



Large Infrastructure

The Leapfrogging and Large Infrastructure scenario

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The Leapfrogging and Large Infrastructure scenario

- Briefly
- Impact of the Leapfrogging and Large Infrastructure scenario on growth, employment and poverty
- Impact of the Leapfrogging and Large Infrastructure scenario on human development
- Impact of the Leapfrogging and Large Infrastructure scenario on trade

Briefly

This section explains the structure of the Leapfrogging and Large Infrastructure scenario, which could set the continent on a more positive human development trajectory than the Current Path forecast. The same scenario is used for the theme on Leapfrogging .

Although they are discussed separately the two themes, large infrastructure (this theme) and leapfrogging necessarily overlap and complement one another, particularly with regard to the impact of large-scale renewables and the introduction of off-grid and micro-grid systems on electricity access. That and the multiplier effect of ICT have the impact of lowering the entry point for private capital as well as more rapidly crowding in the informal sector into the formal.

The IFs forecasting platform distinguishes between traditional infrastructure (water, roads, electricity, sanitation and wastewater), ICT infrastructure (mobile phones, fixed broadband and mobile broadband) and a residual called 'other infrastructure' (facilities such as ports, airports, railways etc.). Rather than focusing on a specific type of infrastructure (e.g. for water and sanitation or education), the Leapfrogging and Large Infrastructure scenario increases investments in both. It allows the algorithms in the forecasting platform to 'allocate' the additional spending and then to forecast the associated impact.^[1] IFs consider both public and private spending on core infrastructure and public spending on other infrastructure, but do not provide for infrastructure that is explicitly funded through public-private partnerships (one could argue that is captured through domestic and FDI in the economy). It also [models and forecasts](#) the construction and maintenance of public and private infrastructure.

In general, the intervention that increases infrastructure spending pushes harder on 'core' infrastructure in lower-income countries than in higher-income countries. The inverse applies in the case of advanced or 'other' infrastructure.

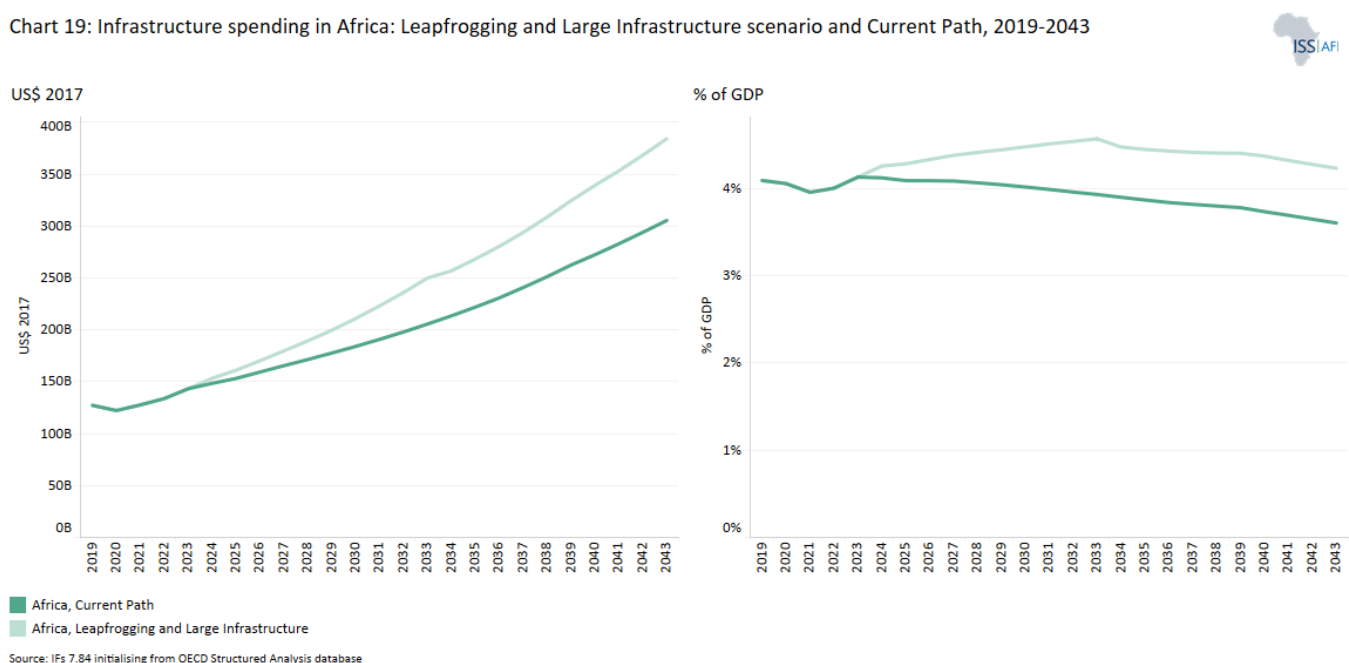
The interventions for the Leapfrogging and Large Infrastructure scenario are presented schematically in Chart 18. This theme subsequently discusses the greater investments in 'core' and 'other' infrastructure that lead to improvements in physical capital and subsequently improve the contribution of multifactor productivity (MFP) to economic growth. In addition to physical capital, MFP in IFs consists of contributions from human, social and knowledge capital (the other interventions are discussed in the theme on Leapfrogging).

Chart 18: Schematic of the Leapfrogging and Large Infrastructure scenario

Logic	Intervention	Outcome	Impact
Rapid provision of electricity	Increase electricity access rate for urban and rural	Greater access to electricity	Increased energy production and decreased carbon emissions
	Reduction of electricity transmission and distribution loss		
Provision of renewable energy	Reduction in capital cost to output ratio in hydro, nuclear and other renewables	Increased contribution of renewable energies	
	Increase production of hydro and other renewable energies		
Better and more ICT	Increase access to fixed and mobile broadband	More digitisation	
	Reduction in cost of adding broadband connection		
	Reduce size of the informal sector		
Improved roads	Increase paved roads both urban and rural	Improved physical capital	
Greater investment in infrastructure	Increase government exp. on other infrastructure		

The Leapfrogging and Large Infrastructure scenario models an increase in government spending on infrastructure to 4.2% of GDP by 2043, instead of 3.6% in the Current Path forecast, reflected in Chart 19.

