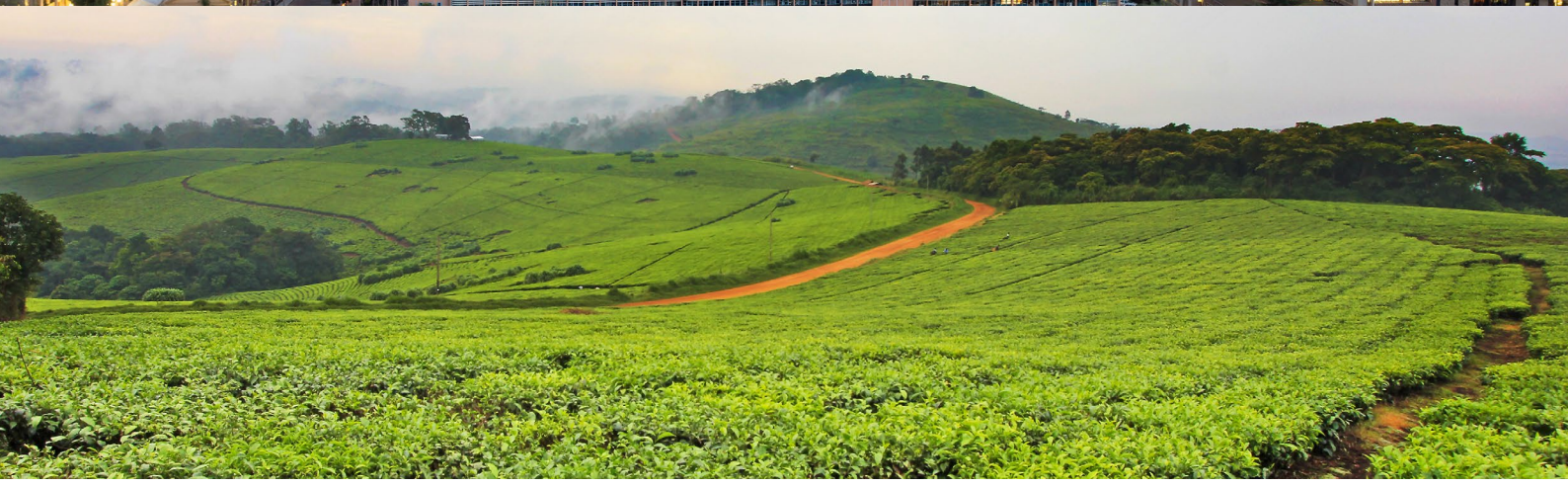
INTEGRATED ASSESSMENT OF AIR POLLUTION AND CLIMATE CHANGE FOR SUSTAINABLE DEVELOPMENT IN AFRICA

SUMMARY FOR DECISION MAKERS



UN environment programme

CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

African Union

ISBN: 978-92-807-3989-3
Job number: DTI/2487/NA

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SUGGESTED CITATION

United Nations Environment Programme (2022). Integrated Assessment of Air Pollution and Climate Change for Sustainable Development in Africa: Summary for Decision Makers. Nairobi.

PRODUCTION

Climate and Clean Air Coalition (CCAC) convened by United Nations Environment Programme (UNEP), African Union Commission, Stockholm Environment Institute (SEI)

ACKNOWLEDGMENTS

The United Nations Environment Programme (UNEP) would like to thank the authors, reviewers and the secretariat for their contribution to the preparation of this assessment report. Authors and reviewers have contributed to the report in their individual capacities. Their affiliations are only mentioned for identification purposes. The preparation of this assessment has been supported by the Swedish International Development Cooperation Agency (Sida) through funding to the Stockholm Environment Institute (SEI) that coordinated the process and publication of the assessment report.

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SPECIAL THANKS

The Climate and Clean Air Coalition and partners appreciate the leadership and support from the H.E. Ambassador Josefa Leonel Correia Sacko, Commissioner for Agriculture, Rural Development, Blue Economy and Sustainable Environment, African Union Commission, and the entire team of officers for supporting and providing policy guidance to the assessment. We express gratitude to Dr. Harsen Nyambe, for Co-Chairing the International Advisory Group, Ms. Olushola Oyalide and Ms. Leah Naess Wanambwa for their support to the assessment coordination team. We would also like to express our gratitude to Frank Turyatunga (Regional Director), Charles Sebukeera, David Ombisi and Julie Kaibe at UNEP for their support of the Assessment and especially the policy engagement process. Special thanks also go to Andrea Hinwood, UNEP Chief Scientist, the head of the CCAC Secretariat, Martina Otto, and the Co-Chairs and Science Advisory Panel of the CCAC for advice and comments.

CONTENTS

MAIN MESSAGES

By investing in solutions to fight the crises of climate change and air pollution together, Africa can build substantially upon progress made in recent decades towards achieving sustainable development objectives. These include improving human health, increasing agricultural productivity and food security, helping reduce poverty, protecting and restoring the biodiversity of degraded ecosystems and forests, improving waste management, and transitioning to clean energy.

Air pollution and climate change are inextricably linked. Air pollutants are dangerous for the environment and deadly for human health. Often, air pollution shares the same drivers and sources as greenhouse gases, and their impacts can exacerbate each other. Many vulnerable groups in Africa and around the world are most at risk from the health impacts of air pollution compounded by climate change.

The ***Integrated Assessment of Air Pollution and Climate Change for Sustainable Development in Africa*** is a new report from the African Union Commission, the Climate and Clean Air Coalition, and the UN Environment Programme, developed by African scientists in a process supported by the Stockholm Environment Institute. It identifies a package of **37 measures to reduce emissions causing air pollution and climate change.** These measures are proven ways for governments throughout Africa to address both air pollution and climate change across five main sectoral areas related to transport, residential energy use, energy generation and industry, agriculture and food systems, and waste management.

The Assessment shows that if these measures are widely implemented across Africa, they could generate substantial environmental, social, and economic development benefits, including:

- Preventing approximately **200,000** premature deaths per year by 2030 and **880,000** deaths per year by 2063 due to air pollution (outdoor and indoor)
- Cutting carbon dioxide (CO_2) emissions by **55 per cent**, methane (CH_4) emissions by **74 per cent**, and nitrous oxide (N_2O) emissions **40 per cent** by 2063
- Improving food security by reducing desertification and i**ncreasing crop yields for rice, maize, soy, and wheat**
- Significantly contributing to global efforts to **keep warming below 1.5°C** and limiting the negative effects of regional climate change.

Most of the measures identified are technically feasible and are already being implemented in parts of the African continent across the key sectors, but need to be scaled up to harness their full potential.

