Framework Convention on
Climate Change

KCI/2025/13/13

Katowice Committee of Experts on the Impacts of the Implementation of Response Measures

Thirteenth meeting

Istanbul

1–3 October 2025

Draft case study

Economic Diversification and Climate Policy Integration in Nigeria: A Case Study from Nigeria

Table of Contents

List of Tables

List of Figures

Executive Summary

Nigeria's macroeconomy remains heavily reliant on hydrocarbons, with oil dominating exports and fiscal revenue, and exposing the economy to external price shocks. Development gaps persist (large energy access deficits, weak infrastructure, and low economic complexity), underscoring the need to expand production and exports beyond crude oil while improving welfare and employment. Policy efforts to date have been numerous but uneven, constrained by unstable power/FX/, and trade settings, thin and volatile capital budgets, and weak inter-ministerial execution.

This study examines how integrating economic diversification with climate considerations can place Nigeria on a more resilient, job-rich growth path. The analysis is grounded in the UNFCCC decisions 7/CMA.1, 4/CP.25 and 4/CMP.15 and responds to the Katowice Committee of Experts' call for regional case studies that use modelling to assess response measures. It uses a dynamic CGE model calibrated to Nigeria's recently rebased macroeconomic statistics and a baseline aligned with the Shared Socioeconomic Pathway 2 (SSP2) trajectories for GDP and population. The baseline incorporates government stakeholder views on crude oil production, the electricity mix, and the evolution of petroleum and electricity subsidies. Modelling follows a two-simulation approach: a *baseline pathway* with existing policies and a *policy pathway* that layers shocks from 2026 onward; impacts are reported as deviations from baseline.

Stakeholder engagement shaped the scenario design and assumptions. Early and sustained interaction with the Macroeconomics Department of the Federal Ministry of Budget and Economic Planning (now preparing the National Development Plan 2026–2030) ensured institutional relevance and consistency with ongoing planning. The framework explores three cumulative scenarios (Cautious Reform, Bold Reform, and Deep Structural Reform) applied to a common set of levers: tax reform and non-oil revenue mobilisation; increased public expenditure in non-oil sectors; climate-resilient infrastructure investment; and trade leverage under the AfCFTA. The scenarios incrementally build on each other but differ only in the magnitude and pace of implementation.

The baseline (business-as-usual) delivers average real GDP growth of 4.4 per cent, with services remaining dominant, oil exports continuing to drive the external account, and gradual energy change that reaches roughly 22 per cent renewables in electricity by 2050. Emissions rise from about 347 $MtCO_2$-eq in 2019 to 1,075 $MtCO_2$-eq in 2050, with some intensity improvements but not enough to meet climate goals. Fiscal ratios remain low: the tax-to-GDP ratio hovers near 5.4 per cent by 2050; petroleum and electricity subsidies are embedded through 2024 (₦5.4 trillion and ₦1.9 trillion, respectively) and then held constant in the baseline.

Policy simulations show the value of sequencing. A stand-alone tax reform that removes energy subsidies, raises the VAT rate uniformly to 15 per cent, introduces a fuel levy, and lowers tariffs in line with AfCFTA improves the budget and lifts the tax-to-GDP ratio (to about 9 per cent in 2026, stabilising near 8.7 per cent), but temporarily decreases employment and consumption as the purchaser price level rises. Recycling part of the revenue into non-oil public investment raises capital formation and factor-cost GDP, with limited employment effects under long-run wage adjustment. When modest productivity gains (labour, capital, land), higher labour-force participation, and transport efficiency are added under the Cautious case, GDP is about 5 per cent above baseline by 2050, exports strengthen, and household welfare improves relative to tax-reform-only outcomes. Scaling ambition in the Bold case (allocating 80 per cent of additional

revenue to investment, modestly raising renewable shares in power to 30 per cent by 2050, and boosting light-manufacturing activity and exports) pushes GDP roughly 7.1 per cent above baseline by 2050, with higher wages, stronger consumption, and larger export gains. The Structural case, which fully recycles additional revenues into investment (100 per cent), deepens productivity improvements, lifts participation rate further, and raises the renewable share to 50 per cent by 2050, delivers the largest benefits: GDP rises by 8.5 per cent, exports by 27.5 per cent, and emissions fall by about 10 per cent relative to baseline, illustrating the payoff from coordinated, long-term reform.

Sector results are consistent with these macro patterns. Investment-linked activities such as construction and equipment manufacturing expand with higher capital formation; electricity supply improves, with renewables gaining share as scenario ambition rises; light manufacturing responds to export opportunities under AfCFTA; and agriculture benefits when land and logistics productivity improve, reinforcing welfare gains where poverty is concentrated. Where tax reform is not paired with investment and productivity measures, consumption and some services lag; where reforms are combined and scaled, gains are broader and more durable.

Overall, the study demonstrates that diversification is not a single policy act but a coherent programme that links revenue mobilisation, disciplined public investment, productivity upgrades, trade facilitation, and an orderly energy transition. The most credible pathway couples fiscal reform with targeted, non-oil investment and gradual but sustained improvements in factor productivity and renewables deployment, beginning in 2026. Read together, the scenarios provide decision-relevant evidence: Nigeria can achieve faster, more inclusive, and more climate-aligned growth by pairing tax and subsidy reforms with investment and productivity measures, and by leveraging regional trade, while the costs of hesitation are visible in the baseline. The report proceeds with the model description, baseline assumptions and results, detailed scenario narratives and impacts, and concludes with policy recommendations grounded in these findings.

Acronym/Abbreviation

Acronym	Definition
AfCFTA	African Continental Free Trade Area
BAU	Business-as-Usual (Baseline)
CBN	Central Bank of Nigeria
CGE	Computable General Equilibrium Model
DCC	Department of Climate Change
ECI	Economic Complexity Index
ERGP	Economic Recovery and Growth Plan
ETP	Energy Transition Plan
GDP	Gross Domestic Product
GHG	Greenhouse Gases
IEA	International Energy Agency
IMF	International Monetary Fund
IOT	Input-Output Table
LT-LEDS	Long-Term Low Emissions Development Strategy
NA-2050	Nigeria Agenda 2050
NBS	National Bureau of Statistics
NCCC	National Council on Climate Change
NCCP	National Climate Change Policy
NCCPRS	National Climate Change Policy Response and Strategy
NDC	Nationally Determined Contribution
NDP	National Development Plan
NESP	Nigeria Economic Sustainability Plan
NIRP	Nigeria Integrated Resource Plan
RCP	Representative Concentration Pathway
SAM	Social Accounting Matrix
SIM	Simulation
SSP	Shared Socioeconomic Pathways
UNFCCC	United Nations Framework Convention on Climate Change

1. National Context

Nigeria ranks among Africa's five largest economies and is the most populous OPEC member[1] with a rebased nominal GDP of about ₦372.82 trillion in 2024 (US$252 billion).[2] Nigeria's macroeconomy remains highly concentrated around hydrocarbons (oil and gas), with external accounts and fiscal revenue closely tied to crude oil. Hydrocarbon revenues account for the majority of government income and a large share of foreign exchange earnings (roughly 72 per cent of federally-collected revenues in the period 2000 to 2019), which indicates macroeconomic dependence on oil and gas cycles and external price shocks (CBN, 2024; Nwokoma et al., 2022). While this dependence has provided substantial revenues during periods of high oil prices, it has also exposed the economy to significant volatility and vulnerability. Fluctuations in global oil markets frequently translate into fiscal instability, balance of payments pressures, and wider economic uncertainty.

Historical export data show that oil products consistently dominate merchandise exports: in 2023, oil accounted for 89.67 per cent of export value (₦32.50 trillion of ₦36.25 trillion), with non-oil exports at 10.33 per cent (₦3.75 trillion) (NBS, 2024). Over multiple decades, the oil share of exports hovered between 87 per cent and 99 per cent, indicating persistent export concentration despite changes in GDP composition. Nigeria's capabilities profile mirrors this pattern: the country's 2023 Economic Complexity Index (ECI) score was −1.74, ranking 142nd of 145 countries, signalling a narrow, low-sophistication tradable base vulnerable to terms-of-trade shocks.[3]

The dependence on hydrocarbon coexists with acute development gaps. As of 2023, roughly 40 per cent (or 90 million) of Nigerians still lack access to electricity[4], the largest unelectrified population worldwide, and climate risks already strain output and prices through heat waves, drought and precipitation variability (Emenekwe et al., 2024; NCCC, 2023; World Bank, 2021). This pattern has highlighted the urgent need for Nigeria to diversify its economy to achieve more sustainable and inclusive growth.

Economic diversification is aimed at expanding production and exports beyond crude oil, with a particular focus on non-oil commodities and services. Strengthening the performance of agriculture, manufacturing, solid minerals, and modern service industries such as finance, telecommunications, and information technology can help stabilise government revenues by reducing reliance on oil. Diversification also broadens the country's export base, making Nigeria less vulnerable to external shocks while positioning it to benefit from growing regional and global demand for a wider range of products.

Beyond revenue stabilisation, diversification carries important implications for employment and welfare. The oil sector, while capital-intensive, generates relatively few jobs compared to Nigeria's fast-growing labour force. By contrast, non-oil sectors such as agriculture, manufacturing, and services are far more labour-intensive and therefore have greater potential to absorb workers,

[1] World Development Indicators (WDI) (2025): US$1 ($) to Nigerian Naira (₦) official period average exchange rate in 2024 was ₦1,478.96. The population size for 2024 was 232,679,478.

[2] National Bureau of Statistics (NBS, 2025). https://www.nigerianstat.gov.ng/elibrary

[3] Harvard Growth Lab (2025). https://atlas.hks.harvard.edu/rankings

[4] World Bank (2025). Access to electricity (% of population) - https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=NG

particularly young people entering the workforce in large numbers. Expanding these sectors can reduce unemployment, raise household incomes, and promote more equitable development across regions.

Ultimately, economic diversification aims to improve the welfare and living standards of Nigerians, stabilise government finances and diversify export revenue. By fostering a more balanced economy, Nigeria can achieve higher resilience, provide more opportunities for its citizens, and build the foundations for long-term prosperity. The shift towards non-oil exports and employment-intensive sectors is not only a policy necessity but also a pathway to achieving inclusive growth, poverty reduction, and improved social outcomes.

The labour market and welfare statistics give the diversification mandate a social dimension. With a population of roughly 227 million in 2023 (UN DESA-PD, 2024), the economy must generate large numbers of quality jobs each year for young entrants, yet the oil sector itself is highly capital-intensive, supporting on the order of 65,000 direct formal jobs—approximately 0.08 per cent of total employment—far too small to deliver inclusive employment growth (ILO and UNDP, 2021; Power for All, 2022). Poverty remains widespread: 63 per cent of Nigerians were in multidimensional poverty as of 2022, with incidence rising to 72 per cent in rural areas where agriculture dominates livelihoods (NBS, 2022). These data points collectively argue for a diversification strategy that is explicitly job-rich—raising productivity and value-addition in agriculture and light industry—and that is anchored in social inclusion.

Nigeria has attempted diversification through multiple efforts: National Economic Empowerment and Development Strategy (NEEDS, 2004–2007)(National Planning Commission, 2004); Vision 20:2020 (FGN, 2009); the Transformation Agenda/National Industrial Revolution Plan (NIRP) (FGN, 2014; Nwokoma et al., 2022); Economic Recovery and Growth Plan (ERGP) (FMBNP, 2017); Economic Sustainability Plan (ESP) (Budget Office of the Federation, 2020); and now the National Development Plan (NDP 2021–2025) and Agenda 2050 (FMFBNP, 2021a, 2021b). Progress has been uneven because three constraints persist: unstable power/FX/trade regimes, thin and volatile capital budgets, and weak inter-ministerial execution.

The Climate Change Act (2021) codifies net-zero by 2060, creates the National Council on Climate Change, introduces five-year carbon budgets, and requires private firms with ≥50 employees to plan, report, and manage emissions (Federal Republic of Nigeria Official Gazette, 2021), thereby signalling regulatory predictability for investment. Nigeria's updated NDC (2021) keeps a 20 per cent unconditional and 47 per cent conditional cut by 2030 relative to BAU, with BAU projected to 453 $MtCO_2e$ in 2030; the corresponding caps are 362 $MtCO_2e$ (unconditional) and 244 $MtCO_2e$ (conditional) (UNFCCC, 2022). The NDC converts ambition into sector measures that also support diversification: in power, 30 per cent on-grid electricity from renewables by 2030 (12 GW large hydro; 3.5 GW small hydro; 6.5 GW solar PV; 3.2 GW wind) plus 13 GW off-grid (5.3 GW mini-grids; 2.7 GW SHS/streetlights; 5 GW self-gen). It also targets cutting T&D losses to 8 per cent and phasing out diesel/petrol generators for electricity. In transport, policy points to BRT expansion and CNG uptake; in oil and gas, zero routine flaring by 2030 and a 60 per cent reduction in fugitive methane by 2031.

In hydrocarbons, the National Gas Policy (2017) and the Flare Gas Regulations (2018) aim to pivot from waste to value: with over 200 TCF of proven gas reserves, domestic utilisation can support power reliability, fertiliser and petrochemical value chains, and cleaner transport fuels (FMPR, 2017; NUPRC, 2018). The literature notes early traction: new urea capacity (e.g., Indorama,

Dangote) has positioned Nigeria as Africa's top producer by 2022, demonstrating how gas feedstock can anchor non-oil industrialisation.

The Energy Transition Plan (Energy Transition Office, 2022) integrates these sectoral threads into an economy-wide pathway to universal energy access and net-zero by 2060. The ETP identifies five pillars (Power, Cooking, Transport, Oil & Gas, and Industry) and projects incremental investment needs of about US$10 billion per year, amounting to roughly US$410 billion above BAU by 2060 (Energy Transition Office, 2022). Crucially, it estimates net job gains of approximately 340,000 by 2030 and 840,000 by 2060 as clean supply chains expand and domestic content deepens. On the supply side, the plan anticipates more than 150 GW of renewable capacity by 2060 and a managed gas-as-bridge strategy to crowd in clean manufacturing, grids, storage, and clean-cooking markets. The long-term Low Emissions Development Strategy (LT-LEDS) (NCCC, 2023) complements this with milestones (peak oil-sector emissions and end routine flaring by 2030; scaling nature-based solutions; CCUS options for hard-to-abate industry).

Macro-fiscal reforms interact directly with the diversification–climate nexus. Petrol subsidies absorbed about ~~₦4–~~4.5 trillion in 2022 (US$9–10 bn), crowding out social and capital spending (Gençsü et al., 2022; Ozili & Obiora, 2023; Simpson et al., 2024; World Bank, 2022). Their removal frees fiscal space if transparently recycled into infrastructure, skills, and firm capabilities for export upgrading. Efficient recycling would also help cushion distributional impacts and sustain political support for the transition (Okereke et al., 2024; World Bank, 2022).

This study is based on the UNFCCC decisions 7/CMA.1, 4/CP.25 and 4/CMP.15, which tasks the secretariat and its Katowice Committee of Experts (KCI) with recommending actions that minimise adverse and maximise positive impacts of response measures, including through "the use and development of modelling tools". Activity 7 of the KCI workplan calls for five regional case studies. This study fulfils that mandate for Africa by focusing on Nigeria, in collaboration with GIZ and under UNFCCC oversight. In alignment with the earlier-listed UNFCCC decisions, this project is designed to identify best practices and support economic diversification through the application of robust climate-economy models.

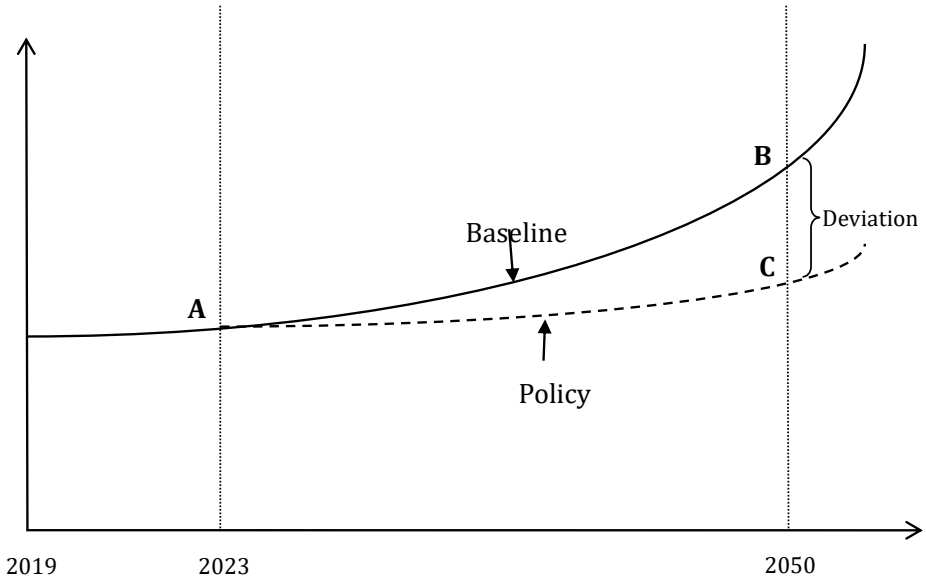
The overall objective of this study is to provide actionable, evidence-based recommendations for policy interventions promoting non-oil diversification, job-rich economic growth, and climate resilience in Nigeria. More specifically, the study develops three broad scenarios (cautious, bold, and deep structural) around four (4) main policy levers: (1) tax reform and non-oil revenue mobilisation; (2) increased public expenditure in non-oil sectors; (3) climate-resilient infrastructure investment; and (4) trade leveraging via the African Continental Free Trade Area, AfCFTA.

The rest of the report is structured as follows: Section 2 provides a brief overview of running simulations with the model (for brevity, we do not report a detailed model overview). Section 3 describes the baseline scenario with highlights of the input data, macroeconomic behavioural assumptions, and results. Section 4 provides a detailed description of the economic diversification scenarios and policy levers, as well as the estimated macroeconomic and environmental impacts. Section 5 concludes the report and provides some policy recommendations.

2. Overview of running simulations with the model

As Figure 1 indicates, policy assessment using the model requires two simulations. The *baseline simulation* (see Section 3) traces the economy's growth path over time with no policy changes. The *policy simulation* incorporates the baseline's exogenous features and superimposes policy-related shocks reflecting the details of the policy under consideration. The policy impacts are reported as deviations from the baseline (per cent or level differences). In other words, the C-B distance in Figure 1, for each year of the projection.

Figure 1. Policy analysis with the dynamic CGE model



Source: Authors' illustration

3. The Baseline

The baseline is the control projection against which policy scenarios are compared (Section 4). For this study, importance is placed on establishing a baseline with credible projections for selected variables, including population growth and real GDP. A typical baseline may be developed in two steps. In the first step, historical data for the known period (statistical years) is introduced. For our baseline, we introduce known percentage changes in real GDP from 2020 to 2024. In the second step, independent forecasts for future periods are obtained for as many variables as practical. For our baseline, the longer-term forecast is based on the Shared Socioeconomic Pathways (SSP)[5] which provides a framework for understanding how different socioeconomic developments might influence the environment (O'Neill et al., 2014; Riahi et al., 2017; van Vuuren et al., 2017). For our study, we use the middle-of-the-road (SSP2) forecasts for GDP and population growth.[6] These assumptions are well-aligned with the medium and long-term trajectories adopted in the modelling of Nigeria's Long-Term Low Carbon Development Strategy (LT-LEDS) (NCCC, 2023) as well as Nigeria's Climate Change and Health Assessment Report (FMHSW, 2024).[7]

[5] The SSPs are a coherent set of five global pathways describing potential alternative socioeconomic (O'Neill et al., 2014). Their main purpose is to describe plausible future evolutions in key socioeconomic variables that together create changes for climate change mitigation and adaptation. Each SSP has been developed using a combination of qualitative descriptions of potential future changes in demographics, human development, economy and lifestyle, policies and institutions, technology, environment and natural resources, and quantifications of some of the key variables such as population growth, GDP and urbanisation (Riahi et al., 2017; van Vuuren et al., 2017). These storylines have been developed based on expertise knowledge (O'Neill et al., 2014; van Vuuren et al., 2017) and the quantified variables have been produced through modelling efforts.

[6] For a description see
https://unece.org/fileadmin/DAM/energy/se/pdfs/CSE/PATHWAYS/2019/ws_Consult_14_15.May.2019/supp_doc/SSP2_Overview.pdf

[7] Total emissions increase over time, but the growth in emissions is less than real GDP.

We further impose views of the Nigerian government stakeholders related to the production of crude oil, electricity generation by technology type and the change in petroleum and electricity subsidies.[8] These specific views of the government stakeholders do not contradict the SSP narrative. Incorporating their views is important as it improves the sector-specific forecasts, which further improves the credibility of the baseline.

In broad terms, we assume that the baseline characteristics interact with SSP2 in the following ways:

- Nigeria's population is projected to increase between 220 – 450 million by 2050. In our baseline, Nigeria's population is just under 440 million.
- Rapid urbanisation continues, which increases the demand for infrastructure and energy.
- Economic growth ranges between 3-5 per cent per annum.
- Reliance on crude oil persists as a source of revenue. We do assume that domestic demand for crude oil increases due to local refining capabilities.
- The energy mix remains dominated by fossil fuels, although there is a gradual increase in renewable energy.
- Total emissions increase over time, although the growth in emissions is slightly lower than real GDP.
- Under SSP2, global warming likely reaches 2.5-3.5 degrees by 2100 without stronger mitigation measures.

3.1. Data input

For the baseline, we adopt forecasts from the SSP2, specific to Nigeria. Specifically, we adopt (1) real GDP and (2) population growth.[9] The IIASA data is presented in 5-year intervals. From these data, we calculate annual values and then the implied year-on-year percentage change. We further adapt the GDP growth rate by incorporating labour and land productivity deterioration due to possible climate effects. Our view is guided by Robson and Satori (2016). Their study provides a summary of results aimed at estimating parameters for several damage functions. The parameters are estimated for each of the 140 countries and regions in the GTAP9 dataset. Their study suggests that the dominant impact on the GDP of Nigeria due to climate damage is heat. In our baseline, we therefore introduce labour productivity and land productivity deterioration. We assume that labour productivity for workers working in agriculture is more impacted than those in manufacturing and services. We also assume that land productivity in agriculture deteriorates, implying that fewer crops per hectare are produced. Consequently, real GDP is slightly lower than what is implied by

[8] These subsidies are present in the 2019 Supply-Use Table developed by the NBS. Tax reform is an important policy tool and therefore a plausible trajectory of subsidies are introduced in the baseline.

[9] These forecasts were downloaded from the International Institute for Applied Systems Analysis (IIASA) using the SSP Extensions Explorer (available at https://ssp-extensions.apps.ece.iiasa.ac.at/explorer?run=42,43,44,45,46,47&variable=46,47,48&region=144&ui=line-chart&dataHash=6634df2ddb56e)

the IIASA GDP data. Tables A1 and A2 in Appendix A list the year-on-year percentage change in the forecast values for selected variables.

The crude oil sector is a major contributor to the Nigerian economy. In the baseline, we impose a view that crude oil will remain an important part of the economy. Growth rates from 2020 to 2023 were taken from the International Energy Agency (IEA) Statistics. Thereafter, we impose a growth rate in the production of crude oil that is consistent with the growth of economic activity. Consequently, crude oil remains an important export commodity.

The development of the Dangote refinery complex is set to significantly reduce Nigeria's reliance on imported petroleum. In our baseline simulation, we increase the domestic use of domestically produced petroleum and reduce imported petroleum in a cost-neutral way. As a result, the share of domestically produced petroleum of all oil products consumed in Nigeria increases to approximately 80 per cent in 2050. In our baseline, exports of domestically produced petroleum also increase.

