

Africa's path to 2063: Choice in the face of great transformation



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ISBN-13: 978-1-7335865-0-4

How to cite this report:

Moyer, J.D., Bohl, D.K., Hanna, T., Mayaki, I. and Bwalya, M. (2018). Africa's path to 2063: Choice in the face of great transformation. Denver, CO and Midrand, Johannesburg: Frederick S. Pardee Center for International Futures and NEPAD Planning and Coordinating Agency.

This report was prepared primarily by the Frederick S. Pardee Center for International Futures at the Josef Korbel School of International Studies at the University of Denver jointly and in collaboration with the AUDA-NEPAD who also provided the critical study conceptualization and detailed guidance throughout the exercise. The authors acknowledge the technical review and input provided by AUDA-NEPAD staff, particularly, Lukovi Seke and Mohamed Abdisalam. This work also benefited from comments from Jakkie Cilliers, Barry B. Hughes, Abigail Muyeba, and Singumbe Muyeba.

The work for this research was primarily carried out by the authors, though additional people provided significant support. Kaylin McNeil provided significant support for the data provided in the analysis, Mickey Rafa supported analysis and graphics, Whitney Doran, Marianne Hughes, and Holden Fitzgerald supported literature reviews. In addition to this, a number of researchers have supported the broader development of the International Futures including Barry B. Hughes, José Solórzano, and Mohammod Irfan. In addition, the authors are grateful to the Korbel School and University of Denver for continued institutional support as well as Frederick S. Pardee for his sustained generosity. Report design and production by Camryn Dreyer and Lisa Lane Filholm.

TABLE OF CONTENTS

Table of Figures.....	ii
Table of Tables.....	iii
Glossary.....	iii
Foreword.....	iv
Executive Summary.....	1
1. Introduction.....	5
2. Methodology.....	7
3. The demographic transition	11
3.1 Fertility rates and the demographic transition.....	13
3.2 Age-sex structure of the population.....	14
3.2.1 Size of the youth population.....	15
3.2.2 Demographic dividend.....	15
3.2.3 Formal and informal employment.....	15
3.2.4 Population growth and urbanization.....	16
3.2.5 Challenges to the explosive growth in urban areas.....	19
4. Human development and inequality.....	21
4.1 Transforming education.....	24
4.2 Transforming health.....	25
4.3 Transforming incomes.....	26
4.4 Transforming infrastructure.....	27
4.4.1 Electricity:.....	27
4.4.2 Road network:.....	27
4.4.3 Rail network:.....	27
4.4.4 Water and sanitation.....	27
4.5 Transforming Inequality.....	28
5. Transforming technology.....	28
5.2 Information communication technology.....	31
5.3 Renewable energy.....	36
5.4 Agriculture and technology.....	37
5.5 Automation, local manufacturing and robotics.....	39
6. Natural systems.....	40
6.1 Natural resources.....	43
6.2 Climate change.....	43
6.3 Localized environmental costs.....	46
7. Governance	47
7.1 Security.....	47
7.2 Capacity.....	48
7.3 Inclusion.....	48
7.4 Institutions.....	48
7.5 Transforming geo-politics.....	49
7.6 How do changing patterns of governance impact transitions?.....	50
7.7 The future uncertainty.....	52
8. Conclusion.....	53
Appendix A: Scenario assumptions and justifications.....	55
Appendix B: Results by country.....	64

TABLE OF FIGURES

Figure 1: Regional share of global population, 1963-2063.....	12
Figure 2: Population of Africa across three framing scenarios, 1963-2063.....	12
Figure 3: <i>Current Path</i> projection for select demographic transformation variables, 2015 and 2038.....	14
Figure 4: Population by employment status, <i>Current Path</i> , 2015-2063.....	16
Figure 5: Urban population for Africa, Europe, China, and India, 1963-2063, using five year moving average.....	17
Figure 6: Urban population by African region 1963-2063.....	17
Figure 7: GDP per capita at purchasing power parity for the <i>Current Path</i> , positive demography, and negative demography, 1963-2063, using five year moving average.....	18
Figure 8: HDI in the <i>Current Path</i> , negative human development, and positive human development scenarios, using five year moving average.....	21
Figure 9: <i>Current Path</i> projection for select human development transformation variables, 2015 and 2038.....	23
Figure 10: Average years of education for people 15 years and older, 1963 to 2063, using five year moving average.....	24
Figure 11: Life expectancy, 1963-2063, using five year moving average.....	25
Figure 12: Populating living on less than \$3.10 per day 1990-2063, using five year moving average.....	26
Figure 13: GDP per capita across African countries and time, ranked.....	29
Figure 14: District GDP per capita projections for Uganda, 2010, 20, 30, and 40.....	29
Figure 15: Distributional income inequality across time and region.....	30
Figure 16: <i>Current Path</i> projection for select technology transformation variables, 2015, 2038 and 2063.....	33
Figure 17: ICT penetration for Africa for mobile phones, smart phones, fixed broadband, fixed telephones, 2000-2063, using five year moving average.....	34
Figure 18: Renewable energy as a share of energy production by region for Africa (across three scenarios, Negative Technology, <i>Current Path</i> , and Positive Technology) and Asia and Europe (both for the <i>Current Path</i> scenario), 1970-2063, using five year moving average.....	36
Figure 19: Average agricultural yields in Africa, history and forecast across three scenarios (negative technology, <i>Current Path</i> , positive technology), using five year moving average.....	38
Figure 20: <i>Current Path</i> projection for select natural system transformation variables, 2015 and 2063.....	42
Figure 21: Temperature change across <i>Current Path</i> , Negative Environment, and Positive Environment scenarios, 2015-2063.....	44
Figure 22: Impact of climate change on agricultural yield change by region, 2015-2063.....	44
Figure 23: Governance transitions in Africa: security, capacity and inclusion, 2018, 2038, and 2063.....	47
Figure 24: Relative power of China, India, US, using five year moving average.....	49
Figure 25: Foreign influence in Africa, using five year moving average.....	50
Figure 26: Human development transition and governance, 2015-2063.....	51
Figure 27: Governance impact on natural system trends.....	51
Figure 28: All scenario results for GDP per capita at PPP (2011\$) with <i>Current Path</i> highlighted, 1963-2063, US, using five year moving average.....	52

TABLE OF TABLES

Table 1: Description of four transformations.....	1
Table 2: Challenges and opportunities by decade.....	3
Table 3: Current Path assumptions for Africa in International Futures.....	8
Table 4: Framing scenario assumptions.....	9
Table 5: Governance scenario assumptions.....	10
Table 6: Evidence, opportunities, and challenges associated with the demographic transformation.....	13
Table 7: Evidence, opportunities, and challenges associated with the human development transformation.....	22
Table 8: Evidence, opportunities, and challenges associated with the technology transformation.	32
Table 9: Evidence, opportunities, and challenges associated with the natural system transformation.....	41
Table 10: Positive and negative sensitivity scenarios for GDP per capita at PPP (in thousands of 2011\$) for 2018, 2038, and 2063.....	53
Table 11: The impact of positive and negative governance on development for GDP per capita at PPP (in thousands of 2011\$) for 2018, 2038, and 2063.....	54

GLOSSARY

- **Agenda 2063:** A strategic framework for the socio-economic transformation of the continent over the next 50 years.
- **Current Path:** A central reference scenario created by the Pardee Center within the International Futures model framework that represents a general continuation of development process in government, business, and development. It is a most-likely development trajectory for the continent.
- **Demographic dividend:** The potential for economic growth resulting from a demographic structure in which the working-age population (aged from 15 to 64) is larger than the dependent populations of children (younger than 15) and elderly (65 and older).
- **Gini coefficient:** A statistical measure capturing the equality of distribution in an outcome indicator. Often this is used to measure income inequality by assessing the distribution of GDP per capita in a country.
- **Gross domestic product (GDP):** The total value of goods and services produced in a country measured at market exchange rates. GDP can be measured at market exchange rates (MER) or at purchasing power parity (PPP).
- **Human Development Index (HDI):** A measure developed by the United Nations Development Programme that measures levels of human development across three dimensions: education, health, economics.
- **Information communication technology (ICT):** Technologies such as mobile phones, smart phones, and fixed line broadband.
- **International Energy Agency (IEA):** An international organization dedicated to research and advocacy to promote reliable, affordable, and clean energy.
- **International Futures (IFs):** The integrated quantitative modeling framework used in this report, available for free at pardee.du.edu.
- **Integrated soil fertility management (ISFM):** Soil management methodology that incorporates locally available resources to improve productivity.
- **Organisation for economic cooperation and development (OECD):** is an intergovernmental economic organization with membership made up mostly of Western states with high GDP per capita.
- **Scenario:** Forecast scenarios are alternative futures modeled within the International Futures platform. Scenarios can be used to frame uncertainty and help policy-makers think about how the world is developing.
- **Water, sanitation, and hygiene (WASH):** Water, sanitation, and hygiene are key measures of human development and are the focus of sustainable development goal 6.
- **Youth bulge:** Refers to the share of the population aged from 15 to 29 and thought to be a factor which may contribute to social unrest and/or political instability.

FOREWORD

While it may sound like stating the obvious, it is important to note that one factor we can be certain about is that data-information, analysis and strategic planning will increasingly be cardinal in Africa's successful development formula. The factors and trends that need to be taken into account in determining development policy and investment choices are not just increasing in number, but are characteristically dynamic and highly inter-dependent (across sectors, disciplines and geographical spaces). Therefore, it is obvious that strengthening analysis and strategic planning capacity in Africa's national and regional systems is essential and should not be taken for granted. It requires deliberate effort to develop and nurture as an integral part of catalysing development planning and implementation.

In the context of the AUDA-NEPAD—specifically fulfilling the role of catalysing the implementation and delivery of transformational economic growth and development results—this study on local and global transformations is an important contribution to Africa's development efforts. The transitions identified here are now at a stage where they have picked up their own momentum and will continue at a pace and direction that for the foreseeable future that maybe outside human control in the short-term. Their momentum will directly impact economic growth and development trajectories—either as “energy” that could be leveraged to speed-up economic growth and development trajectories (i.e. positive energy) or hinder economic growth and development trajectories (i.e. negative energy).

Within the context of Africa, in general, and Agenda 2063 (also linking to the Sustainable Development Goals of the UN) specifically, this study broadly identifies four of these transitions. The AUDA-NEPAD, working with the Frederick S. Pardee Centre for International Futures, have, in this study, brought out evidence and insights on the “pace and direction” of these transitions and what implications they have on the choices Africa (collectively and as individual member states) make in determining their economic growth and development pathways. This study brings out easy to digest and use analytical information that could feed directly into integrated development planning in pursuit of Agenda 2063 goals and targets.

The forecasting element in the study – using the International Futures model – aims to support member states into policy and investment choices which, while responding to “immediate needs” and also directly address the normally structural “medium to long-term needs”. For a 50-year development plan, this report also brings attention and planning capability to determine inter-generational timeframes and related actions that would lead to not just to economic growth, but also to sustainable development – in the context of human well-being.

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EXECUTIVE SUMMARY

The fifty years after the end of colonialism were marked by development challenges and opportunities, with human capabilities improving, economies expanding, and governance institutions consolidating in some cases and unraveling in others. The next fifty years of development—the push from now to 2063—will be characterized by similarly great, or even more dramatic change. This report tracks four of these transformations already taking place at the continental level: demography, human development and inequality, technology, and the environment. The methodology used in this report takes a long-term, macro, and integrated approach to thinking about the future of the continent.

The unfolding demographic transition is well understood, though perhaps not effectively planned for. Africa will grow from 1.25 billion people today to three billion people by 2063, from a period in which ten percent of global population was African in 1963 to one where 30 percent is African by 2063. This, coupled with economic growth and infrastructure devel-

opment, will lead to a massive increase in urban populations, which are projected to expand 30-fold from 1963-2063.

Human development is transforming, leading to changing values, increased consuming power, and an amplified African voice in global affairs. Investments in education, health, infrastructure, and systems of economic production will continue to improve the average years of education (growing faster than population growth), extensions in life expectancy, and improvements in GDP per capita.

These transformations will be profound, with African urban centers characterized by innovation, technology, and vibrant civil societies. However, without significant policy changes, this growth will lead to increases in inequality. Rich cities will flourish while rural areas lag behind and urban slums grow; the middle class will grow along with those living in extreme poverty. Inequality will become an increasingly acute problem across all levels of society and could drive social instability and cleavages.

Table 1: Description of four transformations.

Demographic Transformation	With high fertility rates and lowered burden of communicable disease, Africa's population is set to grow dramatically to 2063. This will create some opportunities, but many challenges as urban growth strains budget and planning processes and growing populations require economic engagement.
Human Development and Inequality Transformation	General measures of human development in Africa have improved since 1990: education access has enhanced, health has strengthened, incomes have grown, and infrastructure has expanded. These trends will continue, though issues associated with growing inequality will potentially drive instability.
Technology Transformation	Continued expansion of information communication technologies will further connect people while renewable energy production will expand, leading to improvements in well-being. Other technologies (artificial intelligence, robotics, etc.) have the ability to disrupt development and impede industrialization.
Natural System Transformation	Climate change will negatively impact African development across multiple dimensions, though the extent of this impact by 2063 remains unclear. Local environmental crises will emerge as the pace of development and urbanization lead to increasing informal settlements that pollute air and water.

Technological transformations will broadly shape African society over the next four-plus decades as well. High levels of penetration of information communication technology characterizes African economies and society. This will deepen as still more people connect to the internet at increasingly greater speeds. Other transitions are also certain, most notably an increase in renewable energy technologies, increasing rural access to electricity far from traditional grid infrastructures as well as producing an increasing large share of total energy consumed on the continent.

Other technological transformations are unfolding but with less certainty. The rise of robotics, automation, sensing technology and artificial intelligence has already significantly displaced labor in the West while contributing to lower the cost of consumer goods. As these technologies become more ubiquitous, African industrialization may occur by only absorbing a small share of the available workforce. Technologically driven growth in agricultural yields—a crucial driver of improved food security—is also uncertain, and transformation in this space would greatly enhance human development.

Natural system depletion will lead to acute environmental stress and global climate change will impact African development with increasing force. But the full impact of these transformations is uncertain. It is true that climate change will increasingly harm agricultural production, but it is unclear whether it will lead to broadly catastrophic environmental change by 2063. While development, demographic growth, and urbanization will lead to increased acute environmental strains, it is difficult to identify when tipping points will be reached. While there is uncertainty about the future impact of natural systems on human development, there is no positive alternative scenario: the future of the environment in Africa should be understood on a scale from strained to disastrous.

Each transformation will present challenges and

opportunities. Table 2 reflects the scale of both challenge and opportunity by future decade by issue area according to the Current Path of the International Futures model.

Most of this report discusses pending transitions, how those transitions will impact African development, and the range of uncertainty associated with each. Here we frame the expected continuity in development patterns from the past to the present to the future. The report is organized starting with the best understood transition and moving to the least well understood transition (from demography to natural systems).

While these transformations are occurring, the future is not deterministic and humans will make choices that put us on better or worse footing. To better understand the impact of decision-making on development outcomes we have introduced a fifth potential transformation, one that will need to be pursued if Africa is to achieve its brightest future.

The fifth transformation that we discuss is in the area of governance (national, regional, and continental). Improved governance security, capacity, and inclusion is a choice and is distinct from the four transitions discussed above. And it is an extremely powerful tool to improve development outcomes broadly. Comparing scenarios in which transformations in governance are successful to those in which governance does not improve, by 2063 the GDP per capita of the continent varies widely, from a low of \$4,900 (near 2018 levels in South Asia) to a high of \$31,100 (near 2018 levels in Europe).

The Africa of 2063 will be made by her people. And choices over the next decade will determine if African human development soars or stagnates. While those choices are crucial, they will occur within the context and structure of the unfolding transitions identified in this report.

EXECUTIVE SUMMARY



Table 2: Challenges and opportunities in Africa by decade.

	2020s	2030s	2040s	2050s	2060s
Urban Population Growth	Red	Red	Red	Red	Red
Youthful Population	Red	Red	Yellow	Yellow	Yellow
Demographic Dividend	Light Green	Light Green	Green	Green	Green
Improved Education	Light Green	Light Green	Light Green	Light Green	Light Green
Improved Health	Light Green	Light Green	Light Green	Light Green	Light Green
Middle Class Growth	Light Green	Light Green	Green	Green	Green
Improved Infrastructure	Light Green	Light Green	Light Green	Light Green	Light Green
Growth in Inequality	Yellow	Yellow	Yellow	Yellow	Yellow
Poverty	Red	Red	Red	Red	Red
Growth in Inequality	Light Green	Light Green	Light Green	Light Green	Light Green
Renewable Energy Growth	Light Green	Light Green	Light Green	Green	Green
Growth in Automation and Artificial Intelligence	Yellow	Yellow	Yellow	Red	Red
Climate Change	Yellow	Yellow	Yellow	Red	Red
Urban Environmental Challenges	Blue-Gray	Blue-Gray	Purple	Purple	Purple
Biodiversity Loss	Yellow	Yellow	Yellow	Red	Red
Water Stress	Blue-Gray	Blue-Gray	Blue-Gray	Blue-Gray	Blue-Gray

3

Legend:	
Red	Significant Continental Challenge
Yellow	Moderate Continental Challenge
Light Green	Moderate Continental Opportunity
Green	Significant Continental Opportunity
Blue-Gray	Moderate Local Challenges
Purple	Significant Local Challenges



INTRODUCTION

Dealing with uncertainty is an inherent part of planning. At times, this uncertainty can be broad and lead to decisions that are forced to mitigate risk. At other times, decision-making is more focused and deals with problems that are more predictable. This report focuses on four predictable transitions that should be discussed, planned for, and leveraged to increase future development opportunities.

While we cannot fundamentally know anything about the future, we do use a variety of tools in our planning processes to better anticipate what is to come. We are often focused on patterns of continuity in our planning processes by identifying how the future will be similar to the past (simple extrapolation). At other points in time we are more focused on understanding how individual systems change as they unfold across time (issue-area modeling). We infrequently represent development trends broadly across issue areas in a systematic way (integrated systems analysis). This report focuses on this third methodology for understanding the future.

This report draws upon four decades of research developing long-term quantitative models to better think about and understand the future of the international system. It relies on macro-level quantitative models integrated within one software platform called International Futures (IFs).¹ The IFs tool represents transitions within and across a wide range of systems, including agriculture, education, economic, energy, environmental, health, governance, infrastructure, international politics, and technology.²

As with all regions, Africa has progressed through multiple transitions that have shaped patterns of development. During colonialism, African leaders fought against foreign rule and for self-determination and autonomy. The immediate post-colonial space created new opportunities for self-governing, but also brought about new challenges. Africa developed from a relatively low base of human capabilities in this post-colo-

nial space with high levels of communicable disease, fertility rates, and low levels of access to education, health, infrastructure and poor governance capacity.

As the Cold War ended and the geopolitical context of African development changed, leaders struggled against debt accumulation and structural adjustment programs which, in some cases, exacerbated poor development dynamics. This high debt burden was coupled with a rising health epidemic in many places that exacerbated the burden of communicable disease related deaths including HIV/AIDS. But the post-Cold War space also provided leap-frog transformations in technology that started to connect more people, create new opportunities, and support development of capacity in areas of education, health, infrastructure, and governance.

The information communication technology (ICT) revolution has connected millions of Africans, created some of Africa's billionaires and led to increased flows of capital (e.g., via mobile banking), while on the other hand creating new challenges for governments regarding the flow of information and social stability. More recently Africa has experienced other significant shifts in geopolitics, with the rise of China creating opportunities for investment and growth challenges as well.

With historical developments in mind, this report turns to future transformations that are characterized by certainty (demographics, increased human development and inequality, the diffusion of technologies, and environmental system transformation). This report explores how these transformations are likely to impact development in Africa – specifically within the context of Agenda 2063 aspirations and goals - both as opportunities and as challenges.

The transitions analyzed in these pages are not deterministic and uncertainty remains a key and defining characteristic of development to 2063. The demographic transition is the most certain and the

most predictable. The human development transition is broadly certain (when measured by indicators like life expectancy and average years of adult education) but the transition related to inequality is less well understood (though still important and unfolding). Transitions related to technology have aspects that will unfold with high certainty (the continued penetration of information communication technology and the spread of renewable energy technology) but other aspects that are less certain (growth in agricultural yields as well as the impact of robotics and artificial intelligence on demand for labor). Natural systems are deteriorating, but the magnitude of impact on human and social development remains unclear (though

clearly negative, with broad spill-over effects across issue areas).

We conclude by discussing the central role of institutions and governance in shaping Africa's ability to leverage opportunities and achieve resilience in the face of disruptive change. As we show at the end of this report, the impact of improved governance can have a sustained and positive impact on African development, will mitigate negative trends, and can mitigate uncertainty. It is a choice that African citizens, civil society, non-state actors, and political leaders will make and it represents the most important driver of the future Africans desire.



METHODOLOGY

Many methodologies support strategic planning. Some are strictly quantitative using tools to predict outcomes. Other methods are qualitative and emphasize scenario framing activities and interactive discussions. This report uses a mixed methodology to 1) identify transformations in Africa, 2) model these transformations into the future, 3) evaluate modeling findings through extant literature, and 4) create alternative scenarios to better understand the role of uncertainty, highlighting policy choices meant to attain Agenda 2063 goals and targets.

Our primary concern is with systemic transformations or transitions, two terms that we use interchangeably. A transformation or transition measures a change in the character or state of a system—from the perspective of development trends, they represent a shift in the magnitude or scope of impact of a variable that is central to the development process. Transformations can have positive or negative implications for development and they may be specific to Africa or they may be a component of broader global change.

To identify significant transformations, we start with trends analysis in system-level variables with one of the following characteristics. First, we are interested in trends that show a significant change in growth rates (significant growth or decline or change in the direction of growth). For example, trends in the diffusion of mobile phone access, prevalence of HIV/AIDS, or foreign debt accumulation each exhibited notable changes in the temporal growth patterns historically. Second, we are interested in transitions that cross a particular threshold important for broader development processes. For example, countries with GDP per capita over \$10,000 tend to not have disruptive onsets of large-scale political violence and crossing this threshold matters.

The framework is then applied to the Current Path

scenario from the IFs model to identify persistent and important transformations likely to occur in Africa to 2063 (more on the Current Path below). IFs is a large systems framework that allows users to analyze variables in their interaction for 186 countries. The system has large historical databases and integrated forecasts for all countries in Africa covering the following systems: agricultural, demographics, economic, energy, environmental, governance, health, infrastructure, international politics, and technology.

The IFs tool covers 54 of the 55 countries in Africa (representing 99.9 percent of the total population), and analysis of the Saharawi Arab Democratic Republic is not included in this report. While development across African countries and regions is varied, this report is focused on continental change (this includes assessing continental change in other diverse regions outside of Africa). We include a small sample of the cross-country variation in development trends in maps highlighting country level projections for key indicators across the four main transitions and additional country-level variation when exploring unfolding patterns of inequality (including at the district level in Uganda).

The *Current Path* is a “most likely” development scenario integrated across each of the issue areas covered in IFs. It captures development patterns in a world where there is no significant change in government policy (stopping spending on the military, for example), significant disruptive event (a continental pandemic, or a third world war, for example), or transformational technology shift (very inexpensive energy, for example). The Current Path scenario is not a linear extrapolation and includes much non-linear behavior. While dynamic, it also represents significant continuity across government policy choices and broader incentives. This scenario is our best attempt to estimate the

	2018	2038	2063
Agriculture Demand growth rate	3.1%	2.3%	1.3%
Energy demand growth rate	4%	4.3%	2.8%
Export growth rate	2.9%	6%	4.5%
Foreign aid growth rate	3.3%	1.7%	1.6%
GDP (MER) growth rate	3.3%	5.9%	4.1%
GDP per capita (at PPP) growth rate	0.8%	2.1%	2.3%
Investment growth rate	4.7%	5.8%	3.8%
Population growth rate	2.5%	1.9%	1.1%
Poverty percent (\$1.90 per day)	36%	23.4%	7.9%

Table 3: Current Path assumptions for Africa in International Futures.

future development of the continent across each of these issue areas studied here. This scenario has been used previously in analysis of African development.³ See Table 3 for some Current Path model assumptions and outputs.

Using the methodology presented above, we identified four transformations to the year 2063: demography, human development and inequality, technology, and the environment. After identifying trends and transformations, we next tested their durability. We did this by creating “framing” scenarios. For ex-

ample, if we alter the underlying drivers of a transition, does that significantly impact the future of that transition? We find some transformations to be very durable while other transformations are less certain or contain aspects of uncertainty. We organize the presentation of the transitions in this report by our current understanding of their durability and their impact on the world.

See Table 4 for general assumptions associated with each framing scenario and Appendix A for more detailed assumptions and justifications.

Table 4: Framing scenario assumptions.

Framing Scenario Assumptions	
Current Path	A continuation of policy choices and incentives across the integrated systems in the IFs platform for 54 countries in Africa.
Positive Demography	Reduced fertility and mortality from communicable disease, particularly AIDS, diarrheal, malaria, and tuberculosis relative to the Current Path.
Negative Demography	Increased fertility and mortality from communicable disease, particularly AIDS, diarrheal, malaria, and tuberculosis relative to the Current Path.
Positive Human Development	Increased spending on health, infrastructure, and education as well as a reduction in the domestic Gini coefficient for income inequality relative to the Current Path.
Negative Human Development	Decreased spending on health, infrastructure, and education as well as a reduction in the domestic Gini coefficient for income inequality relative to the Current Path.
Positive Technology	Increase in agricultural yields, aquaculture production, global economic productivity, return on investment to renewable energy production, and a transition through automation and robotics that does not lead to significant loss of jobs relative to the Current Path.
Negative Technology	Decrease in agricultural yields, aquaculture production, global economic productivity, return on investment to renewable energy production, and a transition through automation and robotics that leads to significant loss of jobs relative to the Current Path.
Positive Environment	Increased agricultural yields, returns on investment in renewable energy, improved crop fertilization with increased CO ₂ in the atmosphere, lower levels of ambient air pollution, less water stress, increased crop-land while protecting forests, and a global carbon tax relative to the Current Path.
Negative Environment	Decreased agricultural yields, returns on investment in renewable energy, improved crop fertilization with increased CO ₂ in the atmosphere, lower levels of ambient air pollution, less water stress, increased crop-land while protecting forests, and a global carbon tax relative to the Current Path.

A second type of scenario was created to explore broader uncertainties in areas with less durable development patterns. For example, we do not find that a durable transformation is underway in the area of governance in Africa. We created two alternative scenarios (see Table 5) to explore how changing governance characteristics will impact the durable transitions iden-

tified above as well as other development outcomes. While the four transformations identified in this report have structural and path dependent characteristics, governance is a space where transformations can be leveraged to produce more sustainable and inclusive human development.

Table 5: Governance scenario assumptions.

Governance Scenario Assumptions	
Positive Governance	Increased government transparency, government effectiveness, improved labor participation, government revenue, gender empowerment and inclusion, and foreign aid relative to the Current Path.
Negative Governance	Decreased government transparency, government effectiveness, improved labor participation, government revenue, gender empowerment and inclusion, and foreign aid relative to the Current Path.

This report frequently reports on three dates: 2018, 2038, and 2063. The data reported in 2018 are primarily estimates taken from the IFs tool built from a database of over 4,000 series from public sources. The longer time horizon used in this report is driven by the

African Union Agenda 2063. The medium time horizon—2038—is the mid-point between 2063 and the year Agenda 2063 was adopted, 2013. When comparing Africa to other regions, United Nations groupings are used.



THE DEMOGRAPHIC TRANSITION

In 1963 the population of Africa was around 300 million. In just over 50 years, that number has quadrupled to roughly 1.3 billion. By 2063 Africa's population is expected to more than double again to nearly three billion. Between 2018 and 2063, 37 percent of the births worldwide will occur in Africa. The number of children in Africa under five was just over 50 million in 1963 and is projected to grow to nearly 250 million by 2040.

Between 1963 and 2063 more than half of African Union member states will increase their population ten-fold. Between 2018 and 2063 Eastern and Western Africa will add over 500 million people each. This population transformation will echo around the world: ten percent of the world was African in 1963 and 30 percent will be by 2063 (Figure 1).

Africa's population is projected to grow at a similar rate between 2018 and 2063 as the population of Asia grew between 1963 and 2018. Asia increased its population by 2.5 times in that period (growing by 2.7

billion from a base of 1.8 billion). Africa's population is expected to increase 2.2 times from now to 2063 in the Current Path, an increase of 1.6 billion people from a base of 1.3 billion.

This transformation is occurring with high confidence. To test this, we created two demographic scenarios (see the Methodology section). In Positive Demography, rates of both fertility and mortality fall more quickly than expected. Negative Demography, on the other hand, simulates persistently higher fertility rates and a slower reduction in deaths due to communicable diseases. Across each of these scenarios the future population projection changes little through 2040. After that point the variation across scenarios becomes more pronounced. Even in the Positive Demography scenario, where fertility rates reduce more rapidly than in the Current Path, the population of Africa grows by one billion people between 2018 and 2063. See the Appendix A for scenario assumptions.

