Report No: ACS22684

Federal Democratic Republic of Ethiopia
Country Environmental Analysis (CEA)
Ethiopia Realizing Green Transformation

June 28, 2017

GEN01

AFRICA

Ethiopia

Country Environmental Analysis

Realizing Green Transformation






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Environment and Climate Research Center
Ethiopian Development Research Institute

This study was prepared by a multidisciplinary, multiagency team led by the Environment and Natural Resources Global Practice of the World Bank, with involvement from global practices responsible for energy, social protection, transport, urban, and agriculture; the Ethiopia Development Research Institute's Environment and Climate Research Center, and the Ministry of Environment, Forest and Climate Change, Federal Democratic Republic of Ethiopia (FDRE) with involvement from other ministries of the FDRE.

Suggested citation:

Danyo, Stephen; Abate, Asferachew; Bekhechi, Mohammed; Köhlin, Gunnar; Medhin, Haileselassie; Mekonnen, Alemu; Fentie, Amare; Ginbo, Tsegaye; Negede, Betelhem; Tesfaye, Haleluya and Wikman, Anna. 2017. Realizing Ethiopia's Green Transformation: Country Environmental Analysis, Environment and Natural Resources Global Practice. Washington, DC: World Bank.

Abbreviations and Acronyms

AFDB	African Development Bank
AGP	Agricultural Growth Program
ARI	Acute Respiratory Infection
ASM	Artisanal and Small-scale Mining
ASGM	Artisanal and Small-scale Gold Mining
AWS	Automatic Weather Stations
BAU	Business as Usual
BOD	Biochemical Oxygen Demand
CCEPM	Cooperation Committees on Environmental Protection and Management
CETP	Common Effluent Treatment Plant
CFA	Coordination Framework Arrangement
COD	Chemical Oxygen Demand
CRGE	Climate Resilient Green Economy
CSA	Climate Smart Agriculture
CSA	Central Statistical Agency of Ethiopia
DALY	Disability Adjusted Life Year
ECRC	Environment and Climate Research Center
EDRI	Ethiopian Development Research Institute
EEA	Ethiopia Electric Authority
EEU	Ethiopian Electric Utility
EHRS	Ethiopian Highlands Reclamation Study
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EIC	Ethiopian Investment Commission
EKC	Environmental Kuznets Curve
EPCC	Ethiopian Panel on Climate Change
EPC	Environmental Protection Council
EPE	Environment Policy of Ethiopia
ETB	Ethiopian Birr
EWCA	Ethiopian Wildlife Conservation Authority
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
FDRE	Federal Democratic Republic of Ethiopia
FEMSEDA	Federal Micro and Small Enterprise Development Agency
GCM	General Circulation Model
GDP	Gross Domestic Product
GGGI	Global Green Growth Institute
GHG	Greenhouse Gas
GIZ	Gesellschaft für Internationale Zusammenarbeit
GNI	Gross National Income
GNNP	Green Net National Product
GoE	Government of Ethiopia
GTA	Green Technology Africa
GTP	Growth and Transformation Plan
Ha	Hectares
ICS	Improved Cookstoves
ICT	Information and Communication Technology
IDS	Industrial Development Strategy
INDC	Intended Nationally Determined Contributions

IP	Industrial Park
IPCC	Intergovernmental Panel on Climate Change
IPDC	Industrial Parks Development Corporation
LCA	Life Cycle Analysis
LMP	Livestock Master Plan
LSA	Livestock Sector Analysis
LSM	Large Scale Mining
LRT	Light Rail Transit
MEFCC	Ministry of Environment, Forests and Climate Change
MoANR	Ministry of Agriculture and Natural Resource
MoFEC	Ministry of Finance and Economic Cooperation
MOI	Ministry of Industry
MoMPNG	Ministry of Mines, Petroleum and Natural Gas
MoUDH	Ministry of Urban Development and Housing
MoWIE	Ministry of Water, Irrigation and Electricity
MSEs	Micro and Small Enterprises
$MtCO_2e$	Million-ton carbon dioxide equivalent
MRV	Measuring, Reporting and Verification
NBSAP	National Biodiversity Strategy and Action Plan
NMA	National Meteorological Agency
NTFP	Non-Timber Forest Product
OFLP	Oromia Forested Landscape Program
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PES	Payment for Ecosystem Services
PFM	Participatory Forest Management
PM	Particulate Matter
PMO	Prime Minister's Office
PSNP	Productive Safety Net Program
RCP	Representative Concentration Pathway
REDD+	Reducing Emissions from Deforestation and Forest Degradation
REF	Rural Electrification Fund
SMFE	Small and Medium Forest Enterprises
SLM	Sustainable Land Management
SLMP	Sustainable Land Management Program
SNA	System of National Accounts
TVET	Technical and Vocational Education and Training
UAP	Universal Access Plan
UMT	Urban Morphology Types
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Emergency Fund
UPSNP	Urban Productive Safety Net Program
WFP	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization

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The team gratefully acknowledges the overall guidance and provision of critical information from a wide range of Ethiopian Government authorities, including the Ministry of Finance and Economic Cooperation (MOFEC), and the Ministry of Environment, Forest and Climate Change (MEFCC), who provided strategic guidance. Active participation and critical inputs were also provided by the Ministry of Water, Irrigation and Electricity (MOWIE); Ministry of Mines, Petroleum, and Natural Gas (MMPNG); Ministry of Urban Planning (MUP); Ministry of Transport (MOT); Ministry of Industries (MOI); Ministry of Agriculture and Natural Resources (MOANR); National Planning Commission (NPC); and diverse regional bureaus.

An extended team of staff from throughout the World Bank's various Global Practices provided key inputs at various stages of preparation. These contributors include Andrew Goodland, Hailu Tefera Ayele, Shewakena Aytenfisu, Sarah Coll-Black, Tesfaye Bekalu, Issa Diaw, Marguerite Duponchel, Klaus Deininger, Shimeles Sima Erketa, Yacob Wondimkun Endaylalu, Senidu Fanuel, Million Alemayehu Gizaw, Roger Gorham, Dereje Agonafir Habtewold, Oliver Jones, Rahul Kitchlu, Assaye Legesse, Mamo Esmelealem Mihretu, Ahmed Alkadir Mohammed, Muderis Abdulahi Mohammed, Alex Kamurase, Ana Luisa Gomes Lima, Teklu Tesfaye, John Bryant Collier, Heywot Kidane-Mariam, and Nagaraja Rao Harshadeep. The Bank team includes colleagues from units responsible for environment, natural resources, forest, climate change, water resources and supply, agriculture, social protection, urban development, rural resilience and land tenure, transportation, energy, mining, private sector development, trade, and the development and economics research group.

The team deeply appreciates the contribution of the World Bank staff who peer reviewed the report for two quality support clinics and for the management decision meeting: Carter Brandon (Lead Economist), Ernesto Sanchez-Triana (Lead Environmental Specialist), and Paola Agostini (Lead Environment Specialist).

The team would also like to thank Deepika Davidar and Cyndi Spindell Berck for editorial support throughout the process.

The team is grateful for financial support from World Bank core budget, and the World Bank's Programmatic Advisory and Analytical Services for the Climate Resilient Green Economy Facility of the Federal Democratic Republic of Ethiopia (FDRE), which includes financing from the World Bank's BioCarbon Fund and its donors: The Kingdom of Norway Ministry of Foreign Affairs and United Kingdom Department for International Development.

Executive Summary

1. **Ethiopia has embarked on an ambitious structural transformation through its successive Growth and Transformation Plans (GTP) and its Climate Resilient Green Economy (CRGE) Strategy.** This transformation requires better integration of environmental and sustainability considerations into the country's policy and institutional frameworks to achieve efficient use of resources that contribute sustainably to economic development, poverty reduction and quality of life.

2. **Ethiopia is a country well-endowed with natural resources and environmental advantages, and the transformation of this natural capital into other forms of capital is crucial for Ethiopia's development strategy.** The natural wealth constitutes a potentially large pool of resources that is subject to competing uses but can be sustainably channeled to enhance physical and human capital if re-invested wisely. This situation offers both opportunities and challenges that affect the nation's development pathways. Reaching the shorter-term GTP II targets and the longer-term CRGE goals, given environmental and climate risks, will require strong synergies between sectors and careful management of trade-offs of various sectors' claims on the same resources.

3. **The country has prioritized the role of natural capital to drive growth and prosperity, and help manage climate risks for greater resilience.** The "degrade now, clean up later" principle is no longer relevant, if it ever was: the stakes are too high in Ethiopia to take this unsustainable path. The country faces high population growth and urbanization; significant vulnerability to climate risks, land degradation, and forest loss; and an agrarian economy that is seeking to diversify in the absence of a sufficiently strong regulatory environment, aligned incentives, or private sector. Ethiopia's commitment to take a green, clean and resilient path to achieve middle-income status by 2025 makes it a highly ambitious global leader--but with much work to do. This Ethiopia Country Environmental Analysis (CEA) is intended to assist the country to strengthen its progress along this path.

4. **The CEA assesses the country's key environmental challenges in this transformation process and the capacity to manage them.** It takes a holistic perspective on environmental issues, covering the major sectors of the economy. The CEA focuses on four clusters of sectors that, together, are determining Ethiopia's development path: (i) resilient rural landscapes, (ii) green industrialization, (iii) sustainable urbanization, transport and living conditions, and (iv) sustainable energy access. Achieving Ethiopia's CRGE goals requires shifting the trajectory that each cluster is on toward more sustainable options. For each of these clusters, the CEA discusses their current and intended trajectories (environmental trends such as degradation and pollution, and the government plans and strategies to respond to these trends) as well as the policies, incentives, institutions, information (the upstream enabling environment) needed to put the country on a green, clean, and resilient development pathway. The report also highlights practical experiences from Ethiopia and elsewhere.

5. **The bulk of the analysis in the CEA focuses on key challenges in the enabling environment in terms of policies, institutions, incentives, and information**—which can contribute to success in achieving sustainability and mobilizing investment if well-designed and consistently implemented, and can impede success if not.

6. **The CEA aims to add value in Ethiopia's development dialogue by discussing large-scale trends, as well as current and emerging environmental challenges.** The report strives for an integrated synthesis of Ethiopia's environmental challenges and the policy and institutional pathways for addressing them. The following figure summarizes the structure of the report. The following sections provide highlights of the CEA.

Ethiopia Country Environmental Analysis – Organization and Key Themes

Chapter 2: Ethiopia's development trajectories for resilient green transformation	Chapter 3: Challenges in the enabling environment for resilient green transformation	Chapter 4: Recommended pathways for resilient green transformation	Chapter 5. Towards implementation of recommendations
Development direction for major clusters: • Resilient landscapes • Green industrialization • Sustainable urbanization, transport and living conditions • Sustainable energy production	**Challenges facing each cluster's trajectory**: • Framework for environmental management • Institutional issues • Policy issues • Incentives and markets • Information and data • Investment gaps	**Pathways for each cluster in terms of**: • Institutional and policy enhancements for resilient growth • Incentives • Information • Investment mobilization for impact: crowd-in and coordinate	**Implementation:** • Actions, lead actors and sequencing • Integrated planning and implementation • Evaluation of competing uses resources • Transparency in information provision • Consistent implementation of regulations

Trajectories for green structural transformation

7. **Ethiopia's economic development plans expect an overall trajectory toward rapid, inclusive and sustainable growth.** To achieve this, transformative change will be needed to make rural landscapes not only four times as productive, but also more resilient to shocks. In parallel, a structural transition of labor from rural to urban areas is needed, and has already begun. This labor is anticipated to contribute to the development of a green industrial sector along with service sectors. Urbanization will also demand a transformation to greater sustainability through the creation of environmentally and socially sustainable living conditions and transportation systems. Underlying these transformations is the need for sustainable energy access to ensure the welfare of rural people now dependent on fuelwood, the provision of reliable green energy for the industrial sector and the fuels for the rapidly growing transport sector. This CEA aims to describe these development trajectories and their environmental implications, as a contribution to dialogue, policies and interventions that can reinforce and sustain Ethiopia's actions toward its intended climate resilient green economy of the future.

Resilient rural landscapes

8. **Ethiopia has high economic growth, but also high levels of poverty and mounting environmental and climate risks, especially in the rural landscape.** Over 80 percent of Ethiopians are rural, dependent on rain-fed smallholder agriculture as their primary income source. Agriculture is the backbone of Ethiopia's economy now and in the near future, and the main driver of poverty reduction. How landscapes are managed affects food security, water security, drought security, climate security, and livelihoods security. Yet natural wealth is being eroded despite pockets of great progress. Ethiopia is a leader in landscape restoration and has restored millions of hectares of land, mostly agricultural, benefiting millions of rural people. The natural wealth produced from rural landscapes can be more secure if current achievements can be expanded from millions to tens of millions of hectares and people.

9. **Managing land, water, agriculture and forest resources more effectively is critical to achieving the country's green and resilient economy objectives.** The GTP II recognizes the need for integrated approaches in the rural landscape to balance competing uses of land and water, aiming to create sustainability and resilience. The GTP II targets for agriculture focus on increasing crop productivity, small-scale dairy production, watershed management and tenure security (through legal land holding certificates). In addition to agriculture, rural people depend heavily on forest resources. The GoE has committed to reform the forest

sector, devolve management and increase forest cover, while also reducing deforestation and forest degradation.

10. **Water is essential for agriculture, forests, and rural livelihoods, and critical for energy production, economic development and continued urbanization.** Ethiopia has significant surface and ground water resources, but integrated development and conservation are needed to meet competing demands from agriculture, industry and energy, as well as the challenges of population growth and climate change in coming decades. Forest and vegetation cover form a large part of the "natural infrastructure" that provides water for farm and energy use while reducing water stress.

Green industrialization

11. **Ethiopia sees industrialization as an important driver of growth under GTP II.** However, if not regulated and managed, expansion of industrial production can cause air, water and toxic pollution and other environmental impacts. Currently, industries tend to use old technologies and lack facilities for waste treatment.

12. **To address these challenges, Ethiopia aims to build a green industry sector** by leapfrogging to modern technologies and prioritizing the development of eco-industrial parks with clean energy, waste treatment and energy-efficient technologies. Shifting the trajectory while the industrial sector is still young is an opportunity to avoid the "pollute-now-clean-up-later" path adopted by previously industrialized nations.

Sustainable urbanization, transport and living conditions

13. **Ethiopia, mostly rural, is currently undergoing rapid urbanization.** Cities constitute only 19 percent of the population, but contribute 38 percent of Gross Domestic Product. There is considerable migration from rural to urban areas, especially to Addis Ababa. This trend is expected to increase and urban populations are expected to triple by 2032, even though urban employment opportunities are limited and mostly informal. Along with urbanization, Ethiopia's transport sector and vehicle fleet are both expanding rapidly. Planning for sustainable urbanization and motorization will be critical for the achievement of the CRGE goals.

Sustainable energy production and access

14. **Ethiopia's energy use is mainly from traditional sources, including wood and biomass from the landscape.** Use of modern energy sources—petroleum products and electricity—will have to grow to keep up with urbanization and industrialization trends and reduce pressure on the landscape from biomass depletion. Electricity is the most important modern energy source since it is domestically and cheaply produced, primarily from hydropower, and is a renewable resource. However, simulation studies show that climate variability will increasingly affect hydropower generation, especially after 2030. Under GTP and CRGE, the GoE has made significant efforts toward improving energy access, for example, with grid expansion, off-grid energy systems and improved cooking facilities.

Challenges in the enabling environment for green structural transformation

Policy and institutional framework for environmental management

15. **Ethiopia's legal framework for environmental management is generally sound; the key challenge is in implementation and enforcement.** Many laws need to be updated to address new challenges such as climate change and community participation. Some laws also lack implementing regulations and standards, which presents an opportunity for updating and upgrading to address key issues. Beyond the laws and rules,

environmental management faces challenges of coordination and communication across sectors and ministries both at federal and regional state levels.

16. **The regulatory framework is characterized by "command and control" approaches that could be supplemented by economic incentive-based instruments to reduce the potentially high transaction and enforcement costs of such command and control policies when applied across the board in environmental management.** In addition, the regulatory system is distorted by a so-called "delegation of power to sectoral ministries to manage, monitor and enforce the EIA processes and outcomes." It also leaves little room for information dissemination and disclosure or for public consultation and participation in decision-making processes.

17. **Improving compliance with laws will require better coordination, monitoring, communication, participation, and more resources.** The environmental and natural resources management agencies suffer from persistently low levels of funding and staffing. Better systems and resources are needed to improve monitoring of environmental conditions, coordination across levels of government, and implementation of appropriate responses to improve compliance. Clarification and harmonization of institutional roles and responsibilities will improve cost-effectiveness. Environmental awareness and education can also contribute improved understanding and compliance at low cost.

18. **Improving environmental management, compliance and outcomes will also require greater participation and engagement of Ethiopian society.** Public participation is a keystone of decentralizing control over the environment and natural resources. Bottom-up input is key to successfully implementing any environmental policy. Although local communities can play a pivotal role in environmental management, they are not regularly and actively engaged in decision-making processes due to lack of priority, or mandate, or funds at the decentralized government level. Regional state officials could play a more active role in environmental management, decisions and enforcement, but their activities mainly follow centrally determined priorities, due partly to funding constraints.

Challenges for building resilient landscapes

19. **Three important institutional challenges in building resilient rural landscapes include strengthening inter-agency coordination, resource monitoring, and integrated land use planning processes.** These gaps make it difficult to address synergies and trade-offs in making decisions on resource use and management, such as expansion of crop land which could come at the expense of forests that provide important water provisioning services and other economic goods.

20. **Producing properly aligned incentives to encourage compliance and proper resource management practices is another challenge for building sustainable and resilient rural landscapes.** For instance, upstream farmers do not now have sufficient incentives to undertake tree planting, landscape rehabilitation, and soil and water conservation to reduce run-off and siltation of dams downstream.

21. **Better information on the economic values of natural resources—land, water, forests and natural areas are typically under-valued—would contribute to better decision making on policies, investments, and interventions.** Very little is known about the potential areas of groundwater sources. Costs and benefits of various uses of resources are incomplete; examples include inputs and outputs of agriculture, forestry, and biofuel production. Information about environmental effects (land degradation, deforestation, loss of ecosystem services, etc.) is also incomplete.

22. **Investment in natural resource management and protection (landscape management, forestry and irrigation water) is insufficient compared with the needs.** For example, more than half of all cropland still needs conservation measures and billions of Ethiopian Birr are needed to invest in soil and water conservation

structures to conserve sloping croplands and to bring degraded land back into production for a growing population. Factors influencing the lack of investments are limited financial and human resources, as well as sustainable financing mechanisms for operation and maintenance of land management and irrigation water infrastructure.

Challenges for green industrialization

23. **Institutional challenges for green industrialization include the need for a comprehensive green industrialization strategy,** clarified vertical and horizontal coordination, reduced bottlenecks in private sector business enabling environment, and structural difficulties in greening micro and small enterprises. The enforcement of existing environmental policies is also not well-coordinated among responsible ministries and regional and local bodies.

24. **The lack of incentives to pursue improved environmental performance and adopt new and clean technologies is a challenge for greening Ethiopia's industrialization trajectory.** For example, firms may need preferential support to build waste treatment facilities and import clean technologies. Lack of access to finance also affects firms' decisions to adopt new technologies. Use of market-based signals is a way to reward firms for improved environmental performance and reduced emissions.

25. **The information challenge for greening industrialization includes lack of awareness and knowledge in Ethiopia's private sector about the benefits of green industry.** Another challenge is the lack of commonly agreed guidelines (minimum requirements and consolidated framework) for development of new or upgraded eco-industrial parks. The lack of data on the scale, practices and environmental impacts of micro and small enterprises is another informational challenge.

26. **Increasing private investments in industrial projects depends on improving the adequacy and reliability of infrastructure.** Despite recent improvement, supply of power and connectivity of transportation are insufficient to attract or promote industrial investments and enhance productivity. Another investment challenge is lack of capability of micro and small enterprises to invest in environment-friendly initiatives.

Challenges for sustainable urbanization, transport and living conditions

27. **Inadequate land management processes and lack of coordination between urban and transport planners are key institutional challenges for Ethiopia's growing urban centers.** There is a lack of clear strategies and appropriate standards to foster resilience. Development and implementation of Comprehensive Master Plans require improvements in content and process. The result is horizontal urban sprawl that is incompatible with the CRGE vision and goals.

28. **Rural to urban migration will help fuel the transforming economy; however, it is currently limited due to a structural labor challenge.** The current, rigid land tenure system contributes to this challenge. Rural land holders are not allowed to sell or mortgage land, or even rent out land for extended periods. So, people stay on the land instead of moving to the cities even when they might benefit economically—for example, those with small holdings or female-headed households without enough labor to cultivate the land. By allowing consolidation of plots, increased migration could provide more labor for the growing industrial economy, increase incomes for those who stay in the rural setting, and reduce pressure on the rural landscape.

29. **Public financing gaps are another challenge to improving basic services and infrastructure in growing urban centers.** Most municipalities have inadequate revenues to cover all investment needs for water supply, sanitation services and transport systems.

Challenges for sustainable energy production and access

30. **The need for effective coordination among institutions is an important institutional challenge in the energy sector.** Several energy sector programs and coordinating functions are fragmented among different institutions.

31. **Energy market distortions undermine sustainable energy production.** Electric utilities and off-grid service providers need to be able to recover operating costs if they are expected to contribute to financing better energy access and investing in new sources of supply. Analysis of willingness to pay is needed to understand the constraints for consumers, and the economic benefits of both grid and off-grid technology options.

Recommended Pathways

Institutional enhancements

32. **The 2013 establishment of the Ministry of Environment, Forestry and Climate Change (MEFCC) has been an important step in elevating attention and responsibility regarding environmental issues.** This relatively new institution presents an opportunity to improve coordination functions, implementation efficiency, and compliance with environmental rules and standards. MEFCC can also serve as a focal point for increasing and leveraging investment in key environmental, forestry and climate change issues.

33. **Strengthening the system for environmental management will be another key step,** with MEFCC empowered to participate effectively in the management and monitoring of the Environmental and Social Impact Assessments and in the enforcement of decisions through its Environment and Social Impact Assessment and Permit Directorate. There is a need for clarification of mandates across all institutions with environmental management responsibilities and units responsible for EIA/ESIA, as well as clearer procedures that reinforce horizontal coordination between sector ministries and MEFCC.

34. **Vertical coordination between MEFCC, sectoral ministries and the regional and local governments can also be improved** through a more formal framework or protocol among key institutions. Establishment of Cooperation Committees on Environmental Protection and Management at the regional state level will be an important step. These coordination committees can be strengthened by including representatives of MEFCC, sector ministries and representatives of the concerned regional state and civil society organizations (private sector, NGOs and local communities). These committees can be a focal point to plan joint actions to address compliance, monitoring and enforcement issues and to promote sound environmental management.

35. **Participatory land use planning and scaled-up participatory forest management approaches are already helping to prevent land degradation and land use conflicts and can be scaled up.** To further support and improve this effort, local level institutions and organizational structures need to be fully staffed and equipped. This type of support can help local PFM initiatives to implement community bylaws effectively. Scaling up successful integrated landscape approaches such as the Sustainable Land Management Program is a key activity to enhance rural resilience.

36. **Enhancing rural resilience also requires multisector, integrated water resources planning and management, as well as more accessible hydrological and meteorological information.** This work requires strong inter-agency delivery and resources to support multiple sectors.

37. **A comprehensive strategy is required to effectively coordinate, support and evaluate green industrialization.** The implementation needs improved coordination among various stakeholders, including MEFCC, Ministry of Industry, Ethiopian Investment Commission, sectoral development institutes, regional authorities and investors. Enforcement of environmental laws, standards and policies would benefit from

increased capacity of regulatory bodies and stronger promotion of industrial compliance. Greening of micro and small enterprises can be promoted by creating an institutional framework for clustering such enterprises.

38. **Ethiopia's rapid urbanization requires prompt, active and efficient planning of land use and infrastructure.** This approach entails designating areas with 20 to 30 years of land supply for the planned expansion of urban areas, based on realistic population and density projections; forward-looking road and infrastructure grid planning; and identification of land to be protected from encroachment. There is also a need for an accountable body based in the Federal Transport Authority to ensure that the country's motorization management is based on timely "no regret" planning.

39. **Institutional coordination among government and non-governmental institutions dealing with energy issues can play a significant role in optimally and sustainably producing and utilizing renewable energy sources.** Ministries and institutions involved in energy resource development (such as cookstoves program in MEFCC, biofuel in MMPNG, and electricity in MOWIE), should enhance their coordination to achieve successful outcomes. Well-coordinated national energy institutions are important in creating an enabling environment for market forces. Functioning and strong institutions help to create clear regulations, effective incentives and subsidies, which are the main inputs for sustainable and resilient energy access.

Information for resilient green growth

40. **Accessible and high-quality information is a fundamental tool to improve environmental management and outcomes.** Ethiopia could benefit deeply from an Environmental Information Management System to collect, analyze and disseminate data and monitor results that are critical for managing implementation, targeting enforcement, planning, policy making, and evaluation for improvement. As a high-level regulatory authority, MEFCC is likely to be the appropriate institutional home for such a system. Without a strong evidence base, resources cannot be well-managed, regulations cannot be well-enforced, and environmental fiscal instruments cannot be effectively implemented.

41. **Better knowledge of the economic values of the environment, natural resources and resource depletion is needed to strengthen the knowledge base for decision making and efficient resource allocation.** More research on costs of environmental degradation by sector is needed to understand and estimate future costs. For example, knowing the real costs of mining would improve planning to avoid environmental degradation. Ethiopia could consider incorporating natural capital measures into its system of national accounts to provide quantitative evidence of achievements toward the CRGE vision. Other critical information gaps are related to groundwater resources, options for electrification (grid vs off-grid), biofuel, and air pollution, as well as climate, hydrology and weather data. This will require investment in the capacities and technologies to generate and analyze such information.

42. **Information disclosure can be a low-cost, effective policy tool to promote compliance with environmental regulations.** Making environmental and compliance information available not only to the regulator, but also to the public and private investors can help to improve compliance, document successes and create an incentive for improved performance. Information can also improve awareness about the importance of green industrialization and the responsibility of the private sector and non-governmental organizations. Information approaches can include, for example, clear guidelines for developing and managing Ethiopia's planned eco-industrial parks.

Toward implementing the recommended pathways

43. **Ethiopia is committed to a development trajectory that will see it become a middle-income country by 2025 with a climate resilient green economy.** The country has already made impressive progress along the path toward its CRGE goals, which are mainstreamed into the GTP II. To meet these ambitious goals,

Ethiopia needs to accelerate movement toward a structural transformation of key sectors of the economy. It will require more integrated planning and more coordinated implementation and investment, both public and private, to ensure the efficient utilization of resources and human capital toward the country's long-term sustainable development.

44. **Focusing on Ethiopia's long-term development, this CEA examined the trajectories of four inter-related clusters:** (i) resilient rural landscapes, (ii) green industrialization, (iii) sustainable urbanization and living conditions, and (iv) sustainable energy access. These are discussed in Chapter 2. In Chapter 3, the CEA discusses critical challenges in the effort to follow and achieve these ambitious trajectories. Chapter 4 lays out concrete actions—in the realm of institutions, incentives, information and investments—that Ethiopia can take to address these challenges and move to pathways that lead to climate resilience and green development. Strong policies, institutions, incentives, and information are all needed to mobilize, manage, monitor, scale up and sustain effective investments. Investments also need to be coordinated spatially and to crowd-in private sector involvement to harness synergies and take proven interventions to scale cost-effectively.

45. The recommended pathways share some common elements that need to be implemented to achieve the CRGE and GTP II objectives:

    - **Integrated planning and implementation.** Landscapes and environmental resources, urbanization and industrialization processes, and provision of sustainable energy in a growing economy are complex and intertwined issues. Planning processes and institutional organization at all levels of government need to reflect this interconnectedness with more integrated and coordinated planning, implementation and monitoring systems. Synergies can be realized by locating or sequencing complementary projects in contiguous or the same areas—for example by locating land tenure improvement projects near threatened forests to reduce incentives for deforestation.

    - **Evaluation of competing uses of resources.** Resources such as land, forest, water, biodiversity, and energy have multiple uses. Careful valuation and optimization of alternative uses, taking into consideration long-term environmental and social implications, is important to enable efficient utilization.

    - **Transparency in information provision.** Information can help influence actors' behavior, which can only be truly efficient if they have full information about the real costs and benefits of their actions. Information that it is available to everyone helps to support efficiency, compliance, transparency and modernization.

    - **Consistent implementation of regulations.** To improve environmental outcomes and to engage stakeholders in this improvement process, environmental regulations and enforcement actions need to be well-founded, fair, well-monitored and applied equally across the board. Consistent implementation and enforcement establishes a standard and a level playing field where market forces can come into play.

    Ethiopia is in a good position to realize a new green development paradigm, but the work of implementation is only just beginning.

1. Introduction

1.1. Objectives of the study

1. **The Ethiopia Country Environmental Analysis (CEA) is a country-level diagnostic tool to support investment and policy dialogues.** It highlights the key environment-related trajectories and challenges facing the country in the coming decade and beyond, and identifies pathways for simultaneously achieving economic, social, and environmental objectives in the context of Ethiopia's Climate Resilient Green Economy (CRGE) Strategy for 2025, and Second Growth and Transformation Plan (GTP II) for 2016-2020. The CEA also informs the early stages of GTP III development. Ethiopia is ranked 163 out of 180 countries in Yale University's 2016 Environmental Performance Index;[1] this ranking has improved by 15 percent since 2006. With the support of the CEA, the country can sustain the progress it needs to achieve its CRGE vision.

2. **The World Bank has developed CEAs in various countries to help clients in prioritizing environmental problems and solutions that can be addressed by key strategic investments, policies, and programs.** CEAs aim to: (i) provide systematic guidance on how to integrate information on and analysis of key environment, development and poverty links into country policy dialogue; (ii) guide provision of environmental assistance and capacity building; and (iii) facilitate a strategic approach to environmental management by analyzing environment-development links.

3. **As such, the Ethiopian CEA aims to:** (i) understand environmental challenges that enable or hinder Ethiopia's aspirations for inclusive economic growth and poverty reduction; (ii) prioritize environmental actions that can help secure public goods and improve performance of various sectors; (iii) provide strategic advice for implementing priority activities in the CRGE Strategy and GTP II; and (iv) build knowledge and enhance the capacity of the GoE, in particular the Ministry of Environment, Forests and Climate Change (MEFCC), to make informed decisions on regulatory issues, and to carry out environmental analysis and sectoral planning. It also aims to contribute to the dialogue between the government and development partners on environment-development linkages and priorities.

1.2. Background

4. **The CEA has been carried out in the context of the implementation of the GTP II and the CRGE Strategy. The CRGE pillars[2], in summary, together aim to make Ethiopia**: (i) *green*, where natural resources are conserved and valued; (ii) *clean*, by following a low-pollution, low-emissions pathway, so that cleaner air, water and cities enable the Ethiopian people to lead healthy, productive lives; and (iii) *resilient*, to be better prepared for, and able to recover from, more frequent natural disasters, including droughts and floods, more volatile weather patterns, and other consequences of climate change. This is consistent with the World Bank definition of Green Growth (Box 1).

5. **The CRGE Strategy and GTP series aim to bring Ethiopia to middle-income status by 2025, with a reliance on resilient "green growth" pathways.** In 2011, the CRGE Strategy was issued under the leadership of the Prime Minister and coordinated by the then Environment Protection Authority (EPA) and the Ministry of Finance and Economic Cooperation (MoFEC). The GTP II was developed by the National Planning Commission and incorporates many elements of the CRGE Strategy. Both strategies emphasize agriculture, forest, and improved land use, recognizing that unless steps are taken to build resilience, climate variability and change could reduce GDP growth by up to 10 percent per year, with agricultural growth facing high risks. The worst case scenario is that in 25 years, Ethiopia could achieve only half of its total GDP potential (FDRE, 2015c).

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1 Yale University's Environmental Performance Index (EPI) is a method of quantifying and numerically marking the environmental performance of a state's policies. This index was developed from the Pilot Environmental Performance Index, first published in 2002, and designed to supplement the environmental targets set forth in the UN Millennium Development Goals.

2 The four pillars of the CRGE strategy are: 1) Adoption of agriculture and land use efficiency measures 2) Protection and rehabilitation of forests for their economic and ecosystem services including as carbon stocks 3) Deployment of renewable and clean power generation 4) Use of appropriate advanced technologies in industry, transport, and buildings *(CRGE Strategy 2011)*

Box 1. Defining Green Growth

The World Bank defines Green Growth as growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing disasters. Accordingly, a transition to Green Growth requires actions to reduce pollution and emissions through cleaner consumption and production patterns, to manage natural capital (e.g., land, forests, water, etc.) more sustainably and efficiently, and to reduce vulnerabilities to climate and disaster risks (e.g., flooding, storms, warming temperatures, etc.). Green Growth is a pathway towards sustainable development.

World Bank (2012) Inclusive Green Growth: The Pathway to Sustainable Development

6. **The CRGE Strategy was presented at the 17th UNFCCC Conference of Parties (COP), Durban, 2011, and was unique. No other country had articulated plans for such an ambitious green economy.** This was reconfirmed at the 21st UNFCCC COP, Paris, 2015, where Ethiopia was one of only five countries to present commitments sufficient to reach the most ambitious 1.5-degree target through its Intended Nationally Determined Contributions (INDC).[3]

7. **By learning from other countries, Ethiopia can leapfrog over the traditional less sustainable and costlier development trajectory**. Most countries have progressed in keeping with the Environmental Kuznets Curve which suggests that pollution and income both grow until rising prosperity creates a demand for a cleaner environment. Ethiopia's CRGE initiative, however, aims to bypass that curve and achieve a green, clean and resilient economy.

8. **The CEA is structured to support and reinforce action toward the CRGE goals. Four clusters constitute the path to resilient green growth in Ethiopia: rural landscapes, industrial development, cities, and energy. The CRGE Strategy and GTP II demand multiple transformations in all four clusters.** The expectation of rapid, inclusive, and sustainable growth presupposes that rural landscapes will become four times as productive as now, more resilient, and less carbon intensive. The CRGE Strategy identified and prioritized 60 initiatives that would reduce 250 MtCO2e per year; about 90 per cent of this reduction will come from the agriculture (, including livestock) and forestry sectors (FDRE, 2015c). Labor will move from the rural to urban areas, alleviating the pressure on rural landscapes. This labor can be absorbed by developing a green industrial sector along with service sectors. As urban areas and transportation systems develop and expand, sustainable urbanization—the creation of environmentally and socially sustainable living conditions—must take place. Underlying this transformation is the need for sustainable energy access to ensure the welfare of rural people who at present depend on fuelwood, the provision of green energy for the industrial sector, and the fuels for the rapidly growing transport sector. Common to all four clusters is the need for greater capacity to manage environmental risks. Smart regulatory regimes and incentives can reduce public expenditure (e.g., increase reservoir lifespan from reduced siltation) and private spending (e.g., health care costs from water and air pollution) while driving green growth options that deliver jobs (e.g., forest-related industries).

9. **Ethiopia is well-endowed with natural resources and environmental advantages; the structural transformation of this natural capital into other forms of capital is crucial for the country's development strategy.** This large pool of natural wealth is subject to competing uses but can be sustainably channeled to enhance physical and human capital if re-invested wisely. This situation offers both opportunities and challenges that affect the nation's development pathways. Given the environmental and climate risks, reaching the shorter-term GTP II targets and the longer-term CRGE goals will require strong synergies between sectors and careful management of various sectors' claims on the same resources.

10. **This transformation must be inclusive** since the poorest households are likely to be the most dependent on natural resources and the most vulnerable to environmental, climate and disaster risks.

3 http://climateactiontracker.org/countries/ethiopia.html

11. **The starting point for green structural transformation is a resilient, productive rural landscape, because, despite the significant urbanization trends, 85 percent of the population still depends on natural resources such as land, soil, water and forests to meet their basic needs and respond to shocks.** Land is the most critical resource, with significant potential to promote inclusive green growth and the transition to a green and resilient economy. However, degradation of productive landscapes remains a threat to sustainability and resilience, despite mitigation and protection measures that are already a part of national policy.

12. **The development goals in the GTP II and CRGE strategies focus on enhancing the resilience of rural landscapes by addressing deforestation and degradation, improving agricultural productivity and production, and expanding renewable energy access**. However, despite impressive achievements in watershed restoration, forest sector planning and reforestation, crop yield improvements, and related policy measures such as land tenure certification, Ethiopia's natural capital management is not yet on a sustainable path. This situation compromises Ethiopia's long-term targets for green economic growth. It also imposes significant socioeconomic costs particularly on vulnerable groups such as poor elders, children and women.

13. **Ethiopia has begun to deliver on a structural transformation towards green industrialization.** A fast growth rate is expected in the industrial sector (20 percent for the GTP II period, 2016-2020) as is an increase in the share of industry as a percentage of GDP from 13 percent in 2012 to 27 percent by 2025. However, if not well-regulated and managed, the expansion of industrial production can have substantial environmental impacts, including greenhouse gas (GHG) emissions and pollution of surrounding soil, water and air.

14. **The structural labor transition and sustainable urbanization of Ethiopia is in its infancy.** Ethiopia is still one of the least urbanized countries in the world, with only 19 percent of the population living in urban areas. However, at 5.4 percent per year, the current rate of urbanization is among the top 10 in the world. Ethiopia's cities and towns have expanded rapidly over the past two decades. The rapid urbanization poses many social and environmental challenges such as pollution (water, air, and noise), urban sprawl, solid and liquid waste management, illegal settlements, lack of social safety nets, jobs, and loss of open green space. These challenges need to be addressed for the transition to contribute to the green growth vision.

15. **Ethiopia suffers from the second largest energy access deficit in Africa (~60m people)[4]. With a growing industry, power shortages can cost up to 2 percent of GDP. A green energy policy can increase energy supply, reliability and access in a manner conducive to a low-carbon economy.** Sustainable energy access will help achieve these multiple transitions and the objectives set forth in the CRGE Strategy. Accessible renewable energy in rural areas can help reduce deforestation and substitute biomass fuel while reducing indoor air pollution; Ethiopia is among the 10 countries in the world most affected by indoor air pollution.[5] Similarly, access to cheap renewable energy is critical for the developing green industry and transport sectors. Demand exists, but production and distribution need to meet this demand in a sustainable way.

16. **The MEFCC, introduced in late 2013, provides an opportunity to review and improve environmental management and policy** based on an analysis of the performance of environmental institutions and the key environmental challenges that Ethiopia faces. This helps environmental authorities develop policies and interventions that take advantage of potential win-win opportunities, assess trade-offs, protect and restore a deteriorating environment, and enforce regulations that incentivize competitiveness and investment. CEA will focus on such analysis.

17. **Given the GoE's strong commitment to the CRGE goals, the CEA focuses on the overall capacity to translate these strategies into practical and actionable policies, projects, programs, and partnerships, and to operationalize existing environmental regulations.** The environmental agencies previously had limited capacity to address the core environmental problems of the country, mainly

4 SE4ALL, 2015

5 WHO 2009. http://www.who.int/indoorair/health_impacts/burden_national/en/

because of human capital and resource limitations, data constraints, and challenges in mainstreaming environmental concerns into national and regional development planning processes.

18. **The timing for the CEA is opportune,** since the fundamentals of environmental and climate strategies and policies have been formulated, and essential institutions are, for the most part, in place and committed to action.

1.3. Methodology and consultation process

19. **The CEA is mainly syntheses of existing literature and data supported by an extensive consultation process.** The data gathering process includes collecting and analyzing the baseline information needed to better understand the environmental challenges and holding stakeholder consultations to fully understand the issues. As such, data and analyses from a wide range of stakeholders including GoE ministries and regional/local governments, reports by development partners and NGOs, research by Ethiopian and foreign individuals and institutions, and lessons learned from international best practices inform the CEA. In particular, the CEA draws upon a comprehensive Policy Research Review6 process on the CRGE conducted by the Environment and Climate Research Center (ECRC) of the Ethiopian Development Research Institute (EDRI). The process covered the main sectors of the economy, and involved more than 20 experts, some of whom are directly involved in the CEA preparation in partnership with the World Bank and GoE.

1.4. Structure of the report

20. **The structure of the report is formed by ongoing policy and investment dialogues in the country on environment, climate, and resilience, across sectors and themes.** The report (i) identifies Ethiopia's current and intended ***trajectories***, including environmental trends and responses, (ii) discusses ***challenges in the enabling environment*** that affect the development trajectory, and (iii) recommends ***pathways*** to confront these challenges and achieve CRGE goals and better environmental performance (Figure 1). These three elements are presented in Chapters 2-4, as summarized below.

21. **Chapter 2 presents Ethiopia's current and intended environment and development *trajectories*.** The country's main environmental challenges, aspirations and responses (such as strategies and plans) are assessed and presented in four clusters that align with the GTP II: (i) resilient rural landscapes; (ii) green industrialization; (iii) sustainable urbanization and living conditions; and (iv) sustainable energy (Figure 1).

