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Green Africa: A growth and resilience agenda for the continent

How the global climate agenda creates opportunities for Africa to build resilience, catalyze sustainable growth, and contribute to the net-zero transition

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The global conversation on climate change in Africa tends to be focused on physical risks. Climate models show that the continent is considered to be among the regions of the world that could be hardest hit by the changing climate.[1] And with 600 million Africans still without energy access and 36 percent of the continent's population living in extreme poverty, low levels of resilience and adaptation in many countries are likely to exacerbate the socio-economic impacts of climate change and make the continent's pressing development imperative more challenging to achieve.[2] But what if this is only part of the picture?

Our assessment shows that, while there are severe physical and socio-economic challenges ahead for African countries, there are also opportunities to be seized as the world moves towards a low-carbon future. For example, as global demand patterns shift away from fossil fuels and other high-emission products, African commodities and exports could suffer, but at the same time, if the continent can use its large renewable energy generation capacity and rich natural capital endowments responsibly and strategically, it could catalyze economic growth and make a substantial contribution to the global net-zero transition. There is potential, too, for African countries to tap into the global decarbonization agenda to access international support to pursue low-carbon development pathways and build a safer, healthier, and more prosperous future.

Africa's development pathway is also important for the world. The continent will play a vital role in the global effort to reach net zero by 2050. While African per capita emissions are, on average, still less than half of those of Organisation for Economic Co-operation and Development (OECD) countries', the continent nonetheless accounts for roughly 10 percent of global annual greenhouse gas emissions, when land-use emissions and all greenhouse gases are taken into account (see Box 1). By comparison, global aviation accounts for less than 2 percent.[3] With rapid population and economic growth expected, Africa's share of emissions is likely to increase if no action is taken.

~10%

Africa's contribution to global greenhouse gas emissions

But Africa is taking action. For example, the Africa Adaptation Acceleration Program, which is endorsed by the African Union, is working with the Global Center on Adaptation, the African Development Bank, and other partners to galvanize climate resilience. It aims to spend $12.5 billion over the next five years to modernize key economic sectors to abate future emissions and invest in adaptive measures.[4] However, more resources and support will likely be required. Right now, with African countries' public finances often constrained and a significant gap between climate funding needs and pledged climate funding by developed countries, there are insufficient funds for the continent to build adaptive capacity, reduce emissions, and create new economic opportunities at the speed and scale required. Exploring ways to change this could be beneficial and in the interest of both the continent and the global community.

In this article, we provide an overview of some of the climate change risks that Africa is facing and describe selected opportunities available that could deliver growth and boost resilience while reducing emissions. We also sketch out potential options for stakeholders and decision-makers to consider at this critical juncture. While this is not an exhaustive outlook—further, more focused research will follow—our intention is to provide a starting point for an expanded dialogue on the continent's options, with the hope of inspiring action towards building a stronger Africa in a net-zero world.

1 *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change,* Intergovernmental Panel on Climate Change, 2021, *ipcc.ch.*
2 "African countries continue to have the highest poverty rates in the world", Development Aid, February 25, 2021, developmentaid.org.
3 Emissions by Sector, Our World in Data, ourworldindata.org.
4 Global Center on Adaptation website. gca.org.

Box 1

Africa's current emissions and pathways to decarbonization

The data landscape on emissions in Africa is relatively more fragmented and diverse than other regions. We have detailed emissions data from multiple sources, which indicate the following emissions breakdown for the continent:[5]

- LULUCF: 2.2 Gt carbon dioxide equivalent (CO_2e), about 40 percent of total.[6]
- Agriculture: 1.1 Gt CO_2e, about 20 percent of total.
- Industry: 0.8 Gt CO_2e, about 15 percent of total.[7]
- Power: 0.5 Gt CO_2e, about 10 percent of total.
- Transportation, waste, and buildings: 0.8 Gt CO_2e, about 15 percent of total.

At a total of 5.4 Gt CO_2e, these numbers suggest Africa currently contributes just under 10 percent of global greenhouse gas emissions—a somewhat higher share than often cited, as this includes non-energy emissions and all greenhouse gases.[8] However, it is worth noting that at 4.5 t CO_2e per annum, the average per capita emissions in Africa are much lower than the annual OECD average of 10.0 t CO_2e.[9]

The sectoral mix on the continent is skewed more towards agriculture and LULUCF and less towards industry, power, and transportation compared to the typical emissions profile of a developed country. By comparison, over three quarters of European emissions come from industry, power, and transport.[10]

Because of its different emissions profile, the decarbonization pathways of African countries will likely differ—in some respects significantly—from those of developed countries. The continent's sectoral composition, which includes a high economic focus on basic materials production, rapid economic growth and urbanization rates, constrained government budgets and capabilities, and last but not least, the imperative of continued inclusive growth to advance living standards and health, will also affect its decarbonization choices.

While generalizations are difficult, key differences in typical African decarbonization journeys will likely include a strong focus on decentralized renewable power solutions alongside grid-scale renewables to enable universal energy access; some build-out of gas power capacity to provide near-term flexibility to balance renewables' intermittency; and a greater emphasis on agriculture, land-use change, and cooking. In some sectors transitions will be slower, for example, the speed of renewables build-out will likely be lower due to institutional capabilities in the power sector, and the slower onset of second-hand electric vehicle availability may delay the transition in the transportation sector until the late 2030s at least.

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5 Global Energy Perspective (McKinsey Energy Insights); EDGAR - Emissions Database for Global Atmospheric Research (Crippa, M., Guizzardi, D., Solazzo, E., Muntean, M., Schaaf, E., Monforti-Ferrario, F., Banja, M., Olivier, J.G.J., Grassi, G., Rossi, S., Vignati, E.,*GHG emissions of all world countries - 2021 Report,* EUR 30831 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-41547-3, doi:10.2760/173513, JRC126363); The Food and Agriculture Organization (FAO) of the United Nations; UNFCCC.

6 Land use, land-use change, and forestry emissions including net forest conversion, drained organic soils (CO_2), fires in humid tropical forests, fires in organic soils, and forest fires.

7 Cement, mining, metals, oil and gas, and chemicals.

8 When only considering CO_2 emissions from energy, Africa accounts for just under 4% of global emissions, but when including non-energy emissions and all greenhouse gases, Africa's emissions share is almost 10%.

9 McKinsey Sustainability EMIT database.

10 McKinsey Net-Zero Europe Report.

Africa faces both physical and transition risks from climate change

The scientific consensus is that global warming of 2°C relative to pre-industrial levels will be exceeded during the 21st century unless rapid and deep reductions in CO_2 and other greenhouse gas emissions occur in the coming decades.[11] It is also clear that not all regions will be affected equally. Parts of Africa, for example, are warming faster than many other world regions, and there is a high probability that African countries will be among the most severely affected by intensifying climate hazards. At the same time, the continent's levels of adaptation and resilience are among the world's lowest. Around 80 percent of African countries have vulnerability scores in the lowest band, meaning that they are likely to be more sensitive to climate hazards and less able to adapt to or cope with climate change.[12] Furthermore, low levels of insurance and savings in many African countries mean that recovery after a disaster typically takes much longer. This puts lives and livelihoods at risk on an unprecedented scale, threatens human health and wellbeing, and jeopardizes hard-won economic gains, which, in turn, could undermine societal stability.

Furthermore, the deep structural changes now underway in the global economy as countries gear up to transition to net-zero emissions by 2050 are resulting in another set of economic risks for economies in Africa, commonly referred to as transition risks. The main concern is that a move towards decarbonization globally could lead to a decrease in demand for fossil fuel exports and a prioritization of low-carbon-intensity production alongside cost by buyers of commodities, which could negatively affect the global competitiveness of African exports. As African economies are generally more dependent on commodity exports than most regions, this could have adverse consequences for employment and fiscal health.[13] These risks are amplified by the generally more constrained monetary capacity of most African countries, which limits their ability to invest in structural countermeasures.

Millions more Africans could be exposed to physical hazards as climate change intensifies

As a result of its high exposure and vulnerability to climate hazards, a third of the people considered most at risk in the world live in Africa.[14] About 370 million people—roughly 30 percent of the total population of the continent—live in areas which are likely to experience high levels of climate hazards and to have high vulnerability. By contrast, 19 percent of the total population of Asia, 4 percent of Latin America, and 2 percent of Oceania are exposed to this combination.

An analysis by the McKinsey Climate Analytics team suggests that if the world sees a 2°C increase in average temperature by 2050, the number of Africans exposed to one or more physical hazards related to climate could almost double from approximately 460 million people today to more than 900 million.[15] This increase is partly due to rapid population growth (tempered by increasing urbanization), but the primary drivers are the broader geographic reach and increasing intensity of climate hazards, with 45 percent of the population likely to be exposed to at least one climate hazard by 2050 compared to 36 percent today. The top four physical hazards confronting Africa in a 2°C-by-2050 world are as follows:

— Heat stress: Upwards of 640 million Africans could be exposed to more days with high levels of heat and humidity.

— Agricultural droughts: About 175 million people in agricultural regions could experience an average of seven to eight droughts per decade,

11 Ibid.
12 McKinsey Climate Analytics; The Notre Dame Global Adaptation Initiative (ND-GAIN); UNDP subnational Human Development Index (sHDI).
13 State of Commodity Dependence 2021, United Nations Conference on Trade and Development, 2021, unctad.org.
14 McKinsey Climate Analytics; The Notre Dame Global Adaptation Initiative (ND-GAIN); UNDP Human Development Index (HDI).
15 Because it is still unclear which macro scenario will manifest, we consider two main scenarios in this article; the first assuming continued high emissions, leading to an expected 2°C warming by 2050, the second assuming an orderly global transition to limit warming to 1.5°C. Approximate mean change in global temperature in both scenarios (1.5°C and 2°C) is relative to pre-industrial average (1850-1900). Stakeholders need to evaluate and prepare for risks under both of these scenarios.

making it much harder for smallholder farmers to maintain a livelihood in rainfed agriculture.

— Flooding: Nearly 130 million more people could be exposed to severe riverine and/or coastal flooding driven by rising sea levels and intense rainfall events which could breach existing defenses.

— Urban water stress: About 20 million more people living in urban areas could experience water stress, meaning that they may not have access to adequate water supplies for drinking, washing, and maintaining industrial operations. This situation is likely to be exacerbated by continued unplanned urbanization.

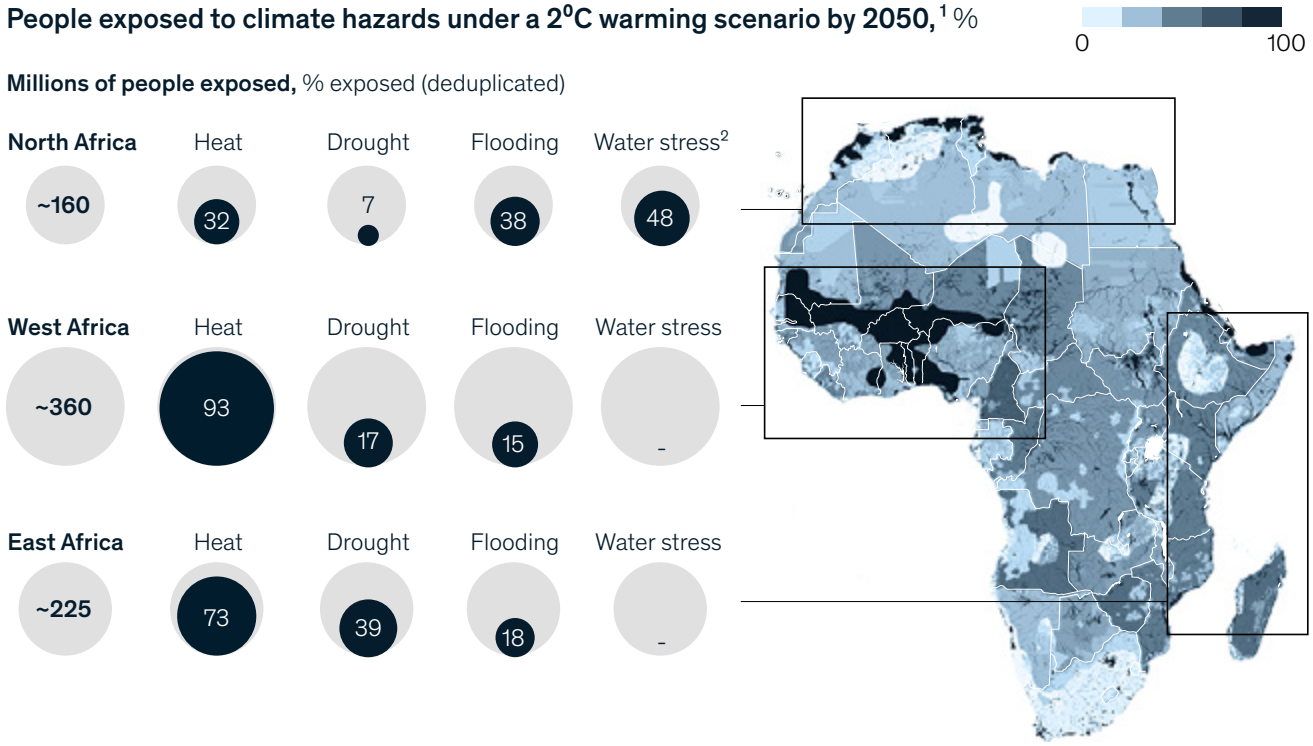
The direct economic impacts of these events could intensify the hardships. Rising temperatures may reduce the amount of time it is possible to work outside by a quarter, cutting productivity, particularly for those employed in outdoor occupations, while increased droughts throughout the growing season could impact crop yields. External research suggests that staple crops such as rice and wheat could be hardest hit with possible yield losses of 12 percent and 21 percent respectively by 2050.[16]

Exposure to climate hazards is not evenly distributed across the continent, with major hotspots of exposed populations in Sahelian West Africa, North Africa, and East Africa (Exhibit 1).