Figure 1: Regional share of global population, 1963-2063.

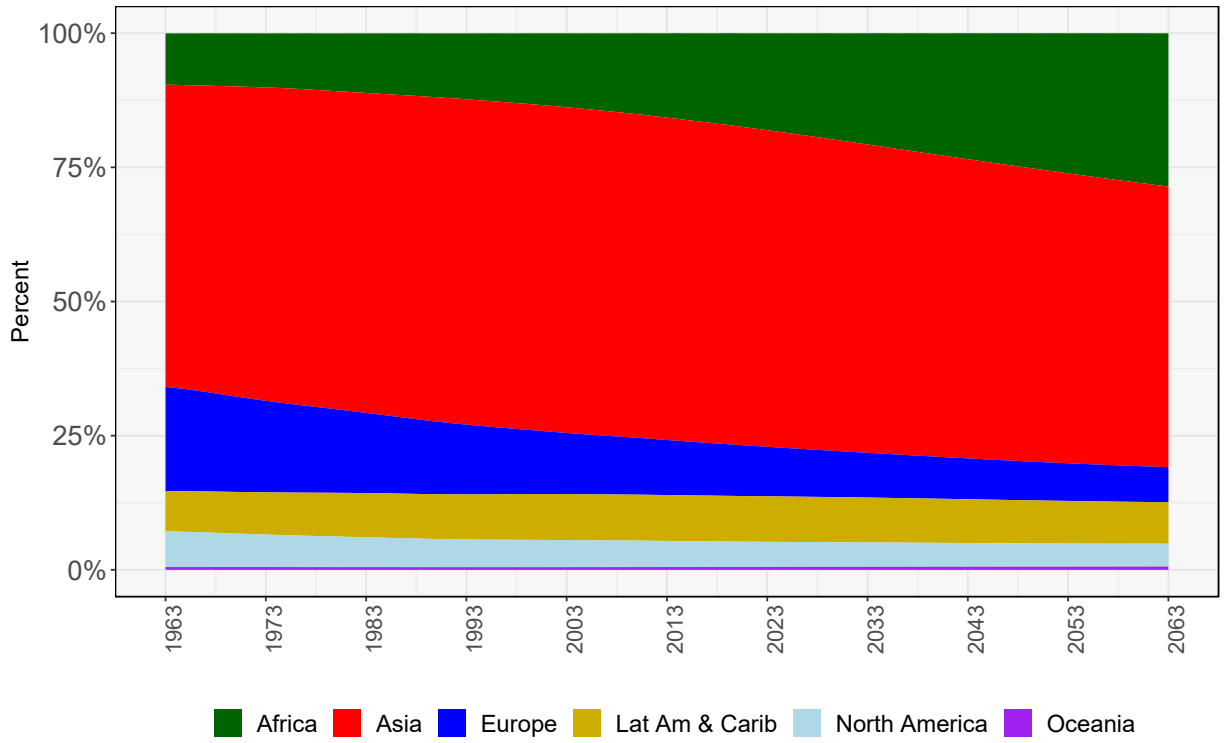
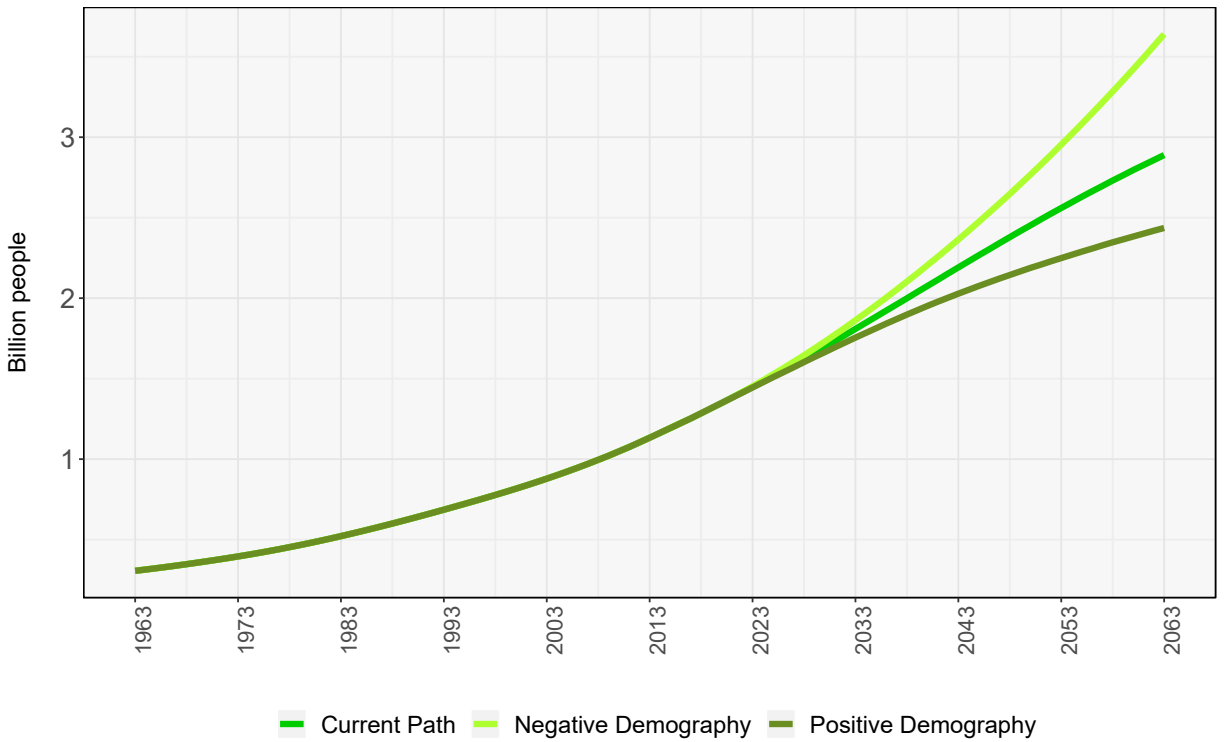


Figure 2: Population of Africa across three scenarios, 1963-2063.



THE DEMOGRAPHIC TRANSITION

Table 6: Evidence, opportunities, and challenges associated with the demographic transformation.

Demographic Transition		
Facts and Evidence	Implications for Africa and Agenda 2063	
	Positive	Challenges
<p>Africa's population is continuing to grow at rates no longer seen in other regions.</p> <ul style="list-style-type: none"> - Africa's population will grow from 1.3 billion today to 3 billion by 2063. - In 2063, 30 percent of the world's population will be African. - Between now and 2063, 37 percent of births worldwide will occur in Africa. 	<p>The power and influence of African states around the world grows, as a result of the increasing demographic basis of economic production.</p>	<p>A bigger population will put greater demands on service delivery. The continent is not currently on track to meet future demands for teachers and health workers.</p>
<p>Africa's population will be increasingly urban.</p> <ul style="list-style-type: none"> - By 2063, Africa's urban population will grow 3.5-fold to 1.8 billion people. - By 2038, over half of Africa's population will live in urban areas. 	<p>Urbanization can drive innovation and productivity, can boost the economy, and can ease public service delivery.</p>	<p>Much of the urban growth in Africa has been taking place in slums, which can hurt human capital and act as poverty traps.</p>
<p>As Africa is continuing to grow, the population will remain young.</p> <ul style="list-style-type: none"> - By 2040, Africa will be home to nearly 250 million children under five. - The youth bulge (the percent of the population aged 15-29) peaked at 48 percent in 2005 and will fall slowly, to 34 percent by 2063. - The median age in Africa will not reach 30 (the level of Asia and Latin America today) until 2063. 	<p>Africa has the potential to harness a 'demographic dividend' – the growth potential resulting from a relatively large working-age population.</p>	<p>The 'youth bulge' will remain high, potentially increasing the risk of political instability and conflict.</p>

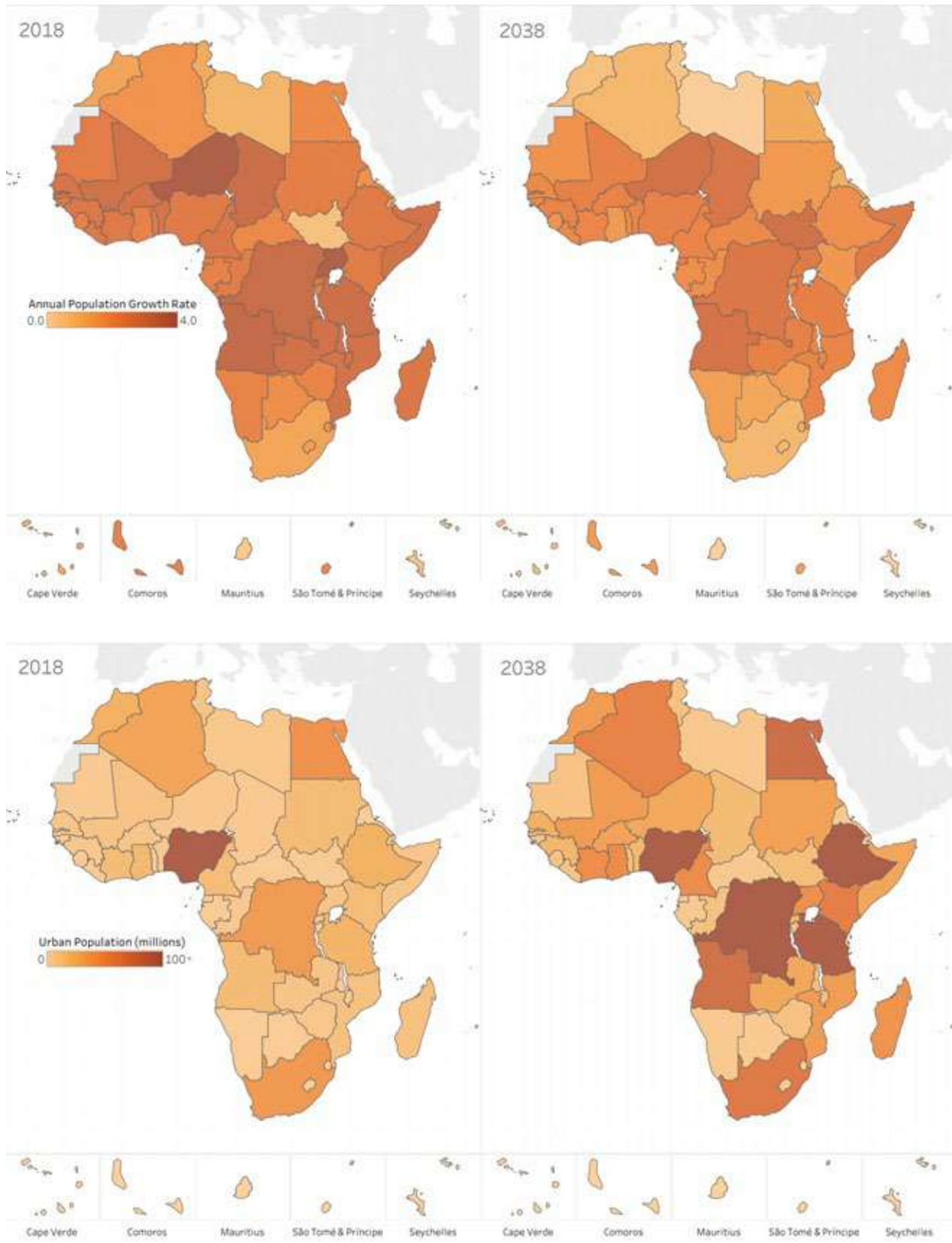


Figure 3: Current Path projection for select technology transformation variables, 2015 and 2038.

FERTILITY RATES AND THE DEMOGRAPHIC TRANSITION

A traditional demographic transition is characterized by movement from a young population structure to a more mature structure and is partially driven by a move from high to low fertility rates. The transition from higher to lower fertility rates lowers the youth dependency ratio – the number of child dependents relative to working adults. The increase in the working age population, as long as most of the adults are productive, leads to an increase in GDP per capita. And with fewer children per family – fewer mouths to feed – people have more to invest in the health and education and the economy.

But Africa's fertility rates are reducing more slowly than expected. Whereas fertility rates in Asia fell by 3.7 between 1965 and 2015 (from 5.9 to 2.2), rates in Africa only fell by 2 (from 6.7 to 4.7). Fertility rates in Africa remain high, even when controlling for GDP per capita, education, life expectancy, and urbanization.⁴ In most of the world's regions, the working share of the population peaked over the course of a generation. In Africa, due to persistently higher fertility rates, the same transition will take at least three generations.⁵

Moreover, fertility rates do not appear to interact the same way with other variables: in other regions, a fall in fertility spurs a greater working population not only through a lowered youth dependency ratio but also through the entrance of more women into the workforce. However, this relationship may be different in Africa. In Ethiopia, for instance, there has not been a correlation between falling fertility rates and increased female employment.⁶ The relationship between urbanization and fertility is also distinct in Africa. While other regions show a correlation between rates of urbanization and lowered fertility, this has not been the case in Africa, where urban growth is due more to natural increase (birth rates) than to migration of workers from rural areas.⁷

Africa's fertility rates are projected to continue their gradual fall – from 4.5 today to 2.2 in 2063.

AGE-SEX STRUCTURE OF THE POPULATION

While absolute population size matters, the distribution of the population across age levels impacts human development and social stability in knowable patterns. A large and growing young population can have a large dependency ratio, a measure of the young to the working age population. As a population matures, a young population can produce a "youth bulge", the percent of the population aged 15 to 29 relative to the population 15 years and older. Large youth bulges can drive social instability. A third concept related to demography and development is the demographic div-

idend, which is the measure of working age adults to dependent people (old and young).¹⁴

SIZE OF THE YOUTH POPULATION

Africa has the largest share of under-15 population of any global region from 1963-2063. Of the 40 countries with the largest share of under-15 population, 36 are African. In 1963 that share stood at just less than 45 percent of the total population, increased slightly through the 1980s, and declined to just over 40 percent of the population today. The Current Path projection shows that declining to 26 percent by 2063.

Between 1963-2063 Africa also has the highest youth bulge of any region in the world. The youth bulge can increase the risk of political instability and conflict,⁸ especially when economic growth is low, and youth unemployment is high.⁹ In 2011, for example, the height of the Arab Spring, Egypt's youth bulge was 42 percent. Over the next fifty years, 43 of the continent's 54 countries will spend some time with a larger youth bulge than that. By 2063, all but two African countries will fall below this level.

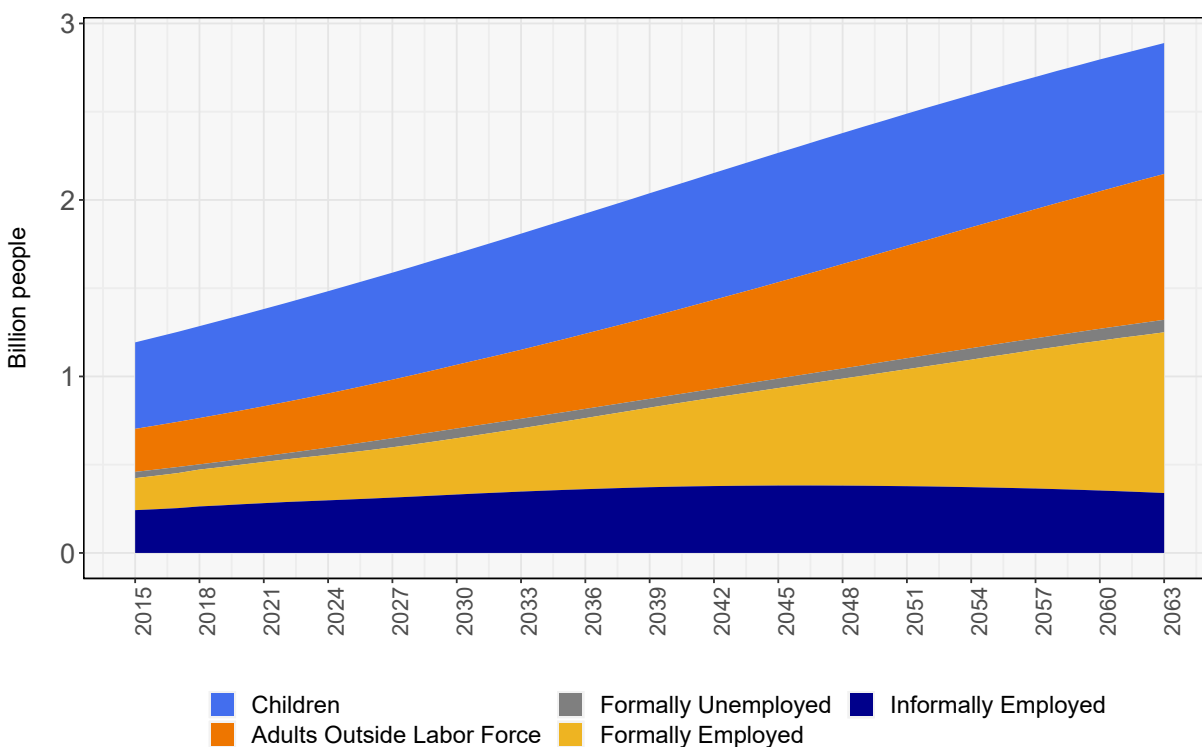
The youth bulge in Africa grew from 45 percent in 1963 to a peak of 48 percent by 2005 and is projected to decline in the Current Path to 34 percent by 2063. Youth bulge levels in Asia and Latin America were similar to Africa in the 60s and 70s but declined rapidly starting in the 1980s as fertility rates slowed. The gap between the youth bulge in Africa and the rest of the world is significant. Of the 40 countries with the largest youth bulge today, 35 are African.

DEMOGRAPHIC DIVIDEND

As populations mature they have the potential for economic growth resulting from larger working age populations compared with dependent populations (the "demographic dividend"). Countries can benefit from the demographic dividends in both thick and thin ways.¹⁰ The thinnest benefit occurs when the working population grows more rapidly than the dependent population, growing per capita income and allowing resources to be redistributed to investments in human capital and economic development. While important, this first 'labor force dividend' can be transitory. A deeper and more structural transforming benefit of the demographic dividend—a 'savings dividend'—opens later in a population transformation, as older working population is pushed to accumulate assets for investment.¹¹ The second dividend has the potential to be larger and more enduring, but harnessing it requires both capturing the first and implementing appropriate policies.¹²

The World Bank and IMF¹³ describe at least four phases of a demographic transition. According to this typology, most African countries are pre-dividend, with 15 in an early dividend stage (Algeria, Botswana, Cape

Figure 4: Population by employment status, current path, 2015-2063.



Verde, Djibouti, Egypt, Eswatini, Ethiopia, Gabon, Ghana, Lesotho, Libya, Namibia, Rwanda, South Africa, and Zimbabwe) and just four in late-dividend stage (Mauritius, Morocco, Seychelles, and Tunisia).

Pre-dividend countries can expect continued population growth but as the working age population grows, will see their dependency ratios decline. The window of opportunity for these countries (where the working population is at its peak) is still several decades away. The priority today is to lay the groundwork to be able to take advantage of a thin dividend. In the early-dividend stage, the focus should be on seizing the dividend that results from having more working age people relative to dependents and to build a foundation for incentivizing savings, which broadens the impact of the dividend.

FORMAL AND INFORMAL EMPLOYMENT

While growth in the demographic dividend will lead to more people in the working age population relative to dependents, deriving benefits from this demographic structure requires that there are adequate jobs. Employment growth has not kept pace with economic

growth¹⁵ and there is still a dearth of stable, wage-paying jobs.¹⁶ Currently, 66 percent employees are considered “vulnerable” (defined as own-account and family contributing workers) – a rate higher than any other world region.¹⁷ And over half of those employed are in extreme or moderate working poverty: 54.8 percent of workers live in households in which daily income or consumption per capita is below \$3.10 USD PPP.¹⁸

Continently, formal unemployment is moderate – around six percent. This is projected to increase in the Current Path to eight percent over the next decade, before reducing again to around 5.5 percent towards the end of the time horizon. Throughout the time horizon, unemployment in Africa is higher than Latin America, Asia, and Oceania but lower than Europe. These numbers mask a great deal of variation through the continent – where unemployment is especially high in Southern Africa (17 percent) and Northern Africa (12 percent) and low in West, East, and Central Africa (four to six percent).

However, measures of formal unemployment fail to capture those individuals who are jobless and discouraged and, more influentially, levels of informal employment.¹⁹ The informal economy contributes roughly a quarter of Africa’s GDP, and nearly 60 percent of the non-agricultural labor force is employed informally.²⁰

POPULATION GROWTH AND URBANIZATION

Population growth will lead to increases in the size of urban centers, which can drive innovation and productivity, but which can also lead to vicious cycles of poverty, inequality and social instability. The urban transformation described here (a 30-fold increase over 100 years) is historically unique. Leveraging the good and eschewing the bad will require planning.

Improved urban hubs can create virtuous cycles of development and change. Cities in Africa generate between 55 and 60 percent of its GDP.²¹ Many of these economic benefits come from the economies of scale and agglomeration economies supported by cities.²² Urbanization has historically had a positive impact on reducing overall poverty (though the urbanization occurring in Africa may challenge this).²³ A strong positive relationship exists between urbanization and education—urban areas have greater primary and secondary enrollment and a smaller gender gap in educational attainment.²⁴ Urbanization may also have health benefits as the population is located closer to health centers and services (though there are also health related costs to urbanization if air quality is poor). It is associated with a significant reduction in under-five mortality in developing countries²⁵ and urban areas in Africa have longer life expectancies, lower rates of infant and under-5 mortality, and lower rates of child malnutrition.²⁶

Finally, people in urban areas have greater access to technology. In Africa, while internet penetration at a whole is at 16 percent, in cities that number was 50 percent.²⁷

Currently, approximately the same number of people in Africa and Europe live in urban centers. Before mid-century Africa’s urban population is expected to surpass that of China across the scenarios explored here.

Rapid urbanization (from a very low base) has been a key part of the African development story as well, with an 9-fold increase in populations between 1963 and 2018. Projected growth in urban African populations is expected to be massive, with an additional 3.5-fold increase between 2018 and 2063. In total, African urban populations are projected to grow over 30-fold between 1963 and 2063. To put this increase in context, urban population growth in Asia increases 5.7-fold between 1963 and 2018 and is projected to increase nearly 10-fold between 1963 and 2063.

While population growth can increase GDP it also increases the dependent population, causes scarcity of resources, reduces GDP per capita, leads to higher levels of poverty, and undermines improvements in human development more broadly. Along the Current Path, the rapid population growth and lack of accompanying economic growth and distribution leads to an increase of 77 million people living on less than \$1.90 a day and 192 million people living under \$3.10 a day from 2018 to 2038.

Figure 5: Urban population for Africa, Europe, China, and India, 1963-2063.

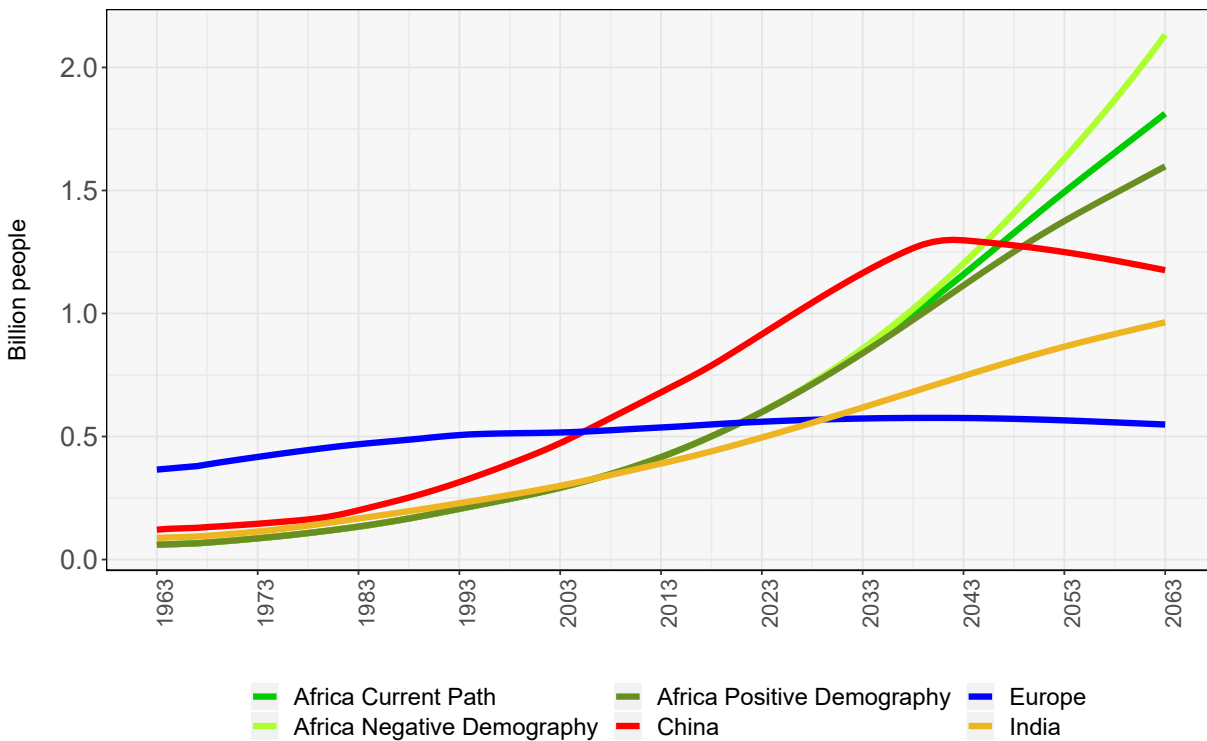


Figure 6: Urban population by African region 1963-2063.