In the baseline, we impose observed values for subsidies paid on petroleum and electricity. It is estimated that the subsidies cost the government US$10 billion in 2022.[10] The removal of fuel subsidies in 2023 caused social unrest and increased political risk. In 2024, Nigeria reintroduced a petroleum subsidy to the value of N5.4 trillion.[11] No fuel subsidies were paid in 2025. Based on the information from the Nigerian government stakeholders, we incorporate subsidies from 2020 to 2024 so that by 2024, an estimated petroleum and electricity subsidies of ₦5.4 trillion and 1.9 trillion were paid, respectively. Thereafter, we assume subsidies remain at the 2024 level.

For 2020 to 2024, we impose observed revenue collections for VAT, customs, direct taxes and natural resource rents. VAT is an important non-oil revenue variable in our simulations. We exogenously impose values for VAT revenue from 2019 to 2024, so that the VAT-to-GDP ratio is 1.8 per cent. Customs is exogenously imposed so that by 2024, the collection totals ₦7,518 billion. For direct taxes, revenues are exogenously imposed so that by 2024, company tax and personal income tax are ₦6,500 billion and ₦2,000 billion, respectively. Resource rent is exogenously imposed so that by 2022, the collection totals ₦5,900 billion.

We impose what we regard as a plausible view on the generation of electricity from fossil fuels and renewable sources (hydro, other renewables). Consistent with the Baseline (BAU) scenario from Nigeria's LT-LEDS report (NCCC, 2023), we assume continuation of the current trend where electricity generation relies heavily on fossil fuels, primarily natural gas. Continuation of this trend means that 80 per cent of electricity will be generated from fossil fuels in 2050. We further assume general improvements in energy efficiency related to the use of petroleum and natural gas of 0.5 per annum.

3.2. Assumptions about macroeconomic behaviour in the baseline

To accommodate the extraneous information supplied to the model, numerous naturally endogenous variables in the model are made exogenous.[12] To allow the naturally endogenous

[10] Reuters (2023). https://www.reuters.com/business/energy/nigerias-nnpc-spent-10-billion-fuel-subsidy-2022-2023-01-20/

[11] BusinessDay (2024). https://businessday.ng/news/article/after-countless-denials-fg-admits-to-n5-4trn-oil-subsidy-in-2024/

[12] We use the term exogenous to mean user-determined. The term endogenous means model-determined. In each simulation, every variable is classified as either exogenous or endogenous, with the number of endogenous variables equal to the number of equations in the model. A feature of the model and all other models solved using the GEMPACK software is that users are allowed to choose which variables are exogenous and which are endogenous, provided that the choice is economically sensible.

variables to be exogenous, an equal number of naturally exogenous variables are made endogenous. For example, in the baseline, real GDP (a naturally endogenous variable) is set exogenously by allowing economy-wide technology to adjust endogenously.

3.2.1 Consumption and investment

In the standard set-up of the model, nominal private consumption expenditure is determined via a consumption function which links consumption to Household Disposable Income (HDI). That is, we assume a constant average propensity to consume throughout the simulation. Thus, any change in aggregate investment is accommodated by a change in foreign savings and not domestic savings. Consequently, the Nigerian current account balance may change.

Within any given year, capital available for production in each industry is given at the start of the year. Within each year, industry-specific investment responds to deviations in the expected rate of return away from the normal rate of return to generate changes in capital formation that gradually return rates of return to their normal level over time.

3.2.2 Government consumption and fiscal balances

The model does not have a formal theory that explains the change in government consumption. Government demand can either be set exogenously or linked to aggregate real private consumption. The latter states that the division of consumption into private and public is governed by an assumption of a constant ratio of real public to real private consumption. In the baseline simulation, we hold the ratio of real public to real private consumption fixed.

The fiscal balance of the Nigerian government is allowed to change in line with changes in economic activity and the associated implied tax rates. To accommodate the increase in revenue collections from VAT, customs and direct taxes, we exogenise tax collections by endogenising the appropriate tax rates. From 2025 onwards, the tax rate is exogenously held fixed at the prevailing 2024 level. As mentioned before, subsidies for petroleum and electricity are imposed from 2020 to 2024, allowing the implied tax/subsidy rate to adjust. From 2025 onwards, the rate is held exogenous at the 2025 level.

Resource rent is exogenously imposed so that by 2022, the collection totals N5900 billion. Thereafter, rents grow in line with capital rental for crude oil and natural gas. Net transfers received from the rest of the world are assumed to follow nominal GDP. Government investment by industry is set as a fixed share of total investment by industry. In the baseline, government investment grows as a fixed proportion of industry-specific investment. Government savings are defined as the difference between government income and savings.

3.2.3 Rest of the world

In the forecast simulation, we allow the model to determine aggregate exports and imports. We assume that the global economy grows over the simulation period. In the CGE model, changes to the trading environment are manifested through shifts in the position of downward-sloping export demand curves and changes in foreign currency import prices. In our forecasts, it is assumed that the demand from the rest of the world for Nigerian commodities expands through the simulation period at a rate that holds the average foreign-currency price of exports unchanged. The position of the foreign demand curves for exports is endogenous and moves to achieve exogenously imposed changes in the price (i.e. fixed terms of trade).

No change is assumed in foreign currency import prices. Combined with the assumption of export prices, this means that the terms of trade is fixed.

3.2.4 Rates of technological progress

The model contains many variables to allow for shifts in technology and household preferences. In the baseline simulation, most of these variables are exogenously held unchanged. The exceptions are technology variables that are made endogenous (such as all-primary factor technological change in oil production) or that are set exogenously to non-zero change.

3.2.5 Labour market

In our baseline, aggregate employment is endogenous. We assume that the employment growth is linked to demographic factors, including population growth. In determining the employment growth, we assume a constant employment rate over the baseline period. To accommodate the employment forecast, wages are allowed to adjust.

3.2.6 Numeraire price

The model explains changes in relative prices and has no mechanism to determine the absolute price level. Thus, one price must be exogenous. This price is called the numeraire, and it is the benchmark against which all other prices are measured. In the standard closure, the numeraire is the nominal exchange rate.

3.3. Results

3.3.1 Macroeconomic variables

Table 1 summarises the baseline projections for key macroeconomic variables. We report results for the income-side components of GDP, for the expenditure-side components, and for other macroeconomic indicators such as the real exchange rate. The first five columns of Table 1 show annual average growth rates over five periods spanning 2021 to 2050. The last column reports annual average growth rates over the whole forecast period.

Table 1. Macroeconomic variables in the baseline (average annual growth rates, %)

	2021-2025	2026-2030	2031-2035	2036-2040	2040-2050	2021-2050
A. Income components of GDP						
1. Real GDP	3.0	3.9	4.7	5.0	4.7	4.4
2. Capital stock	2.9	2.8	3.8	4.1	3.9	3.6
3. Employment (wagebill weighted)	1.7	2.4	2.4	2.2	2.0	2.1
4. Aggregate employment, persons	2.5	2.4	2.3	2.2	2.1	2.3
5. Natural resource	-0.6	0.0	0.0	0.1	0.1	-0.1
6. Multi-factor productivity	1.3	1.6	2.1	2.4	2.4	2.0
7. Real wage (CPI deflated)	1.0	0.9	2.2	2.9	2.7	2.1
B. Expenditure components of GDP						
8. Real private consumption	2.3	3.9	4.5	4.8	4.6	4.1
9. Real public consumption	2.3	3.9	4.5	4.8	4.6	4.1
10. Real investment	0.7	4.7	5.7	4.2	3.5	3.7
11. Export volumes	8.0	2.3	4.5	6.7	6.7	5.8

12. Import volumes	0.8	3.3	4.5	4.5	4.5	3.7
C. Other macro indicators						
12. Real exchange rate (+devaluation)	-0.5	-1.8	-0.9	-0.4	-0.4	-0.7
14. Terms of trade	-2.4	0.0	-0.0	0.0	0.0	-0.4
15. Real GNE	2.1	4.1	4.7	4.7	4.5	4.1
16. GDP deflator	9.0	1.8	0.9	0.4	0.4	2.1
17. Population	2.5	2.4	2.3	2.2	2.1	2.3
D. Other indicators						
18. Greenhouse gas emissions	2.2	3.1	4.0	4.5	4.6	3.8

Source: Authors' compilation

3.3.1.1. Real GDP, employment, and population

We impose, in the baseline, forecast values for multi-factor productivity (row 6)[13] and population (row 17). Via closure design, the employment growth (row 4) follows population growth. With employment growth set, wages adjust to accommodate the employment growth. Together with the multi-factor productivity (MFP), employment and capital stock, the model generates the annual GDP growth rate. The simulation results show that MFP increases (i.e. improves) by approximately 2.0 per cent per annum and real GDP by 4.4 per cent per annum.

3.3.1.2. Capital, natural resource and economy-wide productivity TFP

The use of natural resource supply (row 5) is forecast to grow in line with the production of crude oil. During 2020 – 2023, the production of crude oil falls. Thereafter, the use of natural resources increases in line with production.

Growth in the economy's capital stock is determined largely by initial conditions for the ratio of investment to capital and by the economy's ongoing needs for new and replacement capital. With real GDP growth exogenously imposed and employment determined, there is considerable scope for capital to grow. The growth in employment increases the marginal product of capital, and hence capital grows over time (row 2). The growth in employment increases the marginal product of capital, and hence capital grows over time (row 2). According to our modelling, over the entire period, capital growth is likely to average around 3.6 per cent per annum. With employment growth of 2.3 per cent, capital growth of 3.6 per cent, and MFP improvement of 2 per cent, real GDP grows over time.

Growth in the real wage rate (line 7) is relatively strong at 2.1 per cent per year across the entire period. This is allowed for, in part, by growth in productivity. Another positive factor for wages is the projected shift in the economy toward industries (particularly in the service sectors) in which wage rates are relatively high.

[13] Real GDP is naturally endogenous in the model. To impose shocks to it, we run a side simulation where we exogenise real GDP and endogenise economy-wide primary-factor technical change. This allows us to shock real GDP with the actual and projected GDP growth rates implied by the SSP2 forecast. Together with other changes in the model, the primary-factor technical change variable would change to accommodate these shocks. In the main forecast simulation, we reverse the swap, endogenising real GDP and exogenising the primary factor technical change, and then shock the latter with values they receive in the side simulation. *Ceteris paribus*, the model will reproduce the real GDP growth rate. The advantage of this reverse swap is that it allows GDP to respond to additional changes that we would impose on the model (e.g. impact of labour and land productivity due to due heat stress).

As a final point, the growth in most variables is not constant over the forecast period, with growth at the end higher than at the beginning of the period. This partly reflects the underlying assumption in economic growth. The narrative underlying SSP2 depicts a future of global progress where developing countries achieve significant economic growth. With economic growth exceeding population growth, average per capita income levels improve over time.

3.3.2 Expenditure components of real GDP

In its standard configuration, the model assumes that private consumption is determined via a function that links consumption spending to Household Disposable Income (HDI), with a fixed coefficient of proportionality – the Average Propensity to Consume (APC). Throughout the forecast period, we assume that the APC remains unchanged, allowing the model to determine the growth in private consumption. Accordingly, as shown in row 8 of Table 1, growth in private consumption follows closely growth in real GDP – a good proxy for real income accruing to Nigerian citizens.

The model does not have a formal theory that explains changes in government consumption. Typically, the division of consumption into private and public is governed by an assumption of a constant ratio of real public to real private consumption. Thus, in the baseline, growth in public consumption matches growth in private consumption (compare rows 8 and 9 in Table 1).

In each year, the model determines industry-specific investment based on initial investment to capital ratios and a mechanism that allows those ratios to change in line with changes in actual rates of return. Row 10 in Table 1 shows real investment growth of 3.7 per cent per annum on average across the entire period. This is slightly higher than the growth rate of capital, reflecting, in part, replacement needs for retired capital.

In the forecast simulation, we allow the model to determine the growth in exports and imports. In aggregate terms, with real GDP (Y) assumed to grow at 4.4 per cent, and growth in real Gross National Expenditure ($C + I + G$) at 4.1 per cent per year, implying that there is a positive change in the net volume of trade ($X - M$) to change.[14] In other words, with the growth in real GDP exceeding real GNE, net exports must improve. This is true for the period 2025 onwards, where real GDP exceeds real GNE. For the first few years of the simulation period, real GNE exceeds real GDP, requiring net exports to move towards a deficit.

Import growth is projected to be 3.7 per cent per annum, which is in line with real GDP. This is a little above growth in final domestic demand (real Gross National Expenditure), reflecting in part compositional changes in the economy towards import-intensive forms of expenditure.[15] This leaves real aggregate exports to increase by more than imports.

3.3.3 Other macroeconomic variables

In the absence of expansion in foreign demand for Nigerian products, export growth would need to be accompanied by a decline in export price to encourage foreign purchases of Nigerian goods and services. In the baseline, we assume that as Nigeria expands, foreign markets for Nigerian

[14] Recall the basic real GDP definition: real GDP (Y) = real private consumption (C) + real public consumption (G) + real investment (I) + the net volume of trade ($X - M$).

[15] Compositional changes implies that there is a shift toward imports and away from domestic produced goods. This is partly due to the higher capital and investment growth rates. Capital-intensive industries tend to replay on imported capital goods.

commodities will be found such that there is no change required in the price of exports and hence no change in Nigeria's terms of trade (row 14).

The real exchange rate is the mechanism via which the economy achieves the required growth in exports of 6 per cent per annum. As shown in Table 1, across the entire projection period slight changes are required in the real exchange rate. Note that real appreciation signals a deterioration in the competitiveness of Nigerian producers versus foreign producers. Real depreciation signals an improvement in competitiveness.

The final variable in Table 1 is total greenhouse gas emissions (GHG). We note that up to 2030, the rate of growth in emissions is below the growth in real GDP. Thereafter, the increase in emissions is broadly in line with real GDP. We note that the economy is projected to reduce its greenhouse intensity, measured as emissions per unit of GDP. With GDP growth of 4.4 per cent and emissions growth of 3.8 per cent, we are projecting a fall in emissions intensity. As discussed below, much of this is due to baseline trends towards use of renewable generation for electricity and the efficient use of fossil fuels.

3.3.4 Industry production

Our discussion begins with an overview of the forecast path for the three main categories namely, agriculture, industry and services. We then proceed to describe selected industries that perform well and those that grow at a slower pace.

Throughout the simulation period, the **services sector** remains the dominant contributor to output. Production in both services and manufacturing is largely absorbed domestically, with limited exports. Nigeria's export base continues to be dominated by crude oil, leaving the trade balance highly exposed to fluctuations in global oil prices and external demand. Historically, episodes of currency devaluation have coincided with declines in oil prices. Within our modelling framework, a devaluation enhances Nigeria's competitiveness and can support the expansion of non-oil exports.

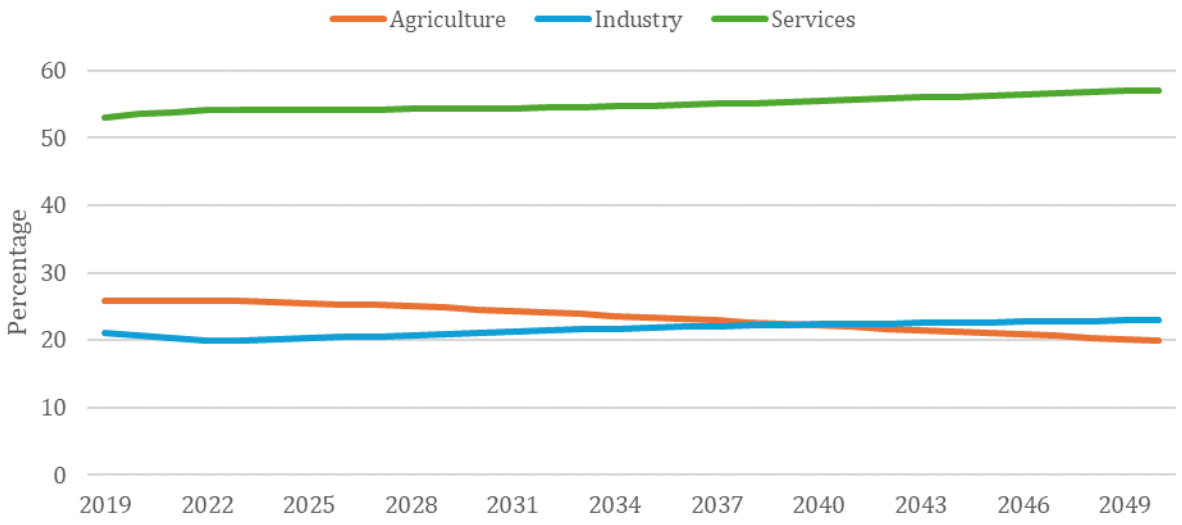
Within the services sector, industries such as finance and insurance, telecommunications, and trade show strong performance. Two key factors drive this growth. First, Nigeria's expanding population fuels rising demand for household-oriented services such as education, housing, arts and recreation, as well as government services like public administration. Second, many service industries act as critical inputs to other sectors, meaning that as manufacturing and energy industries expand, their demand for services (such as telecommunications, finance, and insurance) also increases. These interlinkages highlight the importance of cross-sectoral dynamics in understanding economic outcomes. In addition, Nigeria benefits from digital leapfrogging, where the widespread adoption of mobile technology and digital platforms enables businesses and households to bypass infrastructure constraints, broaden financial inclusion, and rapidly scale services such as fintech, e-commerce, healthcare, and education. Taken together, the growth of services not only strengthens the domestic economy but also offers a natural pathway for diversification away from crude oil dependence.

The share of **industrial** activity in value added remains broadly stable over the simulation period. Within this aggregate sector, however, there is a noticeable reallocation of activity across industries, largely driven by capital deepening in the economy (see macro discussion). The petroleum sector records the strongest growth, reflecting a shift towards domestically produced petroleum and away from imports. This expansion also generates spillover effects, as service

industries such as finance, telecommunications, and administrative support, which are key providers to the petroleum sector, benefit from its growth. Investment-linked industries, including electrical equipment and motor vehicles, also perform well since much of their output is directed towards capital formation. Consumer-oriented sectors such as beverages and tobacco, textiles, and wearing apparel gain from robust household consumption, their relatively labour-intensive nature and limited linkages to investment activities.

Agricultural industries sell most of their output directly to households and therefore benefit from the strong growth in aggregate household consumption. On the supply side, however, agricultural expansion is constrained by the limited availability of land, which is a fixed input in production. This land constraint places an upper bound on the sector's ability to respond to rising demand.

Figure 2. Share contribution in value added by the main sector (%)



Source: Authors' diagram

Below, we highlight a few sectors' performances over the simulation period. First, we note that all sectors grow over the simulation period, with some growing at a rate exceeding real GDP while others grow at a lower rate. The macroeconomic outcomes described above are a key influence on the prospects for industry production. We would expect that:

- with aggregate capital rising relative to aggregate employment, capital-intensive sectors will have relatively good growth prospects;

- with growth in private and public consumption consistent with growth in real GDP, there will be relatively good growth prospects for sectors that sell their output primarily to households and government; and
- industries that are trade-exposed will do well.

Table 2 shows projected growth rates in the production of aggregated industry sectors, with additional detail for electricity.[16] As with the macroeconomic variables, we provide six columns of numbers, with the final column showing, in average annual percentage terms, total growth across the period 2021 to 2050.

Table 2. Industry output by aggregated sector in the baseline (average annual growth rates, %)

Industry output	2021-2025	2026-2030	2031-2035	2036-2040	2040-2050	2021-2050
1. Real GDP	3.0	3.9	4.7	5.0	4.7	4.4
Sector 1 - Agriculture, forestry, and fishing	2.6	3.2	3.7	4.0	3.8	3.5
Sector 2 – Mining	1.7	4.9	4.8	5.1	5.1	4.4
Sector 3 – Manufacturing	4.9	4.9	5.8	5.9	5.3	5.4
Sector 4 – Electricity and gas distribution	4.6	3.3	5.3	6.3	6.4	5.4
4a Fossil fuel electricity services	4.7	2.7	4.7	6.0	6.0	5.0
4b Renewable electricity services	9.9	6.9	8.6	9.4	8.8	8.7
Sector 5 – Construction	0.7	4.8	6.0	4.4	3.7	3.9
Sector 6 - Trade	3.0	3.8	4.6	4.9	4.6	4.2
Sector 7 - Accommodation & food services	7.2	1.5	3.2	4.8	4.9	4.4
Sector 8 - Transport, postal, and warehousing	4.3	5.4	5.8	6.2	6.2	5.7
Sector 9 - Communication services	2.8	4.0	5.0	5.4	5.2	4.6
Sector 10 - Financial & insurance services	3.8	3.4	5.0	5.6	5.3	4.7
Sector 11 – Rental	2.8	4.2	4.9	5.2	5.0	4.5
Sector 12 - Professional services	2.6	3.6	4.7	5.1	4.9	4.3
Sector 13 - Administrative services	3.2	4.1	5.3	5.7	5.4	4.9
Sector 14 - Public administration and safety	3.2	3.2	4.3	4.9	4.7	4.2
Sector 15 - Education and training	2.4	4.4	5.3	5.8	5.5	4.8
Sector 16 - Health care and social assistance	2.2	4.5	5.2	5.6	5.3	4.7
Sector 17 - Arts and Recreation	2.1	4.8	5.7	6.2	5.9	5.1
Sector 18 - Other services	2.5	4.9	5.6	5.8	5.5	4.9
Sector 19 - Ownership of dwellings	2.3	3.3	5.8	7.7	8.3	5.9

[16] The model formally recognises 96 industries. The sectoral detail shown in Table 2 is an aggregations of 96 industries. For example, aggregated sector 1 – Agriculture, Forestry and fishing is a composite of the 45 industries in the 96 classifications.

Source: Authors' compilation

We allow the model to determine industry-specific growth rates. There are a few exceptions, namely (1) fossil fuel and renewable generation, which are part of aggregated Sector 4, (2) the crude oil production, which is part of Sector 2 in Table 2 and (3) the petroleum industry. We assume that the demand for imported petroleum falls and is replaced by domestically produced petroleum. In our baseline, the petroleum industry, part of Sector 3, does well. The settings for these industries are discussed in Section 3.1. In the remainder of this section, we discuss the baseline growth projections for industries not exogenously tied down.

The aggregated sector with the best overall growth prospects is Sector 19: Ownership of dwellings, with projected average annual growth of 5.9 per cent, compared to overall real GDP growth of 4.4 per cent. This sector consists of only capital (housing stock) and benefits from strong initial capital growth.

The aggregated sector with the poorest growth prospects is Sector 1: Agriculture, forestry and fishing. This sector has a lower annual growth rate, mainly due to no growth in arable land. This constrains the supply side of this sector. Mining. Industries within this sector provide outputs mainly to foreign markets (crude oil, natural gas) or sell their output to domestic industries such as the iron and steel sector and cement industry (coal, metal ores and quarrying). The latter industries mainly sell their output to the construction sector. Thus, their performance can be explained by the underlying linkages between local sectors. In our baseline, one of the assumptions is that the demand for domestically produced petroleum will replace imported petroleum. Consequently, the demand for crude oil by the refining sector will increase. In our baseline, the export of crude oil grows at a slower rate as oil is diverted to the local market. However, crude oil remains an important export commodity. Overall, the mining sector benefits from the strong growth in exports (crude oil-dominated) and investments.

As the economy grows, so too does the construction sector. Growth in construction activity (Sector 5) is relatively strong. This industry sells its output to investments and therefore benefits from the strong growth in capital. Sector 17 produces arts and recreation services also performs well. This sector mainly sells to local residents. Its overall growth of 5.1 per cent per annum. Although this sector contracted in the first part of the projection period after COVID, growth returns to normal rates, with the level of activity improving in the latter part of our baseline.