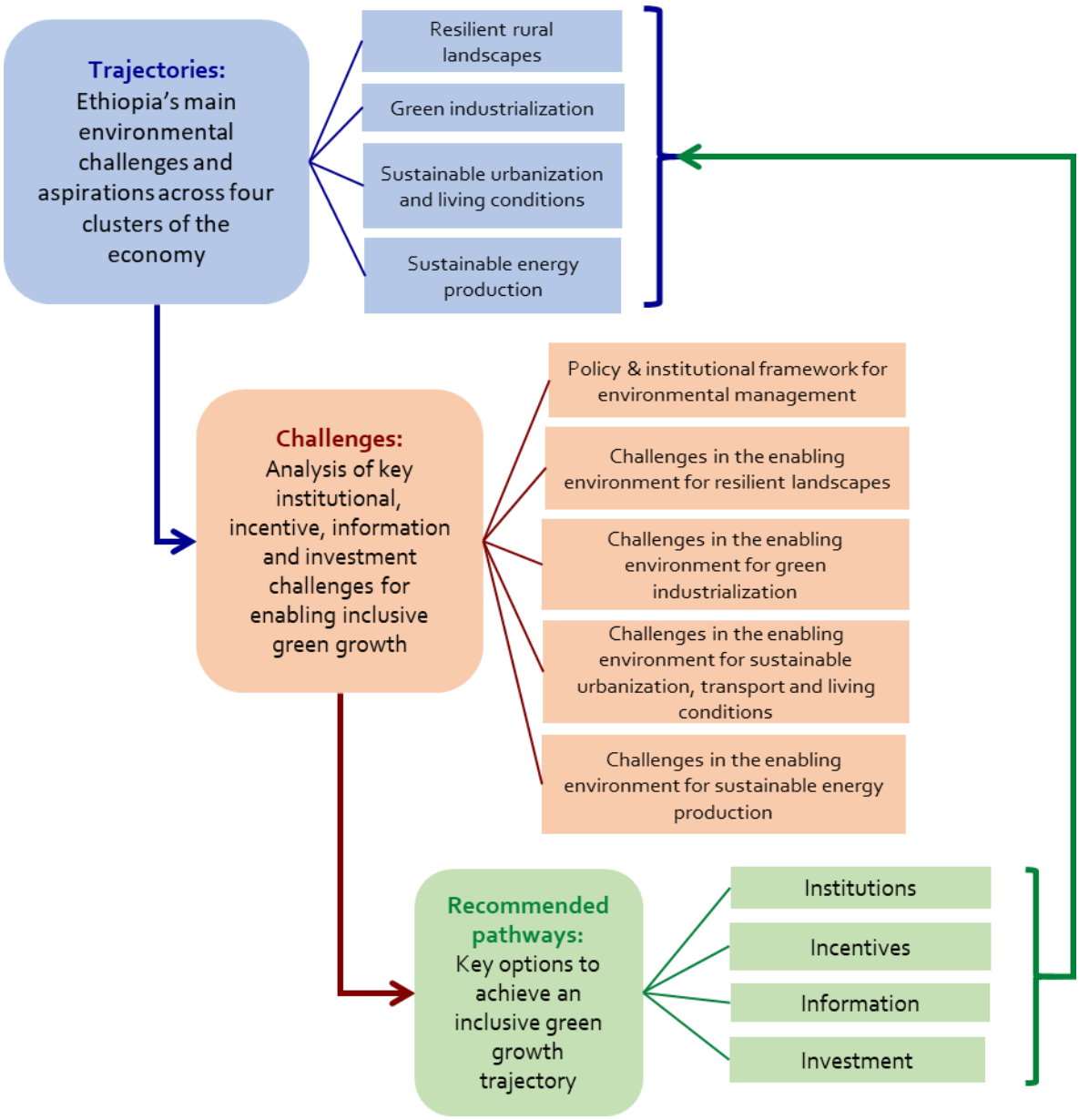
22. **Chapter 3 highlights major *challenges in the enabling environment* (institutions, investments, incentives, policies and information) that affect the trajectories presented in Chapter 2.** These challenges include, most importantly, the legal, policy, regulatory, enforcement and institutional issues that can hinder or drive progress toward CRGE goals. But there are also more cluster-specific challenges, such as the need to deal with competing uses of land, water and energy, as well as the hurdles to achieve the necessary structural labor transformation from the dependence on rural livelihoods to green jobs in the industrial and service sectors (Figure 1).

23. **Chapter 4 identifies *pathways* to address the challenges discussed in Chapter 3.** These green development pathways require coordinated, multisector approaches and are therefore presented thematically as (i) institutions (ii) incentives (including markets, prices, and policies), (iii) information, and (iv) investment opportunities (Figure 1).

24. **Chapter 5 provides concrete near-term and medium-term recommendations that agencies can take to make progress along the pathways identified in chapter 4.**

Figure 1. Structure of the Ethiopia Country Environmental Analysis

[6] Throughout 2015, ECRC was tasked with developing a long-term comprehensive research program that focused on the CRGE. An integral part of this effort was the development of Policy Research Reviews on the thematic areas of sustainable energy transition, sustainable agriculture, sustainable forest management, green industrialization and sustainable urbanization. The reviews pulled together a large amount of existing information on each theme, which made them valuable inputs for the CEA.

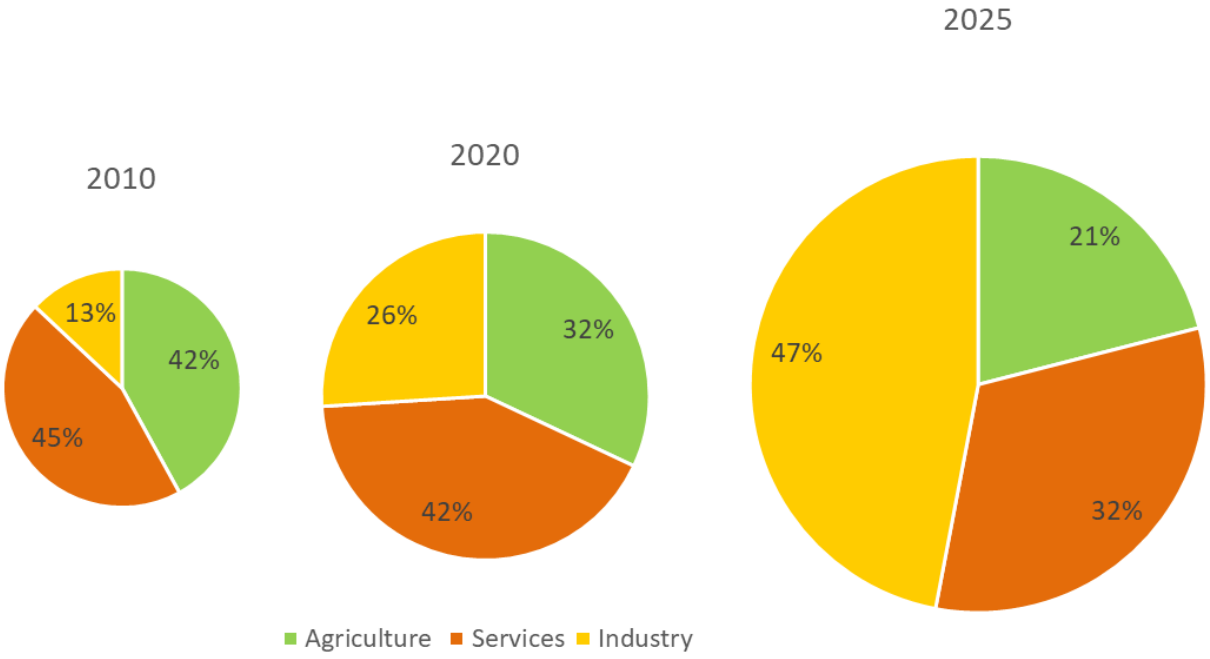

Trajectories:
Ethiopia's main environmental challenges and aspirations across four clusters of the economy
Resilient rural landscapes
Green industrialization
Sustainable urbanization and living conditions
Sustainable energy production
Challenges:
Analysis of key institutional, incentive, information and investment challenges for enabling inclusive green growth
Policy & institutional framework for environmental management
Challenges in the enabling environment for resilient landscapes
Challenges in the enabling environment for green industrialization
Challenges in the enabling environment for sustainable urbanization, transport and living conditions
Challenges in the enabling environment for sustainable energy production
Recommended pathways:
Key options to achieve an inclusive green growth trajectory
Institutions
Incentives
Information
Investment

2. Ethiopia's development trajectories for resilient green transformation

2.1. Introduction

25. **For Ethiopia to achieve middle-income status by 2025 the CRGE Strategy envisions both rapid economic growth and a structural transformation of the economy. By 2025,** the economy is expected to be seven times larger compared to 2010 with a change in composition. Figure 2 illustrates[7] that industry is expected to grow faster than services and much faster than agriculture. This chapter discusses the trajectories of key sectors, which are organized into four clusters: (i) resilient landscapes, (ii) green industrialization, (iii) sustainable urban development, transport and living conditions, and (iv) sustainable energy access. Each cluster affects the others.

Figure 2. Ethiopia's envisioned structural transformation[8]



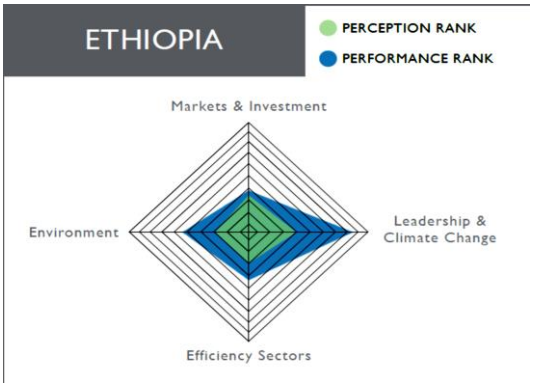
Source: Computations based on raw data obtained from GGGI, projected for GTP and CRGE strategy targets

26. **The CRGE Strategy sets ambitious targets on emissions reductions in different sectors of the economy.** The bulk of the emissions reduction is expected to come from enhancing the management of rural landscapes, particularly from reduced deforestation, planned reforestation and afforestation (FDRE, 2011). As mentioned earlier, Ethiopia is rated as one out of only five countries that have commitments in line with the 1.5-degree target in its INDC. [9] According to a recent Global Green Economy Index (Tamanini, 2016), Ethiopia ranks highest in political leadership in green economy and climate change. But, as Figure 3 shows, political intent is still not fully translated into environmental performance, particularly in the area of markets and investment. This is further borne out by the Environmental Performance Index 2016, developed by Yale University. Figure 4 shows that despite the country's high

7 Note that the sector composition is not stated in the CRGE strategy and that these projections are based on the growth rate needed to reach the targets in the strategy combined with the specific GTP II targets. The actual sector composition in 2030 will most likely differ from these projections.
8 Projection based on compounded annual growth rate (CAGR), GTP growth targets and CSA population estimates.
9 http://climateactiontracker.org/countries/ethiopia.html

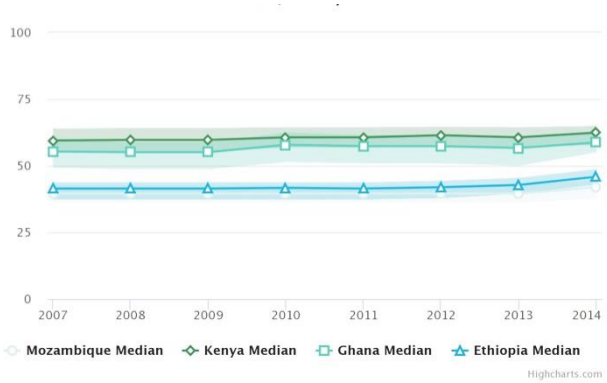
international profile in this area, Ethiopia's environmental performance over the past 10 years has not changed much compared to Kenya, Ghana and Mozambique.

Figure 3. Ethiopian ranking in the Global Green Economy Index



Source: Tamanini, 2016

Figure 4: EPI benchmarking for Ethiopia



Source: Environmental Performance Index, 2007-2014[10]

2.1.1. Resilient rural landscapes: GTP II indicators, trends and costs of environmental degradation

27. **Resilient rural landscapes comprise agriculture, livestock, forestry, and water. The GTP II articulates integrated approaches for optimal land and water use and sustainable resource management to create resilient rural landscapes.** This integrated approach is expected to build on the successes in the agricultural and forestry sectors achieved during the GTP I period to realize GTP II targets (Table 1) which are also important for the CRGE objectives.

10 In this index 0 = lowest possible performance, while highest possible performance = 100. http://visuals.datadriven.yale.edu/countrycompare/

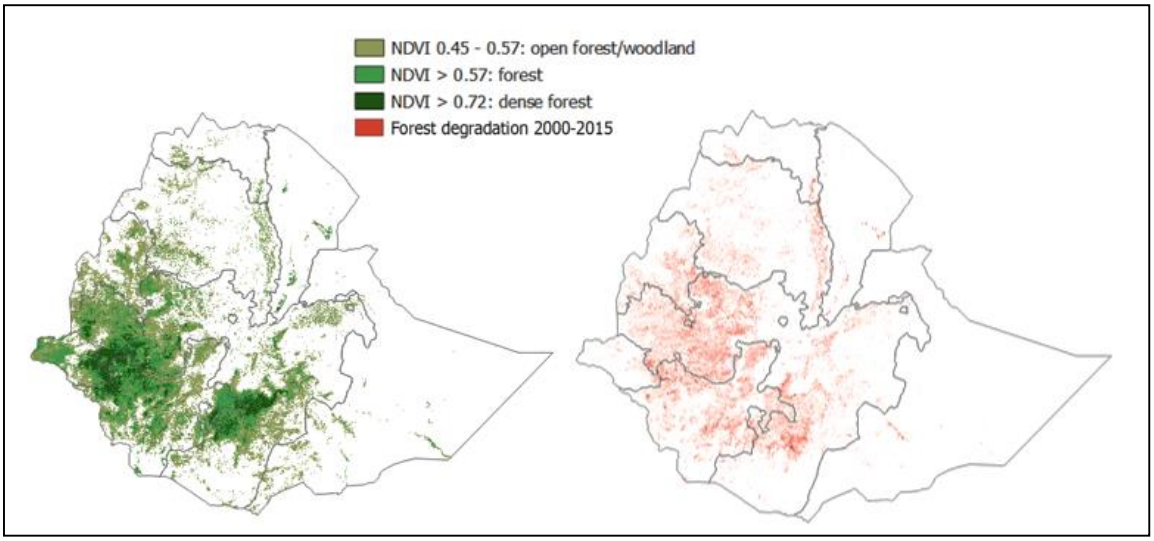
Table 1. GTP II indicators for building resilient rural landscapes

Sector and GTP II indicator	Unit	Baseline year (2014/15)	Target year (2019/20)	Remarks
New agricultural land provided to investors (commercial ag)	Thousands ha	2,430	3100	Demand for commercial agricultural land is expected to increase; careful planning is needed to reduce negative impacts on forests and smallholders.
Increased productivity of major food crops	quintal/ha	16	23	Reduced expansion of crop land
Increased small and medium scale dairy/livestock production units	Number	58,000	158,000	Modern livestock rearing techniques should be used to reduce pressure on the environment (e.g zero grazing).
Farm plots granted secondary land holding certificate	Millions	1.2	30	Secured land tenure and lesser forest encroachment and adoption of sustainable land management practices.
Small-scale irrigation	Thousands ha	2,345	4,088	Reduced pressure on forest due to reduced crop land expansion; also, increased demand for rehabilitation of the upper catchment through afforestation and reforestation to sustain the flow of irrigation water.
Number of farmers receiving extension service	Thousands/ numbers	1,100	16,800	More appropriate/efficient input use.
Share of forest sector in GDP	Percent	4	8	Contributes towards improved ecosystem services.
Forest coverage	Percent	15	20	Same as above–2016 GoE definition of forest used
Area of land rehabilitated	Million ha	11.7	22.5	Includes forest landscape restoration
Area of land with community based watershed development	Million ha	12.16	41.35	Same as above
Construction of medium and large-scale irrigation development	Ha	410,000	954,000	Reduced pressure on forest due to reduced crop land expansion; increased demand for rehabilitation of the upper catchment through afforestation and reforestation to sustain the flow of irrigation water
Additional households benefiting from green economy development technology	Number	0	100,000	Forest sector technology packages can contribute to fulfilling the targets; the use of green energy technologies also reduces pressure on forest resources
Reduced GHG emission	Million tons of CO_2e	0	147	Includes all sectors--namely soil, livestock, forestry, energy, transport, industry and urban development

Source: FDRE (2016b)

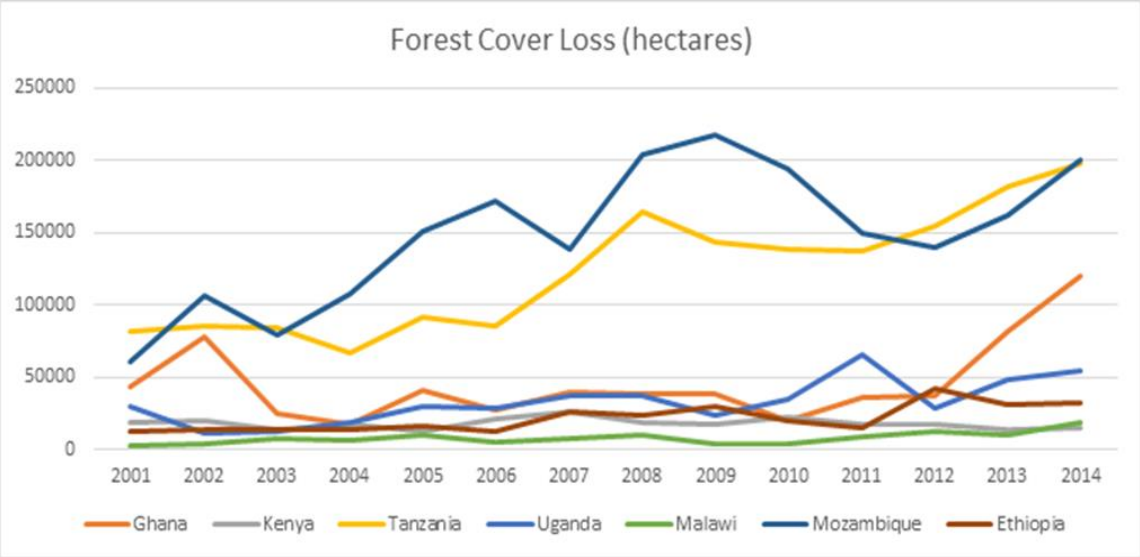
28. **To reach the ambitious GTP II targets, many negative trends need to be reversed. Ethiopia's Forest Reference Level (FRL) study has estimated a net forest loss of approximately 70,000 ha/yr for the period 2000 to 2013 (FDRE, 2016c)**, (Figure 6). Since much of Ethiopia's deforestation preceded 2000, the current rate of deforestation is unsubstantial in absolute numbers. However, CRGE projections indicate that if no action is taken to change the country's development path, 9 million ha will be deforested between 2010 and 2030 (FDRE, 2011). Over the same period, annual fuelwood consumption could rise by 65 percent, leading to forest degradation of more than 22 million tons of woody biomass (FDRE, 2011). To prevent this from happening, Ethiopia aims to not only reverse this degradation but increase forest cover from 15 percent to 20 percent by 2020.

Figure 5. Map of Ethiopia's forest density and deforestation during 2000-2015



Source: FDRE, 2015

Figure 6. Forest cover loss in selected African countries 2001-2014

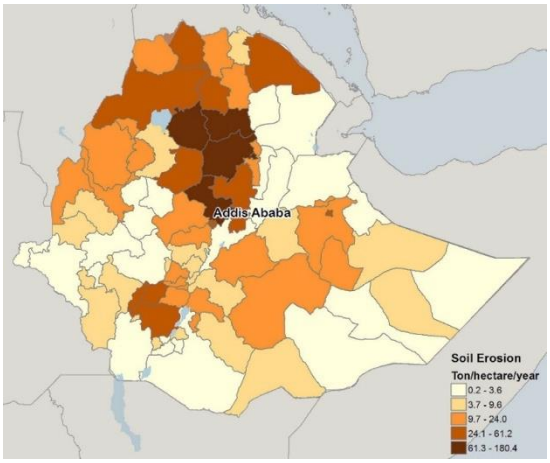


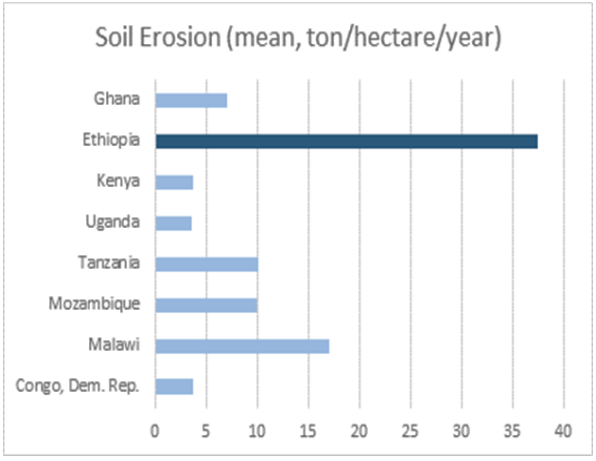
Source: Hansen et al., 2013.[11]

11 Data available online from:http://earthenginepartners.appspot.com/science-2013-global-forest.

29. **In the face of rapid land degradation, GTP II aims to increase agricultural productivity by 44 percent by 2020.** Recent estimates of annual net erosion for areas above 1000 meters elevation are about 18 tons/ha; this increases to about 20 tons/ha when only cropland is considered (Hurni et al., 2015). In a different modeling exercise, Naipal et al. (2015) have derived yearly average soil erosion rates, in tons per hectare per year, by applying an adjusted model more adapted for global analysis instead of using the original universal soil loss equation that accounts for rainfall erosivity differences across different climate zones. The incidence of soil erosion differs immensely between regions in Ethiopia, with the highlands of the Amhara region being the worst affected with rates above 60 tons/ha/yr (Figure 7). This also explains why Ethiopia stands out in an African context with significantly higher rates of soil erosion than neighboring countries that have been analyzed with the same approach. For an account of land degradation hotspot areas by region, please see Annex A.

Figure 7. Soil erosion incidence in Ethiopian regions, and cross-country comparison





Source: Naipal et al. 2015

30. **The estimated monetary cost of land degradation is approximately 3 percent of Ethiopia's agricultural GDP per year or 1 percent of total GDP** (FDRE, 2015a; Bojö and Casells 1995, cited in Yesuf et al. 2005; Sonneveld 2002; Barry 2003)**.** The Climate Resilience Strategy for Agriculture and Forestry indicates that, under some extreme scenarios, the impact of climate change on all sectors could cause a 10 per cent or more reduction in GDP by 2050 (FDRE, 2015c). The 2002/03 drought led to a 4 percent decline in GDP and a 12 percent reduction in agricultural output. Floods also cause damage to land and agriculture. The cost of major floods, which occurred in 1994, 1995, 1999, 2005, and 2006, ranged from US$ 3.5 million to US$ 6 million per event (FDRE, 2015c).

Table 2. Cost of Environmental Degradation in resilient landscapes

Sectors	Contribution to GDP (%)	Major environmental challenges	Costs of degradation
Forestry	4 to 13	Deforestation and degradation; sedimentation of hydro dams; loss of sequestered carbon	Net forest loss of approximately 70,000 ha/yr for the period 2000 to 2013; loss of sustainable harvest (35 percent fuelwood is unsustainably harvested); loss of sequestered carbon (410 million tCO2e/year due to deforestation under BAU projected to 2033); economic cost of deforestation estimated at over US$5 billion during 1990-2010; loss of biodiversity and protected areas could cost up to US$1.5 billion or more.
Agriculture	38.5	Land degradation; Soil erosion Climate change	2-3 percent of agricultural GDP lost due to land degradation (around 1 percent of total GDP); loss of 1-4 percent of total GDP due to droughts; 10 percent reduction of GDP or more due to climate change in 2050.

2.1.2 Green industrialization: GTP II indicators, trends and costs of environmental degradation

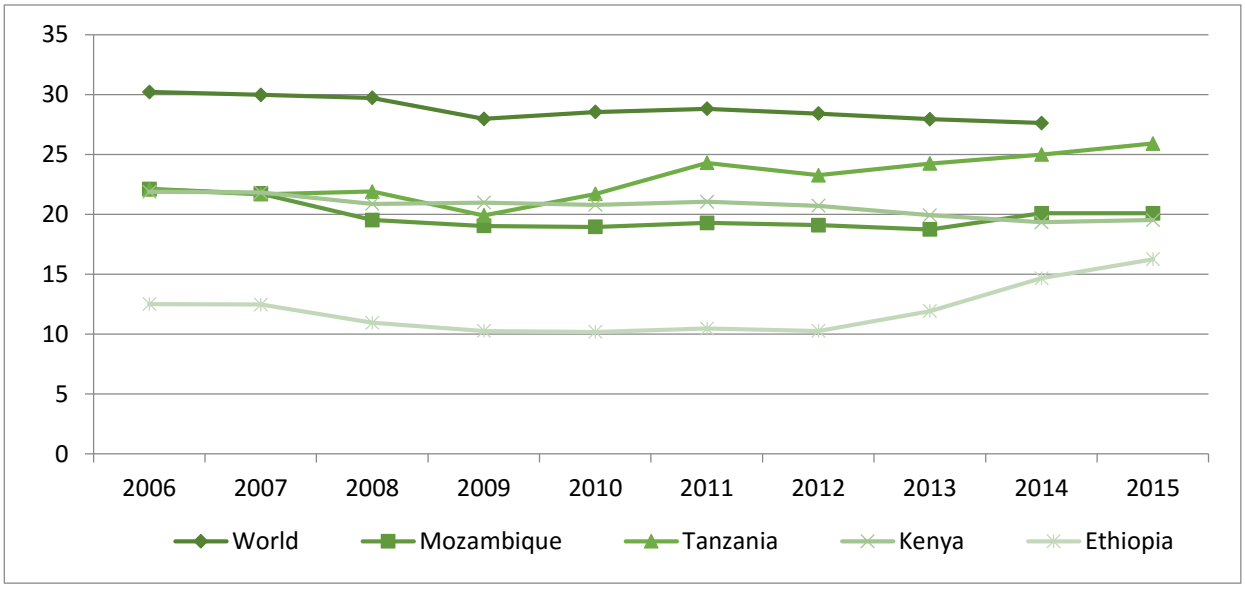
31. **Ethiopia's ongoing rapid economic growth cannot be sustained without a structural transformation toward sustainable industrialization.** Industrialization, especially the development of light manufacturing, is at the core of Ethiopia's drive for rapid structural transformation. The sector grew by an average annual growth rate of 20 percent from 2012 to 2015 (NBE, 2016). GTP II also targets a continued average industrial growth rate of 20 percent and plans to increase its share of value added in GDP from about 15 percent in 2015 to 22 percent by 2020 (Table 3).

*Table 3: **GTP II indicators for greening industrialization***

Sector and GTP II indicator	Unit	Baseline year (2014/15)	Target year (2019/20)	Remarks
Manufacturing industry share in GDP	Percent	4.6	8	
Industry value added share in GDP	Percent	15.1	22.3	
Safe removal of dangerous chemicals (pollutants)	Tons	0	200	
Cleaning polluted areas	Number	0	50	

32. **Ethiopia is catching up with other East African countries when it comes to industry value added to GDP (Figure 8).** Structural transformation is necessary to ensure value addition, sustained job creation, export competitiveness and continued poverty reduction.

Figure 8. Industry value-added as percent of GDP in selected African countries



Source: Computation based on data obtained from World Development Indicators

33. **Even at the current low level of industrialization, Ethiopia's industrial sector is causing water, soil, and air pollution, and is projected to grow without effective environmental management.** Ethiopia's existing industries use old technologies and lack facilities for on-site waste treatment. According to Gebre et al. (2009), about 90 percent of existing industries dump their wastes in nearby water bodies. Tanneries, textiles and coffee processing plants cause significant soil and water pollution as their liquid wastes

pollute aquatic ecosystems and harm water users (Asfaw, 2007; Abera, 2014; Reda, 2015; Tekle et al., 2015). That these industries are priority sectors for Ethiopia's industrial development vision is indicative of the challenges ahead. GTP II indicators report that there is no safe removal of dangerous chemicals and no cleaning of polluted areas. However, data paucity prevents a clear understanding of the trajectory and possible remedies that could boost industrial efficiency and promote clean production.

34. **Expanding industrial production in a conventional way will result in substantial environmental impacts, including GHG emissions and other pollutants.** Industrial GHG emissions in Ethiopia are projected to grow by 16 percent per year under a business as usual (BAU) scenario and reach 71 Mt CO_2e in 2030, compared to 4 Mt CO_2e in 2010 (FDRE, 2011). This is the largest GHG emissions growth rate of all economic sectors. For subsectoral shares, the baseline measurement of emissions carried out by the Ministry of Industries (2015) showed that the cement, chemical, textile and leather, food and beverage, and metal industries emit substantial GHG. Cement production is the largest contributor to Ethiopia's industrial CO_2e emissions (50 percent), followed by mining (32 percent, mainly due to gold mining and processing, coal, extraction of potash and others) and leather and textile (17 percent) (UNDP 2011). The main costs of environmental degradation due to industry are summarized in Table 4.

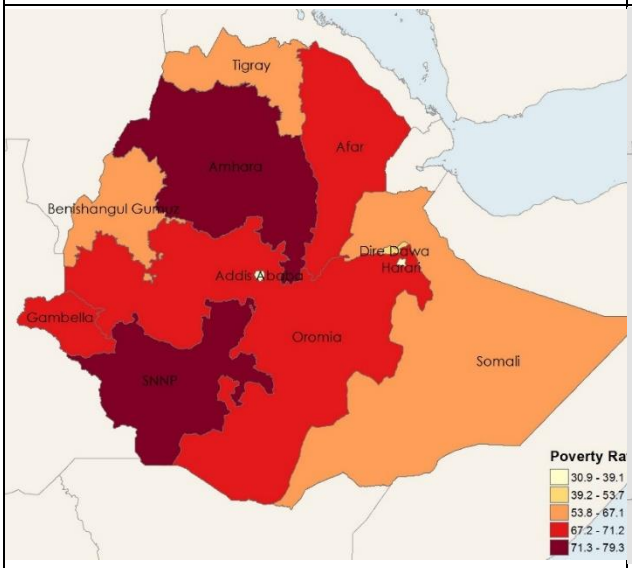
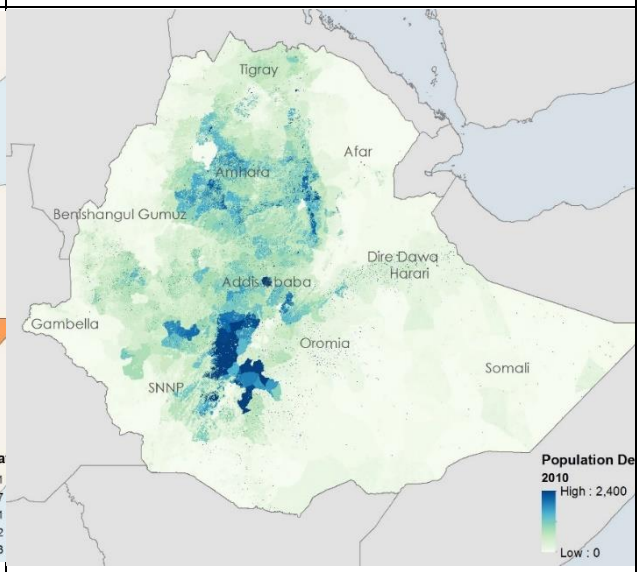
Table 4: Cost of environmental degradation in industry, manufacturing and mining

Sectors	Contribution to GDP (%)[12]	Major environmental challenges	Costs of degradation
Industry and Manufacturing	From 13 percent and 4 percent respectively in 2012, to 27 percent and 17 percent by 2025	Water, soil and air pollution	Industrial GHG emissions projected to grow by 16 percent a year under a BAU scenario and reach 71 Mt CO_2e in 2030. No aggregate figures on industrial effluents and impact on economy but Asfaw (2007) reports that leather industries discharged 547,860 m^3 of wastewater to the Akaki river in Addis Ababa. Emissions from organic water pollutants from the existing industries in Ethiopia has increased from 18,543 kg to 32,182 kg per day (WDI, 2013)
Mining	1.2 for extractive industries (EEITI, 2014)	Deforestation, land degradation, siltation, erosion, and sedimentation	Environmental costs of mining are not well- established.

2.1.3 Sustainable urbanization, transport and living conditions: GTP II indicators, trends and costs of environmental degradation

35. **In Ethiopia, improved management of rural landscapes needs to be accompanied by a structural labor transformation, where labor shifts to occupations in industry and services through a process of well-managed urbanization**. Figure 9 shows that despite the recent fast economic growth, the country is still marred by high levels of poverty especially in the rural landscape, where over 80 percent of Ethiopians live and depend on rain-fed smallholder agriculture as their primary income source. The poverty headcount ratio in Figure 9 is juxtaposed with a population density map in Figure 10 showing the strong correlation of high population density and extreme poverty, notably in the highlands of the Amhara region and in the SNNP. Annex A shows how these areas overlap with those areas identified as land degradation hot spots.

12 According to GTP II and CRGE, except for the mining sector.

Figure 9. Poverty headcount ratio at US$3.10 a day	*Figure 10. Population Density (people/100 km2)*
	
Source: World Bank Monetary Poverty, based on the Household Consumption Expenditure Survey 2010-2011	*Source: World Pop (2013)*[13]

36. **With labor moving from rural to urban areas, it is promising that expansion of urban residential houses is a priority in the GTP II.** In addition to a planned annual construction rate of 120,000 houses per year, the GTP II also addresses the quality of living conditions by creating green areas as well as providing access to potable water and improved stoves.

37. **At 5.4 per cent, Ethiopia has one of the highest rates of urbanization in the world**. At present, approximately 19 percent of the population lives in urban areas; this is projected to increase substantially by 2032, the urban population is expected to triple to 42 million (Ozlu et al, 2015).

*Table 5. **GTP II indicators for sustainable urbanization and living conditions***

Sector and GTP II indicator	Unit	Baseline year (2014/15)	Target year (2019/20)	Remarks
Urban residential houses constructed	Number	157,000	750,000	Increased demand for construction wood and furniture
Green area development and public recreation land utilization coverage	Percent	2	7	
Overall potable water supply coverage as per GTP II standards	Percent	58	83	Improved quality of water supply, which improves human health, which in turn contributes to environmental protection and development
Improved cookstoves	Number	9 million	11 million	Reduced demand for fuelwood through the dissemination of fuel-efficient cookstoves

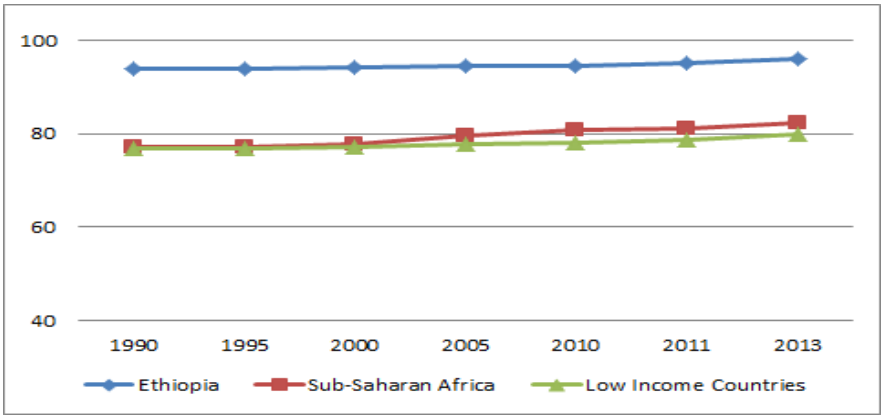
13 Source: http://www.worldpop.org.uk/data/summary/?contselect=Africa&countselect=Ethiopia&typeselect=Population

38. **Rapid urbanization can present many social and environmental risks if social services, jobs and infrastructure do not keep pace with urban development.** Risks include pollution (water, air, and noise), urban sprawl, solid and liquid waste management problems, illegal settlements and loss of open green areas (see Table 6 and Annex A for a summary of the existing evidence on different aspects of pollution in Ethiopia). According to the Global Burden of Disease findings, lower respiratory infections are the leading cause of death in children below five years of age as well as the leading cause of premature deaths overall (http://www.healthdata.org/ethiopia). This is although under-five mortality rate dropped by 48 percent between 2005 and 2015 while the overall number of years of life lost due to respiratory infections dropped by almost 60 percent during the same period. A survey conducted in Addis Ababa showed a prevalence of 24 percent acute respiratory infections among children under 5 years old (Worku et al, 2014), attributable to urban particulate matter pollution (both outdoor and indoor. The Ethiopian population is much more exposed to PM 2.5 than the Sub-Saharan Africa and LDC averages (Figure 11). Recent data from the US Embassy in Addis Ababa show that the Air Quality Index (AQI) in central Addis Ababa indicates that in 2017 the air has not often been rated as "good" given its PM 2.5 level (Figure 12).

Table 6. Cost of environmental degradation related to transport and living conditions

Sectors	Contribution to GDP (%)[14]	Major environmental challenges	Costs of degradation
Urbanization	Urban centers constitute 38 percent of GDP	Pollution (outdoor & indoor), urban sprawl, solid and liquid waste management, illegal settlements and loss of open green areas	Total deaths from air pollution in 2013 was 71,000 and the welfare loss amounted to 4 percent of GDP (WB, 2016)
Water and sanitation access		Water pollution	43 per 100,000 deaths annually in Africa due to lack of access to safe drinking water and sanitation (WHO 2016)

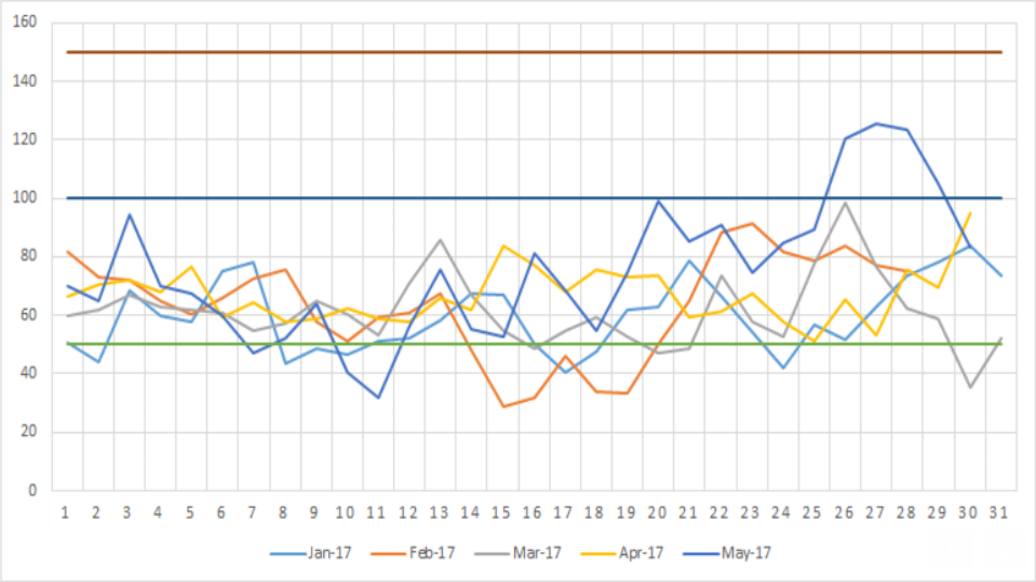
Figure 11. Population exposed to PM2.5 levels exceeding WHO guideline value (% of total)



Source: own computation using WDI 2016 data

14 According to GTP II and CRGE, except for urbanization.

Figure 12. Air Quality Index levels in Addis Ababa during 2017

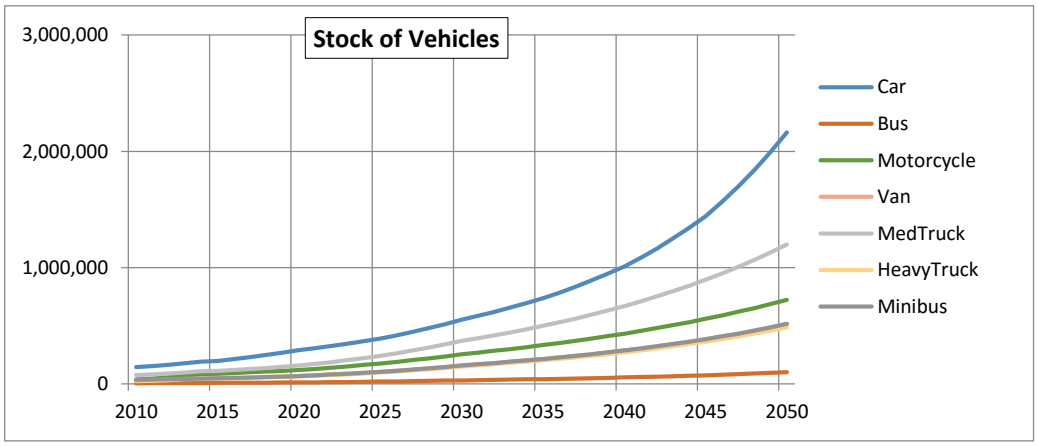


Source: Daily averages from hourly data made available by US Embassy in Addis Ababa[15]

Note: According to Yale University Environmental Index, AQI value 0 - 50 = Good; 51 - 100 = Moderate; 101 - 150 = Unhealthy for sensitive groups; 151 - 200 = Unhealthy; 201 - 300 Very unhealthy; 301 - 500 = Dangerous

39. **The growth in vehicle stock (Figure 13) has environmental implications for Ethiopia. First, fuel consumption is anticipated to increase by about 285 percent between 2015 and 2035, with most of that increase coming from diesel.** Annual GHG emissions from motor vehicles is expected to increase by 258 percent between 2015 and 2035 (Figure 14). The number of "End of Life" vehicles (ELVs) will also increase exponentially. It is estimated that by 2035, the number of scrapped vehicles in Ethiopia will approach 100,000, a 517 percent increase over 2015.This will result in a substantial increase in landfill space.