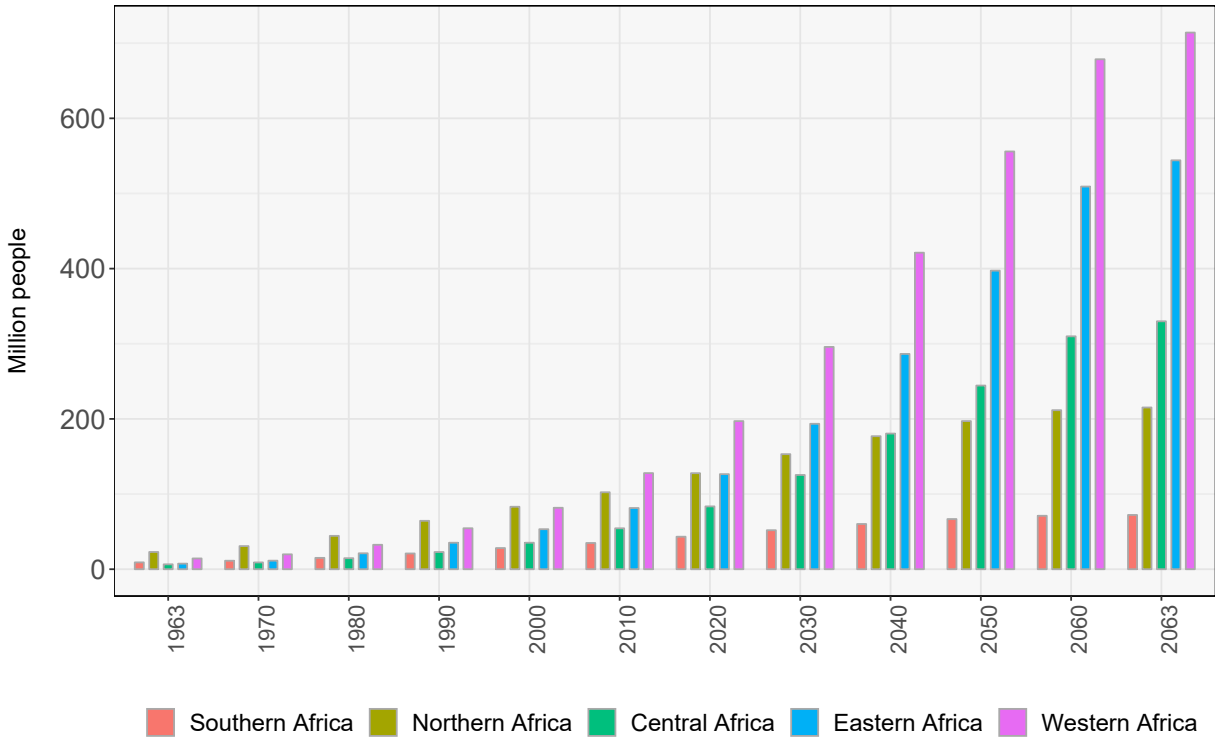
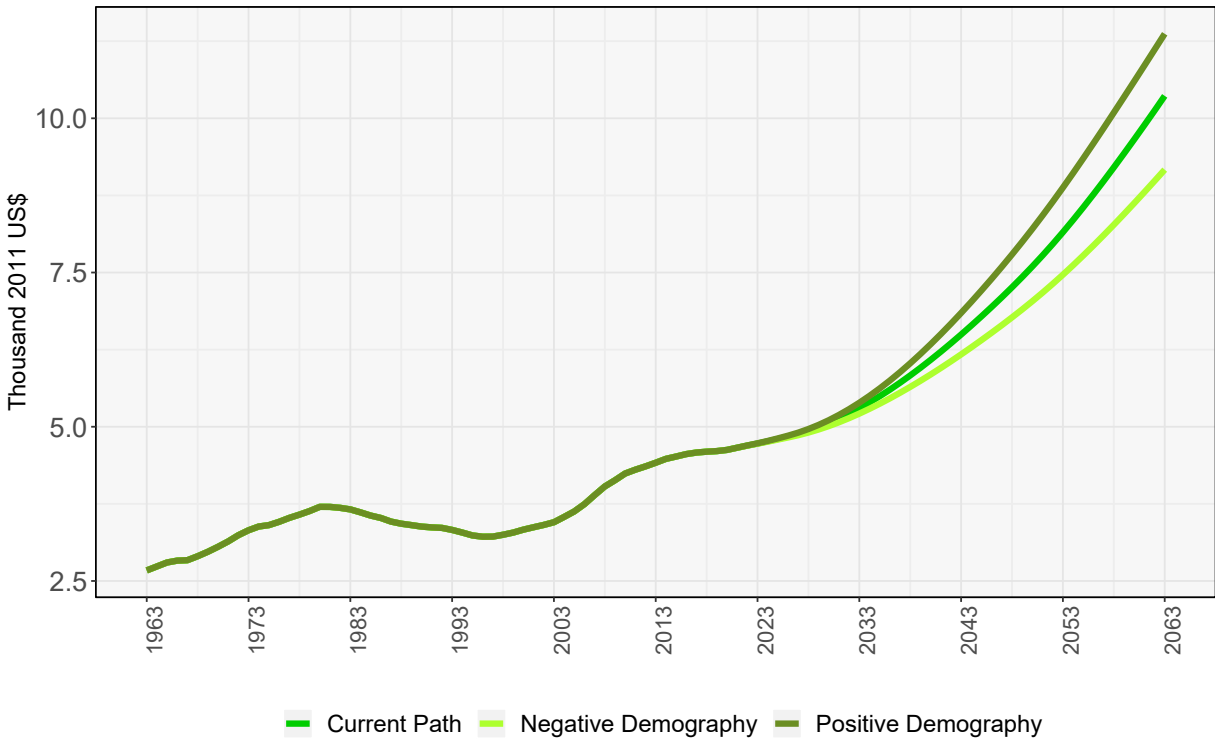


Figure 7: GDP per capita at purchasing power parity for the current path, positive demography, and negative demography, 1963-2063



CHALLENGES TO EXPLOSIVE GROWTH IN URBAN AREAS

Growing populations lead to growing demands for resources. In 2018 there were 43 million births, of which roughly 42 percent were unattended by skilled health personnel.²⁸ The number of births is expected to grow from 43 million in 2018 to a peak of nearly 52.5 million births per year by 2043 and only decline slightly to 49 million by 2063. To serve its growing population, Africa needs 5.6 million more professional health workers and 5.8 million more primary teachers by 2030, an increase which exceeds current trends.²⁹

And urbanization in Africa may be happening in ways that do not lead to the economic growth seen elsewhere. In fact, according to at least one study, sub-Saharan Africa is the only region where poverty reduction has not been correlated with urbanization.³⁰ Historically, urbanization has gone along with industrialization and the migration of working adults from rural to urban areas to work in factories. But Africa's urbanization has not followed this path.

Instead urbanization is more linked to resource exports, resulting in cities that can be characterized as 'consumption cities' as opposed to 'production cities'.³¹ In these cities, workers are mainly employed in non-tradable services and do not experience the same productivity gains as production cities, where employment is primarily in tradables like manufactures and financial services.³² Many African cities are not set up to take advantage of the productivity and efficiency opportunities from having a more concentrated population. As one World Bank report put it, "Africa's cities are not economically dense or efficient".³³

Compared to other developing regions with similar levels of urbanization, cities in sub-Saharan Africa

have lower living standards, lower levels of capital investment and low building stock values, and poor infrastructure.³⁴ For instance, just 16 percent of urban households have a permanent roof.³⁵ Although it is fair to note that urban conditions are often still an improvement from rural areas, where living standards are consistently lower, electricity access is lower, and it is more expensive to provide piped water and waste disposal.³⁶

Transportation infrastructure is still poor, with high costs, considerable congestion, and slow commuting speeds. This limits where people can live and the accessibility of employment and makes it harder to benefit from agglomeration economies.³⁷ Cities' highly fragmented nature also makes it difficult to benefit from economies of scale in service delivery.

One concerning aspect of urbanization in Africa is the prevalence of slums, where homes lack at least one of the following: access to safe water and improved sanitation, a dwelling made of durable materials, and two or fewer persons per room.³⁸ On average, 60 percent of Africa's urban population lives in slums, compared to 24 percent in Latin America and 35 percent in South Asia.³⁹ And while it is possible that slums could be merely transitory, there is evidence that slums can act as poverty traps, stunting human capital.⁴⁰

To benefit from population increases and urbanization, considerable work is needed to improve cities in a way that helps to boost productivity and human capital. Failure to do so could not only stunt Africa's growth, it could exacerbate inequality and lead to social unrest. Foster and Briceño-Garmendia⁴¹ estimated that the cost of addressing the infrastructure backlog on the continent would require \$93 billion USD annually over the next 30 years. Currently, even when improvements do happen they tend to benefit the rich. New roads and rail systems rarely serve slums and new apartments are not affordable for much of the population.⁴²



HUMAN DEVELOPMENT AND INEQUALITY

Africa is rising. Communicable disease mortality has been reduced,⁴³ economies have grown and become increasingly diversified,⁴⁴ security has become more stable,⁴⁵ populations have become better educated,⁴⁶ and infrastructure has been enhanced.⁴⁷ The Human Development Index (HDI), a composite measure that includes education, health, and income, grew by 25 percent from 1991 to 2018 and is projected to grow by 33 percent from 2018 to 2063. During the period between 1991 and 2018 African HDI (starting from a low base) grew more rapidly than Europe, Latin America, North America, and Oceania, though more slowly than Asia. By 2063 the Current Path forecast projects HDI to grow to 0.72, the level of Latin America in 2009. See Figure 8.

These advances in human development are changing African society and placing new demands on governments for accountable and transparent service delivery, thereby pushing for increased spending on services such as education, health, communication, sanitation, on one side, and more diverse economic production, on the other. These projected gains in human development are the outcomes of significant investments by governments, regional, and continental authorities across these sectors.

The following discussion proceeds by tracking some of the sub-components of the HDI (education, health, income) as well as exploring additional aspects of human development (inequality and infrastructure).

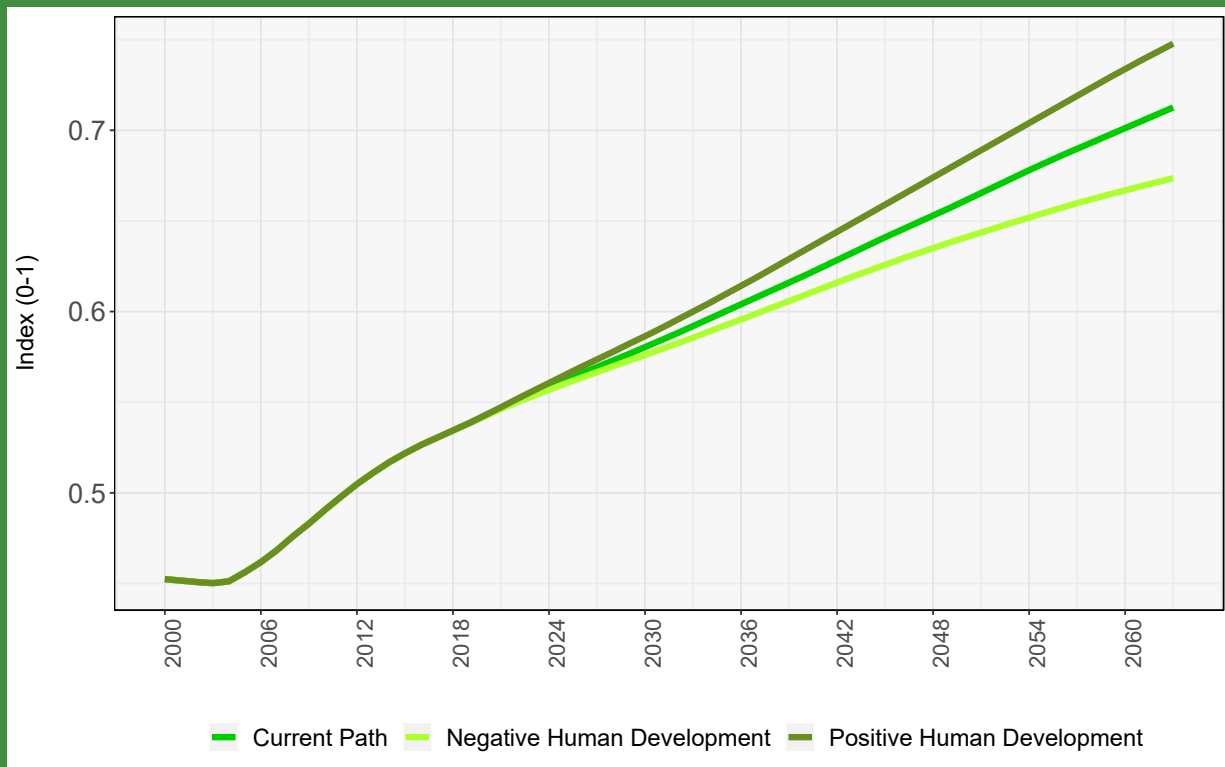


Figure 8: HDI in the Current Path, negative human development, and positive human development scenarios, using five year moving average.

Table 7: Evidence, opportunities, and challenges associated with the human development transformation.

Human Development Transition		
Facts and Evidence	Implications for Africa and Agenda 2063	
	Positive	Challenges
<p>Health is improving.</p> <ul style="list-style-type: none"> - Africans have a longer life expectancy today, at 63 years, than ever before. This will continue to extend by 11 years by 2063. - Deaths from communicable diseases will continue to fall from over 5 million per year to 2 million by 2063. - The burden from non-communicable diseases and injuries will grow. Yearly deaths from NCDs will grow from 4 million today to 14 million by 2063. Yearly deaths from injuries will grow from 900,000 today to 2.6 million by 2063. 	<p>More babies and children will survive into adulthood as the continent tackles infant mortality and communicable diseases.</p>	<p>A longer-living and healthier population will place new demands on the health system as the burden of non-communicable diseases grows.</p>
<p>Africans are becoming more educated.</p> <ul style="list-style-type: none"> - In 1963, the average African adult had just 1.4 years of education. By 2063, that figure will grow to 9 years. - The literacy rate, around 34 percent today, will reach nearly 100 percent by 2063. - By 2063, the tertiary net enrollment rate will reach 36 percent, up from just 13 percent today. 	<p>A more highly educated population will improve Africa's human capabilities and ready the population to meet the challenges of tomorrow's economy.</p>	<p>As educational attainment targets are reached, focus will need to shift toward education quality and toward equipping Africans with the knowledge needed for the future.</p>
<p>African incomes are increasing.</p> <ul style="list-style-type: none"> - GDP per capita will grow from \$4,600 today to \$10,800 by 2063. 	<p>This growth will lead to millions of Africans escaping poverty, with the portion of the population living in poverty more than halving by 2063.</p>	<p>Because of population growth, the number of people in poverty will keep increasing. The population living in poverty will grow to a peak of 930 million in 2038 before falling to 570 million in 2063. This will continue to place heavy burdens on governments to care for the populations.</p>
<p>Africa's middle class is rising.</p> <ul style="list-style-type: none"> - Defined as those living on between \$10 and \$50 per day, the African middle class will grow from 88 million people today to 930 million by 2063. 	<p>The rising middle class will be more empowered, have a greater economic voice, and may push for improvements in health and education policy.</p>	<p>A growing middle class will also have higher expectations for its government and institutions, demanding greater effectiveness and transparency and higher quality public services.</p>
<p>As many are lifted out of poverty, others will be left behind and in many places inequality will deepen.</p> <ul style="list-style-type: none"> - In 2063, 26 of the world's 40 most unequal nations will be African. - By 2063, the gap in GDP per capita between the richest and poorest African countries will more than double that seen in 1963. 		<p>High levels of inequality may stoke social division and political instability.</p>

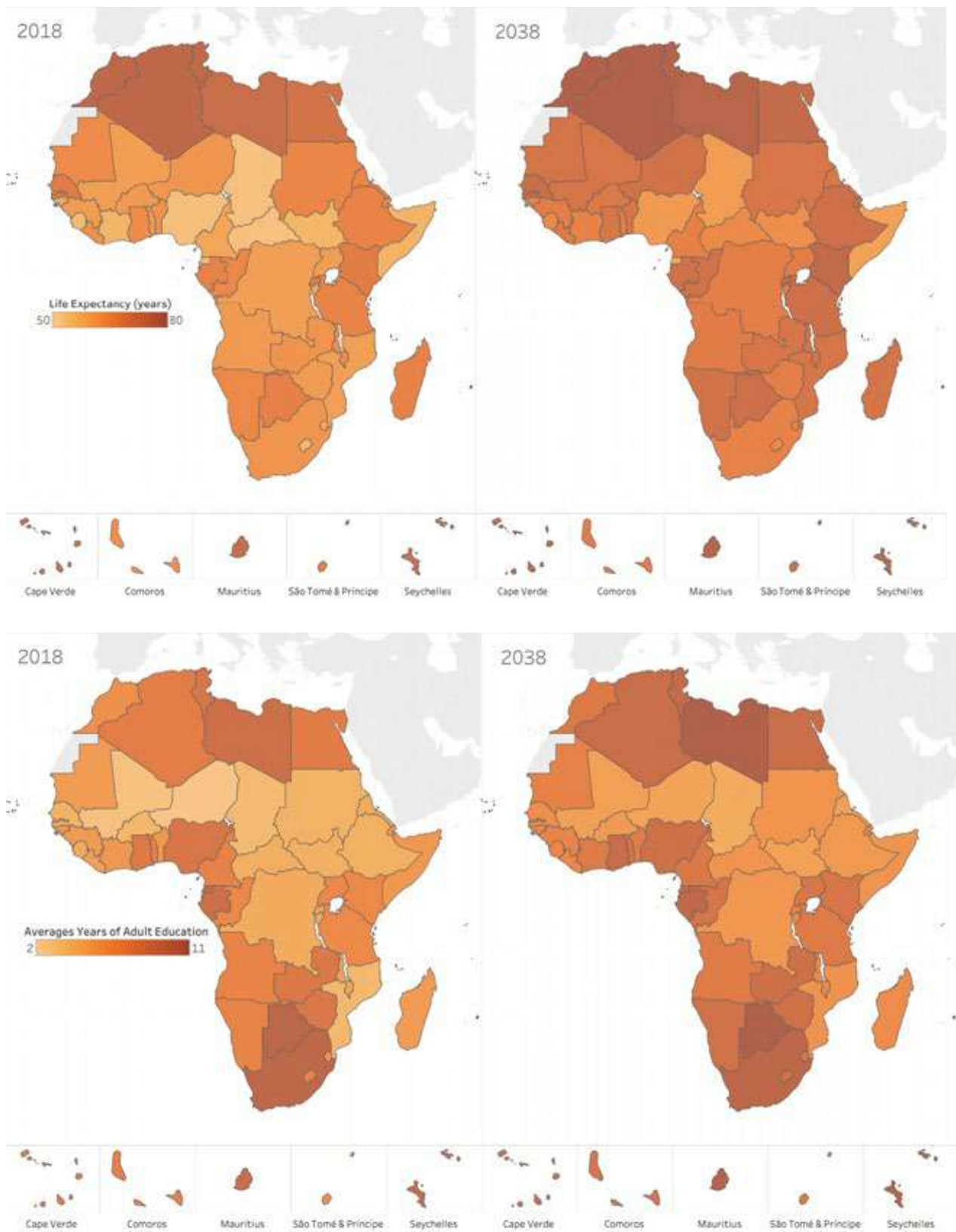


Figure 9: Current Path projection for select human development transformation variables, 2015 and 2038.

TRANSFORMING EDUCATION

Significant improvements in education attainment have occurred over the past 50 years. In 1963, the average African adult (over the age of 15) had just 1.4 years of education, a figure that has risen to 6.3 today. By 2063, the average African is projected to have 9 years of education. This will put Africa just above the global average today (8.2 years), where Europe was in 1992, and where Asia is projected to be in 2033. However, the absolute gap in average years of educational attainment is expected to persist, with Africa trailing behind the global average between 2000 and 2063 by between 1.7 and 2.4 average years of education.

Primary net enrollment has improved in past decades and is projected to grow from 71 percent today to 96 percent by 2063. These advances in basic education are seen in literacy rates, which are projected to be nearly 100 percent by 2063, growing from 64 percent in 2018.

Secondary net enrollment is projected to improve as well, growing from 43 percent today to 71 percent by 2063. In the 1970s, Africa's secondary net enrollment was an average of 34 percentage points below the world average, a gap which shrunk to roughly 29 percentage points in the 2000s. The Current Path projection expects this gap to reduce again through 2063, to 16 percentage points. This is driven by future expected improvements in African secondary enrollment as well as the achievement of full enrollment in many middle-income countries.

The continent is expected to fall further behind in tertiary education. In 1960, gross tertiary enrollment is estimated at one percent with the world average standing at eight percent. Today, 13 percent of Africans enroll

in tertiary education, compared with 40 percent on a global average. By 2038, Africa is projected to see tertiary enrollment grow to 21 percent compared with a world average at that time of 50 percent. By 2063 this projection is expected to grow to 36 percent in Africa and 58 percent globally. In percentage-point terms, the gap between African tertiary enrollment and the World has grown from 11 percentage points in 1990 to 26 percentage points today. This gap in tertiary enrollment is projected to continue growing through 2040 and peak at 29 percentage points before beginning to close as we move to 2063 (though the gap will remain by 2063).

In terms of quality, less than 20 percent of primary students in sub-Saharan Africa scored at least the minimum proficiency in math and below 10 percent did so in reading.⁴⁸ Of children that complete primary school in sub-Saharan Africa, only half have mastered the basic knowledge and skills expected at that point.⁴⁹ The average grade six teacher in 14 countries doesn't perform on reading tests any better than that grade's highest performing students.⁵⁰

There also remain stark inequities in education – both in quality and quantity. Wide gaps in attainment are growing between the richest and poorest households. In Nigeria, for instance, that gap increased 20 percentage points from 2003 to 2013.⁵¹ Gender disparities have improved considerably (primary education parity in sub-Saharan Africa improved from 0.85 in 1999 to 0.92 in 2012 as a ratio of female to male students) but remain the lowest in the world.⁵² Government schools underserve children in slums/informal urban settlements as well as those in nomadic or pastoralist populations, and migrants and working children are also less likely to attend.⁵³

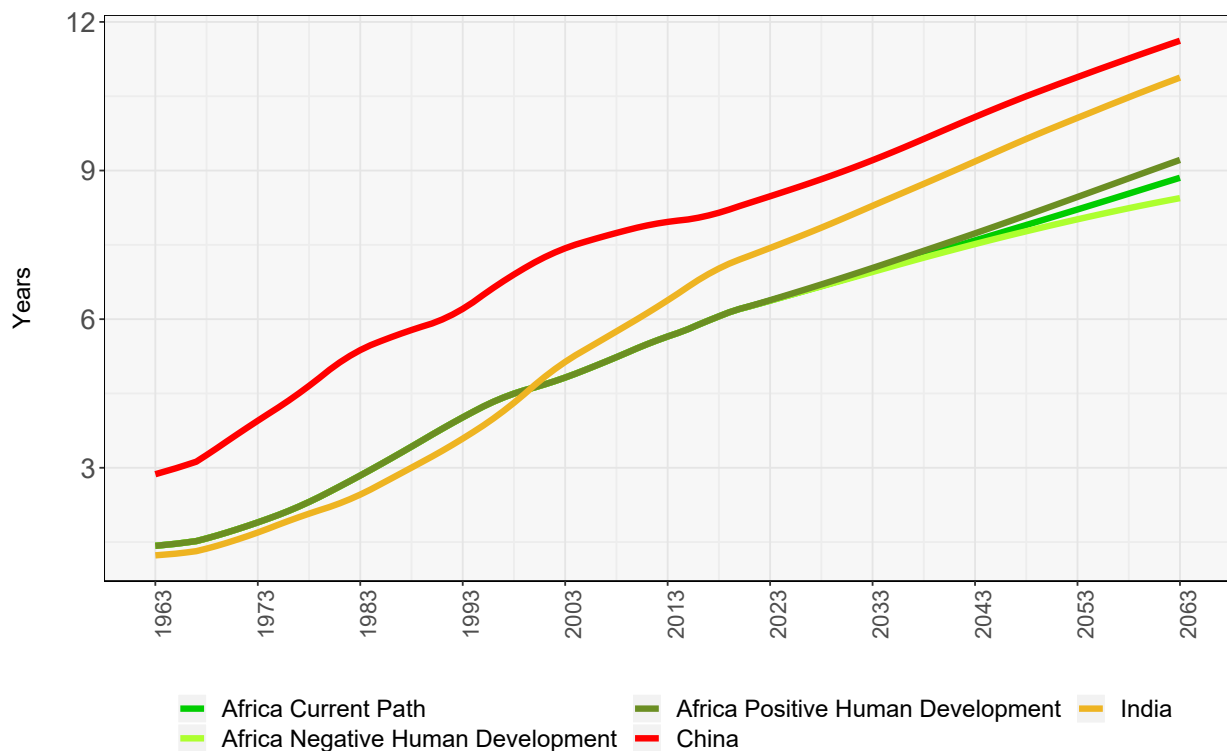


Figure 10: Average years of education for people 15 years and older, 1963 to 2063, using five year moving average.

TRANSFORMING HEALTH

Health indicators have improved as well but remain behind other regions. African life expectancy has grown from 43 in 1963 to 63 today, a 46 percent improvement. While this improvement is impressive, it lags growth in Asia over the same period which increased life expectancy by 24 years, or 50 percent. Other regions show slower growth in life expectancy, but from a higher base value. Moving forward, the Current Path projection shows Africa to be the region with the greatest absolute and relative gains in life expectancy, increasing by 11 years to 2063 (18 percent).

Much of the growth in life expectancy is driven by reductions in both infant mortality and communicable disease deaths. Infant mortality has fallen from over 150 deaths per 1,000 live births in 1963 to just under 50 today. This improvement has paralleled reductions in infant mortality in other regions, with Asia seeing reductions from 130 to 20 and Latin America and Caribbean from 100 to 15 over the same time period. Africa's burden of infant mortality in 2018 is similar to the burden in Asia in 1998 and Latin America and Caribbean in 1987. Moving forward, the Current Path projects Africa's infant mortality to reduce to 28 by 2038 and 13 by 2063, the level in Europe in 1991 and North America in 1979.

The overall burden of communicable disease deaths in Africa grew from 1990 through the mid-2000s largely driven by an increase in AIDS deaths. The burden

of disease from communicable disease excluding AIDS deaths grew slightly from 1990 through 2000 (going from around 4.6 million deaths per year to 4.9 million deaths). It then declined to 4.2 million deaths per year in 2014. The burden of disease from HIV/AIDS has grown from just over 200,000 people in 1990 to a peak of 1.5 million by 2005 and then reducing to less than one million deaths in more recent years.

The Current Path projects the burden of communicable disease deaths to continue declining through to the end of the time horizon, though still representing around two million deaths per year by 2063 (though of a much smaller share of the total population).

While communicable disease deaths are poised to decline, the growth in non-communicable disease deaths and injuries is expected to increase significantly. Africa is in the middle of an epidemiological transition. The continent faces a double burden of disease, where communicable and non-communicable diseases offer not only their own challenges but interact and reinforce each other.⁵⁴ In 1990 approximately two million people died from non-communicable diseases. Today that number is closer to four million people and is projected to grow to seven million by 2038 and 14 million by 2063. Of these, deaths from cardiovascular disease and cancer are expected to grow from 2.5 million in 2018 to 4.3 million by 2038 and 8.4 million by 2063.

Injuries are also expected to grow significantly. In 1990 approximately 500,000 people died from injuries (homicide, suicide, violent conflict, traffic fatalities). That grew to approximately 900,000 by 2018 and is

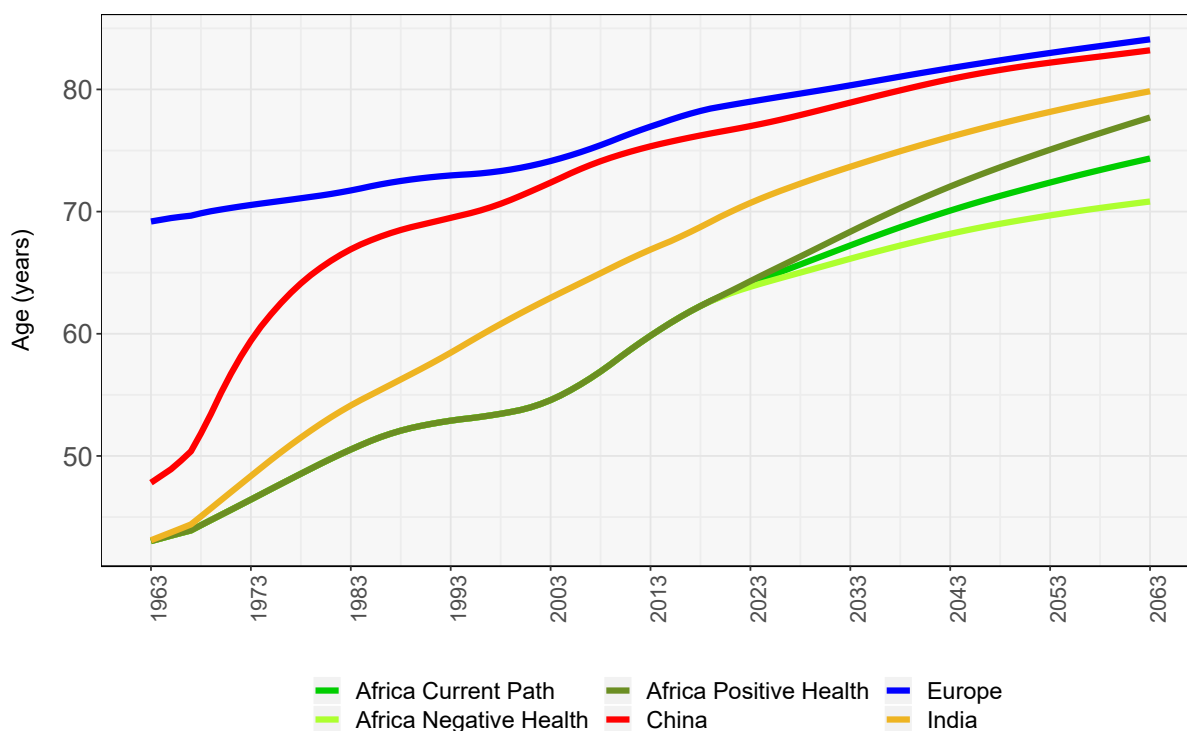


Figure 11: Life expectancy, 1963-2063, using five year moving average.

projected to increase to 1.5 million by 2038 and 2.6 million by 2063, outpacing deaths from communicable disease at that point. Of these deaths traffic accidents are expected to grow significantly from approximately 300,000 deaths today to over 1.1 million by 2063.

The number of malnourished people is projected to decline from 220 million today to 160 million in 2063. This is partially driven by increases in caloric availability, which is projected to grow from just over 2,600 per person today to nearly 3,000 by 2063.

TRANSFORMING INCOMES

Following up strong economic performance for most of this century, African economies are rebounding from a slow 2016, with real output growth projected to reach 4.1 percent in 2018 and 2019.⁵⁵ It was economic growth that—in part—fueled the ‘Africa Rising’ narrative originally and which has the potential to propel vast populations out of poverty and into better living conditions. GDP per capita (at PPP) has nearly doubled in the past fifty years, from \$2,600 in 1963 to \$4,600 today. And it is projected to grow to \$10,800 by 2063.

The portion of those in extreme poverty (below \$1.90/day at PPP) has fallen considerably and, by some estimates, has fallen below 40 percent.⁵⁶ And it is estimated that a net 43 million people will escape poverty in sub-Saharan Africa between now and 2030⁵⁷. But with booming population growth, the number of poor

people is still growing, from about 330 million in 1990 to over 470 million today. As the population continues to grow, the poverty headcount (Under \$1.90/day) is projected to peak around 2033 with just over 550 million before falling to 250 million by 2063. Poverty in absolute terms will increase and is expected to grow (\$3.10 per day at PPP) from over 750 million today to a peak at 930 million by 2038 and then to decline to 570 million by 2063. Figure 12 shows the poverty projection for those living on less than \$3.10 per day in the Current Path and a positive and negative human development scenario. The range of uncertainty on this variable is significant, with the gap between the positive and negative scenario yawning to 700 million people at the end of the time horizon.