The Assessment shows how African governments can help moderate regional climate change and reduce the cost of adaptation. The proposed measures enable individual countries to pursue their development goals while improving air quality and contributing to protecting the continent from the dangerous impacts of climate change. Implementing these measures will help countries meet and exceed their Nationally Determined Contribution (NDC) targets under the Paris Agreement, contribute towards the achievement of the United Nations 2030 Agenda for Sustainable Development, including its Sustainable Development Goals (SDGs) in Africa, and **set the continent on a cleaner development pathway towards meeting the goals of the African Union Agenda 2063 – *The Africa We Want*** – as well as the objectives of the African Union's (AU's) Climate Change and Resilient Development Strategy.

The Assessment provides **a robust scientific basis for clean air action in Africa**, including the recommendation for **a continent-wide Clean Air Program**. It underscores the need for **integrated approaches through strong partnerships,** involving national governments, city authorities, regional economic communities, intergovernmental agencies, scientists, donors, businesses, and non-state actors.

Crucially, the Assessment shows how **Africa can grow sustainably while maintaining and even reducing current emissions levels, despite huge increases in economic activity, urbanization, and population.** *The Africa We Want* is within reach.

WHAT HAPPENS IF WE DON'T ACT?

Without changes in policy, greenhouse gas emissions will triple by 2063.

Outdoor air pollution is projected to get worse, causing about 930,000 premature deaths per year in 2030 and about 1.6 million premature deaths per year in 2063.

Despite advances in clean cooking technologies, household air pollution would still cause about 170,000 premature deaths per year in 2030 (150,000 by 2063.)

Without action, economic growth compounded by population growth, unplanned urbanization, and unsustainable lifestyles will exacerbate pressures on resources, the environment, and human health, and could increase inequalities and limit Africa's ability to achieve sustainable development.

INTRODUCTION

The ***Integrated Assessment of Air Pollution and Climate Change for Sustainable Development in Africa*** is the result of a scientifically underpinned process aimed at catalyzing and supporting transformative development in Africa. It examines the role that short-lived climate pollutants (SLCPs; see Box S1.), greenhouse gases (GHGs), and other polluting emissions play in sustainable development. It analyzes strategies, policies, and measures to mitigate these pollutants while supporting development and human health and wellbeing in Africa as the continent adapts to climate change and pursues its sustainable development objectives over the next four decades. It was undertaken between 2020 and 2022 through a partnership between the African Union Commission (AUC), the UN Environment Programme Regional Office for Africa (ROA), the UNEP-convened Climate and Clean Air Coalition (CCAC), and the Stockholm Environment Institute (SEI) (Box S2). The Assessment was written by a pan- Africa team with contributions from international scientists and experts, and helped build a regional science to policy network.

BOX S1. WHAT ARE SHORT-LIVED CLIMATE POLLUTANTS (SLCPS)?

Short-lived climate pollutants (SLCPs) are powerful climate forcers that remain in the atmosphere for a much shorter period of time than carbon dioxide (CO_2). They can be in the atmosphere for a few weeks to up to two decades; yet their potential to warm the atmosphere can be many times greater than CO_2. Many SLCPs are also dangerous air pollutants that have harmful effects on human health, ecosystems and agricultural productivity.

The SLCPs include methane (CH_4), black carbon (BC) or soot, tropospheric ozone (O_3), and hydrofluorocarbons (HFCs). They are the most important contributors to the human-made climate change after carbon dioxide and are responsible for more than 45 per cent of current global warming. If action to reduce emissions of these pollutants is taken in the coming decades, it could help achieve the 1.5 degree target of the Paris Agreement.

Source: Climate and Clean Air Coalition

BOX S2. POLITICAL MANDATE OF THE AFRICA INTEGRATED ASSESSMENT OF AIR POLLUTION AND CLIMATE CHANGE FOR SUSTAINABLE DEVELOPMENT

In 2019, during the Seventeenth Ordinary Session of the African Ministerial Conference on the Environment (AMCEN-17), African Ministers formally agreed to support the mitigation of short-lived climate pollutants (SLCPs) and the development of the Integrated Assessment of Air Pollution and Climate Change for Sustainable Development in Africa:

"to emphasize the benefits of improving air quality, including through managing, and as nationally appropriate, reducing short-lived climate pollutants in the environment, agriculture, health and forest conservation, while responding to the aspirations of Agenda 2063 of the African Union and the Sustainable Development Goals (hereafter called Agenda 2030), noting the need for an assessment with linkage between policies to address air pollution and policies to address climate change" (AMCEN 2019).

In 2022, at AMCEN-18, African Ministers restated their support of the Assessment and of measures to mitigate SLCPs:

"Note the completion of the Integrated Assessment of Air Pollution and Climate Change for Sustainable Development in Africa and its report, in response to AMCEN decision 17/2. Urge African countries to support further development and implementation of the 37 recommended measures as a continent-wide Africa Clean Air Program, coordinated by strong country-led initiatives, cascaded to the Regional Economic Communities and higher levels of policy." (AMCEN 2022)

THE ASSESSMENT APPROACH

The modeling approach for the Assessment builds on the existing CCAC-funded *Supporting National Action and Planning on Short-Lived Climate Pollutants* (SNAP) project in Africa, which uses SEI's Low Emission Analysis Platform (LEAP). LEAP was also used as the main modeling tool in the Assessment to create Africa-wide harmonized emission inventories and projections for all African countries. These were then used to drive simulations undertaken within the NASA Goddard Institute for Space Studies global composition and climate model that provides estimates of their impacts on African climate and air quality. Impacts of both these physical changes on society, such as food production and human health, were then calculated.

The modeling in the Assessment identifies a feasible and cost-effective pathway that can guide the implementation of nationally appropriate measures. The measures have been carefully assessed and validated for plausibility by the Assessment authors and other stakeholders.

Countries that are already strongly engaged in development of integrated emission inventories of SLCPs, and other air pollutants and GHGs, using the LEAP tool in Africa in 2022 include: Benin, Chad, Central African Republic, Côte d'Ivoire, Democratic Republic of Congo, Eswatini, Ethiopia, Ghana, Guinea, Kenya, Liberia, Mali, Morocco, Nigeria, Togo, and Zimbabwe. Benin, Côte d'Ivoire, Eswatini, Ghana, Liberia, Mali, Nigeria, Togo, and Zimbabwe have also used the integrated emission inventories and impact assessment to inform work on their revised Nationally Determined Contributions (NDCs).

The Assessment aims at enhancing capacity for both short-term and long-term national planning across Africa for integrated air pollution and climate change strategies, policies, and action plans.