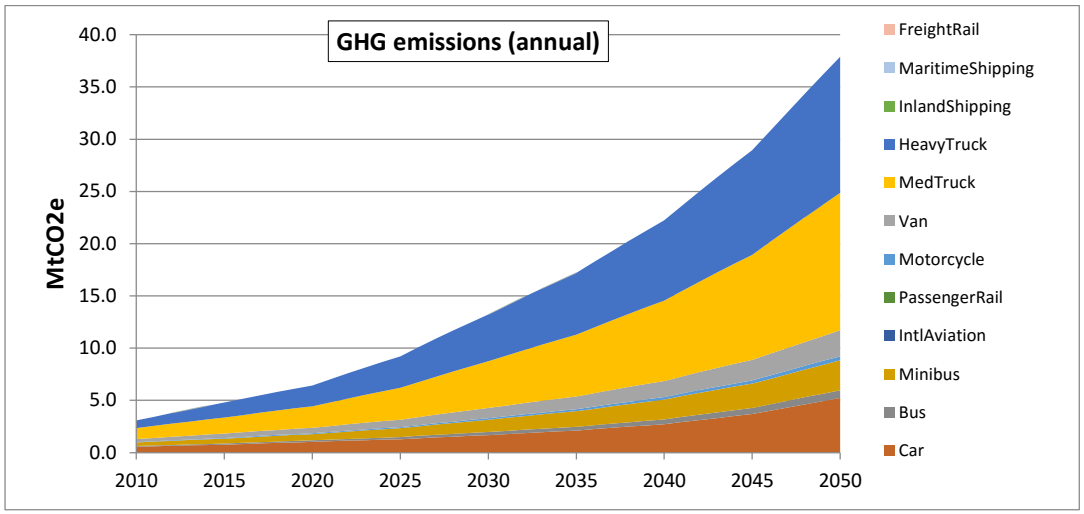
Figure 13. Projection of stock of vehicles



Source: WBG Transport Team calculations, 2017

15 Source: https://www.airnow.gov/index.cfm?action=airnow.global_summary#Ethiopia$Addis_Ababa_Central

Figure 14. Annual GHG emissions from motor vehicles



Source: WBG Transport Team calculations, 2017

40. **Limited access to clean water and sanitation services is a major impediment to the CRGE goals. The World Health Organization estimates diarrheal disease from exposure to unsafe water, sanitation, and hygiene (WASH) as the third leading cause of under-five mortality in Ethiopia, accounting for 20% of all deaths in country (WHO 2016).** Up to 7.3 million people in Tigray, Afar and Somali face multiple risk factors due to limited access to safe water (MoWIE, 2015b). Improved water and sanitation reduces stunting by 12 per cent and diarrhea by 25 per cent (World Bank, 2016a). Improved access to water may also release labor, especially women and children, from fetching water and looking after sick children to other activities that improve household welfare, such as agriculture (World Bank, 2016a).

41. **Access to clean electricity and improved cooking facilities are priority focus areas under GTP and CRGE.** During the GTP II period, the government plans to disseminate 11.45 million improved cookstoves (in addition to the 8.87 million already disseminated under GTP I) and 3,600 institutional PV and 5,000 solar water heaters (MoWIE, 2015b). Environmental sustainability is linked with energy because most environmental burdens are associated with energy consumption patterns, whether for cooking, lighting, transport or industry.

2.1.4. Sustainable energy access: GTP II indicators and trends

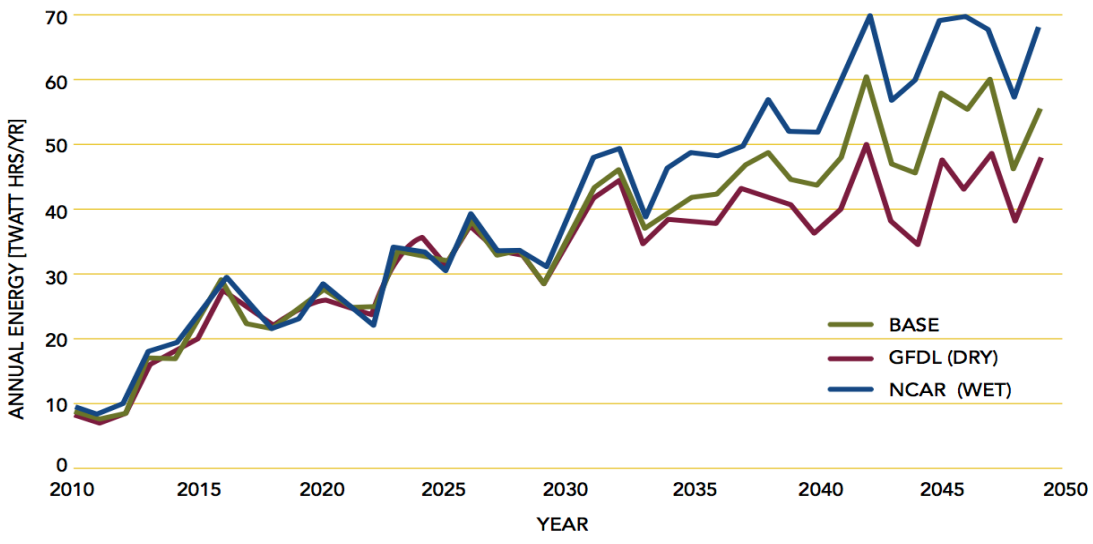
42. **Ethiopia has an abundance of low cost, low carbon energy options, but more than 90 percent of Ethiopians depend on biomass for household energy, which drives forest degradation and indoor air pollution.** Agricultural processing, industrial activity, and living conditions require reliable access to clean power. Ethiopia's grid is primarily fed by hydropower making it vulnerable to climate change. With plans to scale up hydropower, wind, geothermal and solar energy, the country aims to fulfil its own needs and export energy to neighbouring countries. It is therefore timely that the GTP II targets include a 90 percent coverage of electricity services, a rapid expansion of distribution lines and an expansion of solar home systems to areas where the grid is still inaccessible (Table 7).

Table 7. GTP II indicators for sustainable energy access

Sector and GTP II indicator	Unit	Baseline year (2014/15)	Target year (2019/20)	Remarks
Electricity service coverage (towns)	Percent	60	90	Increased access to electricity will reduce the burden on the forest as a resource base for firewood. 96 percent of the grid is hydro-powered, necessitating continued watershed protection activities, which links with land restoration activities
Customer connections (millions)	Number	2.58	6.955	Increased access to electricity will reduce burden on the forest as a resource base for firewood. 96 percent of the grid is hydro, necessitating continued watershed protection activities, which links with land restoration activities
Length of distribution line constructed	Km	13,000	22,000	Increased demand for utility poles, and increased household access to the grid which can reduce fuelwood demand
Solar home systems	Number	41,000	400,000	Lighting remote areas where grid connection cost is high

43. **Hydropower, while being the most important renewable energy source for Ethiopia, is also the most vulnerable to climate change**. Projections of climate models for Ethiopia not only predict a substantial rise in mean temperatures over the 21st century, but also suggest an increase in rainfall variability, with a rising frequency of both extreme flooding and droughts due to global warming (World Bank, 2010, p. 6). This study finds that climate change affects the mean annual energy generation but does not change the variability of hydropower generation. However, the deviations from the base scenario start after 2030 when the increasing impacts of climate change affect the fully developed hydropower sector (Figure 15).

Figure 15. Hydropower generation under different scenarios, 2008-2050 (World Bank, 2010)



Source: IMPEND – CliRun Simulations

2.2. Resilient landscapes

2.2.1 The role of integrated management of rural landscapes in building resilience

44. **This section presents the development trajectory for rural landscapes, focusing on values, achievements and plans related to such natural resource-based activities as agriculture, biodiversity, forestry, and irrigation, all of which are vulnerable to climate and environmental risks**. It is important to focus on rural areas, since Ethiopia remains a primarily rural country, with 81 percent of the population relying on smallholder agriculture as their primary income source and 86 percent of the bottom 40 percent living in rural areas (World Bank, 2016a).

45. **Integrated management is more effective than single-objective or sectoral development approaches.** An integrated approach can incorporate the perspectives of diverse stakeholders, including local communities, to address tradeoffs and conflicting priorities for resource utilization. Further, it can increase the effectiveness of specific programs. This is why the GTP II articulated the idea of an integrated approach to build upon and strengthen the sectoral successes seen in GTP I. The drawback of a single-sector approach is that, often, it insufficiently considers biophysical connections and interactions among production systems in natural resource-based sectors (agriculture, livestock, fisheries, forests, energy/fuel, and water). For example, as thousands of communities in Ethiopia have experienced, trees in agricultural landscapes can play a critical role in improving soil fertility, providing additional fodder for livestock and fuelwood for households, boosting cropland productivity, reducing water stress by reducing soil erosion, while simultaneously contributing to the diversification and enhanced resilience of farming systems. Yet, some agricultural and livestock development programs have not sufficiently considered the key role of trees in agricultural landscapes. One notable example is the ongoing effort by communities and the government to shift from open livestock access on communal lands to cut-and-carry systems, where the livestock is removed from the hillsides to stop degradation of soils and vegetation cover and instead placed in pens on individual lands. This shift addresses the land use conflict and has resulted in greater milk and protein yields, more vegetation cover on the previously degraded hillsides, and reduced pressure on adjacent land.

46. **Land and water management practices are being implemented in Ethiopia to** reduce climate risks, raise yields and lower yield variability, protect valuable soil, strengthen natural buffers against disasters, recharge aquifers, reduce sedimentation, store carbon, and generate livelihoods. These practices often have favorable cost-benefit ratios (see Section 2.2.2)

2.2.2. Natural resource-based sectors: values, achievements and plans

Agriculture and natural resources

47. **Agriculture is a main driver of Ethiopia's economic growth, accounting for almost 40 percent of GDP and more than 80 percent of the labor force, and contributing most of the foreign exchange earnings from export of goods** (FDRE, 2016b). The sector grew at an average rate of 6.6 percent per year during GTP I, and is projected to grow at 8 percent during GTP II (FDRE, 2016b). The share of agriculture and allied activities to GDP stood at about 42 percent in 2009/10 and declined to just under 39 percent in 2014/15. The share is expected to decline further to 33.5 percent in 2019/2020 (FDRE, 2016b). The decline in share of GDP represents the beginning of an anticipated structural shift from agriculture to industrial and service sectors (Figure 2). However, agricultural output is increasing despite the reduction in its share in GDP. For example, production of major crops was 18 million tons in 2009/10 which increased to 27 million tons in 2014/15. This is projected to grow to 40.6 million tons in 2019/20 (FDRE 2016b). Given the competition for a fixed area of land, an integrated land management approach requires that agricultural output increases should occur through productivity increases and measures to both reduce yield variability and cope with climate shocks.

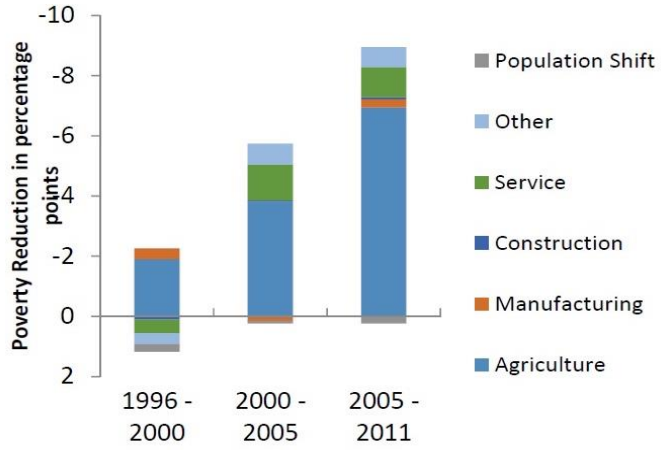
48. **Of the 39 percent of GDP contributed by agriculture in 2014/15, crop production contributed about 27 percent, while livestock contributed 8 percent.** Livestock value added is expected to grow at a slightly higher annual average rate (8.4 percent) than crop value added (8.2 percent) during GTP II. Realizing the potential of the livestock sector, a Livestock Master Plan (LMP) was developed as part of GTP II. The LMP (2015-2020) sets out investment interventions (better genetics, feed and health services), which, together with complementary policy support, could be used to implement and meet the

GTP II targets for livestock, by improving productivity and total production in the key livestock value chains for poultry, red meat, milk, and cross-bred dairy cows. In addition, the LMP argues that poultry development helps to achieve better food security, enable meat exports, and reduce greenhouse gas emissions, thus largely addressing the production-consumption gap. The poultry subsector would help achieve the CRGE target of increasing the share of chicken meat in total meat consumption from the current 5 percent to 30 percent by 2030. The substitution of the surplus chicken meat for domestic red meat consumption could therefore ease pressure on domestic meat prices and enable an increase in the export of live animals, such as cattle, sheep and goats, potentially raising foreign exchange earnings and reducing emissions by nearly 20 Mt CO2e in 2030 (FDRE, 2011). If the proposed investments in LMP of 7.8 billion ETB (US$390 million) were successfully implemented, with 57 percent and 43 percent from the public and private sectors respectively, they could eliminate extreme poverty in approximately 2.36 million livestock-keeping households, helping family farms move from traditional to improved market-oriented systems. It should be noted that this implies huge demand for livestock feed.

49. **Several empirical studies have shown the significant and direct link between agricultural productivity growth and poverty reduction in Ethiopia** (Schneider and Gugerty, 2011; Christiaensen et al., 2013; Zerfu and Larson, 2010; Dercon and Christiaensen, 2007; Abro et al., 2014). Ethiopia's Systematic Country Diagnostic (World Bank, 2016a) shows that each 1 percent of growth in GDP resulted in a 0.15 percent reduction in poverty. Agricultural growth was particularly significant because, for every 1 percent of growth in agricultural output, poverty was reduced by 0.9 percent; the agriculture sector played a key role in poverty reduction from 1996 to 2011 (Figure 16). The challenge is to maintain these gains in a future characterized by climate variability and degradation of land, forest, and water resources.

50. **To ensure that the gains are sustainable, the four agriculture sector objectives of the GTP II are:** (i) increased and market-oriented crop production and productivity; (ii) increased livestock production and productivity; (iii) reduced degradation and improved productivity of natural resources, and (iv) enhanced food security. Emphasis is given to high-value crops and livestock production, as well as enhanced market access. Productivity of major crops increased from 1.6 tons/ha in 2009/10 to 2.2 tons/ha in 2014/15; the goal is to increase productivity to 2.7 tons/ha in 2019/20. The government aims to achieve this by modernizing the sector through the extension system and sustainable agricultural technologies and practices, ensuring an integrated input supply system (e.g., fertilizer, seed), strengthening early warning systems, and considering expanding insurance coverage (FDRE, 2016b) while protecting the natural resource base to reduce environmental and disaster risk.

Figure 16. Sectoral contribution to poverty reduction in Ethiopia



Source: World Bank (2016a)

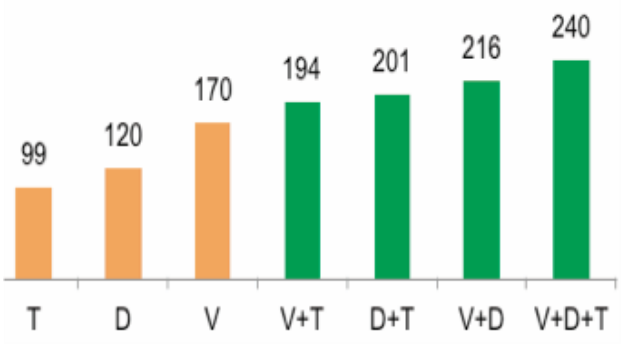
51. **Reducing land degradation and improving productivity of natural resources is a key objective of the Ministry of Agriculture and Natural Resources (MoANR), and is reflected in various sectoral and national strategies, investment frameworks, plans and programs.** Further, one of the pillars of the CRGE Strategy is for the agricultural sector to reduce emissions while building resilience. Ethiopia's

National Action Program of the UN desertification convention recognizes "land degradation, soil erosion, deforestation, loss of biodiversity, desertification, and recurrent drought" as priority issues for the country.

52. **To this end, the Ethiopian government, together with development partners, has implemented several programs at scale to boost agricultural productivity while protecting natural resources, reducing vulnerability and increasing resilience.** These activities include sustainable land management (SLM), land tenure certification, safety nets and early warning systems, small irrigation and extension.

53. **Quantitative evidence of investment in SLM practices shows increases in smallholder farmers' net income and food security, as well as improved nutrition through increases in yield, especially when SLM practices are adopted as part of a package of integrated conservation and intensification methods.** Studies show the welfare impacts of SLM and climate-smart agricultural (CSA) practices by increasing net income and food security (Teklewold et al., 2013; Kassie et al., 2015; Manda et al., 2016). The impact is greater through joint adoption of SLM and CSA (Figure 17). On average, physical soil and water conservation measures combined with fertilizer application and fodder grass have a positive net present value, but results vary across regions (Hurni et al. 2015). Schmidt and Tadesse (2014) also found that investment in sustainable land and watershed management resulted in a 24 percent higher value of production between 1992 and 2002 in the Blue Nile basin. Tesfaye et al. (2016) analyzed the net private benefits of the three most important types of soil conservation measures (soil bunds, stone bunds and fanyajuu[16]) in three watersheds in Ethiopia at farm household level. They found positive net returns, in general implying increased agricultural productivity. However, the results differed by soil conservation type. The internal rate of return was 18 percent for soil bunds, 9 percent for fanyajuu and 4 percent for stone bunds. Ayele et al. (2013) found that small-scale irrigation practices used in the Lake Tana basin increased mean annual household income by 3350 ETB (US$150) per year, a 27 percent increase over income for non-irrigating households. As results for Ethiopia and the Latin American and Caribbean region show, there are significant benefits to restoring degraded lands (Box 2).

Figure 17. Additional income from adoption of complementary SLM practices (USD/ha)



T = minimum tillage (zero or one pass);
V = improved maize varieties;
D= crop diversification (legume-maize intercropping and rotation);

Source: Marenya and Kassie (2016

16 *Fanyajuu* is a terrace bund in association with a ditch, along the contour or on a gentle lateral gradient.

Box 2. Benefits of Restoring Degraded Lands

The costs of action against land degradation are lower than the costs of inaction, by about 4.4 times over the 30-year horizon, implying that a dollar spent to rehabilitate degraded lands returns about 4.4 dollars in Ethiopia (Gebreselassie et al. 2016). For Ethiopia, the costs of action to rehabilitate lands degraded during the 2001-2009 period through land use and cover change were found to equal about US$54 billion over a 30-year horizon; if nothing was done, the resulting losses might equal almost US$228 billion during the same period.

Vergara et al. (2016) estimate the following average net benefits from restoration of degraded lands in Latin America:

- US$70 per hectare from wood forest products
- US$245 per hectare from non-wood forest products
- US$274 per hectare from agricultural production
- US$19 per hectare from food security
- US$270 per hectare from carbon storage
- US$161 from ecotourism

In Latin America, the total additional value from restoration of degraded lands is estimated at US$1,140 per hectare, on average. If 20 million hectares is restored in the region, then a net present value of US$ 23 billion will accrue over 50 years to rural communities (using a discount rate of 3 percent). The internal rate of return is estimated at 8.75 percent.

Gebreselassie et al. (2016); Vergara et al. (2016)

54. **Adopting SLM and CSA practices not only increases incomes but also boosts food and nutrition security and reduces crop failure and agro-chemical use (especially N-based fertilizers and pesticides and herbicides) in Ethiopia** (Kassie et al., 2015; Marenya and Kassie, 2016 Using panel data in Ethiopia, Marenya and Kassie (2016) found that joint adoption of crop diversification and improved maize varieties significantly increases kilogram calories (Kcal), protein, iron, and diet diversity by 27 percent, 29 percent, 50 percent and 7 percent, respectively.

55. **The net benefits of SLM practices depend on matching specific practices to local agro-ecological conditions.** For instance, Kato et al. (2011) find that stone bunds, soil bunds, grass strips, waterways, trees, and contours have positive impacts on crop output in low-rainfall areas, with grass strips having the largest impacts, while only waterways and trees have positive impacts in high-rainfall areas. Kassie et al. (2011) found that using chemical fertilizer is more productive in the high-rainfall area of the Amhara region, where the benefit is in the range of 977-1113 ETB (US$44-53) per hectare, whereas reduced tillage and stone bunds are more profitable in enhancing crop productivity in low-rainfall highland settings, such as Tigray.

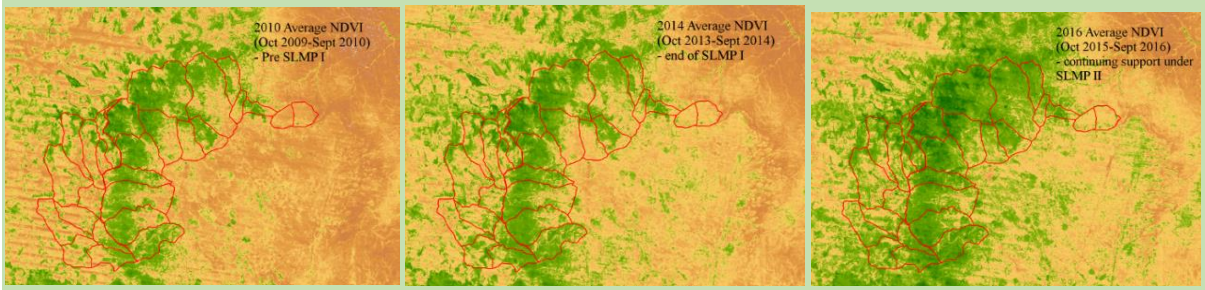
56. **The government's SLM Program is an example of a large-scale intervention that has successfully integrated natural resource management practices and land tenure** to restore the function of watersheds, reduce climate risks such as water stress, and secure resilient livelihoods (Box 3).

Box 3. The Sustainable Land Management Program

Ethiopia's SLM Program, launched in 2008 with WB/IDA financing, and support from Norway and other partners, is the government's flagship program to address land degradation and climate risks by restoring watersheds and improving land tenure. The Ministry of Agriculture and Natural Resources (MoANR) implements the program in all highland states on approximately 2 million hectares, as of 2017, benefitting hundreds of thousands of people directly or indirectly. Gedifew, a farmer in the Tind Wat micro-watershed, said that he had purchased an ox for 2,500 ETB (about US$114) (World Bank 2015). After using the fattening techniques promoted by SLMP for two months, he sold it for 18,000 ETB (US$818). He now owns an Isuzu truck which he uses to transport goods to Bahir Dar city. He has also replaced his thatched roof with a corrugated iron sheet. Now that his children no longer have to tend cattle, they can attend school.

Households that invested in SLM structures on their agricultural plots between 1992 and 2002 and subsequently maintained those structures had a 24 percent higher value of production in 2010 than farming households that did not make such investments (Schmidt et al. 2014). Integrated packages of investments show economically significant increases in household income. Teklewold et al. (2013) find that combining cropping system diversification, conservation tillage, and improved seed varieties provides the highest income (5,580 ETB/ha or US$253/ha), compared with the results of using only one or two of these practices.

In SLMP micro-watersheds in Raya Azebo and Endamehoni woredas, the change in vegetation from December 2008 to December 2016 is clear, thanks to SLM interventions in the watershed. The three images below from LandSat7 show a total of 14 percent expansion in vegetation cover in 2009/2010, 2013/2014 and 2015/2016. Three percent of the total expansion was during the extreme drought of 2015/2016.[17] The community has constructed hillside terraces and trenches, closed off degraded land to prevent livestock from overgrazing, and planted tree and shrub seedlings. They also put in place bunds, cutoff dams, check dams, percolation ponds, and deep trenches. These integrated actions have significantly stopped erosion, saved topsoil, improved surface water availability, and allowed for percolation of rainwater into the soil to replenish groundwater and spring flows that accelerate plant growth and regeneration.



Source: Schmidt et al. (2014), World Bank (2016b, 2016d), FDRE (2013), GIZ (2015a); https://www.youtube.com/watch?v=nak-UUZnvPI

57. **Improvement in land tenure through land user rights registration and certification in Ethiopia has had positive effects on (i) increased productivity, (ii) investment in land, and (iii) women's participation in the land rental market** (Holden et al., 2011; Bezabih et al., 2016, Box 4). The government is addressing this through the registration and certification of rural land. Through the SLMP, about 266,000 households have received legal landholding certificates as of March 2017. This number is projected to increase to 500,000 by the end of 2018, with the legal mapping of the number of land parcels due to reach over 2 million (4 percent of the country's total 50 million parcels of land).

58. **Land holding certification has specifically incentivized tree growing and natural resource management activities such as soil conservation (Holden et al., 2009; Bezabih et al., 2016).** Deininger et al. (2011) find that soil conservation structures on a plot increase output by about 9 percent, implying that investment-induced certification impacts are 56-87 ETB (US$2.50-3.90) per ha. Their estimates also

17 Annual average normalized difference vegetation index (NDVI) values were calculated at the pixel level (30 meter resolution) using collections of LandSat 7 imagery. Digital number values in the native imagery were converted to top of atmosphere reflectance and a masking routine was implemented prior to computing NDVI values to remove pixels containing cloud, shadows from clouds, water features and otherwise removing data which can result in unreliable NDVI estimates. Analyzing and accessing imagery was done using the Google Earth Engine developer platform.

imply that the increment in output from certification-induced investment in the first year alone could be sufficient to cover program costs (US$1/plot or US$3.2/ha). Bezabih et al. (2016) find a 4 percent higher gain in productivity due to certification for women compared to male farmers (Box 4). Positive effects of land certification include increased off-farm employment (Bezabih et al., 2015) and increased access to land for the poor (Holden et al., 2009; Gebreegziabher et al., 2009; Deininger et al., 2011). The growing (albeit from a low base) rental market permits short-term land acquisition, which enables farmers to pool resources (Teklu, 2004), provides farmers with greater flexibility in how they allocate their time and assets (enabling landholders to instead engage in off-farm income-generating opportunities), and requires limited upfront capital for farmers wishing to lease additional land (Deininger and Jin, 2006).

59. **The first level of certification**[18] **in Ethiopia is low-cost: US$1 per farm plot or US$3.5 per household** (Deininger et al. 2008). By comparison, conventional titling costs up to US$150 per household in Madagascar (Jacoby and Minten, 2007). While the gains from investment in land and natural resources, productivity, land market participation and off-farm employment are likely to be positive, further efforts are required to quantify net monetary benefits per each activity. The ongoing second-level land certification process is more technical and expensive, estimated to cost between US$5.88 and US$8.5 (Bezu and Holden, 2014; Ghebru et al., 2016). Additional benefits of second level certification can include increased tax collection and fair taxes due to more accurate measurement of land size.

Box 4. Landless youth at the intersection of land rights, landscapes and livelihoods

The intersection of land rights, management, value, and use is a key development issue for millions of rural Ethiopians, particularly women and landless youth, who face climate insecurity, water insecurity, food insecurity, and livelihood insecurity. The land registration and certification intervention helps to increase landholders' tenure security and facilitates rural land rental transaction in a better way. For example, a study of the welfare impacts of land certification and land rental in the Tigray region of Ethiopia found that, on average, welfare levels were higher for households with certificates. In addition, welfare, measured as real consumption expenditure per adult equivalent, increased by about 7 percent per year of ownership for female-headed households, and these households benefitted particularly from the possibility of renting out land (Holden and Ghebru 2013). Compared to male farmers, women received a 4 percent higher gain in productivity due to certification (Bezabih et al. 2016). (Holden and Ghebru, 2013).

In Oromia, Amhara, Southern Nations, Tigray and Benishangul Gumuz, **landless youth are benefitting from an innovative** approach to restoring land and improving land tenure security. Legal landholding certificates and extension support are given to landless youth in exchange for their restoring degraded communal lands. The project has reduced youth unemployment and incentivized good land stewardship among the next generation of community leaders, while boosting the climate resilience and carbon storage potential of the land brought back into production. By December 2016, over 740 youth groups with more than 15,000 members (40 percent female) had organized for tenure rights to over 2,850 hectares, receiving group landholding certificates or other legal documentation. The youth groups have the support of their communities as they conserve and manage the allocated degraded communal lands.

60. **Climate and weather information and early warning services help farmers and pastoralists reduce or avert impacts of meteorological and hydrological hazards.** The ability to make timely decisions that minimize or avoid loss of lives, livelihoods and property helps build resilience. Ethiopia uses drought early warning tools, such as the Livelihood Early Assessment and Protection (LEAP) tool, Livelihood Impact Assessment Sheet (LIAS), and Hotspots assessments that enable early warning during the onset of a drought. Despite Ethiopia's efforts to modernize its weather observation system, the density of observation networks remains well below World Meteorology Organization standards. The National

18 To improve land tenure security, the GoE provides landholding certificates. Under the "first-level" certification, or "Stage 1", farmers receive temporary certificates with no geo-referencing or mapping of land parcels. With the second-level certification or "Stage 2", farmers receive parcel-level certificates with maps rather than a household-level certificate. The aim is to improve the first-level certification by registering the precise geographical locations and individual land parcels using technologies such as GPS and satellite imagery (MoA, 2011).

Meteorological Agency has developed and adopted a draft station network master plan to expand Automatic Weather Stations to cover all districts, with about 700 planned for the GTP II period.

61. **Analysis shows that benefits of providing early warning services in Ethiopia outweigh the costs even under conservative scenarios** (Law, 2012, cited in WMO, 2015). Timely information about weather can help the rural poor escape poverty traps, in which a climate shock can undermine a household's efforts to accumulate capital, and to invest in productivity-enhancing inputs or human capital. Drechsler and Soer (2016) investigated the use of early warning tools as part of Ethiopia's Disaster Risk Management framework. The study showed that adverse impacts of droughts are aggravated when assistance is provided late, leading to reductions in consumption, long-term welfare losses, malnutrition, and excess mortality. By using early warning systems, it is possible to reduce these negative impacts. For instance, the integration of seasonal climate forecasts into LEAP will provide a stronger basis for applying earlier crop production and needs estimates from LEAP.

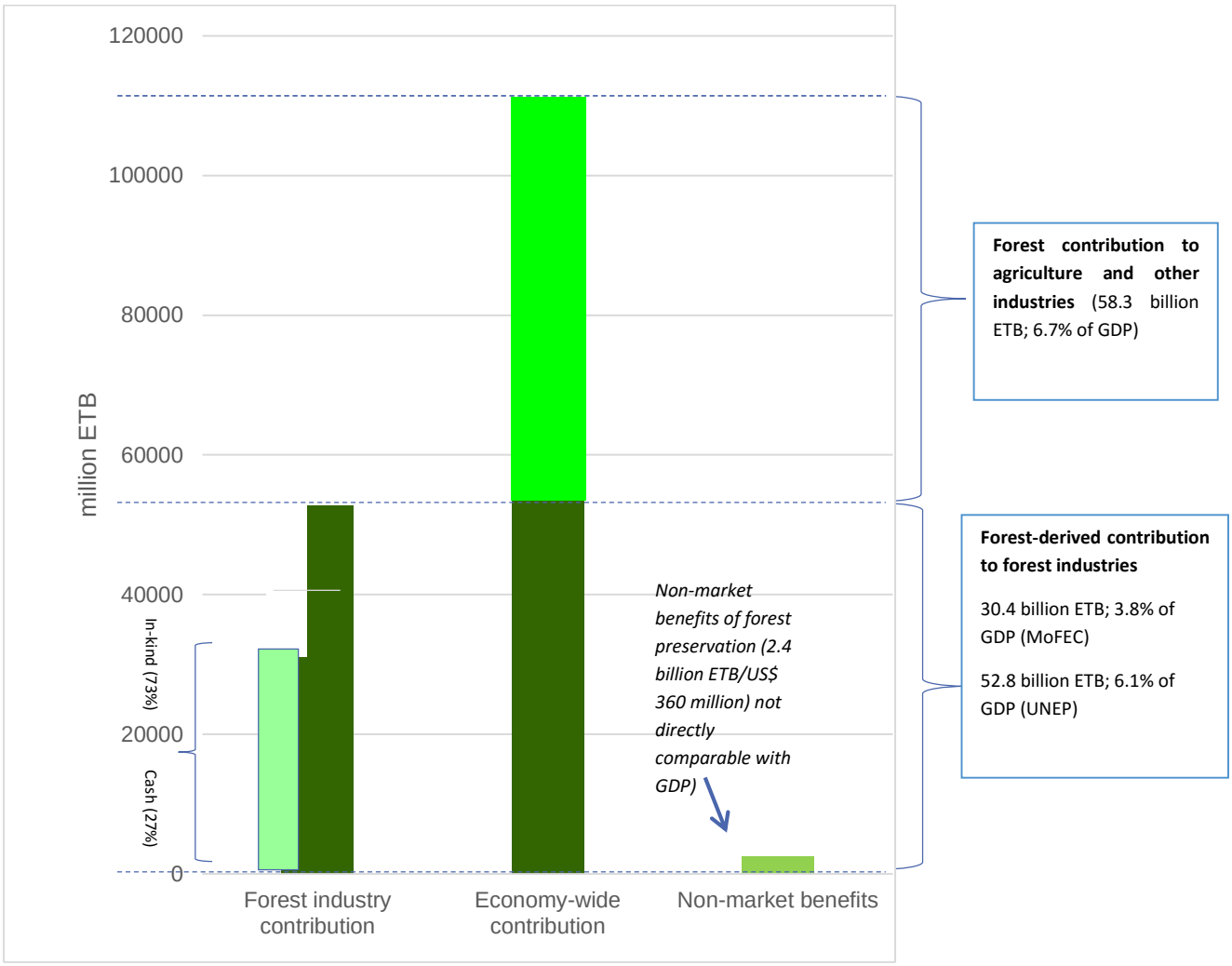
Forests

62. **Approximately 75 million people (about 80 percent of the country's population) depend directly on forests and natural resources** for a combination of income, household biomass energy, medicines, food, fodder, building materials, and water, and as their principal buffer against extreme weather events. The forest sector, although not well-developed, supports jobs for about 5 percent of the country's workforce through the production of honey, forest coffee, and timber.

63. **A key goal of the CRGE Strategy is to reduce households' dependence on biomass-based fuel (firewood and charcoal) by promoting the use of cleaner cooking technologies.** Traditional biomass (wood, charcoal, dung) accounts for more than 90 percent of total primary energy use in Ethiopian households: about 84 percent in urban and 99 percent in rural areas (Johanson and Mengistu, 2013). Reducing dependence on fuelwood is a good example of integrated planning because it can achieve multiple goals: protecting forest resources so that they can continue to provide livelihoods and ecosystems, reducing indoor air pollution, which causes about 75,000 deaths per year in the country (WHO, 2009), and reducing women's and children's time spent collecting fuelwood so they can focus on more productive activities such as schooling and income-generating activities.

64. **Ethiopia has a high potential for developing the forest sector to contribute to its sustainable growth and green economy targets.** The forest sector's direct contribution to total GDP is officially 4 percent (FDRE 2016b). However, several studies suggest this statistic does not capture the full contribution of the forest sector to the economy (MEFCC/WB, 2017). Therefore, there are several new estimates regarding the contribution of the forest sector to the economy. According to MoFEC (2015), the sector's contribution is 3.8 percent, and the CRGE strategy estimated the contribution at between 4 and 6 percent of GDP (FDRE, 2011). Preliminary findings from new studies indicate that the contribution to GDP might be as large as 12.9 percent (UNEP, 2016). The difference between MoFEC's and the UNEP report's figures is explained by the fact that important forest values, such as forest soil erosion control, forest pollination services, and tourism in protected areas, are attributed to non-forest sectors. Another factor is the underestimation of forest-derived benefits in GDP (Figure18).

Figure 18. Summary of forest contributions to the national economy, 2012-2013



Source: UNEP (2016)

65. **Ethiopia's forest ecosystems are rich in biodiversity, with 1,408 known species of fauna and 6,603 species of flora, of which 15.1 percent are considered endemic.** The country is endowed with 10 ecosystems and 18 major and 49 minor agro-ecological zones that are inhabited by a great diversity of animal, plant and microbial genetic resources, making the country one of the biodiversity hotspots of the world (FDRE, 2015). The genetic diversity of Ethiopian coffee has a significant economic value in terms of breeding potential for sustaining the world's coffee production. A study estimates the economic value of Ethiopian coffee genetic resources at between US$420 million and US$1,458 million (Gatzweiler et al, 2007). Another study estimated the value of wild coffee at US$130 million per year (Lemenih, 2009).

66. **The provisioning of ecosystem services contributes 6.7 percent of GDP and provides value-added services to other sectors, particularly agriculture (UNEP, 2016).** Ecosystem services include forest-derived fodder (30 billion ETB/US$1.36 billion); forest soil erosion control (6.6 billion ETB/US$0.3 billion); forest pollination services (5 billion ETB/US$0.23 billion); and protected area tourism (850 million ETB/ US$38.6 million). The valuation report on forests' contribution to national income (UNEP, 2016) indicated that Ethiopian forests generated economic benefits in the form of cash and in-kind income equivalent to 111 billion ETB/US$5 billion, or nearly 13 percent of GDP in 2012-2013. The largest income benefits were associated with flows of fuelwood (39 billion ETB/US$1.8 billion) and livestock fodder from forests (30 billion ETB/US$1.36 billion).

67. **Non-timber forest products (NTFPs) also play an important role in the national economy and rural livelihoods.** The main commercial NTFPs in Ethiopia are: forest coffee, honey, spices, bamboo, gums and resins. Many of these products have stable demand in domestic and international markets, providing foreign currency earnings. The total value of NTFPs is almost a billion dollars per year; forest and semi-forest coffee account for over half of this amount. (MEFCC/WB 2017). For full table, see Annex A.

68. **The total gross production value of roundwood amounts to US$370 million** (MEFCC/WB 2017). The demand for Ethiopian forest products shows a substantial increase in industrial roundwood consumption, from about 8 million m^3 in 2013 to about 16 million m^3 by 2033 (MEFCC/WB, 2017).

69. **The national energy balance is dominated by wood fuels (fuelwood and charcoal), which account for more than 90 percent of the country's household energy supply.** The Ethiopian Forest Sector Review (WB/MEFCC, 2015) estimated the value added of woodfuel in the economy to be US$1.9 billion, equivalent to about 4 percent of GDP in 2013. **However, Ethiopia's wood consumption is not sustainable. The total wood consumption for 2013 was 124 million m^3, of which 116 million m^3 was fuelwood extracted illegally and unsustainably (MEFCC, 2015).** As Ethiopia's economy and population continue to grow, total wood product demand will increase by about 27 percent by 2033, reaching 158 million cubic meters annual consumption by 2033 (MEFCC/WB 2017). Under a BAU scenario, the supply from sustainable fuelwood forests, which stood at nearly 61 percent in 2013, will decrease to 36 percent in 2033, with more than 55 percent coming from unsustainable fuelwood forests the same year (MEFCC/WB, 2017).

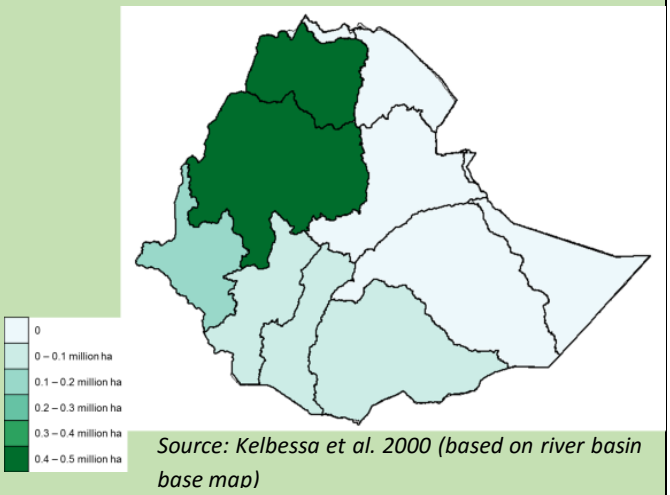
70. **Already, with demand for wood and other forest products exceeding domestic supply, imports are growing (MEFCC/WB, 2017).** In 2013, Ethiopia consumed around 124 million cubic meters of wood (MEFCC, 2015). A substantial amount (about US$25 million per year) of foreign exchange is spent on the import of wood products that could have been produced domestically (ERCA, 2015). Ethiopia also imports unprocessed wood and non-wood products, which are vital inputs for the furniture and construction industries. With population and economic growth, total wood product demand will increase by about 27 percent over the next 20 years, reaching 158 million cubic meters annual consumption by 2033 (MEFCC/WB, 2015) under a BAU scenario.