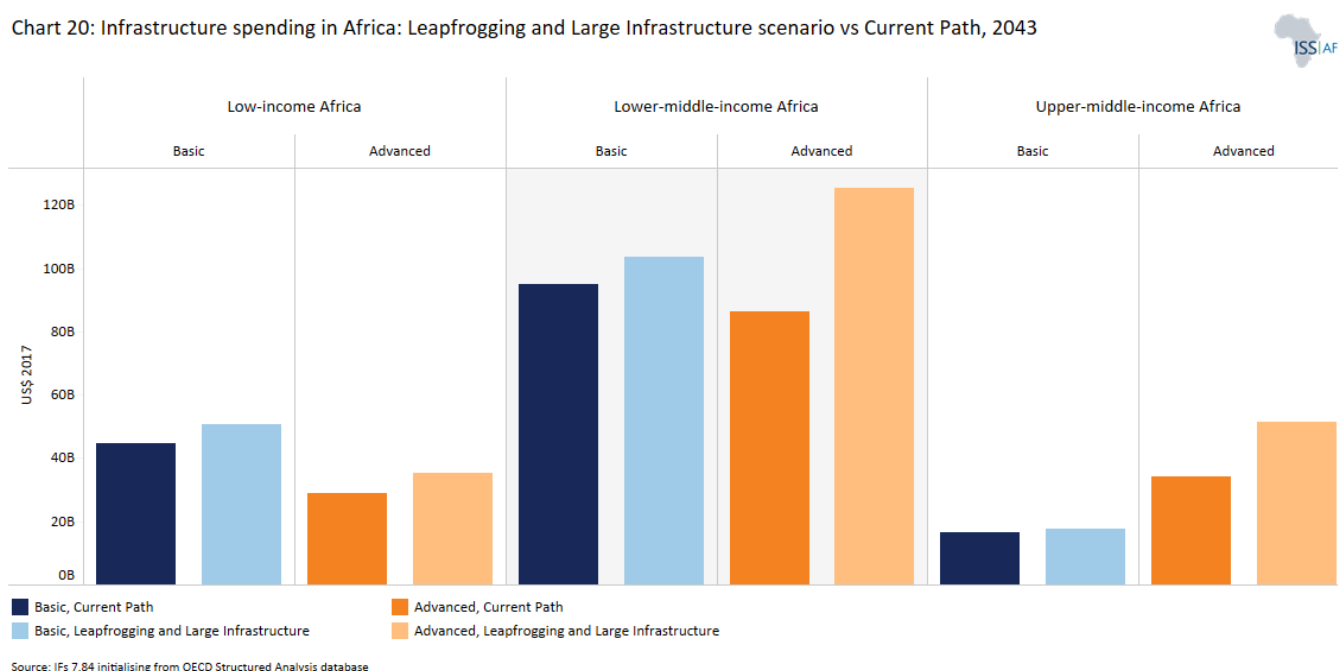
Chart 19: Infrastructure spending in Africa: Leapfrogging and Large Infrastructure scenario and Current Path, 2019-2043



In the Leapfrogging and Large Infrastructure scenario, Africa is expected to spend US\$77.9 billion (US\$ 2017) more on infrastructure by 2043 than on its Current Path—an increase of 25.5%. Cumulatively, the difference amounts to an additional spend of US\$813.5 billion from 2024 to 2043. Low-income Africa increases expenditure on infrastructure (basic plus advanced infrastructure) by 16.4% above the Current Path forecast in 2043, with 26.2% in lower-middle-income Africa and 36.1% in upper-middle-income Africa (see Chart 20). Investments in advanced (other) infrastructure increase relative

to the Current Path forecast in low-income Africa (21.5%) compared to low-middle-income (45.1%) and upper-middle-income Africa (50.5%) in 2043. This follows the logic that lower-income countries should focus on basic infrastructure (even at the expense of more prestigious projects), while higher-income countries should be looking to invest in more advanced infrastructure as their economies become more complex.

Chart 20: Infrastructure spending in Africa: Leapfrogging and Large Infrastructure scenario vs Current Path, 2043



A 25.5% increase in Africa's infrastructure spending relative to the Current Path forecast in 2043 will result in an increase in the share of paved roads (as a percent of total roads) by 6.5 percentage points. In sub-Saharan Africa, the share of paved roads will increase from 46.7% to 53.2% (see Chart 21). However, with such an increase in infrastructure spending, the continent's share of paved roads will remain significantly below the percentage share of paved roads in South Asia's forecast at 79.2% in 2043.

Chart 21: Share of paved roads in sub-Saharan Africa, Africa and income groups, Leapfrogging and Large Infrastructure scenario vs Current Path, 2043