DEVELOPING SCENARIOS FOR THE ASSESSMENT

The Assessment developed three scenarios to model projections of emissions of GHGs, SLCPs and other key pollutants over the period 2019 to 2063:

- The **Baseline Scenario** largely reflects a continuation of past trends in the evolution of fuel shares and energy intensities by sector. For example, in the household sector, the baseline shows a slow but incomplete transition from polluting fuels like wood, dung, and charcoal to cleaner alternatives like electricity, LPG, biogas, and solar.
- The **SLCP Scenario** primarily focuses on technical and behavioral measures that directly target reductions in SLCPs, and co-emitted air pollutants and GHGs. Sample measures include enforcing stringent vehicle emission standards, switching to cleaner fuels and efficient stoves for cooking, and reducing methane emissions from enteric fermentation and manure management.
- In the **Agenda 2063 Scenario**, an additional 20 development and climate focused mitigation measures are modeled, in addition to the 17 under the SLCP mitigation scenario, making 37 in all. Measures include broader changes, such as modal shifts in the transport sector, or off-farm changes such as reducing food waste.

TARGET AUDIENCES

The Assessment is intended to be primarily used by **senior policy and technical officers, academia, professionals and practitioners in national governments, international organizations (including international development partners, and philanthropy), civil society and the private sector** to support policy advancement and decision making and action in the areas of air pollution, climate change, and development.

THE CHALLENGE

Efforts to achieve the UN Sustainable Development Goals (SDGs) and the AU *Agenda 2063* will be supported by significant economic growth across the African continent in coming decades. However, this growth, together with an increasing population, unplanned urbanization, and unsustainable lifestyles, could exacerbate pressure on the environment, resources, and human health, compounding inequalities and limiting sustainable development for all.

- Africa's population is projected to increase by 32 per cent by 2030 and by 137 per cent by 2063 to around three billion people, with over 60 per cent of all Africans living in cities by then.
- The demand for passenger transport is predicted to increase by 51 per cent between 2018 and 2030 and a further 294 per cent by 2063, while freight is expected to rise by 49 per cent between 2018 and 2030 and another 261 per cent by 2063.
- Increasing population and changing diets will mean that ensuring zero hunger by 2063 will require the production of almost three times as much food as is currently consumed.
- The generation of municipal solid waste will more than triple by 2063 compared to current levels, and demand for energy will increase by 37 per cent between 2018 and 2030, and by another 164 per cent by 2063, including a fivefold rise in the demand for electricity.

While, as noted above, these huge changes could exacerbate pressures on the environment, resources, and human health, they also provide opportunities to develop urban and rural areas in a way that reduces air pollution and greenhouse gas emissions and achieves other development goals.

THE OPPORTUNITY

Africa has a huge opportunity to continue developing sustainably, improve human well-being, and protect nature by investing in solutions to fight climate change and air pollution together. The *Integrated Assessment of Air Pollution and Climate Change for Sustainable Development in Africa* shows how African leaders can act quickly to implement 37 measures (Annex 1) across **5 key areas**: transport, residential, energy, agriculture, and waste to fight climate change, prevent air pollution, and protect human health.

This Assessment shows significant benefits for air quality, human health, crop yields and climate if action in the 5 key areas is taken. Implementing the 37 measures will also lead to improvements in water and soil quality, and biodiversity. Furthermore, these measures can help to achieve *Agenda 2063 – The Africa We Want*; the SDGs; and the Paris Agreement.

Importantly, the direct beneficiaries of action taken in Africa will be Africans – when it comes to air quality and health, regional climate change, and helping achieve other development priorities. The modeling carried out by the Assessment shows that African governments can reap many benefits, including:

Major reductions in emissions of SLCPs, other GHGs, and air pollutants

- **Greenhouse gas emissions could be drastically reduced.** The 37 measures can cut carbon dioxide (CO_2) emissions by 55 per cent in 2063 compared to the baseline scenario (Figure S1). This would involve implementation of measures in:
  - the transport sector (32 per cent of the total reduction)
  - industry (14 per cent of the total reduction)
  - electricity generation (48 per cent of the total reduction), by using renewable sources (solar, wind, hydro, and geothermal)
  - with smaller contributions from the residential and commercial services.
- By 2063, methane emission reductions of 74 per cent are projected from implementing measures in:
  - agriculture (74 per cent of the total reduction)
  - oil and gas extraction and charcoal production (16 per cent of total reduction)
  - waste management (9 per cent of total reduction)
  - with smaller contributions from the transport, residential and commercial measures.
- Emissions of the greenhouse gas nitrous oxide (N_2O) could also be reduced by 40 per cent by 2063 compared to the baseline, mainly from implementing measures in the agricultural sector.
- There are also significant co-benefits through the reduction of SLCPs, such as black carbon (BC) and hydrofluorocarbons (HFCs), and air pollutants such as fine particulate matter ($PM_{2.5}$), organic carbon (OC), nitrogen oxides (NOx), sulfur dioxide (SO_2), ammonia (NH_3), carbon monoxide (CO), and non-methane volatile organic compounds (Figure S1). Some of these pollutant emissions, such as methane, carbon monoxide, nitrogen oxides, and (NMVOCs), contribute to producing tropospheric ozone pollution in the atmosphere which has significant health, crop, and climate impacts (e.g. Figures S3 and S7)

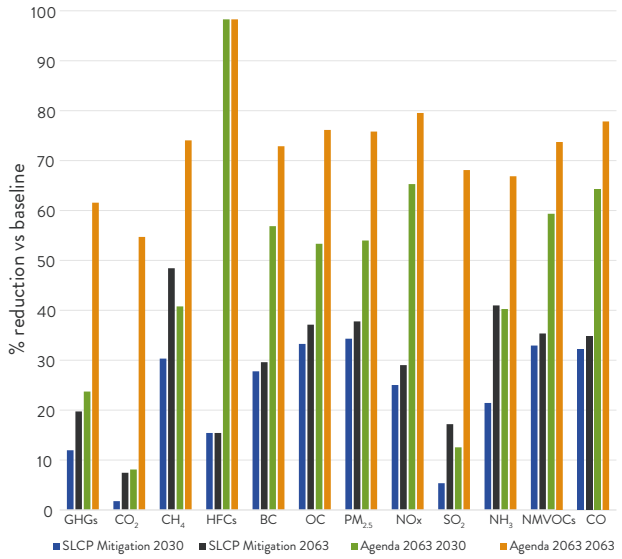
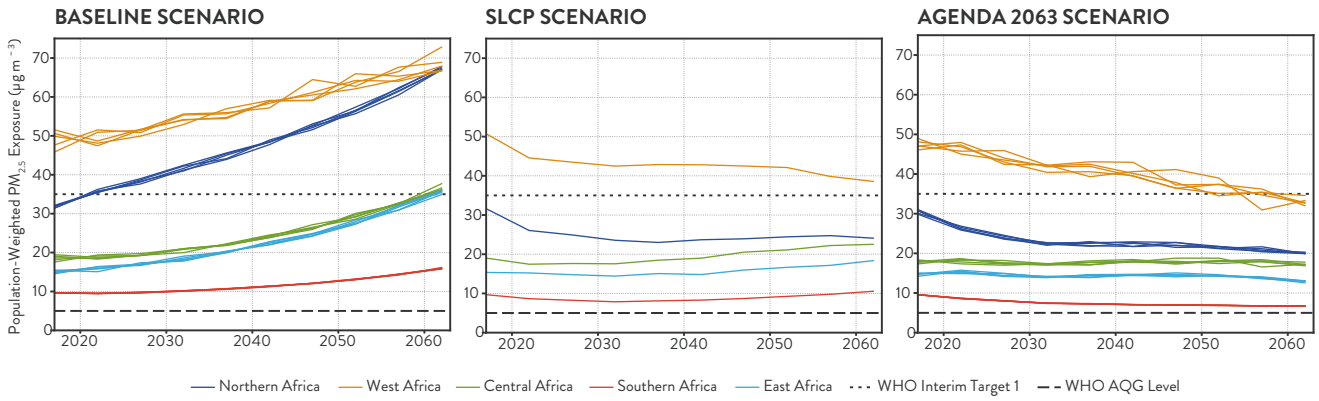