71. **On the plus side, Ethiopia leads the African continent in developing bamboo, with an estimated one million hectares of natural bamboo forest, representing around two-thirds of Africa's total bamboo reserves** (Mekonnen et al., 2014; Kassahun, 2015). The bamboo potential is illustrated in Box 5. According to FAO (2005), the country can sustainably produce three million cubic meters of dry weight annually. It is estimated that over US$1.2 billion can be generated every year if the country's bamboo resource base is properly utilized (INBAR, 2010). Ethiopia is also an attractive place to manufacture bamboo products because the raw material bamboo costs less in Ethiopia compared to other bamboo manufacturing countries. For example, for the year 2015, the cost of production of bamboo in Ethiopia was EUR 15 per m^2, compared to EUR17 per m^2 in China. Moreover, Ethiopia supports export-based businesses through low taxes and beneficial regulations, enabling the country to sell products at a lower cost than competitors in China (from where most bamboo is imported). The GTP II has targeted the preservation and utilization of 0.7 million ha of bamboo forests.

72. **Despite the potential, the Ethiopian bamboo industry remains underdeveloped and suffers from degradation, forest fires and unsustainable utilization practices.** According to the draft bamboo subsector strategy framework (BAS SF, 2009), the Ethiopian bamboo sector is composed of mainly farmers and rural cottage industries. Ethiopia also spends unnecessary foreign exchange on the import of bamboo and rattan that could have been produced domestically.

Box 5. Bamboo promotes inclusive and green development

Ethiopia's bamboo forest is comprised of two native species, namely, highland bamboo (*Yushaniaalpina*) and lowland bamboo (*Oxytenantheraabyssinica).* Traditionally seen as the "poor man's timber," Ethiopia is putting this non-timber forest product (NTFP) at the center of its CRGE Strategy and is supported by the SLMP-2 operation. Bamboo is now considered an important, fast-growing strategic intervention for afforestation and reforestation in the mountainous and degraded areas of the country. The country has addressed bamboo development in the Bamboo Sector Strategy Framework (2009) and the Short and Medium-Term Strategic Plan of Bamboo Development 2013-2015 (2012). Bamboo provides a wide range of environmental services (from landscape and forest restoration to carbon sequestration). It also provides livelihood services and brings new job opportunities and income through micro-enterprises run by rural communities and women's cooperatives and small and medium-sized businesses. These are created by local entrepreneurs and larger companies producing high-value-added products for export.



Source: Kelbessa et al. 2000 (based on river basin base map)

73. **Deforestation is being driven by land conversion. To achieve targets set for the growth of the agriculture sector from 2010 to 2030, crop land expansion of 3.9 percent per annum is required under a BAU scenario (FDRE, 2011).** The total area of cropland in 2011 was estimated at 12.6 million hectares. By 2020, this will increase to 18.5 million hectares and, by 2030, 27 million hectares. It has been estimated that 60 percent of each hectare of cropland increase on average comes from encroachment into forest. This estimation is confirmed by the detection of the land use that replaces forests after deforestation, assessed by Ethiopia's National Forest Monitoring System (FDRE, 2016c). Open woodland (27 percent), agriculture (24 percent) and grassland (23 percent) are the main land uses replacing forest land.

74. **The Government of Ethiopia has made far-reaching commitments to develop the forest sector, devolve its management, and increase the forest cover**. The GTP II sets out to (i) increase forest cover from the current 15 percent[19] to 20 percent; of this forest cover, about 16 million ha is natural forest, of which 19 percent, or 3 percent of total land area, is high forest, and the remainder is plantation (IFC/WB, 2016); (ii) double its contribution to GDP, from 4 percent to 8 percent; (iii) increase rehabilitated degraded areas from the current 11.7 million ha to 22.5 million ha; and increase watershed management from the current 12.2 million ha to 41.4 million ha (FDRE, 2016b, see Annex A for more data). In the longer term, the GoE targets 22 million hectares for broader landscape restoration by 2030, in line with the CRGE ambitions: afforestation on 2 million ha, reforestation on 1 million ha, and improved forest management of 2 million ha of high forests and 2 million ha of woodlands, to be achieved by 2030 (FDRE, 2011).

75. **Forests play a key role in providing livelihoods and reducing emissions. As such, REDD+[20] is one of four key initiatives within the CRGE Strategy which will help fast track implementation of forestry activities with significant reduction in emissions. (FDRE, 2011).** The initiative aims to reverse the current deforestation and forest degradation trends by tackling the major drivers and to protect and increase the economic and ecosystem services that forests provide.

19 Ethiopia's 15.5 percent forest cover is calculated based on the Government's adoption of a new forest definition in February 2015, as follows: "Land spanning at least 0.5 ha covered by trees and bamboo, attaining a height of at least 2m and a canopy cover of at least 20 percent, or trees with the potential to reach thresholds *in situ* in due course" (MEFCC, 2016).

20 REDD+, a UN initiative on climate change, stands for Reducing Emissions from Deforestation and Forest Degradation, and (+) the role of sustainable management of forests, conservation and enhancement of forest carbon stocks in developing countries.

76. **Forests are an important part of Ethiopia's emissions reduction targets.** Ethiopia's Nationally Determined Contributions (NDC) emission reduction target by 2030 is 255 $MtCO_2e$, compared to the BAU emission of 400 $MtCO_2e$. Of this, 130 $MtCO_2e$ would be reduced by the forestry sector. In short, the forestry sector would be responsible for approximately 50 percent of the national emissions target.

77. **Trees on farms are one of the most important mitigation actions being taken by rural people to counter deforestation and degradation while simultaneously contributing to their livelihoods.** In Ethiopia, 38 percent of all rural households have at least one tree on their land, and more than half of Ethiopian farms are located within 10 km of forestland (using a 30 percent tree cover threshold), implying opportunities for holistic landscape management approaches (Miller et al., 2016). The same authors compared real per capita consumption levels (2011 purchasing power parity) among tree-growing households and non-tree growing households, controlling for district-level effects, and found that tree cash crop growers were substantially better off on average (84 percent) than non-tree growing households. In degraded forests, people cultivate tree cash crops (32 percent), mainly coffee (65 percent of total tree cash crops) and *chat* (34 percent of total tree cash crops), and one in six farmers report growing fruit trees (Miller et al., 2016). Bluffstone et al. (2015) report, for example, that 70 percent of households grew Eucalyptus in the six districts they surveyed.

78. **In September 2014, Ethiopia declared its support for the New York Declaration on Forests and the Bonn Challenge by pledging to restore 15 million hectares of degraded and deforested lands (nearly one-seventh of the country's total area) by 2025. This would achieve the CRGE goal of annual emission mitigation of 130 Mt CO_2e from forestry**. The National Tree-Based Landscape Restoration Potential Map, a collaborative project between the MEFCC and the World Resources Institute, has assessed and mapped tree-based restoration potential at the national level. The study identified 10 Forest Landscape Restoration options[21], used eight prioritization criteria, and categorized the options by their level of urgency. Priority 1 calls for a very urgent response for 11 million ha; Priority 2 for an urgent response for 18 million ha; and Priority 3, a moderately urgent response for 25 million ha.

Wildlife and ecosystem services in protected areas

79. **Ethiopia's protected areas account for an estimated 14 percent of the country's land (FDRE, 2015d) and generate substantial tourism opportunities and ecosystem services.** These areas, found throughout the country's diverse landscapes are vital for the maintenance of biological diversity, forest resources, and water provisioning services, and can contribute to economic development. A recent study estimated the value of ecosystem services provided by protected areas[22] to be around US$325 million/year (Van Zyl, 2015). Safari tourism, eco-tourism and recreational tourism contribute to the country's economy. For example, visitor numbers to federal protected areas managed by the Ethiopian Wildlife Conservation Authority (EWCA) increased from roughly 12,800 in 2001 to 83,700 in 2014 (Van Zyl, 2015) although this dropped during 2016 with the state of emergency.

80. **The annual economic value of federal PAs[23] is estimated at US$1.5 billion (EWCA, 2009).** EWCA estimates the value of biodiversity to be up to US$112 million per annum (Table 8).

21 Options identified are: (i) Restoring degraded forest land, (ii) Restocking of degraded natural forest, (iii) Agro-forestry (agri-silviculture, silvo-pastoralism, agrosilvo-pastoralism), (iv) woodlot, (v) commercial plantation, (vi) tree-based buffer zones along river banks and boundaries of water bodies, (vii) tree-based corridors between biodiversity hotspots, (viii) tree-based corridors around religious forests, (ix) tree-based urban green infrastructure (urban parkland, road-side tree planting, buffer zones around water bodies, protected forest, etc.), and (x) road-side trees (outside of urban areas).

22 The following ecosystem services were chosen as the focus of valuation: grazing; harvesting of natural products; harvesting of medicinal plants; watershed protection and water provision; carbon sequestration; pollination and pest control; tourism and recreation; existence and cultural values (Van Zyl, 2015).

23 The newest parks are not included in this calculation and the size of PAs is estimated at 14% of the country's area.

Table 8. Estimates of values of different services of Protected Areas in EWCA managed areas

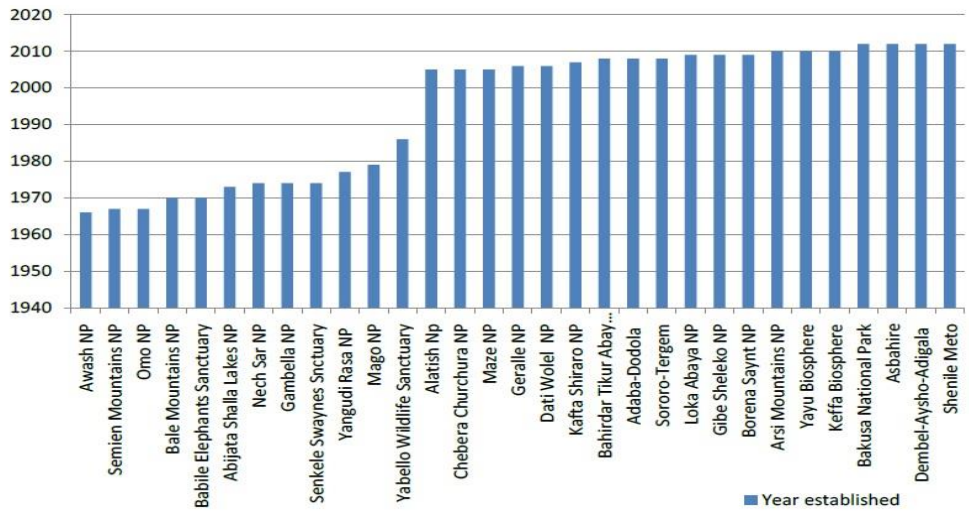
Services type	Values (in million USD)
Biodiversity	112
Watershed	432
Carbon sequestration	938
Total	1,482

Source: EWCA, 2009

81. **Ethiopia's biodiversity and ecosystem services, with their great importance to the livelihoods of poor people, are under pressure.** The National Biodiversity Strategy and Action Plan (NBSAP) describes both direct and indirect causes for biodiversity loss (FDRE, 2015). Among the direct causes are conversion of natural forests, grazing lands, woodlands and wetlands into agricultural land and settlement; unsustainable utilization (overgrazing, harvesting, hunting) of biological resources; invasive alien species, which compete with native species for feed and habitat and alter the physical environment in ways that exclude native species; climate change; replacement of farmers' varieties and breeds; and pollution (solid and liquid). The indirect drivers include demographic change, poverty, and low levels of awareness and lack of coordination among multiple stakeholders working on biodiversity.

82. **Protected areas face major threats that negatively impact biodiversity conservation, ecosystem services and eco-tourism.** Many protected areas in Ethiopia are threatened due to settlement within the parks or adjacent to them (Awash, Simien Mountains, Bale Mountains, Abijata-Shalla, Nechisar, Gambella, Mago, Omo); crop cultivation (Abijata-Shalla, Bale Mountains, Gambella, Siemen Mountains); grazing (Abijata-Shalla, Awash, Bale Mountains, Mago, Nechisar, Omo, Senkelle, Siemen Mountains, Yangudi-Rassa); deforestation (all parks and sanctuaries); mineral extraction (Abijata-Shalla); forest fires; and invasive species (Amare, 2015; EWCA, 2009). Land use changes through agriculture, rural and urban development activities have led to the decline and alteration of wild areas, resulting in the threats of extinction of wildlife species and natural areas that serve as their habitat. Due to accelerated degradation and deforestation, protected areas can also become significant sources of carbon emissions leading to net costs to society on the order of ETB1.8 billion/(US$80 million)/year (Van Zyl, 2015). To conserve wildlife genetic resources, Ethiopia has established different types of protected area systems. These include national and regional parks wildlife sanctuaries, reserves, and hunting areas; controlled hunting areas; botanical gardens; biosphere reserves; national forest priority areas; etc. (see Annex A for details). Ethiopia is one of a few countries where the establishment of protected areas is increasing (Figure 19).

Figure 19. Protected area expansion in Ethiopia



Source: Amare (2015)

83. **Cognizant of the problems of biodiversity loss, the GoE has put in place plans and institutional and legal frameworks.** Ethiopia has ratified international and regional treaties, including the Convention on Biological Diversity (CBD), the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the African-Eurasian Migratory Waterbird Agreement (AEWA), and the Nagoya Protocol (in 2012). The country also prepared the first National Biodiversity Strategy and Action Plan (NBSAP), implemented between 2005 and 2010, to guide national efforts in conservation, sustainable utilization and fair access (through benefit sharing). The second NBSAP is currently under implementation in 2015-2020 with national targets to be considered when determining the spatial priorities to establish and safeguard protected areas, reduce agricultural expansion, increase forest cover, and manage wetlands.

Water resources and irrigation

84. **Because competition over water will increase dramatically, water allocation across sectors is vital to ensure efficient, equitable and sustainable utilization.** Water demand has been increasing over time, mainly due to population growth and increase in incomes. However, water is usually priced inefficiently, with water tariffs seldom covering the costs of providing water. Competition over water is likely to become more serious due to climate change, economic growth, and urbanization. Water demand for domestic use tends to increase with a more urbanized, richer, and growing population. Increasing temperatures are likely to increase demand for water, while projected increased weather variability will likely stifle supply. While increasing supply from groundwater is an option, the high cost of doing so necessitates high-value uses. A related issue is the water balance of river basins, which requires analysis with the objective of addressing deficits that could arise partly because of uncoordinated and unplanned use of water resources.

85. **Water is a key input for agriculture, industrial growth and electricity generation.** Since climate affects water access in many ways (e.g., precipitation, soil moisture, and transpiration), the government's climate resilience strategy for water and energy identifies four priority areas: power generation, energy access, irrigation and access to water, and sanitation and hygiene. Integrated development and conservation of water resources has the potential to meet competing demands for agriculture, industry, human health, energy production, and ecosystem health.

86. **Ethiopia is often called the water tower of East Africa, but the water is not necessarily readily accessible to its population.** Average surface water flows are estimated at 122 billion m^3 per year, while renewable groundwater is estimated to be at least 2.6 billion m^3 (World Bank, 2006; Awulachew et al., 2010). This gives a theoretical average of 1575 m^3 of physically available water per person per year. However, estimates of groundwater potential differ. For example, Kebede (2012) estimates 1,000 billion m^3, while MacDonald et al. (2012) find the best estimate for groundwater storage to be 12,700 billion m^3. Though endowed with significant groundwater potential, Ethiopia may become physically water scarce by 2020, when per capita water availability falls below 1000 m^3 per person per year due to rapid population growth (Stacey et al., 2008).

87. **The average water availability conceals major variation over time and between locations.** Rainfall across much of the country is both highly seasonal–with most of the rain falling in a single, short season–and exceptionally variable and unpredictable. The highest mean annual rainfall (more than 2,700 mm) occurs in the southwestern highlands, and then gradually decreases in the north (to less than 200 mm), northeast (less than 100 mm), and southeast (less than 200 mm) (EPCC, 2015b). Between 80 percent and 90 percent of the country's surface water resources are found within four major river basins located in the west and southwest of the country, where only 30-40 percent of the population resides. The east and central river basins, which are home to 60 percent of the population, have only 10-20 percent of the country's surface water resources (GFDRR 2011; Ndaruzaniye, 2011; UN Water 2013). The Tana Beles operation and the Nile Basin Initiative have developed many tools and approaches to support basin management (Box 6). In developing the country's water resources, key management challenges are therefore the extreme hydrological variability across location and time. Variability is most obviously manifest in recurrent, devastating droughts and floods. Less apparent is the broad range of impacts that variability and seasonality have on the Ethiopian economy, even in good rainfall years.

Box 6. Tana Beles Integrated Water Resource Development Project (TBIWRDP)

The TBIWRDP was started with the development objective of developing enabling institutions and investments for integrated water resources planning, management, and development in the Tana and Beles subbasins to accelerate sustainable growth. The project, which closed in 2016, resulted in the treatment of over 79,000 hectares with improved natural resources management practices, such as soil and water conservation, afforestation, and rain-fed agriculture improvement. Over 219,000 beneficiaries benefited directly from the land treatment and small-scale irrigation, and many income generation and livelihood improvement activities were undertaken, 50 percent of them by women. Because of the project, more than 44,000 land users adopted sustainable land management practices. In addition, the achievements of the project include:

- Tana and Beles subbasin organizations established and equipped with analytical tools;
- Hydrographic Information Systems, including weather radar, installed and integrated into the basin monitoring systems;
- A flood management information system developed and used routinely;
- 12,000 ha of farm area with improved irrigation through rehabilitation of small scale irrigation;
- 740 community drinking water facilities developed; and
- 50 percent reduction in sedimentation in the 163 targeted micro-watersheds.

The Lake Tana/Beles area illustrates the inter-dependence and trade-offs of resources and the resulting need to apply an integrated watershed management approach that takes into account various activities, including irrigation dams, large-scale hydropower production, fishing and tourism, agriculture with resulting soil erosion, land degradation, and siltation of watercourses and reservoirs, as well as increasing local storage of water for small-scale irrigation purposes and livestock, in competition with management of wetlands and other ecosystems.

Source: World Bank (2016c); and SEI (2014)

88. **Projections of climate models for Ethiopia suggest an increase in rainfall variability, with a rising frequency of both extreme flooding and droughts due to global warming.** A 2010 World Bank study on the economics of adaptation to climate change in Ethiopia presents two extremes given the underlying uncertainties that are modeled. Over the period 2045-2055, one scenario shows reductions in average annual rainfall of 10-25 percent in the central highlands, 0-10 percent in the south, and more than 25 percent in the north of the country. The second scenario shows increase in average annual rainfall of 10-25 percent in the central highlands and the south and more than 25 percent in most of the rest of the country. The actual outcome is likely to be in this range, but with increasing severity and frequency of extreme weather events.

89. **Irrigation contributes 4 percent of the total GDP and 12 percent of the agricultural GDP** (Hagos et al., 2009). At the end of GTP I, 2.4 million ha (out of 5.3 million ha of potentially irrigable land) had been developed, using small-scale irrigation. Problems in the irrigation sector include (i) high inefficiency in water use (efficiency loss) in many of the irrigation schemes, with only 30 percent efficiency; (ii) the distribution between head- and tail-end users; (iii) loss of volume of water captured because of siltation from unsustainable land management in the communal areas; (iv) absence of sustainable financing mechanisms for operation and maintenance of the schemes and infrastructure; and (v) weak irrigation institutions and local capital in irrigation schemes.

90. **GTP II plans to irrigate more than 0.9 million ha using medium- and large-scale schemes and 1.8 million ha of small-scale schemes.** While both small- and large-scale irrigation are increasing, their environmental challenges are not properly addressed. The land for potential irrigation expansion, for example, is often already in productive use (Dowa et al., 2008).

91. **Since more than 80 percent of drinking water supply comes from groundwater, sustainable management of groundwater remains a key priority** (MoWIE, 2015b). Groundwater has major advantages over surface water in terms of climate resilience because of the storage capacity of groundwater aquifers (MacDonald et al., 2012). The large storage volume means that groundwater is less sensitive to annual and inter-annual rainfall variability and therefore provides vital insurance against rainfall variability and longer-term climate change. Widespread availability, higher water quality and lower development costs provide additional benefits. A key challenge for better use of groundwater is lack of knowledge on the amount and distribution of the resource (World Bank, 2013; MoWIE, 2015b). A target in GTP II is therefore to raise the coverage of groundwater information[24] from 10 to 25 percent through groundwater studies and preparation of hydrological maps that include quality and distribution of groundwater (MoWIE, 2015b).

92. **Wetlands in Ethiopia cover a small area, estimated at 22,600 km^2 or around 2 percent of the total surface area of the country.** The 12 major wetlands are concentrated in the southwest parts of the country (EPCC, 2015; MOWIE, 2015b). These are among the most productive ecosystems, and they are assessed to have immense economic, social, and environmental benefits (EBI, 2014), although there has so far been insufficient effort to quantify their total economic value. The absence of policies and strategies specific to wetlands remains a key challenge to promote their conservation and protection. However, wetland-related issues are reflected in different policies and strategies of sectors such as water management policies, land administration policies, agricultural and natural resource management strategies, and biodiversity conservation policies. In the GTP II, the government plans to develop a wetland management strategy to tackle challenges including uncontrolled conversion of wetlands into agricultural and grazing lands, using them as waste disposal sites, overexploitation, water diversion, climate change, pollution and invasion of alien species (FDRE, 2015d; Gebresellassie et al, 2014; Amsalu and Addisu, 2014).

Climate change and rural vulnerability

93. **Climate change could reduce Ethiopia's GDP by approximately 10 percent by 2050 compared to 2010 (World Bank 2010).** There has been a warming trend in the annual minimum temperature since the early 1960s of about 0.37^{0}C every 10 years and rainfall variability is common (NMA, 2007). Future climate variability and change may accelerate already high levels of land degradation, deforestation and forest degradation, loss of biodiversity, desertification and water and air pollution (NMA, 2007). In response, Ethiopia's climate resilience strategies for (i) agriculture and forest and (ii) water and energy are mainstreamed to varying degrees with the aim of significantly reducing vulnerability to climate variability.

94. **With a heavy dependence on rain and the low income of farmers and pastoralists, Ethiopian agriculture has high vulnerability and limited resilience to the effects of climate change.** A review of studies shows vulnerability to rainfall risk to be the most cited constraint to welfare and growth in rural incomes (World Bank 2016a). A rainfall shortage of 30 percent generally leads to decreased agricultural income by 15 percent and increased poverty by 13.5 percent (Hill and Tsehaye, 2014; World Bank, 2016a).

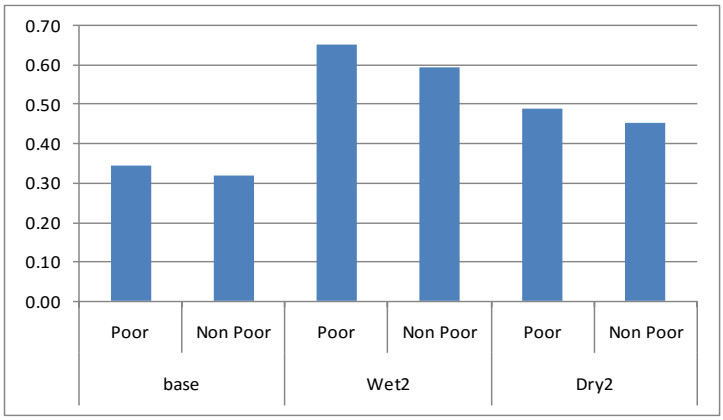
95. **Ethiopia is already suffering from the effects of climate variability and change, including extreme weather events such as drought and flooding**. Compared with its structural peers which have suffered nine droughts over the last 50 years, Ethiopia has suffered 15 drought episodes. (World Bank 2016a).

96. **The country faces increasing variability in crop and livestock production under various climate scenarios, with more pronounced effects likely to materialize in later decades, and greater relative impact on the poor** (World Bank 2010). There will likely be large yield deviations in barley, wheat, maize and sorghum for the various scenarios. The simulations indicate that many regions of Ethiopia will face decreases in crop productivity. While crop yields decrease in general, the wet scenarios tend to be better than dry scenarios, although floods become damaging, especially in the final decade considered,

24 Information coverage refers to groundwater studies that show distribution and quality of the country's groundwater resources by producing hydrological maps. In GTP I, the groundwater study focused on a 95,000 square meter area and aimed at producing a hydrogeological map at a scale of 1:50,000 in order to raise the coverage from 3 percent in 2010 to 22.7 percent in 2015. However, the actual mapping coverage was about 10 percent at the end of GTP I.

i.e., the 2040s (World Bank 2010, p. 59). In all the scenarios considered, severe impacts on livestock incomes are projected, with falls in income ranging from 55 to 80 percent of baseline levels (pp. 34-5). Income variability is higher due to climate change (with dry2 and wet2 scenarios considered) compared with the baseline (base); and the variation is more for the poor than for the non-poor (Figure 20).

Figure 20. Coefficient of variation of year-to-year growth rates in household consumption due to climate change (baseline compared with dry2 and wet2 scenarios)



Source: World Bank (2010)

97. **Adaptation to climate change, as well as mitigation, therefore continues to be an important focus for the Ethiopian government** (FDRE, 2015b, FDRE 2015c). Adaptation is addressed through sector-based climate resilience strategies. Work done to rehabilitate landscapes/watersheds has led to greater resilience, and further scaling up can achieve the country's adaptation/resilience ambitions, while also generating a climate mitigation benefit from carbon storage in biomass. The government's climate resilience strategy for agriculture and forest identifies 41 key adaptation options. The climate resilience strategy for the water and energy sectors identifies three focus areas for irrigation: (i) accelerating irrigation plans; (ii) supporting the Ministry of Agriculture and Natural Resources by improving data from the National Meteorological Agency; and (iii) balancing water demands.

98. **The net benefits of adaptation are large, with benefit-cost ratios of up to 5 or more for agricultural, land, and water interventions. The variability in the growth of agricultural GDP could be restored to close to the baseline scenario through adaptation.** Annual average adaptation costs for 2010-2050 for measures such as irrigation, drainage, and research, development, and extension were estimated to be almost US$70 million. Even so, the benefits of adaptation do not fully offset the negative impacts of the climate change scenarios considered, showing the need for additional measures to close the "welfare gap" due to climate risk (World Bank 2010).

99. **Turning to mitigation, in the CRGE Strategy the plan is to keep total GHG emissions by 2030 at the level of 2010, implying a reduction of emissions from 400 $MtCO^2e$ in 2030 under the BAU scenario to 250 $MtCO^2e$.** Since the agriculture and forestry sectors contribute most of Ethiopia's GHG emissions, and because the industrial sector is expected to grow, most of this reduction is expected to come from agriculture and forestry. The projection for 2030 with a BAU scenario shows that the combined contribution of agriculture and forest to overall GHG emissions will decrease from 87 percent in 2011 to 69 percent (FDRE 2011) due to the increase in the share of other sectors. The CRGE Strategy also presents estimates of costs of achieving targets of both mitigation and adaptation (FDRE 2011, 2015b, 2015c). Woolf et al. (2015) found that a package of targeted watershed management activities improved soil organic carbon stocks up to 300 percent compared to BAU, and the second SLM Project is on track to accumulate nearly 9 million tons of carbon dioxide equivalent in biomass from watershed restoration works on over 1 million hectares from 2014-2018.

100. **Vulnerability to climate change can also be reduced through safety nets.** Ethiopia's Productive Safety Net Program (PSNP) is recognized as a model for providing food and cash payments to households suffering from food insecurity in return for labor to rehabilitate watersheds and build community infrastructure. In addition to the targeted benefits of food security and infrastructure development, PSNP's participatory watershed management interventions, while not the primary

objective, are delivering climate benefits. The GTP II expects an increase in the number of safety net recipients from 3.4 million people in 2014/15 to 8.3 million in 2019/20 (FDRE 2016b).

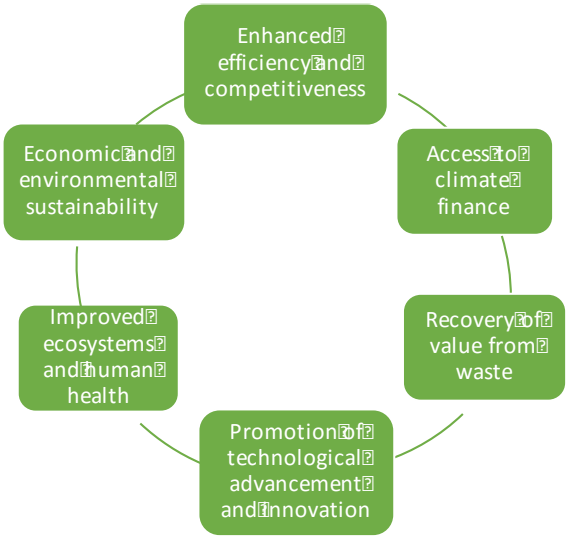
101. **The discussion on resilient rural landscapes is linked to greening industrialization, sustainable urbanization and living conditions, and sustainable energy production,** discussed in the rest of this chapter. Links to greening industrialization include sustainable supply chains and value chains (leather, flowers, food, furniture, medicines, timber, electricity and renewable energy production, and breweries) and water for industrial use (mining, factories). The links to sustainable urbanization and living conditions include the labor transition (discussed later in this chapter), water for urban supply, indoor air pollution and groundwater recharge. Links to sustainable energy production include fuel crops, watershed restoration (which facilitates small hydro and run-of-river turbines for mini-grid development) and reduction of sedimentation of large reservoirs, because sedimentation reduces the service life of hydropower dams and increases dredging costs of irrigation canals.

2.3. Greening Ethiopia's industrialization

102. **Achieving the CRGE vision requires a green industrialization trajectory that addresses emerging problems of pollution while costs are low.** The fact that Ethiopia's industrial sector is still in its infancy is an opportunity to avoid the 'pollute-now-clean-later' trajectory adopted by industrialized nations. Realizing such a vision requires sustainable production: the manufacturing of goods and services using processes and systems that are non-polluting, conserving of energy and natural resources, economically viable, socially rewarding, safe, and thus consistent with sustainable consumption.

103. **Pursuing a green economy path in the industrial sector offers several practical advantages for Ethiopia, such as enhanced efficiency and competitiveness; recycling; improved ecosystems and human health; and promotion of technological advancement and innovation** (UNDP, 2011; Hailu, 2007; Mamo, 2012) (Figure 21). For the industrial sector, implementing a green economy strategy helps ensure sustainability, increased productivity and efficiencies. By contrast, a traditional path of industrialization would result in high dependency on carbon-intensive materials, expensive infrastructure and energy- and material-intensive solutions. Box 7 illustrates an innovative production technology that converts waste to value.

Figure 21. Potential benefits of sustainable industrial production



Box 7. Converting waste to value

Hailu (2007) used the waste-to-energy principle through anaerobic digestion of tannery wastes to estimate the amount of biogas that can be generated from all tanning industries. The study found that a total of more than 4 million m^3 of biogas with 3 million m^3 of methane can be generated per year. This could cover about 67 percent of the fossil fuel needs of the tanning industry and help to mitigate 100 percent and 67 percent of methane and carbon dioxide, respectively. Similarly, Mamo (2012) carried out experimental work on biodiesel production from tannery wastes and showed that biodiesel of acceptable quality can be produced from fleshing oil generated from tannery solid waste. Biofuel produced from industrial waste can help green the sector as well as reduce import dependence. Moreover, it will enable firms cut down on expenses and increase their revenue from exporting green products.

Source: UNECA (2016)

104. **Ethiopia has formulated an Industrial Development Roadmap (2013-2025)** that envisions building an environmentally-friendly industrial sector which is diversified and globally competitive, with the highest manufacturing capability in Africa. To move the country along this trajectory, GTP I laid the foundation for industrialization through large public investment in infrastructure, including clean energy sources, namely hydropower and wind. Ethiopia's vision for green industrialization is in line with the global promotion of inclusive and sustainable industrialization as part of the 2030 Sustainable Development Goals.

105. **The CRGE Strategy explicitly aims to reduce the industrial sector's GHG annual emissions to 50 Mt CO_2e in 2030 from the BAU trajectory of 71 Mt CO_2e**. This represents a reduction of about 30 percent of BAU scenario emissions compared to the absence of abatement measures.

106. **The CRGE Strategy also indicates the abatement potential of specific industrial subsectors.** The cement industry constitutes around 70 percent of the identified industrial abatement potential. The main greening activity in the cement industry is substitution of clinker—a product produced because of energy-intensive heating and cooling of a homogenized raw materials mixture during the first stage of cement production–which involves 5 Mt CO_2e of abatement. Upgrading to more energy-efficient technologies and waste heat recovery systems would also provide savings of up to 6 Mt CO_2e, while use of biomass would reduce GHG emissions by 4 Mt CO_2e in 2030 (FDRE, 2011). Other industrial subsectors, including chemicals, fertilizer, textile, leather, paper and pulp, account for an abatement potential of around 6 Mt CO_2e in 2030 (FDRE, 2011). Moreover, the industrial sector can benefit substantially from low-carbon interventions (due to cost savings resulting from reduced fuel expenditure as energy consumption per unit of production decreases) (FDRE, 2011).

107. **TP II also states specific targets for the development of eco-industrial parks with waste treatment technologies and energy efficiency in factories**. The expectation is that industrial parks will boost manufacturing while safeguarding the environment. There are currently three industrial zones in Ethiopia, two owned by the government (Hawassa Eco-industrial Park, discussed in Box 8, and Bole-Lemi Industrial Zone I) and the other owned by the private sector (Eastern Industry Zone). The government has plans to build about 14 industrial parks with a total area of 5025 ha (www.ipdc.gov.et). The main industrial groups eligible to be established in these industrial parks are textile and apparel, agro-industries (including food processing, furniture and others), pharmaceuticals, electronics and vehicle assembling.

108. **The private sector has a critical but nascent role to play in the industrial sector through job generation fostering technological transfer and innovation, and enhancing productivity and competitiveness.** The GTP II targets building industrial parks and resolving the finance and market challenges faced by small and medium-scale enterprises (discussed further in Chapter 3). Attracting FDI is a key strategy for the government.

Box 8. A closer look at the Hawassa Eco-Industrial Park

In Hawassa, 275 km south of Addis Ababa, Ethiopia recently inaugurated the flagship Hawassa Eco-industrial Park. This is part of the country's ambitious plan to develop world-class Industrial Parks (IPs) to become the hub of light manufacturing industries in Africa.

Hawassa Eco-industrial Park could address the challenges of industrial pollution and waste water treatment. As an Eco-park, Hawassa mostly utilizes renewable electricity sources (hydroelectricity) and fully implements energy and water conservation strategies, including maximization of natural lighting and ventilation, fitting of low-consumption bulbs, recycling of water, and solar-powered LED street lights. Hawassa Eco-industrial Park also has a world-class Common Effluent Treatment Plant (CETP) equipped with 'Zero Liquid Discharge' technology. The treatment plant has the capacity to treat 11,000 m^3 of liquid wastes per day. In addition, 30 percent of the delineated park area is being covered by greenery, including trees and grass.

To ensure sustainable and reliable electricity, a 50MW transmission station will be expanded to 200MW. To ensure water supply, deep underground wells have been built. These initiatives will solve the electricity and water shortages, the main challenges faced by existing industries in Ethiopia. In addition to power from the grid, the park will produce energy from waste. For instance, Africa Bamboo, one of the companies that has rented facilities in the park, will produce its own electricity from bamboo biomass. Moreover, it is expected that other upcoming industrial parks in Ethiopia will implement similar or better technologies of waste management and energy efficiency.

Source: Personal communication during field visit to the park.

109. **In addition to establishing new green industries, the government of Ethiopia also plans to green existing industries**. Plans include building industrial zones with a common waste disposal system and moving existing industries to 'eco-industrial villages.' One example is the planned construction of a common effluent treatment plant (CETP) for tanneries in Modjo town, which will require over US$42 million for proper waste treatment. After constructing the treatment facility, an industrial zone (tannery village) for leather factories will be established at an estimated cost of US$58 million. The village is designed with the aim of spatially concentrating leather factories. Because of the high environmental impact of leather factories (including wastewater and toxic chemicals emissions to the surrounding streams, soil, and air), concentrating these impacts in one place will make it easier to manage them. About 31 medium and large tanneries are expected to move to Modjo or set up their own disposal systems at their current location. As well as the CETP, the leather district will include a landfill for solid waste disposal and treatment, a chromium recovery plant, chemical supply services, and conversion of by-products to valuable products, with the goal of both decreasing the amount of solid waste and producing marketable goods. In addition, the plan targets safely removing about 200 tons of dangerous chemicals and cleaning 50 polluted areas.

110. **Ethiopia's green industrialization policies and strategies have mainly focused on the medium and large-scale industries, with limited focus on Micro and Small Enterprises (MSEs).** The CRGE Strategy mainly targets greening cement, mining, and textile and leather industries due to their larger contribution to industrial GHG emissions. However, MSEs are important sources of employment in Ethiopia and the government actively supports their development. At the same time, MSEs pollute more per unit of output, compared to larger enterprises, which entails a significant cumulative environmental load due to the large number of MSEs (Kent, 1991; Hillary, 2000). MSEs are also less able to adopt clean technologies due to limited resources, knowledge, and technical capabilities. There is therefore a need to devise mechanisms for greening MSEs while fostering their contribution to the economy. A key entry point could be the development of MSEs that focus on green jobs, as well as linkages with industrial parks.

111. **Greening Ethiopia's industrialization will entail greening its growing mining sector.** Under GTP II, mining has the highest annual growth rate target of all industrial sectors, both in terms of volume and quality: it is supposed to grow by 32 percent per year. The cumulative target for export earnings through mining has been set at US$6.16 billion for the entire GTP II plan period (2015-2020)—an amount around three times higher than the sector's contribution of US$2.62 billion during the first planning period (FDRE, 2016b). If not well-managed, this planned expansion of mining activity is likely to cause negative impacts on the environment. Moreover, GTP II includes development of a long-term master plan for the sector, and adoption of international best practices including for environmental management and community development near mining sites.

112. **The informal nature of small-scale mining activity poses challenges for environmental management, although there is high potential for land rehabilitation**. The fact that 80 percent of Artisanal and Small-scale Mining (ASM) operations are still unregistered, the majority of ASM sites are unmapped, chemical use is unrecorded, and pollutants go unmonitored make it difficult to understand the impact of these operations on land and water. Despite the challenges pertaining to informal small-scale mining, there is still potential to rehabilitate abandoned sites to become productive land again.

113. **The most important extracted mineral in the country is gold and ASMs is a major contributor to its production in Ethiopia**. Gold has been produced from placer deposits for several thousand years, and there is currently a large-scale hard-rock industrial mining operation at Lega Dembi, which is the only modern primary gold mine in Ethiopia (EEITI, 2014). ASM contributes two-thirds of the total gold production in Ethiopia (World Bank 2014a, b). Table 12 is a snapshot of artisanal mining in Ethiopia. According to the EEITI ASM report from 2016, almost 1.3 million people are engaged in ASM. Out of these, 1.1 million people are engaged in gold mining. Indirect beneficiaries are estimated to be 5 million to 7 million people (MoMPNG/EEITI ASM, 2016).

Table 9. Major mining locations and estimated number of artisanal miners

Region	Zones	Number of woredas	Estimated Miners	Major Minerals
Amhara	North Wollo, North Shewa	5	18,660	Opal
Benishangul Gumuz	All zones	13	110,950	Gold
Oromia	Guji, Kelem Wallega, West Wallega, Borana	13	650,200	Gold, Tantalum
SNNPR	Mizan, Sidama,	4	320,100	Gold
Tigray	Northwest Tigray	5	160,000	Gold
Total		40	1,259,910	

Source: MoMPNG/EEITI ASM, 2016

114. **Over the next 20 years, medium- and large-scale mining is likely to be focused on gold, potash, tantalum and copper.** Ethiopia has ample resources of potash, a resource that is extracted by highly water-intensive methods. Several potash horizons are recognized, although only the uppermost have been explored. Afar has a potential of 1.3 billion tons of potash (Geological Survey of Ethiopia, 2012). Exploration has confirmed the presence of two ore bodies at the Danakil Depression where two companies are currently active. However, the absence of mining success stories coupled with the unavailability of reliable geological data makes it difficult to attract new investments (World Bank 2014a).

115. **Industrialization, urbanization and energy production are closely related processes with intertwined trajectories.** Industrialization is a key driver of urbanization, and, likewise, green industrialization needs to be an important driver of sustainable urbanization. Green industrial development can be an important means to improve urban livelihoods through the creation of green and productive jobs. It also facilitates economic transformation because it absorbs labor from agriculture and other primary sectors. At the same time, achieving green industrialization and sustainable urbanization requires a reliable supply of clean energy. Yet the challenges to realizing this vision of a green trajectory are significant, as Chapter 3 will explore in more detail.

