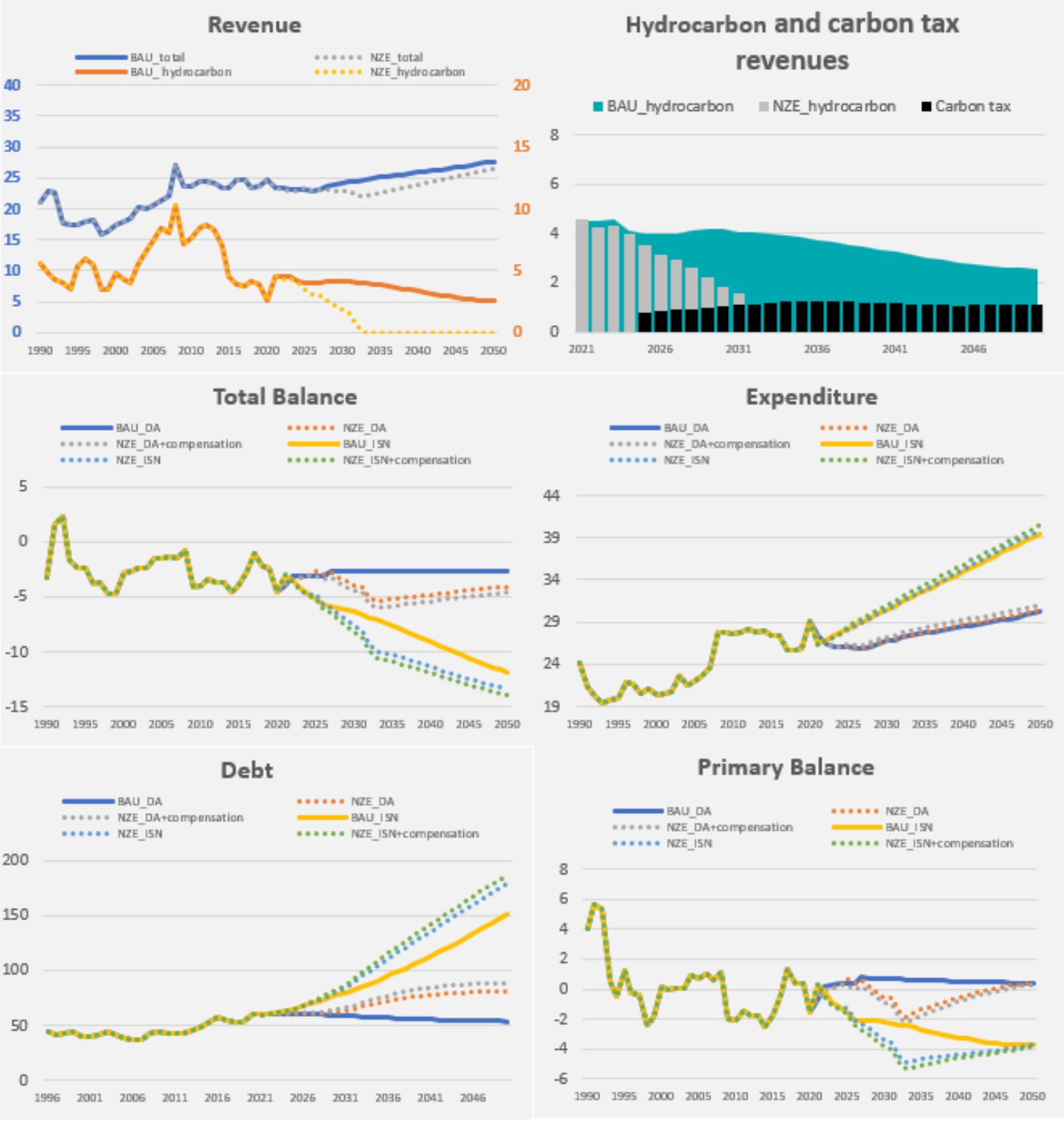
MEXICO BAU

Revenue	Expenditure: Deficit Anchor	Expenditure: Investment and Social Needs
• 2021-2026: IMF • 2027-2050: non-hydrocarbon revenues increase by 6 ppts of GDP	• 2021-2026: Expenditure is such that the debt path in this period equals that of the IMF • 2027-2050: fiscal balance of -2.6 ppts of GDP	• 2021-2050 linear growth to 39.5 percent of GDP in 2050 • 2021-2050: fiscal balance of -8 ppts of GDP