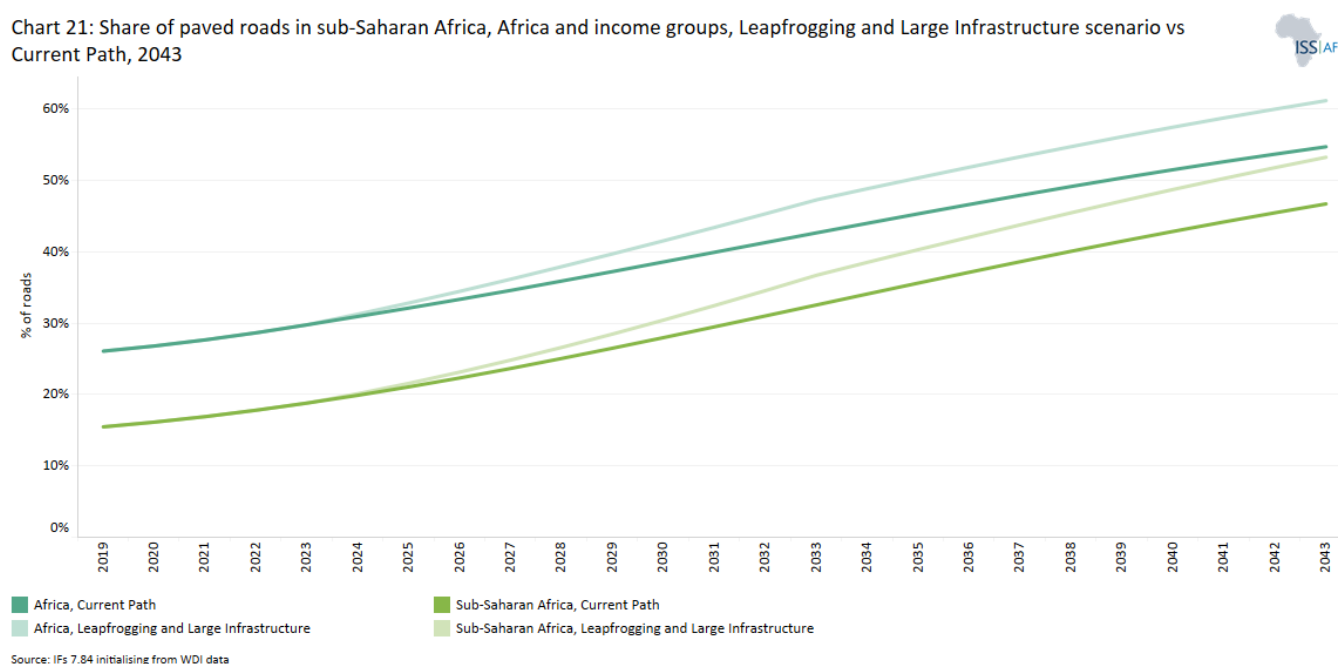


Chart 21 also disaggregates Africa's share of paved roads data by Africa income groups. In 2043, low-middle-income Africa

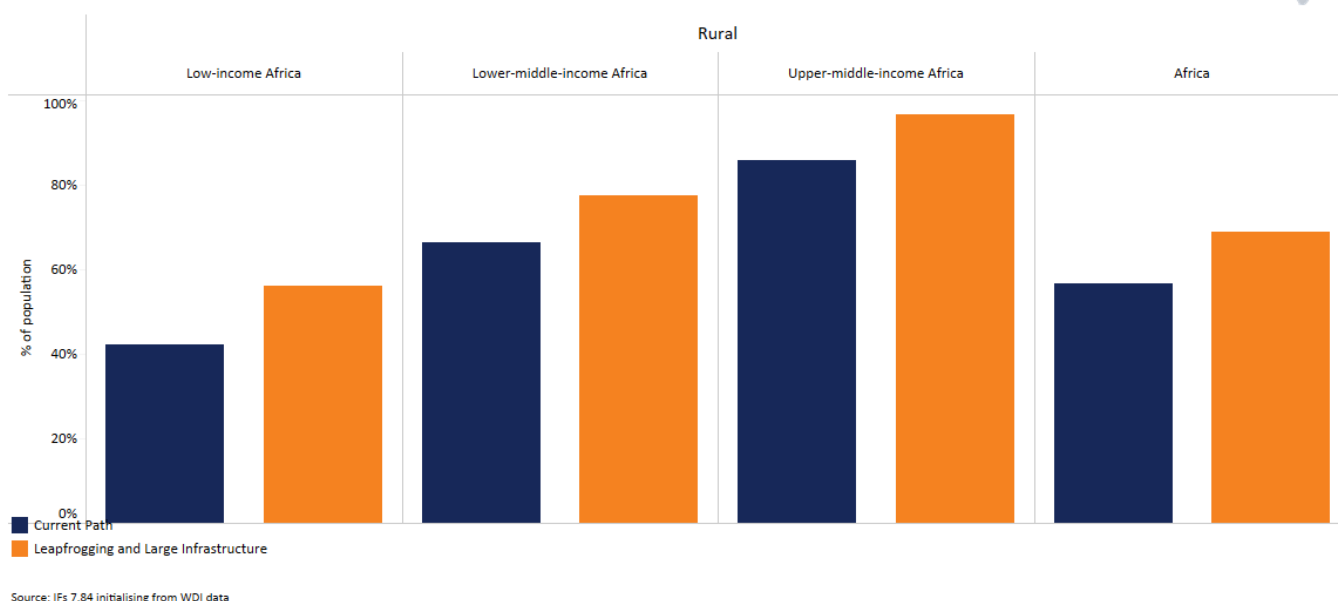
will have the largest share of paved roads relative to low-income and upper-middle-income Africa. The share of paved roads in low-middle-income Africa will increase from 61.9% in the Current Path forecast to 67.6% in the Leapfrogging and Large Infrastructure scenario, whereas the share for upper-middle-income Africa will increase by 6.3 percentage points to 66.8%. High-income Africa (Seychelles), which is not included in Chart 22, will have universal paved roads in 2043. Low-income countries in Africa will further decrease the overall proportion of paved roads in the global economy.

The percentage share patterns of paved roads in sub-Saharan Africa compared to North Africa are also shown in Chart 22. In the Leapfrogging and Large Infrastructure scenario, road networks in sub-Saharan Africa remain below average compared to other developing subregions. Consequently, the significant gap in road infrastructure provision between sub-Saharan Africa and other developing subregions persists. North Africa's share of paved roads will increase by 6.3 percentage points to 91.1% in the Leapfrogging and Large Infrastructure scenario in 2043.

The result of the Leapfrogging and Large Infrastructure scenario is an African economy with 179.9 million (or 8%) more people with access to electricity than expected in the Current Path forecast in 2043. Chart 22 presents the increase in access to electricity that will occur in urban and rural areas in Africa as a result of the Leapfrogging and Large Infrastructure scenario. The disparities between urban and rural access to electricity rates will continue to persist by 2043, however.