The middle class (those living between \$10 and \$50 per day) is projected to grow from 88 million today to 930 million by 2063. An increased size of the middle class leads to more consumption power. This increases the economic voice of Africans by spurring on increases in demand, improving Africa’s negotiating power with large MNCs, and increase the predominance of African MNCs in the international system. There is evidence that growing middle classes may tend to push for more progressive health and education policy and institutional reform.⁵⁸ Improved education and health outcomes will lead to an increasingly empowered population. These citizens will likely consume more news, be more interested in political figures being responsive to local needs and have a more powerful political voice.

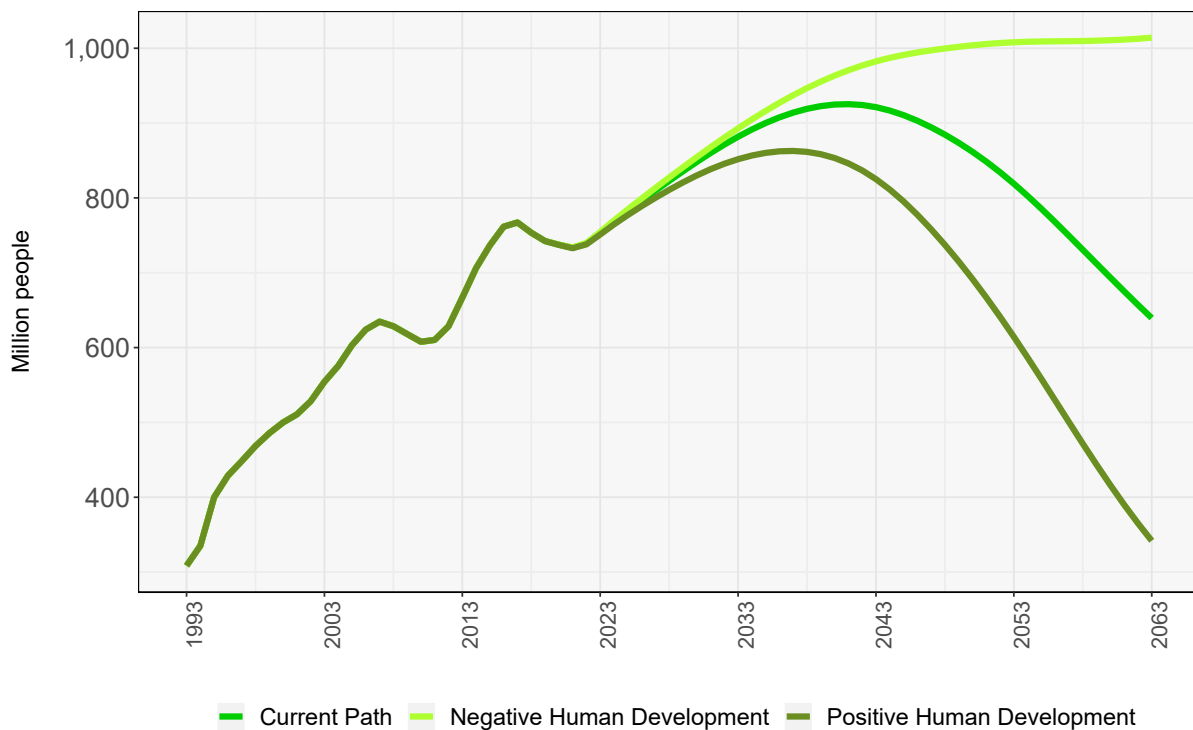


Figure 12: Populating living on less than \$3.10 per day 1990-2063, using five year moving average.

TRANSFORMING INFRASTRUCTURE

Infrastructure forms the backbone of development processes, facilitating the flow of people, ideas, goods, and services. Historically, infrastructure access in Africa has been quite low. But the Current Path projects that electricity production and access will grow, road networks will expand facilitating trade, and water and sanitation access will enhance health and well-being.

ELECTRICITY:

Electricity access stands at 50 percent and is projected to grow to 67 percent by 2038 and 90 percent by 2063 in the Current Path. Supply of electricity will grow as well, under a continuation of current national and global policies, but not enough to cover the increase in demand.⁵⁹ Many projections show a threefold increase in generation capacity in sub-Saharan Africa by 2030.⁶⁰ The Current Path projects electricity access to improve from 630 million people today to 1.3 billion by 2038.

While infrastructure access improves, significant problems will persist. Of the 40 countries worldwide with the lowest access to electricity, 35 are African in 2018 and 36 are projected to be African by 2038. In 2018, 630 million Africans lack access to electricity—a figure projected to grow to over 1.3 billion by 2038 in the Current Path. The IEA⁶¹ supports this finding and projects that roughly the same number of people will be without access to electricity in sub-Saharan Africa as today as in 2040.

One challenge to providing power is the presence of funding gaps – very few power utilities are able to fully recover both operational and capital costs, leading to unreliable power and preventing expansion of access.⁶² Improving energy efficiency at both the supply and demand ends could considerably help tackling energy shortages, poverty, and security along with climate change considerations.⁶³

ROAD NETWORK:

The Current Path estimates the road network in Africa is 2,587,000 kilometers. Roads currently make up the overwhelming majority (80 to 90 percent) of both passenger and freight traffic in most African countries.⁶⁴ The Trans-African Highway network, an idea formulated in 1970, is still not complete. In 2009 it still needed 60,000 to 100,000 kilometers of regional roads to “provide a meaningful level of continental connectivity”.⁶⁵ And the estimated cost to complete it is over \$4 billion.⁶⁶ On average, roads classified as poor (in need of rehabilitation) make up 27 percent of a country’s main road network.⁶⁷ Low population density is a big challenge to providing universal road access, which would require the length of the exist-

ing classified road network to double or triple in most countries.⁶⁸

The Current Path projection for the future road network in Africa forecasts growth in the total network to increase from 2.6 million kilometers today to 2.9 million kilometers by 2038 and 3.8 million kilometers by 2063. In addition, the IFs tool estimates that currently only 52 percent of the rural population has access to an all-weather road (within 2 kilometers). The Current Path projects that this will increase to 53 percent by 2038 and 59 percent by 2063.

RAIL NETWORK:

Rail transport in Africa has been broadly neglected as governments and international organizations focused investments on road transport and other infrastructure developments. However, it has been said that Africa is in the midst of a ‘railway renaissance’ and Vera Songwe, UNECA’s Executive Secretary said at a gathering of experts from the rail sector in Africa, “Rail will be the future land transport mode of choice for Africa”.⁶⁹

Challenges to the development of railways include inadequate (often inoperable or out-of-date) rail infrastructure, low traffic volumes, low productivity of rolling stock and labor. In 2009, over 80 percent of the 69,000 km network on the continent was dilapidated and non-operational.⁷⁰ In some countries, huge portions of track are inoperable and require rehabilitation (up to 91 percent in Uganda) and in others much of it is not regularly used (up to 60 percent in Ghana).⁷¹ Gwilliam (2011) estimates the cost of total infrastructure rehabilitation in sub-Saharan Africa (excluding South Africa) to be on average roughly \$200 million per year over a 40-year interval. Cost to repair most rail track alone is likely an average of \$350,000 per kilometer.

Expansion of rail transport in sub-Saharan Africa will require a comprehensive effort to improve railway performance and stronger governance in the transportation sector.⁷² According to the African Development Bank,⁷³ opportunities for railway development include urban and suburban passenger rail in major metro areas, freight and passenger transport along densely populated corridors, freight between ports and long-distance inland markets, and freight moving materials from mines to ports.

WATER AND SANITATION:

Current levels of water and sanitation (WASH) access in Africa are poor. The number of people using unimproved methods of sanitation grew from 425 million in 2000 to 570 million by 2018. The Current Path projects this to decline starting in 2025 (peaking at over 600 million people) before reducing to below current levels to roughly 360 million people by 2038 and 60 million by 2063. The number of people with un-improved access to water has declined from 320

million in 2000 to 290 million today. The Current Path projects this to decline further to 165 million by 2038.

Global funding levels are insufficient to achieving universal basic WASH in sub-Saharan Africa.⁷⁴ The estimated cost (2010 USD) of achieving universal sanitation access is \$9 billion in sub-Saharan Africa and \$700 million in North Africa, while benefits are estimated at \$25 billion in sub-Saharan Africa and \$3 billion in North Africa.⁷⁵ A major challenge to providing WASH access in sub-Saharan Africa is the rapid expansion of people in informal/unplanned/undeveloped settlements, especially in small towns and peri-urban areas.⁷⁶ Because of this, in some places, the percentage of the population with access to improved water sources has actually fallen. Human water consumption is projected to more than double in Africa by the end of the century.⁷⁷ This includes household and industrial use. Another challenge for water supply, especially in Africa, is the problem of leakage.⁷⁸

TRANSFORMING INEQUALITY

The growth in empowered, healthy, educated, and connected Africans will transform how it is governed, what is consumed, and what is valued. But this development will not be evenly distributed and Africa will increasingly be characterized by the haves and the have-nots. While those in the middle-class will be much more empowered than their parents, hundreds of millions of people will live in extreme poverty in urban and rural slums. If not addressed through government policy dedicated to the redistribution of resources, this inequality is likely to lead to social instability and population divisions that will persist.

Roughly as many countries in Africa are becoming more unequal as are becoming less⁷⁹ although there is more inequality across than within African countries.⁸⁰ This inequality is already a drag on development, and evidence shows that inequality may undermine economic growth broadly.⁸¹ Inequality can also breed future inequality, as income divisions further reinforce unequal access to health and education. Of all the world regions, sub-Saharan Africa loses the most human development due to levels of inequality.⁸² Inequality in sub-Saharan Africa has been shown to lead to political instability and conflict.⁸³

Addressing the issues of extreme poverty in Africa are difficult because much of the poor on the continent are extremely poor. The regional poverty gap in sub-Saharan Africa (a measure of how far incomes are from the poverty line) is 16 percent – around five times greater than that of South Asia.⁸⁴

But inequality is a difficult to measure because it can be understood in various ways. A widely used approach is the Gini coefficient for GDP per capita. This

measures the distribution of the total population with access to a particular level of “income”. A score of zero is perfectly equal and one perfectly unequal. Currently, Africa’s Gini coefficient stands at 0.42, lower than Latin America and the Caribbean (0.47) and higher than other world regions. Of the 40 most unequal countries globally in 2018, 23 are African. By 2063 the Current Path projects the 40 most unequal countries to include 26 African states.

While the Gini coefficient is widely used, it is not the only way to measure changing patterns of inequality. An alternative approach to thinking about the future distribution of inequality across countries looks at how patterns of GDP per capita changed across countries. In 1963, Libya – Africa’s wealthiest country at the time on a per capita basis – had a GDP per capita of roughly \$24,110. That was approximately \$24,000 more per capita than Africa’s poorest nation in 1963 (Somalia). By 2063, the gap between the richest and poorest countries in Africa is projected to more than double the level seen in 1963. By 2063, Africa’s wealthiest country (Libya) will have a GDP per capita level that is similar to the United States in 2018, while Somalia, Burundi, and the Democratic Republic of Congo will remain with similar levels of GDP per capita seen today.

The same phenomenon (growing gap between wealthiest and poorest African countries) is occurring at the subnational level. The graph below shows forecasts of districts in Uganda by decade between 2010 and 2040. Uganda’s wealthiest district (Kampala) is projected to have a level of GDP per capita in 2038 similar to Mexico in 2018, while its poorest districts will remain relatively unchanged compared to today.

Another approach to estimating changing patterns of inequality is to compare the continental population above and below a particular income threshold. Figure 15 compares the population living on less than \$1.90 per day (vertical axis) against the population living above \$10 per day (horizontal axis). It does this across major global regions between 2018 and 2063. Africa is the only region in the world that shows an increase in the number of people living below \$1.90 per day (peaking in the 2040s). It also shows growth in the population living on more than \$10 per day, though this growth happens more significantly much later in the time horizon.

The future of Africa will be characterized by deepening inequality across multiple levels. The countries with the highest GDP per capita will outpace countries at the bottom of the distribution. Within countries large and growing urban centers will significantly outpace growth in rural districts. Africa is the only region in the world that will experience significant growth in extreme poverty coupled with growth in the number of people living with high income.

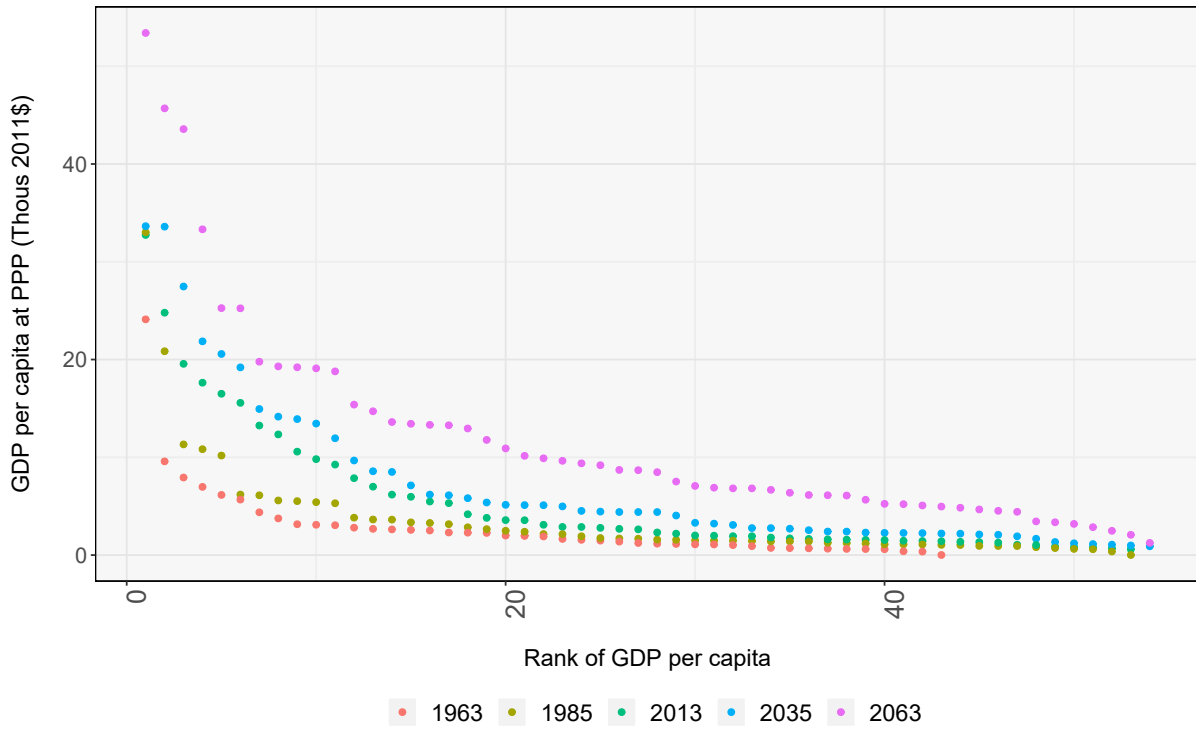


Figure 13: GDP per capita across African countries and time, ranked.

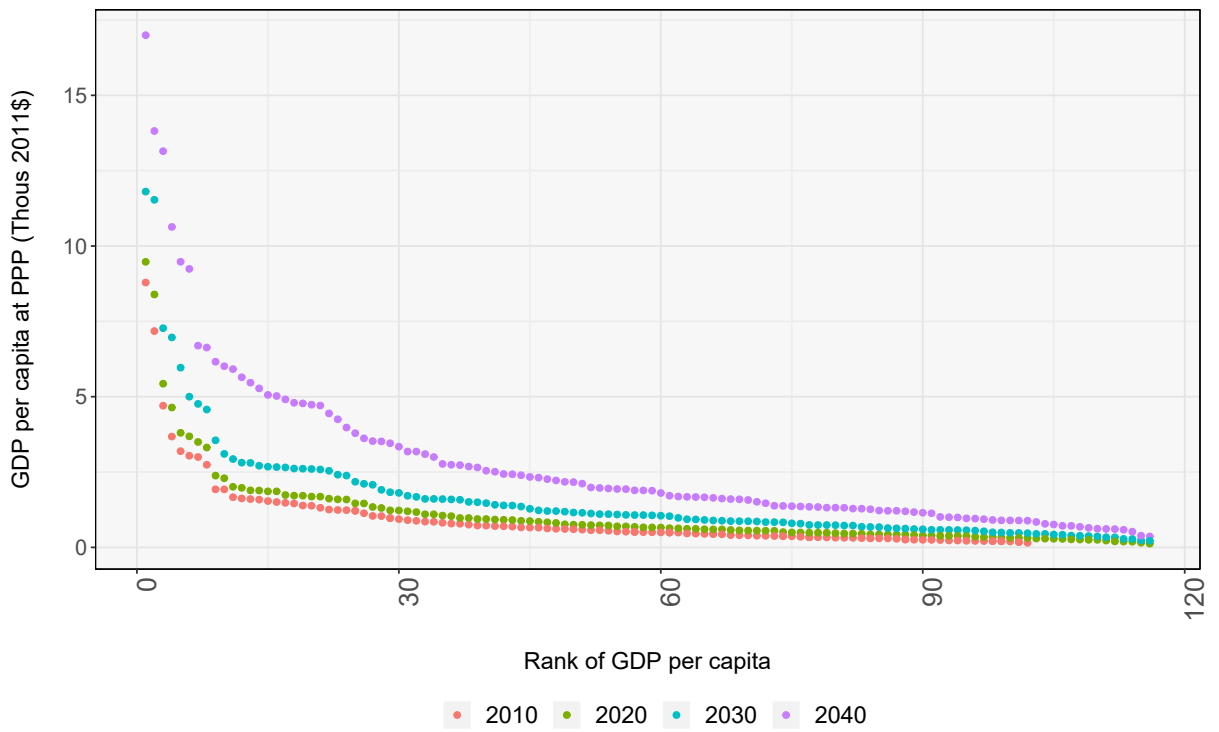


Figure 14: District GDP per capita projections for Uganda, 2010, 20, 30, and 40.

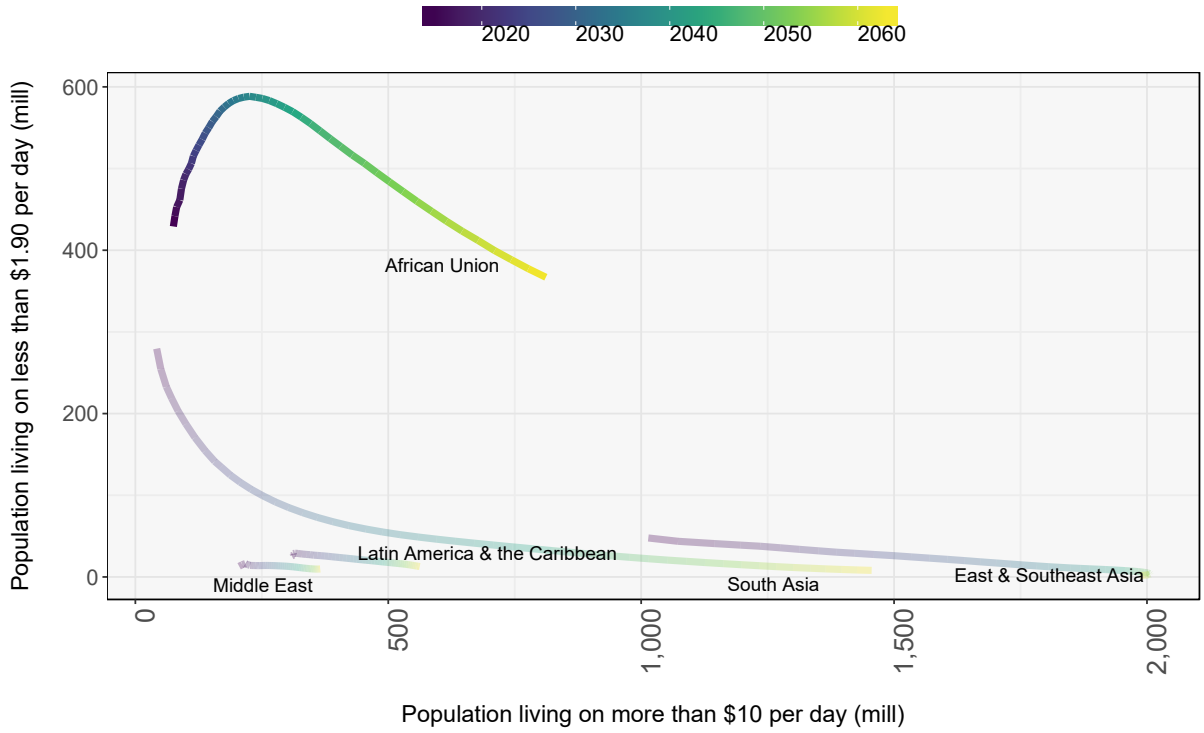


Figure 15: Distributional income inequality across time and region.



TRANSFORMING TECHNOLOGY

Technologies shape how humans interact with each other and the world. Since the end of the Cold War technologies have enhanced connectivity, reduced the cost of goods and services, and allowed for innovations in access to credit and markets, secure financial transactions, and greater shared human knowledge. By one estimate, the digital economy itself – the ICT sector and emerging services – makes up about 5 percent of world GDP and 3 percent of world employment.⁸⁵ Including sectors that involve digital skills and capital in any manner, the digitalized economy makes up 22.5 percent of global GDP.⁸⁶ And the digital economy is growing rapidly – by 10 percent annually in G20 economies and 15-20 percent annually in developing economies.⁸⁷ These technologies have always been transformative. And Africa should expect technological transformations to continue.

Some unfolding technological transformations are understandable and should be anticipated. Transformation will continue in the ICT sector, with more Africans connected to information and the world through the internet, mobile phones, and smart phones. This year, the number of internet users globally surpassed 4 billion, and over two-thirds of the world's population uses a mobile phone.⁸⁸ Over one billion SIM cards exist in Africa, and this is projected to increase to over two billion by 2030.

While ICT has already transformed the continent, penetration remains relatively low. For example, internet penetration is the lowest of all global regions, at 34 percent (435 million users), though it is growing rapidly – up 20 percent in the past year.⁸⁹ Africa's iGDP

(a measure of the internet's contribution to GDP) is 1.1 percent – roughly half that of other emerging economies.⁹⁰

Transformations in renewable energy production are also taking place, though significant growth will not occur for multiple decades, with African production starting from a very low base and rapidly increasing the share of total energy production from renewable sources. As a share of total energy production, we expect African renewable energy to grow from less than 5 percent today to 14 percent by 2038 and nearly 55 percent by 2063. Renewable energy penetration will improve access to energy, transform economies, and reduce reliance on fossil fuels.

Transformations in agricultural yield growth are less certain, though are critical drivers of food security. Current average agricultural yield per hectare stands at 3.6 tonnes for the continent. This is projected to grow to just over 5.5 tonnes per hectare by the end of the time horizon, despite the negative impact of climate change. These average yields are the lowest of any country grouping explored here except Oceania.

But Africa is endowed with rich land and examples of individual countries who have grown yields significantly. Rwanda improved average yields from 5.6 tonnes per hectare in 2007 to 9.6 in 2013 by reducing seed and fertilizer costs and making fertilizer more available.⁹¹ But there is significant uncertainty about whether these models will take hold continentally, as they require effective government intervention, political will, and strategic investment.

Table 8: Evidence, opportunities, and challenges associated with the technology transformation.

Technology Transition		
Facts and Evidence	Implications for Africa and Agenda 2063	
	Positive	Challenges
<p>Africans will be more connected than ever.</p> <ul style="list-style-type: none"> - Already over 1 billion SIM cards exist in Africa, a figure which will double by 2030. - Today, Africa has 2.9 smartphone subscriptions for every 10 people. By 2025 this will more than double, to 6.5 per 10 people. - Internet access on the continent, today around 20 percent, is projected to improve to 35 percent by 2063. 	<p>Africa has been able to leapfrog technology with mobile phones and will be continuously more connected. This also opens up opportunities to expand access to services, as has occurred with mobile banking.</p>	<p>Further advances in ICT, such as in fixed broadband, which is required for real expansion in the high value-add service sectors, will require greater investments in physical infrastructure.</p>
<p>Renewable energy production will increase.</p> <ul style="list-style-type: none"> - Today, renewables account for less than 5 percent of Africa's energy demand. By 2063, this increases to 55 percent. 	<p>Renewables will provide cheaper and cleaner energy to power the continent and help expand electricity access to more remote locations.</p>	<p>High urban growth will place challenges on governments to plan for grid expansion.</p>
<p>Automation and robotics are becoming more pervasive globally.⁹²</p> <ul style="list-style-type: none"> - Robot density increased over 150 percent in a handful of countries worldwide between 1993 and 2007. - Estimates of the vulnerability of jobs to automation globally range from 9 to 67 percent. 	<p>Africa may be able to harness automation for increased economic production or to take advantage of low cost of labor while automation occurs elsewhere.</p>	<p>Taking advantage of automation requires advanced skills and infrastructure. Automation may lead to job displacement or to the restructuring of global value chains, making it more difficult for African to integrate into the global economy.</p>
<p>Food security is a persistent challenge, and with low agriculture yields, Africa will be challenged to meet demand.</p> <ul style="list-style-type: none"> - Africa will rely on global food markets for over 30 percent of food imports by 2038. - Over 10 million children will suffer from malnourishment in 2063. 	<p>If technological advances in agriculture are widely adopted, yields could grow significantly, developing a domestic food market to supply the growing middle class.</p>	<p>The growing food demand and historically slow improvement in yields suggests that the more likely path is increasing dependence on imports for human food consumption.</p>

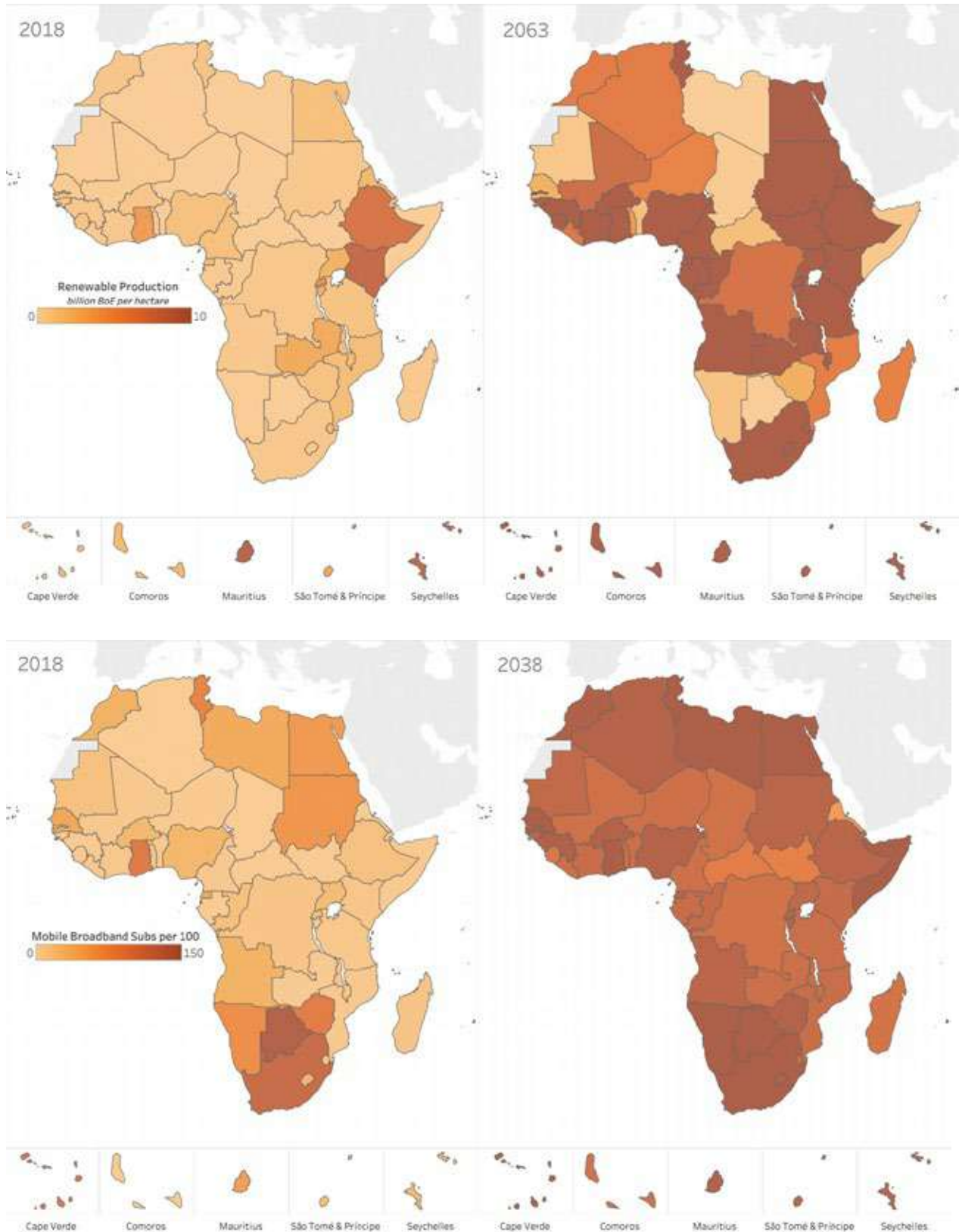


Figure 16: Current Path projection for select technology transformation variables, 2018, 2038, and 2063

INFORMATION COMMUNICATION TECHNOLOGY

Mobile phone diffusion in Africa is a textbook example of technological leapfrogging. Not only did this allow the continent to largely bypass the need for landline telephone infrastructure but it also offered the opportunity for development in related sectors, like mobile banking. Examples like these reinforce optimism in Africa to do the same with other technologies. While just a small portion of the population is online, continued investments in this sector could lead to a, "leap forward in Africa's economic growth and development".⁹³

But leapfrogging requires a bridgeable gap, and the space between African development and the rest of the world remains large in areas including ICT. At around 20 percent, internet penetration in Africa is 15 percentage points below the next-lowest region, Asia and the Pacific, and 16 percent below the world average. By 2063, Africa's internet penetration rate is projected to improve to 35 percent, while the gap between Africa and the rest of the world grows to roughly 20 percentage points.