2.4. Sustainable urbanization, transport and living conditions

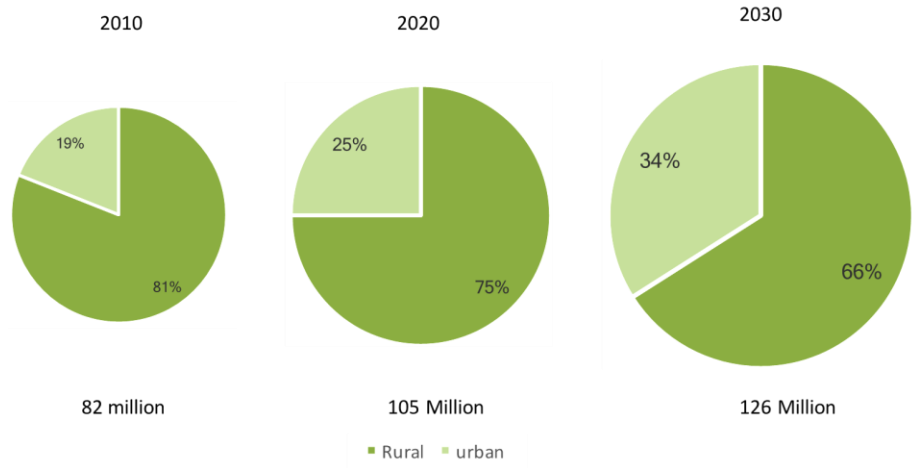
Sustainable mobility and transport

116. **Although Ethiopia is one of the least urbanized countries in the world–only 19 percent of people live in urban areas–the country is undergoing a rapid urbanization trajectory of 5.4 percent per year, making it among the top 10 most rapidly urbanizing countries in the world** (Godfrey and Zhao, 2015; World Bank, 2015). Ethiopia's rapid urbanization is being fueled by rural-to-urban migration, the development of rural villages into towns, and expansion of existing urban centers to surrounding rural areas. More than 73 percent of the urban migrants are from rural areas, indicating high

levels of rural-to-urban migration. The total number of rural to urban migrants has increased from over 5.6 million in 2007 to over 12.2 million in 2015, over one-third of whom are youth.

117. **Different push and pull factors contribute to the urbanization trajectory: population pressure, poverty, and shortage of agricultural land, as well as increased employment and educational opportunities in urban areas** (e.g., Ezra and Kiros, 2001; Atnafu, 2014; Hunnes, 2012). Migration to urban areas of Ethiopia is also affected by the job opportunities created in development projects or "megaprojects" near resources such as water, minerals and land. Migration to new megaprojects such as industrial parks will also become more significant in turning small towns or rural areas into cities. On average, these projects are expected to result in 163,000 additional urban residents each year, and their share of the total annual urban population growth will range from 22 percent (2015) to 16 percent (2032). If the industrial development plans envisioned in GTP II are put into action, this is expected to pull rural residents into urban centers at an increasing rate–which is important for rural resilience as well, given rural land shortages and stress on the natural resource base. **Error! Reference source not found.** 22 and Table 13 summarize these trends.

Figure 22. State and trend of Ethiopia's urbanization and total population



Source: Calculated using data from World Bank, 2016e and CSA 2007

118. **Ethiopia's rapid urbanization is also a result of the on-going "upgrading" of rural villages into towns, as well as expansion of city boundaries.** Rural villages are being upgraded into towns in each region based on criteria established by regional Bureaus of Urban Development and Construction, including: (i) over half of the population are engaged in non-farming activities such as petty trading or service provision; (ii) most of the residents in the area are benefiting from facilities such as electricity, piped water supply, telephones, schools, and health services; (iii) the total population living in the location is 2,000 and above; and (iv) the area is believed to have potential for economic growth and attraction of migrants to engage in non-farm activities.

Table 10. State and trend of Ethiopian urbanization relative to Africa

	Percent of people living in urban areas	Annual urban population growth rate
Ethiopia	19	5.4
Africa	40	1.1

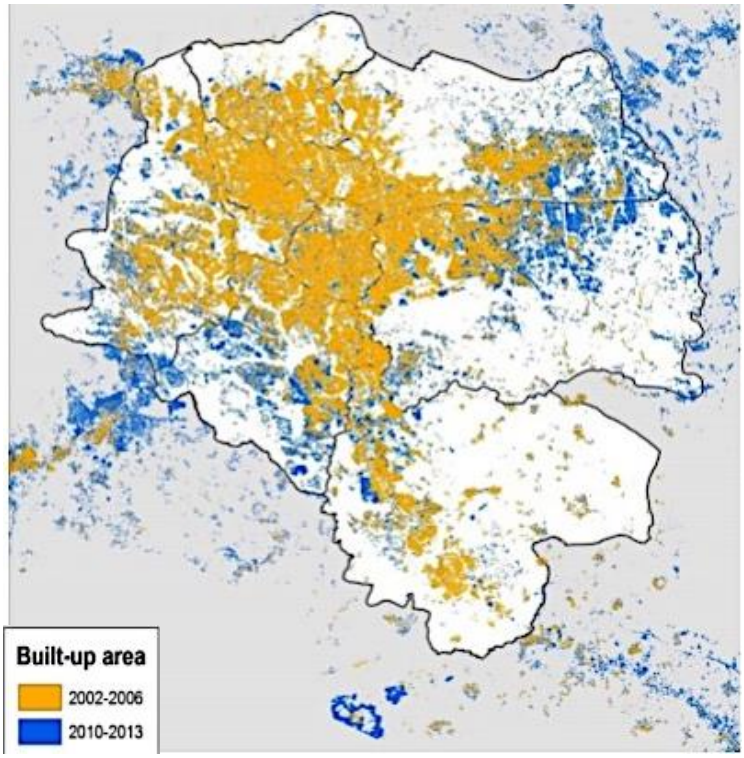
Source: United Nations Department of Economic and Social Affairs (UNDESA) World Urbanization Prospect (2015)

119. **Rapid urbanization, combined with an unbalanced rate of providing social services, jobs and infrastructure, presents numerous social and environmental risks.** These growing problems include pollution (water, air, and noise), urban sprawl, solid and liquid waste management problems, illegal settlements and loss of open green areas (see Annex A for a summary of the existing evidence on different aspects of pollution in Ethiopia). Without effective management, Ethiopia's rapid urbanization

can result in an urban structure that is dysfunctional in design and inefficient, unsustainable and unequal, further resulting in environmental degradation, resource depletion, failure to keep up with demand for infrastructure and failure to take advantage of the economies of agglomeration (NCE, 2015).

120. **The rapid sprawl of Ethiopia's cities is resulting in considerable land use change and degradation around urban centers.** Built areas are expanding in Addis Ababa as well as in secondary cities. In and around Addis Ababa, the total urban agglomeration envelope is expanding horizontally beyond its administrative boundaries. Much of the land that was developed during the period 2007-2014 in Addis Ababa is on the fringe of the existing built-up area and just outside the administrative boundary (see Figure 23). The core of the urban agglomeration envelope (both the built-up area and urbanized open space) now extends more than 50 kilometers across. From 2006 to 2013, this core grew by 59 percent, and captured open space increased by 162 percent (World Bank, 2015a). The rapid expansion of urban areas is not a phenomenon limited to Addis Ababa.

Figure 23. Urban Expansion in Addis Ababa [World Bank (2015d)]



121. **Urban green areas are under extreme pressure in Ethiopia's urban centers.** Addis Ababa in particular is undergoing fundamental changes. In a detailed account of *Urban Morphology Type (UMT)* change in Addis Ababa, Cluva (2012) shows marked losses in agriculture (loss of 4,719 hectares or 9.1 percent) and vegetation (loss of 1,440 hectares or 2.7 percent) between 2006 and 2011. Out of the overall land cover, an estimated 15 percent of the evapo-transpiring surfaces were also lost during that interval.

122. **Well-managed urbanization can contribute to a more resilient trajectory for Ethiopia's economy, rural landscapes and natural resource-based productive sectors.** Ethiopia's population will be more than 170 million by 2050. If the economic and livelihood structure does not change, a dire shortage of agricultural land in the rural areas, especially in the densely populated highlands, seems inevitable unless structural transformation of livelihoods and incentives takes place. The problem of climate change is likely to exacerbate this challenge.

Sustainable mobility and transport

123. **Ethiopia's envisioned structural transformation will bring about a large increase in the demand for mobility of people, goods and services, implying the need for a rapid expansion of capacity in the transport sector.** Ensuring that this expansion occurs in a manner consistent with the country's green growth goals will challenge the capacities of policy makers and implementing institutions at national, regional, and municipal levels. At present, even with low motorization rates, transport in Addis Ababa is characterized by substantial delays and high variability in travel times. Largely, this is due to poor city planning. Public transport in the capital and in most major cities is dominated by small, mini-bus taxis and three-wheeled vehicles in ways that do not facilitate reinvestment and improvement of vehicles, and discourage use of larger vehicles to reduce vehicle kilometers of travel (VKT).

124. **An increase in VKT is inevitable if the goals of the GPT II and CRGE Strategy are to be realized,** but the key policy questions addressing sustainable mobility are (i) how rapidly will VKT increase (that is, how viable are non-motorized trips, and what is the mix of vehicles providing motorized trips and tonne-value movements), and (ii) how "clean" will each vehicle kilometer traveled be? These characteristics in turn depend on how aggressively urban transport and development policy manages the

growth in private vehicle use, how effectively national policy shapes the vehicle fleet (that is, motorization management) over time, and how effectively the commercial transport industry develops into a mature industry.

125. **Urban transport is dominated by walking, small cars, mini-bus taxis, and three-wheelers.** In Addis Ababa, walking was estimated to account for 54 percent of all trips in 2011, and most of the public transport movements were made by mini-bus taxis. Anbessa, the city's public transport operator, accounted for only 32 percent of trips. Outside Addis, urban trips by three-wheelers are prevalent.

126. **Motorization in Ethiopia has occurred in a non-structured way.** Growth in the number of private vehicles in Ethiopia has historically been restrained by high import barriers and lack of availability of foreign exchange. Even with such constraints, anticipated motorization growth in the next 40 years is expected to be exponential. The World Bank projects the total stock of vehicles to grow by 106 percent between 2015 and 2025, and by 307 percent between 2015 and 2035. If either the import barriers are reduced or hard currency becomes more predictably available, the vehicle stock could increase further.

127. **Improving the efficiency of the commercial transport sector is critical to fulfilling the vision of GTP II and CRGE.** Getting the commercial transport sector, for both passengers and freight, to function more efficiently and professionally is not only necessary to reap the benefits of highway and urban transport investments, it is also key to having a more energy-efficient sector, in two main ways: First, more efficient organization of the sector enables better usage of vehicles, reducing the ratio of vehicle kilometers to passenger trips or ton-value movements; second, it enables operators to better accumulate capital to invest in new and more fuel-efficient equipment.

128. **Road freight transportation has increased rapidly in Ethiopia and is expected to continue increasing by more than 13 percent annually from 2011 to 2030, despite high fuel prices and limited availability of foreign currency.** Demand for passenger transport is also expected to increase by approximately 9 percent annually (EPCC, 2015a). According to Ethiopia's CRGE Strategy, the freight transport in ton-km is estimated to grow from 23 billion to 279 billion between 2010 and 2030 because of the rapidly growing economy. Mining and construction transport is also expected to grow from 3 billion ton-km to 34 billion ton-km. Passenger transport, expressed in passenger-km, is expected to grow from 40 billion in 2010 to 220 billion in 2030, driven mainly by an increasing population, a strong urbanization trend, and growing GDP per capita (FDRE, 2011).

Sustainable living conditions

129. **Despite the economic progress made over the past decade, Ethiopia still needs to accelerate the positive trends of providing basic services for sustainable living conditions.** Both rural and urban households face significant gaps in access to clean water and sanitation (Table 14), waste management, and clean energy for cooking and lighting.

Table 11. Access to water and sanitation 1990-2015

		1990	2000	2015
Improved water source *(percent of population with access)*	Rural	3	19	49
	Urban	84	87	93
	National	13	29	57
Improved sanitation coverage *(percent of population with access)*	Rural	0	6	28
	Urban	20	23	27
	National	3	9	28

Source: World Bank (2016e)

130. **Clean and sustainable energy consumption is also a key component of sustainable living conditions**. The energy sector in Ethiopia is dominated by traditional sources (fuelwood, charcoal, crop residues and animal dung), which constitute more than 90 percent of the total energy consumption (Samuel, 2014). On the other hand, modern energy sources (petroleum products and electricity) have only minimal shares, despite a recent increasing trend. Increased access to electricity has great potential to improve the quality of life, and is also domestically produced from renewable sources (except for an insignificant amount of diesel-generated electricity).

131. **In 2005, the GoE launched the ambitious Universal Electricity Access Program (UEAP) with the specific objective of providing grid-based electrification to rural towns and villages.** While UEAP constitutes one of the most significant grid expansion programs in Africa, the focus has so far been on connecting towns and villages, rather than on household connections. Between 2005 and 2015, the grid expanded to about 6,000 towns and villages from the initial 667, reaching 60 percent of the towns in the country; however, the household electrification rate remains quite low, at about 15 percent (2.58 million connections). Over 60 million people have no access to electricity–the second-highest access deficit in Africa.

132. **Despite tangible results, electricity access remains far below GoE targets (see Section 2.5), constraining economic growth and social development.** While significant improvements have been achieved under GTP I in terms of transmission infrastructure, last-mile connections to households have not kept pace with the rapid network expansion. In fact, until recently, the GoE defined electricity access targets based on coverage of the network rather than connection to or use of electricity services. By the end of GTP I, only 2.58million customers (about 15 percent of households) were connected to the network (60 percent of the target envisioned under GTP I), while the network coverage reached 60 percent of the population. Connections have lagged for several reasons, including the absence of a least-cost, nation-wide and comprehensive roll-out program and dedicated resources to provide electricity connections to all households, economic centers, schools and clinics, as well as capacity constraints at the utility level in planning for access expansion and handling a growing customer base. Rolling out connections is a top priority; it is also a high-impact, low-hanging fruit to be reaped in areas already served by the network. The resulting gap has led to increased vulnerability of households to fall back into poverty, with increasingly negative impacts on the economy. The GoE now recognizes the need to focus on connecting households and has shifted the country's energy access paradigm from network access to actual connectivity. With GTP II, the GoE has put strong emphasis on a rapid scale-up of electricity connections in areas that are already within the immediate and short-term reach of the network, with the goal of increasing connections to almost 7 million households. It has also put forward ambitious off-grid targets.

133. **The GoE has made proper management and administration of ongoing urbanization one of the pillars of the GTP.** In GTP I, reductions in poverty and unemployment were set as objectives for urban development. GTP II targets include green infrastructure and recreational areas increasing to 30 percent, waste collection and disposal coverage touching 90 percent in 75 urban centers, and building of 750,000 urban residential units, and creation of other infrastructure and jobs. Further, the plan aims to carry out strategic planning of urban centers to develop an effective and well-functioning urban system, including high-density areas, mixed neighborhoods, high-capacity public transport and smarter, more efficient buildings and utilities. These urban development activities are expected to stimulate and drive economic growth, while reducing both poverty and carbon emissions. A new urban productive safety net program (UPSNAP) has been developed to alleviate poverty among the urban poor. The program aims to provide access to effective safety nets and livelihood services for the poor in 11 urban areas.

134. **Solid and liquid waste management are part of government policy.** The draft revised multi environmental policy (2016) aims to promote waste reduction, sorting and separation at sources; establish facilities and incentives for cleaner production, waste recovery, recycling and re-use; and establish proper liquid waste management systems and facilities. Ethiopia adopted a solid waste proclamation as federal law in 2007; it mandates safe, designated waste sanitation areas for people and the environment, household separation of recyclables, and community-level waste management plans. In addition, conversion of waste to energy is now being tested to efficiently manage waste (see Box 9).

Box 9. The Reppie Waste to Energy Project

The Reppie Waste to Energy (WtE) facility is 80 percent complete, having started full construction in September 2014. When completed, the project will process over 1,400 tons of waste every day and produce over 185 GWh/year of electricity to the Ethiopian national grid.

The Reppie WtE project, producing green energy within city limits from municipal solid waste, is the first of its kind in Ethiopia. as it. Similar to other power plants (but using trash rather than coal, oil or natural gas), the fuel is burned in an environmentally sustainable manner, in a composition chamber to heat tubes of water in boiler walls. The water is heated until it turns into steam, which is then used to drive a turbine generator that produces electricity.

For over 45 years, the Reppie site has been used as an open dump and has served as the only landfill site for Addis Ababa. The WtE project is expected to improve the sanitary situation in the local area by remediating the site, preventing the odor produced from the landfill, and reducing flies and pests. It is also estimated that 46,500 tCO_2e of emissions every year can be avoided through methane capture and flaring.

Source: http://www.africawte.com/about.html

Reppie Dumpsite

135. **Ethiopia is also implementing the national Water, Sanitation and Hygiene (WaSH) program.** The program is designed to fulfill Target 10 of Millennium Development Goal 7 (MDG 7), which is to reduce the proportion of the population without access to water and sanitation by 50 percent in 2015, thereby improving the overall health and socioeconomic conditions and quality of life of the population, especially children and women.

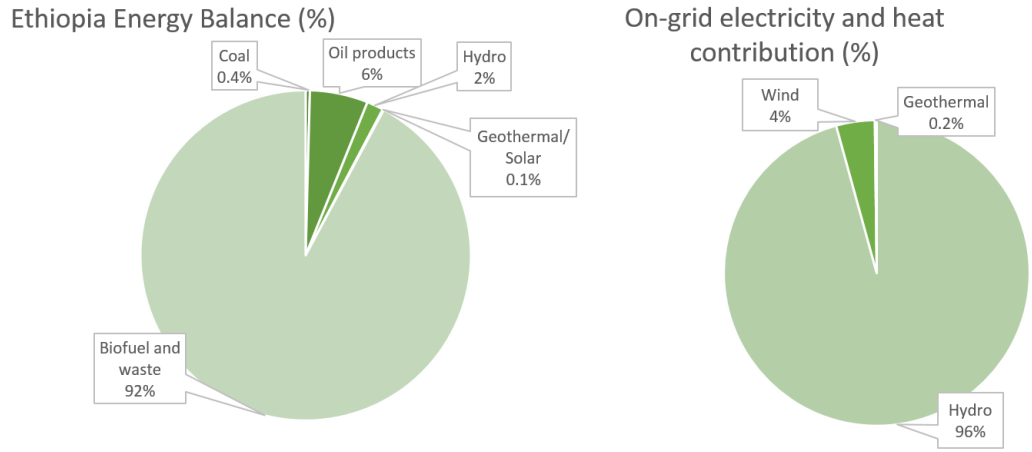
2.5. Sustainable energy production

136. **Energy is the golden thread that connects environmental sustainability, economic growth and social equity**. Sustainable production of modern energy is critical to achieve the ambitious goals of the CRGE and GTP. Investment in modern and sustainable energy is necessary for the resilience of rural landscapes as well as realizing a green and sustainable structural transformation. The resilience of rural landscapes is thwarted by the fact that rural households degrade forests for fuelwood (charcoal and firewood) because they lack access to modern, cleaner cooking fuels. As discussed above, such fuels account for over 90 percent of household energy use in Ethiopia (Johanson and Mengistu 2013). The realization of green industrialization and sustainable urbanization–as well as reducing deforestation and natural resource degradation depend on whether there is sufficient access to affordable clean energy**.**

137. **Ethiopia has huge renewable energy potential**, **and the country's CRGE ambition hinges heavily on exploiting this potential.** Figure 24 shows an overview of Ethiopia's energy balance and the grid electricity shares of wind and hydropower. Only a limited amount of the country's hydropower, wind, solar and geothermal potential has been exploited. For example, less than 6 percent of the hydropower

potential is exploited (Table 15). There is a huge opportunity to expand clean energy production in Ethiopia in both capacity and fuel choice, and this is a government priority.

Figure 24. Energy Sources in Ethiopia



Source: International Energy Agency. Ethiopia 2014

138. **The GoE is planning to prepare a National Electrification Program Implementation Roadmap.** This roadmap will (i) lay out a detailed roll-out and financing plan to achieve the scale and speed of connections necessary to meet the GTP II and NEP targets (over 1 million annually) and beyond (for the ultimate achievement of universal access) (ii) systematically guide the sequencing for both grid and off-grid investments in a coordinated manner across space and time (iii) emphasize, in the short term, the potential offered by densification in sites where the network can support new connections and a significant waiting list already exists.

139. **Ethiopia sees itself as one of the frontrunners in global efforts to improve sustainable energy production and access.** The 2013 plan of the Ministry of Water, Irrigation and Electricity (MoWIE) had the objectives of achieving the following by 2025: (i) ensure universal access to electricity services; (ii) ensure universal access to cleaner and more efficient cooking solutions; (iii) improve energy efficiency; and (iv) diversify the contribution of renewable energy to Ethiopia's energy matrix.

140. **Electricity demand will continue to increase as Ethiopia's economy further develops.** Currently, according to the Ethiopian Electric Power Company, the country produces about 10 TWh of which almost 96 percent comes from hydropower, 4 percent from wind, and less than 1 percent from geothermal and thermal sources (IEA, 2016). Large investments have been made in sources including the Ethiopian Grand Renaissance Dam with a generation capacity of about 6,000 MW, to add a total of 8,000-10,000 MW production capacity. But demand is also projected to increase significantly. For example, Hifab (2012) used the following historical annual growth trends of electricity consumption to project demand in 2022: domestic sector (8.5 percent), commercial sector (7.6 percent), Low Voltage industry (11 percent), and High Voltage industry (7.4 percent). With these assumed growth rates, electricity demand will increase by about 130 percent in 2022 compared with the level in 2012.

141. **In response to the spike in demand, the GoE has made major strides in increasing its generation capacity, which has quadrupled within a decade from about 850 MW to more than 4000 MW**, almost all of it from hydropower. Large-scale hydropower projects, most notably the Grand Ethiopian Renaissance Dam (GERD 6,000 MW) and Gibe-III Hydropower Project (1,870 MW), are at advanced stages of construction or nearing commissioning. Under GTP II, the GoE aims to have over 17,000 MW of installed capacity by 2020.

Table 122. Energy potential and exploited percentage by source

Energy source	Exploitable	Exploited (%)
Hydropower(MW)	45,000	< 6
Solar (Kwh/m^2)	5.5	< 1
Wind power (GW)	1350	< 1
Geothermal	7,000	< 1
Agricultural waste (million tons)	15-20	30
Natural gas (billion m^3)	113	0
Coal (million tons)	300	0
Oil shale (million tons)	253	0

Source: Ethiopian Panel on Climate Change (2015b)

142. **The GoE intends to scale up its solar, wind, and geothermal power generation capacity, to mitigate the risk of overreliance on hydropower, by involving the private sector.** In July 2015, the GoE signed its first Independent Power Purchase (IPP) Agreement for the construction and operation of 500 MW power from the Corbetti geothermal source. A draft regulation to adopt a public-private partnership (PPP) model for power generation in the country has been prepared to support sustainable financing of these large infrastructure projects. The GoE is also preparing a transparent and competitive procurement framework (auction-based bidding process) for private sector investments (independent power producers, IPPs), which would be key in ensuring viable development of these clean energy sources. In October 2016, the GoE contracted with IFC Advisory Services to advise EEP on developing up to 500 MW of solar power generation capacity, to be financed and implemented by private sector developers within the framework of the World Bank Group's Scaling Solar program framework.

143. **Ethiopia has increasingly focused on developing the biofuel sector as part of its renewable energy drive.** The main modern biofuel produced in Ethiopia is ethanol, as a by-product of the ongoing expansion in sugar factories. The GoE's plan is to substitute some share of biomass and mostly kerosene with ethanol for cooking, thereby reducing forest degradation and indoor air pollution. In addition, blending ethanol with petrol could reduce petroleum imports, saving foreign currency. During the GTP II, the GoE aims to produce 1.29 billion liters of ethanol and construct five additional ethanol plants. Although not yet produced in the country, biodiesel has long been promoted in Ethiopia and has now been included in the GTP II. Africa Power Initiative Limited has been planting oil seeds such as jatropha, castor, croton and candle nut trees for the last 5 years on 240,000 ha of degraded land in Tigray, with an estimated feedstock capacity of almost 200 million liters of biodiesel in 2017. During the GTP II period, GoE plans to construct six biodiesel production plants with a production target of 212 million liters. The plan is to use 82 million liters of biodiesel for blending, 22 million liters for household energy and 107 million liters for other sectors. The developments in the biofuel sector, despite a complex set of trade-offs, have significant potential to contribute to the CRGE goals. Concerns remain including the high costs, the potential of economies of scale and lack of real success stories of commercial biodiesel production in Africa.

144. **Ethiopia is also focusing on the development of off-grid energy systems,** partly to increase the total supply of energy not only to clear the backlog of household connections but also to reach remote areas which will never be connected by the grid. Solar technology is among the most attractive low-cost, off-grid options that can provide the basic electricity needs of households, local communities and small businesses in rural areas. Lighting Africa, a World Bank initiative, supports Ethiopia by mapping the markets and supporting businesses that enter the off-grid sector, setting standards and clearing customs, and supporting consumer awareness campaigns for better lighting systems.

145. **Since 2012, the Development Bank of Ethiopia (DBE) has managed the Market Development for Renewable Energy and Energy Efficient Product Credit Line, to provide access to finance to promoters of remote off-grid renewable energy programs.** The credit line covers loans for technologies such as standalone solar home system, solar lanterns, biogas, small wind and various improved cookstoves. The credit line includes two financial components: one supports the working capital requirement of project developers like Private Sector Enterprises (PSEs) and Small and Medium Enterprises (SMEs), and the other provides on-lending support to microfinance institutions (MFIs) for lending to households. Additionally, technical support to MFIs and a consumer awareness campaign have been added to this program. More than 500,000 solar products have reached customers through this program since its inception.

3. Challenges in the enabling environment for resilient green transformation

146. **The CRGE initiative demands environmental transformation in the four clusters—landscapes, industries, cities, and energy. However, there are several challenges in the enabling environment that affect the degree to which this transformation can be achieved. Chapter 3 analyzes the enabling environment:** The starting point is a review of the regulatory framework for environmental management, with attention to key issues such as coordination and the environmental impact assessment (EIA) system. Additional challenges in the enabling environment are then identified for each of the four clusters and organized according to institutions, incentives (including policy), information and investment. These "four eyes" will also provide the organizing principle for Chapter 4, when pathways to resilient green transformation are identified.

3.1. Regulatory framework for environmental management

147. **Ethiopia's environmental management is grounded in a legal and policy framework that governs rights and obligations of citizens and enterprises**. Ethiopia's environmental governance involves, in theory, all levels of government, including accountabilities for kebeles, woredas, zones, regional states, and the federal government. Under the federal system, the Ministry for Environment, Forests and Climate Change (MEFCC) has a pivotal role in developing, adopting and enforcing federal legislation and standards on environmental management and protection. Regional states are empowered to enact their own natural resources and environmental laws, while local governments (woreda administrations) in the regional states participate in decision-making that is likely to affect them.

3.1.1. Policy and legal framework for environmental management

148. **The 1995 Constitution (see Annex B) provides for citizens' rights to live in a clean and healthy environment and guarantees the people the right to sustainable development.** Under the Constitution, a balance is struck between the environmental provisions in the fundamental rights section, and the environmental duties in the economic development and policy section. Economic development must take place and alleviate poverty while keeping the environment intact for future generations.

149. **These Constitutional provisions provided the basis for Environmental Policy of Ethiopia (EPE), which was prepared by the Environmental Protection Authority (EPA) and adopted by the Government in 1997 through a proclamation.** The EPE expresses key principles and objectives including: (i) ensure that natural resources, both renewable and non-renewable, are used sustainably; (ii) prevent pollution in a cost-effective manner; (iii) organize public participation in environmental management, including improvement of the environment of human settlement areas; and (iv) enhance public awareness, education about and participation in the national effort for sustainable development and environmental protection. The EPE considers the existence of other sectoral and cross-sectoral policies related to natural resources and the environment, for which it provides the main environmental policy guidelines (see Box B1 in Annex B). The GoE has announced that it is in the process of amending and enhancing the content of the EPE to include principles, rules and standards to address climate change and other issues. However, no draft has been circulated yet and therefore this report refers to the original EPE as enacted in 1997.

150. **In 2002, the GoE enacted two major environmental laws: the Environmental Impact Assessment (EIA) proclamation and the Environment Pollution Control proclamation.** Many implementing regulations were then developed, including those related to environmental quality standards, which were approved by the Environmental Protection Council (EPC) in 2008. In addition to these core environmental laws, the GoE adopted a wide array of sectoral laws and regulations connected to natural resources management and conservation, including land, biodiversity, water and forests, among others. Finally, consistent with the federal nature of Ethiopia's government, the regional states have enacted

numerous environmental laws, regulations, standards and guidelines,[25] which may be similar to the federal laws, regulations and standards or more stringent. However, although many of the implementing regulations, guidelines and standards for the EIA proclamation have been developed and disseminated, they have never been formally approved.

151. **As part of its regulatory requirements for environmental management and protection, Ethiopia uses:** (i) the Environmental Impact Assessment (EIA) system to regulate the siting and approval of projects that may have detrimental impacts on the environment,[26] and (ii) the system of licenses and permits required to establish, develop and operate projects and facilities related to respective sectors.[27] The EIA should be used as a tool to guide project design, consider the effects of projects on the environment through impact assessment and stakeholder consultation and participation, and propose alternatives to projects that might not adhere to FDRE standards. At present, however, the EIA is mainly used as tool to navigate procedures to allow investment projects to move forward. It is generally used along with the other regulatory instruments (permit and licensing activities and investments) applicable to respective sectors.

152. **This regulatory framework is characterized by the predominant use of command and control approaches[28]. It does not refer to any economic-based instruments or incentives to reduce the potentially high transaction and enforcement costs of such command and control policies when applied across the board in environmental management.** In addition, the regulatory system is distorted by a so-called "delegation of power to sectoral ministries to manage, monitor and enforce the EIA processes and outcomes." It also leaves little room for information dissemination and disclosure or for public consultation and participation in decision-making processes.

3.1.2. Institutional framework for environmental management

153. **Current institutional arrangements involve shared responsibility between the MEFCC and sectoral ministries and between the federal government and the regional states. The central government has responsibility for overall policy and regulatory development and the regional state governments for ensuring implementation and enforcement of national policies and laws.** The power of regional states to regulate natural resource use and extraction is spelled out in federal legislation and reiterated in regional state law related to targeted natural resources, including, among others, land, forests, water and biological diversity.

154. **At the central level, MEFCC is, by current legislation, the main agency responsible for environmental policy making, compliance and enforcement** (see Box B2 in Annex B). Similarly, at the regional state level, the respective state government environmental agency or bureau is the designated agency to perform, implement and enforce most environmental regulatory powers at the regional state level.

155. **MEFCC was established in 2015 to take forward the GoE's commitment to environmental protection and management, sustainable economic growth, forest sector development and climate change.** Since its establishment, MEFCC has addressed numerous challenges, including the definition of its priorities and the need to align its organizational structure, human capacity and financial resources accordingly. MEFCC aims to implement its mandate of building a green economy. and to this end will work towards improved collaboration with sectoral agencies and decentralized authorities, especially those in charge of specific environmental and natural resources mandates, such as agriculture, water and energy, mining and urban development. However, it is important to note that sectoral laws and

25 For example, the Amhara Regional National State (ARNS) has adopted its own EIA guidelines based on the 2001 federal guideline, but "simplified" for easier use (Bureau of Environmental Protection, Land Administration and Use (BoEPLAU), Simplified General Environmental Impact Assessment Guideline, 2006)

26 The EPE recognizes a central place for Environmental Impact Assessments (EIA) of development projects and related activities as the major instrument to be used in decision-making processes related to development activities. The EIA process is established as such through a 2002 proclamation.

27 At the international level, these instruments typically are used by governments to ensure that development projects are sound, contribute to the overall development strategy, and will not negatively impact the country's natural resource base and overall environment.

28 The direct regulation of an industry or activity by legislation that states what is permitted and what is illegal.

regulations dealing with natural resources (except the forest sector) and environmental aspects of industrial development leave very little room for MEFCC to be involved in their implementation, compliance monitoring and enforcement.

156. **At the regional level, environmental bureaus and agencies enjoy a wide range of environmental responsibilities and roles, some of which overlap with sectoral mandates.** However, these responsibilities and roles are not matched with adequate human and technical resources. All regional states and local governments (zones, woredas and kebeles) face technical capacity constraints to effectively set, implement and/or enforce environmental laws, regulations and standards.

157. **To strengthen the environmental management system, key changes must target**: (i) the adoption of an incentive-based approach to environmental management to balance the dominant, yet ineffective, command and control approach (ii) the institutional arrangement for implementing and enforcing the EIA system, and (iii) the need for effective coordination. See Chapter 4 for specific key recommendations to improve the environmental management system.

3.1.3. EIA system challenges

158. **Unless the EIA system is fully functioning, Ethiopia will face challenges in achieving its resilient green growth targets.** The system must work efficiently from the lowest administration level (woreda) to the federal level. At present, (i) enforcement of the existing polices, laws and regulations is weak, and (ii) policies, laws and regulations need to fit better with the CRGE Strategy. Recently, the government developed a safeguards framework for projects financed by the CRGE Facility, based on experience in several sectors. This creates awareness of the need to take a more robust approach to environmental risk management throughout the economy. Building on this awareness, the EIA system must be strengthened at an operational level through several measures including providing MEFCC with the budget and capacity to review EIAs and their implementation.

3.1.4. Coordination challenges

159. **The allocation and use of resources for competing uses requires more dialogue and greater coordination among stakeholders.** Regulatory affairs underpin many of the decisions; a strengthened MEFCC could have a much stronger role to play in the broader economy and help deliver more favorable outcomes. The existing regulatory framework is, however, built without clear arrangements for effective coordination among the various agencies and institutions involved in environmental and natural resources management and conservation, including dispute resolution when conflicting uses of the same resources are at stake.

3.2. Challenges in the enabling environment for building resilient landscapes

160. **In this section, selected policy challenges to building resilient rural landscapes are discussed.** First, institutional challenges are assessed, beyond what was discussed in Section 3.1, followed by analyses of incentives, information and investment challenges.

3.2.1. Institutional challenges

161. **Inter-ministerial coordination is needed because decisions and implementation of activities related to land involve at least eight sectoral ministries.** The frequent restructuring of ministries with changing responsibilities has been a challenge. The Ethiopia Wildlife and Conservation Agency (EWCA) is a case in point; it used to be under MOA, is currently under the Ministry of Culture and Tourism, and is being considered for a move to MEFCC, which is also responsible for forestry and climate change. Likewise, responsibility for forests was transferred to MEFCC from MOANR in 2013.

162. **If land use planning is properly coordinated inefficiencies, potential inconsistencies and conflict could be vastly reduced.** To address these past and current challenges with land use planning, the GoE has established an inter-ministerial committee led by the Prime Minister's Office (PMO) and MOANR which will develop a new land use policy and national plan by 2018, including related instruments to advise the government on the management of land assets and avoid potential conflicts. This newly-

established committee is, however, at an early stage of its work and has not yet issued a draft policy or program about its mandate.

163. **The increasing need for coordinated land use planning comes from increased development pressure from multiple sectors.** Land in Ethiopia is primarily used for agricultural production (smallholder and some commercial food production, livestock grazing and fodder, woodlots for household energy and construction material, and feedstocks for biofuels), and secondarily for forestry, protected areas for conservation, urban settlements, rural settlements and, increasingly, mining.

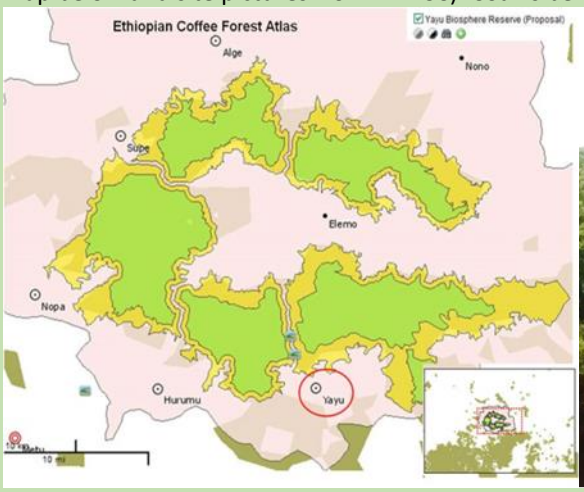
164. **Development plans exacerbate the competition for land.** As noted in Chapter 2, GTP II targets an increase in forest cover of about five million ha from 2015 to 2020. Two of these five million ha are expected to be under participatory forest management, which means that they will be close to rural villages. GTP II also projects an increase in new agricultural lands of 700,000 ha during the same period. It is therefore likely that the more productive lands will be under ever-increasing pressure. If Ethiopia achieves the same efficiency in ethanol production as Brazil, around 58,000 ha will have to be allocated to reach the GTP II target of annual bioethanol production of 438 million liters.

165. **The forest sector in Ethiopia has experienced recent improvements but is currently constrained by the absence of strong implementing institutions that could provide, for example, development agents (extension workers) or facilitate a mature public-private dialogue.** Efforts have focused on developing policies and strategies, while implementation in the field remains a challenge. Poor law enforcement is one reason for forest loss and degradation. In addition, with the direct and indirect effects of the multitude of sectors affecting forests (energy, agriculture, roads, mining, urban development, etc.), policy alignment and the lack of cross-sectoral coordination among government, non-governmental, and private institutions hinder national efforts to reduce the 0.5 percent[29] annual net deforestation rate while expanding forest cover dramatically. The forest sector is also constrained by limited integration of fire management into landscape programs, and limited responsible private sector involvement due to a variety of factors.

29 Calculations according to the Ethiopian Forest Reference Level (FRL) submitted to UNFCCC in January 2016. Also note that deforestation rates vary between hotspot areas. Historical deforestation rate for Bale Mountain estimated revealed the averages annual deforestation rates of 1.1 percent for the Moist Evergreen forest stratum and 6.67 percent for the Dry Evergreen forest stratum for the period from 2000 to 2011" (Bale Mountains REDD+, 2014)

Box 10. Managing the trade-offs between mining and conservation: the case of the Coal Phosphate Fertilizer Project

The most popular coffee in the world, Coffee Arabica, comes from the UNESCO-registered Yayu Coffee Forest Biosphere Reserve. However, right next to this Reserve, a coal-based fertilizer complex is being constructed (see map below and site pictures from MEFCC). Coal is being extracted through tunnels under the forest and



environmental concerns include leakage of chemicals from the mining site trough water bodies, which might harm the biosphere and wildlife. Additionally, the effects on the biosphere of the influx of workers, road construction and extraction of wood for fuel, and emissions from coal burning are major concerns that have not been considered. Today, 42 percent of the construction has been completed and 3,500 people are employed to mine coal and sell locally while the facility is being completed. (*MEFCC, Yayu EIA Field Report, 2016)*

166. **Participatory Forest Management (PFM) suffers from limited legal support and lack of harmonized benefit sharing rules.** PFM lacks specificity in the country's forest legislation and PFM communities are not granted forest tenure security within their respective jurisdiction. Even though there is a law that supports benefit sharing regarding forest management (the Federal Forest Development, Conservation and Utilization Proclamation No. 542/2007), there are no harmonized benefit sharing rules between government and communities. The REDD+ initiative of MEFCC, in partnership with regional governments and most recently via the newly approved Oromia Forested Landscape Program, is developing a benefit sharing mechanism.

167. **Land and water rights are another institutional challenge.** As noted in Chapter 2, significant progress has been made by providing rural land user rights through land registration and certification, especially for smallholder and communal agricultural land holdings. Areas for developing and enhancing resource rights include restrictions on land use and land rental on private holdings—such as limits on land size and duration of land rental transactions—and legal issues related to communal rights for water and forest land, although Oromia is currently developing a communal land tenure declaration.

168. **Despite recent progress, institutional challenges exist at several levels in the agricultural sector.**[30] For example, the country's seed regulatory system is currently at a nascent stage and constrained by

30 A key achievement in this respect is the establishment of the Agricultural Transformation Agency (ATA) in 2011 to support MOANR (World Bank, 2015g). Also, the new Agricultural Cooperatives Development Strategy aims to strengthen governance and regulation of agricultural cooperatives, while the new Seeds Proclamation is designed to increase the efficiency of seed markets and farmer access to good quality seed.

multiple bottlenecks including inadequate logistics, limited infrastructure, and insufficient human resource capacity (ATA, 2016). Though there are more than 285 seed-producing cooperatives operating at different scales and efficiencies in Ethiopia's four main regions, 95 percent of these do not meet the regulatory requirements to become accredited institutions.

169. **Systemic bottlenecks for environmental risk management in crop production** include low awareness of the dangers posed by unsafe use of pesticides; weak storage infrastructure for safe handling of pesticides; and weak enforcement of quarantine regulations (ATA, 2016). This area is also plagued by weak early warning systems for major pests; a lack of national pesticide diagnostics facilities; and weak legislative provisions for pesticide registration and control.