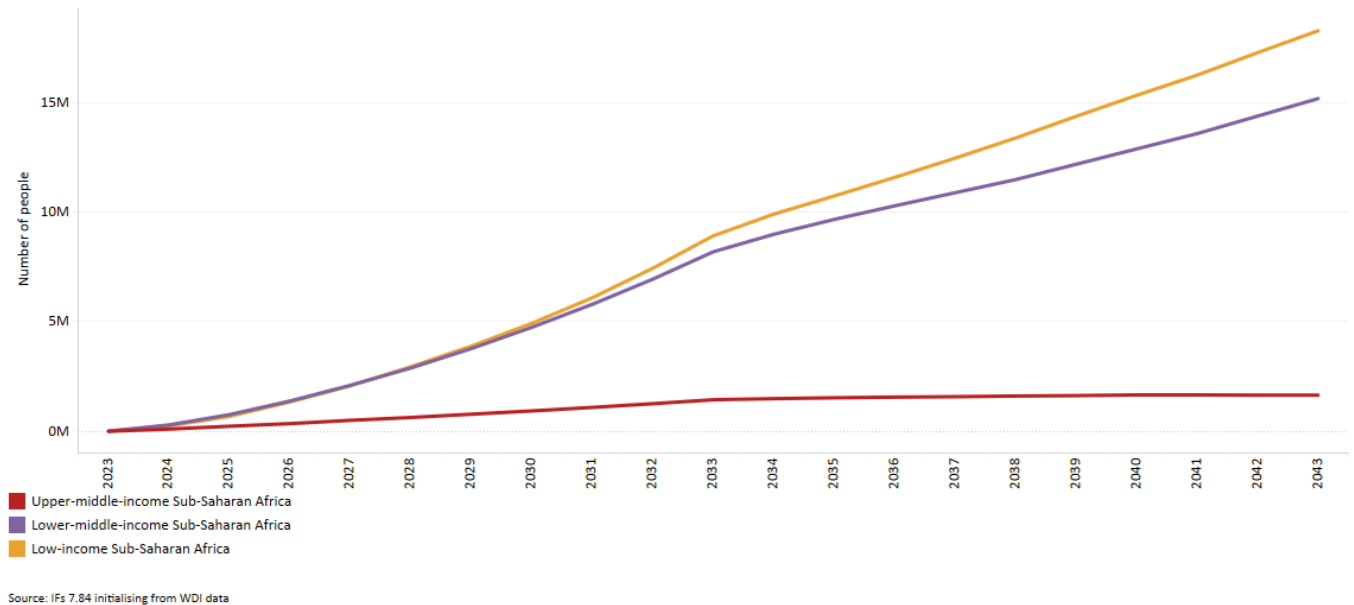
By 2043, the Leapfrogging and Large Infrastructure scenario projects a 3.2% increase in access to grid electricity in urban areas of Africa, benefiting an additional 37.7 million people. In the scenario, in rural areas there is a rise from the current 56.6% access to 68.9%, providing grid electricity to approximately 132.8 million more people in Africa by 2043.

Chart 22: Access to electricity in Africa's urban and rural area, Leapfrogging and Large Infrastructure scenario vs Current Path, 2043



Sub-Saharan Africa has the largest proportion of population without access to grid electricity in the world. In the Leapfrogging and Large Infrastructure scenario, 35.2 million more people in the region are expected to be connected to grid electricity in 2043 than in the Current Path forecast.

Chart 23: Additional electricity connections in sub-Saharan Africa in Leapfrogging and Large Infrastructure scenario relative to the Current Path, 2023- 2043

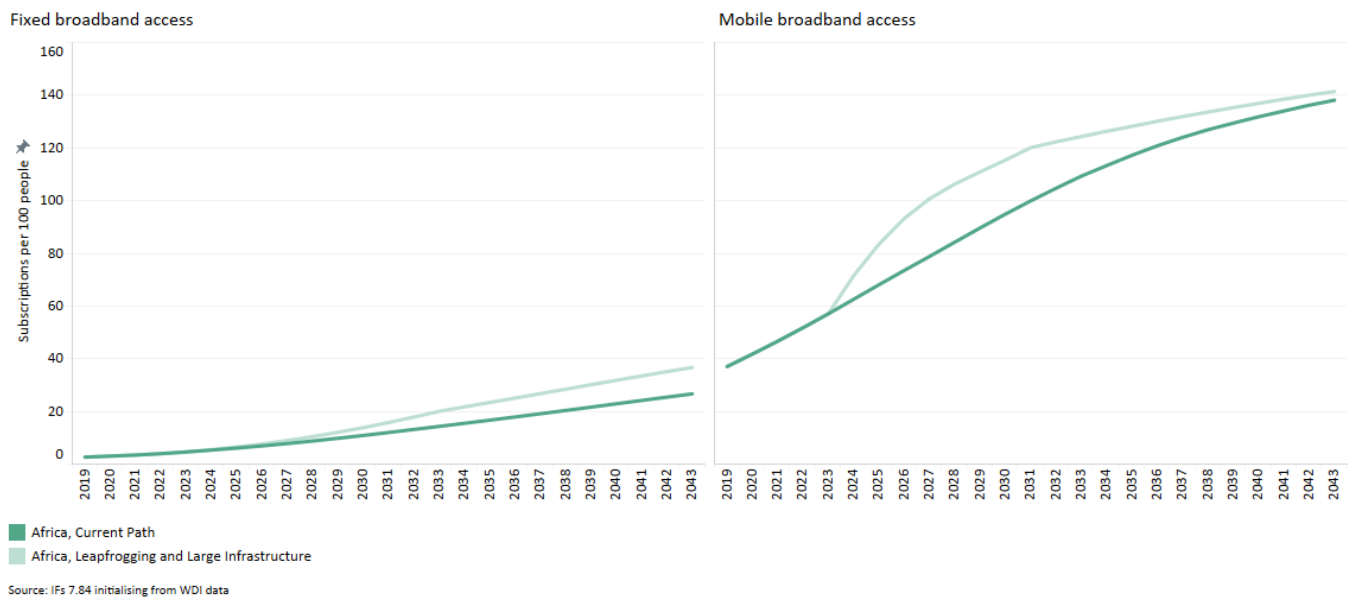


Low-income sub-Saharan African countries will have the largest additional number of people on the continent connected to grid electricity in the Leapfrogging and Large Infrastructure scenario relative to the Current Path forecast in 2043. An additional 18.1 million people will be connected to grid electricity in low-income sub-Saharan Africa relative to the Current Path forecast in 2043.

Chart 23 also displays how this pushes the percentage of the population with access to electricity in sub-Saharan Africa low-income countries from about 60% (Current Path forecast) to nearly 70% (Leapfrogging and Large Infrastructure scenario). Overall, sub-Saharan Africa is expected to have 78.2% of its population connected to grid electricity in the Leapfrogging and Large Infrastructure scenario compared to 69.1% in the Current Path forecast in 2043—an increase of 9.1%.

Chart 24 shows the impact of the Leapfrogging and Large Infrastructure scenario on fixed and mobile broadband infrastructure in Africa. In 2043, fixed broadband will remain below one subscription per person in 2043, whereas mobile broadband will increase from 1.38 subscriptions per person on the Current Path to 1.41 subscriptions per person in this scenario.

Chart 24: Access to fixed and mobile broadband in Africa, Leapfrogging and Large Infrastructure scenario vs Current Path, 2019 - 2043



Even Africa's low-income group is expected to have at least one mobile broadband subscription per person by 2043. Mobile broadband in low-income African countries will increase from 1.29 subscriptions per person to 1.34 subscriptions per person in 2043.