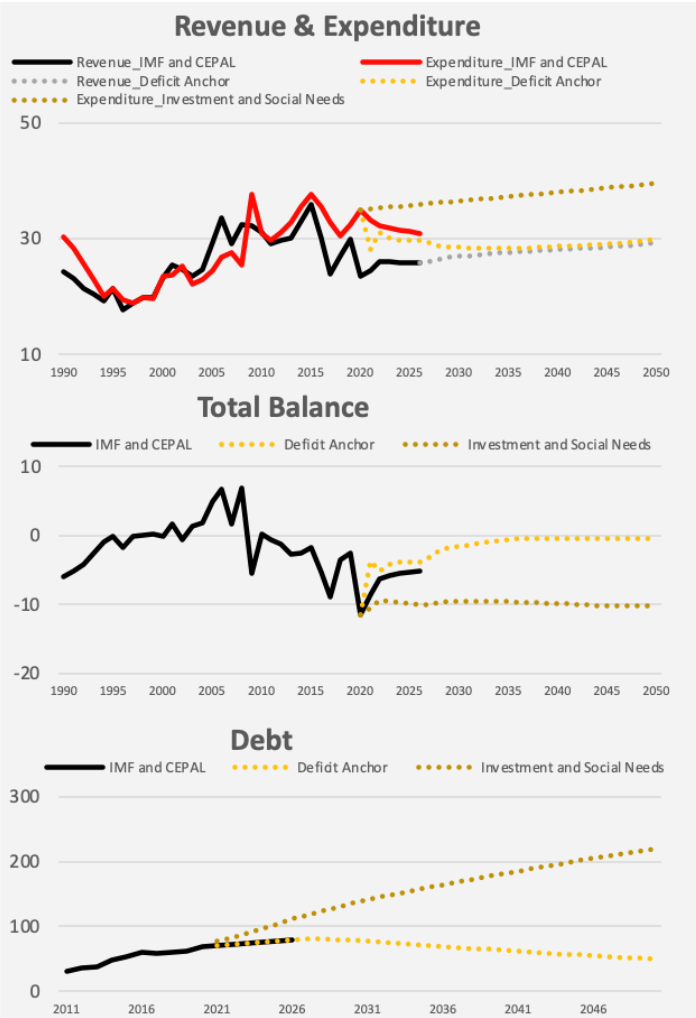


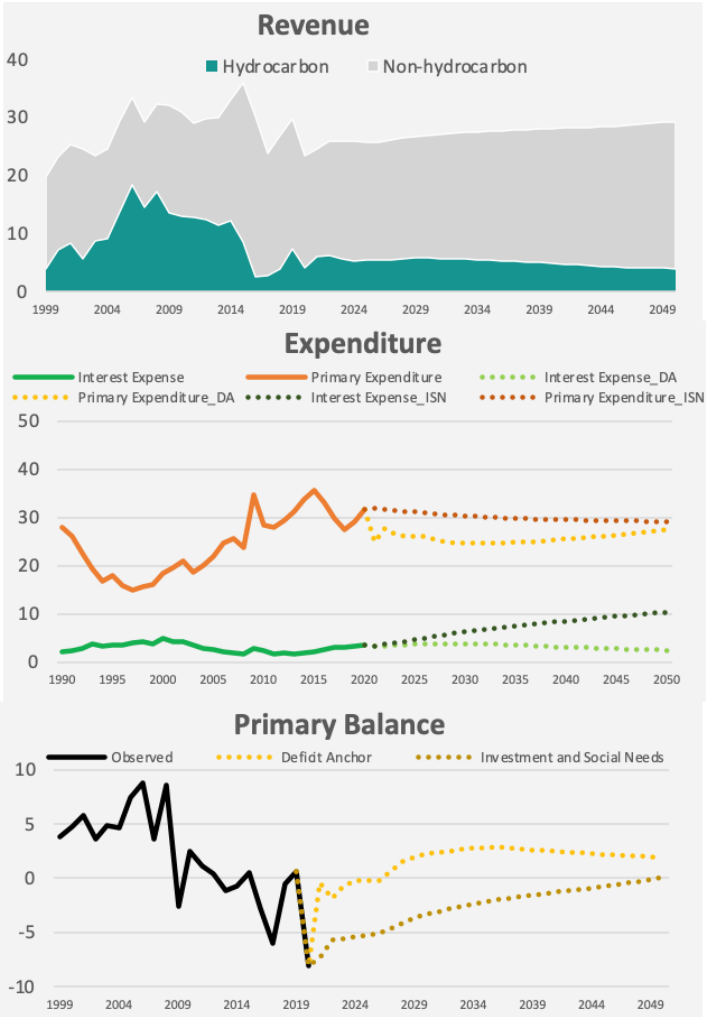
MEXICO BAU VS NZE

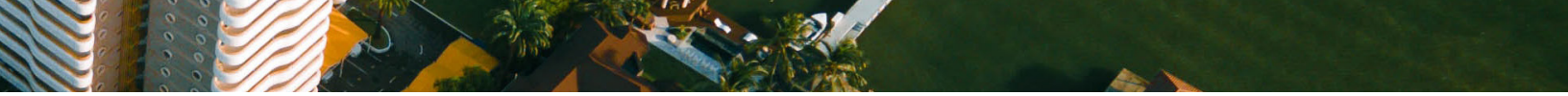


TRINIDAD AND TOBAGO BAU

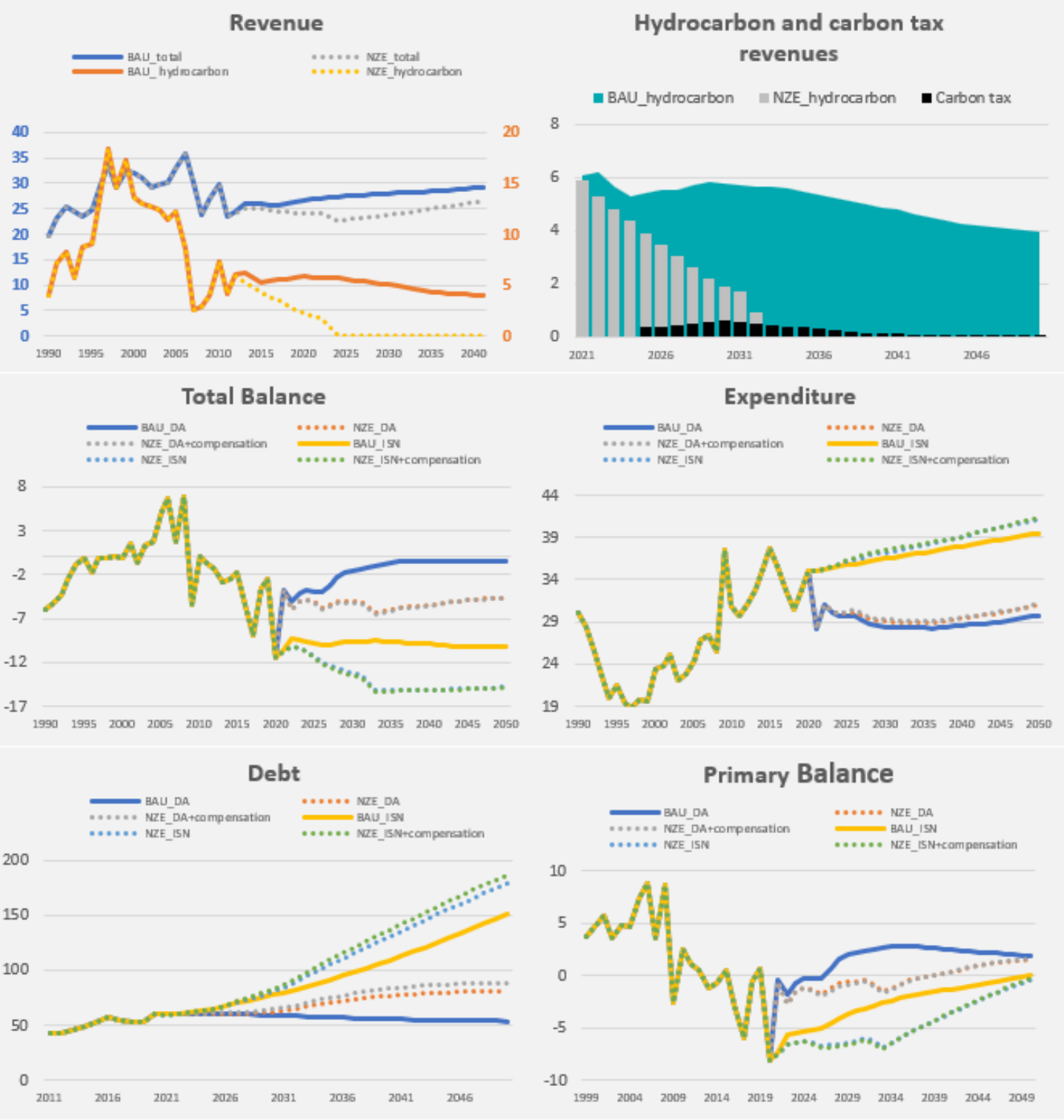
Revenue	Expenditure: Deficit Anchor	Expenditure: Investment and Social Needs
• 2021-2026: IMF • 2027-2050: non-hydrocarbon revenues increase by 5 ppts of GDP	• 2021-2026: Expenditure is such that the debt path in this period equals that of the IMF • 2027-2050: fiscal balance of -0.5 ppts of GDP	• 2021-2050 linear growth to 39.5 percent of GDP in 2050 • 2021-2050: fiscal balance of -10 ppts of GDP







TRINIDAD & TOBAGO BAU VS NZE



TASK FORCE ON CLIMATE, DEVELOPMENT AND THE INTERNATIONAL MONETARY FUND