170. **Crop and livestock insurance products are not yet proven in Ethiopia.** Index insurance schemes have been established with subsidies and support from donor agencies. Withdrawal of such support may undermine financial sustainability and, ultimately, demand for insurance products. A sustainable approach is needed.

171. **Limited capacity to plan, implement, and consistently monitor soil and water conservation and climate-smart agricultural practices persist at all levels.** Extension workers ('Development Agents') lack sufficient capacity, especially on complex interactions between natural resources and climate and how these aspects are addressed on communal and household landholdings. Development Agents are, nevertheless, the unsung heroes of the SLM Program, which has brought hundreds of thousands of hectares of degraded and climate-vulnerable land back into production and boosted drought and climate resilience, and the government is rightfully continuing to enhance Development Agents' capacity.

172. **There is limited focus on environmental management and rehabilitation for both artisanal and large-scale mining.** Little effort is made to apply regulatory frameworks, including enforcement of no-go zones for mining, to small-scale miners. Miners also need to be aware of their rights and duties as artisanal miners, including long-term security of tenure, realistic environmental and safety requirements. Currently, artisanal mining activities are not considered in land use planning processes. For ASM in protected areas and sensitive ecosystems that have not been declared off-limits for mining, government should facilitate the use of environmentally friendly technologies.

173. **The development of a large-scale mining sector will bring substantial environmental challenges which will need to be managed; however, present environmental policies no longer match or address the current or future mining sector development.** The absence of mining-specific guidelines for Environmental and Social Impact Assessment (ESIA) and Environmental and Social Management Plans (ESMP) undermines compliance with regulations. Large-scale mining also leads to difficult relationships between the mining company and the community within which the mine is based, which can affect the sustainability of the mine and the surrounding landscape.

3.2.2 Incentive-related challenges

174. **There is little incentive to implement sustainable and climate-resilient land and water management.** For example, benefits from off-site effects of land and water management do not generally accrue to those who incur the costs of such management. Upstream farmers are incentivized to adopt practices such as afforestation and soil and water conservation to reduce run-off and siltation of rivers, streams and reservoirs. Incentives to use land and water resources efficiently are also lacking.

175. **Restrictions on land rental land transactions and land use, as well as inability to use land as collateral, are constraints that could affect efficient and sustainable use of private landholdings.** Unclear rights, especially to communal resources, including water, forest and land, are also constraints to improved management and use of these resources. Recent achievements in issuing communal landholding certificates for grazing land in the SLM Program (in some cases issued to youth in exchange for rehabilitating degraded communal land) show how incentives can deliver multiple wins for jobless youth, productive natural resources, and the green economy (see Box 5). Sustainability of financing arrangements for the second-level land certification is another issue.

176. **The incentives for private sector involvement in sustainable forest management are insufficient.** Despite existing incentives in the forestry sector for private investors (such as income tax exemption for up to nine years for forestry development investment projects), forestry investment remains an untapped

opportunity. Informal trade in the forest sector (especially for furniture production and traditional housing construction), the lack of transparency and open public markets hinder the participation of the private sector (MEFCC/WB, 2017). Moreover, private investors have the right to acquire land for investment for a limited period only, while investment in the sector requires long-term returns. The lack of coordination among different institutions (Ethiopian Investment Commission, MoANR, and MEFCC, as well as civil society) contributes to the lack of successful private sector participation in the promising forest sector. Small-scale farmers also lack adequate incentives to expand tree plantation on their plots.

3.2.3 Information challenges

177. **Environmental management information systems are weak, including those for monitoring forest, water, soil, and land resources.** To optimize the contribution of land, forest and water resources to welfare, it is important to consider the opportunity cost of alternative uses, as well as the net returns from use of these resources, so that decisions can be made on their best alternative uses. Such analysis requires availability of information on land, forest and water resources across time and location, as well as careful valuation of direct costs and benefits of various uses of these resources (e.g., inputs and outputs of agriculture, forestry, and biofuel production, or benefits of irrigation water), as well as their environmental effects (land degradation, deforestation, loss of ecosystem services, etc.). There is also lack of public access to data and information, poor use of information to inform policy and investment action, and weak monitoring and evaluation of investment operations. Information on water balance of river basins, and benefits of inter-basin transfer is also limited. Innovative new remote sensing solutions for resource monitoring, such as new satellite sensors and low-cost drones, can be better deployed to support decisions and monitoring projects and programs. Regarding resource economics, although several studies exist on the valuation of natural resources, including the recent work by the UNEP on the contribution of forests to national income, more work is still needed on non-market aspects, such as benefits of improved land and forest management, improved water supply and contribution of irrigation water. Capacity to develop and handle such information is also limited.

178. **Climate information and early warning systems in the agriculture sector are limited.** Despite developments in providing climate information and early warning services, noted in Chapter 2, and the importance of these services to reduce rural vulnerability, existing climate information and early warning systems are limited in geographical coverage as well as quality.

179. **Lack of adequate information about ground water (information coverage about ground water is only 10 percent) poses significant challenges in the water sector**. Given that ground water is the major source for potable water and irrigation, very little is known about potential areas of ground water sources. As noted in Chapter 2, the government plans to increase the information coverage of ground water from 10 percent to 25 percent, but this is still inadequate for the sustainable development of the water sector.

180. **The ongoing effect of potash mining on water bodies is unknown.** The activities of the potash mining industry potentially result in a wide variety of adverse environmental effects (UNEP 2001). Typically, these effects are quite localized, and in most cases, confined to the mine site, but the cumulative effects of multiple mines should be considered. Currently, two potash mining sites are active in Afar and water issues could become an issue if more sites operate in Afar. Managing the environmental impacts and water use requires addressing better resource monitoring and regulatory capacity.

3.2.4. Investment-related gaps and challenges

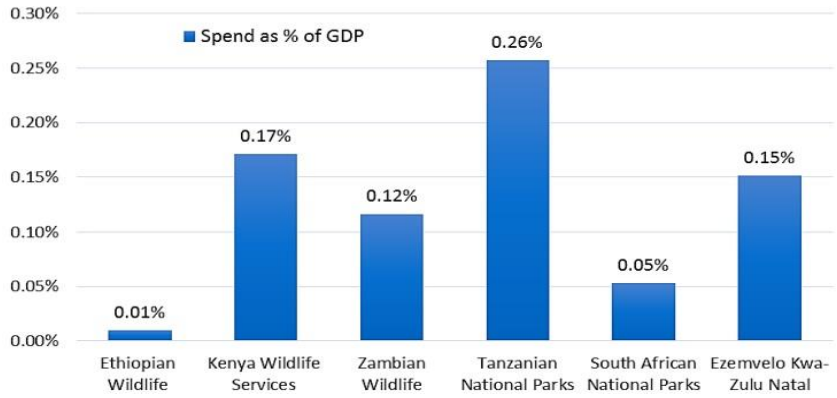
181. **The Ethiopian economy is heavily dependent on natural resources–land, water, forest–and economic growth is at risk due to under-investment in the natural resource base which prevents replenishment at sustainable rates.** While successful efforts to improve land and water management are noted in Chapter 2, investment in land management, forests, and irrigation water, especially at landscape level, is still limited compared to the need. For example, more than 50 per cent of all cropland still needs to be protected from land degradation and climate risks, and a total of 44 billion ETB (US$1.95 billion) still needs to be invested in soil and water conservation structures to protect sloping croplands (Hurni et al. 2015).

182. **Factors that contribute to the investment shortfall include limited availability of financial resources, absence of sustainable financing mechanisms for operation and maintenance of land**

management and irrigation water infrastructure, and the related issue of limited human capacity needed to undertake and maintain these investments. In addition to these factors, the various institutional, incentive and information challenges discussed earlier contribute to the limited investment. Implementation challenges reduce the effectiveness of any attempt to improve the situation.

183. **Protected areas are largely under-valued, and significant opportunities are being missed, such as eco-tourism in national parks and biodiversity conservation.** The Ethiopian Wildlife Conservation Authority's (EWCA) spending is equivalent to 0.001 percent of Ethiopia's GDP. EWCA spends approximately US$0.8/ha annually on protected area management (Van Zyl, 2015), far below benchmark countries. The lack of finance will hinder achievement of national development goals, especially regarding land restoration and forest cover (Figure 25).

Figure 25. National protected areas management authority spending as a percentage of GDP for selected African countries compared to EWCA



Source: Van Zyl, 2015

184. **Private sector investment in forest is very low; yet, well-managed commercial operations can help sustainably finance the development of the sector while achieving national objectives related to forest cover.** Competing land uses, lack of integrated supply chains, long administrative processes and inconsistent or weak incentives are among the key constraints for commercial forestry plantation investors. Existing commercial plantations are not integrated with wood industry value chains. Implementation of policies related to land use are weak, and have negative implications for land allocation for commercial plantations.

185. **Investment is limited in well-managed small and large irrigation interventions.** Less than 50 percent of the potential irrigable land is irrigated (2.4 million ha was irrigated as of the end of GTP I out of the total potential irrigable land of 5.3 million ha). Limited private sector participation in the irrigation sector is causing a bottleneck for sustainable land and water management and resilience.

3.3. Challenges in the enabling environment for green industrialization

186. **This section focuses on key policy challenges pertaining to institutions, incentives, information and investment that impede the prospects for green industrialization in Ethiopia.** As stated in its CRGE Strategy, Ethiopia wants to green its industrialization process, now in its early stage. Any form of industrialization faces similar challenges in the enabling environment, but more so when pursuing a green trajectory. In addition, the challenges facing each of the four thematic clusters in the GTP II are inter-related. For example, pressures on landscapes can be reduced through a structural labor transformation from agriculture to green industrialization.

3.3.1. Institutional challenges

187. **Despite the central role of green industrialization for the achievement of the CRGE, there is still no comprehensive green industrialization strategy that guides policy implementation**. The GTP II includes industrialization targets that are in line with the CRGE Strategy but coordination between MEFCC and other ministries is needed to ensure an integrated approach, with both adequate regulatory capacity and active private sector engagement. Without a comprehensive green industrialization strategy, Ethiopia's emerging industrial sector could deviate from the targets set in the CRGE. Further, such

comprehensive green industrialization must be complemented by the necessary proclamations and regulations, and their implementation, including those that ensure proper and effective implementation of sectoral/strategic environmental assessment for industries and industrial parks.

188. **The enforcement of existing environmental policies is not well-coordinated among the responsible ministries and regional and local bodies.** Besides a lack of clear demarcation of activities, there are often overlapping responsibilities among different organizations, namely the MOI, MEFCC, Industrial Parks Development Corporation (IPDC), Ethiopian Investment Commission (EIC) and regional authorities. Each entity seems to have a different set of priorities, which often complicates coordination in implementing environmental requirements and objectives. There is also a lack of clarity in mandates. For example, there seems to be little coordination between the MOI's integrated agro-industrial parks initiative and IPDC's industrial parks initiatives. Indeed, effective institutional coordination between MOI and its affiliate institutions and IPDC could be enhanced for mutual benefit.

189. **The current arrangement for industrial parks or 'eco-industrial parks' lacks the clarity needed to reduce the public and private costs of pollution**. Currently, single or similar industries are all in one park. For instance, Hawassa, Mekelle and Kombolcha industrial parks target only textile industries, an approach that undermines the creation of industrial symbiosis among industries which could otherwise transform waste streams into productive inputs.

190. **Ethiopia's overall business environment is characterized by many bottlenecks that impede green industrialization.** Ethiopia is ranked 146th of 189 countries on the ease of doing business index as of 2015 (World Bank, 2016e). In addition, Ethiopia stands 176th on starting a business, 167th on credit access, and 166th on trading across borders and protecting minority investors. The 2014-2015 Global Competitiveness Index identifies inefficient bureaucracy, foreign currency regulation, access to finance, corruption, and electricity supply as the five most important binding constraints to doing business in Ethiopia (see Table 12). These barriers are also highly relevant for greening industry.

Table 133. Major constraints to doing business in Ethiopia, various rankings

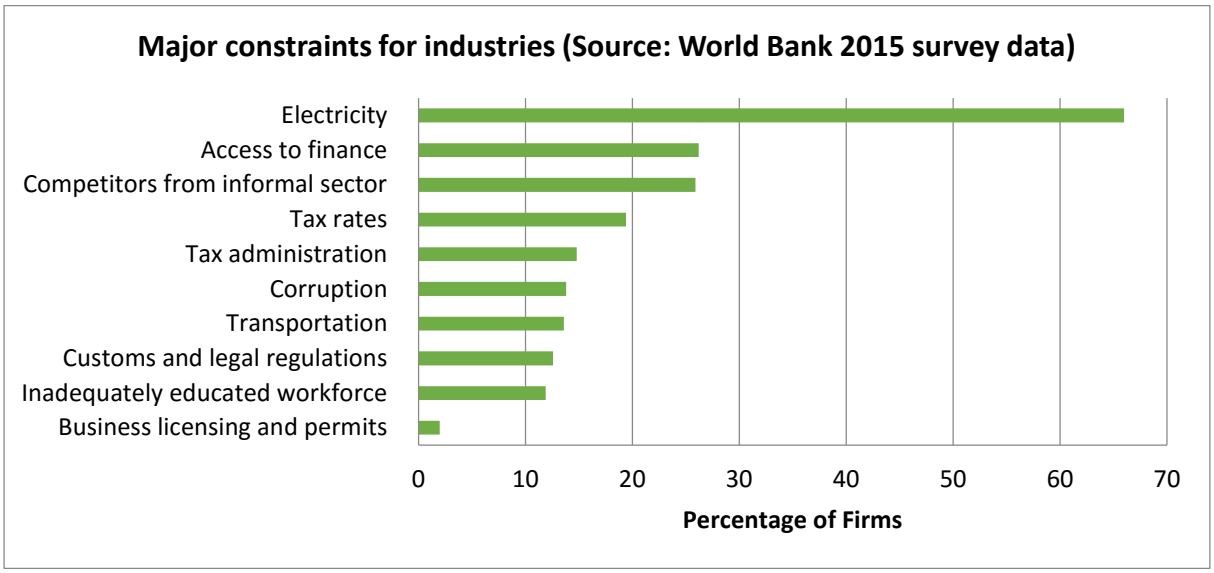
	Doing Business 2015	Global Competitiveness Index 2014–2015	Consultations on National Business Agenda 2015	Enterprise Survey 2011
1	Starting a business	Inefficient Government Bureaucracy	Tax Administration	Access to finance
2	Trading across borders	Foreign Currency Regulations	Access to finance	Access to land
3	Getting credit	Access to finance	Access to land and construction permits	Electricity
4	Protecting minority investors	Corruption	Availability/quality of energy	Paying taxes
5	Paying taxes	Inadequate supply of electricity	Unfair competition	Customs, trade regulations

Source: World Bank, 2015b.

191. **There are several bottlenecks for private sector participation in green industrialization, especially electricity access and various institutional policy barriers** (Figure 26). The institutional and governance issues mentioned earlier are commonly experienced across firms, hampering growth and other performance indicators, constraining capital that could be used for green technology, undermining the productivity of existing firms, and creating barriers to entry for new firms.

192. **Ethiopia also faces structural challenges in greening its numerous micro and small enterprises (MSEs).** Reducing the environmental footprint of MSEs and creating jobs is instrumental to realizing a green economy due to MSEs' large number and their reputation for being significant polluters per unit of output, with sizeable cumulative environmental impacts (Kent, 1991; Hillary, 2000). However, MSEs are very difficult to green due to their low capacity to adopt new technologies. MSEs are mostly located in urban areas such as Addis Ababa, making them prime contributors to the complex pollution and waste challenges in these areas. The intertwining of MSEs with the urban fabric, combined with their small size, large number, and the lack of information about them, severely limits effective enforcement of environmental standards on MSEs.

Figure 26. Major constraints for manufacturing industries in Ethiopia



Source: Calculation based on raw data obtained from the World Bank Enterprise Survey 2015

3.3.2. Incentive-related challenges

193. **The lack of incentives to adopt clean technology hinders greening industrialization in Ethiopia.** There is limited enforcement of environmental laws (discussed in Section 3.1), and poor implementation and follow up of EIAs. Moreover, the initial investment cost of clean technologies is often more expensive than traditional ones. There are limited economic or regulatory incentives for industries to build waste treatment facilities and invest in clean technologies but no "polluter pays" system to incentivize adoption of clean production.

194. **Constraints on access to finance can affect and limit firms' decisions to adopt new and clean technologies**. Ethiopia lags behind comparable countries when it comes to access to credit. According to the World Bank (2015b), private sector credit is only about 9 percent of GDP in Ethiopia, compared to more than 20 percent in Sub-Saharan Africa. Access to finance (credit constraint) is cited by all measures as a binding challenge hindering doing business in Ethiopia. Credit-constrained firms in Ethiopia have 15 percent lower sales growth, 5 percent lower employment growth, and 11 percent lower labor productivity growth than firms that have no credit constraints. With no access to credit, firms will not prioritize investment in clean technologies, including treatment facilities. This is a crucial problem, especially for small-scale firms, which are dominant in Ethiopia.

3.3.3. Information challenges

195. **Ethiopia's private enterprises, particularly domestic firms, lack awareness about their responsibilities and green options.** The main problems hindering private sector participation include knowledge gaps, lack of cost-benefit analysis of new technologies and investments in green practices, and a perception that greening is the responsibility of the government alone.

196. **An example of a knowledge gap is the minimum requirements and consolidated framework of what constitutes an eco-industrial park (EIP) –** a term that refers to a designated group of industries built in a way that reduces environmental consequences and increases economic efficiency (Lowe, 2001). There is no commonly agreed guideline on eco-industrial parks that can be applied to industrial parks in Ethiopia. This makes it challenging to certify industrial parks as "eco." Moreover, lack of commonly agreed guidelines hampers efforts to plan and develop new EIPs and to further develop and upgrade existing industrial parks into EIPs.

197. **There are also information gaps on opportunities and effective technologies for reducing environmental impacts from the industrial sector.** Available data on industrial pollution and emissions is unorganized and has numerous gaps. In addition, data on the economic cost and health impacts of pollution is almost non-existent. Environmental data is also rarely publicly disclosed. Moreover, there is

almost no data on the environmental impacts of MSEs, and there are knowledge gaps on the challenges and opportunities of greening them.

3.3.4. Investment-related gaps and challenges

198. **Industrial investments in Ethiopia face inadequate and unreliable infrastructure facilities**. Inadequate supply of infrastructure is cited as one of the five major challenges for investments. (Figure 26). Although there have been recent improvements in the supply of power and connectivity of roads and railways, provision of other infrastructural facilities is insufficient to promote industrial investments and enhance productivity.

199. **Although electricity is among the cheapest in the world and the grid is powered by renewables, access is unreliable**. Ethiopia's manufacturing firms identify electricity supply as the most critical bottleneck (Figure 26). This finding is striking given that Ethiopia's potential for cheap renewable energy is cited as the foremost opportunity for green industrialization. Electricity outages in Ethiopia last much longer than those of close competitors for foreign direct investment in Africa: 7.8 hours per month in Ethiopia compared to 3.8 hours in Kenya and 6 hours in Tanzania, for example (World Bank, 2015b). These outages negatively affect industrial productivity. For instance, our analysis of the data collected by World Bank Enterprises Survey in 2015 indicated that firms lose 6.9 percent of their potential annual sales due to electricity outages in Ethiopia.

200. **In addition to the significant losses that they cause for factories, electricity outages trigger costly investments in fossil fuel-based alternative energy sources**. Once firms make such investments, they are committed to a higher emission path, which further complicates the sustainable energy transition. The proportion of green electricity in Ethiopia's manufacturing firms is relatively low compared to the amounts of "dirty" alternative sources (Table 13). None of Ethiopia's manufacturing clusters use green electricity for more than 50 percent of their energy, and most of them use it for less than 25 percent.

201. **Non-metallic mineral and concrete, cement and plaster industries consume the largest proportion of fuelwood as compared to other industrial groups (Table 13).** The percentage of clean electricity consumption by these industries is very low, indicating substantial negative environmental impacts, including increased emissions and deforestation. For instance, the cement sector is highly energy-intensive and claims a very high share of industrial emissions that can be partly attributed to the use of "dirty" energy. In addition, the use of fuelwood by the industries can cause severe health impacts for the workers and surrounding residents.

202. **Given their high level of pollution per unit of production, the lack of investment by MSEs in environmentally sustainable alternatives is a hindrance to greening industrialization**. The main policy focus of the government, however, has been on developing EIPs that mainly aim at attracting FDI and domestic large-scale industries.

Table 144. Type and cost of industrial energy consumption in Ethiopia, 2012/13

Industrial group	Cost of energy consumed (in '000 US$)			Percentage of total energy costs		
	Electricity	Wood and charcoal	Other fuels	Electricity	Wood and charcoal	Other fuels
Food and beverages	13 599	756	47 424	22	1	77
Textiles	4 937	1097	16 516	22	5	73
Wearing apparel	222	43	2 450	8	2	90
Tanning and leather	2 154	59	3 834	36	1	63
Chemicals and products	1 628	548	5 744	21	7	72
Non-metallic mineral products	11 463	31 946	42 167	13	37	49
Structural clay products	1 348	0	1 655	45	0	55
Cement, lime and plaster	2392	136	16733	12	0	87
Concrete, cement and plaster articles	6751	31776	22342	11	52	37

Source: Calculation based on data obtained from Central Statistical Authority's Manufacturing Survey 2012/13

3.4. Challenges in the enabling environment for sustainable urbanization, transport and living conditions

203. Ethiopia is on a rapid urbanization trajectory, which will intensify even further as the country continues to progress in its structural transformation envisioned by the GTP and CRGE Strategy. However, the process of urbanization needs to be sustainable if the CRGE targets are to be met, meaning a growing green industrial sector in the cities needs to absorb significant labor. Migration from rural to urban areas can reduce pressure on rural landscapes while providing labor for industrialization. But it is important for labor to exit the traditional rural sector in a sustainable manner. The expansion of the transport sector should be compatible with environmental targets, and infrastructure should be resilient to the impacts of climate change. Living conditions in urban and rural areas should also be sustainable. This subsection briefly outlines the key underlying policy challenges that need to be addressed in institutions, incentives, information and investments.

3.4.1. Institutional challenges

204. **Urban land management, especially the lack of properly functioning land markets, is a key challenge for Ethiopia's growing urban centers.** According to the Ethiopian Constitution, the ownership of rural and urban land is exclusively vested in the state and peoples of Ethiopia. In urban areas, the government supplies land mainly through allocation and auctions. The old system of urban land tenure (the rent system) is being replaced by a more market-oriented system of long-term leases. However, the government has been unable to satisfy demand for land and housing through these channels. There is a strong unmet demand for urban land from people of all levels of income, the poor, in particular. For example, the number of bidders has been 12 to 24 times higher than the number of plots for residential land, and 3 to 7 times higher for commercial land. This has been one reason for informal development, particularly on the urban periphery, with resulting environment degradation. The inefficient land market has also opened up speculative investments in urban land, thereby competing with investment in productive sectors, as well as creating the risk of a housing and land price bubble. There is also a growing problem of corruption associated with land allocation.

205. **In parallel with land auctions, allocation of land at below-market value, combined with large lot-size regulations, has led to the horizontal sprawl of urban areas.** In cities such as Addis Ababa, there has been a decline in density even as the urban population has increased. Such urban sprawl has exacerbated the challenges of providing infrastructure and services (World Bank, 2015a). Moreover, some entities obtain land for free or below market price; these entities include government agencies and enterprises, infrastructure providers, NGOs, religious organizations, large and small industry, urban

agriculture, and condominiums. Unsurprisingly, this has boosted consumption of land for construction. In Addis Ababa, for example, this has increased, on average, from about 50 m^2 in 2003-2004 to 110 m^2 in 2005-2011 (World Bank, 2015a). According to the Integrated Housing Development Project Office of Addis Ababa, this has led to a great increase in the cost of housing production and/or off-budget subsidies provided by the government.

206. **Too much time is spent preparing comprehensive master plans in a slow and costly process.** Despite the clear urgency of preparing for urban expansion, planners spend a great deal of time in the preparation of comprehensive master plans that aim to coordinate the activities of many different sectors, while providing relatively little of what is so urgently needed: well-planned land for expansion. Many of these plans are never implemented and cities continue to grow rapidly without a proper framework (Patrick et al., 2015).

207. **Lack of appropriate codes and standards**. The Ministry of Urban Development and Housing Construction (MoUDHCo) has put in place building codes as well as different green area and infrastructure standards. However, the challenge is to develop codes that are in line with the CRGE Strategy, in aspects such as energy efficiency, water recycling, transport solutions, etc. Most of the designs and strategies lack appropriate codes and standards that foster resilience.

208. **The existing tax system on imported cars encourages the import of old second-hand cars, which tend to be more polluting.** Although vehicle taxes depend on engine size, original car price when new, and purpose (commercial or personal use), the system encourages the import of old cars by giving tax discounts for older cars. For instance, cars with a service period of more than three years benefit from a 30 percent reduction from the total tax, while cars with a service period of less than one year get no tax discount. Other countries have the opposite taxation system. In 2015, Kenya adopted an age-based taxation scheme which raises tax on imported second hand vehicles older than 3 years by 150 per cent and reduces tax to 30 per cent for vehicles less than 3 years. And in India, a green tax is levied on vehicles that are over 8 and 15 years old for public and private vehicles respectively. Furthermore, there is no age limit on imported vehicles to Ethiopia. Many countries in Africa have fixed the age of imported vehicles. For instance, in Gabon the age limit is 4 years and in Mauritius it is 3 years. (CSE, 2016). A high level of air pollution in Addis Ababa is caused by vehicles, and can be addressed by relatively simple vehicle maintenance that will significantly reduce tailpipe emissions (KPMG, 2015)

209. **Ethiopia does not have a clear motorization strategy informed by the CRGE strategy**. The country's vehicle fleet is expected to increase rapidly, as noted in Chapter 2. This growth will have profound implications for several environmental outcomes, including pollution, carbon emissions, and urban sprawl and land use.

3.4.2. Incentive-related challenges

210. **Structural labor challenges might impede a shift of the labor force from agriculture to other sectors.** An important manifestation of structural transformation is a massive movement of labor from the rural areas to towns and regional cities; a limited amount of such migration indicates there is a structural labor challenge.[31] There are several characteristics that make this perspective more relevant to Ethiopia today than ever before. Chapter 2 noted, unfortunate trends in Ethiopian agriculture, which are characterized by high population pressure; this, in turn, has led to small and fragmented plots of land that in many cases have low productivity due to land degradation and low levels of inputs such as fertilizers, most appropriate seeds, mechanization, etc. Although farm households may add more of these inputs to try to increase production out of their small plots, they also have to put in more labor; on average, they end up with no improvement in net income as a result of these efforts, according to Headey et al. (2013). The gender productivity gap in Ethiopian agriculture is one of the highest in Sub-Saharan Africa, with female farm managers (largely comprised of female heads of households) being 23 percent less productive than their male counterparts (World Bank 2015f). According to Headey et al. (2013), larger farm size is strongly positively correlated with net farm income, suggesting that land constraints are an

31 Theoretically, all these policies are based on principles that promote protection, prevention, precaution, and conservation approaches in their respective areas. Grounded on these sectoral policies, a wide array of environmental laws and regulations has been developed to include environmental aspects of sector-specific laws and regulations to define the specific statutory mandates, environmental quality standards and norms.

important cause of rural poverty. This is further evidence of the potential win-win outcome of an intensified and well-managed rural-to-urban migration. When farmers on small plots decide that wage labor in a city is a better choice than uncertain production on a small plot, these migrants fuel the industrial and service sectors, particularly if they can obtain training in new skills. The small plots of land left behind can be combined into larger and more profitable farms. In the end, a shift of population to urban areas can reduce the pressures on agricultural land, grazing land, and forests, or at least not exacerbate the current high pressure.

211. **The existing user-holding based land-tenure system may be contributing to structural labor challenges** (Gebeyehu, 2014)**.** Although land certification is well-documented to have improved tenure security, increased land investment, and raised productivity, it also comes with several constraints that may induce people to stay on the land instead of moving on to the cities. It remains illegal to sell or mortgage land, and there are restrictions on the extent of land rentals, based on the duration of land rental contracts and the proportion of farms (maximum 50 percent) that can be rented out; otherwise, the farmer loses the land without compensation (Holden and Ghebru, 2016). Holden and Ghebru suggest that the current land tenure policy contributes to strengthening a rural poverty trap that ties people to the land. In particular, female-headed households benefit from renting out land because they do not have the labor to cultivate it. More efficient outcomes are likely under policies that encourage the best farmers to take on more land, which they can consolidate and even mechanize (if well-planned). At the same time, labor can be made available for productive occupations in other sectors.

3.4.3. Information Challenges

212. **The existing knowledge base and professional human resource is not enough relative to the nature and scale of the development challenge facing urban centers.** The existing weak institutional coordination, low financial and management capacity, together with the knowledge gap, have aggravated the problems in planning and managing cities. There are challenges in filling gaps in specialists such as urban designers, environmental specialists and engineers, urban landscape architects, property appraisers and specialized disciplines as traffic and transport planners, urban economists, tourism planners and social planners. Attention needs be given to the qualitative capacities of the existing professional workforce.

213. **Evidence-based planning and policy face several gaps in organizing and using data and information.** Reliable data and information on the state of cities and their current and future risk profiles are in short supply, and the available data on urbanization is not methodically organized for use in policy or planning, nor is it readily shared with policy makers. Although research is being undertaken, it is limited in scale. Without reliable information, planning is a close to impossible task. There is a need for common standards for computing systems to ensure compatibility and resilience.

3.4.4. Investment-related gaps and challenges

214. **Ethiopia faces the challenge of providing infrastructure and services not just to meet the current level of demand, but also that of the rapidly expanding urban population.** The infrastructure must be developed in accordance with the CRGE, with the objective of reducing GHG emissions and integrating green growth strategies. The state of infrastructure in Ethiopia (mainly water supply and sanitation, electricity, housing, roads, transport and Information and Communication Technology) is already inadequate, even for the current level of urban population, and is failing to meet the demands of the rapidly growing urban population (at about 5.4 percent per annum). The electricity sector is estimated to need investment of more than US$ 1 billion to reach universal access.

215. **There are investment gaps in water and sanitation services in Ethiopia's growing urban centers, despite large-scale investment in water, sanitation and health solutions.** Ethiopia's water supply systems are stressed and inefficient, exacerbating challenges for sustainable living. Most urban water supply systems experience significant water losses, estimated at 30 percent in Addis Ababa and as high as 35 percent in other towns. Leakage results in consumption of polluted water by consumers due to the sucking of dirty water into pipes because of negative pressure developing in the pipe system. Most of the time, these water losses and resulting problems are not addressed in time due to the absence of a water loss monitoring system; for instance, town water supply offices do not have systematic data on the

location of water distribution infrastructure. Moreover, the absence of a street and home address system further complicates the capacity to respond to reported cases of water leakage. Other contributing factors include corrosion of metallic pipelines; poor quality of fittings and workmanship; inappropriate laying of pipelines and/or traffic loadings; absence of planned maintenance; delayed responses due to limited capacity to detect and/or locate leakages, as well as absence of decentralized service centers in larger urban centers; and a shortage of resources to upgrade distribution systems.

216. **Most urban investments are financed from municipal revenues which are too small to meet the infrastructure investment demands.** The federal government transfers block grants to regional states based on a formula. Regional governments then transfer about half of these grants to lower government levels, based mainly on expenditure needs, primarily for the regional functions delegated to them. While transfers to the local level are increasing, most block grants are used to cover operating costs, with little left for investment and development. In addition, user fees charged for infrastructure services are low and do not cover operational, capital, and debt-service costs**.** In addition, absence of adequate cost recovery and neglect of maintenance remain persistent problems.

217. **Ethiopia's transport systems are too constrained to support rapid transformation of the economy, and require significant investment.** Only 10 percent of Ethiopia's rural population lives within two kilometers of an all-weather road (Foster et al., 2011). This is a high degree of isolation because as much as 80 percent of Ethiopia's population lives in rural areas. Overall, the transport system and the available urban road space in Ethiopia are far from coping with the increase in traffic that comes along with rapid urbanization. The current transport system does not meet demand without substantial delays and variability of travel time. The rise in automobile ownership, together with the poor condition of the roads and the poor traffic management system, have resulted in high levels of congestion, particularly at peak hours. The average traffic congestion intensity in Addis Ababa, expressed in vehicle-minutes or person-minutes, is considered high; on average, about 38 vehicle-days and 352 person-days are wasted at intersections or congestion spots each day (Wondossen, 2011). Transport also plays an important role in supporting industrialization and trade in general. The introduction of electrified rail systems is an important contribution to emission reduction, although rail transport will never have the reach that road transport will deliver, and there are concerns about the financial sustainability.

3.5. Challenges in the enabling environment for sustainable energy production

218. Sustainable energy production is the golden thread that connects Ethiopia's CRGE and GTP goals. Addressing the key challenges of energy production is vital to progress along the country's intended green growth trajectory. In the following sections, institutional, incentive, information and investment challenges are discussed.

3.5.1. Institutional challenges

219. **Lack of effective coordination among institutions dealing with energy issues is one of the key institutional challenges facing the energy sector of Ethiopia**. All renewable energy and fuel-related programs were housed under MoWIE until mid-2015. Currently, several energy sector programs and coordinating departments are fragmented among different institutions, namely MoWIE, MEFCC, MoMPNG, and the Ethiopian Energy Authority (EEA). The current setup results in coordination challenges and wasted resources, and hampers effective implementation of energy and environmental programs.

220. **There is currently no national electrification policy in place that defines the national government program and commits the GoE to provide sustainable funding.** Because of the natural monopoly characteristics of power transmission, extension of electricity access and improvement of existing service reliability need to be pursued through a government program. A national electrification policy is needed to ensure that all concerned government agencies and activities work toward a well-defined and common goal in line with the development objectives set under the GTP II.

221. **A new Department of Electrification (DoE) is being set up within MoWIE.** The DoE will be responsible for program oversight, coordination among GoE agencies, and monitoring program progress. The purpose of the new department is to provide improved policy guidance and inter-agency coordination. The DoE will not engage directly in implementation of electrification activities but will oversee the electrification program and facilitate successful implementation of the goals and objectives of

the National Electrification Strategy through the implementing agencies. The major obstacles hindering the current expansion efforts are of a planning and operational nature. For example, Ethiopian Electric Utility's planning and operational capacity will have to be strengthened to be able to manage the growing customer base and to expedite the connection process.

222. **The national biofuels strategy needs updating, as the latest version is from 2007 and is being revised in 2017 to reflect GTP II and CRGE objectives**. Institutional mandates overlap and face gaps; for example, the newly established, Ethiopian Mineral, Petroleum and Biofuel Corporation (EMPBC) is only handling biodiesel as the Ethiopian Sugar Corporation did not merge with the new corporation. Major challenges for the biofuels subsector are that demand is still not fully analyzed, supply chain gaps and waste management needs are unknown, demand for land and land use management needs are unmapped, cost estimates need updating, and there is little coordination with the land management-related institutions in the country, mainly MOANR and MEFCC.

3.5.2. Incentive-related challenges

223. **Overcoming distortions in the electricity sector is a key challenge for sustainable energy production in Ethiopia**. For electrification programs to be sustainable, electric utilities and off-grid service providers must be allowed to recover operating costs. Currently, there are no rational retail tariff structures that recover all operating costs, including the cost of purchased power, and that provide an allowance for end-of-life replacement of those facilities that have been constructed with grant funds. There is also little use of analysis of national willingness to pay, affordability, and consumer preferences in tariff setting.

224. **There are currently few incentives for adopting biofuels, the market for which is embryonic**. Biofuels regulations are cumbersome and challenging to meet. Kerosene is VAT exempted, but this exemption does not apply to ethanol, which could be a direct fuel replacement for kerosene for cooking if widely available. The price of ethanol is also fixed, around 10 ETB or US$0.4/liter factory price and 15 birr or US$0.7/liter retail price. This is an inflexible approach to support a market that the GoE wants to scale up.

3.5.3. Information challenges

225. **Lack of empirical evidence on the values and impacts of different energy sources, and how these may change over time, pose a significant challenge in promoting sustainable and resilient energy production in Ethiopia.** In particular, as hydropower accounts for the largest share of grid-fed electricity, and is highly affected by climate variability and change, hydromet services and information on the likely impacts of climate change on water resources are crucial for decision-making about energy production and energy source diversification.

226. **Decisions on the development of energy sources are not informed by rigorous cost-benefit analysis.** Ethiopia will need to weigh the costs and benefits of alternative electricity sources and create an economic policy environmental suitable to expand low emissions options. Work will be needed to evaluate economic benefits for projects, including decisions regarding the relative value of grid versus off-grid technology options for specific locations and conditions. More generally, complementarity and cost considerations are involved in decisions on the share of different sources of electricity from the grid, such as wind, hydropower, solar, thermal, and geothermal. The same applies to options such as biogas, traditional biomass fuels, fossil fuels, biodiesel and bioethanol, solar home systems, and micro-dams. Appropriate policies will be needed to incorporate higher-cost renewable resources. For example, to increase the share of wind in electricity generation, a carefully designed feed-in-tariff may be needed as an incentive mechanism. But the information base will need to be enhanced to support evidence-based policymaking.

227. **Improved information on basic resource availability is important for both geothermal electricity and development of additional natural gas production.** For natural gas, which can be used in a variety of sectors, a fuels master plan does not yet exist, but could support decision making and investment by combining resource availability estimates with evaluation of alternative uses.

228. **To have a more effective grid expansion and off-grid coordination in place, a central element will be the development of a geospatial master planning framework that lays out optimal investment planning for grid and off-grid expansion.** Thus far, the electrification program has relied on manual, as

opposed to digital, planning mechanisms. The selection of specific investments is currently informed by the regional offices that submit plans to the EEU, which then prioritizes based on political decisions. EEU and MoWIE faces a challenge in software and expertise gaps needed to develop and update the master planning process on a regular basis.

3.5.4. Investment-related gaps and challenges

229. **Expanding investment in several clean and renewable energy sources is needed to support the production of sustainable, affordable, and resilient energy, which in turn will be critical in achieving resilient landscapes, green industrialization and sustainable urbanization.** Because hydropower has the largest share, there is a need to diversify the sources of energy, as well as to make hydropower more resilient to climate change. The recent El Nino effect on hydropower dams in Ethiopia is a good example of the potential vulnerability of the subsector. The Tekeze power plant, for example, was seriously affected by the El Nino induced water shortage; due to the drought, three of the four turbines of the power plant were damaged (EEP, 2016). The Koka, Neshe and Melkawakena hydropower dams face similar challenges. Investing in other alternative energy sources therefore would help diversify risks associated with climate change, as well as other production challenges, such as seasonality and intermittency of wind and solar energy sources.

230. **Spatial coordination of investments that can generate win-win outcomes is not typically carried out, which is a lost opportunity.** For example, investment in resilient landscapes, specifically to rehabilitate and maintain watershed functions through better land and forest management, affects the maintenance cost of reservoirs important for hydropower production by reducing run-off and sedimentation. Investment to address land and forest degradation, if taken at scale, could also allow for small hydropower and run-of-river turbines to emerge as a new investment opportunity; smaller rivers are currently highly sedimentized.

231. **Lack of investment in replacing old transmission lines is another key challenge for sustainable energy production.** Old transmission lines are one of the main causes of frequent power blackouts, so investing in replacing them is critical for reliable electricity distribution.

232. **The efficiency and sustainability of power supply may be compromised by weak participation of the private sector in grid-based generation and micro-grids.** This strategy would necessitate tariffs that provide for cost recovery, as well as a more conducive investment climate for participation by the private sector.

4. Pathways for resilient green growth

233. **To transition the economy to a more resilient green growth path, all actors and sectors will need to (i) build the capacity of *institutions* to act, (ii) strengthen and align *incentives* (markets, prices) and policies, (iii) generate, share, and apply environmental *information* to inform policy and investment action, and (iv) mobilize and coordinate *investment*.** Multiple and complementary approaches will be needed to achieve this, building on existing successes, together with the considerable political momentum toward the CRGE's objectives. This chapter identifies pathways to accelerate and enhance this progress, while Chapter 5 provides a summary of recommendations for actions that various institutions can take.

4.1. Institutional enhancements for resilient green growth

234. **Establish and maintain strong high-level coordination. Current ad hoc inter-ministerial committees for coordination of specific matters could be further strengthened by an institutionalized coordination body involving all relevant institutions and stakeholders.** This body could provide advisory policy guidance, evaluation, and recommendations on matters related to regulatory affairs, environmental management, and natural resource management. Specifically, it could (i) review the performance of the programs and plans and recommend improvements; (ii) advise on the appropriateness of the delegation of environmental functions among organs of state; and (iii) recommend measures to strengthen coordination of environmental mandates, compliance and enforcement. Improved coordination

can help respond to identified institutional challenges and competing demands on natural resources and the environment.

235. **Improve vertical coordination in implementing and enforcing environmental laws, regulations and standards.** This vertical coordination is needed on a regular basis between the federal, regional state, zone, and woreda institutions. MEFCC could consider preparing and institutionalizing a coordination framework in consultation with regional and local governments and relevant sectoral ministries, as well as NGOs and the private sector. Through this coordination framework, agencies could pool their existing capacities and maintain regular working processes to prepare, adopt and implement activities related to environmental management. This would facilitate sharing information and organizing joint supervision of development projects that have been subjected to EIA/ESIA. This approach has proven useful in countries such as Indonesia, Morocco, and Brazil, although implementing such a coordination framework would be a major undertaking requiring commitment and resources.