Our analysis shows that in a 2°C warming scenario by 2050, over 90 percent of the population in West Africa could be exposed to heat stress.[17] In North Africa, 40 to 50 percent

Exhibit 1

Africa's climate-exposed populations are mainly in the Sahel region in West Africa, with pockets of high exposure in North and East Africa.



Note: The boundaries and names shown on maps do not imply official endorsement or acceptance by McKinsey & Company.
[1]Global mean temperature increase is relative to pre-industrial average from 1850-1900 and is estimated based on mean warming across 21 CMIP5 models under the RCP 8.5 emissions scenario (IPCC, 2013).
[2]All water stress exposure is considered to be severe. Urban water stress increases due to increased demand from population growth and urbanization as well as decreased supply from climate change. Increased demand, rather than climate change, is the dominant factor in increased water stress exposure.
Source: IHS Markit; International Labor Organization; NASA NEX; NCAR IAM; SEDAC; Woodwell Climate Research Center; World Resources Institute; McKinsey Climate Analytics

[16] "Climate change is an increasing threat to Africa," United Nations Climate Change, October 27, 2020, unfccc.int.
[17] 2°C warming is relative to pre-industrial average (1850-1900)

of the population could be exposed to water stress or flooding. And in East Africa, 70 to 75 percent of the population could be exposed to heat stress and approximately 40 percent to agricultural drought over the next 30 years. A UN report published in 2020 estimated that by 2050, overall agricultural yield in that region could be reduced by 8 percent.[18]

Physical climate risk could trigger broader disruption, and current levels of adaptation are insufficient

The impacts of climate change are already being felt in regions such as the Chad Basin and the City of Cape Town. Recent studies have shown that Lake Chad has reduced in size by over 90 percent in the last 60 years and the Chad Basin is drying, negatively affecting about 30 million people in Cameroon, Chad, Niger, and Nigeria who are dependent on the region for agriculture, fishing, and livestock production.[19] The City of Cape Town, meanwhile, nearly became the first major world city to run out of water in 2018 following a record-breaking drought in the region.[20] As severe climate change effects such as these take hold, they could trigger migration, social and political unrest, and potentially even conflict in affected regions, which may have global repercussions. The Stanford Environmental Assessment Facility estimates that the impact of climate change on conflict may double compared to today if the world warms by 2°C by 2050, with about 13 percent of conflicts influenced by climate change.[21] The World Bank projects that by 2050, climate change may be a driving force for over 100 million Africans to migrate within their countries, away from areas with lower water availability and crop productivity or rising sea level and storm surges. While climate change is often not the sole factor in migration decisions, it may amplify other factors such as poverty and conflict.[22]

Current levels of adaptation and resilience are insufficient to meet these future hazards, and a decisive response from governments would be required to improve this. Compared to their global peers, however, African countries have limited means to respond and are constrained by competing priorities. This situation has been exacerbated by the COVID-19 pandemic; Africa faced its first recession in 25 years during 2020, threatening to push 40 million people into extreme poverty. More than 50 percent of the African population currently experiences food insecurity and public debt increased in sub-Saharan Africa to more than 66 percent of GDP in 2020, the highest level in almost 15 years.[23,24] Inclusive economic growth, therefore, remains the priority.

The COVID-19 pandemic has also highlighted the challenges the continent faces in responding to shocks. While some developed countries rolled out stimulus packages with an average size of over 30 percent of GDP, African countries' responses were typically less than 5 percent of GDP.[25,26] Some developed cities are spending up to 35 times more per capita to protect their populations against climate change than major African cities such as Lagos and Addis Ababa. In 2014/15, New York spent the equivalent of $360 protecting each of its residents, compared to just over $8 in Addis Ababa.[27] Additionally, most African countries do not have adaptation plans in place; at the time of writing, while most African countries have started working on their National Adaptation Plans, only six have submitted theirs to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat.[28]

Levers exist that could help increase adaptation and resilience

While several levers exist to increase adaptation and resilience, they require substantial investments and sometimes difficult choices of

18 "Climate change is an increasing threat to Africa", United Nations Climate Change, October 27, 2020, unfccc.int.
19 "Drying Lake Chad Basin gives rise to crisis," Africa Renewal, December 24, 2019, un.org.
20 "Day Zero: one city and a record-breaking drought," African Climate and Development Initiative, July 21, 2019, acdi.uct.ac.za.
21 "Stanford-led study investigates how much climate change affects the risk of armed conflict," Stanford News, June 12, 2019, news.stanford.edu.
22 "Millions on the Move in Their Own Countries: The Human Face of Climate Change," The World Bank, September 13, 2021, worldbank.org.
23 "State and Trends Report 2020," Global Center on Adaptation, 2020, gca.org.
24 Abebe Aemro Selassie and Shushanik Hakobyan, "Six charts show the challenges faced by sub-Saharan Africa," *IMF News, April 15, 2021.*
25 Based on G7 countries. Accurate as of March 2021.
26 Based on the average from Egypt, Kenya, Morocco and Nigeria. Excludes South Africa. Accurate as of March 2021.
27 "Huge divide in spending on climate change adaptation across world's megacities," Carbon Brief, February 29,2016, carbonbrief.org.
28 "National Adaptation Plans 2020. Progress in the formulation and implementation of NAPs," United Nations Development Programme Climate Change, May 4, 2021, unfccc.int.

what to protect versus when to retreat. Three key levers have been shown to be effective in other developing countries and the rest of the world, and there is scope for these to be scaled up across the continent.[29]

Firstly, it is possible to "harden" infrastructure in at-risk locations to allow it to sustain a direct impact from extreme events, reduce the event's effects, and even bounce back better. Flood defenses such as dikes and reinforced riverbanks are common examples of this tactic.

A second lever is "buffering", which buys time to deal with extreme events and ensures continuity. For example, by creating strategic stocks such as grain in silos and back-up systems such as extra power generation capacity, it is possible to reduce reliance on vulnerable assets or inputs. Similarly, developing and boosting the adoption of early-warning systems to forecast extreme events and create time to tweak response policies could be vital as climate hazards intensify. For example, better crop forecasting could inform digital food balance sheets, which in turn could help improve food security and trade by creating near real-time transparency on available food in a country. Such systems could also help stakeholders deal more effectively with the aftermath of a disaster. For example, a swifter response to a crisis could reduce damages and limit insurance payouts, which in turn could mean that more smallholder farmers could access and afford the premiums of regional agricultural insurance schemes. However, setting up effective early-warning systems requires more than just the relevant technology; high-quality and accurate data input needs to be embedded in a decision-making process that tracks action on the ground. In data-light environments, this can be challenging to achieve.

Diversifying practices and operations at local levels is a third lever with potential for Africa, especially in regions that are reliant on a specific product and export, for example cocoa production in West Africa.

While these three levers work to reduce vulnerability to climate change, climate adaptation plans may also need to focus on reducing exposure by relocating vulnerable populations and activities. Highly populated African cities have seen the expansion of settlements into coastal and riverine areas with high flooding risk, necessitating a review of urban land use plans. Additionally, stakeholders could work to preserve ecosystems by leveraging Africa's vast nature-based solutions potential. This could help to reduce the level of risk and generate added benefits such as an increase in biodiversity and access to the carbon credits market. For example, planting mangroves offers protection against waves and storm surges in certain estuarine areas, and reforestation projects could help to combat desertification, support local communities' food security, and increase biodiversity.

To activate these levers, additional financing would be needed, and while developed countries have pledged some funding to support developing nations in addressing climate risk, even more will likely be needed (see Box 3 on page 27). According to the World Meteorological Organization,

As a result of its high exposure and vulnerability to climate hazards, a third of the people considered most at risk in the world live in Africa.

[29] United Nations Climate Champions Race to Resilience analysis.

adaptation costs in Africa are expected to reach $50 billion annually by 2050.[30] African countries currently spend between 2 percent and 9 percent of their GDP on adaptation.[31] In a funding-constrained environment, African governments may need to be clear about national and cross-border priorities and make sure that these are well communicated in order to ensure buy-in from local populations and other stakeholders. This is important because the scale of the challenges facing African countries will almost certainly require collaboration both within and between countries to achieve the necessary shifts.

Transition risks threaten key economic pillars and could undermine Africa's future growth prospects

The global community is increasingly committed to limiting warming to 1.5°C and countries are putting in place plans and measures to achieve this. This is putting additional pressure on African economies. As the rest of the world moves forward in the race to net zero, Africa could see a drop in global demand for fossil fuel and its exports could become less competitive as carbon intensity of commodity production becomes more important.

Africa has a much higher dependence on commodities than any other region in the world, with commodity exports—notably oil and minerals—accounting for about 16 percent of the continent's GDP. In addition, the production of Africa's commodities is often more carbon intensive than in other regions.[32] Without strategic action to mitigate these risks, up to $150 billion of commodity revenue and more than 1 million jobs in Africa could be vulnerable. This in turn could have knock-on impacts, for example, on fiscal health.

Buyers of commodities are increasingly prioritizing lower carbon intensity production

As global consumer pressure increases and manufacturers strive to decarbonize global value chains, the amount of greenhouse gases emitted during production is becoming a key competitive factor for commodity producers, and high-emission players may lose market share. In Africa, we calculate that this could put $20 billion of commodity revenue and about 200,000 direct and indirect jobs at risk.[33] African producers' cost of production would likely be in the bottom decile for some of the continent's largest commodity exports if a robust shadow carbon price is applied.[34]

Carbon intensity has already become a key purchasing decision factor in many industries. While some African countries may benefit from this shift—the DRC and Zambia are at the low end of the global commodity carbon intensity curves for copper, for example—for others the trend is more concerning. South Africa, for example, has a high proportion of underground mines, which are more emission-intensive than open-pit mines, and a carbon-intensive electricity supply—about 90 percent of the country's energy comes from coal. This could put pressure on South African commodity exports. For example, the majority of South Africa's platinum group metals currently flow into the global automotive industry, but in the past two years almost every major car manufacturer has announced ambitious supply chain decarbonization targets with many aiming to reach carbon neutrality between 2040 and 2050. This could see customers starting to use a shadow carbon price when making purchasing decisions and could prompt them to look for substitutes if South African platinum becomes too expensive.

~1 million

African jobs that could be lost as the world transitions to net zero

[30] State of the Climate in Africa 2020, World Meteorological Organization, 2020, library.wmo.int.
[31] Ibid.
[32] "Countries dependent on commodities hit 20-year high, says UN," May 15, 2019, unctad.org.
[33] Job numbers are calculated based on mines or plants that are in the 90th percentile or above of the primary producer cost curve for that respective commodity after shadow carbon pricing is factored in. Indirect jobs include those that are in the supply chain of the impacted industry and are calculated using region- and industry-specific input /output multipliers.
[34] McKinsey Energy Insights Global Energy Perspective 2021, December 2020, mckinsey.com; McKinsey MineSpans.