Measures of ICT use, access, and skills on the continent were far below even lagging countries in other regions.⁹⁴ And generally, existing ICT services are unaffordable for many Africans. The ICT basket price, the cost of key ICT services (fixed telephone, cellular, and fixed broadband), is around 24 percent of the continent's gross national income (GNI) per capita, compared to just 14 percent in lower middle-income

countries overall and 3 percent in upper middle-income countries.⁹⁵ This is reinforced by a poor systems infrastructure and high cost of capital. Nearly every African country ranks in the bottom half of the ITU's ICT Development Index (ITU) and internet performance on the continent is much poorer than in other regions.⁹⁶

The *Current Path* of African ICT development (Figure 17) projects growth in mobile phone penetration followed by subsequent growth in smart phones. In Africa in 2018 there were, on average, 9 SIM cards per 10 people. This lags behind Asia and Oceania where the number stands at 10 SIM cards per 10 people and other regions with higher penetration. By 2025 the *Current Path* projects Africa to have 11.5 SIM cards per 10 people, higher than Oceania and Asia today, and the same level as North America in 2015, Latin America and Caribbean in 2017, and Europe in 2007. Africa also lags behind on smart phone access, though this is expected to converge. In 2018 Africa had 2.9 smartphone subscriptions per 10 people, similar to levels in Asia in 2016, but below levels in Latin America and Caribbean (5.2), Oceania (8.8), Europe (8.5), and North America (12.1). By 2025 the *Current Path* projects smart phone subscriptions in Africa to reach 6.5 per 10 people, similar to the level of Latin America and Caribbean in 2018, and North America around 2010.

As mobile phones become even less costly, more people will be connected to family, friends, and markets who currently lack access. As smart phones grow, more of Africa's growing middle class will have access to the internet, social media, and information in real time. As fixed broadband grows, the service sector will be able to further expand, driving economic growth and connection. The future of Africa is connected.

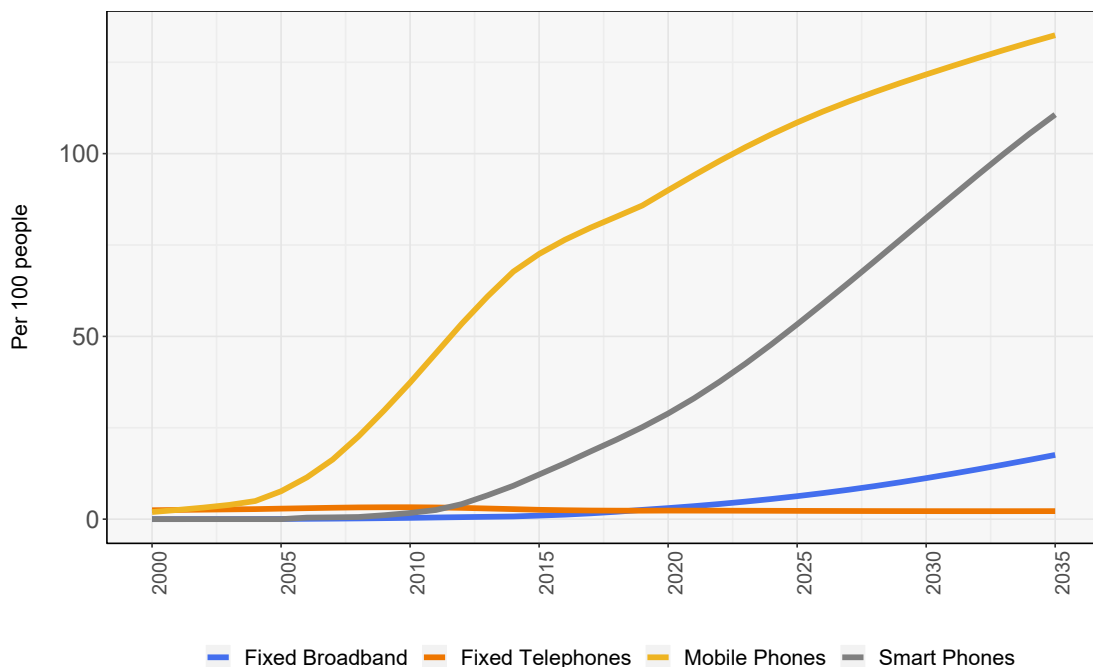


Figure 17: ICT penetration for Africa for mobile phones, smart phones, fixed broadband, fixed telephones, 2000-2063, using five year moving average.

While mobile ICT infrastructure is less costly to install and scale across a large population, fixed ICT infrastructure is important for a growing service sector as it provides for the secure transfer of large amounts of data more rapidly. While Africa was able to leapfrog the development of physical telephone line infrastructure, it will need to invest in the future of fixed-line broadband, which the Current Path projects to grow to over 20 lines per person by 2038.

Fixed broadband provides faster internet access speeds with more secure connections and is important for high value-add service sectors. On this measure Africa lags more significantly behind, partially reflecting

very low early investments in fixed-line telephones (old fixed-line telephone infrastructure can be transformed into fixed broadband, for example). In 2018 Africa had 3 lines per 100 people, fewer than Latin America and the Caribbean (13), Asia (15), Oceania (26), Europe (32), and North America (36). The Current Path projects that African access to fixed broadband will converge with global averages, but only after a delay. By 2025 penetration is projected to be less than 10 per 100, a similar level to Asia in 2015, Latin America and Caribbean in 2011, Oceania and Europe in 2005, and North America in 2003.



RENEWABLE ENERGY

Renewably produced energy will also transform Africa. Biomass, wind, solar, and hydro will make up a large share of the African energy mix by 2063, with smart grids characterizing urban spaces, and electricity access for nearly 90 percent of the continent. The Current Path estimates that currently 5 percent of the continent's energy needs are met from renewable sources, a level below Asia (six percent) and Europe (nine percent) today. The Current Path projects this share to increase to 14 percent by 2038 and over 50 percent by 2063. Under the more optimistic technology diffusion scenario, over 70 percent of the continent's energy needs are met from renewable sources, surpassing projections for the share in Asia and Europe. Even a pessimistic scenario shows significant growth in the share of energy from renewables, achieving over ten percent by 2038 and nearly 35 percent by 2063, the projected level of renewable energy penetration in Europe at that time.

In 2016, 4,400MW of renewable-power capacity was added on the continent, an amount which approximates Nigeria's current consumption. Since 2010, the cost of solar panels has fallen 80 percent and the cost of wind turbines is also falling quickly.⁹⁷ Hydropower

offers considerable opportunity as well, as 90 percent of Africa's hydropower potential is yet untapped.⁹⁸

Renewable energy also provides an opportunity to improve electricity access in hard-to-reach locations. Mini-grids bypass the need for a traditional grid system and have made up 6 percent of new electricity connections worldwide since 2012. According to the IEA,⁹⁹ it is the most cost-effective way to supply three quarters of the remaining connections in sub-Saharan Africa.

One potential bottleneck to the diffusion of renewable energy is future urban development. A 30-fold increase in urban populations between 1963 and 2063 will seriously strain infrastructure development and government planning processes. Deloitte¹⁰⁰ argues that Africa is in a good position to increasingly adopt smart city technologies, due to a lack of legacy infrastructure and a population that is young, increasingly middle class, and increasingly urban, entrepreneurial, and highly connected.

The 'smart city' model may be able to address the challenges of urbanization through smart grids, smart transportation systems, and smart governance, facilitating human and economic development. Well implemented, smart cities could help boost human and economic development by improving urban living conditions and productivity and by facilitating a more welcoming environment for private investment.

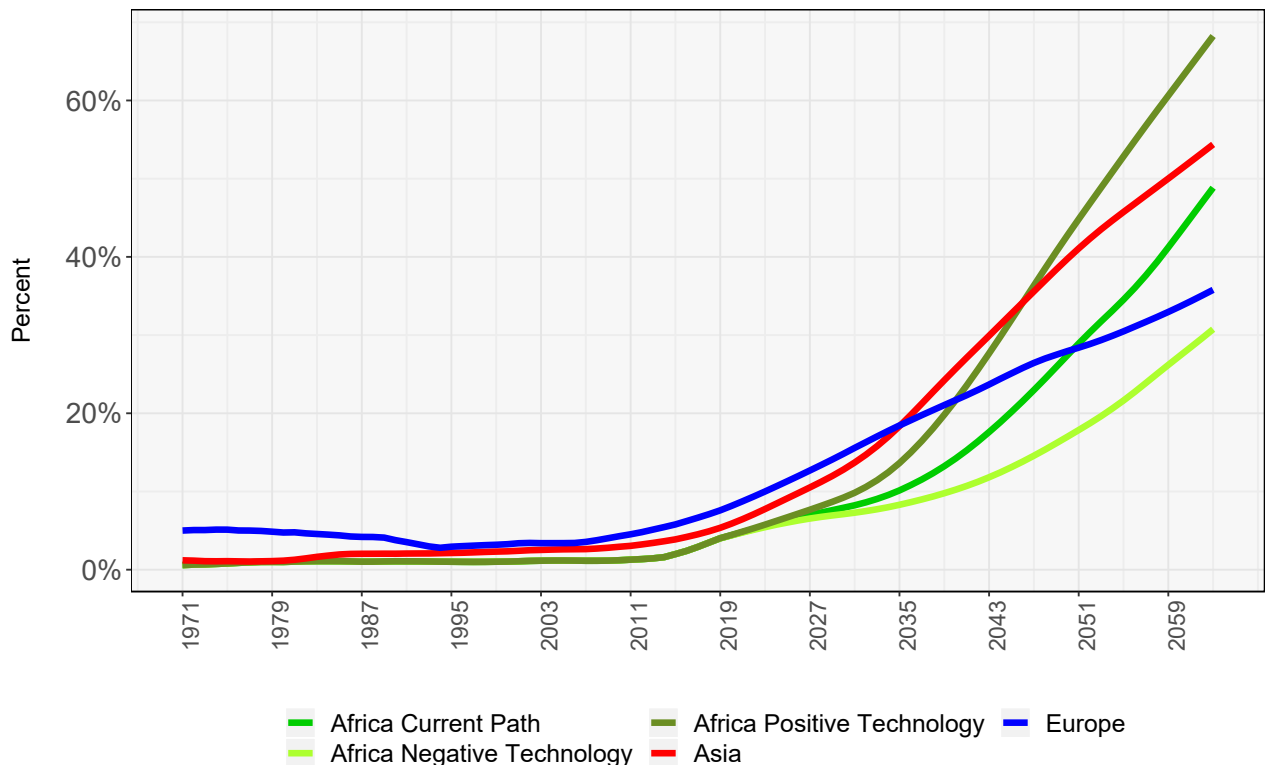


Figure 18: Renewable energy as a share of energy production by region for Africa (across three scenarios, negative technology, current path, and positive technology) and Asia and Europe (both for current path scenario), 1970-2063.

AGRICULTURE AND TECHNOLOGY

With high levels of population growth and growing inequality, African food security will remain a challenge. Food security can be characterized by access to calories (including the quantity of calories produced and the ability to buy calories), the quality of calories (both in terms of diversified food supply as well as broader conditions important to food digestion like clean water and sanitation), where those calories are produced (domestically or internationally), and how the production of calories interacts with sustainable environmental practices.

Food security in Africa has improved considerably over time, though challenges persist. Calories per capita have increased from 2,000 in 1963 to over 2,600 today and are expected to grow to 2,780 by 2038 and nearly 3,000 by 2063. While calories are available, the number of malnourished children is high: over 15 percent today and expected to decline to nine percent by 2038. That translates to 32 million children in 2018, 22 million in 2038, and still over ten million by 2063. Malnourished children directly drive the stunting rate, or the percent of the population with permanent reductions in physical and mental abilities as a product of childhood under-nutrition. In 2018 the stunting rate stood at 21 percent of the population and is projected to decline to 19 percent by 2038 and 13 percent by 2063.

One food security challenge driven by technological transformations is whether food is produced domestically or imported from abroad. Historically, Africa has been a net importer of food for consumption with values that range between five and ten percent of total food demand between 1985 and 2018. However, as growth in agricultural yield has been slow and little land is placed under cultivation, the Current Path suggests

that Africa will increasingly be dependent on outside production for human food consumption, putting it on a dangerous path of relying on global food markets for over 30 percent of food imports by 2038.

This challenging food security situation is driven in part by poor growth in agricultural technology. Figure 19 shows the Current Path for agricultural yield growth and two alternative scenarios. The high-growth scenario assumes an increase in diffusion of agricultural technology.

Growth in agricultural yield could be catalyzed in many ways. While technology adoption is an issue, ICT-based agricultural information sharing is receiving attention as an important component for the advancement of agriculture in sub-Saharan Africa.¹⁰¹ Integrated soil fertility management (ISFM) with sustainable application of fertilizer has been found to be a successful yield-increasing practice in sub-Saharan Africa. ISFM is combining practices involving “proper fertilizer management, use of improved varieties, the combined application of organic inputs and fertilizer, and adaptation of input application rates to within-farm soil fertility gradients” to improve agronomic efficiency.¹⁰²

Biotechnology is seen as a potential revolutionary technology for sub-Saharan Africa, and genetically modified crops have the potential to resist drought, disease, and provide supplemental nutrition, though risks remain.¹⁰³ Drip irrigation can also contribute to food security in sub-Saharan Africa. Drip irrigation can significantly improve crop yields and can be coupled with other renewable resource power sources.¹⁰⁴

But, perhaps the biggest barrier to growth in agricultural yields is a growing and consistent domestic food market. As middle classes grow, the incentive to improve yield will increase, and this could lead to a tipping point in the leveraging of agricultural technologies to improve domestic food system security.

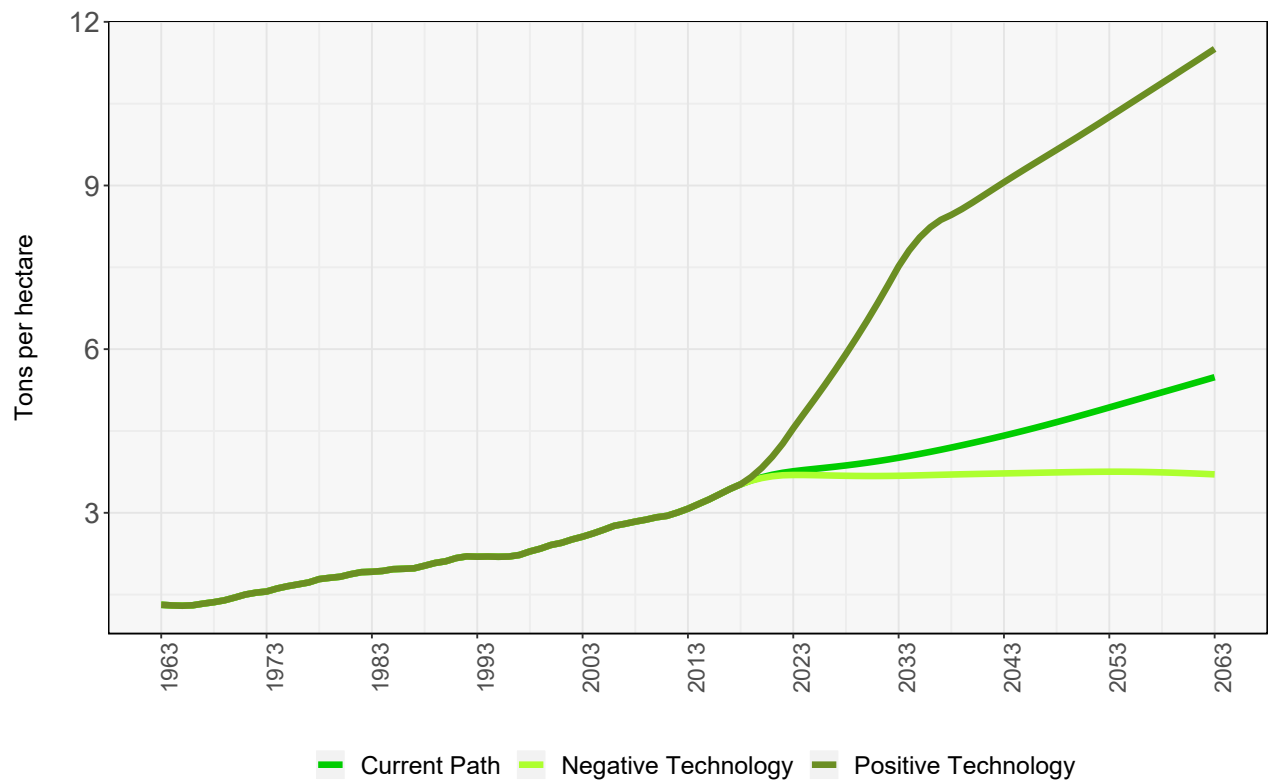


Figure 19: Average agricultural yields in Africa, history and forecast across three scenarios (negative technology, current path, positive technology).



AUTOMATION, LOCAL MANUFACTURING AND ROBOTICS

Automation and robotics continue to decrease the unit cost of production, making imminent the transformation of global industrial production. Worldwide, robots have been getting better, cheaper, and more widely used. In a handful of countries, robot density increased by over 150 percent from 1993 to 2007.¹⁰⁵ This can be an opportunity, with many studies showing positive effects of automation on overall GDP, GDP per capita, and labor productivity without major hits to employment.¹⁰⁶ In fact, increased robotics may even lead to net job creation from increased production, the reinvestment of higher profits, the need to create new machinery, and spillover effects.¹⁰⁷ These transformations are underway in other areas of technological development that impact production processes such as sensing technology, natural language learning, 3D printing, and artificial intelligence.

But just because a job can be automated doesn't mean that it will be automated right away. In fact, Africa's young, cheap workforce may be able to take advantage of a window of opportunity where the cost of robots is lower than manual labor in advanced economies but still higher than production in Africa. Bughin¹⁰⁸ projects that total manufacturing output could nearly double in the next decade (by 2025), and even more so with policies that improve the environment for manufacturers, which could create 6-14 million jobs in Africa. Because technology moves fast, this window of opportunity is narrow. For instance, in the Kenyan furniture industry, Banga and te Velde¹⁰⁹ estimate that there are ten years before automation becomes cheaper than labor in the country.

However, technology also has the potential to significantly disrupt the industrialization of the continent. While new technologies offer new possibilities, the ability to take advantage of them may be constrained by a stark and persistent digital divide, low skill levels, and inadequate physical and systems infrastructures. And with gaps in human capital and physical infrastructure, Africa may not be quite as competitive as it would need to be to take advantage of the window of opportunity offered by automation elsewhere. Low and middle-income countries on the continent have high costs of manufacturing labor relative to their GDP and high capital costs relative to competitors.¹¹⁰ These costs act as a barrier to foreign investment and industrialization.

At a more basic level, new automation and artificial

intelligence technologies threaten to transform the traditional global supply chain model entirely. Automation may destroy jobs, especially in the global South. Most studies exploring the employment effects of robots are done in the developed world, where skill levels are higher and other sectors may be better equipped to absorb displaced labor.

Ugur and Mitra¹¹¹ found that technology adoption was less likely to have a positive effect on employment in low-income countries and when related to unskilled labor employment or farm employment. Agriculture, which employs over half of the continent's labor force, is especially susceptible to automation. And the automation of agriculture could have further adverse effects in pushing more people into the service sector and lowering wages.¹¹²

Estimates of vulnerability to automation range widely. McKinsey¹¹³ estimates that around 40-50 percent of jobs are automatable in countries like South Africa, Kenya, Nigeria, and Ethiopia. The World Bank¹¹⁴ claims that two-thirds of jobs in the developing world are susceptible to automation but that this will be slowed by low wages and slower adoption of technology. In the United States, Frey and Osborne¹¹⁵ estimate that 47 percent of US workers are in jobs that could be automated in the next decades. Arntz et al.,¹¹⁶ taking a task-based rather than occupation-based approach, thinks these estimates are too high and that just nine percent of jobs in OECD countries are vulnerable to automation.

New goods require more advanced infrastructure and skilled labor throughout the entire value chain rather than just at the ends, which may further concentrate manufacturing in developed countries.¹¹⁷ Already many jobs have been lost to firms reshoring activities. While most of these losses have been in Asia, seven US companies re-shored from Africa between 2010 and 2016, leading to a loss of 885 jobs.¹¹⁸ With technologies like 3D-printing gaining ground, manufacturing is shifting from trade in tangible physical to electronic goods, like design files and software.¹¹⁹

Thus, the definition of what makes a 'manufacturing hub' is changing. Traditional patterns of economic development emphasize moving from agricultural, commodity, and raw-material production (extractive resources characterized as "primary" sector development) through to large-scale industrialization ("secondary" sector development) and then to services ("tertiary" sector development). Each of these rungs in the development ladder is driven by higher productivity per worker. This virtuous cycle characterized development in South Korea, for example.

NATURAL SYSTEMS

Africa is rich in resources that can be used to promote development. Thirty percent of mineral resources in the world are in Africa but under five percent of mineral exploration worldwide has occurred on the continent, so there is a huge potential for undiscovered resources as well.¹²⁰ Recently, foreign mining investment has skyrocketed. Investments from China, for instance, quadrupled from 2000 to 2009. Natural resources are also plentiful in rich tracts of land, forests, aquaculture, and untapped resources in the broader blue economy.

But development and growth also come with environmental costs. Africa is poised to be negatively impacted by a changing global climate—a challenging global collective action problem it contributed to in only marginal ways. In addition, the local consequences of population and economic growth without commensurate growth in governance will lead to acute environmental problems.

The future of Africa's environment will need to be adaptive and resilient.



Table 9: Evidence, opportunities, and challenges associated with the natural system transformation.

Natural Systems Transition		
Facts and Evidence	Implications for Africa and Agenda 2063	
	Positive	Challenges
<p>Africa is rich in natural resources.</p> <ul style="list-style-type: none"> - 30 percent of global mineral resources in the world are in Africa but just 5 percent of mineral exploration has occurred there.¹²¹ 	<p>Revenues from resources could be significant and at least have the potential to be leveraged into improvements in human development.</p>	<p>Dependence on resources could slow economic growth and lead to additional problems, exacerbating issues with corruption (the 'resource curse') or make it difficult to diversify an economy (the 'Dutch disease').</p>
	<p>Mining investments can potentially be turned into development corridors, improving infrastructure and expanding market access to hard-to-reach locations.</p>	<p>Mining and the subsequent spillover infrastructure and indirect effects may have environmental consequences, such as increasing pollution and hurting biodiversity, and social effects, through displacement of communities.</p>
<p>Climate change will have significant effects in Africa.</p> <ul style="list-style-type: none"> - Temperature increases in Africa are projected between 1.5 and 3 degrees by 2063. - Regional precipitation changes in Africa range from a decrease of 6 percent by 2063 (Southern Africa) to an increase of 5 percent (Eastern Africa). 		<p>Climate change is likely to have a negative impact on agricultural yields, which are already grown close to their thermal limits. It will also lead to more frequent and intense extreme weather events, such as more intense flooding and droughts.</p>
		<p>Climate change is likely to have a negative impact on agricultural yields, which are already grown close to their thermal limits. It will also lead to more frequent and intense extreme weather events, such as more intense flooding and droughts.</p>
<p>Localized environmental impacts will be increasingly felt.</p> <ul style="list-style-type: none"> • In certain areas water stress will be a key characteristic of development. • As urban areas develop air and water quality will suffer. 		<p>Local environmental costs can undermine broader development plans causing unrest, poor health, and reduced economic activity.</p>
		<p>Climate change could also lead to increased incidence of malaria, cause conflict over scarce food and water, lead to increased migration, displace coastal communities, and reductions in biodiversity and tourism.</p>

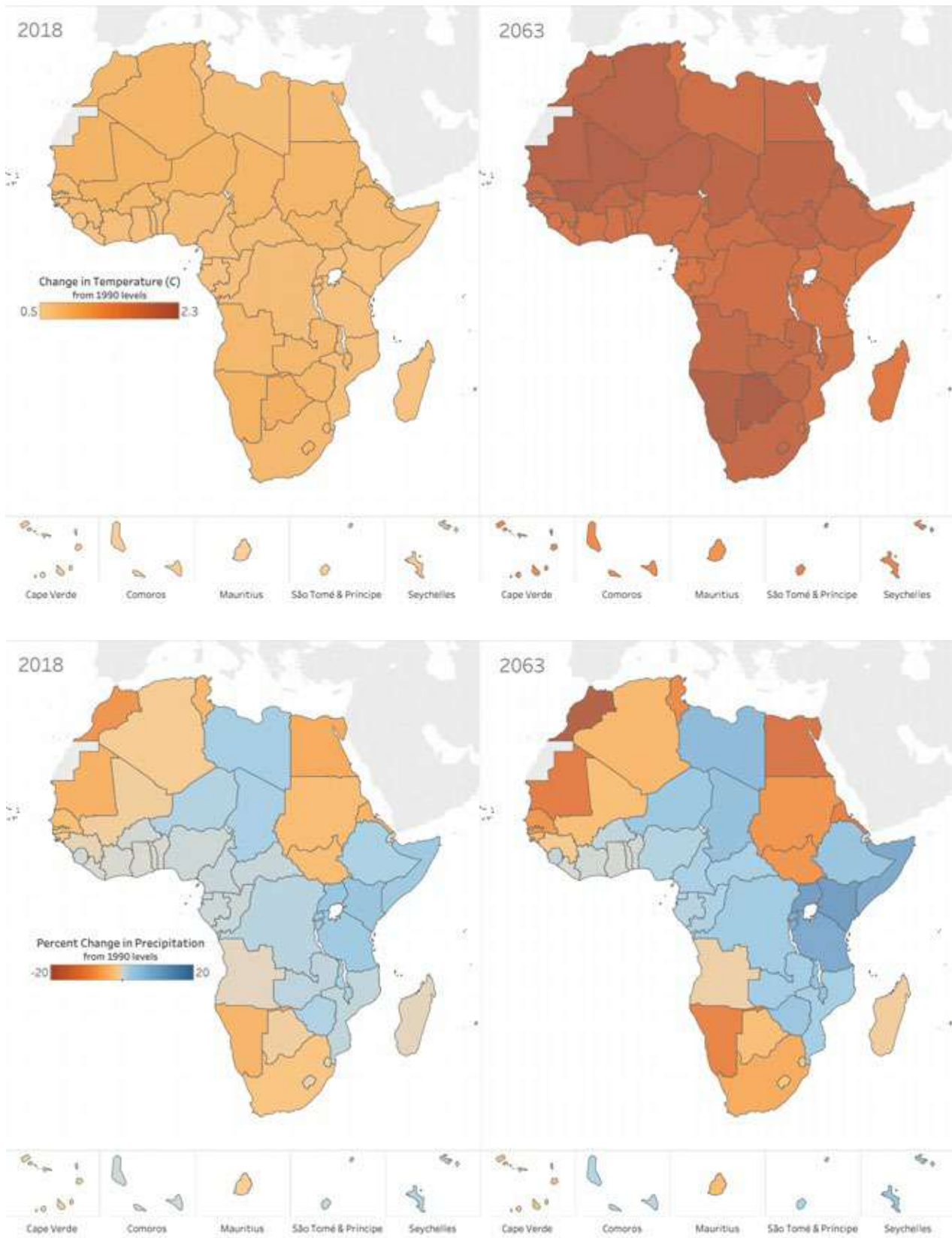


Figure 20: Current Path projection for select natural system transformation variables, 2018 and 2063.