236. **Enhance the regulatory framework and strengthen capacity to enforce environmental laws, regulations and standards.** Measures to achieve this include:

i. Review and enforce EIAs and ESIAs through MEFCC, as it is best placed to be the central agency responsible for these tasks. Current 'delegated' ministries and agencies could be granted a technical role in preparing EIAS/ESIAs and the responsibility of submitting the documents to MEFCC and regional environmental bureaus for review and approval. A clear boundary would be needed between the regulatory, implementation and enforcement mandates related to EIA/ESIAs to avoid conflicts of interest in the assessment process and proposed mitigation measures.
ii. Disclose EIA, ESIA and related monitoring reports to the public to facilitate compliance monitoring and public access to environmental information.
iii. Strengthen the capacity of local governments to enforce the conditions in the permits that they issue for natural resource extraction. Currently, the incentives to generate fees and taxes by issuing such permits are not matched by the necessary monitoring and enforcement capacity.
iv. Prepare a needs assessment to strengthen the capacity of all environmental agencies to monitor the ever-growing portfolios of development projects under their responsibilities. The design of a capacity building plan should involve stakeholders at all levels of government. Such a plan should emphasize the following:
    a. Providing local communities at woreda and kebele levels with training on environmental protection and natural resources management and conservation;
    b. Developing and implementing a more inclusive and community-oriented system of decision-making and dispute resolution to ensure that the issues faced by the weakest segments of the society, particularly those directly affected, are addressed effectively at the lowest level of government; Strengthening local governmental institutions by improving the status of environmental management staff, including their salaries and other incentives, to attract skilled human resources; and
    c. Developing local capacity for environmental planning through sustained training and collaboration with MEFCC and regional agencies.

4.1.1. Institutional enhancements for building resilient rural landscapes

237. **Align policy and develop an integrated approach to land use because multiple sectors (energy, agriculture, construction, water supply, etc.) affect one another**. For example, Development Agent services could be coordinated across forest, agriculture, water, and energy sectors or the application of participatory land use planning could be used to bring different actors together to develop a shared vision and consolidate priorities.

238. **Scale up successful integrated landscape approaches by spatially and temporally aligning packages of investments; this will require closer inter-agency cooperation at an operational level.** This includes soil and water conservation, individual and communal landholding certification, reforestation through natural regeneration and planting, forest conservation and PFM, management of genetic resources such as local landraces, livestock and rangeland management (including enclosures), non-farm income opportunities, climate-smart crop production, household energy access, and small infrastructure such as roads, water harvesting and small irrigation. As shown by the World Bank-financed SLMP-2 experience, integrated packages that are spatially concentrated using a watershed management approach can achieve

multiple benefits rather than if each activity operated in isolation. Where investment packages underperform due to exogenous shocks such as droughts or floods or changes in global prices, safety nets via the PSNP, can support subsistence, while also helping to scale up soil and water conservation civil works and resilience.

239. **Integrate biodiversity planning into production landscapes through various measures, given that Ethiopia is a global biodiversity hotspot.** Implementation of the National Biodiversity Strategy and Action Plan (NBSAP) can be better supported by land use planning and zoning that considers synergies and trade-offs between different land use options. The ongoing development of the National Integrated Land Use Plan could allow for demarcating areas for future expansion of protected areas, forests, wetlands, and land restoration to achieve the specific targets set in the NBSAP. Protected areas contribute to tourism potential as well as water provisioning and carbon storage. Ethiopian landraces for barley and wheat outperform improved varieties in terms of yield as well as drought and flood resilience. These successes could be scaled up to more fields and farmers through inclusion in the national seed distribution system. More crops and landraces would need to enter participatory trials following the 'Seeds for Needs' model.

240. **Institutionalize structures and support for implementing and scaling up Participatory Forest Management (PFM).** Administrative support could be provided to local authorities, and to communities to develop and implement their own bylaws as part of PFM implementation (or scale up). This support can include improvements in enforcement, such as capacity development for judiciary systems and police forces, and provision of tools and income-generating opportunities for communities, such as by establishing cooperatives to market both timber and non-timber forest products (NTFPs). PFM policies should also be harmonized nationally.

241. **Integrate fire management into landscape programs to improve forest resource use and management.** Coordination between relevant ministries and agencies can achieve a cross-sectoral landscape perspective on restoration and production and reduce the risk of catastrophic wildfires. Community involvement through initiatives such as a community-based forest fire management initiative, while making use of existing indigenous knowledge, would help to mitigate catastrophic wildfires. To coordinate this, a clearly defined institutional arrangement with responsibility for fire management, both at the national and regional level, would be a step in the right direction. MEFCC could investigate possibilities such as prescribed fires as a tool to increase long-term carbon storage in savannas, as has been done in other countries such as Australia. Education and extension in wildfire ecology is also necessary.

242. **Manage water resources through a multisector integrated water resources planning approach.** This would require investment in the capability of water resource agencies to carry out analytical work—including modelling, utilize enhanced hydrological and meteorological data acquisition, and monitor networks to support river basin development. This institutional capacity could focus on river basin and sub-basin water resource assessments and the associated institutional capacity to continuously assess and manage potential storage for irrigation, hydropower, water supply, flood management and wetland conservation, including strategic climate risk. This will require mechanisms to disseminate these assessments and related data to support strategic planning in sectors that are dependent on the basins' natural resources.

243. **Establish an autonomous land administration entity at all government levels, mandated to oversee overall land administration issues** related to tenure and use according to the value of land in rural, peri-urban and urban areas. The responsibilities could include:

    i. a juridical function, including cadastre and land registration;
    ii. a regulatory function, focusing on land use planning and land development control;
    iii. a fiscal function, focusing on valuation and taxation;
    iv. a functional land information management system that monitors land governance issues and informs policy improvements (already under preparation).

4.1.2. Institutional enhancements for greening Ethiopia's industrialization

244. **Formulate a comprehensive green industrialization strategy and guidelines to facilitate the implementation of CRGE in the industry sector**. This can help concerned stakeholders, including

MEFCC, MOI, EIC, IPDC, sectoral development institutes, private investors, and regional authorities, to coordinate, support and evaluate greening activities in all industrial subsectors. In addition, it is important to formulate regulatory frameworks and strategic environmental assessment for industrial parks.

245. **Include clear guidelines and requirements for certifying new and existing eco-industrial parks, which will help expand the model, improve regulatory compliance, and help attract FDI.** Fulfilment of requirements and certification of new pilot parks such as the Hawassa Industrial Park are important to help firms gain access to global green markets and to showcase the potential of industrial parks in Ethiopia. Improving the ease of doing business will attract more investment and private sector participation in clean technologies. Foreign currency regulation and customs systems can also be improved in ways that promote the import of new and clean technologies. Developing an attractive business environment for joint ventures between FDI and domestic industries will facilitate technology transfer and innovation. In addition, raising the efficiency of government bureaucracy and reducing delays in land acquisition would facilitate industrial investments. These actions could be done in coordination with ongoing efforts to improve the business climate through reforms to governance and tax administration.

246. **Organize time- and cost-limited demonstration campaigns plus improved access to microfinance for micro, small and medium enterprises.** A clear regulatory framework for clustering micro and small enterprises could be formulated to help promote clean technology adoption through economies of scale.

4.1.3. Institutional enhancements for sustainable urbanization and motorization

247. **Organize prompt, active and efficient spatial planning of land use and transport infrastructure around three complementary actions:** (i) designate sufficient land areas for the planned expansion of cities over the coming 20-30 years based on realistic population and density projections (ii) plan an arterial road and infrastructure grid into the expansion area, with approximately one km between parallel roads of 25-30 meter width that can carry public transport (iii) identify high-priority open spaces in the expansion area which need to be protected aggressively from urban development, and create the institutional and financial mechanisms to ensure that they remain open in the face of pressure from either the formal or informal sector to occupy them.

248. **Consider establishing a body at the Federal Transport Authority with a clear mandate to develop a motorization strategy to ensure that the country's motorization management is based on timely "no regret" planning.** A team with representatives of various involved stakeholders from government, non-government organizations and research centers to coordinate the development and implementation of various programs related to motor vehicle improvement will bring substantial benefits in the future. Such a team is an example of a "no regret" early action that can be taken regardless of any specific measures adopted to improve safety and fuel economy and to reduce emissions. The team could become a key generator and repository of data, information and knowledge pertaining to the motorization strategy.

4.1.4. Institutional enhancements for sustainable energy access

249. **Strengthen national energy institutions to create an enabling environment for market forces.** Such institutions can help to create clear regulations and effective incentives and subsidies.

250. **Implement a national electrification policy to ensure that all agencies work toward a well-defined and common goal in line with the GTP II development objectives.** Many countries have found that having a national electrification policy in place helps to define the program and commits the country to sustainable funding.

4.2. Incentives for resilient green growth

251. **Consider moving from the command and control approach to using economic instruments to induce compliance, raise funds for enforcement activities and environmental protection, and cut costs of compliance and enforcement.** MEFCC could promote environmental initiatives that provide economic incentives for compliance. Economic instruments include: (i) fees high enough to deter pollution, so as to prevent them being perceived as a "license to pollute", (ii) tax incentives such as reduced taxes for costs associated with improving environmental quality, e.g., installing pollution control equipment or changing

a process in order to prevent pollution, (iii) pollution taxes based on the volume and/or toxicity of emissions, effluents, or wastes generated, (iv) subsidies to promote the use of environment-friendly technologies where and when they are more expensive than traditional technologies, (v) eco-tourism policies that provide livelihood opportunities, generate money for environmental protection, and ensure that visitors act in an environmentally sensitive manner, (vi) emissions trading programs (although not used much in developing countries), (vi) offset requirements, often viewed as a tax on new investments to ensure they will reduce or "offset" pollution at an existing facility, (vii) price adjustment, and (viii) concessional credits or loans.

252. **Get the prices right—this is the most direct incentive in the policy toolbox.** Unfortunately, many important resources and environmental services such as air, water, soil and fuelwood do not have a price that signals their true value to society. And because undervalued goods and services are over-used, there can be an excess of pollution, extraction and degradation. It would be much easier for households and firms to decide the environmentally appropriate use of these resources if their prices included the environmental costs of their use. Environmental taxes and fees are a method to adjust prices so that market signals are 'corrected.' Such taxes are sometimes possible to implement. One such example, from advanced economies such as Sweden and British Columbia, Canada, is "carbon pricing," where the climate impact of fossil fuels is added to the fuel price and other taxes are reduced in exchange. There is an ongoing study on the relevance of carbon pricing to Ethiopia by the World Bank and GoE, as part of Ethiopia's high-level participation in the Carbon Pricing Leadership Coalition (www.carbonpricingleadership.org).

253. **Consider pricing utilities in a way that addresses inefficiency in the use of these resources while also considering distributional concerns.** In the long run, electrical grid expansion will be the least cost, lowest-carbon alternative compared to other renewable energy and energy-efficient technologies. Currently, electricity tariffs paid by households and businesses are below the cost of providing the service. While this implies a subsidy to users, it also reduces the revenues that government has available to support grid expansion, reinforcement of the network, and last-mile connections, to provide more efficient service. Residential electricity pricing is based on an increasing block tariff, in which customers who use a larger quantity pay more, effectively subsidizing smaller-scale users. (There are also peak and off-peak rates for the commercial/business sector, which is expected to induce more efficient decisions among those customers). While an increasing block tariff was originally expected to help poor people, in practice only 10 percent of the implicit subsidy goes to the poorest 30 percent of the population and 65 percent of the subsidy goes to the richest 30 percent of the population (World Bank, 2016).

254. **Improve access to and reliability of clean water supply with increased collection of water fees.** The pricing structure for water can also be reassessed to address the issues of access and reliability, while also addressing efficiency and equity issues. As noted above, differential pricing between private and public uses has been applied in some cities.

4.2.1. Incentives for enhancing the resilience of rural landscapes

255. **Develop a payments for ecosystem services (PES) approach to further improve land and water management.** PES creates a mechanism where users or beneficiaries of an environmental service can compensate the "providers" of the service. Lessons from PES schemes elsewhere (e.g., Costa Rica) show that simple PES arrangements can be established and then made more sophisticated over time. Key challenges for putting PES in place include the need for open access to information, strong capacity to monitor the resource, the ability to manage financial transactions transparently, ensuring that local land users are supported and that buyers' and sellers' aims and prices are well-aligned.

256. **Build on the country's positive experience with community-based approaches to wildlife conservation to promote both local people's livelihoods and the conservation of resources.** In principle, conservation should be considered a "win-win" approach, so that the communities gain access to compensating services or livelihood opportunities in and around protected areas.

257. **Create incentives that encourage farmers to plant trees and promote regeneration on marginal farmland. This can help create woodlots, and opportunities for farmers to participate in commercial plantations.** Such incentives may include providing extension services and weather information,

seeds/seedlings based on fair prices/subsidies, accessible markets, economic support (such as tax reduction for farmers/pastoralists who allocate part of their land to agro-forestry) and outgrower schemes.

258. **Consider a public procurement policy requiring sustainable and quality certification for key wood products.** This could incentivize investment in sustainable forest management, industrialization and professionalization of the sector.

259. **Consider, when clarifying and strengthening individual and communal rights to land, forest and water resources, approaches that create incentives for more efficient, sustainable, and equitable resource use.** Farmers with more secure access to land, water and other resources tend to invest in better land use – which is an important concern given the need to sustain investment once external funding exits. In SLMP-2, for example, landless youth are given legal land rights in return for rehabilitating degraded land and returning it to production – an innovation ready for scaling up. The possibility of lifting existing restrictions on land use and rental markets, legal rights related to communal water and forest land, and the possibility of using land as collateral are areas that would benefit from careful examination for improved land management and use.

260. **Apply a range of incentives to improve the enabling environment for private sector involvement in the forest sector.** These have been discussed in recent analyses and in a public-private dialogue in April 2017 and include: (i) developing modalities for Public Private Partnerships (PPP), e.g., intensifying the management of public plantations in joint ventures with the private sector, provisioning for fixed concession periods, and engaging smallholders through outgrower schemes; (ii) enabling investments on forest lands (this could be addressed by the government issuing suitable land free of lease payments or granting forest land certificates that guarantee long-term use); (iii) creating economic incentives for long-term forest investments, such as access to finance through credit facilities and guarantees, duty-free imports of relevant machinery and other inputs, and delaying the tax levied on the land until the forest attains maturity; and (iv) lobbying private sector actors to invest in the forest sector. To facilitate access to finance and to mobilize domestic private capital, Uganda has had success in promoting forest investment through establishment of a national public-private forest fund that provides concessional loans and result-based incentives. Capacity building and supporting grants for business start-ups are also needed. Because forest investment creates environmental goods services and rural jobs as well as commercial products that can contribute to Ethiopia's development and growth, public spending to catalyse investment may be justified. However, note the caution below that complex financing and subsidy schemes are not usually recommended. Maintaining dialogue among the key parties–ministries, industries, sector associations, unions, smallholders and investors, as well as development partners–would help to ensure that these ideas are developed further and adopted into policy for the long-term development of the forest sector.

261. **Consider requiring large-scale mines to rehabilitate a portion of the land with the intention of developing agricultural or forested area.** When the mine closes and the rehabilitated land is returned to the community, the land should be carefully managed and monitored in line with Ethiopia's rich experience with SLM and PFM.

262. **Expand The traditional rehabilitation of mining sites to include payment for carbon storage and sequestration**, as an incentive for better land management in the future. Currently, this option has not been adopted; however, mined sites may have significant potential to sequester carbon into degraded soils (Hirons, 2013). This could be achieved relatively easily by including a carbon accounting requirement in ESIAs and Environmental Management Plans (EMP). This could be part of the revision of the *Environmental Impact Assessment Guideline for Mineral and Petroleum Operation Projects* (Draft 2003), especially Chapters 8 and 9 on 'Mines closure and decommissioning' and 'Socio-economic consequences of mines closure on local community'.

4.2.2. Incentives for enhancing green industrialization

263. **Consider how best to provide incentives for entrepreneurs and investors in green infrastructure, clean technologies, and green innovation**. Clean technologies and waste treatment facilities can be very expensive, particularly for Micro and Small Enterprises (MSEs). Government support is warranted given the environmental damages at stake but needs to be based on clearly defined performance targets. Such support could include reduction in fees (e.g., water processing fees, emissions charges, etc.) for larger firms or targeted credit to MSEs and SMEs. Tax-related incentives (e.g., import duty exemption for green

technologies) are also an option, but they should be applied with caution. The complexity of tax-related incentives can result in problems of verification and in high transaction costs.

264. **Move towards a less complicated fiscal system.** Ethiopia, like most developing countries, is encouraged to do this because special tax breaks and expenditure pots create considerable allocative inefficiency and gaming of the system. Preferential measures provide little opportunity to direct the benefits toward the stronger enterprises rather than the weaker ones, since it is difficult to "pick the winners". The result of complexity and special arrangements is significant expenditure or lost revenue from tax breaks. This can significantly raise the cost of greening. For larger enterprises, the requirement to invest in greener technologies is a reasonable expectation even without preferential measures, and incentives can be given, e.g., by reduced water processing fees.

265. **Enhance the incentive mix for private sector investment in cleaner technologies.** The government has stated its commitment to improve the investment climate for both domestic and foreign investors. Ethiopia provides extensive income tax and customs exemptions to encourage investment in several priority areas, including clean electricity (generation, transmission and supply) and imports of LPG. Such incentives can, if carefully managed, help reduce industrial dependence on the use of fuelwood and diesel as energy sources. These incentives can be fine-tuned to maximize the benefits of agglomeration of complementary industries while avoiding congestion of industries in a few areas (e.g., Addis Ababa). Systematically targeting different incentives to the different industrial parks planned by the government could be a good solution. One way of establishing partnerships is engaging private investors in eco-industrial park development through granting a certain proportion of ownership and benefits sharing. This can create a system for shared financing and management of parks.

266. **Promote greening practices such as investment in waste water treatment and clean technology through the mechanism of preferential credit.** Noting the caution above on fiscal complications, preferential credit can be justified in cases where the public benefits—cleaner air and water—are clearly needed. Entrepreneurs and innovators do not have easy access to finance, which creates a disincentive for private sector investment in clean technology. Improving both access to and adequacy of credit to green-industry start-ups is therefore important, especially to domestic entrepreneurs. This is particularly important for MSEs, as they do not have enough capacity to invest in new technologies. Increasing access to finance can encourage firms to adopt efficient technologies and increase their environmental performance.

267. **Establish a "polluter pays" system to encourage industries to pursue cleaner production practices**. In addition to penalizing polluters, the polluter pays system is the typical means for rewarding best environmental performance and ensuring responsibility of individual firms to care for the environment.

268. **Use information as a form of incentive for improved environmental outcomes.** Encouraging public disclosure of EIAs and similar information would promote institutional transparency and more engagement by firms and the public in improving environmental performance. Dissemination of environmental information (e.g., firm or agency environmental management reports) can be a stakeholder engagement. A low-cost, effective incentive for improved performance would be to mandate the widespread dissemination of environmental information, including EIA and environmental management reports by industry and government agencies, especially those in charge of large infrastructure projects and natural resources development projects (e.g., mining and fossil fuels, large-scale forest logging and development projects, oil development, etc.). This approach is called 'authorized incentive' and is provided for in both the 1997 EPE and the 2002 EIA Proclamation.

4.2.3. Incentives for sustainable urbanization and motorization

269. **Allow individuals with landholding certificates to rent out agricultural land on a longer-term basis. This is a measure that regional states could consider to promote a sustainable rural to urban transition.** The income from the rent would act as a safety net for migrants during the transition. At the same time, such a policy would enable the most effective farmers to consolidate larger parcels of agricultural land, which would improve labor productivity in farming.

270. **Incentivize the import of newer and cleaner vehicles.** The current system of lower customs and taxes for the import of older vehicles has led to the concentration of older, more polluting vehicles in Ethiopia. The rules and regulations related to vehicle imports could be revised. There could also be a limit to the age

of imported vehicles. The specific design of such a policy would need to be developed based on an in-depth study of vehicle consumer demand responsiveness to changes in import duties.

271. **Develop policies to stimulate the creation of more green enterprises in the formal sector and, in turn, create jobs to manage the rural-to-urban transition.** These could include, for example, streamlining business registration procedures, simplifying policy and tax incentives for green enterprises such as renewable household energy businesses or furniture production, and expanding and targeting provision of start-up support, such as reducing credit restrictions. Supporting and creating incentives for SMEs, such as providing centralized services, skills and other advisory services, could help incentivize job creation in secondary urban centers.

272. **Expand efforts to transform the informal sector into the formal sector.** This would improve the overall performance of enterprises and would also benefit cities through compliance with business license regulations, adherence to labor and environmental laws and regulations, better regulation of service quality, and expansion of the tax base and municipal revenues. Formalization is, however, a complex process, and incentive-based efforts achieve better outcomes than legal tools (e.g., enforcement of registration requirements). Incentives could include bringing better training programs to the informal sector, family businesses and local networks.

4.2.4. Incentives for sustainable energy access

273. **Technologies such as improved biomass and ethanol cookstoves, biogas, solar home systems and solar lamps need to be priced according to the market to best respond to demand.** During grid expansion efforts and until electricity connections catch up, off-grid renewable energy and energy efficient technologies should continue to be part of the clean energy transition plan.

4.3. Information for resilient green growth

4.3.1. Information systems to manage environmental and natural resources

274. **Strengthen information collection and database management,** both in terms of geographic coverage and thematic areas. This could be done among nearly all stakeholders, at the federal level (MEFCC and line ministries), subnational level (regional bureaus and enterprises), basin agencies, meteorological agencies, and industrial zone corporations.

275. **Set up an Environmental Data and Information Management System (EDIMS). This would help coordinate the collection, analysis, and dissemination of existing and future environmental data** (water, pollution, land, weather, climate, and the like) needed for decision making on policies, projects and programs. It is important to highlight that an EDIMS or similar environmental information system works best when it involves all users (not only government) involved in environmental management. The EDIMS could fulfil major tasks assigned to the State of the Environment and Trend Preparation Directorate of MEFCC, which collects information and prepares a periodic State of the Environment report. The EDIMS will help with ecosystem valuation, and will be useful for cataloguing results achieved in greenhouse gas emissions reduction. A properly designed and maintained EDIMS would be more efficient and accessible than current systems which are generally in rudimentary form, and, as a result, do not provide accurate and timely data. The EDIMS would ideally be established within MEFCC and connected via internet to all federal and regional state agencies (which also requires much more robust internet services in the country). Through training, it could support information users and providers in government, academia, business, and NGOs. An EDIMS can be decentralized at the lowest level of environmental governance to allow a reliable and regularly updated flow of information to policy makers and end users. It could also be a key tool for the information disclosure.

4.3.2. Improve understanding of the economic value of the environment, natural resources and resource depletion

276. **Generate and make available better knowledge of the economic value of the environment, natural resources and resource depletion to help with efficient resource allocation.** A theme throughout this CEA is the need to plan for efficient use of resources for which there are competing demands, for

example, land, water and energy. Estimates of economic values are essential for evaluating the impacts of programs and investments; understanding the true costs of business-as-usual trajectories and the benefits of green interventions; and internalizing the social costs of private decisions. For example, valuation studies on ecosystem services and biodiversity would be useful with respect to investments in eco-tourism or the contribution of genetic diversity to climate change adaptation. While Chapter 2 provides an overview of some key work in this area, more focused, rigorous analyses are needed to underpin evidence-based policy development, investment decisions, and planning. There is a strong network of environmental economists in Ethiopia who could be leveraged by government institutions.

277. **Develop fuller estimates of the contribution of the environment to various sectors.** A recent study (UNEP, 2016) on the economic contribution of forests in Ethiopia is an example of the importance of estimating the economic value of ecosystems. While the study used market prices of different types of forest resources, there was a lack of reliable estimates of the non-market values of forests' contribution to the economy. It is, therefore, recommended to increase efforts to assess the non-market environmental values of different sectors.

278. **Consider piloting approaches to incorporating the UN System of Environmental-Economic Accounting (SEEA) into Ethiopia's national accounting system. This could mainstream the costs of environmental degradation into strategic national planning**. While the benefits of economic growth are traditionally quantified in the System of National Accounts (and readily available in GDP terms), increasing attention is given to methods that can account for degradation of natural capital and changes in the flow of ecosystem services, such as the value that watersheds contribute to agricultural and hydropower production. Developing measures such as Green Net National Product (GNNP) is key for informing policy making whether environmental sustainability principles are being observed. Implementation of SEEA would provide quantitative evidence of achievements toward the country's CRGE vision.

279. **Accelerate MEFCC's and sectors' ongoing efforts to establish an effective measuring, reporting and verification (MRV) system for industrial GHG emissions, especially from the emerging industrial sector.** Currently**,** there is no comprehensive emissions measurement platform in Ethiopia. An MRV system would make it possible to evaluate the carbon intensity of industries, potentially mobilizing climate financing while also helping to secure local air quality benefits since low carbon technologies generally reduce both carbon and air pollutant emissions.

280. **Fill critical information gaps:**

- **Map groundwater resources: Investment in sustainable development of groundwater resources has potential but requires more analytical work** due to a lack of comprehensive understanding of the complex nature of groundwater resources in Ethiopia (World Bank, 2016a). A related issue is water balance of basins, which should be carefully analyzed with the objective of finding solutions when there are deficits, including exploring inter-basin transfer as an option.
- **Develop a comprehensive planning framework and coordinated approach for both grid and off-grid expansion.** The development of a geospatial master planning framework, as well as a comprehensive, multiyear electrification plan that lays out optimal investment strategies, is important for scaled-up energy service delivery and improved access to modern energy sources.
- **Establish reliable and accessible climate, hydrology and weather data:** Modernizing databases and information systems is critical to support better planning, better productivity, and better resilience of natural-resource based sectoral activities such as agriculture, livestock, irrigation, inland fisheries, and forestry. More accessible and accurate information will also reinforce the country's abilities to manage and respond to disasters. To diversify the current hydropower-dominated energy production, there is a need to understand hydropower generation, with detailed climate change scenarios and the availability of potential alternative energy sources. Strengthening the Hydrology and Water Quality Directorate and the National Meteorological Agency will give these organizations an increased understanding of the kind of data their sister ministries need for planning and managing mixed power generation.
- **Conduct empirical studies on the analysis of demand, costs and benefits of biofuel production**, and synergies and trade-offs of investment in biofuels for the development and utilization of biofuels without compromising the need for food production, forest development, conservation, and other uses. This information could be the basis for updating the government's 2007 biofuels strategy.
- **Invest in generating reliable data and managing information on air quality in urban and industrial areas.** The overall responsibility could rest with MEFCC while collection could be done in collaboration with the National Meteorological Agency and other institutions such as city administrations. The information could be made readily available to the public, perhaps via alert procedures to mitigate the health impacts on sensitive populations.

4.3.3. Strengthening the information base via quantitative research and disclosure

281. **Strengthen the implementation of the CRGE Strategy, and the mobilization of funds to implement it** by institutionalizing a scientific, policy-oriented and multidisciplinary research and knowledge management process involving key think tanks and research institutions, with sector agencies and investment project teams as the "customers." Ethiopia has the capacity to carry out carefully designed, action-oriented impact evaluation research, equipped with institutionalized feedback loops to inform policy design and implementation. By systematically learning from its own on-the-ground actions, the country will have quantitative evidence of results. As Ethiopia expects to fill a significant part of the finance gap for CRGE implementation with an external influx of resources, this quantitative knowledge will help attract external finance.

282. **Disclose environmental information to improve regulatory performance.** Access to accurate, timely information, such as information about polluters, supports the main environmental policy levers–regulatory enforcement and taxation. More recently, information has become a policy instrument (Sterner and Coria, 2012). By ensuring that certain information is not only available to the regulator, but also to the public and private investors, numerous incentives can be triggered at low regulatory cost. Furthermore, with access to information, workers can request proper protection from hazardous substances, and producers can avoid environmental taxes or penalties through documented compliance. Banks can demand of prospective borrowers that investments will not be jeopardized by liability for environmental violations. Information disclosure increases the expected costs of non-compliance through channels that do not directly involve the regulator. A public disclosure program can provide a useful mechanism for data collection that is less contentious than other enforcement mechanisms. The disclosure can be effected through: (i) certification–of products, firms, processes, or management procedures–by independent

agencies, (ii) self-certification, without fixed criteria or independent outside review, or (iii) provision of raw data, without interpretation or judgment, sometimes in the form of life-cycle analysis (i.e., analysis of the environmental cost of a good or service through all phases of production and use). The collection of information is also a signal that the authorities are becoming more serious about environmental quality, and that signal itself can have important effects.

4.4. Investment mobilization: convene, crowd-in and coordinate

4.4.1. Investment in human capital

283. **Strengthen Environmental Impact Assessments (EIAs) by launching a multidisciplinary MSc program to increase the number and capacity of experts**. Section 3.1 pointed out the critical role that EIAs play in environmental enforcement. For EIAs to be properly carried out, a country requires many consultants and civil servants trained in this methodology, with a solid understanding of both the environmental science underpinnings and the implications of pollution and environmental degradation for human health and poverty reduction.

284. **Enhance capacity for environmental valuation and cost-benefit analysis. This is vital for efficient decisions based on sound economic evidence**. This report highlights significant information gaps regarding the contribution of various natural resources to economic activities and welfare. Proper valuation of long-term streams of goods and services from natural resources is particularly important when it comes to strategic decisions regarding competing uses of land and water. Since these values are often site-specific, capacity is needed at federal, state and local levels. It is therefore important to graduate more MSc students with practical training in environmental economics.

285. **Increase the quantity and quality of skilled human resources for integrated land-use planning and resource management**. There is a great need for policy practitioners who are well-trained in multidisciplinary programs, where the science of biological interaction is taught together with economics, social science, and communication tools. Training programs where experts from various fields solve complex problems together could be a good starting point.

286. **Improve the efficiency and creativity of urban planners by investing in capacity building.** Building the capacity of urban planners on the basics of land economics, land management, and urban planning, along with up-to-date building standards, will enable them to modernize the system of urban spatial and land use planning.

287. **Strength and modernize industry-university connections as well as technical and vocational education and training (TVET) to build human capital during the structural labor transformation in support of green industrialization**. The concentration of population in urban areas and availability of a young labor force offer a potential for enhanced urban productivity. Labor market information is important to match supply of labor with industry-specific demands. It is also important to train this new labor force in a way that enables introduction of new, greener technologies and maintains innovation in the green service sector. Industry-university/TVET linkages can be strengthened though demand-driven curriculum and labor market research as universities focus on meeting the demand for green jobs.

4.4.2 Investment in resilient landscapes

288. **Consider scaling up successful investments in resilient landscapes according to the FDRE's new Multi-Sector Investment Plan for Climate Resilience (agriculture, forest, livestock, water, energy) that was approved by the Climate Investment Funds in June 2017.** Interventions focused on sustainable land management, for example, show a benefit-cost ratio of well above 1 (meaning positive returns) and even 5 or higher (meaning that five times the value is returned on the investment) for some adaptation options (World Bank, 2010), as well as internal rates of return that are highly positive in most Ethiopian settings. For example, existing successful programs such as the Sustainable Land Management Program could be expanded.

289. **Make investments in land tenure certification, forest, water resources, household energy, crop and livestock production, small irrigation, non-farm livelihoods, disaster risk management, and rural**

safety nets more efficient by ensuring that they are spatially coordinated under a locally managed landscape approach with strong land use planning mechanisms. This approach helps manage the trade-offs and harness synergies to provide a wide range of resilient environmental and livelihood benefits. And while it may add complexity, so does the business-as-usual scenario of fragmented investments working at cross purposes and resulting in overwhelmed local authorities.

290. **Tap the potential of the forestry sector to contribute to livelihoods, economic growth, and environmental security (water, food, climate).** Diverse forest investments could be coordinated and scaled up in terms of theme (PFM, conservation, reforestation, afforestation, plantations) and financing modality (conventional grants and lending, government budget and direct financing, emissions reductions payments and other results-based financing, public-private partnerships, and FDI). All these forms of investment are needed to reduce deforestation and forest degradation and meet the demand for forest and wood products. Ethiopia's REDD+ initiative provides a potential platform for coordinating the land use related actors and partners to reduce the fragmentation that confronts effective forest action. These forms of investments and institutional reforms could be included in the context of large public sector interventions such as the new Oromia Forested Landscape Program (OFLP). This program seeks to create a joint platform for action for all forest-related investment in the sector, convening emissions reductions payments with upfront grants, NGO projects, and an IFC-supported Nespresso coffee project with Technoserve. Using this platform, more could also be done on household energy and commercial forestry.

291. **Increase commercial forestry and related industries, specifically regarding construction, furniture and utility poles.** Inclusive growth can be fostered by combining private sector investments with outgrower schemes and by facilitating partnerships between communities (via PFM) and companies. Experiences in other African countries suggest that the forest sector can develop through the establishment of core dedicated commercial plantations combined with outgrower schemes that equitably engage surrounding communities. The Ethiopian Forest Sector Review (MEFCC/WB, 2017) focuses on investments required to ensure that the significant gaps between supply and demand are met with sustainably produced domestic wood.

292. **Close the future industrial roundwood gap by using modern plantations and planting stock of about 310,000 ha (MEFCC/WB, 2016).** This would require investments of about US$638 million. The employment effect of these investments in plantations and processing is about 51,000 jobs. A 2016 forecast by the World Bank and International Finance Corporation confirms the potential for investment in commercial forest plantations, and the potential in sawn wood, wood-based panelling, and pulp and paper production. If these investments are realized, the forest sector could contribute almost US$1 billion to GDP by 2033 (calculated as gross value added) (MEFCC/WB, 2015). These investments will further reduce imports and will support sector development through industrialization and commercialization. In terms of carbon stocks, establishing the plantations required to fill this gap would mitigate around 89 million tCO_2 through forest carbon stock enhancements (MEFCC/WB 2015).

293. **Explore sustainable financing mechanism options for protected areas to address funding shortfalls** (public budget, donor funding, corporate and individual sponsorship, gate receipts and concession fees, tourism, etc.). Effective management of protected areas in Ethiopia requires sustainable funding. A study on the economic value and potential of protected areas in Ethiopia (Van Zyl, 2015) shows that Ethiopia's public funding of protected areas management is low compared to other African countries.

294. **Plan for climate change impacts. While climate adaptation measures are needed in the short term, medium- and long-term solutions require early planning for the more severe impacts of climate change in mid-century.** For example, careful decisions on investment in infrastructure with a long life span could help the country avoid being locked into a development trajectory vulnerable to climate change. Uncertainty of future climate outcomes implies the need for a risk-based investment planning approach. This is an important reason to prioritize no regret or low regret adaptation options. Measures for the medium and long term could include promoting diversification of income and employment across sectors, facilitating rural to urban migration, evaluating the climate resilience of large infrastructure projects, and proactively addressing conflicts in water and land uses.

295. **Invest in livestock productivity to improve rural resilience.** Poverty reduction in rural areas will be more successful if crop production is complemented by support to livestock production. Improved livestock productivity can help, but a wider set of interventions is needed to make a difference, including combinations of pasture consolidation, rangeland improvement, enclosures combined with a shift to cut-

and-carry systems as proven in SLMP, other forms of reduced grazing, animal health, access to feed, non-livestock income, tree-based pastoral systems, and mobile pastoral systems. Some of these investments have delivered ancillary benefits to education by freeing children from tending herds to attend school, as shown by the SLMP experience.

296. **Expand investment in small-scale irrigation systems, along with intensification of rain-fed crop production. This is critical for sustainable food security and rural incomes**. Combined interventions are critical to reduce yield variability and improve system resilience. These include drought-tolerant germ plasm, heat-tolerant germ plasm, and locally suited soil fertility and soil/water conservation measures. Adding farmer-managed natural regeneration of tree cover and small-scale irrigation significantly increases benefits. Development of small-scale irrigation is constrained by inadequate knowledge, extension services and management skills, all of which require attention through measures such as development of human capital (World Bank, 2016a). SLMP and the Agricultural Growth Program (AGP) are well-positioned to scale up these activities.

297. **Continue investing in large-scale irrigation but with a risk reduction strategy to reduce costs**. Past attempts to expand large-scale irrigation have been marred by problems, which shows that this sector is constrained by limited technical capacity and weak institutional and policy frameworks that need to be addressed (World Bank, 2016a). While irrigation can provide an important buffer against droughts, particularly in the less arid parts of the drylands, it is underdeveloped in the Ethiopian drylands (Cervigni et al. 2016). Investing in capacity building can include strengthening the capacity of institutions that provide training in large-scale irrigation. It is also necessary to make sure that environmental impact assessments are conducted when implementing large-scale irrigation projects, and that the command area is well-managed, using best SLM practices proven throughout Ethiopia to ensure reliable flow and extend the life of reservoirs and canals.

298. **Invest in hydro-meteorological information and early warning systems which are essential for rural sustainability and resilience.** Dissemination of weather and hydrological data to farmers and pastoralists, as well as planners and policy makers, is essential to reduce vulnerability. Ethiopia has a range of early warning tools for food insecurity that can be used to inform early action including the Livelihoods, Early Assessment and Protection (LEAP) tool, the Livelihood Impact Assessment Sheet (LIAS), Hotspot Assessments, Integrated Food Security Phase Classification, and the Famine Early Warning Systems Network (FEWS NET). Such systems have been found to have positive and large net benefits in Ethiopia (Law, 2012, cited in WMO, 2015). By triangulating the predictions of these tools and using more and better data as it becomes available, the tools could be used to detect the onset of a drought and the need to respond. The existing instruments can be the building blocks of a well-functioning early warning framework for Ethiopia. For instance, the LEAP tool could be used to produce early warning data as early as August-September, enabling a drought response by December, thereby protecting lives and livelihoods. In addition, the integration of seasonal climate forecasts into LEAP will provide a stronger basis for applying earlier crop production and needs estimates from LEAP (Drechsler and Soer, 2016).

299. **Increase youth employment through labor-intensive environmental infrastructure projects and programs** such as landscape restoration, watershed management, rural roads, and small-scale irrigation**.** This has the double benefit of addressing both unemployment or underemployment and environmental sustainability.

4.4.3. Investment in green industrialization

300. **Strengthen both private and public investments by building eco-industrial parks in various parts of the country.** The expansion of eco-industrial parks could solve problems related to land acquisition, infrastructural facilities and bureaucracy pertaining to services provision, while also addressing environmental problems.

301. **Create and strengthen industrial symbiosis among the firms in industrial parks—this will pay multiple dividends.** One of the key features of eco-industrial parks is ensuring symbiosis among the firms in terms of resource sharing. For example, the waste material from one industry can be used as production inputs by another industry, reducing costs and waste material, and boosting profit margins. The same results can be achieved by creating linkages and/or clusters around the industries within the IPs, or by integrating industrial park development, where the waste/outputs of one IP can be used as inputs for

another industrial park. Therefore, clustering of inter-related industries will help to create a system where by-products and wastes are shared among industries.

302. **Promote industries' investments in energy-efficient technologies to realize green industrialization.** This would require promoting innovation and transfer of new and clean technologies which could be connected to trade and investment policies. Most relevant technology is supplied in global markets, so policies that raise the cost of importing state-of-the-art technologies slow the development of the sector. By the same token, some measure of foreign direct investment (e.g., through joint ventures) can be an important avenue for raising additional capital and acquiring valuable expertise, in addition to new technology.

303. **Reduce pollution in a targeted manner by prioritizing dirty industries for investment in cleaner, low-emission technologies**. Some industries, such as non-metallic minerals, cement, concrete, and plaster, use a significant amount of dirty energy sources such as fuelwood and diesel. Both local pollution and carbon emissions could be reduced by increasing these industries' access to electricity. For instance, the government could consider prioritizing the delivery of reliable clean energy for energy-intensive industries such as the cement subsector; this would also reduce the cost of cement production.

4.4.4 Investing in resilient infrastructure and cities

304. **Revamp investment in infrastructure that supports green industrialization and sustainable urbanization. Ethiopia has made significant progress in infrastructure development over the past two decades; however, investment could now be directed toward** green power generation; climate-friendly transport infrastructure such as an electric national rail system and bicycle lanes in cities; and waste-recycling systems for industries and households. According to Foster (2011), meeting Ethiopia's infrastructure needs (energy, roads, ICT, among other things) would cost US$ 5.2 billion per year for the next decade. Capital expenditure accounts for 82 percent of this requirement. Ethiopia is also losing an estimated US$ 450 million per year to various inefficiencies in infrastructure operations or spending.

305. **Invest in market integration.** Removing physical and regulatory trade barriers can help build resilience in normal years and facilitate movement of food in crisis years. Improved infrastructure can enlarge market access and thus lower food prices. Simple, low-cost efficiency improvements can also be undertaken, such as eliminating the re-testing of already market-approved Lighting Africa products at the Ethiopian conformity authority—this would reduce the current 47-day delays for clearance at the Mojo dry port. Improvement in the quality assurance and inspection system will help address some of the issues around market access. The government could also consider increasing access to risk capital for entrepreneurs and investing in collateral support facilities.