Figure S1 The percentage reduction in GHG, SLCP and air pollutant emissions in 2030 and 2063 for the SLCP Mitigation and Agenda 2063 scenarios versus the Baseline Scenario.

WIDESPREAD HUMAN HEALTH BENEFITS

- The emission reductions that could be achieved by the 37 measures are estimated to prevent about **180,000 premature deaths per year by 2030** and **800,000 deaths per year by 2063** from outdoor air pollution.
- Figure S2(a) shows how exposure to $PM_{2.5}$ can be significantly reduced under the SLCP Scenario, and further reduced under the Agenda 2063 Scenario, across the five major regions of Africa, bringing values closer to the WHO Air Quality interim targets and guideline.
- Figure S2(b) shows the improvements that can be made in reducing annual premature mortality attributed to $PM_{2.5}$ in the five major regions.
- Figure S3(a) and (b) show similar trends for tropospheric ozone, the other main pollutant affecting human health in Africa, and for ozone-attributable deaths. The human health benefits over time associated with reduced exposure to $PM_{2.5}$ and ozone are qualitatively similar, with those associated with $PM_{2.5}$ being larger.

A. Annual average exposure to outdoor $PM_{2.5}$ concentrations in Africa's major subregions



B. Premature mortality due to $PM_{2.5}$ exposure in Africa's major subregions

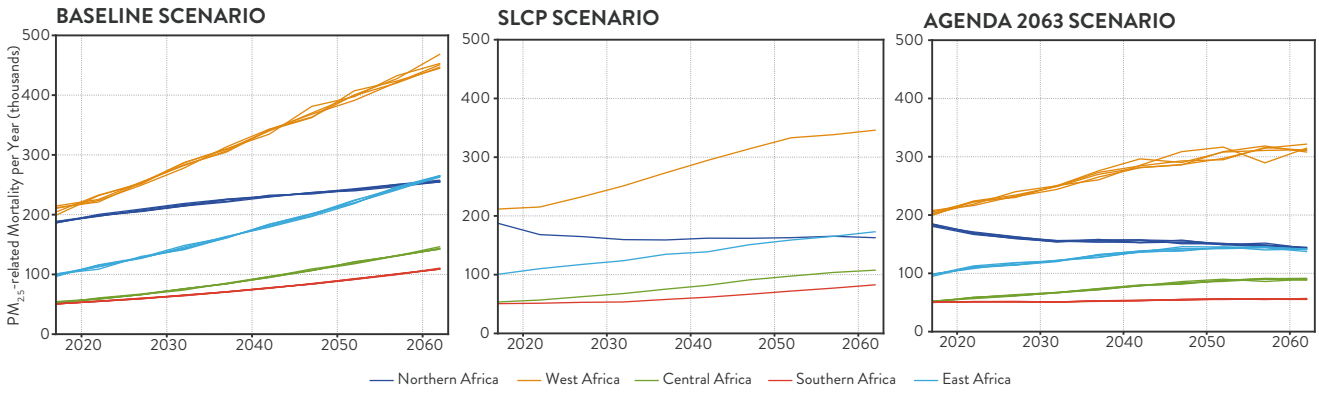
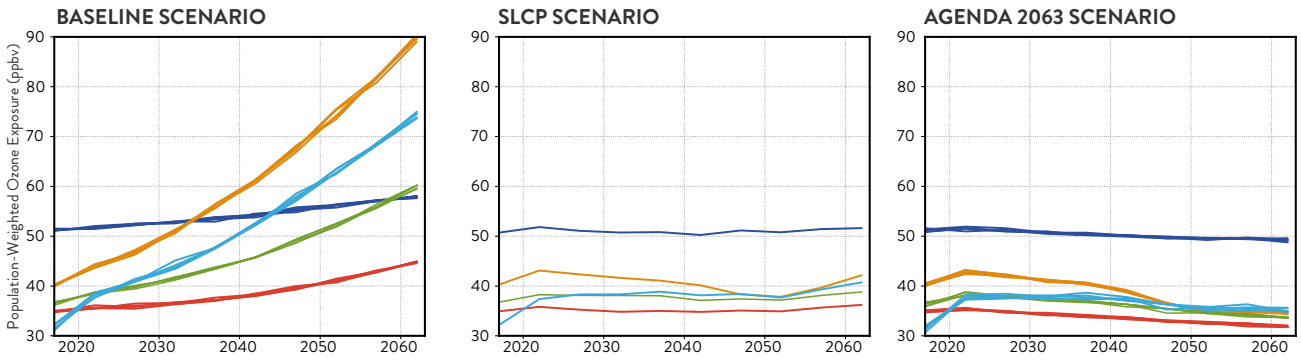


Figure S2 Modeled estimates under the Baseline, SLCP and Agenda 2063 Scenarios, for the period 2019 to 2063, of (A) annual average exposure to outdoor $PM_{2.5}$ and (B) premature mortality due to $PM_{2.5}$ exposure in Africa's major subregions. The exposure graphs also show the WHO Air Quality Guideline (5 µg m^{-3} annual average) and interim Target 1 (35 µg m^{-3} annual average).