NATURAL RESOURCES

Recent discoveries of oil, gas, and minerals have the potential to generate 9-31 percent of additional government revenues for some countries in the first ten years of production.¹²² In Mozambique, natural resource revenues could potentially supply around half of the country's needed health financing and in Ghana could supply roughly a third of needed health and education funding combined.¹²³

There has been considerable enthusiasm around the idea of leveraging mining investments into development corridors. This has the potential to unlock development in the agricultural sector, which is constrained in some regions by poor access to quality infrastructure.¹²⁴ The transportation improvements that often result from extractive industry investments allow farmers to access markets more efficiently, get higher prices, and access better technology, helping to increase production and reduce losses.¹²⁵

But resource extraction in Africa can lead to additional problems and exacerbate issues with corruption (the "resource curse") or make it hard to diversify an economy (the "Dutch disease"). There is evidence that resource wealth and dependence can lead to slow economic growth¹²⁶ and heightened inequality,¹²⁷ especially in the face of poor quality institutions and corruption. There are numerous explanations for this. Dutch disease occurs when resource wealth makes it difficult for an economy to diversify, due to currency appreciation. Countries dependent on resource exports are vulnerable to commodity price shocks and high resource wealth puts a country at higher risk of civil conflict.¹²⁸ A wealth of natural resources may incentivize rent-seeking behavior and corruption.¹²⁹

The potential infrastructure and agricultural improvements promised by proponents of extractive investments come with serious environmental and social trade-offs as well. Mining can hurt the environment directly (through the construction and mining activities themselves) and indirectly (through spillover infrastructure, pollution, and migration). By increasing access to some of the most biodiverse ecosystems in the world, roads and railways built to serve mines pose a serious threat to wildlife and their natural habitats.¹³⁰ And the improvements in agriculture could also mean land use changes that threaten biodiversity.¹³¹

Of Africa's major metal mines, 44 percent are within 10 kilometers of a protected area (compared to only 25 percent in Asia and South America)¹³² and 33 planned development corridors would cut across more than 400 protected areas and, through habitat disruption, could degrade an additional 1,800.¹³³ Corridors can displace local communities initially through their construction and further in a second wave from land use changes and urbanization.¹³⁴

CLIMATE CHANGE

Africa contributed just 3.5 percent of total global carbon emissions from 1963 to 2018. In spite of this, much research anticipates that the effects of climate change will be far more severe for Africa than other global regions.¹³⁵ For one, the direct effects of climate change will be intense. Africa is warming faster than the global average and at an increasing rate over the past 50-100 years.¹³⁶ The Current Path projects that the temperature in Africa will grow by two degrees centigrade by 2063, with high and low estimates ranging from nearly three degrees of change to just over 1.5 degrees. This is consistent across African regions. African rainfall changes driven by human induced warming will be more varied. Central Africa and Eastern Africa are projected to experience more rainfall, growing by 2.5 percent and five percent respectively in the Current Path by 2063. Northern, Southern, and Western Africa are projected to experience less rainfall, the distance between potential and actual production – could range from 10 to 90 percent across the continent.¹³⁷ Climate change will exacerbate this problem. Many crops grown on the continent are already close to their thermal limits, which will strain the production of these crops further.¹³⁸ Africa is also projected to lose, on average, 4.1 percent of cropland by 2039 and 18.4 percent by 2100.¹³⁹

Africa is expected to experience the largest negative impact on agricultural yield compared with other global regions. By 2063, the Current Path suggests that African yield will be five percent less compared with 1990 levels (using the same technology and agricultural inputs). This is supported by a meta-analysis that projects that average crop yields in the continent will fall eight percent by the 2050s.¹⁴⁰

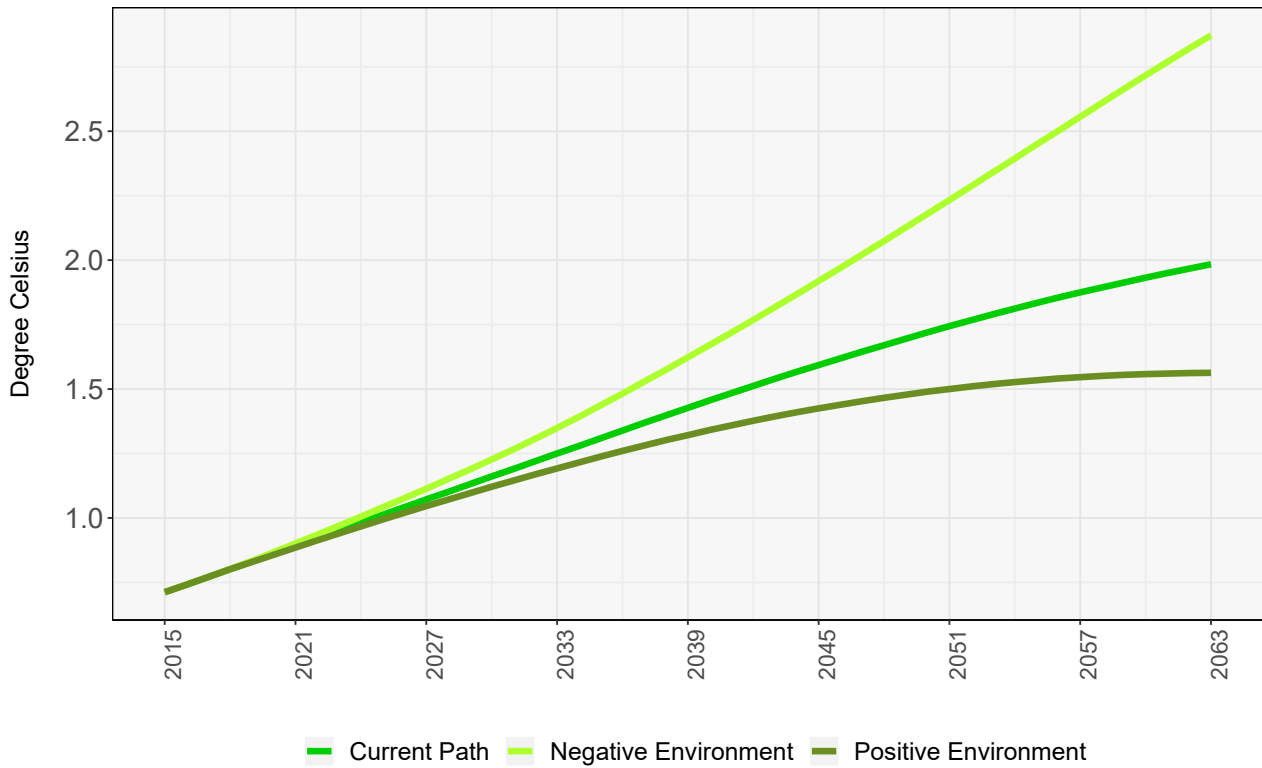


Figure 21: Temperature change across Current Path, Negative Environment, and Positive Environment scenarios, 2015-2063.

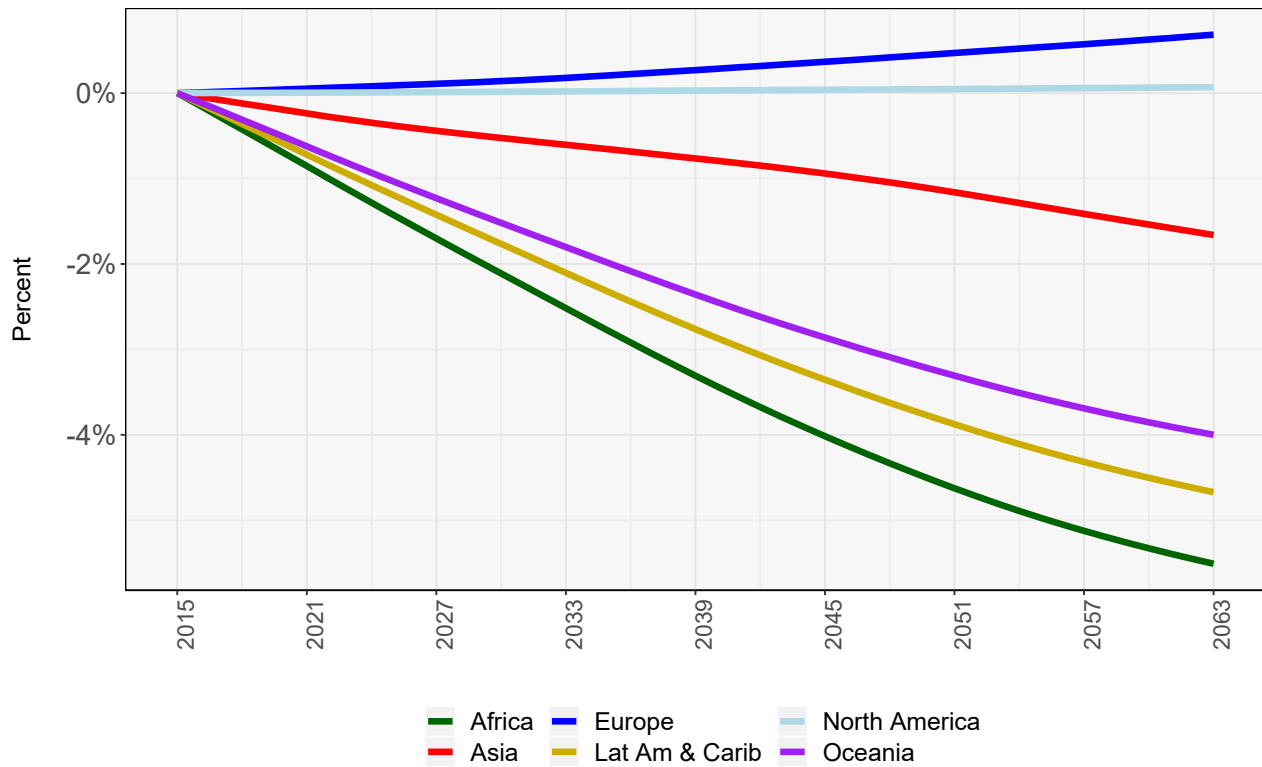


Figure 22: Impact of climate change on agricultural yield change by region, 2015-2063.

Africa's climate is also expected to be more volatile as we move through the 21st century. Although there is considerable uncertainty and variability in precipitation projections,¹⁴¹ extreme weather events will likely increase in frequency and intensity. Africa may experience deeper and more prolonged bouts with floods as well as droughts.¹⁴² One third of Africans already live in drought-prone areas¹⁴³ and by the 2080s Africa's proportion of arid and semi-arid areas is projected to grow between 5 and 8 percent.¹⁴⁴

Africa may be especially vulnerable to the effects of climate change, due to the economic composition of its countries and regions. African countries are particularly dependent on agriculture, which will face threats to productivity and arable land from climate change. Over half of all employment and 18 percent of Africa's GDP is from the agricultural sector. In addition to agriculture, many people work in other sectors vulnerable to climate change, like forestry, energy, tourism, and coastal and water resources.¹⁴⁵ By 2100, climate change could lead to losses for African farms of \$19 to \$48 billion.¹⁴⁶

Rain-fed agriculture is more vulnerable to hot and dry conditions than irrigated farms.¹⁴⁷ Africa's farming

infrastructure is much less reliant on irrigation, relying instead on rainfall to sustain crops. Only six percent of agricultural land in Africa is irrigated as opposed to 18 percent worldwide.¹⁴⁸

These risks may be mitigated through innovation and enhancements to agricultural infrastructure. Improved inputs, such as seeds, fertilizers such as improved seeds and increased irrigation.¹⁴⁹ Irrigated farms are more resilient to changes in precipitation, compared to rain fed farms.¹⁵⁰

All of this drives concerns about food security. By 2050, the portion of the population that is undernourished could increase by 25-90 percent compared to the present, under a moderate warming scenario,¹⁵¹ and severe stunting could increase 23-55 percent compared to a world without climate change.¹⁵² By the 2080s, climate change could place 80-120 million additional people at risk of hunger worldwide, with 70-80 percent of those in Africa.¹⁵³

Water stress may become more acute across the continent over the next fifty years. Between 75 and 250 million people are projected to be at risk of increased water stress by the 2020s and from 350 to 600 million by the 2050s.¹⁵⁴

The possible consequences of climate change are wide-reaching,¹⁵⁵ and will likely include:

- Health – climate change may be associated with increased incidence of malaria.¹⁵⁶
- Domestic conflict – climate change may increase the likelihood of conflict through causing conflict over scarce food and water resources, depressing economic growth, and triggering migration.¹⁵⁷
- Sea-level rise – rising oceans will displace coastal dwellings and require adaptation that could cost 5-10 percent of GDP.¹⁵⁸ Changes in ocean ecosystems could lead to losses in maximum catch potential by as much as 50 percent in some areas.¹⁵⁹
- Reduced tourism and biodiversity – reduced biodiversity hurts tourism, with from 20 to 40 percent of species of mammals in national parks becoming endangered.¹⁶⁰
- Straining fisheries – changes in ocean ecosystems could lead to losses in maximum catch potential by as much as 50 percent.¹⁶¹
- Informal settlements – many informal settlements are vulnerable to flooding, which can further lead to health problems as water and sanitation services are affected.¹⁶²

LOCALIZED ENVIRONMENTAL COSTS

While climate change will negatively impact development in Africa, local environmental issues will arise with frequency. These include local issues with polluted or scarce water resources, air pollution in developing urban areas, large slums and informal settlements without proper infrastructure connections, and general issues with waste and trash removal. Many of these issues cannot be tackled within a large quantitative model, but there is evidence that other developing contexts experienced similar pressures.

Other countries and regions with rapid economic and demographic transformations have experienced serious localized environmental costs. A 2014 publication elaborated on the highly mobile and hazardous groundwater contaminant common at hazardous waste sites, Chromium (Cr), that has been growing annually in Chinese cities like Hebei, Shandong, Guangdong, Zhejiang, and Shanxi in the past twenty years from industrial activities like metal fabrication and leather tanning.¹⁶³ The Yangtze River in China continues to face enormous pollution from metals and agro fertilizers that are exacerbated and trapped by hydropower impoundment reservoirs; levels of mercury in suspended sediment in the waterway now exceeds European Union recommendations by a factor of four.¹⁶⁴

African development has already created localized environmental challenges. The Lake Victoria watershed has also faced elevated levels of the chemical pollutant polychlorinated biphenyls (PCBs) in its air that have resulted from combustion activity in nearby African urban centers like Kampala, Kigali, Mwanza, and Kisumu.¹⁶⁵ Ghana's biggest urban slum, Old Fadama, is host to high levels of E-coli, fecal coliforms, and BOD5 levels that not only threaten the health of the residents, especially in the case of heavy flooding, but also the aquatic life and soil health of the area.¹⁶⁶ Recent studies have revealed the influence of agricultural practices in Northwestern Africa on airborne dusts, with a doubling of dust emissions in the past century that align specif-

ically with the expansion of common agriculture in the Sahel region.¹⁶⁷

High concentrations of cadmium, lead, copper, and zinc were found in the kidneys, livers, and muscles of livestock grazing on the Ait Ammar iron mining area in Morocco at levels that are not adequate to human health.¹⁶⁸ Although abandoned, this iron mine continues to leak toxic chemicals into its immediate surroundings that are then passing through the food chain via livestock. The rapid expansion of commercial horticulture production that has proliferated in Central Kenya has contributed to declining surface water quality, as sampled from 14 rivers in commercial hotspots Laikipia and Meru.¹⁶⁹ These water samples revealed the likes of cadmium, phosphate, and zinc from phosphate fertilizers and copper-based agrochemicals used in intensive farming that has since become common in the region.

Urban population growth and industrial behavior near coastal marine environments have also steadily increased in recent decades, as demonstrated in the Bay of Oran in Algeria. Urban waste dumped into the Bay without treatment, in addition to the waste products of nearby oil and gas refineries, actively contributes to the deterioration of marine biota and may affect bioaccumulation of toxic substances in edible seafood.¹⁷⁰ This situation is visible in a smaller scale urban waste environment on the shores of the Volta Lake in Ghana, too, where high levels of fecal coliform and other toxins harmful to local fish populations were found in the water immediately adjacent the shoreline market.¹⁷¹

These local environmental issues drive negative health outcomes. Over 400 farming villages in China experienced extremely high levels of cancer related to water contamination from nearby industry.¹⁷² Since 1973, documented increases in air pollution in India have been studied in tandem with available data on public health that resulted in more, total, and more severe cases of chronic bronchitis, respiratory problem, asthma and cardiovascular problem, especially in major metropolises.¹⁷³ Africa's natural system will continue to be tested at continental, regional, national, and more local levels as development continues.

GOVERNANCE

Governance consists of three dimensions based on transitions that underpin the typical Wesphalian state-formation processes.¹⁷⁴ The first transition is the security transition from anarchy to rule by a sovereign government. The second transition is to a government with greater capacity, with increasing competence, effectiveness, and resources. The final process is one in which states become more inclusive through increasing democracy and expanding political participation.

SECURITY

Conflict is still a serious concern across the continent, but its character is changing. Of 25 ongoing conflicts identified by the Council on Foreign Relations,¹⁷⁵ nine are located in Africa and four of those are worsening. According to the Peace Research Institute Oslo, there has been an increase in conflicts in Africa over the past five years – in fact 2015 and 2016 saw the most conflicts since 1946.¹⁷⁶ This increase has been driven

largely by the Islamic State’s involvement in pre-existing conflicts. But this increase has not been associated with an increase in battle deaths and conflicts are geographically constrained.¹⁷⁷ The number of successful coups and coup attempts has also fallen over the past twenty years but remains between two to four annually.¹⁷⁸ In 2018, Africa has 14 of the top 20 most fragile states, according to the Fund for Peace’s Fragile States Index.¹⁷⁹ And in 2016, 21 of the 26 countries deemed either extremely or highly fragile, according to the Center for Systemic Peace’s State Fragility Index, were African.¹⁸⁰ Moreover, with a large young population, increasing inequality, climate change, and the challenges brought by technological change, many areas will remain vulnerable to conflict for the foreseeable future.

Africa scores 0.68 on the IFs security index, the lowest of all world regions. It is projected to improve to almost 0.8 by 2063, bringing it to the level of Latin America and Caribbean and Asia in 2018. But measure masks a great deal of heterogeneity, with scores ranging from 0.53 (Somalia) to 0.96 (Mauritius).

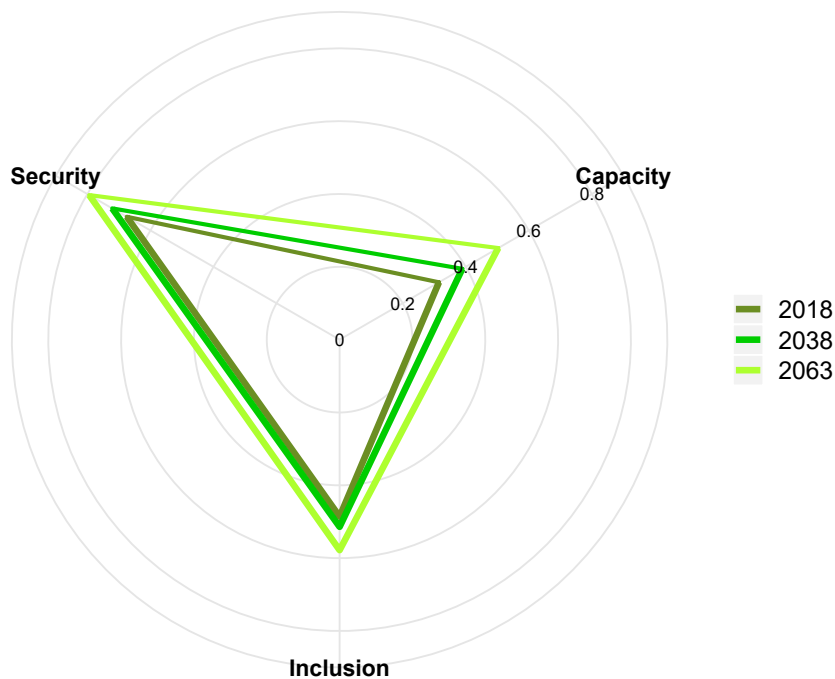


Figure 23: Governance transitions in Africa: security, capacity and inclusion, 2018, 2038, and 2063.

CAPACITY

A country with high levels of capacity is able to both mobilize resources and use them effectively. Africa broadly struggles in both of these areas. Governance capacity measures capture the ability of governments to generate revenue as well as measures of the quality of service provision (effectiveness and corruption). Capacity at the national level in Africa is poor; at 0.3 it is the lowest of all world regions. It is projected to improve to 0.5 by 2063 passing current levels of government capacity in Asia by mid-century and Latin America and Caribbean by 2063. But again, this aggregate measure conceals the wide range of scores on the continent, from 0.08 (Somalia) to 0.75 (Botswana). And while some countries are projected to see significant gains in capacity out to 2063, many are facing very little improvement along the Current Path.

In terms of resource mobilization, African countries have the lowest government revenue to GDP ratio of all world regions, at around 26 percent. Compare this to the OECD average of 38 percent and Asia's 29 percent. This is projected to improve to roughly 33 percent by 2063. Moreover, these figures include foreign aid. Africa currently receives over \$65 billion in net foreign aid and 18 countries receive aid that is more than 10 percent of their GDP (roughly the average for low-income economies as a whole). Aid will continue to grow in absolute terms but fall as a share of GDP.

Once resources are mobilized, states also need to be able to use them effectively and efficiently. One major barrier in this regard is corruption, which causes the leakage of resources before they are used for public services. Corruption remains prevalent on the continent. In 2017, just seven African countries ranked above the global average on Transparency International's Corruption Perception Index. Besides just reducing the government's resources available to use on the public, corruption has numerous other negative effects. Especially once considered the norm, corruption hurts a government's legitimacy, frustrates service delivery, discourages foreign investment, and leads to greater levels of informality, which then hinders the government's ability to collect revenue and then hurts anti-corruption efforts.¹⁸¹ Beyond corruption, the World Bank's Government Effectiveness index measures the quality of government services, policymaking and implementation, and civil service quality and independence from political pressure. In 2015, seven African countries scored above world average values on this measure (Mauritius, Seychelles, South Africa, Botswana, Namibia, Rwanda, and Cape Verde).

INCLUSION

Inclusive decision-making can be very resilient and happens in formal and informal ways. IFs measures inclusion to be a function of regime type (measures of

institutional inclusion), economic freedom, and gender empowerment. Currently, the score for inclusion on the continent is 0.48, a level similar to Asia though below other world regions. This is projected to improve slowly to 0.58 by 2063. But as with the other governance measures, this varies widely across the continent, from 0.25 (Republic of Congo) to 0.82 (South Africa), with just 16 countries exceeding the global average of 0.56 in 2015.

Democratic governance made considerable gains beginning in the 1990s. In 1990, just four countries in Africa were considered democracies, a number that jumped to ten by 2000 and 18 by 2010. In 2016, 23 African countries could be considered democracies, four were autocratic, and the rest were classified as some form of mixed regime (anocracy). But these gains are precarious – a fact demonstrated in recent years by contested elections, protests and secessionist sentiment, and a 'soft coup'. Gains have also been made in the area of gender inclusion. The Gender Empowerment Measure measures gender inclusion in Africa to be just over 0.3 lower than Asia (0.4) and Europe and Oceania (0.7). While this is projected to improve slightly – to 0.4 by 2063 – the continent on the whole is projected to lag behind other world regions. When looking at African countries individually, there is a wide range of values (0.16 to 0.7).

INSTITUTIONS

Regional and continental institutions also play an important role in leading governance in Africa. The African Union, African Development Bank, United Nations Economic Commission for Africa along with the eight regional economic communities represent a dense tapestry of overlapping rules, norms and values that shape African development. Development institutions create legal frameworks that can enhance continental wealth and development, like the recently agreed-upon Continental Free Trade Agreement. They can also play coordinating roles with other broader international agreements, like the Paris Agreement on climate change. These institutions will play a key role in shaping the future Africa wants.

There are very few data sources that can be used to better understand institutional characteristics related to governance—there is no measure of international organizational security, capacity, and inclusion, for example. However, while there are not data measuring governance characteristics across international organizations, it is clear that regional and continental organizations change the behavior of states by creating new norms, rules, and institutional frameworks that can change national incentives. These organizations are as much a part of the governance puzzle in Africa as are nation-states.

TRANSFORMING GEO-POLITICS

National governance and international organizations will operate within a transforming geopolitical framework. One transformation underway is the reduction in influence and power of historically colonizing nations. The percent of global military capabilities of France has declined from 6.4 in the 1960s and 1970s to 4.8 by 2018. The power of the United Kingdom declined from a peak of over nine percent of global power in 1960 to four percent today.

While traditional colonial powers decline, new powers are emerging with the rise of China and India. Figure 24 shows the relative material and security capabilities of China, India, and the US across time. Historically, the US has been the most powerful country in the international system with between 20-30 percent of global capabilities. But China has risen significantly and now stands with nearly 15 percent of global power. India follows behind and will begin to grow in might as well.

Across time, the US relative power position declines.

An alternative approach to measuring the influence of one country over another considers the dependencies that emerge from increasing trade, investment, aid, and diplomatic connections.¹⁸² Using this new bilateral measure we can look at how changing patterns of foreign influence are impacting African countries. Most notable is the decline of French influence, which stood as the most influential foreign country in Africa from 1963 to the mid-2000s. In addition, the relative influence of the United Kingdom has declined across time as well.

The relative rise of China in Africa can also be clearly seen in Figure 25. China is currently has the most influence of any foreign power in Africa surpassing the US in 2013. Unfolding geopolitical conflict between China and the US is likely to unfold—at least in part—in Africa. These future geopolitical shifts will dramatically impact African governmental decision-making and call for a more unified foreign policy response to avoid the real possibility of being divided along new Cold War lines.

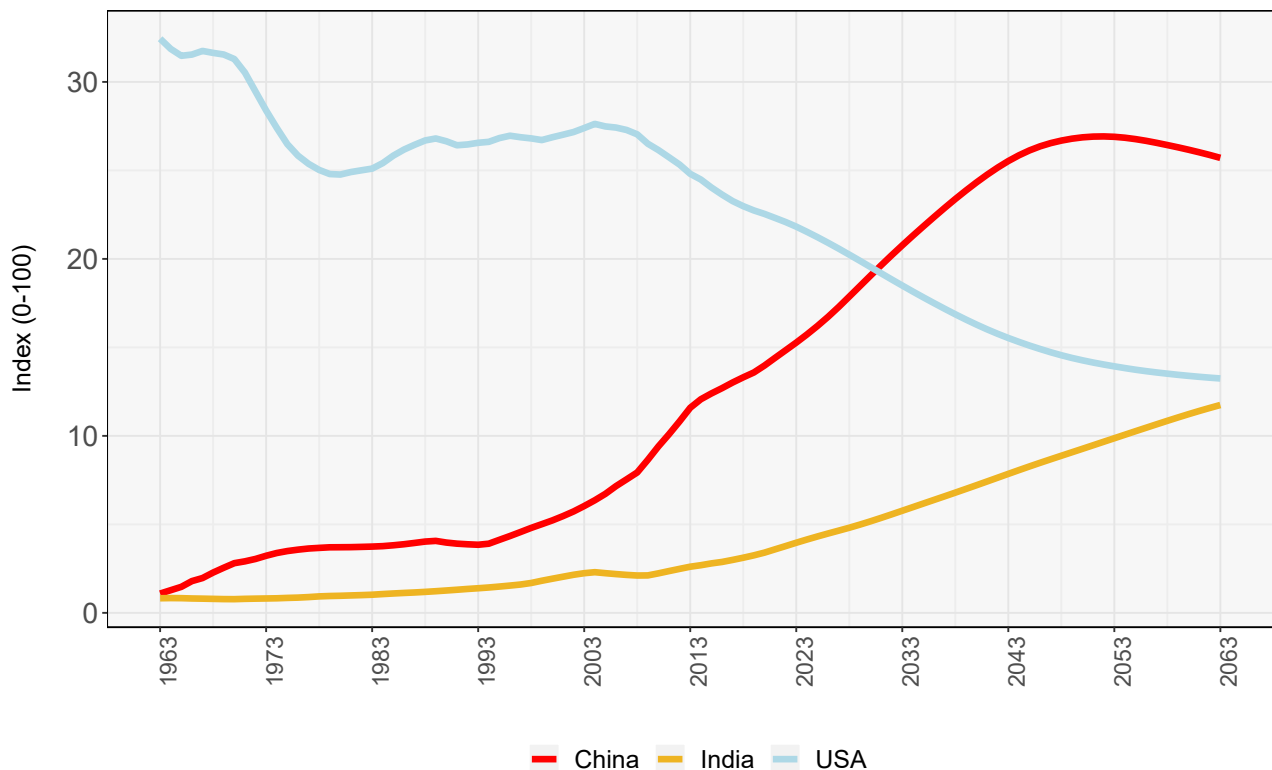


Figure 24: Relative power of China, India, US, using five year moving average.