Another example is gold. If buyers implement a shadow carbon price of $100 per ton of CO_2, it would lead to an 18 percent increase in unit costs for South African mines versus an average increase of 7 percent for global peers, pushing South African mines further to the right of the global cost-curve and potentially out of the market. This would have marked socio-economic impacts, since high-emission underground mines are labor-intensive, and the average mining employee in South Africa supports five to 10 dependents.[35]

To maintain and enhance their competitiveness, African countries and companies can consider steps to reduce the carbon intensity of their production by assessing opportunities for emissions reductions across the value chain. One important lever would be to switch to renewable sources of energy as fast as possible. Mining players in South Africa, for example, are already taking bold steps in this direction and could play an important role in engaging public sector stakeholders on the need to decarbonize the grid and accelerate the power sector transition through a step-change in renewable self-generation. This could have the added benefit of relieving constraints on the national transmission grid.

Beyond the adoption of renewables, commodity producers could identify and assess the cost/benefit of emission-reduction levers and prioritize their deployment. A key lever tends to be the decarbonization of mining equipment, including haulage trucks through electrification or hydrogen fuel cell energy, which can reduce emissions by about 40 percent. Encouragingly, our analysis shows that solutions to decarbonize the majority of emissions will become economically viable within this decade, helping to address both scope 1 and scope 2 emissions.[36]

Mining companies may also want to ensure appropriate verification and reporting of carbon emissions so that customers have the granular information needed to inform purchasing decisions, instead of having to apply possibly disadvantageous country averages or conservative assumptions.

Falling demand for fossil fuels could impact African countries economically

Shifting global demand patterns could have implications for the continent's oil and gas players in particular. At a global level, the demand for oil could decline by about 50 percent by 2040 under a 1.5°C scenario.[37] This could render more than 80 percent of African production uncompetitive by 2040 under a 1.5°C scenario, because African countries tend to be at the expensive end of the global supply cost curve, putting $130 billion of commodity revenue and 800,000 direct and indirect jobs at risk (Exhibit 2). Furthermore, because African producers often have a higher carbon intensity of oil production than global peers—about 40 percent higher carbon dioxide equivalent (CO_2e) per barrel—these impacts could be exacerbated by shifting purchasing behavior. Petroleum products account for more than 50 percent of export revenues and more than 60 percent of government revenues for more than half of African oil and gas producers.[38] Without strategic countermeasures, highly oil- and gas-dependent countries may find themselves under severe fiscal stress as global demand for fossil fuels continues to decline.

Further risks stem from declining global demand for thermal coal. Under a 1.5°C scenario, coal-fired power generation would need to decline by 80 percent by 2030 and drop to close to zero by 2050.[39] While some South African mines have relatively advantageous cost-curve positions, with about 50 percent of production concentrated in the lower half of the export cost curve, the inevitable decline in demand for export coal in a net-zero world could put all direct coal jobs—more than 90,000—at risk.[40]

To limit and delay the impacts of the erosion of fossil-fuel exports, African oil and gas producers can take strategic actions now. For upstream operations, key actions include switching to renewable power sources, reducing fugitive emissions (by improving leak detection and repair, installing vapor-recovery units, and applying state-of-the-art seals), electrifying equipment (for example, replacing gas boilers with electric steam-production systems),

[35] Mine SA 2016: Facts and Figures, Chamber of Mines of South Africa.
[36] Henry Legge, Clemens Müller-Falcke, Tomas Nauclér, and Erik Östgren, "Creating the zero-carbon mine," McKinsey & Company, June 29, 2021, mckinsey.com.
[37] McKinsey Energy Insights Global Energy Perspective 2021, December 2020, mckinsey.com.
[38] McKinsey Energy Insights; Stanford OPGEE; IOGP; OGCI; API; IEA Methane Tracker; EI emissions benchmark; operator annual reports.
[39] The 1.5-degree Challenge, McKinsey Sustainability, mckinsey.com.
[40] AME database.

and reducing routine and non-routine flaring by introducing predictive maintenance and improving and expanding gas processing.

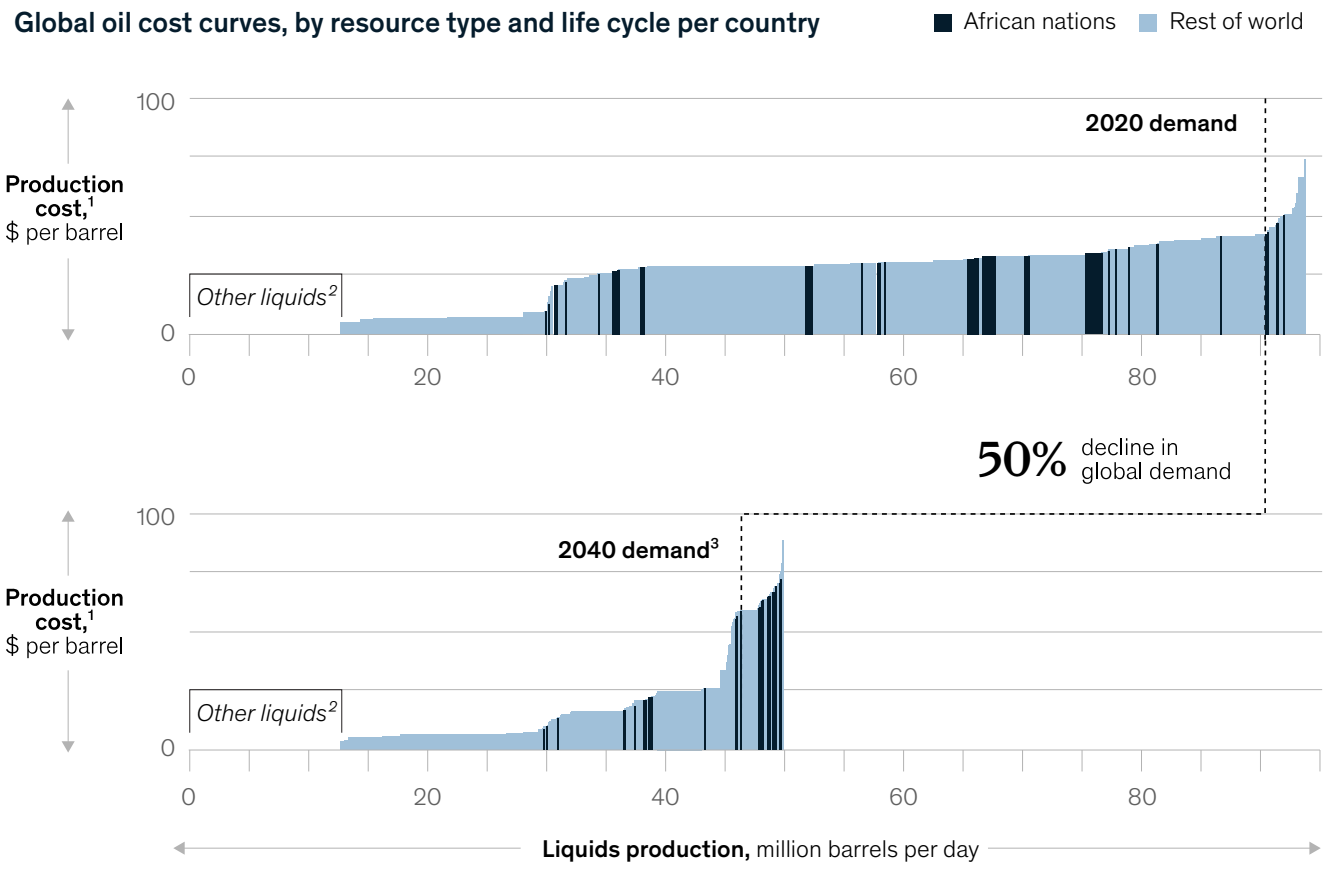
For downstream operations, energy efficiency improvements and rotating equipment electrification could be a major lever, alongside switching to zero-emissions hydrogen (green or blue), renewable power and heat sources (such as solar photovoltaic (PV), biomass and biomethane) or carbon capture utilization and storage. Switching to bio-based or circular feedstocks could also help reduce the Scope 3 footprint. Many of these levers save money and can pay back the required investment within a few years.

Developing new natural gas markets will also be important. For many African countries, their domestic decarbonization pathways will likely, at least for some time, entail a higher use of natural gas to replace high-emission diesel-powered generation in manufacturing plants and to provide balancing capacity in grids with increasing shares of renewables. Unlocking these regional demand volumes would require investing in new gas infrastructure projects in the medium-term to enable intra-regional trade.

It may also be advantageous to look further ahead to identify and kick-start investments into new businesses such as green fuels and to diversify economically into new areas. This would include ensuring that labor is reskilled to transition to new industries.

Exhibit 2

More than half of African oil production could become uneconomical by 2040 under a 1.5°C pathway.

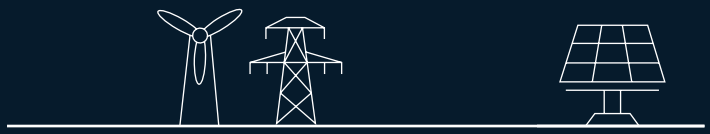


[1]Includes technical cost (capital expenditures, operating expenditures, exploration cost), government take (taxes and royalties), cash cost for existing fields, and full life-cycle cost for greenfield project developments; no government take in the Middle East. Scope 1 and 2 tax, no abatement assumed.
[2]Includes biofuels, GTLs (Gas-to-liquids), CTLs (Coal-to-liquids), MTBE (Methyl tertiary-butyl ether), refinery gains, and NGLs (natural gas liquids). Breakeven costs are not shown.
[3]Based on IEA's "net zero" scenario, which achieves net zero by 2050 and limits warming to 1.5°C
Source: IEA; Stanford OPGEE; Energy Insights by McKinsey

Exhibit 3

There are ten clear opportunities for Africa to capitalize on its natural capital and the global decarbonization agenda.

Energy access and affordability



1 Accelerate the deployment of grid-scale renewables

2 Expand distributed-generation renewables

Inclusive green growth

3 Accelerate agricultural transitions

4 Scale green manufacturing

60–70 percent

least-cost options for new connections by 2030 will be through distributed off-grid or mini-grid power

~800,000 jobs

by 2030 in 8 high-potential new green business areas

Health and quality of life

5 Transform urban mobility

6 Shift to clean cooking

7 Improve waste management and sanitation

Green exports

8 Export green hydrogen

9 Benefit from 'transition metals'

10 Enhance carbon sequestration and export credits

~15 percent

of African emissions from cooking, waste, and transportation can be abated while also significantly reducing air and water pollution, noise, and congestion

~$35 billion

combined export revenue potential for green hydrogen, transition commodities, and carbon credits

Catalyze green financing pledged by developed nations for developing nations

$100 billion pledged for climate funding annually, but only...

...$20 billion per annum has materialized in Africa

A focus on green opportunities could unlock new development in Africa

While there are clearly important climate change risks to consider and prepare for in Africa, there are also opportunities available to the continent in a world transitioning to net zero. African countries can take advantage of a supportive international environment and the changing needs of a decarbonizing global economy to accelerate domestic decarbonization and invest in new low-carbon opportunities. Development banks and donors, for example, are re-focusing their strategies on climate change mitigation and resilience. African countries could access this support to help drive local and regional decarbonization initiatives with the potential to improve the health and lives of citizens while making an important contribution to the global net-zero transition, for example, by exporting metals that will be critical for the global transition (provided they are responsibly mined), green hydrogen, and carbon credits.

Because Africa's emissions profile is fragmented and diverse, there is no silver bullet to achieve a reduction in emissions. We highlight four broad areas of opportunity containing ten actions that could help contribute to a new green agenda in Africa by delivering energy access and affordability, ensuring resilient and productive economies, improving health and quality of life, and opening up major new export sectors (Exhibit 3). We also present some specific ideas that stakeholders could consider to help achieve these goals (Box2).

1. Expanding energy access and affordability

Achieving energy access for the 600 million people in Africa who are still without it is a key development objective, and keeping grid power costs low as demand increases is critical for continued economic growth. Renewable power can help provide a solution to both challenges, while also creating new jobs. Our analysis shows that expanding utility-scale renewables and building out distributed generation renewables across the continent could create 190,000 direct and 160,000 indirect jobs in solar by 2030—even if manufacturing does not happen in Africa—and 60,000 direct and 50,000 indirect jobs in the wind industry.