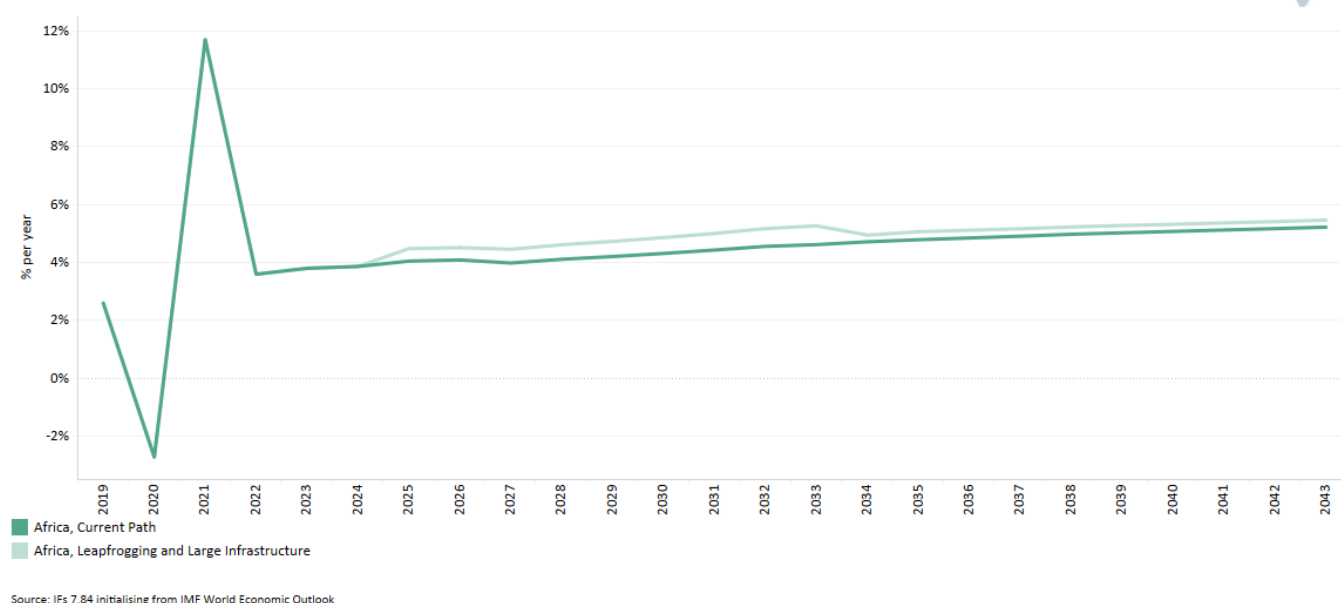
The Leapfrogging and Large Infrastructure scenario makes a significant dent in the World Bank's estimation of Africa's infrastructure shortfall. As economic growth rates accelerate, the influence of other scenarios becomes more significant. In the absence of such growth, these scenarios can undermine government spending priorities like education and health, resulting in undesirable outcomes. This demonstrates the importance of other measures to increase rates of economic growth, such as through more regional trade and through the intensification of agriculture examined in the [Combined Agenda 2063 scenario](#).

Impact of the Leapfrogging and Large Infrastructure scenario on growth, employment and poverty

Infrastructure investment is a primary factor of economic growth and rising income per capita over time. This is a lesson that has been well learned and applied in Asian countries over the last several decades, where large infrastructure investments have contributed to [high economic growth](#). However, government expenditure is believed to be consumptive and leads to crowding out of private investments if financed with public debt. Government borrowing or raising taxes could have negative effects on economic activity, which might offset the gains of public sector capital spending.

In the Leapfrogging and Large Infrastructure scenario, Africa's economy will grow by about 5.6% in 2043—a growth rate of around 0.2 percentage points above the Current Path forecast. Across the entire forecasting period (2024–2043), the average growth rate for the continent will just be approximately 0.4 percentage points above the Current Path forecast.

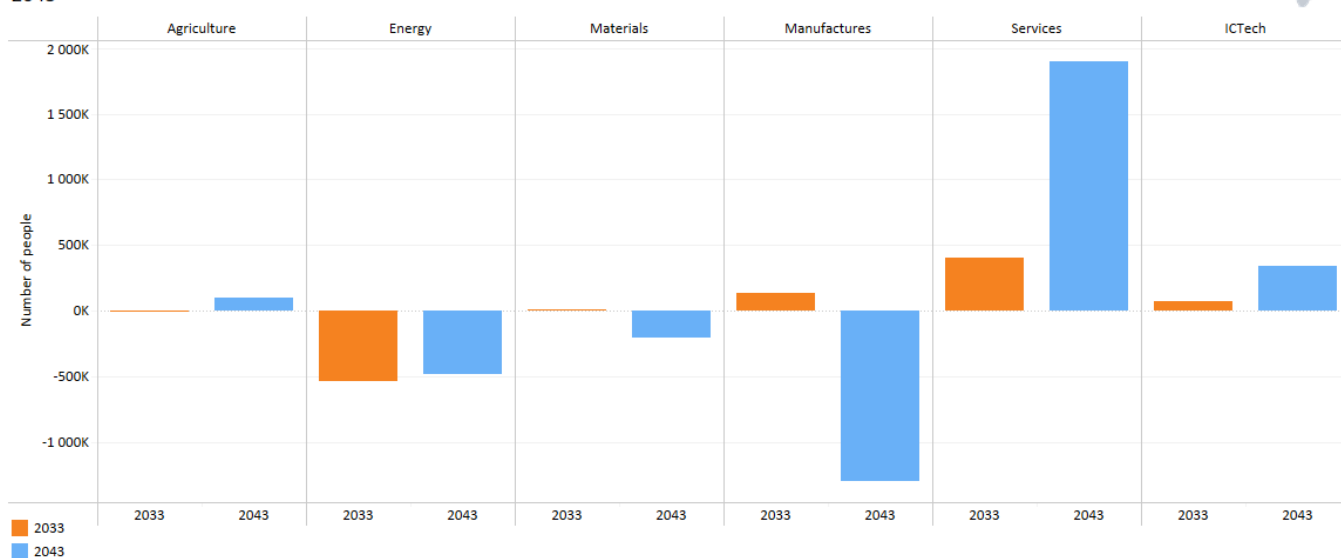
Chart 25: Growth rates in Leapfrogging and Large Infrastructure scenario vs Current Path forecast, 2019–2043



The result is that the African economy will be US\$600 billion (at market exchange rates), or 7.1%, larger in 2043 than expected in the Current Path forecast. The growth rate translates to GDP per capita (at purchasing power parity) of about US\$377 (or nearly 4.9%) higher than expected on the Current Path.