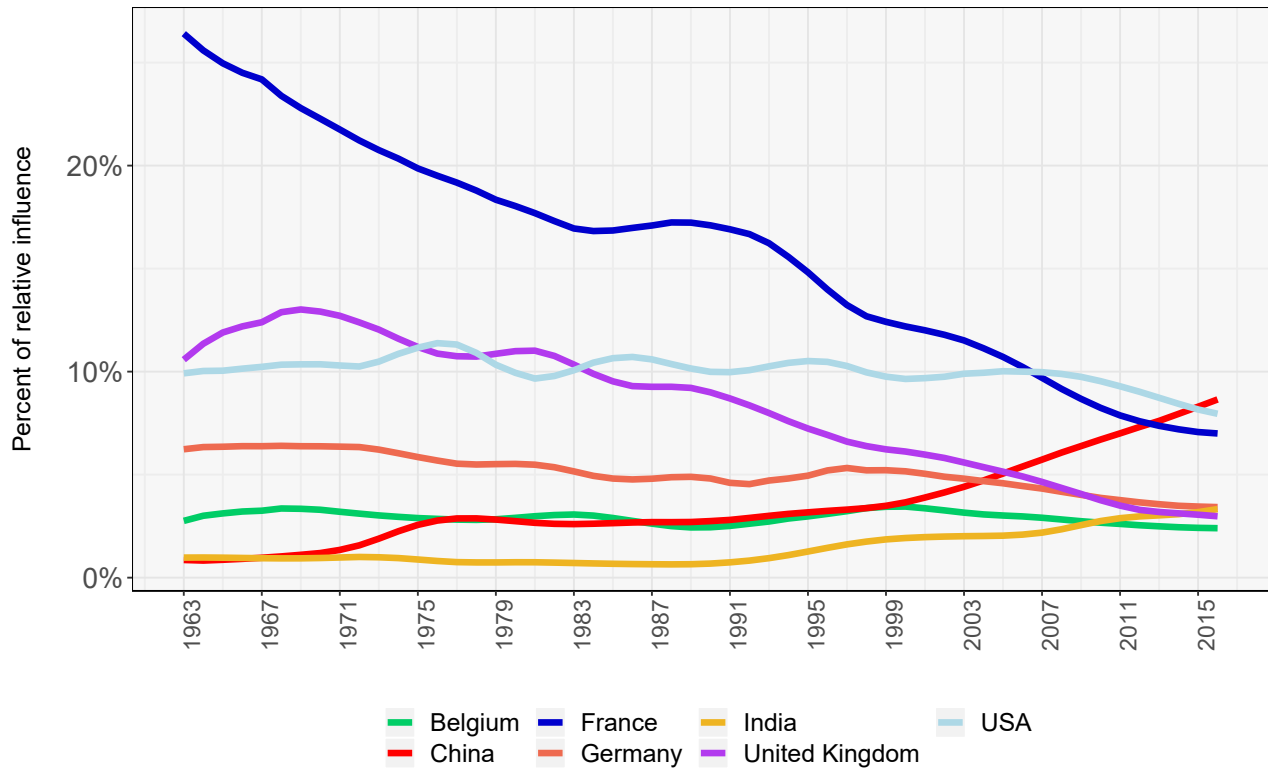


Figure 25: Foreign influence in Africa, using five year moving average.

HOW DO CHANGING PATTERNS OF GOVERNANCE IMPACT TRANSITIONS?

Changing patterns of governance will impact some of the transformations outlined earlier in this report. For example, Figure 26 shows the Current Path along with high and low framing scenarios for human development. Those scenarios are shown in the three shades of green used throughout this report. In addition to these scenarios, though, we have layered high and low human development along with high and low governance development (the scenarios in light and dark blue). Good governance can double the impact of the high human development scenario. This demonstrates that enhancing governance while at the same time improving human development-oriented policies can cre-

ate a virtuous cycle. Additionally, good governance can mitigate some of the negative impact of poor policies associated with human development. When combining a negative human development scenario with good governance, the development outcomes are the same as shown in the Current Path.

However, the impact of good governance on improving development outcomes is contingent on the issue-area in question. Figure 27 shows seven scenarios (the same number of scenarios as is shown in Figure 26): the Current Path, Positive Natural System, Negative Natural System, Good Governance and Negative Natural System, Bad Governance and Negative Natural System, Good Governance and Positive Natural System, and Good Governance and Negative Natural System. However, only three lines appear. This is because the positive and negative governance scenarios in Africa do not have a significant impact on reducing global carbon emissions.

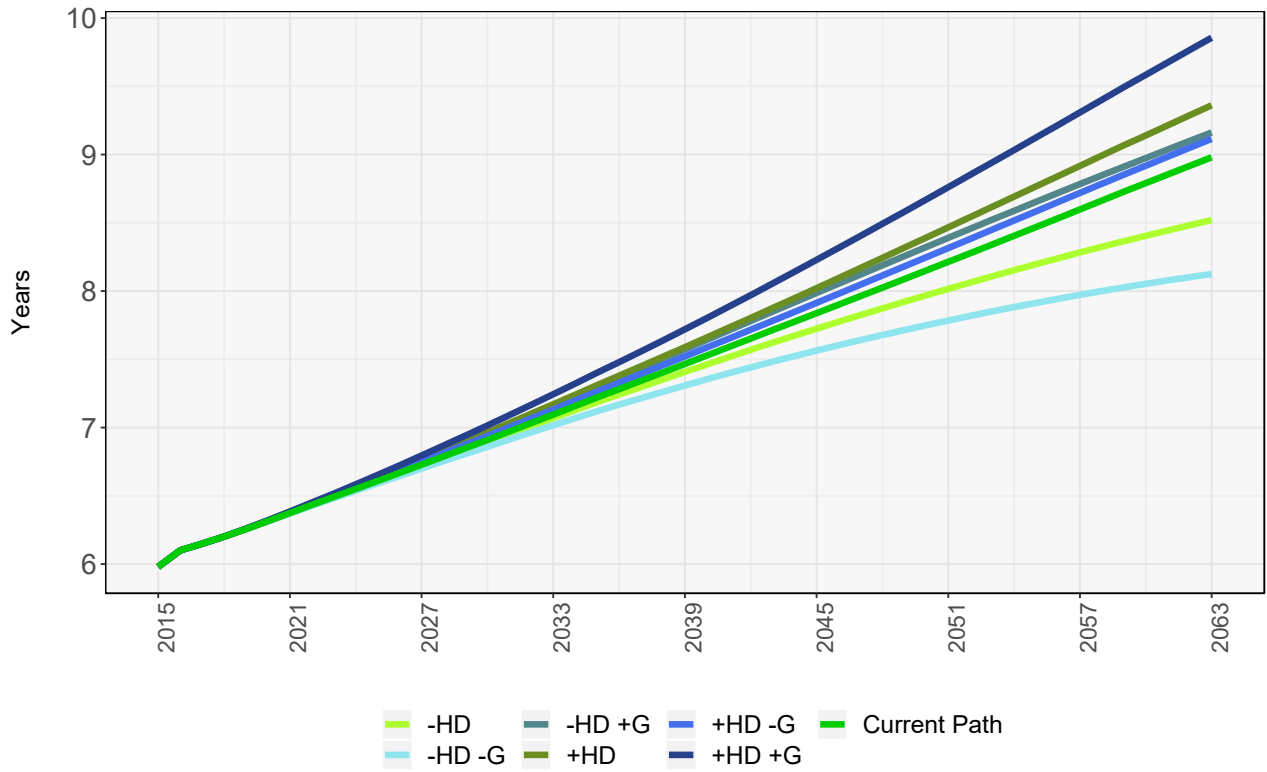


Figure 26: Human development transition and governance, 2015-2063.

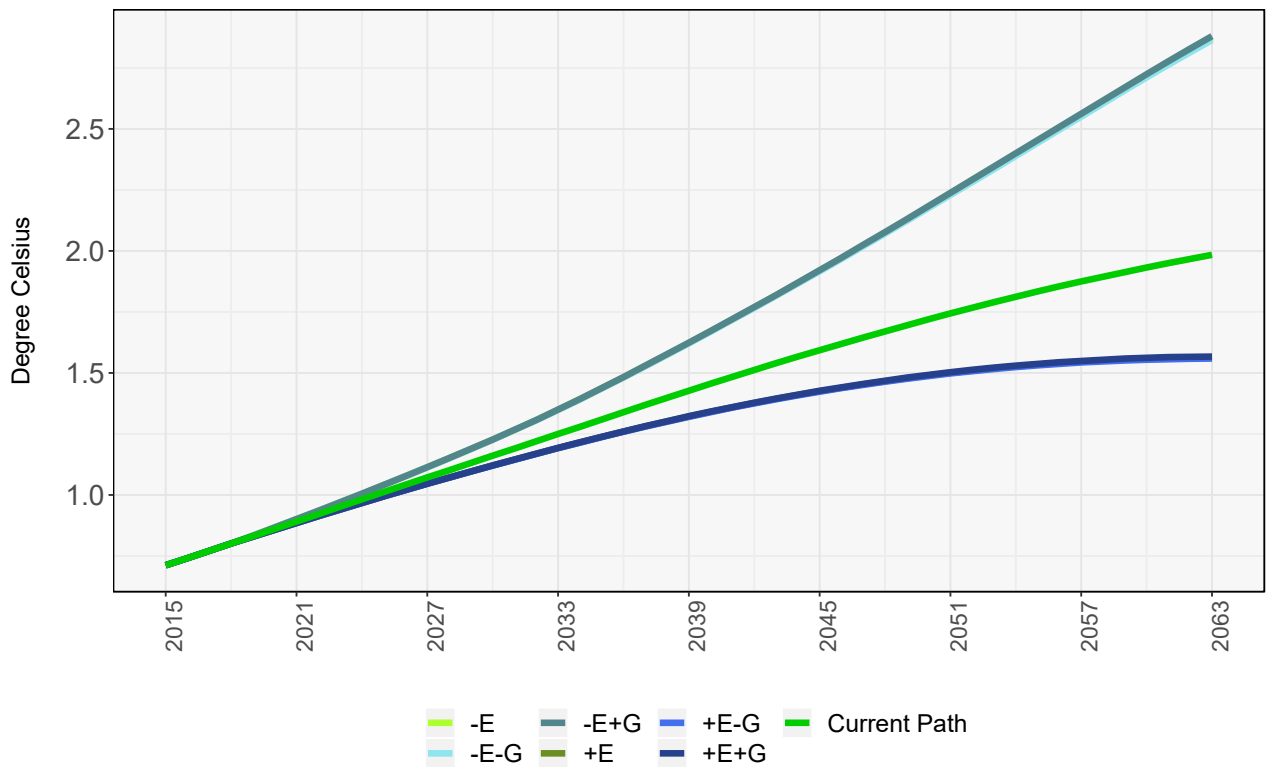


Figure 27: Governance impact on natural system trends.

THE FUTURE UNCERTAINTY

Transforming governance in Africa at the national, regional, and continental level will be increasingly crucial as the continent moves through the four transformations outlined in this report. But changing governance is not easy and relies on building transparent and accountable institutions that promote broad-based and sustainable human development. Choosing to improve this characteristic of development will have costs that we cannot anticipate in this modeling effort.

This report is primarily focused transformations oc-

curing at the continental level with high degrees of confidence. The transitions described here represent both opportunities and challenges that will need to be confronted by governments and institutions to move Africa on a more optimal development trajectory. Because choice still exists within the context of continental transitions, the future Africa wants is yet to be determined. Figure 28 shows the impact across all scenarios tested in this report on GDP per capita at PPP for Africa. The green line represents the Current Path projection. Each grey line represents an alternative scenario (see the section on Methodology).

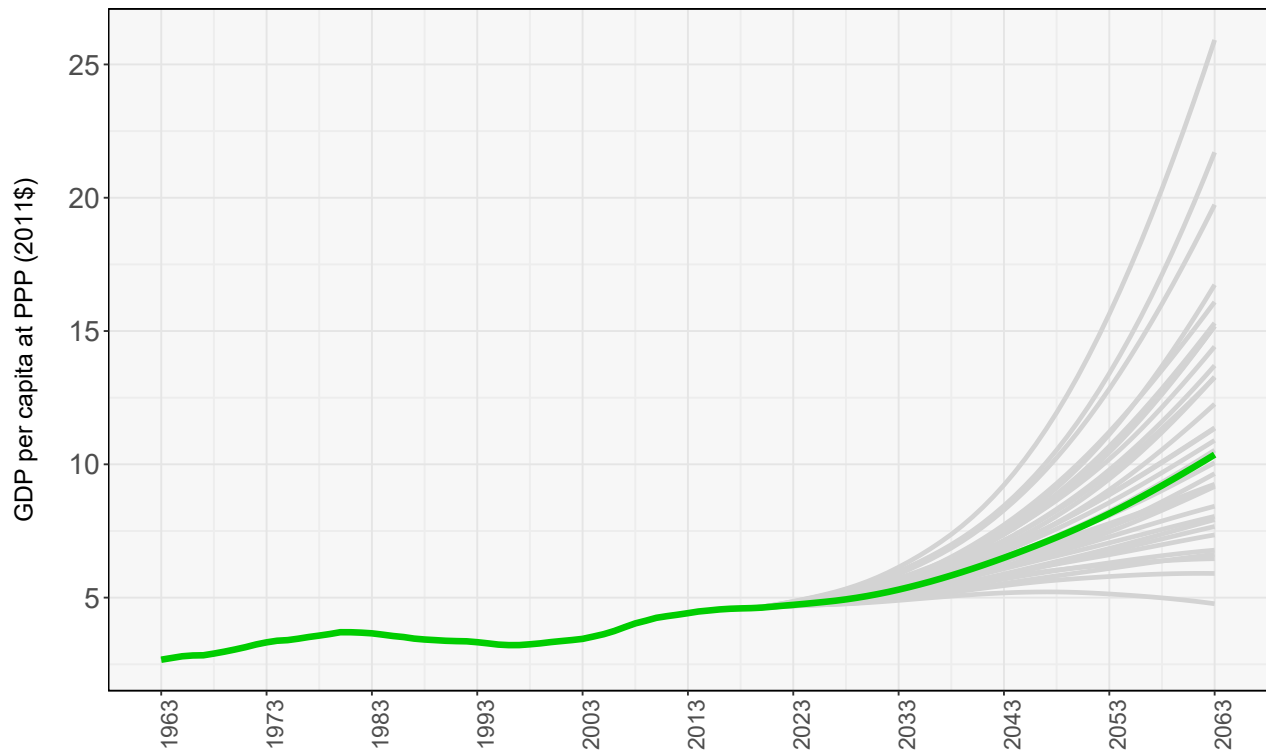


Figure 28: All scenario results for GDP per capita at PPP (2011\$) with Current Path highlighted, 1963-2063, US, using five year moving average.

CONCLUSION

This report has outlined four broad transitions occurring within Africa along with some implications of these development trends. Table 10 shows the impact of framing scenarios on the persistent transitions identified in this report. GDP per capita (at PPP) varies only slightly across these broad framing scenarios indicating that these transformations are occurring with high levels of certainty.

The sensitivity scenarios demonstrate that these four transformations are occurring with a high degree of certainty. The gap in GDP per capita (at PPP) between the high and low framing scenarios in 2038 is only \$800. Leaders should be aware that these transformations are occurring, understand how they will impact their country, and incorporate these transformations into their development planning. At a regional

and continental level organizations such as the African Union should also be poised to leverage the opportunities associated with each transformation and mitigate the challenges. This will require real effort and will involve trade-offs.

The transformations we outlined—demography, human development and inequality, technology, and natural systems—occur within a developmental context in which decision-making and leadership matters. When testing additional scenarios that include improvements to governance, the future range of possibility is much larger. Table 11 reports this by bringing all of the positive and negative scenarios together into combined scenarios and then also layering in improved or deteriorated governance. This table shows the power of good governance to mitigate negative development

Table 10: Positive and negative development scenarios for GDP per capita at PPP (2011\$) for 2018, 2038, and 2063.

	2018	2038	2063
Current Path	\$4.6	\$6.5	\$11.8
Negative Demographics	\$4.6	\$6.3	\$10.6
Positive Demographics	\$4.6	\$6.8	\$12.7
Negative Human Development	\$4.6	\$6.4	\$10.3
Positive Human Development	\$4.6	\$6.8	\$14.2
Negative Technology	\$4.6	\$6.3	\$8.9
Positive Technology	\$4.6	\$7.1	\$18.3
Negative Environment	\$4.6	\$6.6	\$11.4
Positive Environment	\$4.6	\$6.6	\$12.1

scenarios. The Combined Negative scenario with Positive Governance leads to GDP per capita on a continental basis that is close to the Current Path scenario. It also shows the power of good governance to amplify positive development outcomes. In a scenario in which all development transformations proceed optimistically and governance is significantly enhanced, continental GDP per capita grows to \$31,100, the level of World Bank High Income economies in the late 1990s.

The future Africa wants will be determined by her

people working through political leaders, civil society, and international institutions. It requires decision-making and capacity building to more effectively discern the future. It requires an understanding unfolding transformations and the political choices that can be made to catalyze development, mitigate negative externalities and collective action problems, and encourage healthy societies to grow, change, and express themselves.

Table 11: The impact of positive and negative governance on development for GDP per capita at PPP (2011\$) for 2018, 2038, and 2063.

	2018	2038	2063
Negative Governance	\$4.6	\$6.0	\$8.7
Positive Governance	\$4.6	\$7.1	\$16.0
Combined Negative without Governance	\$4.6	\$6.0	\$7.1
Combined Negative with Negative Governance	\$4.6	\$5.5	\$4.9
Combined Negative with Positive Governance	\$4.6	\$6.7	\$10.5
Combined Positive without Governance	\$4.6	\$7.7	\$23.6
Combined Positive with Negative Governance	\$4.6	\$7.0	\$18.0
Combined Positive with Positive Governance	\$4.6	\$8.5	\$31.1

APPENDIX A: SCENARIO ASSUMPTIONS AND JUSTIFICATIONS

Scenario	Assumptions
Demography (negative)	Fertility rates fall more slowly than projected, similar to the historical pattern of Mozambique. The fertility rate in Africa reaches 3.7 births per woman in 2063, comparable to rates in Zimbabwe or Papua New Guinea in 2015 (Current Path in 2063 = 2.2).
	The burden of AIDS falls more slowly than projected. The death rate from AIDS in Africa reaches 0.005 deaths per 100 people by 2063, similar to India in 2015 (Current Path in 2063 = 0.003).
	The burden of diarrheal disease falls more slowly than projected. The death rate from diarrheal disease in Africa reaches 0.024 deaths per 100 people by 2063, similar to Laos or Sudan in 2015 (Current Path in 2063 = 0.016).
	The burden of malaria falls more slowly than projected. The death rate from malaria in Africa reaches 0.02 deaths per 100 people by 2063, similar to Senegal or Rwanda in 2015 (Current Path in 2063 = 0.016).
	The burden of respiratory infections falls more slowly than projected. The death rate from respiratory infections in Africa reaches 0.03 deaths per 100 people by 2063, similar to Yemen or Pakistan in 2015 (Current Path in 2063 = 0.02).
	The burden of other communicable diseases falls more slowly than projected. The death rate in Africa from communicable diseases other than those listed above reaches 0.09 deaths per 100 people by 2063, similar to Botswana or Indonesia in 2015 (Current Path in 2063 = 0.04).
Demography (positive)	Fertility rates fall more rapidly, at a rate comparable to that seen in Egypt from the mid-1980s to the early 2000s. The fertility rate in Africa reaches 1.9 births per woman by 2063, similar to Sweden or the United States in 2015 (Current Path in 2063 = 2.2).
	The burden of AIDS falls more rapidly. The death rate from AIDS in Africa reaches 0.002 deaths per 100 people by 2063, similar to Australia in 2015 (Current Path in 2063 = 0.003).
	The burden of diarrheal disease falls more rapidly. The death rate from diarrheal disease in Africa reaches 0.01 deaths per 100 people by 2063, similar to Cape Verde or Bolivia in 2015 (Current Path in 2063 = 0.016).
	The burden of malaria falls more rapidly. The death rate from malaria in Africa reaches 0.005 deaths per 100 people by 2063, similar to Namibia or India in 2015 (Current Path in 2063 = 0.01).
	The burden of respiratory infections falls more rapidly. The death rate from respiratory infections in Africa reaches 0.016 deaths per 100 people by 2063, similar to New Zealand or Colombia in 2015 (Current Path in 2063 = 0.023).

Demography (positive)	The burden of other communicable diseases falls more rapidly. The death rate from other communicable diseases reaches 0.02 deaths per 100 people by 2063, similar to Egypt or Argentina in 2015 (Current Path in 2063 = 0.04).
Human Development (negative)	Health spending, as a percent of GDP, begins to fall instead of growing slightly through the horizon, as seen in the Current Path. In 2063, Africa spends 1.8 percent of GDP on health, similar to Uruguay or Chad in 2015 (Current Path in 2063 = 3.7).
	Education spending as a share of total government consumption falls instead of remaining relatively constant. In 2063, Africa spends 2.4 percent of GDP by 2063, similar to the Democratic Republic of Congo or Uganda in 2015 (Current Path in 2063 = 5.2).
	Spending on core infrastructure (including road transportation, electricity, ICT, and water and sanitation), as a share of total government consumption, falls more rapidly than in the Current Path. Africa spends 0.6 percent of GDP on these types of infrastructure in 2063, similar to Angola or Seychelles in 2015 (Current Path in 2063 = 0.7).
	Other infrastructure spending falls as a share of total government consumption through the forecast horizon instead of remaining relatively constant. Africa spends 1.1 percent of GDP on other infrastructure in 2063 (Current Path in 2063 = 2.2).
	Access to piped water expands at a slower pace, similar to the rate seen in the Republic of Congo since 2000. Access in Africa reaches 53 percent of the population by 2063, similar to Eswatini or the Republic of Congo in 2015 (Current Path in 2063 = 92).
	Access to improved sanitation expands at a slower pace, similar to the rate experienced by the Republic of Congo since 2000. Access in Africa reaches 53 percent of the population by 2063, similar to Bolivia or Eswatini in 2015 (Current Path in 2063 = 95).
	Road construction progresses more slowly than historical averages. The road network in Africa reaches 3.5 million kilometers by 2063 (Current Path in 2063 = 3.9 million).
	The share of paved roads begins to plateau in the mid-2040s. In 2063, 43 percent of roads are paved in Africa, similar to Djibouti or Malawi in 2015 (Current Path in 2063 = 50).
	Communicable disease mortality rates fall less rapidly, and non-communicable disease mortality rates grow more rapidly than in the Current Path. The overall mortality rate in Africa reaches 0.8 deaths per 100 people by 2063, similar to Namibia or Sudan in 2015 (Current Path in 2063 = 0.7).
	African countries become more unequal, reaching levels seen in some of the most unequal countries on the continent today. Africa reaches a Gini index score of 0.52 by 2063 (Current Path in 2063 = 0.42).
Human Development (positive)	Health spending, as a percent of GDP, increases at a rate similar to historically high continent-wide levels (2005 - 2015). Africa spends 5.7 percent of GDP on health by 2063, similar to Israel or Algeria in 2015 (Current Path in 2063 = 3.7).
	Education spending grows instead of remaining relatively constant as a share of total government consumption. Africa spends 6.4 percent of GDP on education in 2063, similar to Mozambique or New Zealand in 2015 (Current Path in 2063 = 5.2).

<p>Human Development (positive)</p>	<p>Core infrastructure spending (including road transportation, electricity, ICT, and water and sanitation) grows and then remains steady at around 16 percent of total government consumption through the mid-2030s before gradually declining. Africa spends 1.3 percent of GDP on core infrastructure by 2063, similar to Botswana or Sweden in 2015 (Current Path in 2063 = 0.7).</p>
	<p>Spending on other infrastructure grows as a share of total government consumption through the forecast horizon instead of remaining relatively constant. Africa spends 3.9 percent of GDP on other infrastructure by 2063 (Current Path in 2063 = 2.2).</p>
	<p>Access to piped water grows more quickly, at a pace similar to Uganda or Somalia from 2000 to 2015. Access in Africa reaches 100 percent of population by 2063 (Current Path in 2063 = 92).</p>
	<p>Access to improved sanitation grows more quickly, at a pace similar to Angola during the 2000s. Access in Africa reaches 100 percent of population by 2063 (Current Path in 2063 = 95).</p>
	<p>The share of paved roads grows steadily through the forecast horizon. By 2063, 67 percent of Africa's roads are paved, similar to Morocco or the United States in 2015 (Current Path in 2063 = 50).</p>
	<p>Road construction matches historical peaks by end of horizon. By 2063, the road network in Africa reaches 7.9 million kilometers by 2063 (Current Path in 2063 = 3.9 million).</p>
	<p>Communicable disease mortality rates fall more rapidly, and non-communicable disease mortality rates grow more slowly than in the Current Path. The overall mortality rate in Africa reaches 0.6 deaths per 100 people by 2063, similar to Cape Verde or Israel in 2015 (Current Path in 2063 = 0.7).</p>
	<p>African countries become more equal, reaching levels seen in some of the most equal countries on the continent today. The Gini index in Africa reaches 0.33 by 2063 (Current Path in 2063 = 0.42).</p>
<p>Technology (negative)</p>	<p>Renewable energy adoption is slow, and it does not become the dominant source of energy in Africa before the end of the forecast horizon. In 2063, renewables make up 28 percent of total production in Africa, similar to Spain or Turkey in 2015 (Current Path in 2063 = 48).</p>
	<p>Fixed broadband adoption occurs more slowly. Despite this, access still surpasses leading countries today. Access in Africa reaches 46 subscriptions per 100 people by 2063 (Current Path in 2063 = 50.5).</p>
	<p>Mobile broadband adoption occurs more slowly. Despite this, access still surpasses the level of access seen in Sweden today. Access in Africa reaches 128 subscriptions per 100 people by 2063 (Current Path in 2063 = 152).</p>
	<p>Due to a slower advance and diffusion of technology, global GDP growth is an annual 0.6 percentage points lower on average through 2063. In Africa, average annual GDP growth is nearly 1 percentage point lower. In Africa, 2063 GDP growth reaches 2.7 percent (Current Path in 2063 = 4.5).</p>

Technology (negative)	<p>Crop yields remain relatively constant through the horizon. In 2063, yields in Africa are 3.7 metric tons per hectare by 2063, similar to the Democratic Republic of Congo or Romania in 2015 (Current Path in 2063 = 5.6 million).</p>
	<p>Electricity access grows along historical rates but plateaus earlier than in the Current Path. Access in Africa reaches 65 percent of population by 2063, similar to Cote d'Ivoire or Bangladesh in 2015 (Current Path in 2063 = 89).</p>
	<p>Fish landings steadily decline through the forecast horizon. Catches in Africa reach 1.7 million metric tons by 2063 (Current Path in 2063 = 5.3).</p>
	<p>Aquaculture production grows more slowly before plateauing and beginning to decline by the mid-2040s. Production in Africa reaches 5.9 million metric tons by 2063 (Current Path in 2063 = 11.5 million).</p>
Technology (positive)	<p>Renewable energy becomes the dominant source of energy in Africa by the mid-2040s. By 2063, renewables make up 69 percent of total energy production in Africa, similar to Portugal or Costa Rica in 2015 (Current Path in 2063 = 48).</p>
	<p>Unemployment grows in reaction to increased automation but begins to decline again during the mid-2020s. Unemployment in Africa reaches 5.5 percent by 2063, similar to USA or Russia in 2015 (Current Path in 2063 = 5.4).</p>
	<p>Fixed broadband adoption accelerates, surpassing the level of adoption seen in Switzerland today by 2038. Africa reaches 49.9 subscriptions per 100 people by 2063 (Current Path in 2063 = 49.5).</p>
	<p>Mobile broadband adoption accelerates, surpassing the level of adoption seen in Switzerland today by the early 2030s. Africa reaches 153 subscriptions per 100 people by 2063 (Current Path in 2063 = 152).</p>
	<p>Due to more rapid advance and diffusion of technology, global GDP growth is an annual 0.7 percentage points higher on average through 2063. In Africa, average annual GDP growth is nearly 1.2 percentage points higher. In Africa GDP growth in 2063 reaches 5.8 percent (Current Path in 2063 = 4.4).</p>
	<p>With the rapid adoption of agricultural technology and best practices, yields increase dramatically through 2030. Yields in Africa reach 11.8 metric tons per hectare by 2063, similar to Switzerland or Israel in 2015 (Current Path in 2063 = 5.6).</p>
	<p>Electricity access increases significantly through the 2020s and 2030s, before beginning to plateau at around 95 percent in the late 2040s. Access in Africa reaches 99 percent of population by 2063 (Current Path in 2063 = 89).</p>
	<p>Fish landings grow at a steady pace, doubling by the end of the forecast horizon. Catches in Africa reach 10.5 million metric tons by 2063 (Current Path in 2063 = 5.3).</p>
	<p>Aquaculture production grows steadily, tripling by the end of the forecast horizon. Production in Africa reaches 17.3 million metric tons by 2063 (Current Path in 2063 = 11.5 million).</p>

Environment (negative)

Air pollution (micrograms per cubic meter) remains at constant 2018 levels, instead of decreasing. Pollution in Africa reaches 39 micrograms per cubic meter by 2063, similar to Tunisia or Ethiopia in 2015 (Current Path in 2063 = 15).