Accelerate the deployment of grid-scale renewables

Solar and wind costs have fallen considerably over the last few decades to the point where new-built renewables are now more competitive than existing coal-fired and gas generation in many regions.[41] The global average solar unit capital expenditure declined by 76 percent in the last ten years, while that for wind declined by 56 percent.[42] Electricity demand in Africa is expected to at least double over the next two decades. This increase will be higher under a scenario that sees a substantial decarbonization of the economy, where demand currently supplied by thermal fuels is shifted to renewable electricity. For example, we recently found that for Nigeria to continue to develop while also achieving net-zero energy-related emissions, grid-based electricity production would have to increase by nearly nine times.[43]

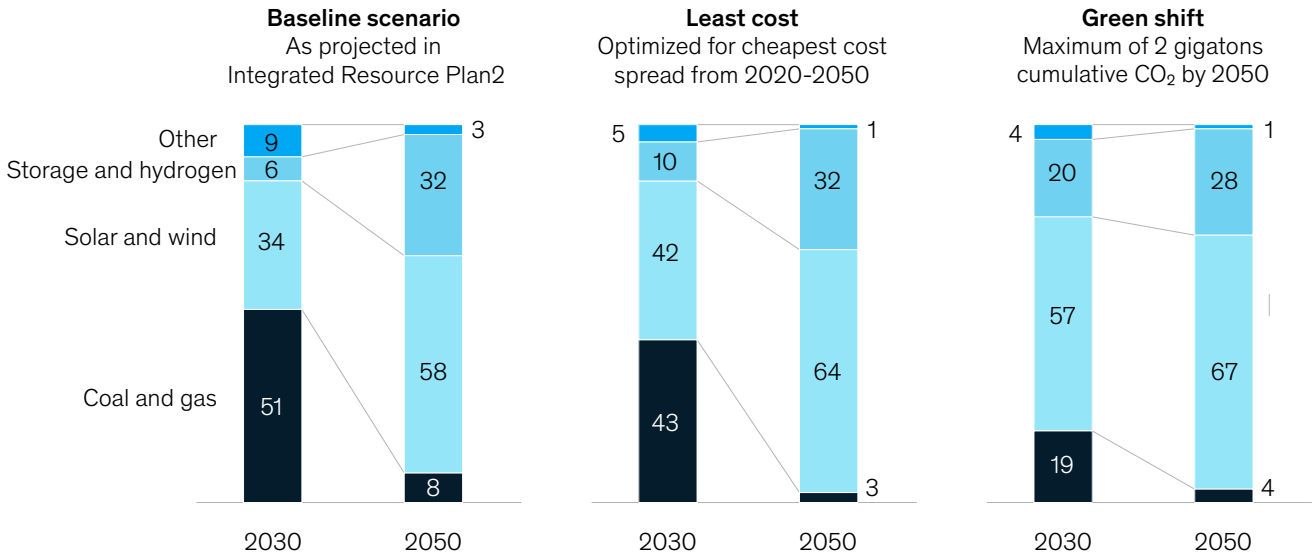
Accelerating the deployment of utility-scale renewables could be critical and is economically compelling. The switch to renewables is also likely to benefit the wider economy. For example, our research finds that in South Africa, a faster transition of the power sector to renewable sources, along with the accelerated decommissioning of coal plants, could be cost effective while also creating jobs and contributing to carbon neutrality (Exhibit 4). However, ensuring a positive economic and social impact from an accelerated transition would require that manufacturing opportunities of new value chains are localized and that workers are reskilled and shifted into new industries as coal-fired powered plants are decommissioned and coal mines retired.

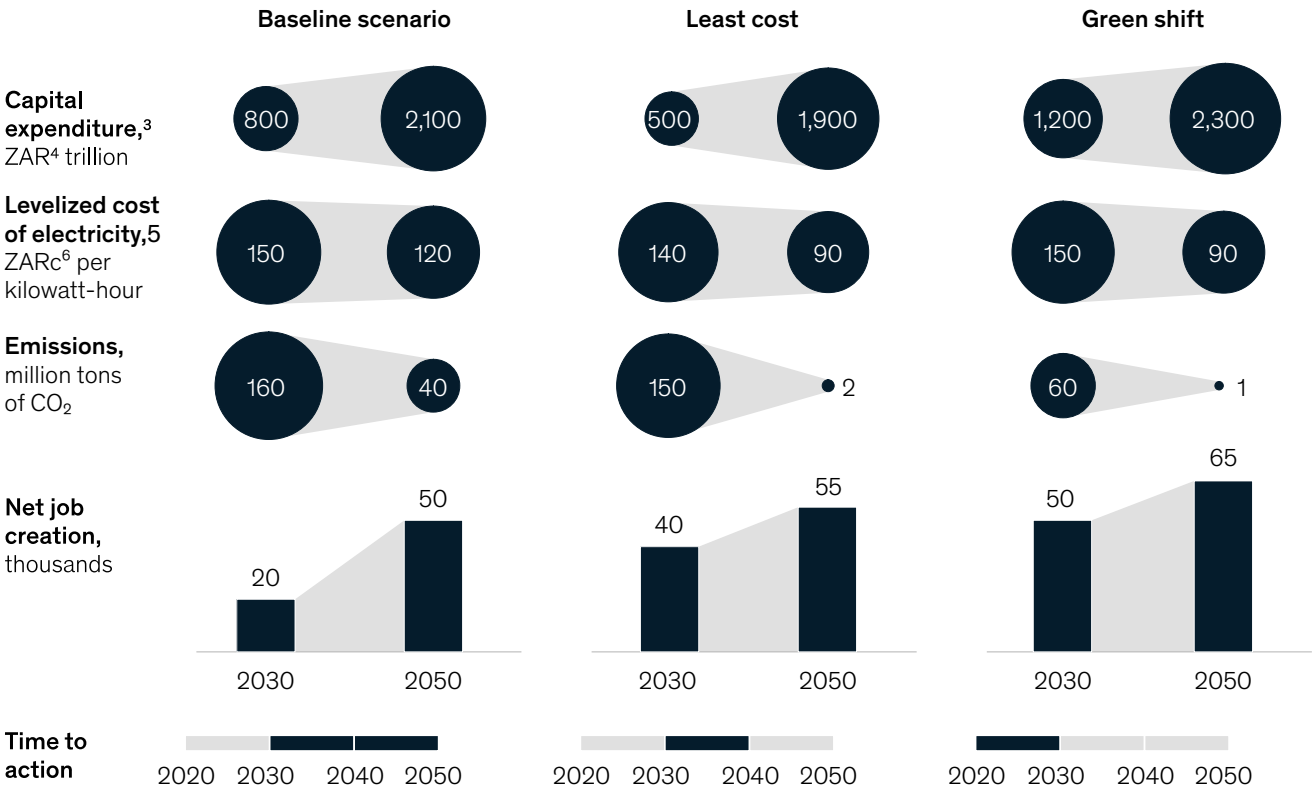
[41] McKinsey Energy Insights Global Energy Perspective 2021, December 2020, mckinsey.com.
[42] Ibid.
[43] Ibid.

Exhibit 4

An accelerated transition of South Africa's power sector could be more cost-effective, while also having a positive net effect on employment.

Potential scenarios for South Africa's energy transition,[1] capacity mix, %





[1]Figures may not sum to 100%, because of rounding. [2]Renewable energy build limits, capacity expansion, decommissioning as per IRP with technology cost evolution as per conservative McKinsey Power model outlook. [3]Cumulative capital-expenditure requirement up until 2030 and 2050, including written-off capital expenditures due to the early decommissioning of coal plants. [4]South African Rand. [5]Considers a combination of annual system costs for new assets calculated by the model and annual system cost of existing assets determined through team analysis. [6]South African Rand cents.

In the long term, achieving this transition to a largely renewable energy supply will require the build-out of long-term energy storage through green hydrogen or grid-scale batteries, technologies that are not yet fully commercially viable at scale in Africa. Our analysis shows that in Nigeria, nearly 15 percent of capacity in 2050 would need to come from new long-term energy storage technologies, with another 5 percent coming from hydroelectric assets to reach net zero.[44] In South Africa, approximately 30 percent of capacity would need to come from long-term storage assets.

In the medium term, to support ongoing economic development, most of the continent would need to build out additional dispatchable assets. Where economically viable—as in East Africa—geothermal plants can play this role. In most countries however, gas will likely play a role as a transition fuel to allow for flexible and dispatchable power. The long-term risk associated with stranding these assets can be mitigated if they are built with the ability to burn hydrogen as a fuel in the future.

In addition to ensuring sufficient storage and flexible capacity, this transition would require upgrading and strengthening transmission and distribution infrastructure across the continent, as well as strengthening grids across borders to enable international trading. USAID has identified ten major opportunities for regional electricity trading that would better balance power surpluses and deficits, provide export opportunities for a range of countries, and lower the average cost of power for most importing countries.[45]

Options to achieve the acceleration of grid-scale renewables include launching large scale procurement programs that bring in waves of renewable capacity. Experience from Morocco and South Africa shows that each wave results in greater investor confidence and improved economics being offered to the country. A central challenge in these programs is appropriately managing the various risks. Governments may need to accept ownership for the counter-party risk such as default or non-payment by the distribution company. Alternative approaches to consider for scaling up renewable capacity include allowing for more targeted contracting of renewable technologies to individual distribution companies or to franchise areas within distribution companies, and establishing a framework that allows for a feed-in-tariff for new developers.

An integrated approach that includes plant decommissioning and land restoration could help build out new renewable capacity while protecting the livelihoods of affected workers and communities.

[44] In a growing economy, it is critical that electricity can be dispatched when needed, but wind and solar are intermittent and considered to be non-dispatchable power. To balance the grid, investments in additional technologies, including dispatchable renewables such as hydro and geothermal, battery storage solutions, and green hydrogen would be required.

[45] *Power Africa Transmission Roadmap to 2030: A practical approach to unlocking electricity trade*, USAID, November 2018.

Beyond standard renewables procurement, countries can consider utility-scale "fossil to renewables" transformation programs, starting with decarbonizing coal-dependent grids. An integrated approach that includes plant decommissioning and land restoration could help build out new renewable capacity while protecting the livelihoods of affected workers and communities through re-skilling efforts, direct support, and regional economic diversification measures. These programs could combine different funding sources, including catalytic donor capital, cash flow from carbon credits, impact investors, and capital market funding.

The building of regional "super grids" could also contribute to improving energy access, affordability, and decarbonization by optimizing the use of existing generation capacity, realizing lowest-cost renewables potential, and improving grid balancing. Since transboundary regional interconnections face a complex set of regulatory, financing, technical, and execution challenges, a coordinated multi-stakeholder effort to identify high-priority transmission projects, resolve bottlenecks, and mobilize financing— including model innovations such as Build Operate Transfer (BOT) with private sector operators—could be required.[46]

Expand the build-out of distributed generation renewables

Renewables are not only cost-competitive, but also highly modular and scalable, from off-grid rooftop solar to commercial and industrial installations, and mini-grids to utility-scale solar and wind farms. Thus, they can provide affordable power to both consumers who are connected to the grid and those who are not connected, while also helping to provide universal rural energy access. We estimate that to achieve universal access, about 60 percent of African households could be served by urban and rural grids, and about 40 percent by off-grid solutions and mini-grids.[47] An integrated utility model, where the off-grid and mini-grid sector complements new connections through the main grid, could result in cost-effective service and higher access rates.

Commercial and Industrial (C&I) solar installations are already rapidly scaling up. Inconsistent performance of grid electricity, coupled with a desire to adopt affordable green inputs has resulted in businesses building C&I solar assets linked directly to their operations. This has resulted in solar C&I installations doubling annually for the past five years, reaching more than 200 MW of capacity excluding the North African region and South Africa, and more than 370 MW for the whole continent. C&I plays a critical role in scaling up distributed renewables for residential areas because it builds local photovoltaic (PV) capabilities and supply chains within a country, and helps build credibility and a track record for solar in new markets.[48,49]

Several barriers are currently hampering the scale-up of distributed renewables in Africa including regulation—for example, the inability to sell energy produced back to the grid is an issue in Nigeria and South Africa—insufficient project development capabilities, and lack of access to finance, especially for large off-grid systems and solar home systems. An idea to address this could be to set up a dedicated mechanism for renewable distributed generation development, such as the recently announced Rockefeller Foundation and IKEA Foundation $1 billion fund, which aims to provide technical assistance and project development and to catalyze additional development finance and commercial capital for investments in distributed renewables.[50]

2. Building resilient and productive economies

Increasing productivity and diversifying economies into segments that provide high-quality jobs and value creation are central ingredients of sustainable economic development. A low-carbon pathway can meet these goals, with clear opportunities in two high-emitting sectors: agriculture and manufacturing.