A. Exposure to outdoor annual mean 8hr maximum ozone concentrations



B. Premature mortality due to ozone exposure in Africa's major subregions

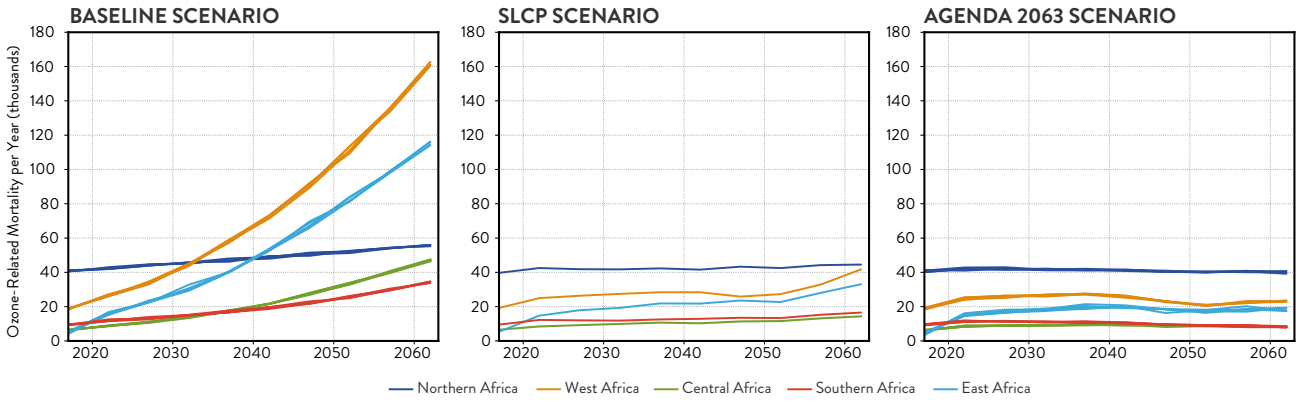


Figure S3 Modeled estimates under the Baseline, SLCP and Agenda 2063 Scenarios, for the period 2019 to 2063, of (A) exposure to outdoor annual mean 8hr maximum ozone concentrations and (B) premature mortality due to ozone exposure in Africa's major subregions.

- **The Assessment's SLCP measures would also prevent 20,000 household scenario (indoor) air pollution-related premature deaths per year by 2030 and 80,000 per year by 2063**, corresponding to a 12 and 53 per cent reduction in premature deaths, respectively (Figure S4). This would decrease the vulnerability of populations most affected by household air pollution exposure: children, women, people with underlying chronic conditions, and the elderly in the household environment.
- There is also emerging evidence that the negative effects of air pollution on cognitive function, especially for children, could also be reduced by the recommended measures.

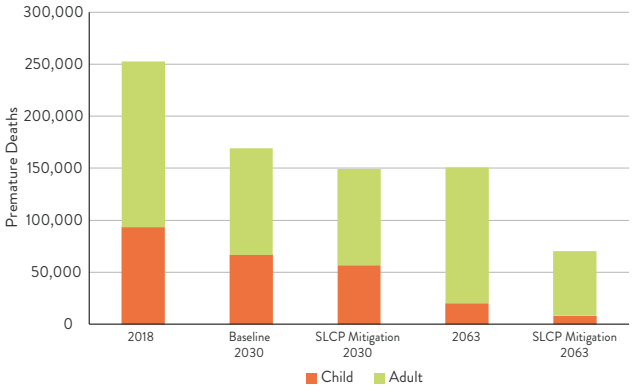


Figure S4 Premature deaths attributable to household air pollution from solid fuel combustion in 2018, 2030 and 2063 for baseline and SLCP mitigation scenarios disaggregated by children and adults.

CLIMATE CHANGE BENEFITS FOR AFRICA

- **Implementing the 37 measures has the potential to greatly reduce regional climate change in Africa**, significantly lessening further land degradation and desertification and improving food production and quality. If all the measures are implemented, **in some areas there would be much smaller changes in local precipitation patterns than if there were no changes in policy.** For example, the Assessment projects there will be reduced drying in the Sahel and West Africa in June–August and potentially also in southern parts of Africa in December-February due in part to reduced air pollution (Figure S5).

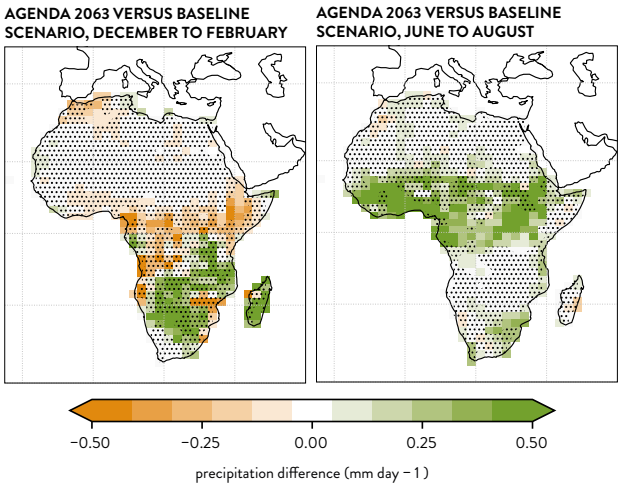


Figure S5 The difference between Africa seasonal average precipitation changes for 2050-2059 relative to 2015-2025 in the modeling for the Agenda 2063 and the baseline simulations for Dec-Feb (left) and Jun-Aug (right). Stippling indicates the differences are not statistically significant (95 per cent confidence).

- The Assessment's measures also lead to a modest but widespread reduction in annual average warming across Northern and Central Africa (Figure S6). There are also reductions in seasonal warming, with the most significant avoided increases in temperature during the winter months in Northern (December-February) and southern Africa (June–August).

- **Implementing the recommended measures could contribute substantially to keeping global emissions within limits that are compatible with 1.5° C and 2° C scenarios.** This is particularly true for mitigating methane emissions.

- **Given Africa's development path, the Assessment found that Africa is likely to emit more than half of the global greenhouse gas emissions consistent with a 1.5° C scenario by 2050.** This is even if the rest of the world is limiting emissions consistent with achieving the Paris Agreement under the most optimistic circumstances, emphasizing the critical importance of implementing the 37 measures across Africa.

- All countries outside of Africa must drastically reduce their own emissions to help limit warming to 1.5°C to help Africa avoid the worst impacts of climate change and reduce the cost of adaptation.