Sector 10: Finance and insurance services are another sector with good growth prospects, with average annual growth of 4.7 per cent over the full period. This sector provides financial and insurance services to industries as well as households and benefits from the growth in household demand. This industry is more labour-intensive and experiences some constraints on the supply side. Nevertheless, this industry grows by more than the real GDP. Within the manufacturing sector, motor vehicles also perform well. Motor vehicles are mainly imported and sold to investments and therefore benefit from the strong growth in investments.

The electricity sector also performs well and grows at a rate of 5.4 per cent per annum. Electricity is mainly sold to the local market (industries and households) and exported to neighbouring countries such as Benin, Togo and Niger. This sector grows in line with the size of the economy and domestic consumption. These sectors are more capital-intensive and therefore they benefit from the strong growth in investments and capital. Although the energy mix is dominated by fossil fuels, electricity from renewable sources increases over time. In our baseline, just over 20 per cent of electricity is from renewable sources in 2050.

Prospects for the remaining industries are above average, especially in the later years of the projection period. This signals that in areas outside of electricity, crude oil and petroleum, the baseline story is of balanced growth with *no industry in decline* and most industries growing at around the economy-wide average.

3.3.5 Employment

Table 3 shows projected growth rates in employment by aggregated industry sectors, with additional detail for electricity. As with the macroeconomic variables, we provide six columns of numbers, with the final column showing, in average annual percentage terms, total growth across the period 2021 to 2050.

Table 3. Employment by aggregated sector in the baseline (average annual growth rates, %)

Employment by main industry	2021-2025	2026-2030	2031-2035	2036-2040	2040-2050	2021-2050
Sector 1 - Agriculture, forestry, and fishing	1.4	2.6	2.0	1.8	1.7	1.9
Sector 2 – Mining	-4.2	1.2	1.1	1.4	2.1	0.6
Sector 3 – Manufacturing	2.3	2.5	2.3	1.9	1.6	2.0
Sector 4 – Electricity and gas distribution	1.1	2.4	2.6	2.2	2.3	2.2
4a Fossil fuel electricity services	3.4	0.8	1.0	1.6	2.0	1.8
4b Renewable electricity services	9.5	5.4	4.6	4.6	4.1	5.3
Sector 5 – Construction	1.8	5.8	2.0	-0.2	-0.1	1.5
Sector 6 - Trade	1.6	2.1	2.3	2.1	1.8	2.0
Sector 7 - Accommodation & food services	5.0	-0.6	0.9	2.2	2.1	1.9
Sector 8 - Transport, postal, and warehousing	3.2	3.7	3.2	3.1	3.2	3.3
Sector 9 - Communication services	1.4	2.6	2.5	2.3	2.2	2.2
Sector 10 - Financial & insurance services	2.3	1.7	2.7	2.8	2.5	2.4
Sector 11 – Rental	1.5	2.5	2.7	2.6	2.4	2.3
Sector 12 - Professional services	0.7	2.0	2.3	2.1	2.0	1.8
Sector 13 - Administrative services	1.6	2.5	2.9	2.7	2.4	2.4
Sector 14 - Public administration and safety	1.6	1.5	1.9	2.0	1.8	1.8
Sector 15 - Education and training	0.9	2.9	2.9	2.8	2.6	2.4
Sector 16 - Health care and social assistance	0.8	3.0	2.8	2.6	2.4	2.4
Sector 17 - Arts and Recreation	0.8	3.5	3.3	3.1	2.8	2.7
Sector 18 - Other services	1.1	3.2	3.4	3.2	2.8	2.8
Sector 19 - Ownership of dwellings	0.0	0.0	0.0	0.0	0.0	0.0

Source: Authors' compilation

In our baseline simulation, we assume that national employment grows in line with the growth in the working-age population. In general, industries with a higher labour share (arts and recreation, other services, transport services) will show relatively stronger employment growth paths. Table 3 shows that the industries with the highest employment growth are the renewable electricity

generation, followed by transport, other services and arts and recreation. By assumption, we let the renewable electricity grow at a fast rate (see Section 3.1). This industry is relatively small and thus, the high rate of increase in employment is from a small base. Industries with the lowest employment growth tend to be more capital-intensive and/or are constrained by the fixity of natural resources (i.e., mining).

In terms of employment by gender, over the medium-to-long term, employment growth for males and females remains strong at 2.4 and 2.2 per cent, respectively. Employment growth for males is slightly higher due to the strong growth in economic activity in industries that generally employ more males (i.e. manufacturing and utilities). Male employment, specifically unskilled males, remains dominant. Employment for females grows in line with the activity level of industries that employ mainly females (i.e. agriculture and services).[17]

3.3.6 Government income and expenditure

Over the simulation period, revenue from non-oil sources improves in the long-run. There are two reasons for strong growth in non-oil revenue. First, recall from our baseline assumptions, we impose an increase in the VAT revenue so that by 2024, VAT as a share of GDP is 1.8 per cent. The model endogenously determines the change in the implied tax rate required to accommodate this increase in revenue collection. Observed data shows that collection increased from ₦1.1 trillion in 2019 to approximately ₦6.7 trillion in 2024.[18] From 2025 onwards, a higher VAT rate is levied on the use of commodities, leading to higher revenue for the government. Secondly, in our baseline, we introduce energy subsidies so that by 2024, ₦5.4 trillion and ₦1.9 trillion are paid in subsidies. From 2025 onwards we assume that (1) the value of subsidies remains at the 2024 level, and that (2) no new subsidies are paid. The implication is that, over time, the drain on government revenue, due to energy subsidies, is reduced.

Tax revenue includes direct and indirect taxes. Direct taxes include income and corporate tax. Direct taxes are levied on factor income generated by industries and households. Given a fixed tax rate, direct taxes grow in line with factor payments. The share of direct taxes in total government income remains stable over the simulation period. Indirect taxes include commodity taxes and subsidies, tariffs and production tax. For each of these taxes, the determinants include the tax rate, the real use of a commodity by the different agents and the basic price of a commodity. Indirect taxes grow over time in line with the underlying quantity and price variable.

In the baseline, the tax revenue to GDP ratio remains low. In our baseline simulation, the tax-to-GDP ratio is approximately 5 per cent in 2024. This ratio remains fairly stable over time and increases slightly so that by 2050, this ratio is 5.4 per cent. Other sources of revenue include royalties from natural resources and transfers received from the rest of the world. The share of these income sources remains stable over the simulation period.

In terms of expenditure, the largest item is government spending. Other items include transfers to households and enterprises as well as to the rest of the world. The share of each of these items in total spending remains stable throughout the simulation period. Government investment grows in line with total investment. Over the simulation period, the share of government investment to GDP remains stable at 1.8 per cent.

[17] Data table is not provided, for brevity.

[18] Total VAT revenue increased with approximately ₦3 trillion per annum from 2022 to 2024.

At the beginning of the simulation period, the government budget is a deficit. The deficit is slowly reduced due to the increase in tax collection (see above), and no subsidies are paid from 2025 onwards. In the medium to long run, the budget reflects a small surplus. The surplus to GDP ratio increases from 0.6 per cent to approximately 1 per cent in 2050.

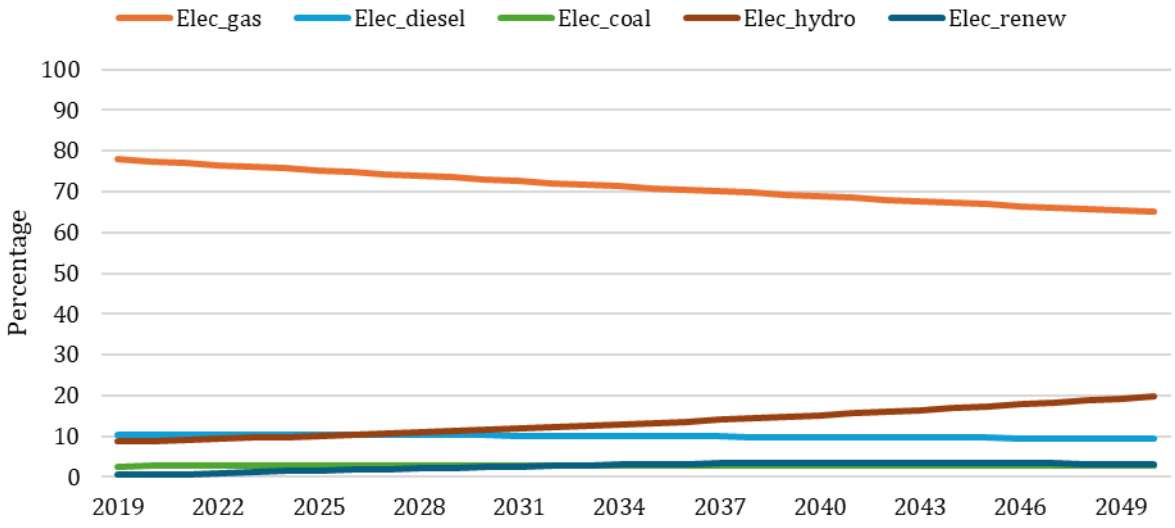
3.3.7 Household income and expenditure and consumption

Households generate income from labour, capital and transfers from enterprises, the government and the rest of the world. Over the simulation period, household income grows in line with labour and capital. Rich households' incomes grow slightly faster because they earn more from capital than poorer households. Richer households' nominal consumption grows slightly at a higher rate than poorer households.

3.3.8 Electricity generation

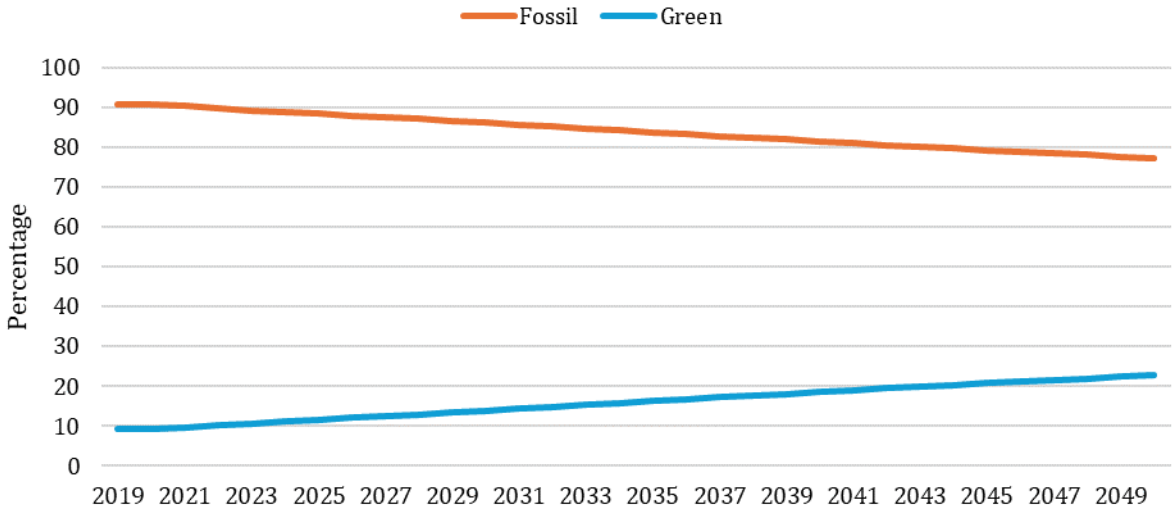
We impose what we regard as a plausible view on the generation of electricity from fossil fuels and renewable sources (hydro, other renewables), which are independent of changes in relative price or final demand. This includes the increase in electricity generation and distribution, as well as a continuation of the current trend towards renewables. Continuation of this trend assumes that 22 per cent of electricity will be generated from renewable sources in 2050 (Figure 4).

Figure 3. Share of electricity generated by fuel, 2020-2050 (%)



Source: Authors' diagram

Figure 4. Share of electricity generated by fossil and renewable sources, 2020-2050 (%)

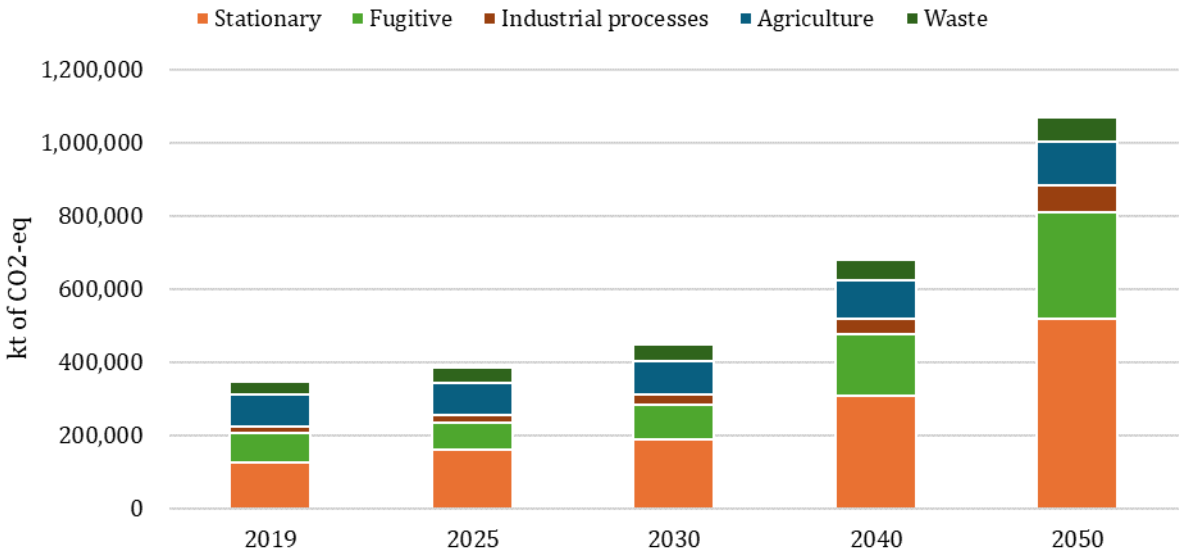


Source: Authors' diagram

3.3.9 Greenhouse gas emissions

Figure 5 shows the level of greenhouse emissions expressed as kt of CO_2-eq in five-year intervals in the baseline. For each of the years, we show a total with a breakdown into the key Kyoto categories. Noted already is the growth in overall emissions (see the final row of Table 1). In 2019, emissions totalled around 347 $MtCO_2$-eq (UNFCCC, 2022). Emissions rise to reach 1,062 $MtCO_2$-eq in 2050. From 2020 onwards, emissions in all categories continue to grow, but general improvements in energy efficiency, a shift towards renewable generation and the rate of growth across the full period in each category is lower than real GDP.

Figure 5: Greenhouse gas emissions by major Kyoto category, baseline (kt of CO_2-eq)



Source: Authors' diagram

4. Economic impact of diversification

4.1. Introduction

This section examines how a coherent package of reforms could reshape Nigeria's growth path. The scenarios are illustrative rather than predictive: they are designed to test plausible futures and to show, with evidence, how different choices on tax, public investment, trade, and productivity will shift outcomes relative to a no-reform baseline. To ground the work institutionally, we followed a structured engagement plan. At the early stages, we held policy-level consultations with the Macroeconomics Department of the Federal Ministry of Budget and Economic Planning (FMBEP), which is preparing the National Development Plan (2026–2030). Working together, we refined a scenario framework that aligns with government thinking and is implementable within existing institutions. Three growth paths **(1) Cautious Reform**, **(2) Bold Reform**, and **(3) Deep Structural Reform (structural, from now on)**, build cumulatively: each step increases the ambition and magnitude of the same reform package rather than shifting objectives midstream. Across all scenarios, the levers are consistent: tax reform and non-oil revenue mobilisation to broaden the base and reduce distortions; higher and better-targeted public expenditure in non-oil sectors; climate-resilient infrastructure to raise productivity; and trade leverage under the AfCFTA to cut costs, meet standards, and expand non-oil exports. The distinctions among scenarios lie in the magnitude of shocks and the depth and speed of implementation.

Calibration rests on Nigeria's recently rebased macroeconomic statistics, ensuring that sector shares, factor incomes, and trade structures reflect the current economy rather than an outdated snapshot. We first generate a baseline path with existing policies and no new reforms. From 2026 onward we layer the same policy package at increasing intensities across the three scenarios. The comparison to baseline then quantifies the effects on GDP, employment, welfare (measured by private household consumption), industry activity, etc.

Below, we provide a narrative of the simulations. The policy shocks are introduced from 2026 onwards.

a) The first scenario focuses on tax reform, specifically the removal of the fuel and electricity subsidies, the increase in the VAT rate, as well as the introduction of a fuel excise tax. In line with the African Continental Free Trade Area (AfCFTA), we reduce tariffs on imported commodities. *Ceteris paribus*, government revenue will increase, improving the government budget. These changes in tax collections (and increase in government income) form the foundation upon which we introduce an increase in government investment as well as the productivity improvements.

b) With an increase in tax revenue, it matters how these funds are used. In the policy simulation, we allocate a percentage of the increase in government revenue to government investment in all non-oil sectors to enhance innovation and technological adaptation.[19]

   These investments may include investment in (1) resilient infrastructure such as agricultural irrigation, road infrastructure reducing high transport losses, and improving supply of inputs to the largely rain-fed agricultural sector, (2) facilitating investment and activity in the non-

[19] Non-oil sectors are defined as all sectors excluding crude oil, natural gas, petroleum and public administration.

oil, non-agriculture economy, including in the dynamic services sector which is a pathway to promote diversification, (3) increased investments to support higher electricity production and distribution, (4) improving trading infrastructure and reducing the excessive regulatory burden.

If these investments are implemented effectively, they can help to improve infrastructure (such as roads, electricity, and storage facilities), remove structural bottlenecks that reduce both time and transaction costs, enabling more efficient production. Productivity thus improves.

c) Capital can become more productive due to better infrastructure (roads, ports, power plants, digital access, reduced transport delays and energy costs). Government investment overall reduces bottlenecks and lowers costs.

d) Labour can become more productive because, as the government invests in education and training programs, particularly for unskilled workers, skill levels improve and enhance the ability of workers to adopt and benefit from new technologies. Targeted training programs for informal and low-skilled workers can also improve their chances of securing formal employment or transitioning into higher-paying jobs. In addition, service sectors such as finance, trade, telecommunications, and professional services, many of which are labour-intensive, stand to gain significantly from these improvements. Investment in infrastructure improves roads, which may reduce the travel time required for workers to move from their residence to their place of work. Finally, investment in health services overall may improve the health of the labour force, which reduces the number of days taken for sick leave. Consequently, these investments make labour more efficient, leading to higher output per worker.

e) Increase in labour participation rates for all skills. Ultimately, a larger share of the working-age population supplies labour to the market.

f) Nigeria's agriculture is highly vulnerable to climate change, as it relies heavily on rainfall and has limited irrigation infrastructure. Variability in rainfall patterns, along with flooding and droughts, directly affects output and productivity. Rising temperatures and shifting rainfall patterns further drive desertification and increase the risk of pests and diseases, compounding the decline in crop yields. For instance, the agricultural sector employs a large share of the labour force, especially unskilled labour. Thus, climate change disproportionately impacts the agricultural sector and disproportionately impacts the poor.

In our policy simulations, agricultural investments may be directed towards climate-smart agriculture (CSA) and climate-resilient infrastructure. Key measures include expanding irrigation systems and adopting drought-tolerant seed varieties, both of which raise output per hectare. Complementary improvements in roads and storage facilities further reduce post-harvest losses. Together, these interventions enhance land productivity and strengthen the sector's resilience to climate risks, so that more can be produced per hectare of land. On the demand side, most of the agricultural outputs are directly sold to households. Thus, any disruption directly affects rural income, food supply and food prices.

g) Road transport becomes more efficient as freight services can operate more reliably, as road infrastructure is more resilient to floods and erosion. This reduces transport disruptions and ultimately the cost of transport. Thus, in our simulations, transport becomes more efficient in moving commodities and requires "fewer resources" per unit of output.

Why are these productivity impacts important? Nigeria's infrastructure gaps are large, implying that productivity is low across all sectors. Nigeria's $2.3 trillion infrastructure need up to 2043, according to the revised National Integrated Infrastructure Master Plan (NIIMP) (FMBNP, 2020), if approached through a climate lens, means building differently – e.g., roads with better drainage, coastal defences for ports, expanding rail (electrified preferably) to move freight instead of road trucks, and building resilient power grids that integrate renewables. Government investments improve labour, capital and land productivity so that the productivity payoff is especially strong.

Below, we briefly list the shocks imposed in our policy simulations as well as the closure used in our policy simulations. The macroeconomic closure is similar for all the policy simulations.

4.2. Policy shocks

Table 4 provides an overview of the simulations reported. Column 1 shows the simulation under consideration. Column 2 reports a short narrative while columns 3 to 5 list the three broad policy simulations, **namely cautious, bold, and structural**. The letters in the table link to the narrative in Table 4 and the accompanying text below.

We run 5 simulations (Sim). We begin with a simulation to investigate the economic impact of only the tax reform. This is Sim 1 in Table 4. The purpose of this simulation is to show the net impact of only tax reform. The results are discussed in Section 4.4. Sim 2 builds on Sim 1 and incorporates only a 50 per cent increase in government investment. We do not consider any productivity improvements. The purpose of this simulation is to show the impact of an increase in investment on the deviation in real GDP. The results are discussed in Section 4.5. Sim 3 is Sim 2 and incorporates all productivity improvements and increases the labour participation rates. Sim 3 is what is referred to as the Cautious scenario. We then run two additional policy simulations where we shock the same variables as in Sim 3, but the magnitude of the shocks differs. Sim 4 represents the Bold scenario, while Sim 5 represents the Structural scenario.

Table 4. Summary of the policy simulations

Code	Narrative	Cautious	Bold	Structural
Sim 1	▪ In this simulation, we remove petroleum and electricity subsidies, increase VAT collections, increase fuel levy on petroleum and remove tariffs. Ceteris paribus, government income increases. Assuming no change in government spending, the overall government balance improves. There is no increase in government investment.	a	a	a
Sim 2	▪ Sim 1 plus an increase in government investment, with 50% of the increase in government revenue.	b		
Sim 3	▪ Sim 2 plus increase in industry-specific capital productivity (low).	c		

	▪ Industry-specific labour productivity improvements for skilled and unskilled labour (low).	d		
	▪ Increase the labour participation for skilled and unskilled labour (moderate).	e	e	
	▪ Increase land productivity for agricultural (crops) sectors.	f		
	▪ Efficiency improvement in the use of freight and passenger road transport.	g	g	g
Sim 4	▪ Government investment of 80% of the additional government income. 20% remains with the government.		h	
	▪ Increase activity and exports of level of light manufacturing activities		i	i
	▪ Increase in the share of electricity generation from renewable sources to 30% in 2050		j	
	▪ Industry-specific capital, land and labour productivity improvements for skilled and unskilled labour (moderate).		k	
Sim 5	▪ Government investment of 100% of the additional government income.			l
	▪ Increase in the share of electricity generation from renewable sources to 50% in 2050			m
	▪ Industry-specific capital, land and labour productivity improvements for skilled and unskilled labour.			n
	▪ Increase the labour participation for skilled and unskilled labour.			o

Note: Sim is short for 'Simulation'.

4.2.1 Tax reform

Nigeria has one of the lowest revenue-to-GDP ratios in the world.[20] The below-average revenue has mainly been driven by narrow tax bases of its indirect taxes, low compliance, a large amount of tax exemptions as well as low tax rates (IMF, 2023). The authorities adopted a national plan with the aim of raising the revenue-to-GDP ratio.[21] In our simulations, we focus on:

- Remove petroleum and electricity subsidies.
- Uniform increase in the VAT rate to 15%
- Introduce petroleum levy
- Remove tariffs in line with the African Continental Free Trade Area agreement (AfCFTA).

[20] World Bank (2022). Nigeria's need to spend more and better

[21] The tax capacity can be defined as the highest level of tax revenue measured as a percentage of GDP, that a country can expect to achieve given certain underlying macroeconomic and institutional conditions. The difference between actual tax revenues and tax capacity measures the theoretical tax gap or tax potential (IMF, 2018a). Several studies estimate Nigeria's tax capacity be between 8-11 percent of GDP, or even higher (IMF, 2018a, 2018b, 2023).