[46] BOT is a type of public/private financing model typically used in infrastructure projects where the private sector designs, builds, and operates the assets to meet certain agreed outputs, and after a set time frame control over the project is returned to the public entity.
[47] *Sustainable Energy Investments in Africa*, McKinsey & Company, IEA numbers.
[48] "Solar for Businesses in Sub-Saharan Africa", BloombergNEF, January 24, 2019, resources.solarbusinesshub.com.
[49] *Africa solar outlook 2021: A country-by-country review of the status of solar in Africa*, Africa Solar Industry Association, February 2021, afsiasolar.com.
[50] "Ikea Foundation and The Rockefeller Foundation Join Forces to Set up a Historic $1 Billion Initiative to Catalyze Investments in Distributed Renewable Energy," Rockefeller Foundation, 21 June, 2021, rockefellerfoundation.org.

Accelerate agricultural transitions

Increasing agricultural productivity in Africa has been central to the development agenda for decades, and this sector is also very important in the decarbonization context. Agriculture currently directly accounts for about a fifth of the continent's greenhouse gas emissions and is also an important driver of land-use change emissions, which account for another two fifths of Africa's emissions (see Box 1). Accelerating agricultural transitions could create new growth industries that support Africa's economic development and decarbonization and enhance food security, with opportunities in livestock in particular.

The role of livestock as a major contributor to methane emissions has come under increasing scrutiny in recent years. According to the UN Food and Agricultural Organization (FAO), domesticated animals emit about 5 percent of total human-caused greenhouse gas emissions, rising to 14.5 percent when feed production, transport, and other factors are taken into account.[51] McKinsey research shows that the agricultural industry could reduce methane emissions at a manageable cost with measures ranging from new feed supplements and selective breeding to reduce methane produced in the stomachs of ruminants, to methane capture techniques such as facemasks for cows.[52,53] Improving animal health monitoring and illness prevention could reduce emissions by meeting the world's projected animal protein demand with fewer, healthier animals.[54]

Health and environmental concerns around meat production are also opening up a new market for alternative protein sources that offers Africa an important opportunity. With the lowest protein intake per capita in the world—just 55 grams per person per day according to the FAO—there is room to grow the African market for meat substitutes, especially as the population grows. Plant-based meat substitutes are around 85 percent less carbon-intensive than beef per gram to produce while providing the same nutritional content, and are becoming cost competitive too.[55] Additionally, the plant-based protein manufacturing process is not capital intensive. It can easily be scaled up, making it an attractive prospect for investors and small- and medium-sized enterprises. Recent McKinsey research demonstrates that this is a potential new market

Increasing productivity and diversifying economies into segments that provide high-quality jobs and value creation are central ingredients of sustainable economic development. A low-carbon pathway can meet these goals.

[51] "Key facts and findings," Food and Agricultural Organization of the United Nations, fao.org.
[52] "Curbing methane emissions: How five industries can counter a major climate threat," McKinsey & Company, September 23, 2021, mckinsey.com.
[53] Natasha Doyle et al., "Use of lactic acid bacteria to reduce methane production in ruminants, a critical review," 1 October 2019, Frontiers in Microbiology, frontiersin.org.
[54] "Agriculture and climate change: reducing emissions through improved farming practices," April 2020, mckinsey.com.
[55] "Meat: The future series—alternative proteins," World Economic Forum white paper, January 2019, weforum.org.

for the continent that could deliver around $470 million in revenue per year by 2030 while helping to reduce emissions by 4.3 $MtCO_2e$.[56]

The continent could also look to tap into international development support to build resilience in the sector. These interventions could be critical in helping to ensure food security and stabilize the incomes of smallholder farmers who currently make up more than 50 percent of sub-Saharan Africa's working population.[57]

Further opportunities for Africa lie in continuing to pursue efforts to boost agricultural productivity and increase agricultural yields through, for example, access to state-of-the-art inputs, training, and financing, and reducing supply chain losses through improved transport, storage, and refrigeration. The restoration of degraded land through conservation farming practices and targeted landscape interventions such as terracing could also be vital.

Scale green manufacturing

As African countries continue on their economic development journeys, they will likely grow their manufacturing sectors in order to meet local demand as populations increase and become more affluent. Over the next 30 years, the continent is expected to urbanize rapidly and build out its infrastructure and manufacturing backbone, and there are direct and indirect socio-economic benefits in shaping a low-carbon pathway as they do this.

Firstly, "green" manufacturing often creates more socio-economic value. For example, our analysis shows that the building out of a cross-laminated timber industry in Africa—a low-carbon alternative to cement and steel in the construction industry—could create more than 100,000 jobs by 2030 across the value chain and over 3 million jobs in the longer term. This would more than compensate for the 1.4 million jobs, which may be lost due to the associated reduction in cement production.[58]

Cross-laminated timber is one of eight high-potential green manufacturing opportunities identified in recent McKinsey research that collectively could generate between $5 billion and $10 billion in revenue and create 800,000 jobs while abating 70 $MtCO_2e$ in greenhouse gas emissions by 2030.[59]

Achieving a low-carbon pathway for African manufacturing not only offers socio-economic benefits, but is also critical to limit warming to 1.5°C and thus avoid the extreme physical impacts predicted for the continent if the global temperature rises by 2°C or more. Even though African manufacturing currently contributes only around 3 percent to global manufacturing emissions, a high-emissions growth pathway could see this nearly double as the continent industrializes over the next 30 years, which would make the 1.5°C target all but impossible to achieve.[60]

A low-carbon manufacturing pathway could also help attract capital into the continent, as development partners are looking to provide financial and in-kind assistance for the decarbonization journeys of African countries, and investors are looking for sustainable investable projects. And finally, by choosing a low-carbon growth path now, African countries can avoid having to tackle a more costly transition of an existing asset base down the line, as many developed countries are now facing. McKinsey estimates that about 50 percent of potential manufacturing assets in Africa have not yet been

800,000 jobs

could be created by 2030 in new green business areas

[56] Lyes Bouchene, Kartik Jayaram, Adam Kendall, and Ken Somers, "Africa's green manufacturing crossroads: Choices for a low-carbon industrial future", McKinsey & Company, September 2021, mckinsey.com.
[57] "Employment in agriculture (% of total employment) (modeled ILO estimate) – Sub-Saharan Africa", January 29, 2021 International Labor Organization ILOSTAT database, The World Bank, data.worldbank.org.
[58] Lyes Bouchene, Kartik Jayaram, Adam Kendall, and Ken Somers, "Africa's green manufacturing crossroads: Choices for a low-carbon industrial future", McKinsey & Company, September 2021, mckinsey.com.
[59] Ibid.
[60] Lyes Bouchene, Kartik Jayaram, Adam Kendall, and Ken Somers, "Africa's green manufacturing crossroads: Choices for a low-carbon industrial future", McKinsey & Company, September 2021, mckinsey.com.

built and so there is a window of opportunity for African countries to choose a green growth path.

There are four main types of levers available to manufacturers to reduce emissions: switching to alternative energy sources, implementing process efficiencies, adopting circularity solutions and renewable feedstocks, and making the necessary technology shifts such as the use of carbon capture and storage. However, to reach net-zero emissions, especially in high-emitting industries, a demand shift to new green alternatives will also be required.

For example, as described above, transitioning from high-emission materials such as steel and cement to low-carbon, wood-based alternatives such as cross-laminated timber, and from meat to plant-based proteins, could be significant. Cement production alone produces about 10 percent of the continent's total emissions.[61] Other opportunities to create new business value and reduce emissions could lie in the production of biofuels, particularly bioethanol production, to provide lower-carbon alternatives for cooking and transport. Sustainable biofuel production would be suited for regions where arable land is plentiful. Bioethanol feedstocks can consist of sugar plants, such as sugar cane and sugar beets, starchy plants like cassava and potatoes, and grains such as corn and wheat. All these crops grow readily on the continent. We calculate that just one million hectares of land is enough to cultivate the feedstock required to produce around 2.4 billion liters of bioethanol per year.[62]

3. Improving health and quality of life

In many domains, notably cooking, mobility, and waste management and sanitation, decarbonization transformations could deliver substantial improvements in health and quality of life to citizens while helping Africa to reduce its greenhouse gas emissions. African countries could look to take advantage of support from development partners to realize these benefits.

Transform urban mobility

The transformation of urban mobility is an untapped opportunity with multiple benefits from improved health and wellbeing of citizens to the unlocking of economic efficiencies. Rapid urban expansion, coupled with urban planning and infrastructure challenges and under-developed public transportation, is leading to high levels of traffic congestion, air pollution, noise, and lost productivity in Africa's megacities, with lower-income citizens often the worst affected. Transport contributes about 10 percent to emissions in major African economies and congestion can increase automobile emissions, which ultimately degrades ambient air quality.[63] During periods of rush hour traffic, concentrations of hydrocarbons, carbon monoxide, and oxides of nitrogen are normally double the rate of free-flow periods.[64] Additionally, substantial amounts of time are lost daily to traffic. In Lagos, commuters spend an estimated 30 hours in traffic every week—potentially consuming up to 3.5 times more fuel than they would in free-flowing traffic.[65]

By developing more sustainable and accessible urban mobility systems, cities could improve the quality of life of their citizens while also freeing up time for more productive tasks. Some countries are moving in this direction. For example, Kenya is putting in place measures for dedicated lanes for electric buses to reduce congestion and incentivize moves towards electric vehicles.[66] Rwanda announced in June that it aims to have 20 percent of all buses transition to electric by 2030 and has initiated several incentives, including a preferential corporate income tax rate for investors in e-mobility and rent-free land for the installation of charging infrastructure.[67]

The adoption of electric vehicles offers additional economic benefits. Our recent analysis shows that electric motorbikes in Kenya are already more cost effective than an internal combustion engine equivalent once drivers cross the 20 kilometers a day threshold. In Kenya this is easy to achieve as the vast majority of motorbike owners—95 percent—are taxis or delivery services and travel 90 to 100 kilometers per day. Lower maintenance

[61] Ibid.
[62] Ibid.
[63] McKinsey Sustainability EMIT database.
[64] "Daring to breathe: Why reducing traffic congestion in African cities is urgent," Stockholm Environment Institute, July 26, 2021, sei.org.
[65] Ibid.
[66] Government website: vision2030.go.ke.
[67] "Rwanda aims to have 20% of all buses transition to electric by 2030," Global Green Growth Institute, June 2031, gggi.org.

and charging costs are also making it cheaper to own an electric motorbike, with a 25 percent reduction in total cost of ownership (TCO) over five years expected. And because Kenya is considering introducing a lower electricity tariff for electric vehicles—at about 7 cents per kWh instead of the business price of about 12 cents—TCO could drop even further with a potential 8 percent saving over the lifetime of the vehicle.

To accelerate these shifts, African cities can look to drive lighthouse urban mobility transformation programs comprising five elements: a reliable and expansive public transport system and shared mobility models; a network of connectivity such as bike lanes and public bike rental systems making active mobility the new normal in African cities; a focused transition to e-mobility including electric buses and mini-buses; a public electric vehicle charging network to support the uptake of private electric vehicles; and better integrated urban areas to reduce inner city travel.

Shift to clean cooking

In sub-Saharan Africa, where more than 950 million people rely on wood and charcoal for cooking—a number that is expected to reach 1.7 billion by 2050—and 50 percent of residential emissions are from cooking, a shift to clean cooking could be transformational.[68] About 600,000 people die annually in sub-Saharan Africa due to exposure to biomass smoke.[69] The use of wood and charcoal also contributes to deforestation leading to further greenhouse gas emissions.[70] Furthermore, the collection of cooking fuels and preparation can take on average 1.4 hours each day, taking time away from other activities that could promote human and social development.[71]

By contrast, liquefied petroleum gas (LPG), electronic (e-cooking), or biogas-based cooking are viable alternatives that could have important public health and environmental benefits. LPG, while still a fossil fuel, emits five times less greenhouse gas than firewood and is therefore an important transition fuel in the absence of electrification or biogas.[72]

About 600,000 people die annually in sub-Saharan Africa due to exposure to biomass smoke. The use of wood and charcoal in cooking also contributes to deforestation leading to further greenhouse gas emissions.