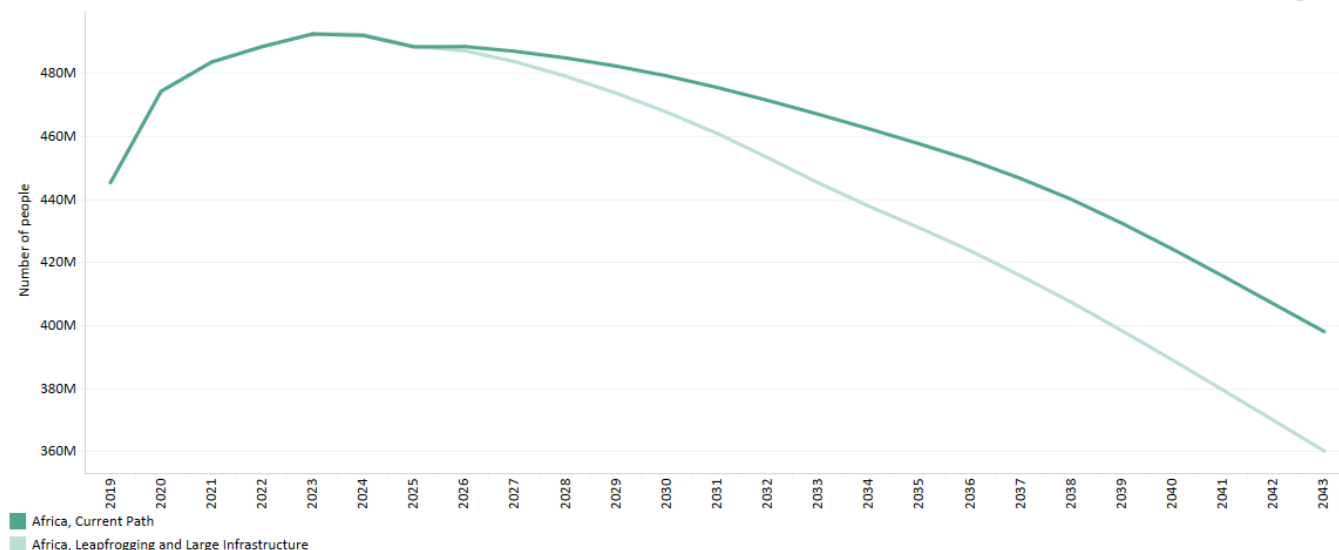
The Leapfrogging and Large Infrastructure scenario will create 310 000 more jobs relative to the Current Path forecast in 2043. The increase in jobs in the Leapfrogging and Large Infrastructure scenario is expected to come from the service sector, with a shift more towards the service economy (see Chart 26). In contrast, the size of the labour force in the energy, materials and manufacturing sectors is projected to decrease in 2043, with the manufacturing sector having the largest reduction. Labour employment gains from the Leapfrogging and Large Infrastructure scenario will be mainly driven by increases in Africa's low-middle-income countries (184 000 jobs) and low-income countries (117 000 jobs).

Chart 26: Labour employment from the Leapfrogging and Large Infrastructure scenario relative to the Current Path forecast, 2033 and 2043



Poverty reduction requires inclusive economic growth. The growth rate in the scenario, shown in Chart 27, translates into 37.8 million fewer people living in extreme poverty (using the benchmark of US\$1.90 per day) in 2043. About 50.8% of the people lifted out of extreme poverty will be from low-income Africa, 48.4% from low-middle-income Africa and just 0.8% from upper-middle-income Africa.

Chart 27: Extreme poverty in Leapfrogging and Large Infrastructure scenario vs Current Path forecast, 2019–2043



Source: IFS 7.84 initialising from UNPD Population Prospects estimates, WDI population data and PovcalNet World Bank data

Chart 27 also illustrates the reduction in extreme poverty at country level. Nigeria is projected to have the largest number of people (nearly 9.4 million) lifted out of extreme poverty relative to the Current Path forecast in 2043, followed by DR Congo (3.4 million) and Tanzania (2.6 million). Extreme poverty will worsen in Equatorial Guinea and the Republic of the Congo. About 100 more people will fall into the extreme poverty bracket in Equatorial Guinea and around 25 000 more people will experience extreme poverty in Congo compared to the Current Path forecast in 2043.

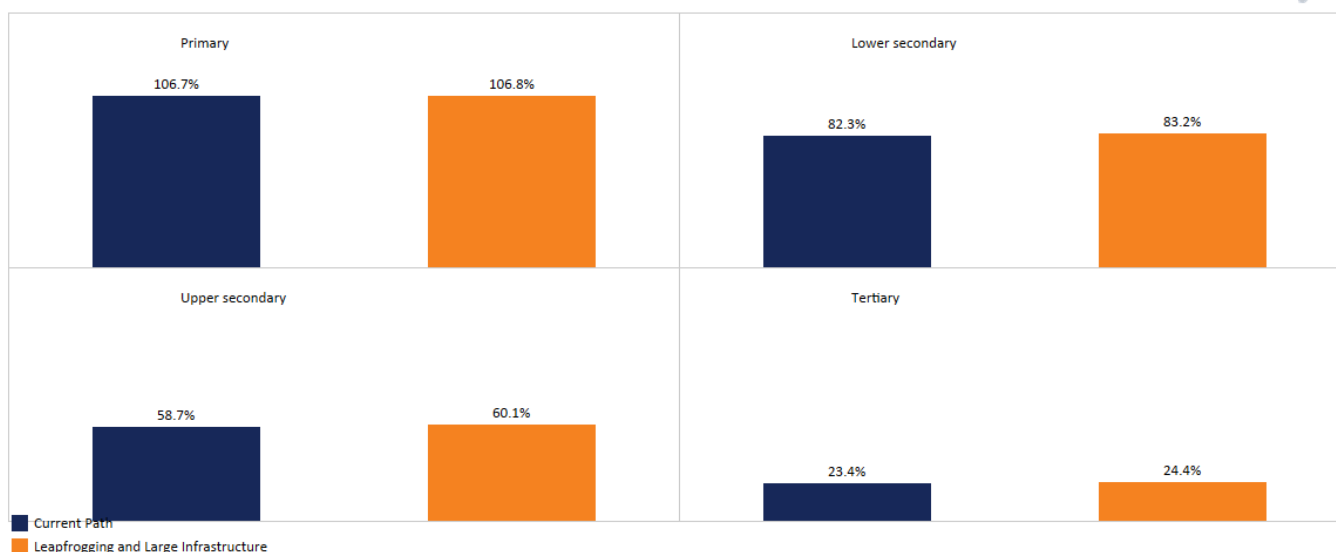
Impact of the Leapfrogging and Large Infrastructure scenario on human development

An increase in government spending on infrastructure has a significant impact on human capital development, in addition to the positive effects of increased infrastructure spending on growth and poverty reduction. For instance, increased access to ICT, clean water, roads and electricity may lead to improved education and strengthen the population's health.