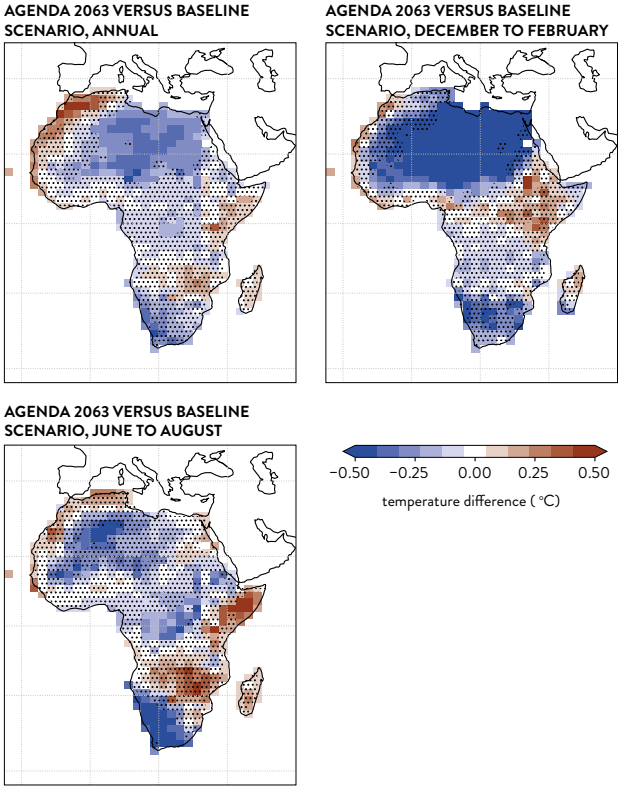


Figure S6 Africa average surface air temperature changes for 2050-2059 relative to 2015-2025 in the modeling for the difference between Agenda 2063 and the baseline simulations, for the annual average (upper left), Dec-Feb (upper right) and Jun-Aug (lower left). Stippling indicates the differences are not statistically significant (95 per cent confidence).

CROP YIELD BENEFITS

- Implementing the 37 measures will lead to yield gains for crops across Africa (Figure S7):
  - rice (approximately 1 per cent)
  - maize (approximately 4 per cent)
  - soy (approximately 6 per cent) and
  - wheat (approximately 11 per cent in East Africa).

These yield gains are due to reduced warming, changes in precipitation, and reduced concentrations of ozone resulting from the implementation of the measures across Africa. These gains outweigh small yield decreases due to reduced carbon dioxide concentrations in the atmosphere, and the net changes will also benefit ecosystems and forests.

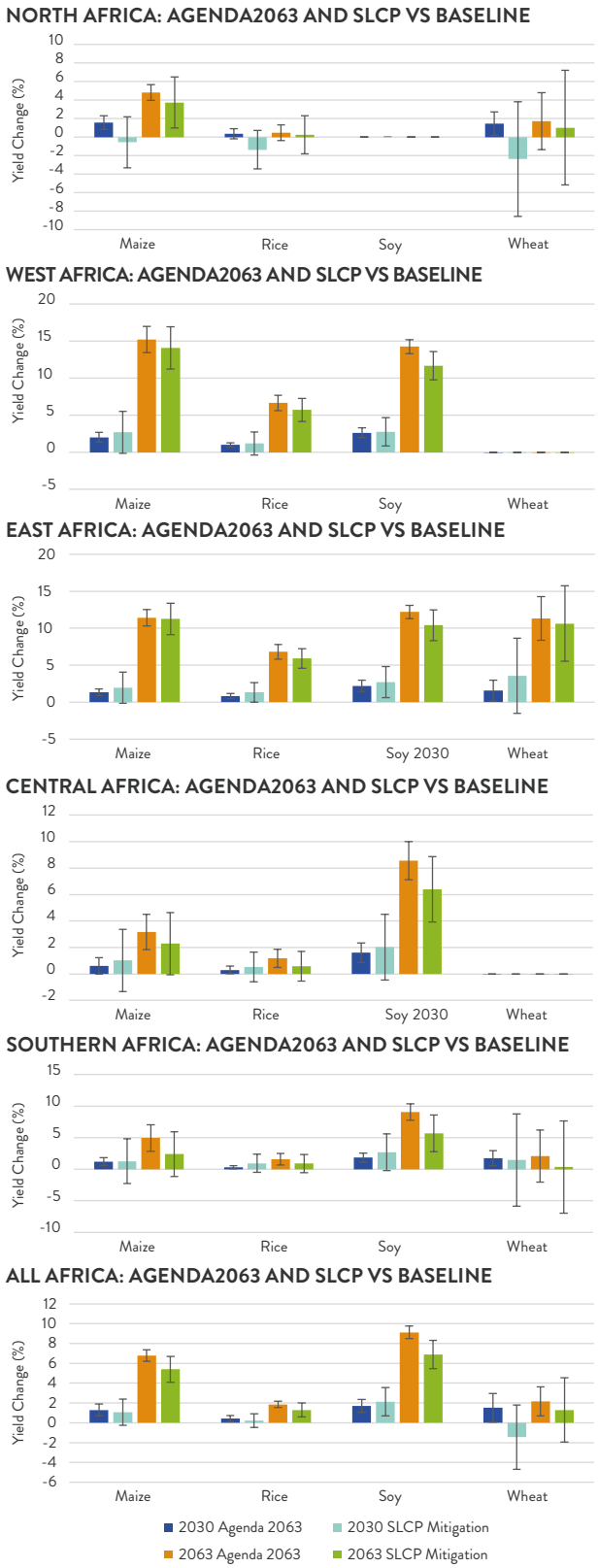


Figure S7 Simulated crop (maize, rice, soy and wheat) yield gain changes (per cent relative to baseline) under the SLCP scenario by 2030 (light blue) and 2063 (green) and the Agenda 2063 scenario by 2030 (blue) and 2063 (orange) in response to changes in ozone, CO_2, temperature, and precipitation, using data from the modeling for all of Africa, North, Central, West, Southern and East Africa. Uncertainty bars reflect the variability in climate and ozone across the five ensemble simulations completed for the baseline scenario and indicate when the modeled changes are statistically significant.

REDUCING EMISSIONS WHILE ENSURING SOCIOECONOMIC DEVELOPMENT

The air quality and climate change modeling indicates that energy consumption in Africa will increase to meet development objectives. However, implementing the Assessment's 37 recommended measures would allow Africa to move towards a more decarbonized or low-carbon energy system, including in the following areas:

1. **Transport** – a shift to cleaner vehicles and modal shift to safe and affordable public transport, cycling and walking.

2. **Residential energy** – a shift to sustainable clean cooking and efficient household appliances for refrigeration and air conditioning.

3. **Energy generation and Industry** – a shift to efficient charcoal production; post-combustion emissions controls; methane capture from oil, gas, and coal extraction; increasing energy efficiency in industry, electricity generation and distribution, and service sectors; shifting to renewable electricity generation; and the possibility of carbon capture and storage for industry and electricity generation.

4. **Agriculture** – reducing methane emissions from livestock production and manure management and implementing alternate wetting and drying for flooded rice; reducing air pollution from vegetation and crop residue burning; implementing measures that reduce crop losses and food waste at point of consumption; and promoting healthy diets.