[68] "Too many cooks," June 14, 2021, United Nations Climate Change, unfcc.int.
[69] Henri Casteleyen, "Clean cooking in sub-Saharan Africa: Modeling the cooking fuel mix to 2050," Master of Science Thesis, KTH School of Industrial Engineering and management, 2017, diva-portal.org.
[70] "Global report cites progress in slowing forest losses," FAO newsroom, March 13, 2007, fao.org.
[71] IEA World Energy Outlook: Energy Access Outlook 2017.
[72] "Baseline effects on carbon footprints of biofuels. The case of wood," Environmental Impact Assessment Review, November 2012, www.researchgate.net.

However, there are many challenges to overcome in promoting the uptake of these cooking systems, including affordability, cultural norms, and a lack of understanding about the value of these products.

In Nigeria, which has the continent's largest population of households using emissions-intensive cooking technologies, we find that despite the fact that clean cooking solutions are relatively affordable, household adoption remains low. Among households currently using emissions-intensive cooking technologies, almost two-thirds could afford the total cost of ownership for LPG-based cooking, and over 90 percent could afford biogas.[73] However, cooking is a deeply habitual, social, and cultural activity and interhousehold decision-making on cooking behavior may be preventing uptake. For example, low levels of female education in a household is often correlated with low levels of adoption.[74] Overall, without strong promotion activities, our model predicts an uptake of clean cooking in just 10 to 12 percent of households.[75]

Promoting the transition to clean cooking would likely require targeted interventions from governments, donors, development partners, and the private sector. The availability of cookstoves, canisters, and fuel or electricity (depending on the technology) would also require investments in filling stations, biogas digesters, transport capacity (either pipelines or trucks), and cookstove distribution. Addressing the remaining affordability challenges may require subsidization of either upfront household costs or ongoing fuel prices. Most critically, large scale community-based efforts will likely be required to improve knowledge about the health impacts of emissions-intensive fuels and the benefits of clean cooking technologies.

Improve waste management and sanitation

Lack of access to sanitation and poor waste management currently contribute to poor health and illness in many African countries. Over 760 million people in sub-Saharan Africa do not have access to sanitation, with 220 million still practicing open defecation.[76] Poor sanitation contributes to a loss of about 1 percent to 2.5 percent of a country's GDP according to the United Nations.[77] Waste pollution also takes a high socioeconomic toll. Almost 90 percent of Africa's waste is disposed of at uncontrolled dumpsites and landfills, often followed by open burning, which is creating health hazards and adding to air pollution.[78] Poor waste management and sanitation also contribute to the continent's methane and CO_2 emissions. About 7 percent of Africa's greenhouse gas emissions currently come from waste, compared to an average of 4.2 percent for other developing countries.[79] Left unchecked, these risks will intensify in a rapidly urbanizing continent.

In closing the sanitation gap, African countries could benefit from integrating climate considerations into sanitation policy and planning. Climate change impacts existing sanitation systems—for example through flooding and the unpredictability of water availability—and can impede progress in building out services. Future sanitation and waste-water systems will need to withstand intensifying climate hazards and can be built to limit greenhouse gas emissions. Centralized waste treatment plants, for example, require considerable energy input, and the degradation of organic matter during water treatment contributes about 1.57 percent of global greenhouse gas emissions and 5 percent of global non-CO_2 greenhouse gas emissions.[80] Discharge of untreated waste into the environment and the use of onsite technologies, such as septic systems and pit latrines—leading sanitation solutions for low-income countries—are also sources of emissions, although these remain poorly quantified. Opportunities for African countries could therefore lie in the development of innovative systems that seek to reuse water or recover nutrients contained in waste, while also providing indirect reduction of emissions through renewable energy production and reduced

[73] McKinsey analysis for Sustainable Energy for All (SEforALL); Nigeria Integrated Energy Plan, 2021.
[74] Ibid.
[75] Ibid.
[76] Ayat Soliman, "Action at scale: How to accelerate access to adequate and equitable sanitation and hygiene in Africa," World Bank Blogs, March 26, 2019, blogs.worldbank.org.
[77] "Inadequate sanitation costs 18 African countries around US$5.5 billion each year," The World Bank, April 16, 2012, worldbank.org.
[78] "What a waste: Innovations in Africa's waste material management," African Union Development Agency, July 10, 2021, nepad.org.
[79] Couth, R., Trois, C., "Waste management activities and carbon emissions in Africa", University of KwaZulu-Natal, CRECHE, School of Civil Engineering, Survey and Construction, Durban 4041, South Africa.
[80] Sarah Dickin, Moustafa Bayoumi, Ricard Giné, Kim Andersson and Alejandro Jiménez, "Sustainable sanitation and gaps in global climate policy and financing," *npj Clean Water*, May 25, 2020, nature.com.

dependency on fossil-fuel-based chemical fertilizers. For example, East African sanitation start-up, Sanergy, has a three-step solution that provides sanitation units in Nairobi's urban slums as an effective alternative to sewers. Waste is collected from these units and converted into valuable end products such as organic fertilizer and insect-base animal feed using the larvae of the black soldier fly that feed off organic waste.[81]

Key opportunities to capture value from waste management lie in waste collection improvements to reduce the uncontrolled burning of waste and waste separation to reduce the amount of decomposing organic matter in landfills. The current waste collection chain across most African countries is highly fragmented and a significant portion of waste is informally dumped or burned. Research shows that the average organic content for urban municipal solid waste in Africa is around 56 percent and its degradation is a major contributor to greenhouse gas emissions.[82]

Establishing a network of semi-automated material recovery facilities (MRFs) could help ensure more efficient collection, separation, and recycling, especially of higher-grade waste. Our analysis shows that for higher grade waste, MRFs could pay up to $50 per truck (dumpsites currently charge $2 to $5 per truck) and still make a profit.[83] This higher fee could incentivize waste collectors and community-based organizations to deliver higher grades of waste by creating pressure to sort at source. MRFs would likely need to be launched in public-private partnerships, with lower land costs and taxation incentives needed to strengthen the business case.

Other levers that could be explored to improve waste management include establishing and leveraging extended producer responsibility (EPR) schemes to raise and direct funds to facilitate collection, equipping households with color-coded bags to drive sorting at source, and increasing incomes for collectors and employees at sorting facilities. In all solutions, integrating informal waste pickers could be an important system design element to create more secure and formalized employment for low-income citizens.

4. Realizing new export sectors

The structural changes underway in the global economy as it transitions to net zero provide openings for African countries to draw on their rich endowment of renewable resources, natural

Competitive clean energy exports from regions with excess low-cost renewables to supply-constrained industrial centers could be a critical enabler for achieving global climate neutrality while also creating economic value in the exporting regions.

[81] Company website, sanergy.com.
[82] Couth, R., Trois, C., "Carbon emissions reduction strategies in Africa from improved waste management: A review", Waste Management 30 (2010) 2336–2346.
[83] McKinsey analysis.

capital, and minerals to open up new export sectors. Three major opportunities here lie with green hydrogen, critical 'transition metals', and carbon credits.

Export green hydrogen and derivatives to meet global demand for clean energy

Africa has an opportunity to export green hydrogen and derivative products to meet global demand for clean energy. Industrialized countries will require ready supplies of clean energy to fully decarbonize; the EU, for example, estimates that by 2050 it will require between 65 and 70 million tons of green hydrogen per annum to achieve its climate neutrality goal, accounting for about 25 percent of its total energy demand.[84] For some industrialized countries, building out renewable energy assets at the scale and speed required may prove challenging due to land use conflicts in more densely populated areas and other complications. Hence, competitive clean energy exports from regions with excess low-cost renewables to supply-constrained industrial centers could be a critical enabler for achieving global climate neutrality while also creating economic value in the exporting regions.

Exporting countries may see benefits for their domestic markets too. The massive build-out of renewables capacity and long-term storage capability could enable domestic decarbonization, for example, of industry and mobility, through electrification. Additionally, local industries such as ammonia and steel could switch to hydrogen feedstocks, unlocking new value and ensuring that exports can remain cost-competitive in a low-carbon world economy.

Because the continent's endowment of renewable energy resources far exceeds expected domestic energy demand, there is an opportunity for African countries to valorize these "stranded" renewables through the production and export of clean energy or of processed goods based on clean energy. Africa's primary annual energy demand is estimated to grow to 15 to 20 Petawatt hours (PWh) by 2050, compared with an estimated potential of about 1,100 PWh for concentrated solar power, onshore wind, and solar PV.[85,86]

Regions with both large wind and solar resources are optimal for hydrogen production, with Northeast, Northwest, and Southern Africa all having the potential to achieve highly competitive green hydrogen production costs of between $1.1 and $1.3 per kilogram by 2040. Additionally, North African countries could take advantage of low-cost transport through trans-Mediterranean pipelines, resulting in a cheaper landed cost in Europe compared with any other export region that would require shipping. For Southern Africa, green hydrogen could be sold in Africa or shipped overseas, with a landed cost of about $2.6 per kilogram in Europe by 2040. This would be competitive with hydrogen shipped from Australia, Chile, or Saudi Arabia, at estimated landed costs of $2.4 to $2.6 per kilogram (Exhibit 5). Given the cost advantages North African countries have because they can use pipelines into Europe, it may make more sense for Southern Africa to focus on exporting derivative products like methanol, ammonia, synthetic fuels, or direct-reduced iron ore that are easier to ship (this would also have the advantage of deepening local value-add). There may also be scope for Southern Africa to export hydrogen into countries like Germany if they wish to have a diversified supply base or there are complications with creating a trans-European hydrogen pipeline network.

Our analysis shows that supplying about 20 percent of the EU's expected 2050 green hydrogen demand—roughly 10 to 15 million tons per year—could be achieved by dedicating less than 1 percent of Namibia, Morocco, and Egypt's land to renewables, and could translate into export revenue of between $20 to $30 billion and create 120,000 to 160,000 direct and indirect jobs.

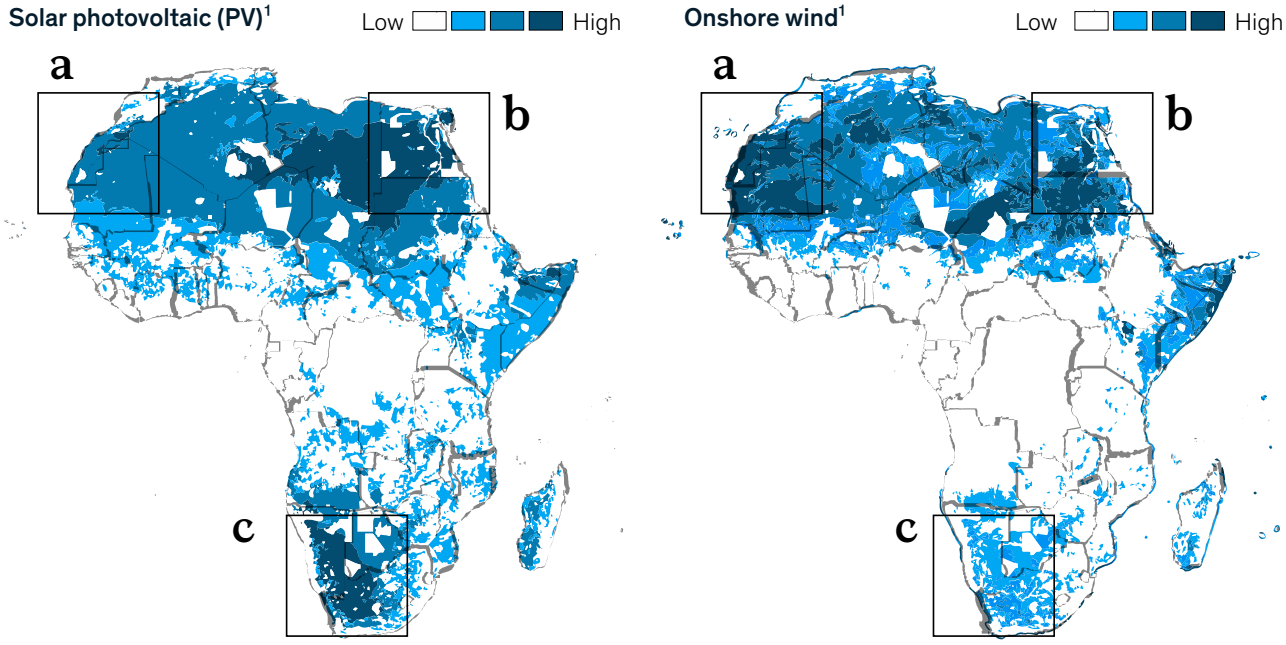
Both the EU and Japan are currently exploring supply sources and entering strategic partnerships to secure their future green energy needs. These agreements may include technical and financial assistance to allow producing countries to build up domestic industries. Proactively engaging with such prospective partners could enable African countries to capture this opportunity.