Water demand from agricultural, industrial, and municipal sources increases, due to water use efficiency advancing more slowly. African demand reaches 180 cubic meters per capita by 2063, similar to Qatar or Ireland in 2015 (Current Path in 2063 = 130).

Surface water resources become increasingly constrained due to environmental, economic, or political reasons. By 2063, surface water resources in Africa fall to 1,300 cubic kilometers (Current Path in 2063 = 1,800).

Ground water resources become increasingly constrained due to environmental, economic, or political reasons. By 2063, surface water resources in Africa fall to 690 cubic kilometers (Current Path in 2063 = 970).

Temperature is more responsive to climate change, leading to an increase in global temperature in line with IPCC high-emission scenarios. Temperature rise in Africa reaches 2.9 degrees Celsius by 2063, similar to the IPCC high-emission scenario (Current Path in 2063 = 2).

Fossil fuels become relatively cheaper to produce, leading to an increase in oil production. Oil production in Africa makes up 22 percent of total energy production by 2063, similar to Comoros or Micronesia in 2015 (Current Path in 2063 = 12).

Fossil fuels become relatively cheaper to produce, leading to an increase in gas production. Gas production in Africa makes up 33 percent of total energy production by 2063, similar to Libya or the United States in 2015 (Current Path in 2063 = 29).

Fossil fuels become relatively cheaper to produce, leading to an increase in coal production. In Africa, coal production makes up 25 percent of total energy production by 2063, similar to the United States in 2015 (Current Path in 2063 = 6).

Technological advance in renewable energy production is slower, resulting in limited and offset adoption. In 2063, renewables account for 16 percent of total energy production in Africa, similar to Belgium or Senegal in 2015 (Current Path in 2063 = 48).

Crops are more negatively responsive to climate change, resulting in slow and more volatile yield growth. In addition, the adoption of better agricultural practices and technologies advances more slowly. Yields in Africa reach 4.2 metric tons per hectare by 2063, similar to Iran or Kenya in 2015 (Current Path in 2063 = 5.6).

As a result of lower crop yields, additional land is used for cultivation. By 2063, 340 million hectares in Africa are under cultivation (Current Path in 2063 = 300 million).

As a result of expanding cropland, deforestation accelerates. By 2063, Africa's forests cover just 420 million hectares (Current Path in 2063 = 530 million).

<p>Environment (positive)</p>	<p>Water demand from agricultural, industrial, and municipal sources decreases, due to improvements in water use efficiency. Demand in Africa falls to 80 cubic meters per capita by 2063, similar to Botswana in 2015 (Current Path in 2063 = 130).</p>
	<p>Surface water resources become less constrained due to environmental, economic, or political reasons. By 2063, African surface water resources reach 2,200 cubic kilometers (Current Path in 2063 = 1,800).</p>
	<p>Ground water resources become less constrained due to environmental, economic, or political reasons. By 2063, African ground water resources reach 1,200 cubic kilometers by 2063 (Current Path in 2063 = 970).</p>
	<p>Temperature is less responsive to climate change, leading to an increase in global temperature in line with IPCC low-emission scenarios. Temperature rise in Africa reaches 1.6 degrees Celsius by 2063, similar to the IPCC low-emission scenario (Current Path in 2063 = 2).</p>
	<p>Renewable energy technology advances and adoption increases more rapidly. By 2063, renewables make up 55 percent of total energy production in Africa, similar to the Philippines or Jordan in 2015 (Current Path in 2063 = 48).</p>
	<p>As a result of increased carbon taxes, energy demand is somewhat depressed. Demand in Africa reaches 6.9 barrels of oil equivalent (BOE) per capita by 2063, similar to Uruguay in 2015 (Current Path in 2063 = 7.1).</p>
	<p>As a result of higher yields, less additional crop land is necessary to meet demand. In 2063, 280 million hectares are under cultivation in Africa (Current Path in 2063 = 300 million).</p>
	<p>There is greater protection for forests and an increase in reforestation efforts. Forests in Africa reach 640 million hectares by 2063 (Current Path in 2063 = 530 million).</p>
	<p>Crops are less negatively responsive to climate change, resulting in a higher growth in yields. In addition, the adoption of better agricultural practices and technologies accelerates yield growth. Yields in Africa reach 6.3 metric tons per hectare by 2063, similar to Cuba or India in 2015 (Current Path in 2063 = 5.6).</p>
	<p>Air pollution (micrograms per cubic meter) continues to decline at historical rates instead of slowing. Pollution in Africa reaches 10 micrograms per cubic meter by 2063, similar to Spain or Ireland in 2015 (Current Path in 2063 = 15).</p>
<p>Governance (negative)</p>	<p>By the late 2020s, foreign aid as a percent of GDP increases to early 2000s levels before falling again. Aid in Africa makes up 3.9 percent of GDP by 2063, similar to Ghana or Myanmar in 2015 (Current Path in 2063 = 4.4).</p>
	<p>Labor participation rates plateau today and begin to decline more rapidly. Most of this reduction is attributed to a decrease in male participation. Total participation in Africa reaches 55 percent by 2063, similar to France or Nigeria in 2015 (Current Path in 2063 = 62).</p>

Governance (negative)	<p>Informal employment (as a percent of total non-agricultural employment) remains fairly constant through the forecast horizon. In 2063, 51 percent of non-agricultural labor in Africa is informal, similar to Angola or Djibouti in 2015 (Current Path in 2063 = 27).</p>
	<p>Unemployment grows steadily before plateauing around 2050. Unemployment in Africa reaches 14.9 percent by 2063, similar to Tunisia in 2015 (Current Path in 2063 = 5.4).</p>
	<p>Government effectiveness improves only marginally through the horizon. Along the World Bank's Government Effectiveness Indicator, Africa reaches a score of 1.9 by 2063, similar to Eswatini or Burkina Faso in 2015 (Current Path in 2063 = 2.6).</p>
	<p>Government transparency remains fairly constant through the forecast horizon. Along Transparency International's Corruption Perceptions Index, Africa reaches a score of 3.2 by 2063, similar to Eswatini or Zambia in 2015 (Current Path in 2063 = 4.3).</p>
	<p>Gender empowerment remains fairly constant through the forecast horizon. Along the UNDP's Gender Empowerment Measure, Africa reaches a score of 0.34 by 2063, similar to Cameroon or Mozambique in 2015 (Current Path in 2063 = 0.41).</p>
	<p>The threat of internal war remains constant throughout the forecast horizon. Africa reaches a score of 0.18 on the IFs Internal War index by 2063 (Current Path in 2063 = 0.07).</p>
	<p>Homicides steadily grow throughout the forecast horizon. The death rate from homicide in Africa reaches 14 deaths per 1000 people by 2063, similar to Belarus or Argentina in 2015 (Current Path in 2063 = 8).</p>
	<p>Governments are unable to significantly improve tax revenue collection. Government revenues in Africa reach 24 percent of GDP by 2063, similar to Costa Rica or Paraguay in 2015 (Current Path in 2063 = 33).</p>
	<p>In 2063, the operational and administrative budget allocation is similar to 2015 levels. In 2063, 27 percent of total government consumption in Africa is spent on operations and administration (Current Path in 2063 = 23).</p>
Governance (positive)	<p>Foreign aid as a percent of GDP remains relatively constant through the forecast horizon. Aid in Africa reaches 4.5 percent of GDP by 2063 (Current Path in 2063 = 4.4).</p>
	<p>Government effectiveness improves at a rate somewhat slower than the gains seen in Rwanda since the mid-1990s. Along the World Bank's Government Effectiveness indicator, Africa reaches a score of 3.3 by 2063, similar to Poland or Qatar in 2015 (Current Path in 2063 = 2.6).</p>
	<p>Government transparency improves more rapidly through the forecast horizon. Along Transparency International's Corruption Perceptions Index, Africa reaches score of 5.6 by 2063, similar to Cape Verde or Puerto Rico in 2015 (Current Path in 2063 = 4.3).</p>

Governance (positive)	Gender empowerment improves more rapidly through the forecast horizon. Along the UNDP's Gender Empowerment Measure, Africa reaches a score of 0.49 by 2063, similar to Eswatini or Brazil in 2015 (Current Path in 2063 = 0.41).
	Labor participation rates continue to grow through the mid-2030s before plateauing and falling slightly. Most growth can be attributed to an increase in female participation. Total participation in Africa reaches 68 percent by 2063, similar to Cape Verde or Switzerland in 2015 (Current Path in 2063 = 62).
	Informal employment (as a percent of total non-agricultural employment) falls at a rate similar to historical trends in Peru and Colombia. By 2063, 14 percent of non-agricultural labor in Africa is informal, similar to Mauritius or South Korea in 2015 (Current Path in 2063 = 27).
	Unemployment, already at a relatively low level, falls somewhat relative to the Current Path. By 2063, unemployment in Africa reaches 4.9 percent, similar to Senegal or Switzerland in 2015 (Current Path in 2063 = 5.4).
	The threat of internal war approaches zero by the end of the forecast horizon. Africa reaches a score of 0.02 on the IFs Internal War index by 2063 (Current Path in 2063 = 0.07).
	Homicides decline at a rate similar to what was experienced on the continent during the 2000s. The death rate from homicide in Africa reaches 4 deaths per 1000 people by 2063, similar to Mauritania or Israel in 2015 (Current Path in 2063 = 8).
	Governments successfully improve tax revenue collection. Government revenues in Africa reach 44 percent of GDP by 2063, similar to Ukraine or Bosnia in 2015 (Current Path in 2063 = 33).
	By 2063, the operational and administrative budget allocation is 50 percent lower than 2015 levels. By 2063, 14 percent of government consumption in Africa is spent on operations and administration (Current Path in 2063 = 23).

APPENDIX B: RESULTS BY COUNTRY

GDP			GDP per Capita			Population			Urban Population		
<i>billion 2011 USD</i>			<i>thousand 2011 USD</i>			<i>million people</i>			<i>percent of population</i>		
2018	2038	2063	2018	2038	2063	2018	2038	2063	2018	2038	2063

North	764.8	1585.0	3,046.0	10.9	14.3	18.5	200.3	251.3	286.3	56	62	67
Algeria	240.6	411.3	708.6	13.5	15.9	19.4	42.1	52.4	59.3	73	88	92
Egypt	303.5	729.9	1,501.0	10.4	14.4	18.6	99.6	131.1	155.5	43	45	50
Libya	35.4	95.8	131.4	24.8	39.8	58.6	6.3	5.4	3.6	81	92	91
Mauritania	6.7	15.2	37.5	3.6	4.9	7.4	4.5	6.8	9.4	63	81	89
Morocco	125.9	239.5	494.9	7.5	10.3	15.9	36.2	42.5	45.1	62	73	80
Tunisia	52.8	93.7	172.6	10.9	14.1	19.5	11.7	13.1	13.6	67	73	78

South	708.2	1467.0	4,149.0	6.2	7.8	13.2	180.7	273.6	383.7	45	52	61
Angola	129.2	369.9	1,591.0	6.0	8.6	17.3	30.7	57.2	100.1	46	60	74
Botswana	21.3	52.7	116.6	16.1	23.6	33.8	2.3	3.1	3.9	58	63	69
Lesotho	3.2	8.8	25.4	2.8	5.2	10.7	2.3	2.8	3.2	29	40	54
Malawi	7.4	23.0	147.2	1.1	1.9	5.8	19.1	31.5	44.4	17	21	29
Mozambique	19.8	87.8	475.8	1.2	2.8	8.1	30.5	50.4	72.8	33	39	50
Namibia	16.2	37.4	100.7	9.8	13.9	23.6	2.6	3.7	4.7	49	69	83
South Africa	459.0	758.6	1,209.0	12.2	15.2	19.4	57.4	69.1	77.1	66	76	82
Swaziland	4.4	8.6	18.5	7.2	9.4	13.7	1.4	1.9	2.2	21	21	23
Zambia	32.3	91.3	346.0	3.7	5.5	10.9	17.6	29.8	44.9	42	51	64
Zimbabwe	15.4	29.3	118.9	1.9	2.6	6.3	16.9	24.2	30.4	32	30	31

West	57.5	65.5	72.2	6.6	7.8	9.5	26.4	233.6	2,182.0	0.1	0.2	0.2	0.8	1.4	2.0
Benin	62.6	70.5	75.7	5.7	7.4	9.1	0.1	0.3	1.3	0.2	0.3	0.4	0.8	1.3	1.9
Burkina Faso	61.5	69.4	74.8	3.7	5.4	7.5	1.8	12.5	104.1	0.4	0.7	0.9	0.8	1.4	2.0
Cape Verde	73.1	76.0	79.4	7.9	9.2	10.4	0.1	0.6	4.5	-1.1	-1.9	-2.8	0.6	1.0	1.4
Cote d'Ivoire	55.8	66.6	73.2	5.5	7.7	9.9	1.5	6.4	79.4	0.2	0.3	0.4	0.7	1.3	1.8
Gambia	62.8	69.9	74.2	4.7	6.5	8.3	0.2	1.0	10.5	-2.7	-4.6	-6.5	0.7	1.3	1.8
Ghana	64.1	70.6	75.7	7.8	9.3	10.7	8.3	127.0	624.0	0.1	0.2	0.3	0.7	1.3	1.8
Guinea-Bissau	58.5	66.3	72.6	5.5	6.6	8.0	0.2	0.6	7.2	-1.7	-2.9	-4.1	0.7	1.2	1.8
Guinea	60.8	67.9	73.7	5.4	6.7	8.9	1.2	3.3	44.6	-0.6	-1.1	-1.6	0.8	1.3	1.9
Liberia	62.9	69.0	72.8	5.0	6.4	7.9	0.3	0.7	6.2	0.1	0.1	0.2	0.7	1.2	1.7
Mali	60.5	70.8	75.4	3.0	5.0	7.6	2.1	11.8	93.4	-1.2	-2.2	-3.0	0.9	1.6	2.2
Niger	62.2	72.2	75.4	2.7	4.8	7.4	0.1	5.0	66.9	1.6	2.8	3.9	0.9	1.5	2.1
Nigeria	53.7	61.4	70.0	8.2	8.9	10.2	9.5	62.0	1,117.0	0.6	1.1	1.6	0.8	1.3	1.9
Senegal	68.4	73.9	77.6	4.0	6.0	8.3	0.3	0.9	4.2	-3.2	-5.5	-7.7	0.8	1.4	1.9
Sierra Leon	54.6	65.0	70.5	4.6	6.6	8.5	0.6	1.1	16.5	0.4	0.7	0.9	0.7	1.2	1.7
Togo	61.4	67.5	72.3	7.0	8.2	9.3	0.1	0.4	2.0	0.0	0.0	-0.1	0.7	1.3	1.9

East	65.0	71.3	76.7	5.2	6.7	8.5	144.2	807.1	3,944.0	0.2	0.4	0.7	0.8	1.3	1.9
Comoros	64.2	69.0	73.2	7.5	8.6	9.8	0.0	0.3	2.6	0.7	1.2	1.7	0.6	1.0	1.4
Djibouti	64.1	72.3	77.3	5.2	6.5	8.3	0.2	1.0	4.5	0.3	0.5	0.7	0.8	1.4	2.0
Ethiopia	66.0	72.7	77.8	4.1	5.5	7.8	68.6	387.2	2,041.0	1.8	3.2	4.6	0.8	1.4	2.0
Eritrea	65.4	69.9	74.2	4.4	5.0	6.3	1.6	4.8	15.8	-4.4	-7.6	10.6	0.9	1.5	2.1
Kenya	68.2	75.4	81.9	6.5	8.2	9.9	46.8	277.7	900.5	4.7	8.3	11.9	0.7	1.2	1.8
Madagascar	66.4	71.1	75.5	5.3	6.2	7.8	2.0	5.0	32.2	-0.5	-0.9	-1.3	0.7	1.2	1.6
Mauritius	75.3	78.8	82.1	9.5	10.8	12.5	0.2	0.4	1.0	-1.5	-2.7	-3.8	0.5	0.9	1.3
Rwanda	68.1	74.4	79.6	4.8	6.7	8.6	1.1	4.8	46.4	3.4	6.0	8.6	0.7	1.2	1.8
Seychelles	74.3	77.6	80.3	9.6	10.7	11.9	0.0	0.1	0.4	2.0	3.5	5.0	0.6	1.0	1.5
Somalia	56.3	59.8	65.6	5.5	5.7	6.4	0.3	0.6	3.2	3.7	6.5	9.4	0.7	1.2	1.8
South Sudan	55.8	63.7	70.6	4.1	4.9	6.1	0.1	0.5	55.4	-3.3	-5.6	-7.9	0.8	1.5	2.1
Sudan	65.3	70.5	74.3	3.9	5.8	7.7	11.2	85.5	364.4	-3.3	-5.6	-7.9	0.8	1.5	2.1
Tanzania	66.0	72.7	79.3	6.4	7.8	9.5	7.6	12.2	199.5	3.6	6.4	9.2	0.7	1.2	1.8
Uganda	60.6	68.1	74.8	6.5	8.1	9.6	4.3	26.9	276.9	4.5	8.1	11.6	0.7	1.2	1.8

Central	59.4	66.9	72.7	4.9	6.0	7.4	19.5	60.1	547.4	1.3	2.3	3.3	0.8	1.3	1.9
Burundi	59.2	68.1	73.2	4.5	6.2	8.1	0.5	2.4	13.5	3.4	6.0	8.6	0.7	1.3	1.8
Cameroon	59.1	67.1	73.6	7.0	7.9	9.1	5.0	16.2	151.5	0.8	1.4	2.0	0.7	1.3	1.8
Central African Republic	53.2	64.4	71.0	4.2	5.8	7.7	0.2	1.3	7.7	0.8	1.5	2.1	0.8	1.3	1.9
Chad	53.3	60.9	68.7	3.5	4.4	5.9	0.4	1.0	3.0	2.1	3.6	5.2	0.8	1.5	2.1
Democratic Republic of Congo	60.5	67.6	73.0	4.4	5.6	7.0	11.4	31.6	160.0	1.3	2.3	3.3	0.8	1.3	1.9
Republic of Congo	64.9	71.9	77.5	6.4	8.2	10.3	0.8	2.8	86.5	0.7	1.2	1.7	0.7	1.3	1.8
Equatorial Guinea	54.6	58.9	67.2	9.6	9.7	10.9	0.4	2.0	57.4	0.6	1.0	1.5	0.7	1.2	1.7
Gabon	66.4	72.0	76.3	9.0	9.8	11.0	0.7	2.6	67.1	0.6	1.0	1.4	0.7	1.2	1.7
Sao Tome and Principe	67.8	73.5	77.6	6.4	8.3	9.8	0.0	0.1	0.8	1.1	1.9	2.8	0.6	1.1	1.5

Life Expectancy			Average Adult Education			Renewable Energy Production			Precipitation Change			Temperature Change (from 1990 levels)		
years			years			million BOE			percent			degrees C		
2018	2038	2063	2018	2038	2063	2018	2038	2063	2018	2038	2063	2018	2038	2063

North	73.7	76.6	79.5	7.2	8.9	10.5	18.2	83.1	642.0	-2.1	-3.5	-4.8	0.8	1.4	2.0
Algeria	76.3	79.1	82.0	7.4	9.2	11.1	2.1	7.1	143.0	-1.5	-2.7	-3.8	0.9	1.5	2.1
Egypt	71.8	74.9	77.8	7.5	9.2	10.6	11.2	49.7	425.1	-5.5	-9.5	13.2	0.8	1.4	1.9
Libya	73.9	77.6	80.8	8.9	10.7	12.4	0.2	0.4	0.7	2.5	4.4	6.2	0.8	1.3	1.9
Mauritania	64.3	71.3	75.4	5.3	7.0	8.5	0.7	1.3	5.6	-4.8	-8.2	11.5	0.9	1.5	2.2
Morocco	76.1	79.1	81.9	6.0	7.8	9.7	2.8	10.0	26.6	-8.0	13.5	18.6	0.8	1.4	2.1
Tunisia	76.0	78.5	81.4	8.1	9.5	11.1	1.2	14.6	41.0	-3.8	-6.5	-9.1	0.7	1.3	1.8

South	62.0	68.9	74.9	7.3	8.0	9.5	46.9	368.7	2,705.0	-0.8	-1.4	-2.0	0.8	1.4	2.0	
Angola	61.4	68.3	75.6	6.8	7.6	9.4	5.3	64.2	1,390.0	-0.4	-0.7	-1.0	0.8	1.4	2.0	
Botswana	66.9	73.3	77.9	10.0	10.9	12.2	0.2	0.3	0.3	-1.2	-2.1	-3.0	0.9	1.6	2.3	
Lesotho	55.7	64.4	71.1	6.7	8.7	10.6	0.1	0.9	9.7	-0.9	-1.5	-2.1	0.8	1.4	2.0	
Malawi	64.1	71.4	76.0	5.1	6.5	8.3	1.3	7.4	63.7	2.0	3.4	4.9	0.8	1.4	1.9	
Mozambique	60.4	70.8	76.5	3.6	5.9	8.5	10.0	9.5	45.7	1.0	1.8	2.6	0.7	1.3	1.8	
Namibia	64.8	71.8	77.2	6.8	8.6	10.6	1.0	1.9	7.2	-4.3	-7.3	-	10.2	0.9	1.5	2.2
South Africa	62.4	66.5	71.2	9.9	9.9	10.6	5.7	224.2	917.5	-2.2	-3.8	-5.4	0.8	1.4	2.0	
Swaziland	58.1	65.9	71.6	5.8	7.7	9.7	0.3	1.7	9.2	-0.8	-1.5	-2.1	0.7	1.3	1.8	
Zambia	62.6	70.8	76.7	7.9	8.8	9.8	19.5	54.4	251.9	1.2	2.0	2.9	0.8	1.4	2.0	
Zimbabwe	61.2	67.7	73.5	8.0	8.8	10.2	3.5	4.3	9.4	1.7	3.0	4.3	0.8	1.4	2.1	

West	57.5	65.5	72.2	6.6	7.8	9.5	26.4	233.6	2,182.0	0.1	0.2	0.2	0.8	1.4	2.0
Benin	62.6	70.5	75.7	5.7	7.4	9.1	0.1	0.3	1.3	0.2	0.3	0.4	0.8	1.3	1.9
Burkina Faso	61.5	69.4	74.8	3.7	5.4	7.5	1.8	12.5	104.1	0.4	0.7	0.9	0.8	1.4	2.0
Cape Verde	73.1	76.0	79.4	7.9	9.2	10.4	0.1	0.6	4.5	-1.1	-1.9	-2.8	0.6	1.0	1.4
Cote d'Ivoire	55.8	66.6	73.2	5.5	7.7	9.9	1.5	6.4	79.4	0.2	0.3	0.4	0.7	1.3	1.8
Gambia	62.8	69.9	74.2	4.7	6.5	8.3	0.2	1.0	10.5	-2.7	-4.6	-6.5	0.7	1.3	1.8
Ghana	64.1	70.6	75.7	7.8	9.3	10.7	8.3	127.0	624.0	0.1	0.2	0.3	0.7	1.3	1.8
Guinea-Bissau	58.5	66.3	72.6	5.5	6.6	8.0	0.2	0.6	7.2	-1.7	-2.9	-4.1	0.7	1.2	1.8
Guinea	60.8	67.9	73.7	5.4	6.7	8.9	1.2	3.3	44.6	-0.6	-1.1	-1.6	0.8	1.3	1.9
Liberia	62.9	69.0	72.8	5.0	6.4	7.9	0.3	0.7	6.2	0.1	0.1	0.2	0.7	1.2	1.7
Mali	60.5	70.8	75.4	3.0	5.0	7.6	2.1	11.8	93.4	-1.2	-2.2	-3.0	0.9	1.6	2.2
Niger	62.2	72.2	75.4	2.7	4.8	7.4	0.1	5.0	66.9	1.6	2.8	3.9	0.9	1.5	2.1
Nigeria	53.7	61.4	70.0	8.2	8.9	10.2	9.5	62.0	1,117.0	0.6	1.1	1.6	0.8	1.3	1.9
Senegal	68.4	73.9	77.6	4.0	6.0	8.3	0.3	0.9	4.2	-3.2	-5.5	-7.7	0.8	1.4	1.9
Sierra Leon	54.6	65.0	70.5	4.6	6.6	8.5	0.6	1.1	16.5	0.4	0.7	0.9	0.7	1.2	1.7
Togo	61.4	67.5	72.3	7.0	8.2	9.3	0.1	0.4	2.0	0.0	0.0	-0.1	0.7	1.3	1.9

East	65.0	71.3	76.7	5.2	6.7	8.5	144.2	807.1	3,944.0	0.2	0.4	0.7	0.8	1.3	1.9	
Comoros	64.2	69.0	73.2	7.5	8.6	9.8	0.0	0.3	2.6	0.7	1.2	1.7	0.6	1.0	1.4	
Djibouti	64.1	72.3	77.3	5.2	6.5	8.3	0.2	1.0	4.5	0.3	0.5	0.7	0.8	1.4	2.0	
Ethiopia	66.0	72.7	77.8	4.1	5.5	7.8	68.6	387.2	2,041.0	1.8	3.2	4.6	0.8	1.4	2.0	
Eritrea	65.4	69.9	74.2	4.4	5.0	6.3	1.6	4.8	15.8	-4.4	-7.6	-	10.6	0.9	1.5	2.1
Kenya	68.2	75.4	81.9	6.5	8.2	9.9	46.8	277.7	900.5	4.7	8.3	11.9	0.7	1.2	1.8	
Madagascar	66.4	71.1	75.5	5.3	6.2	7.8	2.0	5.0	32.2	-0.5	-0.9	-1.3	0.7	1.2	1.6	
Mauritius	75.3	78.8	82.1	9.5	10.8	12.5	0.2	0.4	1.0	-1.5	-2.7	-3.8	0.5	0.9	1.3	
Rwanda	68.1	74.4	79.6	4.8	6.7	8.6	1.1	4.8	46.4	3.4	6.0	8.6	0.7	1.2	1.8	
Seychelles	74.3	77.6	80.3	9.6	10.7	11.9	0.0	0.1	0.4	2.0	3.5	5.0	0.6	1.0	1.5	
Somalia	56.3	59.8	65.6	5.5	5.7	6.4	0.3	0.6	3.2	3.7	6.5	9.4	0.7	1.2	1.8	
South Sudan	55.8	63.7	70.6	4.1	4.9	6.1	0.1	0.5	55.4	-3.3	-5.6	-7.9	0.8	1.5	2.1	
Sudan	65.3	70.5	74.3	3.9	5.8	7.7	11.2	85.5	364.4	-3.3	-5.6	-7.9	0.8	1.5	2.1	
Tanzania	66.0	72.7	79.3	6.4	7.8	9.5	7.6	12.2	199.5	3.6	6.4	9.2	0.7	1.2	1.8	
Uganda	60.6	68.1	74.8	6.5	8.1	9.6	4.3	26.9	276.9	4.5	8.1	11.6	0.7	1.2	1.8	

Central	59.4	66.9	72.7	4.9	6.0	7.4	19.5	60.1	547.4	1.3	2.3	3.3	0.8	1.3	1.9
Burundi	59.2	68.1	73.2	4.5	6.2	8.1	0.5	2.4	13.5	3.4	6.0	8.6	0.7	1.3	1.8
Cameroon	59.1	67.1	73.6	7.0	7.9	9.1	5.0	16.2	151.5	0.8	1.4	2.0	0.7	1.3	1.8
Central African Republic	53.2	64.4	71.0	4.2	5.8	7.7	0.2	1.3	7.7	0.8	1.5	2.1	0.8	1.3	1.9
Chad	53.3	60.9	68.7	3.5	4.4	5.9	0.4	1.0	3.0	2.1	3.6	5.2	0.8	1.5	2.1
Democratic Republic of Congo	60.5	67.6	73.0	4.4	5.6	7.0	11.4	31.6	160.0	1.3	2.3	3.3	0.8	1.3	1.9
Republic of Congo	64.9	71.9	77.5	6.4	8.2	10.3	0.8	2.8	86.5	0.7	1.2	1.7	0.7	1.3	1.8
Equatorial Guinea	54.6	58.9	67.2	9.6	9.7	10.9	0.4	2.0	57.4	0.6	1.0	1.5	0.7	1.2	1.7
Gabon	66.4	72.0	76.3	9.0	9.8	11.0	0.7	2.6	67.1	0.6	1.0	1.4	0.7	1.2	1.7
Sao Tome and Principe	67.8	73.5	77.6	6.4	8.3	9.8	0.0	0.1	0.8	1.1	1.9	2.8	0.6	1.1	1.5

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