5. **Waste management** – implementing standard waste management procedures around collection and sorting of waste for recycling and the development of formal, well managed sanitary landfill sites to reduce open burning of waste and enable methane capture; reducing the generation of organic waste and diverting what is produced from landfill to composting or biogas generation; developing universal access to improved water and sanitation services and methane capture at wastewater treatment plants.

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TIMING AND SIZE OF EMISSIONS REDUCTIONS

By 2030, the modeling shows considerable potential to reduce SLCP emissions related to clean cooking, implement advanced emission controls for road vehicles, reduce burning of wastes, improve crop and livestock management in agriculture, and improve solid and liquid waste disposal. For example, the clean cooking measures are projected to reduce fine particulate matter emissions, mostly black and organic carbon, by 27 per cent by 2030. This will improve health outcomes in children, who are among the most vulnerable to household air pollution.

Other measures will reduce methane emissions and pollutants related to transport, such as nitrogen dioxide, that, combined, contribute to ozone formation in the atmosphere. Short-lived climate pollutant measures do not affect carbon dioxide emissions as much (see Figure S1), but progress can be made by 2030 with more development focussed measures related to energy efficiency and shifting to renewable energy.

By 2063, the Assessment shows greater compliance with the *AU Agenda 2063* as more development focussed measures are implemented, especially those related to energy generation and use, and agricultural and waste management practices. The timing of implementing the different measures varies in the modeling and was confirmed with a range of stakeholders. In reality, progress will depend on factors such as the availability of technology, finance, uptake of renewable energy options, penetration rates, and political will. These challenges must not prevent the world from acting.

MAKING IT HAPPEN

EXPERIENCE IN AFRICA ALREADY EXISTS

Most of the recommended measures have already been successfully implemented in different parts of Africa, and in other parts of the world. There are many examples of how this is being done as part of ongoing agreements, initiatives, strategies, and projects across Africa.

POWER GENERATION

Solar panels on a farm Mali Photo © Curt Carnemark World Bank.jpg

Policies recognize Africa's huge solar energy potential. Africa is home to 60 per cent of the best solar resources globally, but has only 1 per cent of installed solar photovoltaic (PV) capacity. Many African governments have established policies and set targets for renewable energy expansion in their NDCs under the United Nations Framework Convention on Climate Change (UNFCCC).

RESIDENTIAL ENERGY

Photo: Sistema.bio

Adoption of clean cooking options is increasing across Africa. In North Africa, the proportion of the population with access to clean fuels increased from 75 per cent in 2000 to 85 per cent in 2014, and in sub-Saharan Africa, access to clean cooking fuels increased from 9 per cent in 2000 to 18 per cent in 2020, despite an increase in population. There is slow progress, but it is faster in some countries than others.

Promisingly, 40 per cent of African countries have now adopted mandatory minimum energy performance standards (MEPS) for air conditioning.

TRANSPORT

Morocco Minister of Environment Hakima El Haite and Namibia's Environment Minister Pohamba Shifeta inspect electric buses. Photo Ministry of Environment Rwanda.jpg

Countries are working to decrease emissions from public transport. Several African countries are implementing Bus Rapid Transit (BRT) measures. The United Nations Environment Programme (UNEP) is providing support to introduce soot-free and electric buses in selected countries. The manufacture of electric buses has also begun in Africa.

Regional implementation of action in the transport sector is advancing. Agreements to limit the sulphur content of fuels imported and sold and improve vehicle emission standards are already being implemented in the East African Community (EAC), Economic Community of West African States (ECOWAS) and Southern African Development Community (SADC). In addition, several African countries have witnessed small but increasing imports of electric vehicles, and there is potential for increased deployment of e-transport, especially through support for local manufacturing. Countries are considering different options for promoting electrification in the transport sector, and a few have started to manufacture electric two- and three-wheelers.

Safe, non-motorised modes of transport are becoming more central to transport policies in Africa, especially in cities that are now recognizing the integral role of walking and cycling as part of their sustainable transport system. Several cities in Africa, including Nairobi, Kenya and Kampala, Uganda, are already working to increase non-motorised transport options.

INDUSTRY

Oil refinery Durban South Africa Photo John Karwoski.jpg

Several African countries have pledged to significantly reduce methane emissions in the oil and gas sector by 2030, committing to reducing methane emissions by 45 per cent by 2025 and 60–70 per cent by 2030. In addition, more than 20 African countries have joined the Global Methane Pledge adopted at the 26th Conference of Parties (COP) of the UNFCCC in 2021**.**

The Kigali Agreement (to the Montreal Protocol) **has seen hydrofluorocarbons (HFCs) gaining attention in African countries since 2016.** Several countries have embarked on projects to take advantage of the climate and economic benefits from improvements in the energy efficiency of refrigerators, air conditioners, and other products and equipment that use HFCs.

AGRICULTURE

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Agricultural measures to cut SLCPs are being implemented. Alternative wetting and drying (AWD) in rice fields has been successfully validated in semi-arid, sub-humid dry and sub-humid humid climatic zones in West Africa. Initiatives to reduce the open burning of agricultural crop residues are helping farmers upcycle post-harvest residue for different uses, such as fuel briquettes and composting. Agricultural practices including improved livestock and nutrient management and use of crop residues as a sustainable resource for improving soil conditions and fertility, are on the rise in Africa.

WASTE MANAGEMENT

Collecting plastic and cans for recycling, part of the Waste to Wealth project in Port Harcourt, Nigeria. Photo by Simone di Vicenz

Innovative public-private partnerships are growing in the waste management sector in Africa. This has led to improved waste management cycles, from collection to sanitary disposal, in some urban areas. Such partnerships also promote circularity through resource recovery and the use of waste as a secondary resource input. These examples underscore the importance of private sector partnerships with governments, the informal sector, and other key stakeholders to invest in waste management, specifically in the recovery, recycling, and treatment of waste.

CONTRIBUTING TO AGENDA 2063, THE SUSTAINABLE DEVELOPMENT GOALS AND THE PARIS AGREEMENT

Almost all of the 37 recommended measures are being considered in the Nationally Determined Contributions (NDCs) of African countries under the UNFCCC and are identified as contributing to achieving national climate change mitigation goals. The two measures not currently considered in NDCs are capture of coal-mine methane and post-combustion controls in industrial facilities.

The 37 recommended measures are closely aligned with key priorities of AU *Agenda 2063*. They relate to:

- Modern and liveable habitats and basic quality services
- Health and nutrition
- Communications and infrastructure connectivity
- Sustainable consumption and production patterns
- Agriculture productivity and production
- Poverty, inequality and hunger

The recommended measures align closely with the goals and targets of the SDGs. Thirty five of the 37 recommended measures relate closely to *SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable* and *SDG 12: Ensure sustainable consumption and production patterns*. Some measures also relate to other SDGs. For example, energy measures relate to *SDG 7: Affordable and clean energy*, household energy measures relate to *SDG 5: Gender equality*, and the greenhouse gas reductions from all the measures relate to *SDG 13: Climate action*.