Recall that the baseline includes petroleum and electricity subsidies to the total value of ₦7.1 trillion in 2024. From 2025 onwards, we keep the subsidy at the 2024 level. In the policy simulation, we reduce subsidies by 60 per cent per annum on both petroleum products and electricity. The first year of the removal of subsidies is 2026. By 2030, more than 95 per cent of the subsidies have been eliminated.

In our policy simulations, increasing the VAT rate and introducing a levy on petroleum are the preferred tools over changing direct taxes. This is in line with the Presidential Committee on Fiscal Policy and Tax (PCFPTR) guiding principles.[22] The principles include that economic diversification and prosperity are promoted by using tax reform as a tool. Taxes on investment and production will be eliminated in favour of taxes on returns, income and consumption. A further objective is to promote investment and facilitate economic growth as a way to diversify and sustain government revenue. Promote fiscal equity for all stakeholders, including investors and businesses, both local and foreign. In our policy simulation, we introduce a once-off increase in the VAT rate. We further introduce a fuel levy of 5 per cent on the use of petroleum in the economy.[23]

Nigeria is participating in the, which aims to promote regional and continental integration (Emenekwe et al., 2024; World Bank, 2020). Regional integration creates access to larger regional markets that are currently not explored by Nigerian companies. For our simulation, we are guided by the World Bank study on the impact of AfCFTA on Africa (World Bank, 2020).[24] Among the tools identified in the AfCFTA, one of the aims is to gradually eliminate tariffs on 90% of goods traded between member countries, with specific timelines and exemption mechanisms. Thus, in our policy simulation, we reduce the overall tariff rate in line with the World Bank study (World Bank, 2020, p. 33)[25].

4.2.2 Recycling of the increase in government income

In our policy simulations, tax reform yields an increase in tax revenue. *Ceteris paribus*, as government revenue increases, the government budget improves. In all our policy simulations, we use the additional revenue to increase government investment in all non-oil sectors, focusing on innovation and education. That is, industry investment is tied down by government investment by industry. For the different policy simulations, we assume that:

- In the cautious simulation (Sim 2 and 3), we allocate 50 per cent of the increase in revenue to government investment ((b) in Table 4).

[22] PCFPTR (2023). Three pillars underscore the terms of reference of the Fiscal Policy committee. They are fiscal governance (tax review and enactment of harmonised tax laws), revenue transformation (harmonised single digit list of taxes and levies) and growth facilitation (revised National Tax Policy, National fiscal risk framework etc.). https://fiscalreforms.ng/index.php/guiding-principles/

[23] To mitigate the negative effects of subsidy removal and an increase in commodity taxes, revenues saved must be redistributed in an effective way – through lump sum payments to households or to industry to boost production, innovation and productivity. Consequently, we increase government investment, leading to an overall increase in total investments.

[24] The impact of AfCFTA stems from two main features (World Bank, 2020, p. 13). First, the AfCFTA will provide a non-discriminatory reduction in tariffs and a common regulatory framework, which will reduce fragmentation of the continental market. Secondly, subregional agreements in Africa tend to be limited to a few non-tariff measures that affect trade integration. AfCFTA may provide substantial progress in ensuring that non-tariff barriers are more conductive to continental trade integration.

[25] The study by the World Bank designed for policy scenarios by employing the global dynamic CGE model and the global microsimulation framework Global Income Distribution Dynamics (GIDD). The core data for their study was taken from the Global Trade Analysis Project (GTAP) database.

- In the bold simulations (Sim 4), we allocate 80 per cent of the increase in revenue to government investment ((h) in Table 4).
- In the structural simulation (Sim 5), we allocate 100 per cent of the increase in revenue to government investment ((l) in Table 4).

4.2.3 Productivity improvement

In our simulations, productivity improvements are important. We account for an improvement in **labour, capital** and **land** productivity improvements, as well as an efficiency improvement in the use of road transport.

In the **cautious** simulation (Sim 3), we improve:

- Capital productivity by industry improves from 2030 upwards at a rate of 0.1 per cent per annum (point (c) in Table 4).
- Labour productivity for unskilled labour and skilled labour improves from 2028 onwards at a rate of 0.1 per cent per annum (point (d) in Table 4).
- Land productivity for all crops improves from 2030 onwards by 0.1 per cent per annum (point (f) in Table 4).
- The efficiency improvement of road transport by industries and households improves from 2030 onwards by 2.5 per cent per annum (point (g) in Table 4).

In the **bold** simulation (Sim 4), we improve:

- Capital productivity by industry improves from 2030 upwards at a rate of 0.15 per cent per annum (point (k) in Table 4).
- Labour productivity for unskilled labour and skilled labour improves from 2028 onwards at a rate of 0.15 per cent per annum (point (k) in Table 4).
- Land productivity for all crops improves from 2030 onwards by 0.15 per cent per annum (point (f) in Table 4).

In the **structural** simulation (Sim 5), we improve:

- Capital productivity by industry improves from 2028 onwards at a rate of 0.2 per cent per annum (point (n) in Table 4).
- Labour productivity for unskilled labour and skilled labour improves from 2028 onwards at a rate of 0.2 per cent per annum (point (n) in Table 4).
- Land productivity for all crops improves from 2028 onwards by 0.2 per cent per annum (point (n) in Table 4).

In all three policy simulations, we include an efficiency improvement in the use of freight and passenger transport of 2.5 per cent per annum.

4.2.4 Participation rates

In the cautious and bold simulations (Sim 2 and 3), we increase the participation rates for:

- Skilled and unskilled labour by 1 per cent (point (e) in Table 4).

In the structural simulation (Sim 5), we improve:

- Skilled and unskilled labour by 1.5 per cent (point (o) in Table 4).

4.2.5 Share of electricity generation

For the different policy simulations, we assume that:

- In the cautious simulation (Sim 3), the share of electricity from renewable sources remains at the baseline level.
- In the bold simulations (Sim 4), the share of electricity from renewable sources increases to 30 per cent by 2050 ((j) in Table 4).
- In the structural simulation (Sim 5), the share of electricity from renewable sources increases to 50 per cent by 2050 ((l) in Table 4).

4.2.6 Increase the production of light manufacturing industries

In the bold simulation (Sim 4), we impose an increase in the production of light manufacturing industries. This increase in output is exported to foreign markets ((i) in Table 4).

4.3. Assumptions for the macroeconomic environment

Below, we describe the macroeconomic closure for the policy simulations.

4.3.1 Labour markets

At the national level, lagged adjustment of the real-wage rate[26] to changes in employment is assumed. This means that the policy outcomes can cause employment to deviate from its baseline value initially, but thereafter, real wage adjustment steadily eliminates the short-run employment consequences. In the long run, the benefits of policy outcomes are realised almost entirely as an increase in the real wage rate, rather than as an increase in national employment. This labour-market assumption reflects the idea that, in the long run, national employment is determined by demographic factors and immigration policy, which we have assumed are unaffected by the policy. In simulation 2 - 4, we also introduce an increase in the participation rates for skilled and unskilled labour. This increases employment permanently above baseline.

4.3.2 Private consumption and the indicator of economic welfare

Private consumption expenditure is determined *via* a consumption function that links nominal consumption to household disposable income. In all policy simulations, the average propensity to

[26] The real wage rate is a nominal wage rate divided by the price of a good and is a transparent measure of how much of the good an hour of work buys.

consume (APC) is held fixed. Private consumption is then determined as a fixed proportion of disposable income.

4.3.3 Investment

Investment in all the existing industries is allowed to deviate from its baseline value in line with deviations in expected rates of return on the industries' capital stocks. The model allows for short-run divergences in rates of return from their baseline levels. These cause divergences in investment and hence capital stocks that gradually erode the initial divergences in rates of return. Provided there are no further shocks, rates of return revert to their baseline levels in the long run.

In Sim 2 and all subsequent policy simulations, we increase industry-specific investments relative to the baseline in line with the increase in industry-specific investment. To accommodate the increased investments, the expected rate of return is allowed to deviate from the baseline. Consequently, aggregate real investment increases relative to the baseline.

4.3.4 Government consumption and fiscal balances

As noted previously, the contains no theory to explain changes in real public consumption. In the policy simulations, real public consumption is simply held at the baseline level. The model contains many variables to allow for shifts in tax rates and subsidies, which impact tax revenue collections. The tax rates variables are naturally exogenous. In our policy simulations, we model the removal of petroleum and electricity subsidies, the increase in the VAT rate, the introduction of a fuel levy and the removal of tariffs.

We introduced subsidies in the baseline (Section 3.1) so that by 2024, the petroleum subsidy is N 5.4 trillion, and for electricity, it is N1.9 trillion. In the policy simulations, we remove the subsidies over several years. To allow for the increased collections of VAT revenue and the fuel levy, we introduce a once-off increase in 2026, in the effective tax rate, to simulate an increase in tax revenue. Thereafter, the tax rate is left fixed at the higher level. The model then determines VAT revenue based on the higher VAT rate and any modelled changes in the VAT base.

To remove tariffs, we lower the implied tariff rate over 9 years. This is in line with the World Bank (2020) study on the impact of the African Continental Free Trade Area (AfCFTA) agreement. Thereafter, the implied tariff rate remains at the lower level. The model then determines customs revenue based on the lower rate and any modelled changes in the use of imports. The net impact of the tax reforms implies an improvement in tax collections and, leaving everything else unchanged, an improvement in the fiscal balance. We assume that the increase in government income is (a) used to improve the government balance (Sim 1) or (b) allocated back to the economy as investments (Sim 2 – Sim 5). Thus, in simulations 2 - 5, we hold the government budget balance fixed at the baseline level by allowing government investment to increase (see Section 3.3.6).

4.3.5 Production technologies and household tastes

The model contains many variables to allow for shifts in technology and household preferences. In the normal setup of the model, most of these variables are exogenous and have the same values as in the baseline projection. In our policy simulations, we exogenously impose technological improvements for labour, capital and land. Improvement in land productivity is phased in over a few years to account for the fact that public works and extensions arrive in stages. We also assume that there are adoption lags since climate-smart practices diffuse over time. We introduce labour

productivity with a lag to represent improvement in skills. Similarly, capital productivity is also introduced with a lag to show the efficient use of capital. The efficiency improvement of road transport is also introduced with a lag since road improvements take time to be completed.

4.4. Sim 1: Impact of an increase in tax revenue

The net impact of tax reform causes net tax collections to increase over time. Recall from the baseline simulation (Section 3.3.6) that the ratio of tax-to-GDP ratio remains fairly stable at 5.4 per cent over the simulation period. In the policy simulation, tax revenue as a share of GDP increases to 9 per cent in 2026 and remains above the base level, stabilising at 8.7 per cent in the long run. Consequently, revenue from non-oil revenue increases over time, so that over time, the share of non-oil revenue in total revenue increases to 9 per cent in 2026 and remains relatively stable over the simulation period. We assume that the increase in revenue is offset by an increase in investment, so that the budget balance remains at the baseline level.

4.4.1 Macro results

Our discussion begins with a review of the results from tax reform (Sim 1). We discuss the macro, industry and welfare impacts. Results are reported as percentage deviations away from baseline unless otherwise stated. Selected macroeconomic impacts are dealt with first, followed by impacts on industry production. The explanation of the macro effects begins with the impacts on the labour market of Sim 1.

In the short run, removing the energy subsidies and increasing tax rates causes employment to fall relative to its baseline level. Over time, the employment deviation is progressively eliminated as the real wage rate adjusts. At the national level, lagged adjustment of the real-wage rate[27] to changes in employment is assumed. Figure 6 shows the percentage deviations in national employment for all simulations. The short-run result for Sim 1 shows that the net impact of the tax reforms[28] cause employment to fall relative to its baseline level.

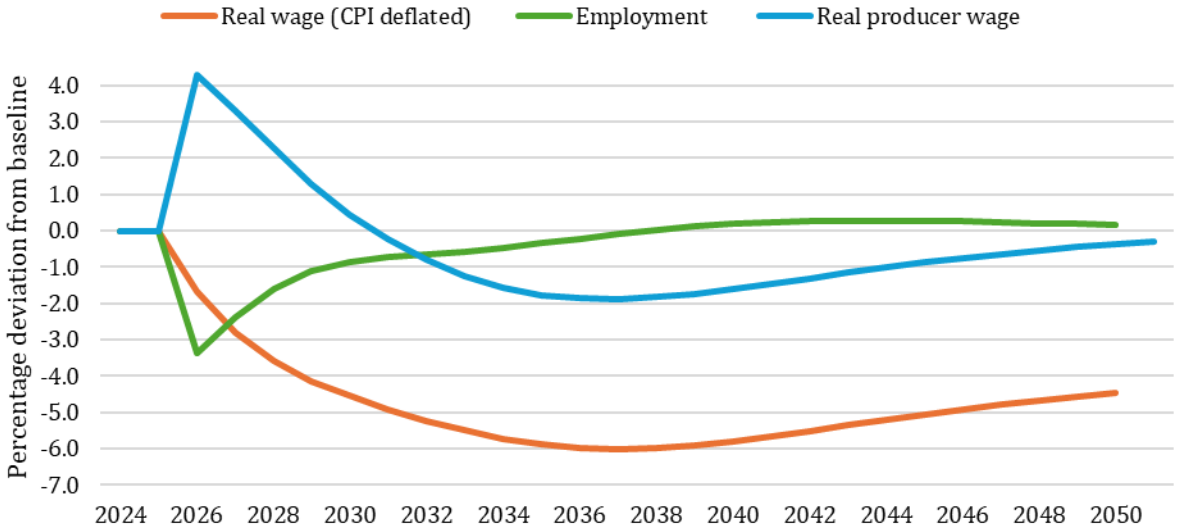
This is due to our assumption of a sticky real consumer wage rate. The consumer wage rate is defined as the ratio of the nominal price of labour (wage) to the CPI. Removing subsidies or increasing taxes increases the cost of spending (e.g. CPI) relative to the price of output (e.g. price of GDP). If the consumer wage is sticky, then the real cost of labour (defined as the price of labour relative to the price of GDP) will increase when subsidies (taxes) are removed (increased). This causes producers to substitute away from labour towards cheaper alternatives such as capital. Over time, the real wage adjustment mechanism in the model eliminates the short-run deviations in employment. Thus, the short-run fall in employment relative to baseline levels is gradually eliminated and forces employment back towards its baseline level. In the long-run, employment rises slightly relative to its baseline level due to compositional shifts in the economy. A final point to note is that even though the long-run change in national employment is small, this does not

[27] A real wage rate is a nominal wage rate divided by the price of a good and is a transparent measure of how much of the good an hour of work buys.

[28] Subsidy reduces the price consumers pay for a product thereby lowering consumer prices. This leads to the inefficient and wasteful use of a commodity. Removal of the subsidy (i.e. a negative tax) increases the purchasers price consumers pay for these products. Thus, removing the subsidy on petroleum and electricity, increases the price of fuel and electricity leading to a decrease in the demand for these commodities. Similarly, the increase in the VAT rate on commodities, increases the purchasers' price of these commodities. Removal of tariffs decreases the import price of commodities, leading to an increase in imports.

mean that employment at the individual industry level remains close to baseline values. In most industries, there are significant permanent employment responses to changes in commodity prices.

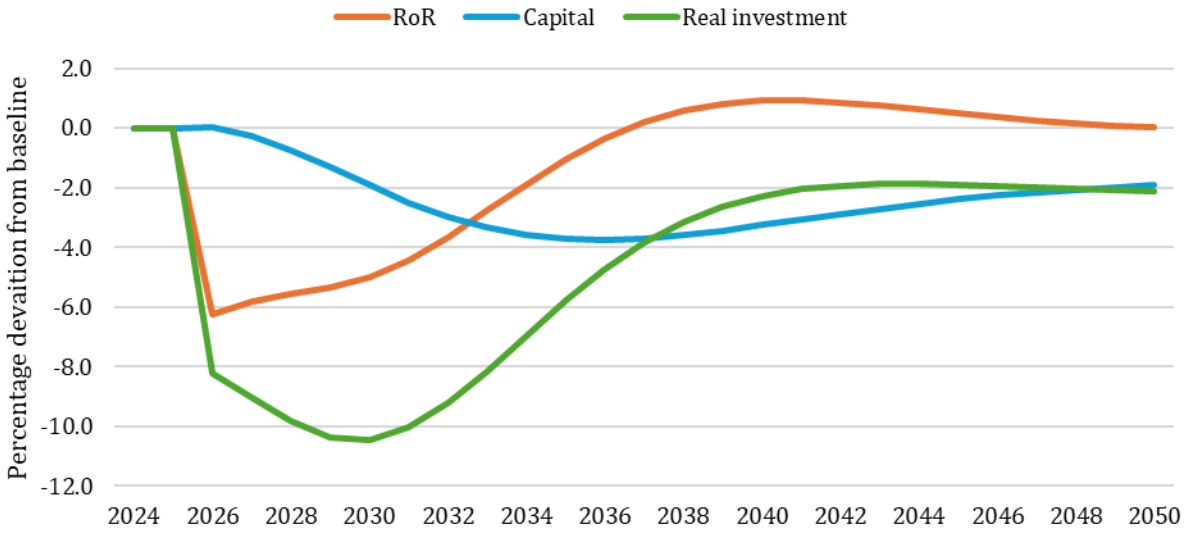
Figure 6. Employment and real wages (Sim 1) (% deviation from baseline)



Source: Authors' diagram

With capital fixed in the short-run, the fall in employment causes the economy-wide K/L ratio to increase, leading to a fall relative to the baseline in the rates of return on capital. With lower rates of return in the short-run, investments are lower. Over time, this fall is tempered as capital adjusts, driving the rates of return back to baseline.

Figure 7. Investment, capital and rates of return (Sim 1) (% deviation from baseline)

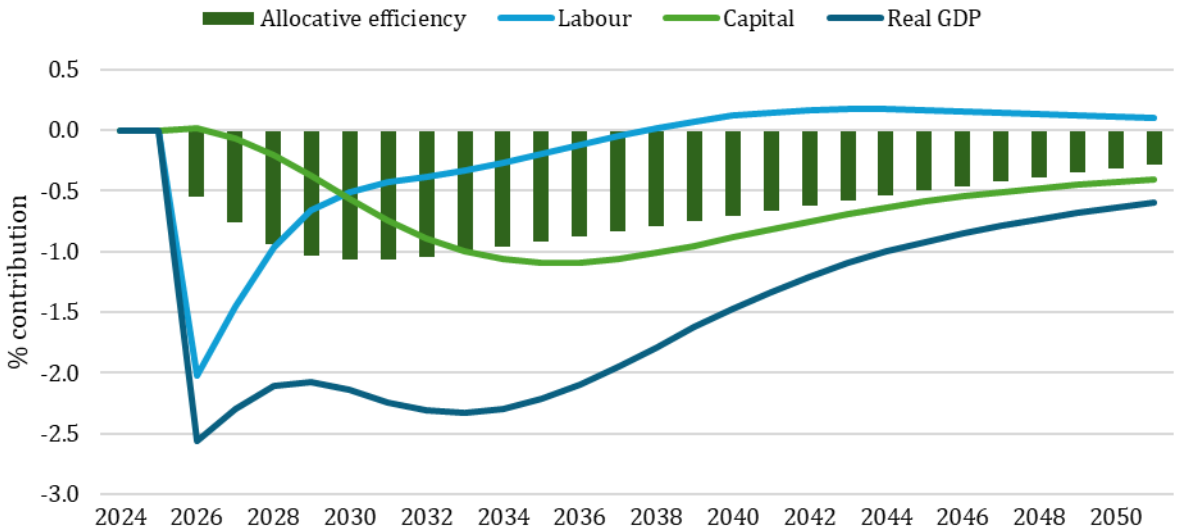


Source: Authors' diagram

The percentage change in real GDP is a share-weighted average of the percentage changes in quantities of factor inputs (labour, capital and natural resources), with allowance for changes in the efficiency of resource use. Reduced (increased) efficiency reduces (increases) real GDP even with unchanged levels of factor inputs. Figure 8 shows, in the smooth lines, the contribution of each component to the overall percentage deviation in real GDP. Note that the contributions of natural resources to the real GDP deviation are zero (because in this simulation, natural resource supply does not change between policy and baseline) and are not shown.

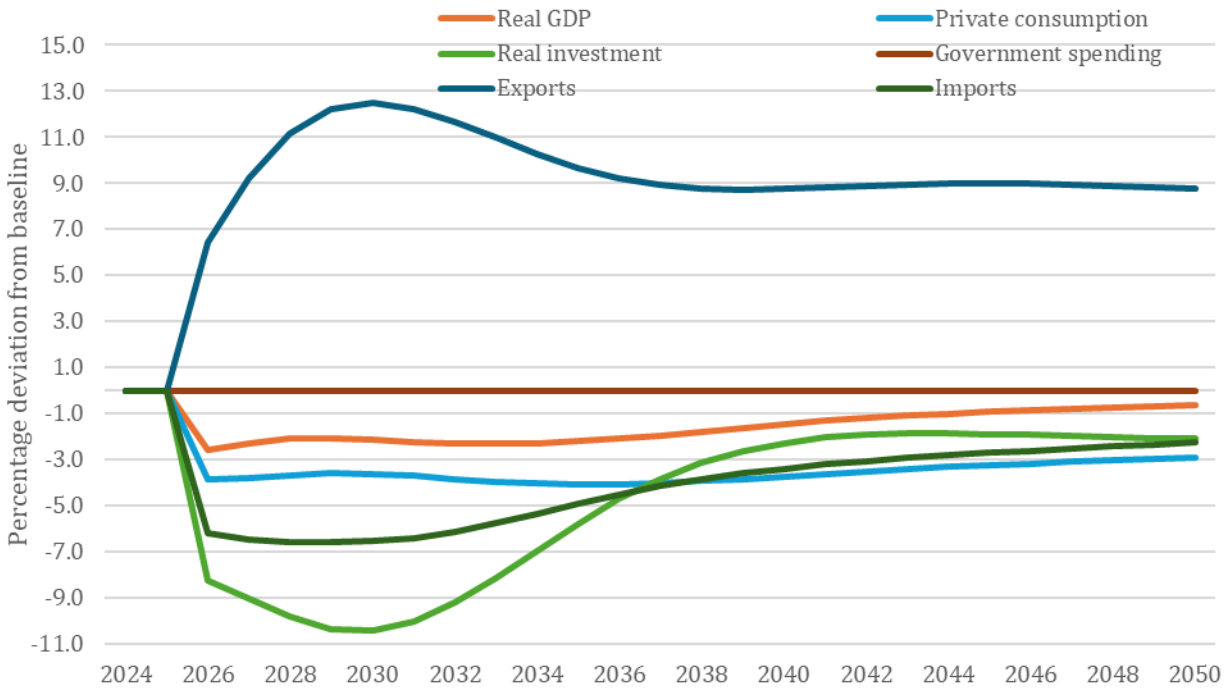
Real GDP falls relative to its baseline level in all years of the simulation. In the final year, it is lower by 0.6 per cent. In the first year of the simulation, the negative deviation in GDP is nearly completely explained by the fall in employment (given fixed capital). The remainder of the fall in GDP is explained by the efficiency contribution and the fall in capital. Thus, the net effect in Sim 1 is that the efficiency of resource use is reduced, such that real GDP falls.

Figure 8. Contribution to the overall deviation in real GDP (Sim 1) (% contribution)



Source: Authors' diagram

Figure 9. Expenditure components of real GDP (Sim 1) (% deviation from baseline)



Note: The net effect of the tax reform reduces consumption and lowers the overall welfare of the population.
Source: Authors' diagram

Figure 9 shows percentage deviations from base-case values for the three main components of real Gross National Expenditure (GNE): real private consumption (C), real public consumption (G) and real investment (private plus public) (I). Note that by assumption, the deviation in real public consumption is held at the baseline level.