[84] McKinsey Net-Zero Europe Report and "Green Hydrogen: Bridging the Energy Transition in Africa and Europe" (EU Africa Hydrogen Partnership, pp. 21), The Africa-EU Partnership, September 2020, africa-eu-energy-partnership.org.
[85] Gregor Schwerhoff and Mouhamadou Sy, "Where the sun shines: Renewable energy sources, especially solar, are ideal for meeting Africa's electrical power needs," March 2020, Finance and Development, imf.org.
[86] "Estimating the renewable energy potential in Africa: A GIS-based approach," IRENA, August 2014, irena.org.

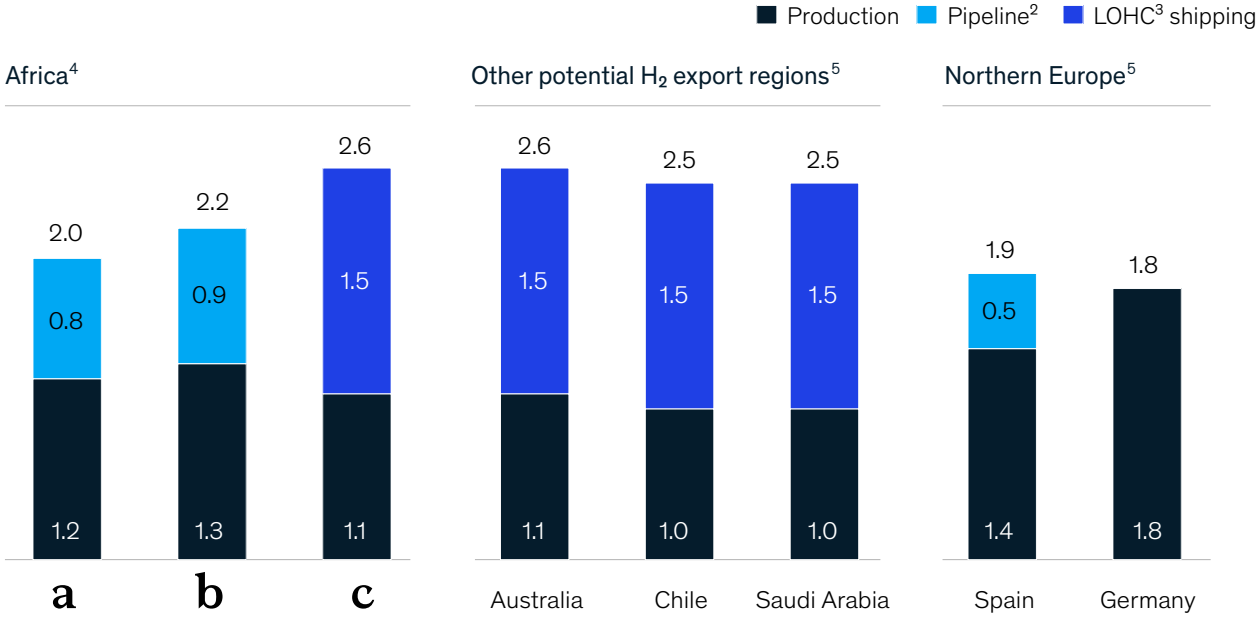
Exhibit 5

The northeast, northwest, and southwest of Africa could deliver green hydrogen to northern Europe at competitive prices.

Renewable-energy potential in Africa



Estimated landing costs for green hydrogen in Germany in 2040, $ per kilogram



[1]For feasible locations, excluding military, protected, and biodiversity areas; land slopes >10%; buffers around settlements; and airports for wind.
[2]To Hamburg, Germany.
[3]Liquid-organic-hydrogen carrier.
[4]Levelized cost of hydrogen (LCOH) optimized according to combined local generation profiles and costs of solar and onshore wind mix; hydrogen production firmness of 90%; electrolyzer utilization factor of 40–50%.
[5]LCOH based on the cost and utilization factor for one optimal renewable technology (ie, either solar PV, or onshore or offshore wind).
Source: Global Solar & Wind Atlas; McKinsey analysis

Actions to develop African clean energy export powerhouses in North Africa and in the Southwest of the continent could include developing a hydrogen vision and associated strategy, and engaging partners to turn this into reality. Regulatory and infrastructure-related improvements informed by global best practices and enabled by regional infrastructure plans and investment frameworks would need to be in place, along with a platform for end-to-end value chain development, streamlining of permitting processes, and support for onsite assessment and acquisition. Cooperation with international donors could help to de-risk first-of-their-kind ventures and unlock foreign direct investment.

Scale up 'transition metal' production and expand downstream

Africa has rich endowments of a number of commodities such as cobalt, copper, nickel, lithium, and manganese that are expected to see demand increases due to the global decarbonization agenda. Global demand for battery raw materials, for example, is expected to increase strongly over the coming decade and beyond, driven by electric vehicle uptake. Expanding production in Africa to capture 10 percent of this demand increase could create an estimated $16 billion in GDP.

Furthermore, there could be an opportunity for African producers to expand downstream into the material processing parts of the value chain. For example, raw material refining and active material production needed for batteries present especially attractive margins and growth rates.

Countries in Africa could localize these two segments owing to their access to raw materials; the continent holds more than 60 percent of global cobalt reserves, for example. This could enable countries to compete in and capture a share of a market which is expected to reach between $200 and $250 billion globally by 2030. If Africa is able to capture around 10 percent of this market, it could generate $7 billion in additional GDP.[87]

Critical to the success of this would be a focus on improving environmental, social, and governance (ESG) challenges often associated with the mining of many of these commodities in Africa.

To unlock this potential, countries would need to create an enabling environment by incentivizing manufacturers to produce locally, for example by providing R&D grants and setting up special economic zones to support manufacturing. An idea to capture this market could be to create battery-active material production hubs in Southern and Central Africa including in the DRC and South Africa. The DRC is endowed with the raw materials needed for the attractive cathode segment of batteries, and is thus well positioned to become a global battery manufacturing hub that combines extraction and refining of raw materials with production of cathode active materials. This would require the upskilling of the local workforce and the development of required infrastructure for electricity supply, transport, and storage across the value chain in order to ensure best-in-class environmental standards in mining and manufacturing.

Africa's rich natural capital endowment harbors carbon abatement potential estimated at 1.2 $GtCO_2$ per year—about 2 percent of current global emissions.

[87] Securities research, Expert interviews, Yano Research, Press search.

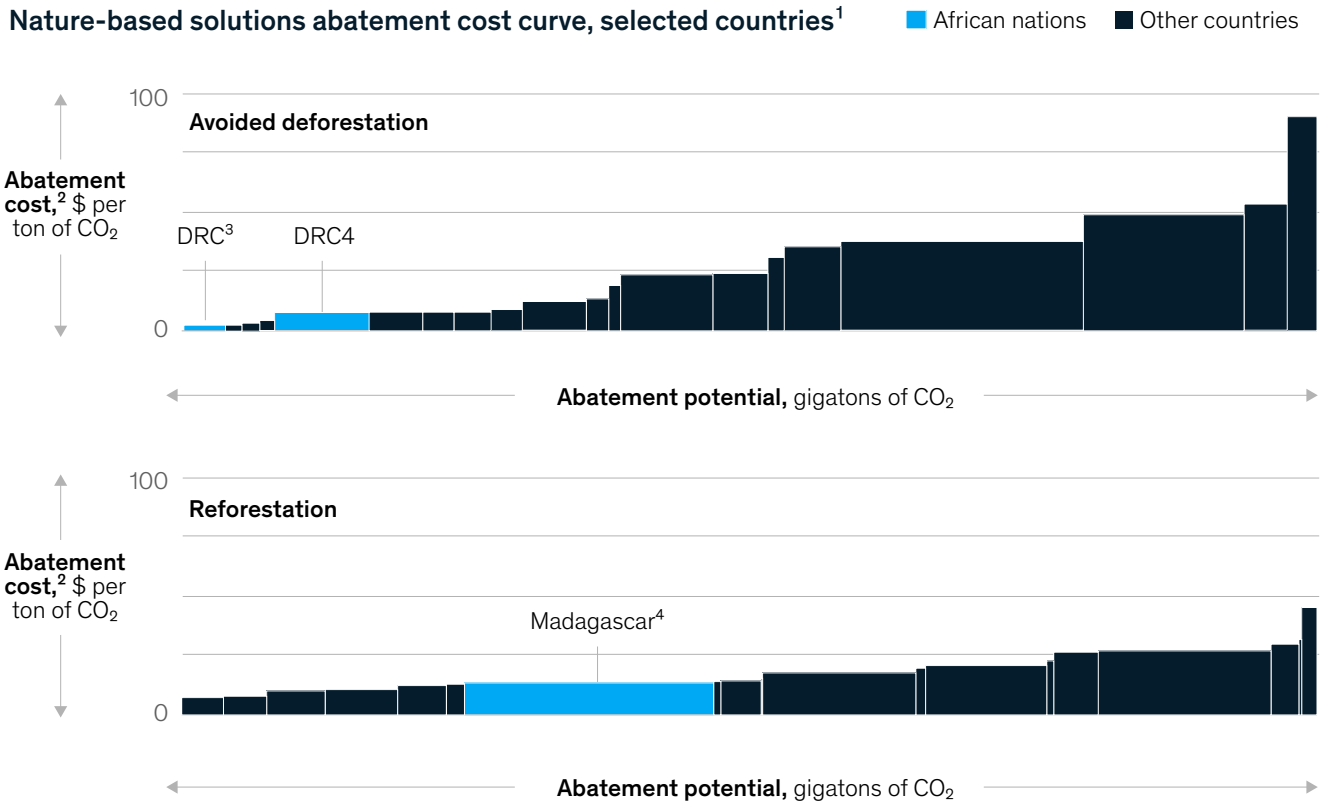
Protect and enhance carbon sequestration and export carbon credits

A third opportunity for the continent lies in turning carbon credits into a major new export commodity. Protecting and expanding carbon sinks is a critical lever to combat climate change; in the near-term to stretch the carbon budget and allow more time for emissions reductions, and in the long-term to offset hard-to-abate residual emissions. Halting deforestation and other land-use changes can avoid emissions, while expanding carbon sequestration in natural carbon sinks such as forests and soils or through technological means such as direct air capture technology could create negative emissions.

Our research shows that Africa's rich natural capital endowment harbors carbon abatement potential estimated at 1.2 $GtCO_2$ per year—about 2 percent of current global emissions.[88] Much of this could be realized at comparatively low costs. For example, avoiding deforestation in the DRC is estimated to cost $2 to $8 per ton of CO_2, well below the global average (for other avoided deforestation levers). The value of markets for voluntary carbon offsets—such as those used by corporations or individuals to offset emissions and help fulfil climate neutrality pledges—is expected to grow by a factor of 15 by 2030 to more than $50 billion per annum. Additionally, the eventual implementation of Article 6 of the

Exhibit 6

Madagascar and the Democratic Republic of the Congo can provide cost-effective, large-scale nature-based abatement solutions.



[1]Countries that represent ~70% of global abatement potential.
[2]All costs assume a 30-year project duration and future costs are discounted using a 10% discount rate.
[3]Democratic Republic of the Congo.
[4]Medium feasibility.
Source: Araya and Hofstad, 2014; expert interviews; FAO; Gold Standard for Global Goals; Grieg–Grann, 2008; Pagiolat and Bosquet, 2009; Verra; World Bank; McKinsey Nature Analytics

[88] McKinsey Nature Analytics

Paris Agreement, allowing for emissions trading between countries, could provide a vehicle for African countries to valorize these carbon sequestration potentials.[89]

With just 4 percent of the DRC's avoided deforestation potential currently funded through carbon offsets, there is potential for African countries to unlock these opportunities.[90] Beyond the low costs of nature-based solutions compared to other climate mitigation options, carbon sequestration also provides important environmental and socio-economic co-benefits such as safeguarding biodiversity, securing water supplies, and providing jobs for local communities. Realizing 20 percent of the continent's carbon sequestration potential and bringing it to market at a price of $10 per ton of CO_2 could create a new export 'commodity' with a potential volume of $3 billion per annum and an associated 500,000 direct and indirect jobs (Exhibit 6).