RECOMMENDATIONS FOR IMPLEMENTATION AND SUSTAINABILITY

MOBILIZING PARTNERSHIPS FOR MULTIPLE BENEFITS

Actions across the five key areas involving implementation of the 37 recommended measures at scale requires partnerships to pool technical and financial resources. These partnerships can come from scientific, business, finance, non-state actors, government, development, and UN-system organizations. The proposed Africa Clean Air program, led by the African Union Commission in close collaboration with African multilateral institutions, the Regional Economic Communities (RECs) in different African sub-regions, and linking the African Union Member States that lead national action, could provide a key rallying point.

This Assessment contains recommendations across six different scales and types of action and considers relevant institutions and timelines that could promote implementation of the measures. Recommendations cover the following broad categories:

- Communication and awareness raising
- Planning
- Financing and resource mobilization
- Policy development, legislation, regulation, compliance and enforcement
- Strengthening scientific, technological and technical capacity
- Governance and institutional coordination, including horizontal (local, national, and regional- South – South) and vertical (between sectors – integration) and South-North partnerships.

The recommendations include, but are not limited to, the following:

- **African multilateral institutions and policy organs** include the 37 measures in their planning, programmes, and reporting to gain high-level political support and mobilize finance, technology, and knowledge. These include the African Union and its agencies (the African Union Commission (AUC) and the African Union Development Agency New Partnership for Africa's Development [AUDA-NEPAD]); the African Ministerial Conference on the Environment (AMCEN); the African Development Bank (AfDB); Africa Export and Import Bank (AFREXIMBANK), and other relevant institutions
- **Regional Economic Communities (RECs)** integrate the 37 measures into regional development plans, enhance regional institutional capacity and develop regional specialist centers, develop regional air quality agreements to support implementation of the measures, and mobilize finance for regional processes, institutions, and national action. These include the East African Community (EAC); the Economic Community of Central African States (ECCAS); the Economic Community of West African States (ECOWAS); the Intergovernmental Authority on Development (IGAD); and the Southern African Development Community (SADC), and others.
- **National governments of African countries** include the 37 measures in their environment, health, and climate policies and national development plans; integrate planning across government and develop stakeholder partnerships, including with the private sector; enhance national capacity to develop national air quality strategies and plans; include progress on implementation of the 37 measures in the voluntary national reporting for the SDGs and allocate national budgets to implement the measures; enhance cooperation with local governments and rural communities to promote alternatives to burning agricultural crop residues and municipal wastes and to cooking and heating with solid fuels.
- **Local governments and city authorities** link urban planning with national strategy development and integrate the 37 measures.
- **Inter-governmental organizations** support the implementation of the 37 measures by providing financial support; promote best-practice planning and strategy development; promote resolutions on clean air; enhance the capacity of institutions in regions and countries to develop their own models and data to support planning processes; and coordinate amongst themselves to maximize the impact of support from international organizations and development partners. These include the United Nations System (United Nations Environment Programme [UNEP]; the United Nations Economic Commission for Africa [UNECA], the United Nations Development Programme [UNDP], the World Bank; the World Health Organization [WHO]; and the World Meteorological Organization [WMO]; the Food and Agriculture Organization [FAO]); initiatives like the UNEP-convened Climate and Clean Air Coalition (CCAC) which gathers the above agencies as well as governments and NGOs in an effort to deliver in partnership; non-state actors (non-governmental organizations, local communities and industry groups) and others, such as the International Energy Agency (IEA).

Finally, the Assessment strongly recommends:

- The development of an **Africa Clean Air Program,** a continent-wide platform led by countries and with input from all relevant stakeholders to promote more comprehensive air quality management across the continent. This program would collect and share data, utilize existing data and information sources, and increase capacity and equipment for new data collection and management, with monitoring and evaluation, emissions and air quality modeling, and education and communication.
- The development of an **African transboundary convention for the prevention and management of air pollution**, given the common problems and transboundary movement of polluted air in Africa and beyond.
- The development and implementation of a continent-wide practical **program for sustainable waste management** that builds on existing initiatives, including the COP27 Presidency's *50 by 2050 Global Waste Initiative* and a multi-stakeholder partnership to phase out open burning of waste in Africa, which are key to addressing existing systemic issues with waste management in Africa.

ANNEX 1: THE FIVE AREAS AND 37 MEASURES MODELED BY THE ASSESSMENT

TRANSPORT:

1. CLEANER EXISTING TRANSPORT
2. BETTER AND MORE PUBLIC TRANSPORT OPTIONS
3. MORE ELECTRIC VEHICLES
4. MORE HYBRID VEHICLES
5. MORE CYCLING AND WALKING
6. FREIGHT FROM ROAD TO RAIL
7. RAIL ELECTRIFICATION
8. ROAD FREIGHT ELECTRIFICATION

RESIDENTIAL:

9. CLEAN LIGHTING
10. CLEAN COOKING
11. EFFICIENT AIR CONDITIONING
12. EFFICIENT REFRIGERATION
13. HOUSEHOLD ENERGY EFFICIENCY

ENERGY:

14. EFFICIENT CHARCOAL MAKING
15. EMISSION CONTROL IN INDUSTRY
16. COAL MINING METHANE CAPTURE
17. OIL AND GAS METHANE LOSS REDUCTION
18. IMPLEMENTING THE KIGALI AMENDMENT
19. REDUCE ELECTRICITY TRANSMISSION AND DISTRIBUTION LOSSES
20. INDUSTRIAL ENERGY EFFICIENCY
21. SERVICE SECTOR ENERGY EFFICIENCY
22. CEMENT MAKING ENERGY EFFICIENCY
23. CARBON CAPTURE AND STORAGE
24. SHIFT TO RENEWABLE ENERGY

AGRICULTURE:

25. EFFICIENCY OF LIVESTOCK PRODUCTION
26. IMPROVED LIVESTOCK FEED TO REDUCE EMISSIONS
27. IMPROVED MANURE MANANGEMENT
28. ALTERNATE WET AND DRYING FOR RICE PRODUCTION
29. ELIMINATE BURNING OF CROP RESIDUES
30. REDUCE FOOD WASTE
31. HEALTHIER DIETS

WASTE:

32. LANDFILL TO REDUCE WASTE BURNING AND CAPTURE METHANE
33. METHANE CAPTURE AT WASTEWATER PLANTS
34. WASTE COLLECTION AND NEW SANITARY LANDFILLS
35. ORGANIC WASTE TO COMPOST AND BIOGAS GENERATION
36. REDUCE ORGANIC WASTE
37. IMPROVED WATER AND SANITATION SERVICES