As discussed with reference to Figure 7, investment is below baseline to accommodate the fall in capital. In Sim 1, with no lump-sum transfers to households, all the benefit of the reform returns to the government as an improvement in the government balance. For consumers, the net effect of the tax reform reduces real consumption throughout the simulation period because increasing taxes and removing subsidies permanently raises the price of consumption (CPI), leaving all households worse off. The fall in real consumption relative to the baseline level in 2050 is 3 per cent (Figure 9).

Removing the energy subsidies leads to an improvement in the net volume of trade. In this simulation, the fall in real GNE (C+I+G) exceeds the fall in GDP (Y), with the result that the net volume of trade (X-M) must improve.

Figure 9 shows that the deviation in imports remains below the GDP deviation. This is because consumption and investment have a high import share, and therefore, the negative deviation in consumption and investment drives the lower imports. For the trade balance to improve, the

deviation from the baseline in exports must lie above the deviation in imports. This requires the terms of trade[29] to deteriorate. As shown in Figure 9, at the end of the simulation period, the volume of exports is 9 per cent higher than the baseline, while the volume of imports is lower by 2.3 per cent.

4.4.2 Industry

This section focuses on the net effect of the removal of energy subsidies and higher taxes on industry output. As with the previous results, we provide five columns of numbers, with the final column showing, in average annual percentage terms, total growth across the period 2025 to 2050.

Three key factors largely explain the output changes of other industries.

1. input-output linkages;
2. connections to international trade;
3. connections to domestic final demand; and
4. factor intensities.

At the macro level, over the whole period, employment falls but over time moves back to base, investment, consumption and imports are projected to grow at a lower rate than real GDP. Natural resources remain at the base level. The real wage falls, and there is a real devaluation.

- Labour-intensive industries would benefit from the lower real wage;
- Any expansion of agricultural and mining industries will be constrained by the fixity of agricultural land and natural resources;
- Trade-exposed industries should benefit from the higher rate of export growth and the real depreciation;
- With growth in private and public consumption lower than growth in real GDP, service and manufacturing sectors that sell primarily to households and government will have lower than average growth rates.

(1) Trade-exposed industries tend to do relatively better in this simulation due to the increase in exports brought about by real devaluation. Good examples are industries in Sector 8: Accommodation and food services, which sell to the local industries, households and foreigners. This industry is also labour-intensive and benefits from the fall in wages. Sector 2: Mining: growth paths show that the aggregate output remains relatively unchanged, even though they would benefit from an increase in exports. On the supply side, these sectors use capital and natural resources as inputs. Natural resources are fixed.

[29] The economy's terms of trade is defined as the ratio of the average price of exports to the average price of imports. An improvement in the terms of trade means that from a given quantity of production, the economy can afford an increased level of real consumption. A deterioration of the terms of trade means that the economy cannot afford an increase in the level of real consumption.

(2) Connections to domestic final demand, which grows relatively poorly, explain the output response of most of the remaining composite sectors, nearly all of which produce services. Good examples are Sector 17 (Arts and recreation), Sector 21 (Dwelling services), Sector 1 (Agriculture), Sector 18 (Other services) and Sector 15 (Education), which mainly sell to households. Sector 14 (Public administration) does well because this sector is mainly labour-intensive and sells most of its output to the government. Via assumption, we hold the deviation in government spending exogenous.

(3) Input/output linkages explain production declines for Sector 6 (Trade), Sector 13 (Administration support services), Sector 11 (Rental services), Sector 10 (Communication sectors), and Sector 11 (Financial and insurance services). Demand for these services moves with economic activity, or they sell to industries that, in turn, sell their output to final demand.

Table 5: Industry output by aggregated sector (Sim 1) (% deviation from baseline)

Industry output	2026-2030	2031-2035	2036-2040	2040-2050	2025-2050
1. Real GDP	-2.2	-2.2	-1.8	-1.0	-1.4
Sector 1 - Agriculture, forestry, and fishing	-1.5	-1.8	-2.0	-1.6	-1.4
Sector 2 – Mining	0.2	0.2	-0.1	0.0	0.1
Sector 3 – Manufacturing	-1.8	-1.9	-1.2	-0.1	-0.9
Sector 4 – Electricity and gas distribution	-4.9	-6.8	-6.7	-5.6	-5.0
4a Fossil fuel electricity services	-5.6	-7.2	-7.2	-6.4	-5.5
4b Renewable electricity services	-1.6	-6.9	-6.0	-3.5	-3.6
Sector 5 – Construction	-9.7	-8.2	-3.4	-2.1	-4.3
Sector 6 - Trade	-2.2	-2.2	-1.8	-0.9	-1.3
Sector 7 - Accommodation & food services	6.7	8.1	7.2	6.6	5.8
Sector 8 - Transport, postal, and warehousing	-3.0	-2.6	-2.1	-0.6	-1.5
Sector 9 - Communication services	-3.4	-3.6	-3.4	-2.6	-2.6
Sector 10 - Financial & insurance services	-0.7	-0.6	-0.2	0.7	0.0
Sector 11 – Rental	-2.9	-2.7	-2.2	-1.2	-1.7
Sector 12 - Professional services	-1.1	-0.8	-0.2	0.5	-0.2
Sector 13 - Administrative services	-2.0	-1.9	-1.2	-0.2	-0.9
Sector 14 - Public administration and safety	2.2	2.2	1.9	1.8	1.6
Sector 15 - Education and training	-5.4	-5.8	-6.2	-5.8	-4.8
Sector 16 - Health care and social assistance	-2.9	-2.7	-2.5	-1.9	-2.0
Sector 17 - Arts and Recreation	-6.4	-6.9	-7.4	-6.9	-5.8
Sector 18 - Other services	-5.5	-5.0	-4.4	-3.1	-3.5
Sector 19 - Ownership of dwellings	-1.2	-4.6	-6.8	-6.5	-4.3

Source: Authors' compilation

4.4.3 Household welfare

Household income is determined by changes in labour and capital income, both decline over time. All households' income is affected negatively, with rural households affected the most due to the decrease in their income from the downward pressure on wages. The results show that the income of the poor, in general, falls more than the income of richer households. Richer households earn more income from capital and earn a higher wage, whereas poorer households, especially those in rural areas, earn more from unskilled labour income. Given a fixed APC, household nominal consumption will also be lower. With the increase in CPI relative to the price of output, real consumption falls. Thus, over the simulation period, household welfare for all households falls.

In terms of commodity consumption, poorer households' expenditure on agricultural commodities is higher than richer households, while richer households spend more on service commodities such as communications and recreation.

- Rural rich spend on agriculture and services, but less than the rural poor.
- Rural poor spend most on agricultural commodities
- Urban rich households spend most on services and then on manufacturing commodities
- Urban poor spend most on agriculture (not as much as rural poor but more than urban rich) and then services. The urban poor have better access to services.

4.5. Increase industry-specific investment

Government balance is held at the baseline level by allowing government investments to increase. Thus, by holding the government balance at the baseline, the increase in government income implies that an expenditure component, in this case, government investment, must increase. It is the increase in government investments in non-oil sectors that is modelled in subsequent simulations. In other words, in these simulations, investments by industry are tied down by investments in government investments by industry. Overall, economy-wide investments increase. In the model, capital is the accumulation of investments, and therefore, we expect capital to increase over time. Consequently, real GDP increases above baseline.

The closure for the remaining policy simulations is described in Section 4.3. Below, we briefly highlight the macroeconomic impacts of an increase in investments. For the different policy simulations, we assume that:

- In the cautious simulation (Sim 2 and 3), we allocate 50 per cent of the increase in revenue to government investment ((b) in Table 4).
- In the bold simulations (Sim 4), we allocate 80 per cent of the increase in revenue to government investment ((h) in Table 4).
- In the structural simulation (Sim 5), we allocate 100 per cent of the increase in revenue to government investment ((l) in Table 4).

4.6. Sim 2: Economic impact of an increase in investment

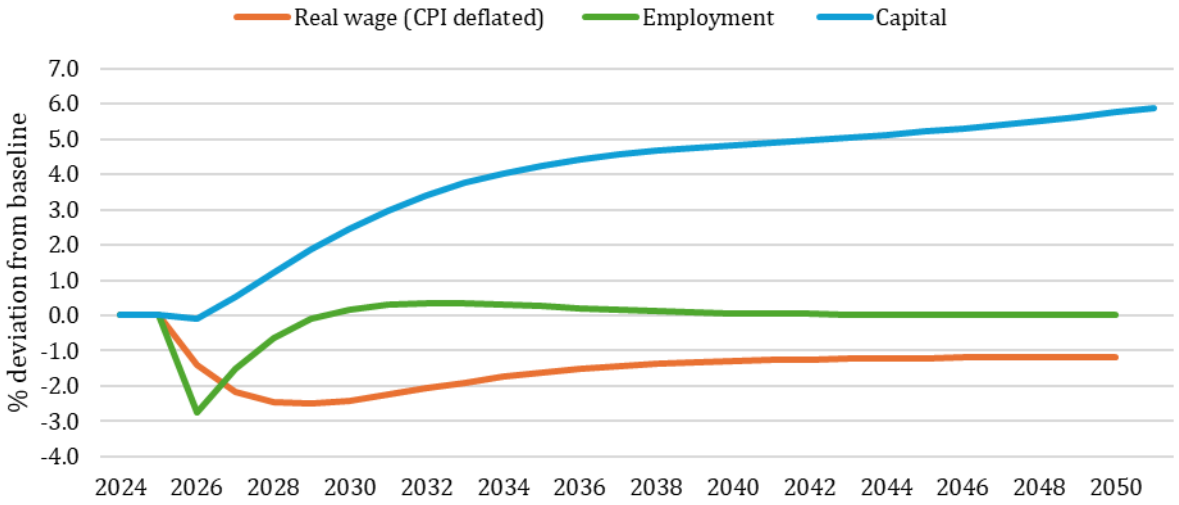
In this simulation, we increase government investment by 50 per cent of the additional government revenue. This leads to economy-wide capital deepening. All non-oil industries receive more capital. Hence, all else unchanged, this leads to economy-wide capital deepening

4.6.1 Macro results

An increase in investments leads to an economy-wide increase in capital. The increase in non-oil sector investment leads to an increase in national investment. Capital is the accumulation of investments, and therefore, national capital increases above baseline over the simulation period. Figure 10 shows an increase in capital throughout the simulation period. By 2050, capital is 6 per cent higher than baseline. In the long run, with labour at the baseline level, the capital/labour ratio increases.

The increase in capital leads to capital deepening – a rise in capital per worker in the economy, and is accompanied by an increase in the real wage rate. Despite increased capital, there is comparatively little change in persons employed. As shown in Figure 10, initially, there is a fall in employment. Over time, the real wage adjustment mechanism in the model eliminates the short-run deviations in employment. Thus, the short-run fall in employment is gradually eliminated and moves back towards its baseline level. Although there is an improvement in real wage relative to the real wage in Sim 1, it remains below baseline. Overall, in 2050, the capital-stock deviation is 6 per cent and the increase in employment is 0.0 per cent, implying an increase in the ratio of capital to labour of around 6 per cent.

Figure 10. Capital, employment and real wage (Sim 2) (% deviation from baseline)

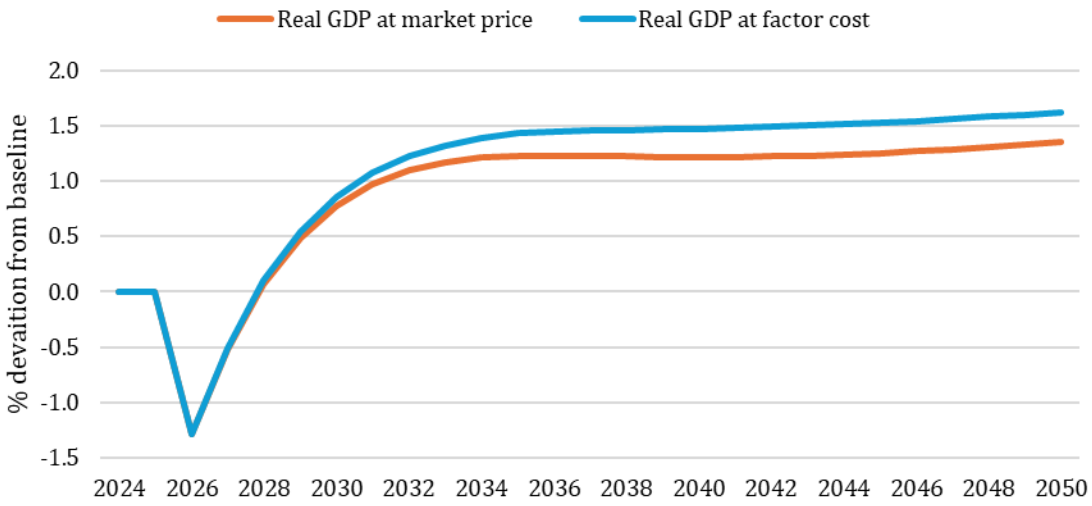


Source: Authors' diagram

With little change in employment and no change in TFP, the increase in capital leads to an increase in real GDP at factor cost. Real GDP *at factor cost* is a measure of economy-wide production based on the use of labour and capital without hindrance due to *distortions* arising from commodity taxes and subsidies. In our modelling, the percentage change in real GDP at factor cost is a share-weighted average of the percentage changes in quantities of factor inputs (labour, capital), with allowance for changes in TFP.

Figure 11 shows the projected effects on real GDP at factor cost arising from an increase in government investment. By 2050, real factor-cost GDP is 1.6 per cent above its baseline value. Real GDP *at market prices* is the headline measure of real GDP. In nominal levels, it equals the value of GDP at factor cost plus the collection of commodity taxes net of subsidies. The percentage change in real GDP at market prices equals the percentage change in real GDP at factor cost plus any change to the efficiency with which resources are used due to commodity taxes and subsidies. As discussed in Sim 1, the increase in taxes reduces the efficiency with which resources are used. Thus, real GDP at market prices lies below real GDP at factor cost.

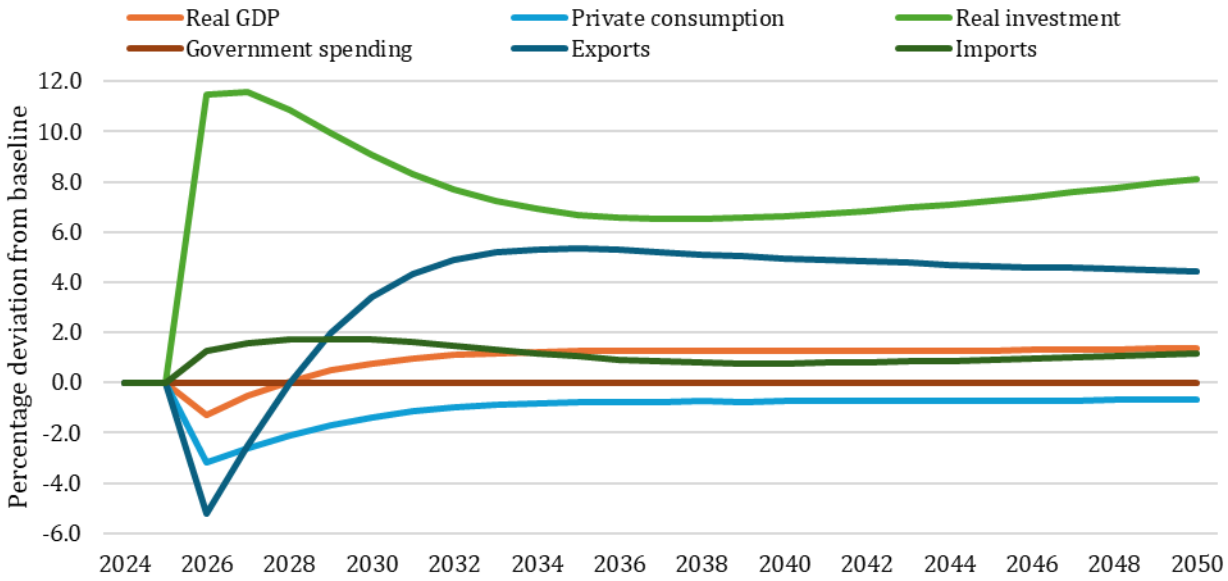
Figure 11. Real GDP at market price and factor cost (Sim 2) (% deviation from baseline)



Source: Authors' diagram

Real GDP (Y) increases relative to the real gross national expenditure (C + I + G), leading to an improvement in the net volume of trade (X − M). Figure 12 shows percentage deviations from baseline values for real consumption – public and private (*C* and G), real investment (*I*), real exports (*X*), and real imports (*M*). As already explained in Section 4.3, public spending (G) is exogenously held at its base case level throughout the simulation period.

Figure 12. Deviations in expenditure components of real GDP policy (Sim 2) (% deviations, 2024 to 2050)



Source: Authors' diagram

As mentioned before, investment is above baseline. Recall from Sim 1, the net effect of the tax reform reduces real consumption throughout the simulation period because increasing taxes and removing subsidies permanently raises the price of consumption (CPI), leaving all households worse off. In Sim 2, there is an increase in income accruing to Nigerian households. Much of this increase is from the increase in income from labour and capital, which is reflected in the increase in real GDP at factor cost. In Sim 2, all household incomes improve relative to the household income in Sim 1. The fall in real consumption relative to the baseline level in 2050 is 0.7 per cent, which is lower than the fall in real consumption in Sim 1 (Figure 9).

Real gross national expenditure ($C + I + G$) increases at a lower rate than real GDP, implying an improvement in the net volume of trade ($X - M$). As shown in Figure 12, the volume of exports increases by approximately 4.4 per cent compared to its baseline value in 2050. By contrast, the volume of imports grows in line with real GDP, finishing the period 1.2 per cent above its baseline level.

To achieve the necessary change in net trade volumes, a mild devaluation of the real exchange rate is necessary. This improves the competitiveness of export industries in foreign markets and the competitiveness of import-competing industries in local markets. Improving the competitiveness of Nigerian exporters results in a slightly lower price being paid for Nigerian exports. Thus, there is a fall in the country's terms of trade (the ratio of export to import price).

4.6.2 Industry results

This section focuses on the impact on industry output of an increase in investments. As with the previous results, we provide five columns of numbers, with the final column showing, in average annual percentage terms, total growth across the period 2025 to 2050.

Table 6. Industry output by aggregated sector (Sim 2) (% deviation from baseline)

Industry output	2026-2030	2031-2035	2036-2040	2040-2050	2025-2050
1. Real GDP	-0.1	1.1	1.2	1.3	0.8
Sector 1 - Agriculture, forestry, and fishing	-0.1	1.1	1.3	1.3	0.8
Sector 2 – Mining	0.3	0.6	0.6	0.4	0.4
Sector 3 – Manufacturing	-0.3	1.2	1.5	1.6	0.9
Sector 4 – Electricity and gas distribution	-0.3	2.5	3.5	4.1	2.3
4a Fossil fuel electricity services	-0.4	2.9	4.3	5.1	2.8
4b Renewable electricity services	1.3	3.4	3.6	3.5	2.6
Sector 5 – Construction	9.4	6.1	5.3	6.0	5.4
Sector 6 - Trade	0.4	1.6	1.6	1.6	1.1
Sector 7 - Accommodation & food services	-2.2	3.7	4.4	4.3	2.4
Sector 8 - Transport, postal, and warehousing	-2.0	-0.2	0.2	0.5	-0.2
Sector 9 - Communication services	-2.0	-0.3	-0.1	0.0	-0.4
Sector 10 - Financial & insurance services	-1.5	1.0	1.1	1.3	0.5
Sector 11 – Rental	-1.1	0.5	0.7	0.7	0.3
Sector 12 - Professional services	-0.1	2.0	2.2	2.4	1.5
Sector 13 - Administrative services	-1.0	0.8	0.9	0.9	0.4
Sector 14 - Public administration and safety	-0.5	0.3	0.2	0.2	0.1
Sector 15 - Education and training	-4.5	-2.7	-2.8	-3.0	-2.7
Sector 16 - Health care and social assistance	-1.7	-0.2	0.0	0.1	-0.3
Sector 17 - Arts and Recreation	-4.3	-2.5	-2.6	-3.0	-2.6
Sector 18 - Other services	-3.6	-1.6	-1.4	-1.1	-1.5
Sector 19 - Ownership of dwellings	-0.2	-1.3	-2.6	-3.7	-1.9

Source: Authors' compilation

We note that relative to the industry results from Sim 1 (Section 4.4.2), most industries do well. This is not surprising as the increase in capital improves the activity levels of most sectors. Those who do not perform well (mostly Services) sell most of their output to households (e.g. Arts and entertainment, Education) or the government (e.g., public Administration). Not surprisingly, the best performing sector is Construction. Construction is a capital-intensive sector which sells most of its output to investments.

4.7. Sim 3. Sim 2 plus productivity improvements (Cautious)

In this simulation, we build on Sim 2 (Section 4.6) and introduce a set of productivity improvements and an increase in participation rates for both skilled and unskilled labour. Productivity improvements are discussed in Section 4.2.3, and participation rate in Section 4.2.4. Although the underlying Sim 1 and Sim 2 outcomes are captured in Sim 3, we avoid repetition of the macroeconomic impacts discussed in Sim 1 and Sim 2 by focusing on the impact of productivity.

In the cautious scenario, we model (as in previous simulations) the:

- tax reform ((a) in Table 4), which is part of all simulations,
- we allocate 50 per cent of the increase in revenue to government investment ((b) in Table 4).

In the **cautious** simulation (Sim 3), we improve:

- Capital productivity by industry improves from 2030 upwards at a rate of 0.1 per cent per annum (point (c) in Table 4).
- Labour productivity for unskilled labour and skilled labour improves from 2028 onwards at a rate of 0.1 per cent per annum (point (d) in Table 4).
- Land productivity for all corps improves from 2030 onwards by 0.1 per cent per annum (point (f) in Table 4).
- The efficiency improvement of road transport by industries and households improves from 2030 onwards by 2.5 per cent per annum (point (g) in Table 4).
- Increase skilled and unskilled labour force participation rates by 1 per cent (point (e) in Table 4).

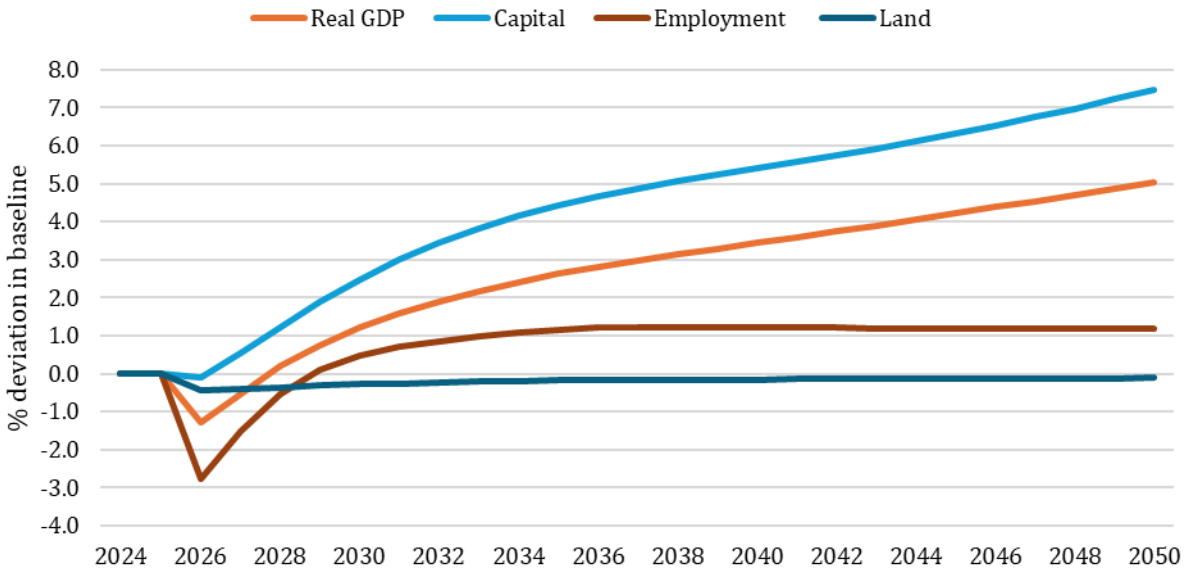
4.7.1 Macro results

The improvement of labour (capital) productivity implies that more can be produced by the same number of workers (capital).[30] We also see an improvement in wages as the marginal product of labour increases.