The Leapfrogging and Large Infrastructure scenario shows that an increase in government infrastructure investment from 3.6% to 4.2% of GDP will improve education gross enrollment and completion rates. It also reduces infant mortality and fertility rates in Africa.

Chart 28 presents the increase in education enrollment and completion rates in Africa. An increase of 0.6% of GDP in government infrastructure investment will have a larger impact on upper secondary education in 2043. The upper secondary education enrollment rate will increase by 1.4 percentage points relative to the Current Path forecast, while the completion rate will increase by 1.6 percentage points in 2043.

Chart 28: Increase in education gross enrollment in Leapfrogging and Large Infrastructure scenario vs the Current Path, 2043



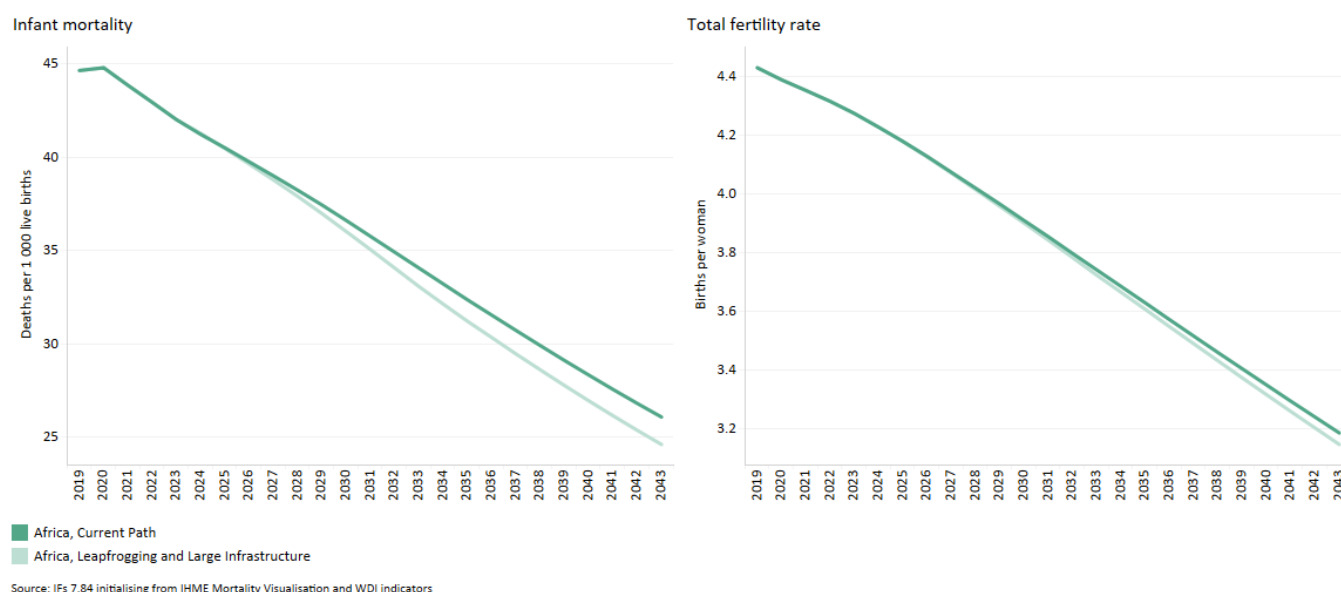
Source: IFS 7.84 initialising from UNESCO Institute for Statistics

The Leapfrogging and Large Infrastructure scenario has the least impact on the primary education enrollment rate and the tertiary education completion rate. The former will increase by just 0.1 percentage points, while the latter will increase by only 0.3 percentage points relative to the Current Path forecast in 2043.

Women (or parents) with less education tend to have a higher number of children compared to those who have more education. A woman's education level has a positive impact on the well-being and survival of her children as educated mothers often follow safer hygiene practices, which contribute to better health and increased chances of surviving children. In addition, improved access to infrastructure can allow women to dedicate more time to economic activities, which promotes greater economic growth.

This scenario will lead to a reduction in both infant mortality and fertility rates in 2043. An increase in infrastructure investment of 0.6% of GDP in Africa will result in a reduction of infant mortality by 24.6 deaths per 1 000 children born. This represents a 5.2% decrease (equivalent to 1.4 fewer deaths per 1 000 children born) compared to the Current Path forecast in 2043. The total fertility rate will drop by about 1.2% relative to the Current Path in 2043, from about 3.2 births per woman (Current Path forecast) to nearly 3.1 births per woman (scenario) (see Chart 29).

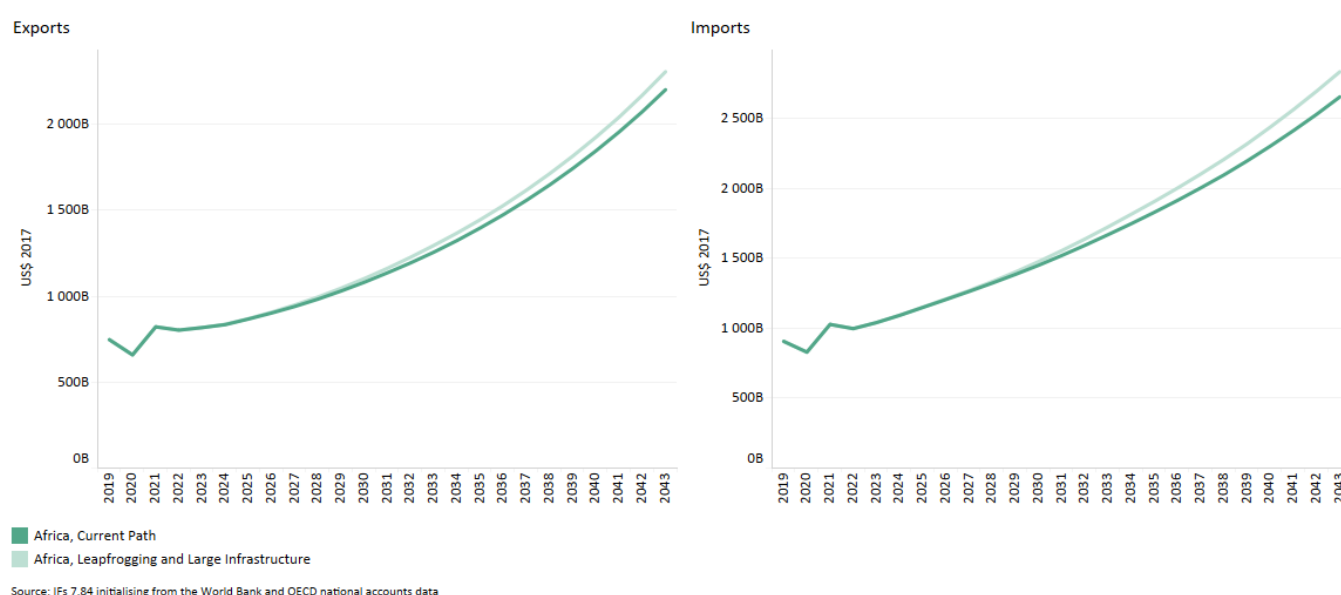
Chart 29: Reduction in Infant Mortality and fertility rate in Leapfrogging and Large Infrastructure scenario vs the Current Path, 2043