Four ideas to help realize this new export potential could include:

— Setting up a multi-stakeholder transboundary effort to protect the Congo Basin and Rainforest. While the challenges of operating in this region are substantial, the benefits of extending protections for this region of important biodiversity could be considerable. The Congo Basin accounts for about 40 percent (0.48 Gt) of Africa's natural carbon abatement potential, with larger potential from avoided deforestation than any region globally other than the Amazon Forest, and globally the lowest-cost abatement estimated at $2 to $8 per ton of CO_2. Since the DRC is currently still seeing limited rates of deforestation, this effort would need to make use of new models such as "Payment for Ecosystem Services" successfully trialled in Costa Rica, under which land owners and farmers receive direct payments for different forest protection activities.

— Initiating an at-scale reforestation program in Madagascar could contribute 0.1 Gt per annum of carbon abatement at a comparatively low cost of $10 to $15 per ton of CO_2 (compared to the global average of $18 per ton of CO_2). This is the equivalent of about 5 percent of the total natural carbon sequestration potential in Africa and offers the second largest reforestation potential globally after the Amazon Forest.

— Developing a "blue carbon" farming sector in West Africa and East Africa's coastal ocean where the combined seagrass avoided degradation and seagrass restoration potential is 0.08 Gt CO_2 per annum, concentrated in Nigeria, Guinea, Guinea-Bissau, and Madagascar. Our recent research highlights three key steps to help unlock this: increased research funding, governments including blue-carbon solutions in NDCs, and improving access to voluntary carbon markets.[91]

— Support communities to restore the East and Central African savanna rangelands and improve their ability to support critical biodiversity and millions of livelihoods, as well as to utilize their potential for carbon sequestration of more than 0.2 Gt per year of CO_2e through soil enhancements. Savanna rangelands are an iconic African landscape that sustain the livelihoods of millions of cattle-keeping people, but overgrazing and land use change has decreased carbon in the soil and put biodiversity and community climate resilience at risk. Community-led restoration projects in northern Kenya offer a replicable and scalable example that could lead to sequestration at scale and provide access to carbon markets through existing verification methods.[92] Such carbon markets may not only directly finance community efforts to improve soil carbon stocks, but also offer premium carbon credit pricing because of community and biodiversity co-benefits, and may in time finance standalone biodiversity credits.[93]

[89] Christopher Blaufelder, Cindy Levy, Peter Mannion, and Dickon Pinner, "A blueprint for scaling voluntary carbon markets to meet the climate challenge", McKinsey, January 2021, mckinsey.com.
[90] "Democratic Republic of Congo Taps Carbon Finance to Save Forests", Ecosystem Marketplace, November 9, 2015, ecosystemmarketplace.com.
[91] Forthcoming McKinsey research.
[92] "Northern Kenya Rangelands Carbon Project: Building Sustainable Livelihoods and Conserving the Natural Environment", Northern Rangelands Trust, nrt-kenya.org.
[93] For example, EcoAustralia™ credits blend government-accredited Australian Biodiversity Units with international carbon credits from high-quality, Gold Standard projects. Sourced: southpole.com.

Box 2

Ideas that could help power African growth and prosperity in a net-zero world

Across the continent, opportunities exist to draw on regional strengths and natural capital to capture opportunities resulting from the global transition.

Energy access and affordability

1. Drive utility-scale "fossil to renewables" transformation programs
An integrated approach that includes plant decommissioning and land restoration could help build-out new renewable capacity while protecting the livelihoods of affected workers.

2. Build regional "super grids"
Improve energy access, affordability, and decarbonization through optimizing the utilization of existing generation capacity, realizing lowest-cost renewables potential, and improving grid balancing.

3. Create a dedicated mechanism for renewable distributed generation development
Address barriers that are currently hampering scale-up of distributed renewables in Africa, including regulation, insufficient project development capabilities, and lack of access to finance, especially for large off-grid systems.

Resilient and productive economies

4. Mobilize capital for domestic decarbonization journeys through a "new deal" on climate finance
Catalyze the flow of $100 billion per year in pledged finance from industrialized countries by helping African countries develop ambitious and detailed climate action plans with specific initiatives and near-term milestones translated into bankable projects.

5. Manufacture plant-based protein
Develop local, cost competitive, plant-based meat substitutes for Africa's growing population.

6. Set up regional cross-laminated timber industries
Identify high-growth urban centers near potential reliable, sustainable timber supplies and work with city administrators and entrepreneurs to create supporting mechanisms and value chains.

7. Scale up biofuels production
Tap into Africa's abundant sources of biomass to produce biofuels, particularly bioethanol, at scale from sustainable plantations to provide low-carbon alternatives for transport and cooking.

Health and quality of life

8. Drive lighthouse urban mobility transformation programs
Build a reliable and integrated public transport system with a focus on e-mobility that makes active mobility the new normal in African cities.

New export opportunities

9. Develop African hydrogen export powerhouses in North Africa and Southwestern Africa
Develop a hydrogen vision and associated strategy and engage partners to turn them into reality.

10. Create battery active material production hubs in Southern and Central Africa
Position the DRC to become a global battery manufacturing hub that combines extraction and refining of raw materials and production of cathode-active materials.

11. Launch a multi-stakeholder transboundary effort to protect the Congo Basin and Rainforest
Protect the carbon stocks of the Congo Basin, which has the lowest-cost abatement and largest potential from avoided deforestation than any region globally, with the exception of the Amazon Forest.

12. Initiate an at-scale reforestation program in Madagascar
Realize carbon sequestration without infringing on land needs for farming or other pursuits and at a comparatively low cost.

13. Develop "blue carbon" farming in West Africa's coastal ocean
Tap into the combined seagrass avoided degradation and seagrass restoration potential concentrated in Nigeria, Guinea, and Guinea-Bissau.

14. Restore iconic savanna rangelands
Support communities to restore the East and Central African rangelands and improve their ability to support critical biodiversity, millions of livelihoods, and potential sequestration of more than 0.2 Gt per year of CO_2e through soil enhancements.

Box 3

Climate financing is critical to help African countries mitigate risks and seize growth opportunities

To unlock the opportunities and protect against the physical and transition risks posed by a warming climate, Africa will need to attract substantial amounts of additional finance. The current climate funding gap for adaptation and mitigation on the continent is estimated to be in the region of $200 billion per annum.[94] Developed countries have pledged $100 billion per annum for decarbonization and adaptation initiatives in developing countries, although only a fraction of this is currently flowing, with current public climate funding for Africa estimated to be $20 billion per annum.[95, 96] More public funding and private capital is therefore required to close the climate funding gap.

While there is, in principle, sufficient capital seeking investable opportunities in Africa, there are a number of barriers that limit private sector capital deployment into African countries. These include a lack of knowledge about investable opportunities on the part of potential investors and financiers, difficulties in the business climate including political uncertainty leading to country risk premiums and higher costs of capital, and the low attractiveness of green investment opportunities as a result of the low political priority currently given to the decarbonization agenda. The time and resources required to create projects that are bankable are also often significant. Additionally, a mismatch between investors and transition investment needs—for example, high-emitting sectors that need the most capital to transition typically do not meet the investment criteria of "green" investors—makes it difficult to allocate funds to the most relevant projects. And finally, the often low maturity of local financial sectors limits their ability to mobilize funds for green projects.

To help catalyze the pledged donor climate finance flows and unlock private investment African stakeholders can consider the following tactical interventions:

— Create a pipeline of investable projects. While many countries have already outlined climate action and adaptation plans, these are often high level and do not contain concrete, near-term initiatives and investable opportunities with a clear business case. With a more detailed plan in hand, African countries could make concrete financing asks coupled to specific initiatives with concrete near- and mid-term milestones that allow impact to be measured. Further work will then be required to translate initiatives into bankable projects.

— Scale up technical assistance to African governments. African countries could look to leverage existing initiatives and interventions designed to help improve the business climate, provide regulatory stability, and implement adequate green regulations as well as looking to tap into new opportunities.

— Provide technical assistance to green businesses via active on-the-ground collaborations with civil society organizations and local stakeholders to support project development and grow the pipeline of investable projects. This could include feasibility studies and business plan development as well as project risk assessment, developing environmental reporting mechanisms, and supporting access to carbon credits.

— Reduce knowledge and data gaps for investors regarding Africa's business and political environment, carbon reduction potential, and business opportunities. Investors can also be supported to accelerate data sharing and capability building.

— Raise funding and develop financial instruments targeted at green projects. These could include venture capital funds to scale-up early-stage projects, growth funds to help expand established green businesses, and green transition banking solutions in collaboration with donors, local governments, and local banks.

— Facilitate transactions to help close deals between investors and local green businesses, for example, investor liaison via workshops and presentations and sourcing and prioritization of project pipelines for investors.

To achieve a step-change in mindset and impact, a "new deal on climate finance" could see African countries develop ambitious and detailed climate action plans with specific initiatives and near-term milestones translated into bankable projects. Based on this, industrialized countries, development finance institutions, and philanthropic institutions could provide at-scale financing and in-kind support for these concrete projects, tying the financing flows to decarbonization milestones achievement.

[94] Climate Policy Initiative, 2020 Joint Report on Multilateral Development Banks' Climate Finance, World Economic Outlook, IEA World Energy Outlook, Statista, Cefic, World Steel.
[95] "Post-2020 climate finance – a much needed response to multiple crises," German Watch, April 21, 2021, germanwatch.org.
[96] "UN Climate Chief Urges Countries to Deliver on USD 100 Billion Pledge," United Nations Climate Change, June 7, 2021, unfccc.int.

Charting a way forward

Africa is on the cusp of a new era. On the one hand, it faces physical and transition risks as climate change hazards increase in a warming world and the world economy undergoes deep structural changes as it transitions to net-zero. On the other hand, it has considerable potential to turn its natural assets to its advantage and to make sure it is part of and contributing to the global transition towards net zero.

To give Africa the best chance in a warming and decarbonizing world, stakeholders need to understand their specific risks and take decisive action that protects lives and livelihoods while also making sure they capture the opportunities available to them.

As an overarching framework, within which to embed the specific actions and ideas outlined above and more, African leaders could consider embracing a comprehensive "Big Five" green agenda:

1. **Adaptation and resilience:** Increase levels of adaptation and resilience to protect lives and livelihoods from intensifying climate hazards. Initial steps may include a comprehensive physical risk diagnostic to identify key risk vectors and exposed populations and assets and working with international partners to draw up a national climate adaptation plan.
2. **Nature and land use:** Protect and valorize natural capital. Initial steps may include conducting a natural capital inventory, identifying key carbon sinks and how to ascribe value to them through carbon credits, and working with international development partners on agriculture, livestock, and clean cooking transitions.
3. **Zero-carbon power for all:** Decarbonize the grid and commit to an energy transition plan to provide universal zero-carbon energy access. Initial steps may include drawing up an integrated plan for achieving universal energy access by 2030 and fully decarbonizing power production by 2040, and identifying key roadblocks and working with international development partners on removing them.
4. **Resilient green growth:** Align economic growth with global net-zero targets to protect current growth drivers and tap into new green value pools. Initial steps may include diagnosing which existing economic sectors face transition risks, supporting companies' decarbonization plans, and identifying and prioritizing new green manufacturing opportunities.
5. **Green financing:** Catalyze pledged climate finance and mobilize private investment to boost Africa's resilience and adaptation and to unlock new green opportunities. As things stand there is insufficient funding available to the continent either to adapt to the risks or capture the opportunities we outline here. Initial steps may include setting up a cross-regional effort to overcome investment barriers, and engaging with donors to match climate finance pledges with concrete projects.

$100 billion

pledged per annum for decarbonization and adaptation initiatives in developing countries

Despite the challenges of the COVID-19 pandemic and the severe risks that a changing climate poses to the continent, African countries have room to maneuver. While it will not be easy, the continent is not without the resources and support it needs to carve out a bold new chapter in its development story in a low-carbon world. The next decade will be decisive, as decision-makers fundamentally rethink the infrastructure, assets, and systems of the future, and the world collectively sets a path to manage the risk of climate change. For African stakeholders, recognizing physical climate risk, understanding the landscape of opportunity, and integrating these perspectives into decision making and strategy can help build a strong position. Collaboration will be key here. The climate agenda creates an opportunity for collaboration between countries, which is potentially more powerful than competition.

The transition to net zero offers the continent an opportunity to work together to capitalize on its assets, mobilize finance, and build a low-carbon economy that protects and enhances lives and livelihoods while safeguarding natural capital and contributing to the global decarbonization agenda.

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