Figure 13 shows the percentage deviation from baseline for real GDP, employment and capital for the cautious simulation. Relative to the baseline and Sim 2 (Figure 10), we note that employment is permanently above baseline. This is because an increase in the labour force participation rate increases the supply of labour, thereby permanently increasing the level of employment for both skilled and unskilled males and females. By 2050, employment is 1.2 per cent above baseline.

Figure 13. Real GDP, employment and capital (Sim 3) (% deviation from baseline)

[30] Alternatively, the same level of output requires fewer workers and less capital.



Source: Authors' diagram

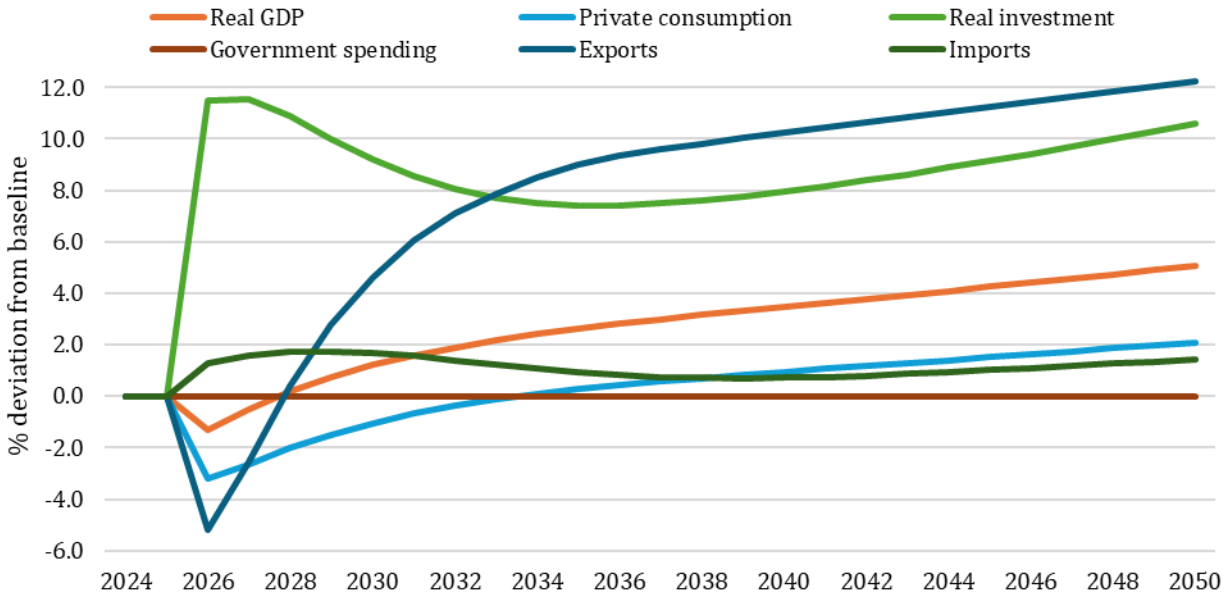
The improvement of industry-specific capital productivity improves the use of machinery, equipment and infrastructure. The productivity improvement also increases the returns to capital.

Figure 13 shows that relative to the baseline, capital is approximately 7.5 per cent higher. This is an improvement in capital compared to Sim 2, where only investments were increased (Figure 10). Similarly, an improvement in agricultural land implies that farmers can produce more crops per hectare. When agricultural infrastructure is improved and farmers can produce more, the cost of producing crops falls. Land rent rises, and farm owners benefit from higher productivity. This improves the income of rural households. As both factors are used more effectively, real GDP improves.

Figure 13 shows that real GDP is approximately 5 per cent higher than the baseline in 2050. This is an improvement from Sim 2, where real GDP increases by 1.4 per cent (Figure 12). Productivity further reduces the cost of production, making domestically produced goods cheaper and more competitive in foreign markets. With Nigerian commodities becoming more competitive, we expect exports to increase more than imports. The mechanism by which this occurs is a real devaluation.

Figure 14 shows the percentage deviation in the expenditure components of real GDP for Sim 3. By assumption, real government consumption is held at the base level. As in Sim 2, aggregate investments are above baseline. We do note that the deviation from baseline investments is a bit higher in Sim 3 than in Sim 2, as the improvement in capital productivity increases the returns to capital, which may further increase investments. As productivity improves wages and the returns to capital, the real income of households improves. This further improves real household consumption, which in Sim 3 is approximately 2 per cent above baseline. All households' welfare improves.

Figure 14. Deviations in expenditure components of real GDP policy (Sim 3) (% deviations, 2024 to 2050)



Source: Authors' diagram

With the growth in real GDP exceeding real GNE, the trade balance must move towards surplus. We note that as Nigerian commodities are more competitive, exports increase so that by 2050, exports are 12.2 per cent above baseline. For exports to increase, there is a fall in the terms of trade. Imports grow below real GDP. Since the domestic price level falls relative to import prices, the demand for imports falls.

4.7.2 Industry output (Sim 3) (% deviation from baseline)

This section focuses on the impact on industry output of an increase in industry-specific land, labour and capital productivity. As with the previous results, we provide five columns of numbers, with the final column showing, in average annual percentage terms, total growth across the period 2025 to 2050.

Table 7. Industry output by aggregated sector (Sim 3) (% deviation from baseline)

Industry output	2026-2030	2031-2035	2036-2040	2040-2050	2025-2050
1. Real GDP	0.1	2.1	3.1	4.3	2.3
Sector 1 - Agriculture, forestry, and fishing	0.0	1.9	2.7	3.5	1.9
Sector 2 – Mining	0.3	0.8	1.0	1.0	0.7
Sector 3 – Manufacturing	-0.1	2.5	4.0	5.7	2.9
Sector 4 – Electricity and gas distribution	-0.2	3.4	5.4	7.4	3.9
4a Fossil fuel electricity services	-0.2	3.9	6.2	8.5	4.4
4b Renewable electricity services	1.4	4.1	5.2	6.4	3.9

Sector 5 – Construction	9.5	6.6	6.4	8.0	6.4
Sector 6 - Trade	0.5	2.5	3.4	4.5	2.6
Sector 7 - Accommodation & food services	-1.6	7.0	10.0	11.7	6.3
Sector 8 - Transport, postal, and warehousing	-1.9	0.3	1.1	2.3	0.7
Sector 9 - Communication services	-1.8	0.7	1.8	3.0	1.1
Sector 10 - Financial & insurance services	-1.2	2.7	4.1	5.5	2.7
Sector 11 – Rental	-0.9	1.6	2.8	3.9	1.9
Sector 12 - Professional services	0.2	3.6	5.0	6.6	3.6
Sector 13 - Administrative services	-0.8	2.0	2.9	3.9	2.0
Sector 14 - Public administration and safety	-0.4	1.0	1.3	1.8	0.9
Sector 15 - Education and training	-4.3	-1.5	-0.8	-0.2	-1.2
Sector 16 - Health care and social assistance	-1.5	0.6	1.4	2.1	0.8
Sector 17 - Arts and Recreation	-4.1	-1.3	-0.4	0.3	-0.9
Sector 18 - Other services	-3.3	-0.3	1.0	2.3	0.3
Sector 19 - Ownership of dwellings	-0.1	-0.7	-1.3	-1.2	-0.7

Source: Authors' compilation

As expected, industry output for all sectors increases relative to the baseline. This is mainly the increase in output per unit of input (labour, capital, land). More efficient use implies higher output and income. The cost of producing a unit of output falls, making Nigerian goods more competitive. This benefits those industries that export most of their output to foreign markets. Industries that rely on imported commodities may substitute away from imports towards cheaper locally produced goods. Industries that also sell output to households perform better than in Sim 1 and 2. As noted, household incomes improve, and thus, industries that sell to households do well. One industry that does well is the electricity sector. Electricity is used as an intermediate input to production and by households. Thus, the increase in investments in the electricity sector improves power generation, transmission and distribution. This is particularly useful when focusing on extending electrification and scaling up renewable energy to power rural industries and households.

4.8. Sim 4: Sim 3 plus industry-specific changes (Bold)

In the bold scenario, we model (as in previous simulations) the:

- tax reform ((a) in Table 4), which is part of all simulations,
- increase in labour participation rates for skilled and unskilled workers. This assumption was introduced in Sim 3.
- an efficiency improvement in the use of freight and passenger transport of 2.5 per cent per annum ((g) in Table 4), which is part of all simulations.

In Sim 4, we:

- allocate 80 per cent of the increase in revenue to government investment ((h) in Table 4).

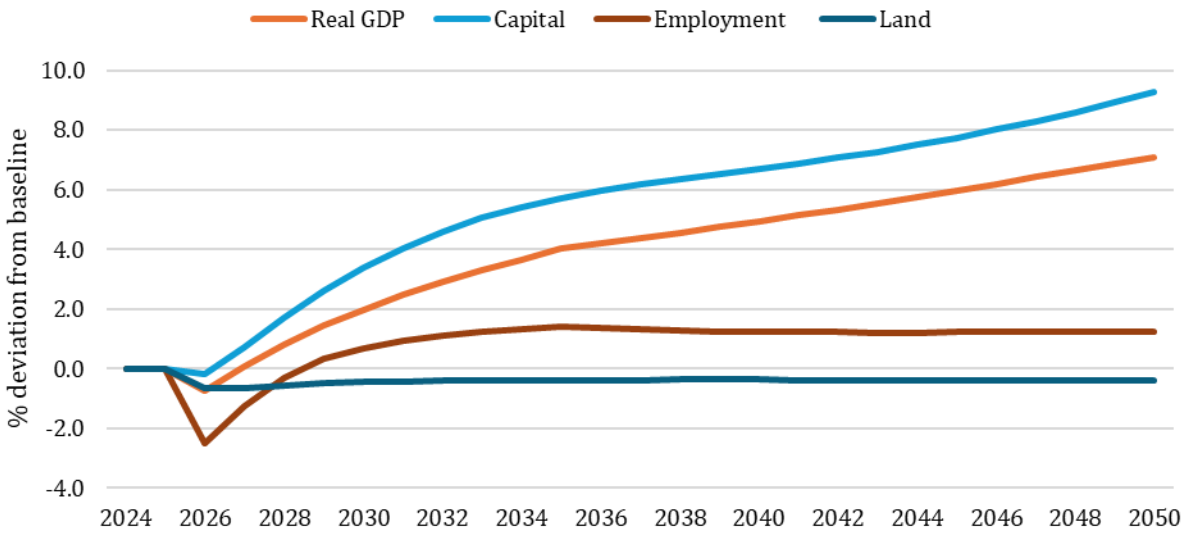
- Increase activity and exports of level of light manufacturing activities.[31] We assume that these industries' output increases by 10 per cent in 2025. The additional output is sold on foreign markets ((i) in Table 4).
- The share of electricity from renewable sources increases to 30 per cent by 2050 ((j) in Table 4).
- Capital productivity by industry improves from 2028 upwards at a rate of 0.15 per cent per annum (point (k) in Table 4).
- Labour productivity for unskilled labour and skilled labour improves from 2028 onwards at a rate of 0.15 per cent per annum (point (k) in Table 4).
- Land productivity for all corps improves from 2028 onwards by 0.15 per cent per annum (point (k) in Table 4).

4.8.1 Macro results

For Sim 4, the macroeconomic outcomes are presented in Figures 15 and 16. Figure 15 shows the percentage deviation from baseline for real GDP, employment and capital for the Bold simulation (Sim 4). Figure 16 shows the percentage deviation in the expenditure components of real GDP for Sim 4. By assumption, real government consumption is held at the base level. The reader will note that the growth paths for most of the macroeconomic variables are very similar to Sim 2 and 3. The difference is in the magnitude of changes. In this simulation, we increase government investment by 80 per cent of the increase in government revenue. This is reflected in the increase in aggregate investments in Figure 16. In the short-run, investments increase to just over 18 per cent above baseline. This is higher than in Sim 3, where aggregate investments increase by 11.4 per cent in the short-run. Higher investments lead to a higher level of capital. In Sim 4, we see that by 2050, capital is 9.4 per cent higher than baseline (Figure 15). In Sim 4, we improve industry-specific capital, land and labour by 0.15 per cent per annum. This further improves the use of the factors, which increases output and lowers overall domestic prices. This also improves wages and the returns to capital, which improves income and the overall welfare of all households. In Sim 4, the labour participation rates are similar to those imposed in Sim 3. Thus, we expect the employment growth to be similar to Sim 3. We see that by 2050, employment is 1.3 per cent higher than baseline. With capital and labour increasing (with little change in the use of natural resources), real GDP is above baseline. Figure 16 shows that real GDP is 7.2 per cent above baseline in 2050.

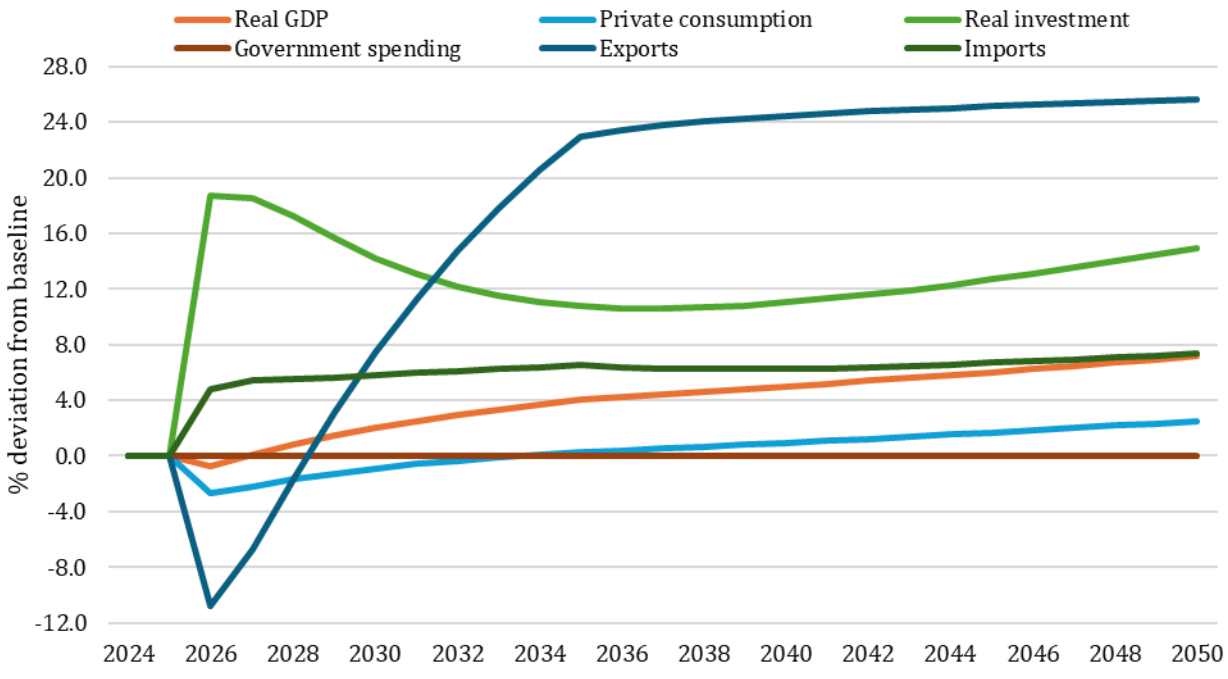
Figure 15. Real GDP, employment and capital (Sim 4) (% deviation from baseline)

[31] The light manufacturing industries include Food and beverages, Textiles and wearing apparel, Pulp, paper and printing, Rubber and plastics and Other Manufacturing.



Source: Authors' diagram

Figure 16. Deviations in expenditure components of real GDP policy (Sim 4) (% deviations, 2024 to 2050)



Source: Authors' diagram

The growth paths of real GDP components from the expenditure side are presented in Figure 16. By assumption, real government spending is held at the baseline level. Investments are above baseline due to the increase in government investment, and we also see that real household consumption is above baseline (reasons are similar to those explained in Sim 3). What is different in this simulation is what happens to aggregate exports. In Sim 4, we increase the activity level of light manufacturing industries and assume that this increase in output is exported. Thus, the exports of light-manufactured commodities increase total exports.

In Sim 2 and 3, we also noted an increase in exports. In this simulation, the growth in real GDP exceeded the growth in real GNE, implying that the trade balance must move towards surplus. Thus, the growth in exports exceeds the growth in imports. To achieve this increase in exports, the terms of trade deteriorate, i.e. a movement down the export demand curve. We also see a real devaluation in the exchange rate (as domestic goods become cheaper and thus more competitive).

In Sim 4, we assume that we find new markets for the increased production of the light-manufactured commodities. This is a right-outward movement in the export demand curve for light-manufactured commodities. This causes the terms of trade to improve, and even though domestic production costs fall, we note that the real exchange rate appreciates. This is a case of Dutch disease where the exports of some commodities lead to an appreciation of the currency, which impacts traditionally exported commodities negatively. Import-competing industries are also impacted. Import-competing industries produce goods that directly compete with imports on the local market. When the real exchange rate appreciates, foreign goods become cheaper. With a stronger exchange rate, domestic industries and consumers substitute away from domestically produced goods towards imported goods. Consequently, local industries competing with imports will struggle.

4.8.2 Industry results

This section focuses on the effect of the imposed shocks, highlighting the influence of trade effects. For reporting purposes, we rank the industries based on the percentage change in output for 2035.

Table 8 presents the results for the ten most advantaged (lines 1-10) and the ten most adversely affected (lines 11-20) industries. The percentage deviation in industry output is shown in column 4. The remaining columns separate the overall change in output into contributions from three underlying market forces. The first column of numbers (export) shows the contribution to the change in domestic commodity output, brought about by the change in exports. The second column of numbers (import replacement) is the contribution due to relative price changes favouring import replacement. The third column (market effect) shows by how much we would expect domestic-commodity production to change if output of the domestic commodity increased in line with the change in domestic demand for the commodity, regardless of source (i.e., domestic or imported).

Line 7 in Table 8 shows that the output of wood products (line 1) is 21.2% above baseline in 2035 (column 4). Column 3 shows that an expansion in the overall size of the local market contributes 1.5 percentage points to the increase in total production. Column 1 shows that increased export demand contributes 23.4 percentage points to the change in total production. Column 2 shows the change in relative prices, favouring imported wood products, contributes a further -3.6 percentage points (column 2). The sum of columns 1 – 3 shows the percentage change in the production of wood products. It is not surprising that most of the best-performing industries are in the top part of

Table 8. They are Rubber and plastic (line 4), Textiles and wearing apparel (line 6), Food production (line 8), and Pulp, paper and printing (line 9). For these industries, we note that the increase in exports mostly explains the total output of these industries.

Table 8. Decomposing output results from Sim 4, 2035 (%)

		Trade effects			Total
		Exports	Import replacement	Total market	
	Industry	1	2	3	4
	Best performing				
1	Wood products	22.7	-3.5	2.1	21.3
2	Electrical equipment	10.4	-1.5	3.4	12.3
3	Chemicals	11.8	-0.7	0.8	11.9
4	Rubber and plastic products	12.7	-4.7	3.4	11.4
5	Motor Vehicles	4.0	0	6.8	10.6
6	Textiles, wearing apparel and footwear	0.0	0.0	10.3	10.3
7	Electricity from hydro	10.2	-0.8	0.9	10.3
8	Food production	13.8	-1.6	-2.1	10.1
9	Pulp, paper and printing	0.0	0.0	10.0	10.0
10	Construction	12.4	-4.7	1.8	9.5
	Worst performing				
11	Crude oil	-2.9	0.0	2.9	0.0
12	Public administration	0.4	0.0	-1.0	-0.6
13	Arts, recreation and entertainment	-0.7	0.1	0.0	-0.7
14	Movies and music	-0.9	0.0	0.0	-0.9
15	Electricity from natural gas	-1.0	0.0	0.0	-1.0
16	Education	-1.4	-0.1	0.0	-1.5
17	Rail transport	-1.7	0.0	0.0	-1.7
18	Electricity from coal	-5.5	0.7	0.0	-4.8
19	Road transport	-7.7	0.0	0.0	-7.7
20	Petroleum	-10.1	0.0	0.0	-10.1

Source: Authors' compilation

Electricity from hydro (a renewable source to generate electricity) is number 7 of the best-performing industries. This is due to our assumption that the share of electricity produced from renewable sources increases to 30 per cent in 2050 in Sim 4 (up from 20 per cent in the baseline).

Table 8, line 7, shows that the increase in production of electricity from hydro is completely explained by the increase in total demand. This is expected because electricity (regardless of fuel source) is used as an intermediate input and by households. As the economy expands, so too does the demand for inputs. The output of Construction (line 10) of 10 per cent is completely explained by the increase in domestic demand for construction. This is due to the strong growth in investments (explained previously).

Line 5 shows that motor vehicles do well with an increase in output of 10.6 per cent, of which 4.0 per cent is due to an increase in exports and 6.8 per cent due to the increase in total domestic

demand. Motor vehicles is mainly used as an investment good, and in our simulations, investment increases. Thus, industries supplying commodities as investment goods will perform well. This is also true for electrical equipment that increases output by 12.3 per cent. Increase in domestic demand and an increase in the exports of this commodity explain 3.4 per cent and 10.4 per cent, respectively, of the increase in total output.

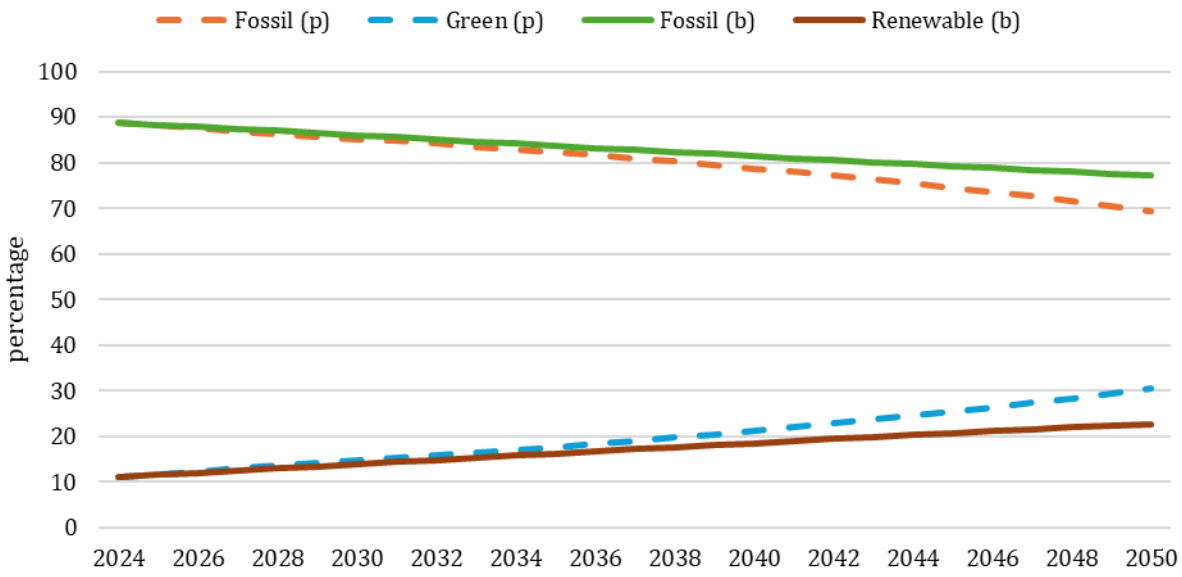
The bottom half of Table 8 shows the worst-performing industries. The worst-performing industry is petroleum. Recall from the baseline that we assume that the local production of petroleum increases and that the imports of petroleum fall. Thus, locally produced crude oil is diverted to the local petroleum industry. Locally produced petroleum is then sold on the domestic market and exported. In policy simulation 4 (Sim 4), the expanding economy still uses petroleum, but the removal of subsidies increases the petroleum price and reduces local demand. We see this confirmed as production contracts by 12 per cent in 2035. We note that the domestic demand for petroleum increased by 7.5 per cent while the imports of petroleum increased by 9.4 per cent (column 2). Thus, as the economy expands, local users will substitute away from domestically produced petroleum towards imported petroleum. Due to the increase in local petroleum price as well as the appreciation of the real exchange rate, exports of petroleum fall by 29 per cent (column 1).