Impact of the Leapfrogging and Large Infrastructure scenario on trade

The Leapfrogging and Large Infrastructure scenario will boost trade (both exports and imports) in Africa. In 2043, total trade gains (exports plus imports) from this scenario will increase by US\$272.5 billion (or 5.6%) relative to the Current Path forecast. Africa's total exports will increase by US\$100.6 billion (or 4.6%), while total imports increase by US\$172 billion (or 6.5%) relative to the Current Path forecast, as shown in Chart 30.

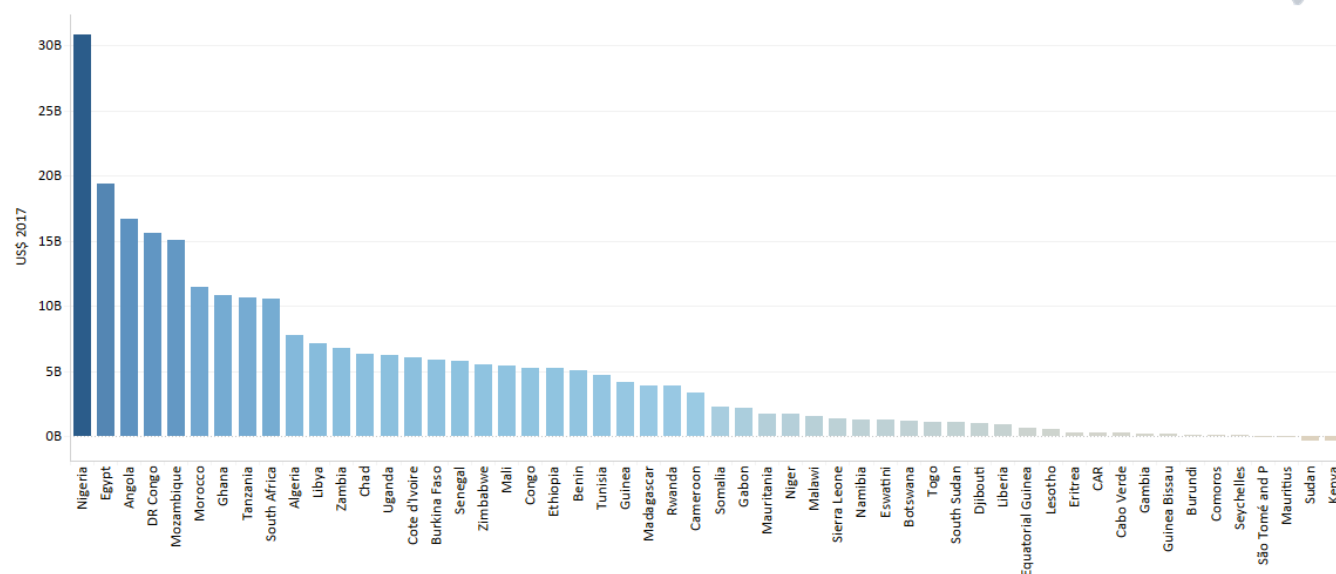
Chart 30: Africa exports and imports in Leapfrogging and Large Infrastructure scenario vs Current Path, 2019-2043



The majority of Africa's trade benefits, with regard to total trade value, are anticipated to come from Nigeria in the Leapfrogging and Large Infrastructure scenario (see Chart 31). Relative to the Current Path forecast, Nigeria's trade value

will increase by nearly US\$35.4 billion.

Chart 31: Gains in total trade in Leapfrogging and Large Infrastructure scenario relative to the Current Path, 2043



Source: IFs 7.84 initialising from the World Bank and OECD national accounts data

At the low end, however, the total trade values of Sudan and Kenya are expected to decrease relative to the Current Path. Sudan's total trade will decrease by US\$306.5 million and Kenya's total trade will fall by US\$723.5 million relative to the Current Path in 2043.

Endnotes

1. The allocation is to: paved roads; unpaved roads; electricity generation; rural and urban electricity access; irrigation; safe water for households; improved water access; household sanitation; improved sanitation; wastewater; telephones; mobile broadband and fixed broadband.

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About the authors

Dr Jakkie Cilliers is the ISS's founder and former executive director. He currently serves as chair of the ISS Board of Trustees, head of the African Futures and Innovation (AFI) programme at the Pretoria office of the Institute, and is an extraordinary professor at the University of Pretoria. His 2017 best-seller *Fate of the Nation* addresses South Africa's futures from political, economic and social perspectives. His three most recent books, *Africa First! Igniting a Growth Revolution* (March 2020), *The Future of Africa: Challenges and Opportunities* (April 2021), and *Africa Tomorrow: Pathways to Prosperity* (June 2022) take a rigorous look at the continent as a whole.

Dr Blessing Chipanda joined the African Futures and Innovation (AFI) programme in January 2023. Before joining the ISS he worked as an assistant lecturer/research assistant at the University of Pretoria, Department of Economics. He is particularly interested in tasks within the wider realm of international trade, development economics, public policy, monetary policy, and econometric modelling. Equally interested in economic and socio-economic activities that impact social welfare. Blessing has a PhD in economics from the University of Pretoria, South Africa.

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