By closure setting, the production of crude oil remains unchanged, but the market where crude oil is sold has changed. The local demand for crude oil falls by 2.9 per cent while exports increase by 2.9 per cent. This is expected because as the local petroleum sector contracts, its demand for crude oil, as an intermediate input, falls. Column 1 shows that increased export demand contributes 2.9 percentage points to the change in total production. Note that the contribution in column 2 is zero – no crude oil is imported. Thus, for this industry, the story is a mixed one. Cuts in domestic subsidies reduce domestic demand. However, some of this lost demand is offset by increased foreign demand, leading to no change in output. Note that exports expand, while local demand falls, because the model gives Nigeria's oil producers the capacity to shift between the two general sources of demand with fairly minimal cost. For all other worst-performing industries, the fall in output can be explained by the fall in domestic demand (column 3). The outcomes from 2050 are very similar to 2035 (which are not reported here for brevity).

4.8.3 Electricity generation

In this simulation, we assume that the share of electricity from renewable sources increases to 30 per cent in 2050. The remaining 70 per cent is produced by fossil fuels. It is thus not surprising that electricity from hydro is one of the best-performing industries (Table 8, line 7). The move towards renewable energy also impacts the level of emissions.

Figure 17. Share of electricity by main fuel source (%)



Source: Authors' diagram

4.9. Sim 5: Sim 4 plus industry-specific changes (Structural)

In the structural simulation (Sim 5), we model (as in previous simulations) the:

- tax reform ((a) in Table 4), which is part of all simulations,
- an efficiency improvement in the use of freight and passenger transport of 2.5 per cent per annum ((g) in Table 4), which is part of all simulations.
- increase activity and exports of level of light manufacturing activities. We assume that these industries' output increases by 10 per cent in 2025. The additional output is sold on foreign markets. This assumption was introduced in Sim 4.

In the structural simulation (Sim 5), we:

- allocate 100 per cent of the increase in revenue to government investment ((l) in Table 4).
- Capital productivity by industry improves from 2028 onwards at a rate of 0.25 per cent per annum (point (n) in Table 4).
- Labour productivity for unskilled labour and skilled labour improves from 2028 onwards at a rate of 0.25 per cent per annum (point (n) in Table 4).
- Land productivity for all crops improves from 2028 onwards by 0.1 per cent per annum (point (n) in Table 4).
- Increase the labour force participation for skilled and unskilled labour by 1.5 per cent (point (o) in Table 4).
- Increase the share of electricity from renewable sources to 50 per cent by 2050 ((l) in Table 4).

Sim 5 can be seen as the final simulation where the accumulated impacts of the assumptions listed above are modelled. The reader will note that the growth paths for most of the macroeconomic variables are very similar to Sim 2 - 4. The difference is in the magnitude of changes. We avoid repetition in the explanations and focus on any interesting deviations.

4.9.1 Macro results

For Sim 5, the macroeconomic outcomes are presented in Figures 18 and 19. Specifically, Figure 18 shows the deviation from baseline for real GDP, employment and capital in the structural simulation. Figure 19 shows the percentage deviation in the expenditure components of real GDP for Sim 5. By assumption, real government consumption is held at the base level.

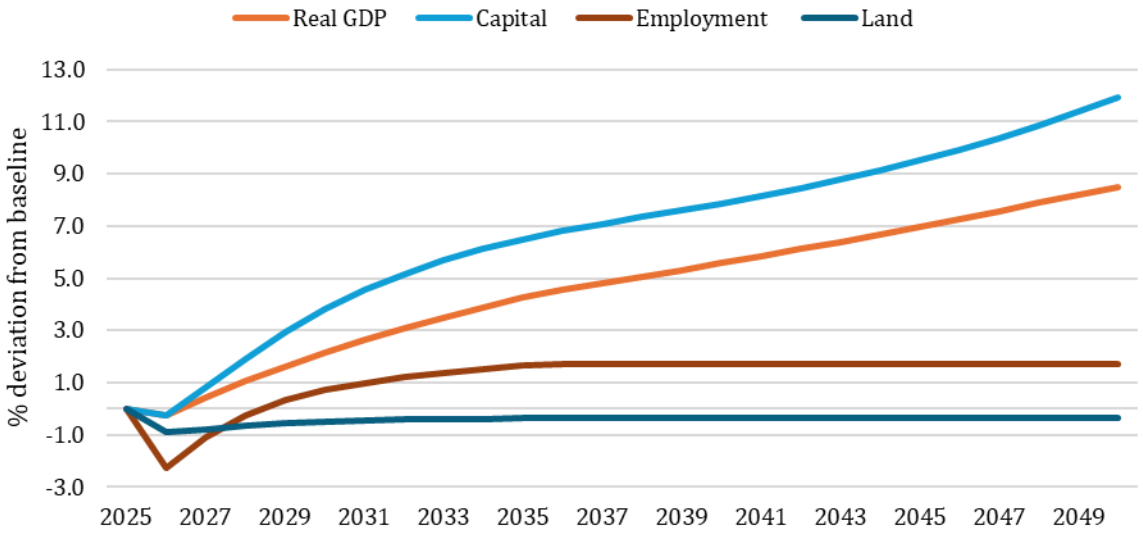
Common to all simulations is the impact of the removal of energy subsidies and the increase in taxes. As explained in Section 4.4, the tax reforms increase the purchasers' price of commodities. This leads to an increase in production costs. Growth in capital and labour is depressed, causing real GDP to be below baseline.

The impact of tax reform is partly offset by an increase in government investment of 100 per cent of the increase in government revenue. This is reflected in the increase in aggregate investments in Figure 19, where, in the short-run, investments increase to 24 per cent above baseline. This is higher than in Sim 3 and Sim 4, where aggregate investments increase by 11.4 per cent and 18.6 per cent, respectively, in the short-run. Higher investments lead to a higher level of capital. In Sim 5, we see that by 2050, capital is 12 per cent higher than baseline (Figure 18). In Sim 5, employment is permanently above baseline at 1.7 per cent. This is due to training and skills upgrades, allowing the labour supply (and participation rate) for skilled and unskilled labour to increase.

In Sim 5, we improve industry-specific capital, land and labour by 0.25 per cent per annum. This implies that with the same number of inputs (land, labour and capital), output will increase. Thus, productivity improves the use of the factors which increase output and lowers overall domestic prices. Sections 4.1 and 4.2.3 detail the nature and impacts of these productivity increases. As with Sim2-4, wages and the returns to capital increase, which improves income and the overall welfare of all households.

In Sim 5, we assume the labour participation rates improve to that the overall employment is permanently above baseline at 1.8 per cent. Nigeria has a talented population. A large share of the working-age population is either unemployed or works in the informal sector. To restructure the economy so that it becomes resilient to climate change (think agriculture sector, infrastructure improvement), a requirement is that the population should be trained towards those skills and occupations that may become important in future. It is not only training that is important, but also allowing formal jobs to be created (for instance, making it easier to do business, encouraging entrepreneurship). With capital and labour increasing (with little change in the use of natural resources), real GDP is above baseline. Figure 18 shows that real GDP is 9 per cent above baseline in 2050.

Figure 18. Real GDP, employment and capital (Sim 5) (% deviation from baseline)

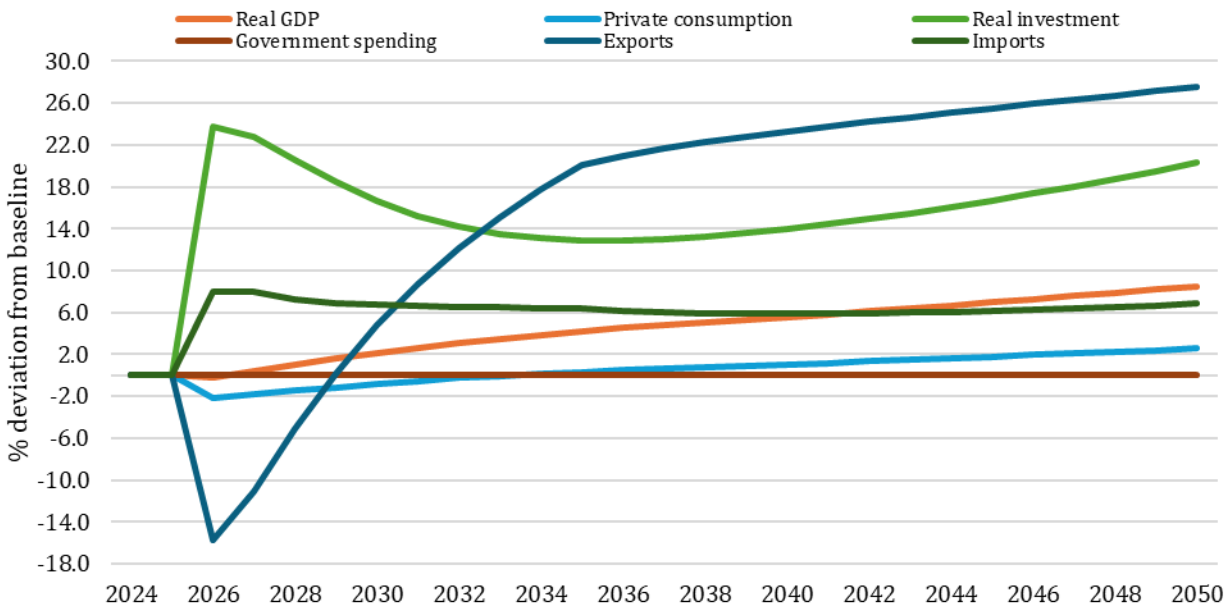


Source: Authors' diagram

Over the medium and long term, the growth in GDP (Y) exceeds the growth in real GNE (C+I+G) with the result that the net volume of trade (X-M) must improve. For the trade balance to improve, the deviation from the baseline in exports must lie above the deviation in imports.

Figure 19 shows that the deviation in imports remains above the GDP deviation. This is because consumption and investment have a high import share, and therefore, the positive deviation in mainly investment drives the growth in imports. Also note that from Sim 4, where we increase the production and exports of light manufacturing products, the terms of trade improved. We also had an appreciation of the real exchange rate. This makes imported commodities cheaper, and local consumers and industries may substitute for cheaper imported commodities. As shown in Figure 20, at the end of the simulation period, the volume of exports is 27.5 per cent higher than the baseline, while the volume of imports is lower by 6.8 per cent.

Figure 19. Deviations in expenditure components of real GDP policy (Sim 5) (% deviations, 2024 to 2050)



Source: Authors' diagram

4.9.2 Industry results

This section focuses on the Sim 5 industry output results. As with the previous results, we provide five columns of numbers, with the final column showing in average annual percentage terms total growth across the period 2025 to 2050.

Four key factors largely explain the output changes of other industries.

- Input-output linkages;
- connections to international trade;
- connections to domestic final demand; and
- factor intensities.

At the macro level, over the whole period, employment is permanently above baseline, investment and exports are projected to grow faster than real GDP. Imports grow in line with real GDP, while real consumption is projected to grow at a lower rate than real GDP. Natural resources remain at the base level.

- Capital-intensive industries benefit from the growth in investments;
- Any expansion of agricultural and mining industries will be constrained by the fixity of agricultural land and natural resources;
- Trade-exposed industries may benefit from the higher rate of export growth, while import-competing industries would struggle due to the real appreciation of the exchange rate.

As expected, the output of most industries increases relative to the baseline. Industries growing faster than real GDP include the manufacturing industries (due to the expansion of the light manufacturing industries), renewable energy (due to the shock imposed that 50 per cent of

electricity is from renewable sources) and construction (due to the increase in investments). The trade and professional, and technical services improve because as the economy expands, the demand for their services increases. Industries growing at a rate lower than real GDP either sell their output to the government (i.e. Public administration) or mainly to households.

Table 9. Industry output by aggregated sector (Sim 5) (% deviation from baseline)

Industry output	2026-2030	2031-2035	2036-2040	2040-2050	2025-2050
1. Real GDP	1.1	3.8	5.5	7.7	4.3
Sector 1 - Agriculture, forestry, and fishing	1.0	3.6	5.1	6.4	3.7
Sector 2 – Mining	0.7	1.6	2.0	2.0	1.4
Sector 3 – Manufacturing	0.1	4.7	7.7	10.7	5.5
Sector 4 – Electricity and gas distribution	-1.5	-1.0	-2.2	-3.6	-2.0
4a Fossil fuel electricity services	-4.0	-13.2	-28.2	-53.2	-28.7
4b Renewable electricity services	4.3	10.7	13.2	16.5	10.0
Sector 5 – Construction	18.8	12.3	11.8	15.4	12.1
Sector 6 - Trade	1.9	5.4	7.4	9.6	5.6
Sector 7 - Accommodation & food services	-10.5	-0.1	4.2	8.4	1.5
Sector 8 - Transport, postal, and warehousing	-1.8	0.7	2.0	4.5	1.6
Sector 9 - Communication services	-1.6	1.4	3.0	5.4	2.2
Sector 10 - Financial & insurance services	-2.7	2.3	4.5	7.5	3.1
Sector 11 – Rental	-0.4	2.8	4.5	6.7	3.3
Sector 12 - Professional services	-0.9	3.5	5.8	9.3	4.4
Sector 13 - Administrative services	-1.2	2.2	3.7	6.1	2.8
Sector 14 - Public administration and safety	-2.6	-0.6	-0.1	0.7	-0.3
Sector 15 - Education and training	-4.6	-1.6	-0.3	1.6	-0.6
Sector 16 - Health care and social assistance	-1.0	1.1	2.3	3.8	1.7
Sector 17 - Arts and Recreation	-3.3	-0.6	0.7	2.8	0.4
Sector 18 - Other services	-2.5	0.2	2.0	4.5	1.4
Sector 19 - Ownership of dwellings	-0.1	-1.2	-2.7	-3.0	-1.7

Source: Authors' compilation

4.10. Emissions

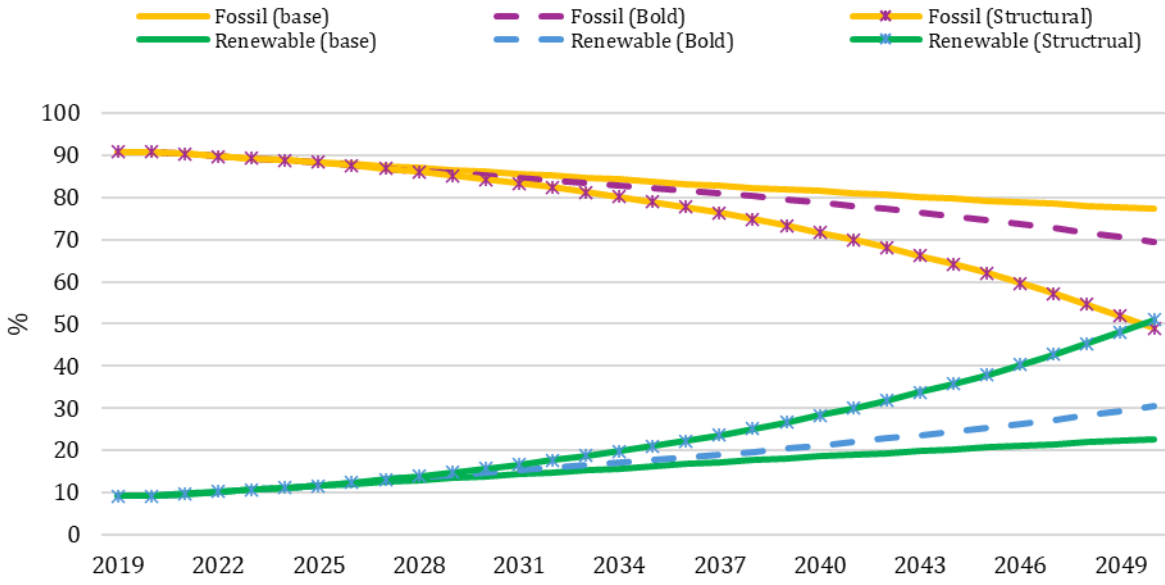
The model tracks emissions of greenhouse gases (GHGs) according to emitting agent (96 industries and the household sector) and emitting activity. Emissions occur from activities that burn fuels (coal, natural gas, petroleum and wood products). Thus, as the economy grows, industries and households demand more energy commodities. Non-combustion emissions, such as emissions from mines and agricultural emissions, do not arise from fuel burning. Instead, they come from chemical, industrial, biological or physical processes. Industrial processes include, for

example, cement production (CO_2 is released from limestone calcination), steel production and chemical manufacturing. Emissions from Agriculture is from the holding of livestock and the management of manure. Fugitive emissions include leaks from oil and natural gas extraction and transport.

As illustrated in Figure 5, in 2019, emissions total around 347 $MtCO_2$-eq. In the baseline, emissions in all categories continue to grow. Two factors depress the growth in emissions: (1) the general improvements in energy efficiency, and (2) a shift towards renewable electricity generation, moderating the rate of growth in emissions so that at the end of the simulation period, the growth in emissions is below that of real GDP.

Figure 20 shows the share of electricity generated from fossil fuels and renewable sources. In the baseline, electricity from renewable sources is approximately 22 per cent in 2050. Fossil-generated electricity is just under 80 per cent. For the Cautious simulation, we assume that the share of each type of electricity remains at the base level. In the Bold simulation, we assume that by 2050, 30 per cent of electricity is from renewable sources and 70 per cent from fossil fuels. Finally, in the Structural simulation, we assume that the split is 50/50. Note that the share of electricity generated by fuel source in the Cautious simulation is the same as in the baseline.

Figure 20. Share of electricity generated by fuel source-Cautious, Bold and Structural simulations (% share)

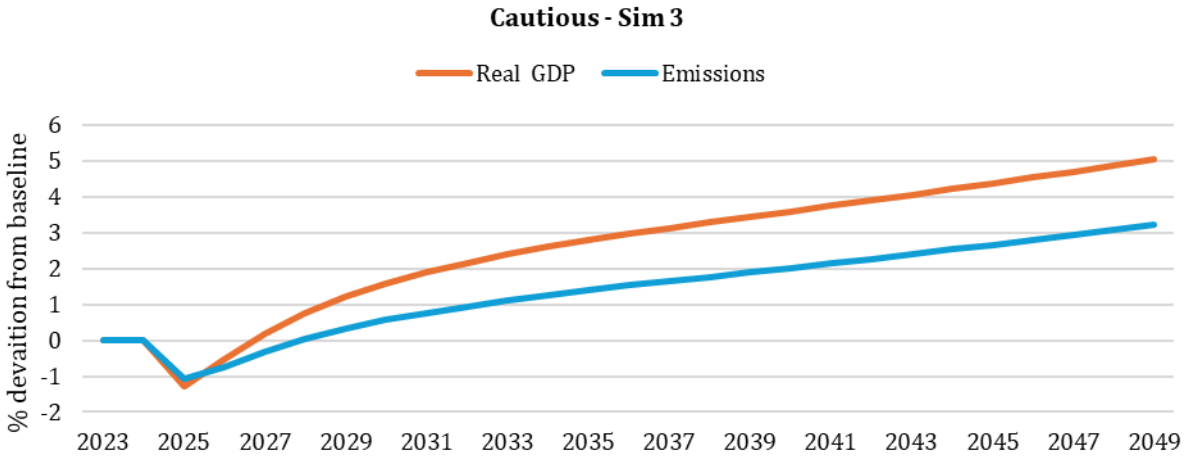


Source: Authors' diagram

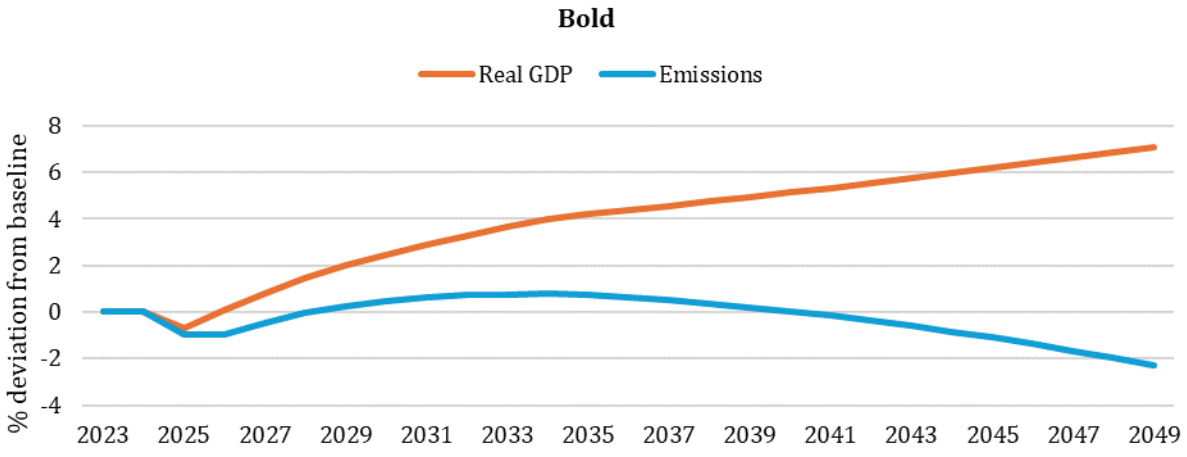
Figure 21 shows the percentage deviation from baseline for real GDP and total emissions for the three main simulations, namely the Cautious (Sim 3, Panel A), Bold (Sim 4, Panel B) and Structural (Sim 5, Panel C) simulations. We notice that in all scenarios, the percentage deviation from the baseline in total emissions lies below the deviation in real GDP. In Sim 3, emissions grow in line with real GDP. In Sim 4 and Sim 5, we see that the deviations from baseline in emissions are negative. These results are mainly driven by our assumption of the share of electricity produced from renewable sources. In Sim 3, 30 per cent of electricity is produced from renewable sources (Section 4.8) while in Sim 5, this share is 50 per cent (Section 4.9). In Sim 4, total emissions are 2.3 per cent below baseline, while in Sim 5, this fall is 10 per cent.

Figure 22 presents this information as an index with 2024 = 100. Figure 22 shows how Nigeria's real GDP and emissions evolve relative to their 2024 levels, set equal to 100. Real GDP grows steadily, more than 3.5 by 2050, while emissions also rise but at a slower pace. This suggests that although economic growth is accompanied by higher emissions, the economy becomes somewhat more emissions-efficient over time, with GDP growing faster than emissions.

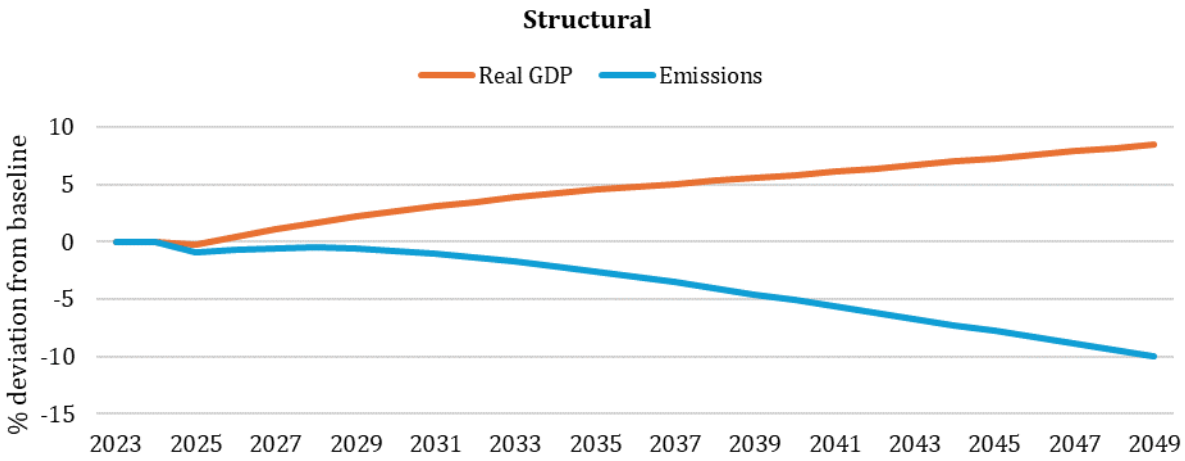
Figure 21 - Panel A. Real GDP and emissions (% change from baseline)



above-Panel B

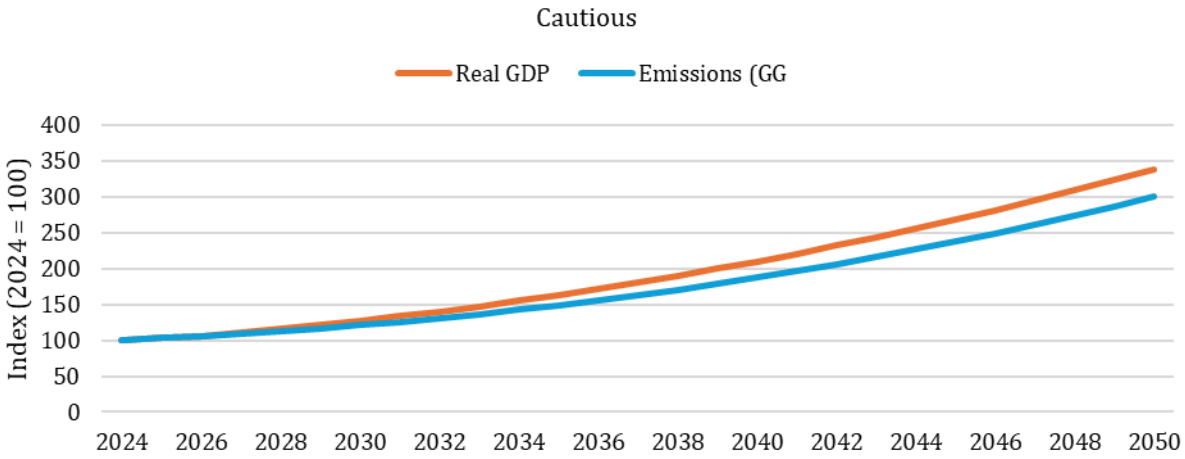


above-Panel C

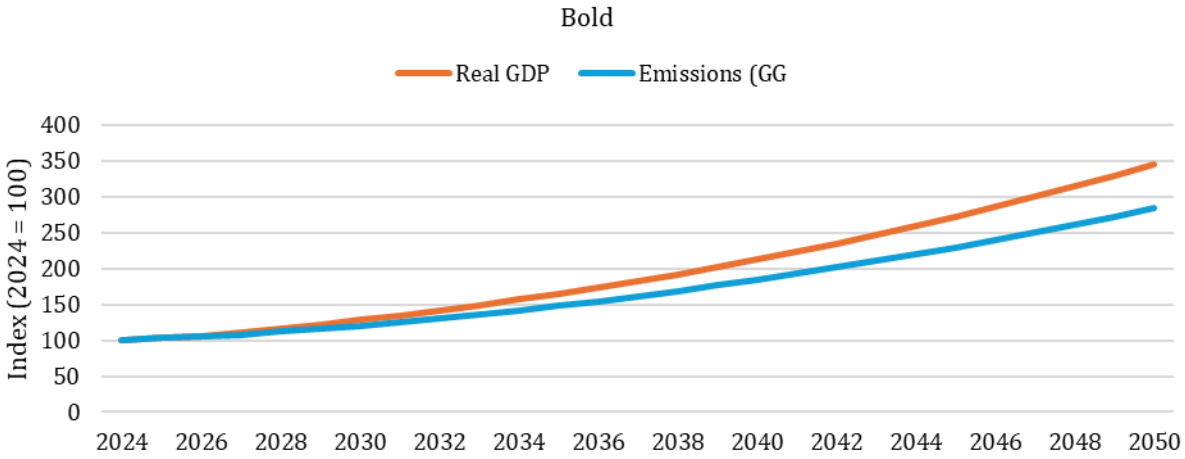


Source: Authors' diagram

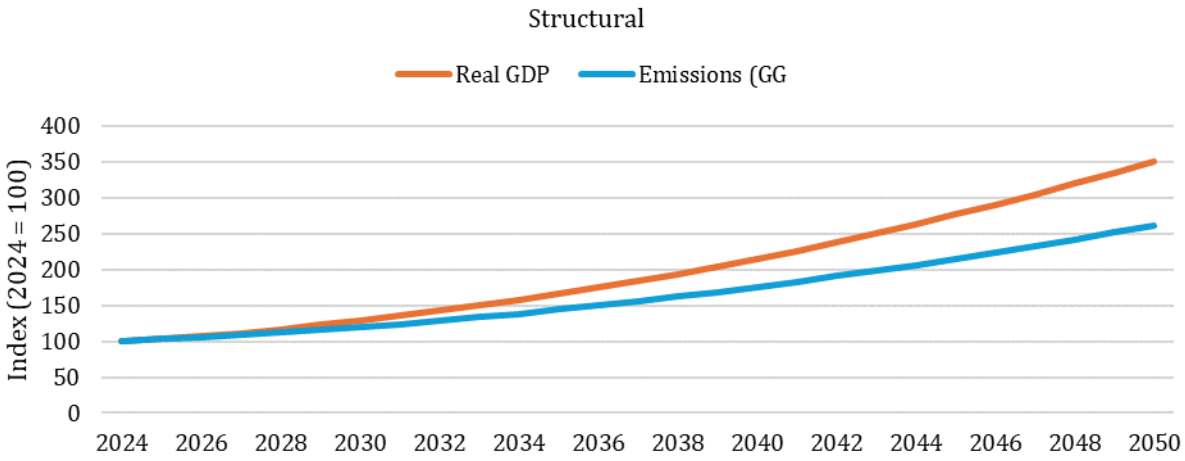
Figure 22 - Panel A. Index for Real GDP and emissions (2024 = 100)



above – Panel B



above – Panel C



Source: Authors' diagram

Emission by source is dominated by Energy, specifically the production of electricity. In Sim 3, the share of emissions from energy increases from approximately 60 per cent in 2019 to 75 per cent. This reflects the increased demand for electricity by industries and households, where the electricity is generated mainly from fossil fuels. The share of emissions from industrial processes increases from 5 per cent to 8.5 per cent in 2050. This is to be expected as the economy grows, as investments focus on manufacturing and services.

In Sim 4, the share of emissions from energy increases to 72.9 per cent, which is lower than in Sim 3, mainly because the renewable sources produce 30 per cent of electricity. The share of emissions from industrial processes increases to 11.1 per cent in 2050. This is to be expected as we increase the production of light manufacturing in the Bold scenario. Sim 5 follows the same trend with emissions share for energy falling to 70.5 as more electricity is produced by renewable sources.

5. Conclusion

Nigeria stands at a turning point. Decades of reliance on crude oil exports have secured fiscal revenues and foreign exchange, yet left the economy exposed to external shocks and constrained in its capacity to generate broad-based jobs and industrial depth. This report examined three

hypothetical diversification scenarios (cautious, bold, and structural) using a dynamic CGE framework to analyse how targeted reforms could shift outcomes relative to baseline (business-as-usual). The evidence shows that without significant reform, Nigeria's baseline growth path remains modest and structural imbalances persist, limiting gains in poverty reduction and environmental sustainability.

The baseline projection, aligned with Shared Socioeconomic Pathway 2 (SSP2), offers a view of Nigeria's future under a "business-as-usual" simulation. Key features include: an economy that expands moderately, with GDP growth averaging 4.4% annually, but not enough to absorb a rapidly growing labour force; Oil continues to dominate exports, investment and productivity remain subdued, and infrastructure gaps slow the reallocation of resources toward higher-value activities; The energy transition proceeds gradually, with renewables reaching only 22% of electricity generation by 2050; and emissions rising more slowly than GDP but still insufficiently aligned with climate objectives.

While services and manufacturing show some promise, their growth is constrained by inadequate investment, low productivity, and weak infrastructure. Employment growth remains closely tied to population trends, with limited gains in labour productivity and persistent gender disparities. The baseline scenario highlights the limitations of incremental change and the need for bold, coordinated action.

We run 5 policy simulations. Sim 1 and Sim 2 are a prelude to Sim 3 – 5, as the tax reform and increased government investment are common to Sim 3 – 5. These scenarios are for illustrative purposes and are not a prediction of the future, nor any preconceived recommendations for Nigeria. These scenarios aim to explore different plausible stylised futures of how the economy may change under different hypothetical reforms. The goal is to provide some guidelines to the Nigerian team on how the consequences of their reform choices may influence future growth paths.

Each scenario builds on the previous, demonstrating the cumulative benefits of fiscal reform, strategic investment, and structural transformation.

- Simulation 1 (Tax Reform): While necessary for expanding fiscal space, tax reform alone yields limited economic gains and imposes short-term welfare costs, particularly for vulnerable households.
- Simulation 2 (Investment Allocation): Redirecting revenue to non-oil sectors begins to shift the growth trajectory, but the impact remains modest without accompanying productivity improvements.
- Simulation 3 (Cautious Diversification): Adding increased labour supply and productivity reforms enhances GDP growth and export performance, signalling the importance of human capital (better trained labour force) development as well as improvement in climate-resilient infrastructure (improved irrigation, dams, roads).
- Simulation 4 (Bold Diversification): A more aggressive investment strategy, coupled with export promotion and renewable energy expansion, delivers stronger outcomes in growth, employment, and emissions reduction.

- Simulation 5 (Structural Transformation): The most ambitious scenario achieves the highest gains in GDP (8.5%), exports (27.5%), and emissions reduction (10%), illustrating the transformative potential of coordinated, long-term reform.

Taken together, the simulations show that diversification is not a single decision but a multi-dimensional strategy. The most robust outcomes arise when revenue mobilisation is paired with disciplined, well-targeted public investment, productivity enhancement, export diversification, and an orderly energy transition. In practical terms, this means expanding fiscal space through subsidy reform and progressive taxation while shielding vulnerable households with targeted transfers; prioritising infrastructure, manufacturing, and renewable energy to crowd in private investment; lifting productivity via education, skills, and technology adoption—especially in labour-intensive sectors; promoting export-oriented industries in light manufacturing and services to stabilise foreign exchange; accelerating the energy transition to broaden access and curb emissions; and strengthening institutions so that policies are coherent, transparent, and executed effectively across federal and state levels.

Nigeria has the fundamentals to achieve robust, inclusive, and sustainable growth. Realising that potential depends on political will, institutional capacity, and a shared commitment to follow through. By moving beyond oil dependence and investing in its people, infrastructure, and competitive industries, the country can shift onto a path that is more resilient, more equitable, and more competitive in the global economy.

References

Budget Office of the Federation. (2020). *Bouncing Back: Nigeria Economic Sustainability Plan (NESP)*. https://www.budgetoffice.gov.ng/index.php/nigeria-economic-sustainability-plan

CBN. (2024). *2023 Statistical Bulletin: Domestic Production, Consumption and Prices*. Annual Statistical Bulletin. https://www.cbn.gov.ng/documents/Statbulletin.html

Emenekwe, C. C., Nnamani, U., & Ayodeji, S. (2024). *Green industrialization in Africa: Opportunities and tensions in Africa-Europe relations: Scoping paper on Nigeria*. https://www.iddri.org/sites/default/files/PDF/Publications/Catalogue Iddri/Rapport/Ukama_NIGERIA.pdf

Energy Transition Office. (2022). *Nigeria's pathway to achieve carbon neutrality by 2060*. https://energytransition.gov.ng/

Federal Republic of Nigeria Official Gazette. (2021). *Climate Change Act, 2021*. Federal Government Printer. https://ngfrepository.org.ng:8443/handle/123456789/6359

FGN. (2009). *Nigeria Vision 20: 2020 - Abridged Version*. https://www.nigerianstat.gov.ng/pdfuploads/Abridged_Version_of_Nigeria Vision 2020.pdf?

FGN. (2014). *Nigeria Industrial Revolution Plan (NIRP)*. Abuja, Nigeria: Federal Ministry of Industry, Trade, and Investment of Nigeria. https://www.nipc.gov.ng/wp-content/uploads/2019/03/nirp.pdf

FMBNP. (2017). *Economic Recovery & Growth Plan 2017-2020*. Abuja, Nigeria: Federal Ministry of Budget and National Planning.

FMBNP. (2020). *National Integrated Infrastructure Master Plan (NIIMP, 2020-2043)*. Abuja,

Nigeria: Federal Ministry of Budget and National Planning. https://ngfrepository.org.ng:8443/bitstream/123456789/2776/1/final EDITED VERSION OF NIIMP - 12th Jan. 2021.pdf#:~:text=The revised NIIMP provides an integrated view of,implementation in line with the current economic realities.

FMFBNP. (2021a). *National Development Plan (NDP) 2021-2025 Volume 1* (1st ed.). Abuja, Nigeria: Federal Ministry of Finance, Budget and National Planning.

FMFBNP. (2021b). *Nigeria Agenda 2050*. Abuja, Nigeria: Federal Ministry of Finance, Budget, and National Planning. Abuja, Nigeria. https://nationalplanning.gov.ng/wp-content/uploads/2023/05/Nigeria-Agenda-2050-Report-Corrected.pdf

FMHSW. (2024). *Nigeria Climate Change and Health: National Vulnerability and Adaptation Assessment Report*. https://www.atachcommunity.com/fileadmin/uploads/atach/Documents/Country_documents/Nigeria_Climate_and_Health_VA_assessment_report_-_FINAL.pdf

FMPR. (2017). *National Gas Policy*. Abuja, Nigeria: Federal Ministry of Petroleum Resouces. https://petroleumresources.gov.ng/wp-content/uploads/2024/10/National-Gas-Policy-Approved-By-FEC-in-June-2017.pdf

Gençsü, I., Walls, G., Picciariello, A., & Alasia, I. J. (2022). *Nigeria's energy transition: reforming fossil fuel subsidies and other financing opportunities*. https://odi.org/en/publications/nigerias-energy-transition-reforming-fossil-fuel-subsidies-and-other-financing-opportunities/

ILO and UNDP. (2021). *Nigeria Green Jobs Assessment Report: Measuring the Socioeconomic Impacts of Climate Policies to Guide NDC Enhancement and a Just Transition*. United Nations Development Programme (UNDP).

IMF. (2018a). *2. Domestic Revenue Mobilization in Sub-Saharan Africa: What Are the Possibilities?* (p. ch002). International Monetary Fund. https://doi.org/10.5089/9781484339862.086.ch002

IMF. (2018b). *Nigeria: Selected Issues*. International Monetary Fund (IMF). https://doi.org/10.5089/9781484345481.002

IMF. (2023). *Nigeria's Tax Revenue Mobilization: Lessons from Successful Revenue Reform Episodes: Nigeria*. https://www.imf.org/en/Publications/selected-issues-papers/Issues/2023/03/07/Nigerias-Tax-Revenue-Mobilization-Lessons-from-Successful-Revenue-Reform-Episodes-Nigeria-530628

National Planning Commission. (2004). *Meeting Everyone's Needs: National Economic Empowerment and Development Strategy (NEEDS)*. Abuja, Nigeria: Nigerian National Planning Commission.

NBS. (2022). *Nigeria multidimensional poverty index (2022)*. Abuja, Nigeria: National Bureau of Statistics.

NBS. (2024). *Foreign Trade in Goods Statistics (Q2 2024)*. https://www.nigerianstat.gov.ng/elibrary/read/1241553

NCCC. (2023). *Nigeria's Long-Term Low-Emission Development Strategy – 2060*. Abuja, Nigeria: National Council on Climate Change (NCCC). https://natccc.gov.ng/publications/Final Version Nigeria's LT-LEDS.pdf

NUPRC. (2018). *Flare Gas (Prevention of Waste and Pollution) Regulation, 2018*. https://www.nuprc.gov.ng/wp-content/uploads/2020/06/Flare-Gas-Prevention-of-Waste-Pollution-Regulations-2018.pdf

Nwokoma, N. I., Adeoye, B. W., Oke, B., Oke, D. M., Taiwo V. Ojapinwa, A. T. O., Iwegbu, O., & Eniayewu, A. (2022). Nigeria's Economic Growth and Diversification: An Appraisal of the Economic Recovery and Growth Plan and Stakeholders' Perspectives. *Nigerian Journal of Economic and Social Studies*, *64*(2), 253–285.

O'Neill, B. C., Kriegler, E., Riahi, K., Ebi, K. L., Hallegatte, S., Carter, T. R., Mathur, R., & van Vuuren, D. P. (2014). A new scenario framework for climate change research: the concept of shared socioeconomic pathways. *Climatic Change*, *122*(3), 387–400. https://doi.org/10.1007/s10584-013-0905-2

Okereke, C., Emenekwe, C., Onyeneke, R., Nnamani, U., & Amadi, M. (2024). *Nigeria's fossil fuel subsidy reforms: the welfare effects on households*. https://odi.org/en/publications/nigerias-fossil-fuel-subsidy-reforms-the-welfare-effects-on-households/

Ozili, P. K., & Obiora, K. (2023). Implications of Fuel Subsidy Removal on the Nigerian Economy. *Public Policy's Role in Achieving Sustainable Development Goals*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4535876

Power for All. (2022). *Powering Jobs Census 2022: Focus on Nigeria*. https://www.powerforall.org/resources/reports/powering-jobs-census-2022-focus-nigeria

Riahi, K., van Vuuren, D. P., Kriegler, E., Edmonds, J., O'Neill, B. C., Fujimori, S., Bauer, N., Calvin, K., Dellink, R., Fricko, O., Lutz, W., Popp, A., Cuaresma, J. C., Samir, K. C., Leimbach, M., Jiang, L. W., Kram, T., Rao, S., Emmerling, J., … Tavoni, M. (2017). The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. *GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS*, *42*, 153–168. https://doi.org/10.1016/j.gloenvcha.2016.05.009

Simpson, N. P., Steadman, S., Tindall, T., Tan, E., Okereke, C., Emenekwe, C., Onyeneke, R., Amadi, M., Nnamani, U., & Nwajiaku-dahou, K. (2024). *Towards sustainable fuel subsidy reform in Nigeria Evaluating progress and pathways to success*. https://media.odi.org/documents/ODI-OM-SustainableFuelSubsidyReformNigeria-WP-Mar24-Proof02.pdf

UN DESA-PD. (2024). *World Population Prospects 2024*. https://population.un.org/wpp/

UNFCCC. (2022). *Nigeria First NDC (Updated submission)*. https://unfccc.int/documents/497790

van Vuuren, D. P., Riahi, K., Calvin, K., Dellink, R., Emmerling, J., Fujimori, S., KC, S., Kriegler, E., & O'Neill, B. (2017). The Shared Socio-economic Pathways: Trajectories for human development and global environmental change. *Global Environmental Change*, *42*, 148–152. https://doi.org/https://doi.org/10.1016/j.gloenvcha.2016.10.009

World Bank. (2020). *The African Continental Free Trade Area: Economic and Distributional Effects*. Washington, DC: International Bank for Reconstruction and Development / The World Bank.

World Bank. (2021). Climate Risk Country Profile: Nigeria. In *Climate Risk Country Profile: Nigeria*. The World Bank Group. www.worldbank.org

World Bank. (2022). *Nigeria Public Finance Review: Fiscal Adjustment for Better and*

Sustainable Results. Washington, DC: International Bank for Reconstruction and Development / The World Bank. https://documents1.worldbank.org/curated/en/099615211172222358/pdf/P1750950fbd29d02008429007d1ed499d61.pdf

Appendix 1. Exogenous shocks in the baseline

Table A1. Year-on-year percentage change in for selected variables, 2020- 2050

	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Real GDP	Population	Oil production	Natural gas	Renewable	Total renewable	Petroleum import
2020	-6.9	2.5	-9.5	-0.6	1.7	2.7	0
2021	1.0	2.5	-11.4	-0.6	31.1	4.5	0
2022	4.4	2.5	-13.9	-0.6	31.5	5.0	0
2023	3.1	2.5	6.6	-0.6	22.6	4.7	0
2024	3.4	2.5	6.4	-0.6	17.4	4.4	0
2025	3.5	2.5	6.2	-0.6	13.9	4.2	-2.5
2026	3.6	2.4	6.0	-0.6	7.6	3.4	-2.5
2027	3.8	2.4	6.0	-0.6	6.6	3.3	-2.5
2028	4.1	2.4	6.0	-0.6	10.0	3.8	-2.5
2029	4.3	2.4	6.0	-0.6	10.0	3.9	-2.5
2030	4.5	2.4	6.0	-0.6	8.3	3.7	-2.5
2031	4.7	2.3	6.0	-0.6	6.1	3.3	-2.5
2032	4.8	2.3	6.0	-0.6	5.3	3.2	-2.5
2033	4.9	2.3	6.0	-0.6	5.3	3.2	-2.5
2034	5.0	2.3	6.0	-0.6	4.0	3.0	-2.5
2035	5.1	2.3	6.0	-0.6	3.7	2.9	-2.5
2036	5.1	2.2	6.0	-0.6	3.8	3.0	-2.5
2037	5.1	2.2	6.0	-0.6	2.7	2.7	-2.5
2038	5.1	2.2	6.0	-0.6	2.4	2.7	-2.5
2039	5.1	2.2	6.0	-0.6	1.7	2.6	-2.5
2040	5.1	2.2	6.0	-0.6	1.2	2.4	-2.5
2041	5.1	2.1	6.0	-0.6	1.3	2.5	-2.5
2042	5.1	2.1	6.0	-0.6	0.5	2.3	-2.5
2043	5.0	2.1	6.0	-0.6	0.0	2.2	-2.5
2044	5.0	2.1	6.0	-0.6	-0.6	2.2	-2.5
2045	4.9	2.1	6.0	-0.6	-1.2	2.1	-2.5
2046	4.8	2.1	6.0	-0.6	-1.3	2.1	-2.5
2047	4.8	2.0	6.0	-0.6	-2.4	1.9	-2.5
2048	4.7	2.0	6.0	-0.6	-3.0	1.9	-2.5
2049	4.7	2.0	6.0	-0.6	-3.9	1.8	-2.5
2050	4.6	2.0	6.0	-0.6	-4.4	1.8	-2.5

Table A2. Year-on-year percentage change in for fiscal variables, 2020- 2050

Year	Fuel subsidy	Electricity subsidy	VAT	Customs	Petroleum tax	Corporate tax	Personal income tax	Rents/ Royalties
2020	864	500	1,430	1,234	1,517	1,275	917	7,828
2021	1,430	250	2,002	2,031	949	1,748	1,247	15,060
2022	4,390	140	2,926	3,101	4,209	2,649	1,043	17,863
2023	3,360	650	3,655	3,748	2,715	3,349	1,353	20,880
2024	5,400	1,940	6,728	7,518	5,761	6,544	2,045	24,938