4.4.5 Investment in sustainable energy access

306. **Continue to pursue the country's two main objectives in power generation: (i) diversify the energy mix and ensure against climate variation affecting the power supply, and (ii) invest in reinforcement of the network and support universal access to clean energy.** Ethiopia is planning to diversify the energy mix to include more solar parks, geothermal power, and wind farms. Decisions to develop different sources of electricity should be based on net social costs and benefits from each alternative. Ethiopia's clean energy sector can also become an attractive investment option through independent power projects (IPPs) for international investors. Well-structured IPPs can not only provide immediate infrastructure development benefits, but can also provide long-term economic benefits to the country through development of local industry and knowledge. This may involve a combination of technical assistance, advice, investments, and guarantees.

307. **Improve energy access through investments in expanding grid-based power. Accelerating access to off-grid energy such as mini-grids and off-grid power can be promoted as a transition solution in parallel during grid expansion**. Biomass, biogas and ethanol stoves increase fuel efficiency, reduce pressure on forests, indoor air pollution and GHG emissions (Beyene et al. 2015) and free women and girls from collecting fuel so that they can go to school or earn income. While these measures are being encouraged by the government both in the GTP II and CRGE strategies, they face investment gaps.

308. **Make alternative energy sources (e.g., solar PV and biogas) easily available to low-income households. At present, these sources of energy come at a relatively high individual investment cost**

for low-income households. Clean energy entrepreneurs could be supported by fast-tracking import processes for Global Solar approved products. They could be encouraged to invest in more than one technology; for instance, they could support the national biogas program in developing a *mirt* stove biogas burner, support the National Improved Cookstove Program in scaling successful cookstove entrepreneurs, and market renewable energy and energy-efficient credit lines through the Development Bank of Ethiopia and MFIs. Investment in a risk capital fund could also stimulate early stage entrepreneurs to develop new businesses and later scale to become eligible for the credit line.

309. **Invest in grid expansion and institutional capacity to be able to scale.** There should be more focus on increasing the rate of household connections and improving operational efficiency in managing a growing customer base. As the customer base grows across the country, EEU will be challenged to operate and maintain increasingly remote electric systems. A feasible option to maintain adequate standards of service is to outsource to local private providers functions such as meter reading, bill delivery and collection, and operation and maintenance activities for low-voltage service in remote electrification schemes. The challenge of building and serving a larger customer base will also require increased logistical support and capacity building of EEU staff. Densification has been largely funded by donors; going forward, government budget could, more strongly, support development.

5. Toward implementation of the recommended pathways

5.1. Approaches for rapid green and resilient growth

310. **Ethiopia is committed to a development trajectory to become a middle-income country by 2025 with a green growth and low-carbon strategy**. Ethiopia is one of only five countries with sufficient INDC commitments to meet the global 1.5-degree temperature rise target–demonstrating Ethiopia's level of ambition.

311. **Ethiopia has already made impressive headway towards its CRGE goals in terms of its GTP I achievements and GTP II targets.** But to meet the ambitious objectives in the CRGE Strategy, Ethiopia needs to continue to involve all sectors in a fundamental structural transformation of the economy. It will require a holistic perspective on the development of the country and much attention to an efficient utilization of resources and human capital in all sectors.

312. **The CEA focused on the trajectories currently being taken by four inter-related clusters critical for Ethiopia's long-term development objectives: (i) resilient rural landscapes, (ii) green industrialization, (iii) sustainable urbanization and living conditions, and (iv) sustainable energy production**; these were discussed in Chapter 2 in terms of the ambitions of the CRGE Strategy and the concrete plans of the GTP II, along with relevant environmental trends and recent experiences.

313. **To realize a greener future, various challenges in the enabling environment need to be addressed**, as discussed in Chapter 3. While Ethiopia's legal framework for environmental management is generally sound, the key challenge is in implementation and enforcement. Credible enforcement provides a level playing field for investment. Improving compliance with laws will require better coordination, monitoring, communication, participation, and more resources. Improved coordination is particularly important for resources such as land, water and energy that have competing uses and cut across sectors. Other cross-cutting challenges include obstacles to the structural labor transition from rural to urban areas and the looming implications of climate change, which threatens water regimes, agricultural production, and infrastructure investments.

314. **Ethiopia can take concrete actions to address these challenges by following the pathways described in Chapter 4. A range of interventions are needed, and many need to be carried out in tandem to achieve synergistic outcomes.** All clusters will benefit from a combination of improved institutions (including legislation and enforcement), incentives (including market signals and policies), information (including easily accessible environmental data) and investments, in physical, human and environmental capital. The sequencing of such actions is discussed in Section 5.2.

315. **The recommended pathways to achieve CRGE and GTP II objectives sustainably all share common elements:**

- ***Integrated planning and implementation.*** Given how intertwined the various environmental resources are, it is important to reflect this interconnectedness in how resource use is planned and managed. This has important implications for the organization at federal, regional and local levels;
- ***Evaluation of competing uses of resources.*** Resources such as land, forest, water, biodiversity, and energy have multiple uses. Careful valuation and optimization of alternative uses, taking into consideration long-term environmental and social implications, is important to enable efficient utilization;
- ***Transparency in information provision.*** Behavior can only be truly efficient if all actors have full information about the real costs and benefits of their actions. Information should therefore be in the public domain to ensure that it is available to everyone. Corresponding investment in information modernization is critical;
- ***Consistent implementation of regulations.*** For market forces to come into play, and to maintain the credibility of environmental enforcement, it is important that environmental regulations are perceived to be well-founded, fair, well-monitored and enforced equally across the board.

5.2 Actions, lead actors and sequencing

316. Ethiopia has embarked on a green development paradigm and efforts to implement it have already led to encouraging results attained during GTP I. But the work has only just begun. The CEA has identified large-scale trends – resilient landscapes, industrialization, urbanization, and growing energy needs – that are affecting Ethiopia's growth and development trajectory. The CEA also identified the need for stronger policy and institutional frameworks for managing the environmental issues and risks coming from these large-scale trends. Recommended actions for improved institutions, incentives, information and investment recognize that some actions can be done relatively soon with existing resources and capacities and others will have to be phased in as capacity is developed, new resources are identified, and consensus is developed on priorities.

317. The summary tables below summarize the CEA recommendations thematically and identify the key responsible agencies, as well as the sequencing key actions for near-term versus medium-term implementation. The CEA analysis first considered "quick win" actions for near-term implementation within a year or two. This includes actions to begin analysis and data gathering, raise awareness, and revitalize existing institutions and processes. Quick win actions are based on existing mandates, and envision increased visibility of enforcement, together with building networks and consensus that will be needed in the longer term.

318. The sequencing analysis also considered medium-term needs, including more complex, innovative or comprehensive interventions that could take several years to plan, organize and implement. This grouping of medium-term needs includes scaling-up of successful efforts, institutionalized capacity building, design and development of new institutional structures and laws, and infrastructure investments that require planning, design and resource mobilization. The resulting table summarizes many of the CEA's key findings and recommendations in a practical and actionable manner.

Institutional strengthening for green transformation

319. Key challenges for improving environmental management are institutional coordination and communication, and implementation and enforcement. Communication and coordination horizontally and vertically across key agencies is critical for managing the complex challenges associated with Ethiopia's green growth path. Improving compliance means also improving coordination, monitoring, communication, participation, and more resources. Improving environmental management, compliance and outcomes will also require greater participation and engagement of Ethiopian society. Experience from other countries indicates that market-based policies can help to improve compliance, while "command and control" approaches may have high transaction and enforcement costs. Better data and analysis on the economic values of natural resources–land, water, forests and natural areas are typically under-valued – would contribute to better decision making on policies, investments, and interventions.

Themes	Recommended Actions		Lead Agencies
	For near-term implementation	For medium-term implementation	
Effective vertical and horizontal coordination in environmental management (4.1.1, 4.1.2)	• Establish a national advisory body to replace the EPC • Convene regular inter-ministerial consultation platforms/processes	• Institutionalize a coordination framework between MEFCC, relevant sectoral ministries, and regional/local government agencies	**Prime Minister's Office**
Coordinated land-use planning amid increasing competition for land and water resources from different sectors (4.1.1, 4.1.2, 4.4.1, 4.4.2)	• Enhance and formalize participatory land use planning processes, including dispute resolution mechanisms • Review policy alignment across different sectors in relation to land and water resources	• Consider need for and mandate of a high-level agency focused on land administration and use • Integrate biodiversity considerations into land-use planning • Develop plans for multisector institutional response on key challenges such as land degradation, drought, water, off-grid HH and grid-connected hydropower energy, protected areas, forest and fire	**Prime Minister's Office**
Compliance and enforcement of environmental regulations, including effective implementation of EIA/ESIA (4.1.1, 4.1.2, 4.3.3, 4.4.1)	• Review budgets allocated for compliance monitoring and enforcement actions • Review existing compliance reporting mechanisms and improvement needs • Make MEFCC responsible for reviewing and enforcing EIA/ESIA • Prepare SEA regulations in a concerted and collaborative way with sector ministries, especially water, forest and mining • Set up a coordination framework that facilitates information sharing and joint-supervision of development projects that have been subjected to EIA/ESIA	• Review mandates for enforcement, especially at decentralized level • Review rules to remove improper incentives for licensing as a revenue source; • Consider voluntary compliance and reward system • Impose and enforce mandatory disclosure of EIA, ESIA and related monitoring reports • Require implementation of SEA regulations for environmentally sensitive sectors such as water, mining, petroleum, forest • Monitor decisions and implementation and feedback results, synergies and trade-offs	**MEFCC**

Resilient rural landscapes

320. The rural landscape, forests and watersheds, agriculture and livestock activities are the backbone of Ethiopia's economy and a key focus for development. Ethiopia is a leader in landscape restoration and has restored millions of hectares of land, mostly agricultural, benefiting millions of rural people. Managing these landscapes – land, water, agriculture and forest resources – effectively and sustainably is a key element of the green and resilient economy objectives, which include reducing deforestation and increasing forest cover. Water is also essential for agriculture, forests, and rural livelihoods, as well as energy. Integrated and sustainable landscape actions (policy, institutions, incentives, investments) can help to meet future needs from agriculture, industry and energy, as well as the challenges of climate change. These recommendations aim to address key challenges that will be faced in building resilient landscapes, including the need for strengthened coordination among sectors and stakeholders (farmers, private sector, etc.), planning, resource allocation and incentives.

Themes	Recommended Actions		Lead Agencies
	For near-term implementation	For medium-term implementation	
Scaling-up of sustainable approaches for building resilience of rural landscapes (4.1.1, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.4.2)	• Convene, coordinate and target sectoral investments at the landscape level–forest, water, HH energy, irrigation, livelihoods, and safety nets–to manage trade-offs and harness synergies in line with the FDRE's new Multisector Investment Plan for Climate Resilience • Scale-up PFM and continue to scale up SLM • Review and enhance the spatial and temporal alignment of different investments/programs and projects such as SLMP, AGP, PSNP, etc. • Continue to pursue REDD+ results-based payments under REDD+ National Strategy and OFLP • Study Payment for Environmental Service schemes and consider local application options • Assess and propose sustainable financing options for protected area management.	• Continuously strengthen inter-agency cooperation and accountabilities in the planning and implementation of large-scale landscape programs • Consider ways to scale up investment in timber processing for construction, electricity poles, furniture and other products needed in a growing green economy • Strengthen access to hydrological, forest, soil, and climate information for resilience planning and investment	**MoANR, MEFCC, plus other relevant ministries responsible for livestock, energy, water, and roads, with active support from MOFEC and NPC**
Enhancement of incentives for building resilience by strengthening individual and community land rights (4.1.1, 4.2.1, 4.4.2)	• Build on existing successful programs for further scaling-up of second-level land certification. • Consider lifting restrictions on land rental transactions. • Examine policies on use of land as collateral for banking transactions.	• Design and implement scaled up programs for improving tenure security as a base for improving investment in individual and communal land. • Examine sustainability of financing arrangements for second-level land certification. • Consider approaches for agricultural land consolidation.	**MoANR and MEFCC** **Prime Minister's Office**

	• Examine, harmonize and enhance policies, legal rights and incentives for management of communal land, forests, water systems – such as Oromia's development of its forthcoming declaration on communal tenure.	• Consider establishing an autonomous land administration entity to oversee issues related to tenure and use according to the value of land in rural, peri-urban and urban areas.	
Enhancing rural resilience and capacity for adaptation to climate change (4.3.1, 4.3.2, 4.3.3, 4.4.2)	• Amplify the effort to mainstream climate resilience into all sector/project investment planning and implementation, such as by incorporating relevant adaptation indicators. • Prioritize rural investment according to the FDRE's new Multi-Sector Investment Plan for Climate Resilience (agriculture, forest, livestock, water, energy).	• Plan early enough for medium- and long-term solutions for the more severe climate impacts that will occur mid-century. Uncertainty of future climate outcomes implies the need for a risk-based investment planning approach coupled with actionable quantitative research. • Increase youth employment through environmental infrastructure projects such as water, energy, roads, soil and water conservation structures, irrigation.	**MEFCC, NPC, MOFEC with all sectors**

Green industrialization

321. Industrialization is key to the GTP II growth ambitions. The following recommendations aim to strengthen the management of the process to prevent air, water and toxic pollution and other environmental impacts that can accompany unregulated industrialization, in line with the CRGE initiative. This will require investments in new technologies and waste treatment facilities for waste treatment, but also incentives and institutions that support a greener industrial development trajectory. Putting the right policies and incentives in place now can help to shift the trajectory in a greener direction at this early stage, while avoiding a high pollution path adopted by previously industrialized nations. In particular, market-based signals are recommended as an efficient tool for moving firms toward improved environmental performance.

Themes	Recommended Actions		Lead Agencies
	For near-term implementation	For medium-term implementation	
Conducive environment for greening Ethiopia's industrialization including greening MSEs and SMEs (4.1.2, 4.2.1, 4.2.2, 4.4.1, 4.4.2, 4.4.3, 4.4.4)	• Prepare a sector-wide strategy to improve green industrialization (consultative)–beginning with industrial parks; • Enhance capacity of IPDC and EIC for establishing environmental standards (with MEFCC and MOI); • Plan for raising private sector awareness of green industrialization benefits; • Improve access to clean energy sources; • Develop strategic plan to deploy performance targets, fiscal incentives, and new technologies to reduce and prevent industrial pollution; • Consider policy or regulatory means to ensure that "polluter pays" principle is put into practice; • Consider pros and cons of applying economic instruments (fees, taxes, subsidies, etc); • Study options for deploying economic instruments in specific sectors to reduce emissions, improve fuel /water efficiency; • Enhance efforts to build "eco-industrial parks"	• Invest in learning lessons from industrial park experience to influence wider replication and improvement of investment enabling conditions; • Review and fine-tune GoE investment incentives (e.g., tax breaks, import waivers) to ensure harmonized approach; • Include incentives to promote energy-efficient technologies; • Consider preferential credit approaches to promote investment in waste treatment; • Consider means for clustering MSEs and MSEs so that treatment costs and energy supply can be more cost effective and efficient; • Plan actively for the adoption and roll-out of specific instruments, chosen as priorities for enhancing achievement of CRGE Strategy; • Promote investment in energy-efficient technologies; • Prioritize dirty industries for cleaner, low emission technologies.	**MOI, with IPDC, EIC, MOFEC and MEFCC**

Sustainable urbanization and transport

322. Ethiopia expects continued rapid urbanization from the current mostly rural conditions. Concentration of people in urban environments can have important economic benefits, but can also result in costly pollution and congestion. Facilitating a smooth transition to a more highly urbanized economy and population will require attention to employment needs, living conditions and quality of life in the urban areas, while also managing the rural transformation as people migrate from agricultural livelihoods to urban employment opportunities. Achieving this will require improved land management processes and better coordination between urban and transport planners in Ethiopia's growing urban centers. There is also a need to set plans and policies for the sustainable transport and motorization needs associated with rapid urbanization. The following recommendations indicate key steps toward a more sustainable path.

Themes	Recommended Actions		Lead Agencies
	For near-term implementation	For medium-term implementation	
Realizing sustainable urbanization, cities and transport systems (4.1.3, 4.2.3, 4.4.4)	• Consider urbanization as one element of a resilience strategy in concert with other actions; • Build into longer term plans: climate-friendly transport, waste recycling systems, soft urban infrastructure for flood protection, green spaces and waste management; • Consolidate existing planning and analysis efforts to prioritize "no regrets" options for motorization; • Establish a core team of urban and transport planners to begin consolidating and generating knowledge; • Analyze and propose options for using/allowing landholders with certificates to rent rural land to facilitate the urban transition; • Recognize and promote the importance of secondary cities and towns in the rural-urban transition; • Provide incentives for generating green jobs in urban areas; • Review import regulations to streamline incentives for newer, cleaner technologies, including vehicles; • Scale up investment in resilient infrastructure–include investment in roads, transport, energy etc.	• Adopt a dynamic urban planning approach that balances long-term "master" planning with "quick" planning; • Plan road and rail grids for urban expansion and public transport; • Plan open and green spaces in future urban designs; • Assess additional policies to advance labor and land productivity in rural areas; • Advance efforts to formalize informal sectors to improve enterprise performance, increase environmental compliance, and contribute to cleaner urban environment; • Coordinate and target sectoral investments in electricity, water, roads, solid and liquid waste management and safety nets to manage trade-offs and harness synergies.	**MoUDH, MoT, MoANR, MOFEC with other agencies**

Sustainable energy

323. Moving to a more sustainable energy trajectory means taking action on both traditional and modern energy sources. Currently, wood and biomass from the landscape is the dominant household energy source, but it contributes to deforestation, forest degradation, erosion, runoff, and reduced soil fertility. There is a need for enhanced regulation and management, as well as rehabilitation. To meet ambitious urbanization and industrialization trends, use of modern energy sources—petroleum products and electricity—will need to increase. These modern sources can also help reduce pressure on the landscape from traditional energy sources. Improving energy sector outcomes will mean reducing institutional fragmentation and getting prices right for utilities delivering services, among others.

Themes	Recommended Actions		Lead Agencies
	For near-term implementation	**For medium-term implementation**	
Enhanced sustainable energy production, distribution and access (4.1.1, 4.1.4, 4.2.2, 4.2.4, 4.3.2, 4.4.2, 4.4.4, 4.4.5)	• Increase access and reliability of clean electricity: expanding grid-based power, as well as off grid use of biomass, biogas, ethanol; stoves for cleaner, safer HH energy use; • Enhance coordination between institutions responsible for energy supply (electricity, cook-stoves, biofuel, ethanol, wood fuel) • Build hydromet information and capacity to support planning and management of hydropower expansion (and water resources management more broadly); • Improve operational efficiency and cost-recovery in electricity delivery – expanding the customer base and professionalizing meter reading, bill delivery and collection; • Assess sectoral opportunities for improved pricing for cost recovery and reducing inefficiencies; • Provide power saving devices and power generating schemes either by the government or private sectors; • Replace old with new technologies, invest in electricity expansion including off-grid (e.g. mini hydro, solar), upgrade quality of transmission lines; • Assess ways and means to lower cost and increase investment in alternative energy sources for low income households.	• Expand the grid to achieve close to national electrification coverage; • Build on existing plans to diversify the energy mix to include solar, geothermal and wind farms; • Consider capital fund to stimulate early stage entrepreneurs on the energy sector; • Establish or augment national energy policy to cover electrification plus other renewable sources; • Assess legal means and public consultation steps needed to institute or revise pricing regimes; • Develop implementation plan for roll out of pricing options; • Explore and implement enabling policies and conditions for power sector investments.	**MOWIE, MEFCC, MoANR**

Information for resilient green growth

324. Accessible, high quality information will help improve environmental management and outcomes. A strong evidence base is needed so that resources are well-managed, regulations are well-enforced, and incentives and policies effectively implemented. Better knowledge of the economic values of Ethiopia's natural resources and environmental assets will strengthen decision making and the efficiency of resource allocation. This will require investment in the capacities and technologies to generate and share such information. Providing environmental and compliance information to the public can be a low-cost, effective policy tool. Information can also improve public awareness among all stakeholders about the importance of moving to a greener development trajectory.

Themes	Recommended Actions		Lead Agencies
	For near-term implementation	For medium-term implementation	
Valuation of environmental and natural resources for improved decision making (4.3.2)	• Improve cost-benefit analysis and valuation efforts of projects; • Undertake/prioritize training on environmental economics for key staff; • Improve environmental economics curricula in universities; • Accelerate ongoing efforts to establish an effective MRV system for GHG emissions.	• Build on technical analyses and improve values/understanding for key issues (mining, pollution, biodiversity, non-market valuation of resources); • Introduce natural resource accounting with special focus on ecosystem services, based on the UN System of Environmental-Economic Accounting (2012).	**MEFCC**
Increased use of information disclosure as a policy tool (4.3.3)	• Identify key items that can be disclosed now; • Establish MEFCC website for environmental information; • Consider incentives for voluntary private information disclosure.	• Expand awareness programs with sector specific information, warnings to consumers; • Encourage banking "know your customer rules" that improve disclosure of private practices; • Assess effectiveness of disclosure programs in terms of agents' practices and outcomes; • Consider implementing disclosure programs to manage pollution cost-effectively.	**MEFCC**
Effective environmental information management system (4.3.1)	• Fulfill major tasks assigned to the State of the Environment and Trend Preparation Directorate (SETPD) which collects, collates information and prepares the state of the environment report; • Operationalize an Environmental Data and Information Management System as part of SETPD.	• Develop processes and standards to convene data and information in existing sector specific and project-specific information systems (geo-spatial, pollution, soils, water, climate, infrastructure, etc); • Strengthen internet function for information and data sharing.	**MEFCC**
Information for assessment, learning and adaptive management (4.3.1, 4.3.2, 4.3.3)	• Develop long-term CRGE-focused impact evaluation programs in think tanks and universities; • Establish and gather input on research agenda on key themes;	• Assess impacts of existing CRGE programs; • Use positive and negative examples as cases in capacity-building efforts.	**Think tanks with other implementing agencies**

	• Develop baseline data suitable to follow major interventions; • Commission studies, analyze and publicize opportunities for green industrialization;		
Build information base on pollution and natural resources (4.3.1, 4.3.2, 4.3.3)	• Commission studies to fill gaps on indoor and outdoor air pollution, water pollution, and interpretation;	• Further study the impacts and economics of these issues, and incorporate evidence into investment and policy; • Consider developing a public disclosure program such as PROPER to reduce pollution;	**MEFCC, and think tanks**
	• Commission studies to fill gaps on groundwater, mining, biofuel, pollution, hydrology, weather data and interpretation.	• Study the impacts and economics of these issues further, and incorporate evidence into investment and policy.	**MOWIE, National Meteorology Agency, MEFCC, and think tanks**

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Annex A: Supplement to Chapter 2 trajectories

1. **The estimated costs of land degradation and climate change on agriculture and forestry are significant and could hinder the targets set for reaching middle-income status by 2025.** The Climate Resilience Strategy for Agriculture and Forestry, indicates that under some extreme scenarios the impact of climate change on all sectors could reduce 10 percent or more of GDP, by 2050 (FDRE, 2015). Moreover, the impact of unsustainable land use and inefficient land management costs about 3 percent of Ethiopia's agricultural GDP (FDRE, 2015; Sonneveld 2002; Barry 2003). Soil erosion is another hazard affecting the agriculture sector, estimated to reduce agricultural GDP by 2 percent to 3 percent (around 1 percent of total GDP). There have been significant improvements made through sustainable land management activities implemented over the last couple of decades as the government has rightly prioritized natural resource management since the early 1990s and has achieved a great deal. The government estimated that the area of land with at least a minimal level of community watershed management (the main government response to tackle land degradation) was 12 million ha at the end of GTP I (2014/15). The GTP II target is to increase this area up to 41 million ha by 2019/20 (FDRE 2016b).

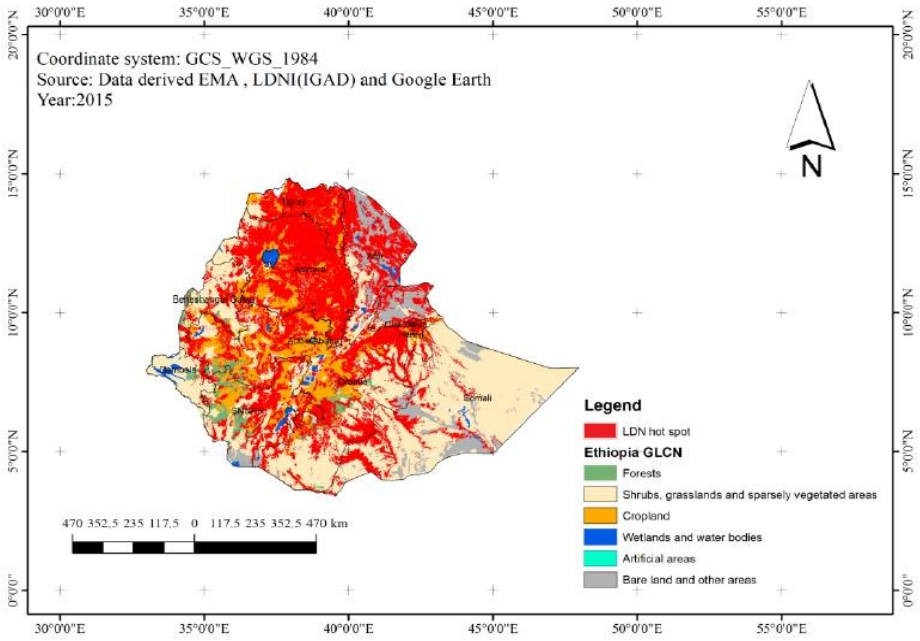
2. **Land degradation, through soil erosion and soil nutrient depletion, is a significant problem in Ethiopia, with recently identified hotspots covering approximately 14 percent of the country (Figure A.1 and Table A.1)**. Degradation of the land resource, which is the main source of livelihood and buffer against risks for poor people, undermines agriculture, drives forest loss and degradation, compromises water bodies' usefulness for energy and irrigation, and causes streams to dry up. Once the land is truly exhausted, it can drive migration or entrench poverty. As Figure A.1 shows, the Amhara region has the largest degraded area, followed by Oromia and Tigray.

Table A.1. Location and Size of Land Degradation Neutrality (LDN) hotspot areas

Region	Total land size (ha)	LDN Hotspot area (ha)	Percent
Addis Ababa	52,700	386	0.7
Afar	7,205,300	1,382,293	19.2
Amhara	15,470,900	5,811,820	37.6
Benishangul Gumuz	5,069,900	314,782	6.2
Dire Dawa	121,300	28,404	23.4
Gambella	2,978,282	62,125	2.1
Harari	33,400	3,625	10.9
Oromia	28,453,800	2,675,890	9.4
SNNP	10,588,718	944,197	8.9
Somali	27,925,200	1,055,774	3.8
Tigray	4,140,995	2,005,986	48.4
Total	**102,040,495**	**14,290,010**	**14.0**

Note: The United Nations Convention to Combat Desertification (UNCCD) Intergovernmental Working Group (IWG) current working definition of Land Degradation Neutrality (LDN) is "a state whereby the amount of healthy and productive land resources, necessary to support ecosystem services, remains stable or increases within specified temporal and spatial scales." (FDRE, 2015a)

Figure A.1. National map of degraded areas



Source: FDRE, 2015a

3 **Possible direct impacts from mining on land and forests entail deforestation linked to the development of roads, deforestation for the excavation of mines, accumulated waste from excavated minerals and earth remaining waste rock, equipment, and population influx resulting in new settlements associated with the mining activities** (Hund et al., 2013). Building a sustainable mining sector calls for integrated planning to manage the use of land, water, and other resources. As Ethiopia's mining sector is still in its infancy the country can learn from these experiences. Compared to other economic activities (for example, agriculture), the area deforested as a direct result of mining is fairly limited. However, restoring forest ecosystems is challenging and costly. Indirect impacts of mining can cover a much larger area and are often related to infrastructure development associated with the (large scale) mineral development, and may include road and/or rail development for the transport of minerals in the region where the mine exists and possibly hydropower plants to supply the often energy-intensive mining industry. Mining operations are also often accompanied by a large influx of workers looking for jobs. They can bring additional activities—such as subsistence agriculture, logging, and poaching—with potentially significant harm to forests.

4 **Road and railway development associated with mining can be particularly harmful** (Hund et al., 2013), if proper environmental impact mitigation measures are not implemented. Building a new road means direct deforestation by tree cutting, but this impact is generally limited. More importantly, roads are the major vehicle for forest degradation through incursion into forest areas for agriculture, hunting, artisanal mining, and other potentially harmful activities. In addition, roads can fragment wildlife habitat. At the same time, road and railway development are part of Ethiopia's growth plans, promoting mobility as discussed above in connection with urbanization, and enhancing market access for agricultural inputs and outputs. This points to the importance of integrated cross-sectoral planning. For example, integrated planning of the development of mines and the necessary transportation infrastructure will require mitigation of both direct and indirect environmental impacts on a landscape scale, and can use benefit-cost principles to maximize welfare and minimize negative impacts for each road or rail project.

5 **Artisanal and small-scale mining (ASM) for gold and opal in Ethiopia is a growing sector and a crucial one for many local communities' livelihood (Pact, 2015) as well as for the country's export revenues.** However, the mining activities can have negative impacts on the environment, which not only have deleterious effects on human health but threaten the viability and sustainability of the artisanal mines themselves (Box A.1). While the effects are relatively localized, seen from a sectorwide perspective, the environmental impacts are of grave concern, primarily because of the ASM sector's fast

growth, its informality, lack of data, lack of understanding of environmental, health and safety issues amongst miners themselves, and currently insufficient planning processes to guide and support responsible mining. Under current Ethiopian law, only small- and large- scale mining operations require an Environmental Impact Assessment (EIA) to be done prior to commencement of mining activities. Artisanal miners are not, however, obliged to undertake EIAs (Pact, 2015), nor would it be feasible to require them to undertake studies of the same scope and nature as large-scale mines. Because of this regulatory void, the environmental impacts of ASM are not mitigated, and abandoned ASM sites are not rehabilitated.

Box A.1. Environmental impacts from opal and gold ASM in Delanta and Shakisso Woreda

Opal is mined from seams in steep rock faces in Delantaworeda, while gold miners in Shakissoworeda redirect portions of the river to wash and pan for gold (Pact, 2015). Slopes are destabilized and water courses are filled with silt. These artisanal mines have few or no environmental risk mitigation measures in place to address these and many other environmental impacts of mining (Pact 2015). Such measures could include anything from bunds, gabions and terracing to reforestation, backfilling, and area closures. Perhaps, more important, is raising awareness, training miners about existing environmental regulations, and effective enforcement of these rules.

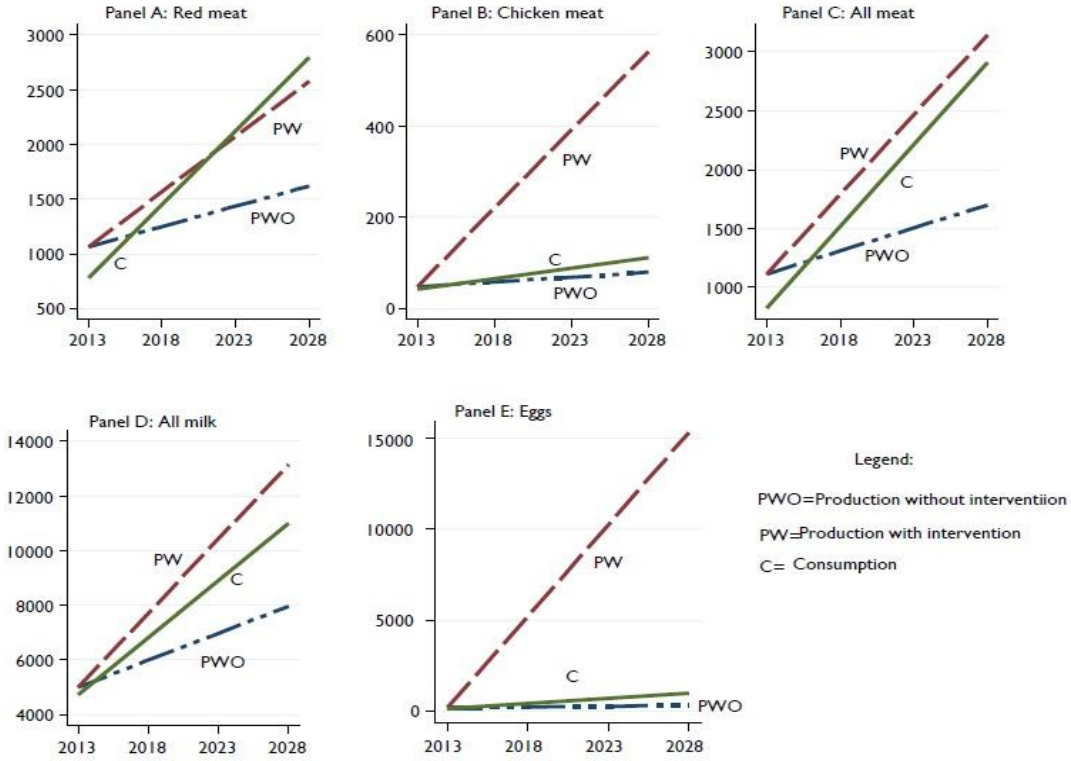
6 **Effects of land degradation become more important when off-site effects are considered.** The off-site environmental effects of land degradation due to soil erosion and deforestation include its effect on the biodiversity of the country and on many ecosystem services (e.g., nutrient cycling and soil formation), regulating services (e.g., flood regulation and water purification), and cultural, spiritual and recreational services for the present and future generations. The total value of land ecosystem services for Ethiopia is estimated to be about US$206 billion and the annual cost of land degradation is about US$4.3 billion (Nkonya et al. 2016). The same study also indicated that, while about US$2.2 billion (51 percent) of this cost of land degradation represents the provisioning ecosystem services, the other (49 percent) represents the supporting, regulatory and cultural ecosystem services. Land degradation is also an important contributing factor for emissions of greenhouse gases (GHG) from agricultural lands (FAO 2016).

7 **Land degradation is caused by several immediate factors, including unsustainable practices such as free grazing and tree removal from farmland, plowing on steep land, and continuous tillage.** Underlying causes also include high population pressure and associated insecure land access and land concessions, deforestation and forest degradation, as well as droughts and floods that are amplified by climate variability and change. All these drivers are mutually reinforcing. For example, insecure land tenure is a disincentive for farmers to invest in the land resource.

8 **Ethiopia's strong economic growth slowed down slightly in FY16 due to the recent drought** (World Bank WDI and Macro Poverty Outlook, 2016). The drought caused by the El Niño phenomenon is estimated to affect the economy negatively through reductions in food production; hence the GDP growth rate is projected at 8.4 percent in FY16 (GOE estimates 8.5 percent; IMF estimates 6.5 percent), lower than the 10.2 percent growth in FY15. Yet, the growth impact is lower than originally envisaged; according to GOE crop data released in July there was a less than expected agriculture production impact partially due to good crop production during the second season harvest of FY16. On the downside, growth could decrease to 7.5 percent if industry and service sector were not to perform as strongly as expected. It is important to note that some areas coped well with water stress because of significant watershed restoration works.

9 **A Livestock Sector Analysis (LSA) shows a positive production-consumption balance from 2013 to 2028 with LMP interventions for chicken meat, all meat, all milk and eggs** (Figure B.2). If the proposed investments in LMP were successfully implemented, with 57 percent and 43 percent from the public and private sectors respectively, they could eliminate extreme poverty in approximately 2.36 million livestock-keeping households, helping family farms move from traditional to improved market-oriented systems.

Figure A.2. Production and consumption projections from 2013 to 2028 with and without LMP interventions



Source: Based on the Livestock Sector Analysis (LSA) results, Shapiro et al., 2015.

10 **The agriculture, forestry and livestock sectors are the most vulnerable to climate change.** Extreme weather variability could lead to an estimated decline in agricultural and livestock productivity of 3 percent to 30 percent by 2050 (FDRE, 2015c). The livestock sector is particularly sensitive to increases in temperature, with estimates suggesting that livestock revenues alone could decrease by 50 percent by 2050, impacting pastoralists' livelihoods (FDRE, 2015c). Coffee, one of Ethiopia's main export commodities, is also vulnerable to climate change. Based on climate change scenarios, the areas suitable for wild coffee production could be reduced by 40 percent to 90 percent by 2080. If similar reductions should occur for commercial coffee, this would lead to a 30 percent reduction in export value by 2030 (FDRE, 2015c).

11 National and regional parks; wildlife sanctuaries, reserves, and hunting areas; controlled hunting areas; botanical gardens; biosphere reserves; national forest priority areas are shown in Table B.2.

Table A.2. Protected area systems of Ethiopia

Types of protected area systems	Total (No.)	Area coverage (ha)
National parks	19	3,532,300
Wildlife sanctuaries	2	703,600
Wildlife reserves	3	1,864,500
Controlled hunting areas	20	800,100
Community conservation areas	6	228,000
Wildlife rescue centers	2	n/a
Community-managed eco-tourism and hunting areas	2	228,000
Open hunting areas	6	66,800
Commercial ranches	3	n/a
Botanical gardens and herbariums	2	n/a
Biosphere reserves	4	1,642,100
National priority forest areas	80	n/a
Municipal parks	3	n/a
Land occupied by research centers, governmental institutions	36	n/a

Source: Young (2012)

12 **Ethiopia plans to increase its foreign currency during the GTP II period through increased production of log products as well as forest gums and incense.** The country also plans to increase the annual production of wood industries to 700,000 tons for domestic use by 2019/20 (see Table A.3).

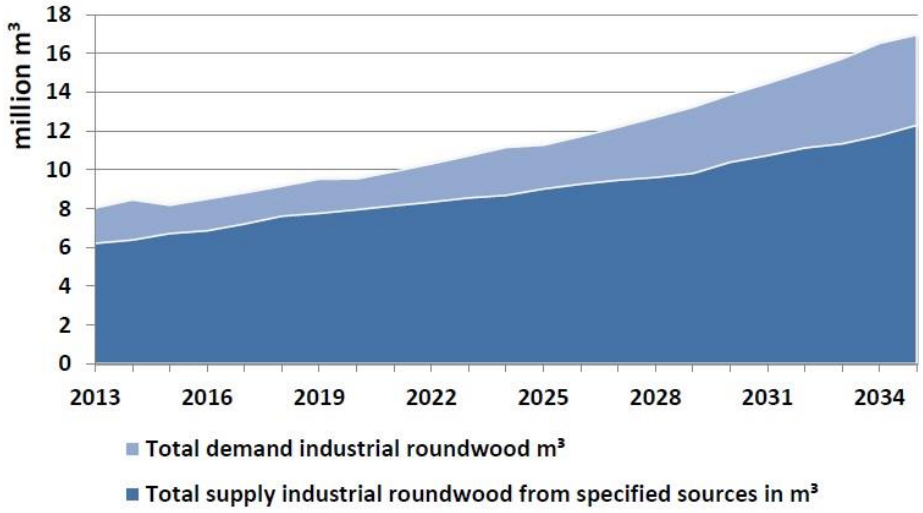
Table A.3. GTP II targets to increase the forest sector's contribution to the national economy.

Target	Unit	2019/2020
Forest development for forest-industries inputs (timber and chipwood) (in millions)	Hectares	1.13
Forest development for fuelwood and construction purposes (in millions)	Hectares	3.4
Plant trees for incense production	Hectares	500
Plant trees for forest gums production	Hectares	5000
Develop Small- and Medium- Forest Enterprises (SMFE) based on forest products (in millions)	Number	1
Create employment opportunities for almost 2 million people (women, youth and low-income groups) in SMFEs	Number	2
Increase annual production of wood industries and provide to the local market (in thousands)	Tons	700
Produce wood for construction (in millions)	M^3	33.27
Produce wood for power lines and telecommunication cables (in millions)	M^3	7.5

Source: FDRE (2015e)

13 **Industrial wood and NTFPs are important contributors to the economy.** Ethiopia even imports wood products as the total demand for industrial roundwood exceeds supply (MEFCC, 2015). The demand for Ethiopian industrial roundwood is expected to increase from about 8 million m^3 in 2013 to about 16 million m^3 by 2033 while supply is lower than demand (MEFCC, 2015) (Figure A.3). NTFPs have important contributions to the GDP of Ethiopia as shown in Table A.4. Ethiopia's imports of wood and bamboo products are shown in Table A.5.

Figure A.3. Industrial roundwood scenario 2013-2033



Source: MEFCC (2015)

Table A.4. Contribution of NTFPs to the GDP of Ethiopia

Type of NTFPs	Total annual gross value (Billions of ETB)	Equivalent in Billions of USD
Honey	2.20	0.1
Beeswax	0.15	0.007
Forest and semi-forest coffee	11.60	0.53
Fodder	3.05	0.14
Gum and incense	0.17	0.008
Traditional pharmaceuticals	2.66	0.12
Bamboo	0.06	0.003
Spices	0.02	0.001
Total	20.10	0.91

Source: MEFCC, 2015

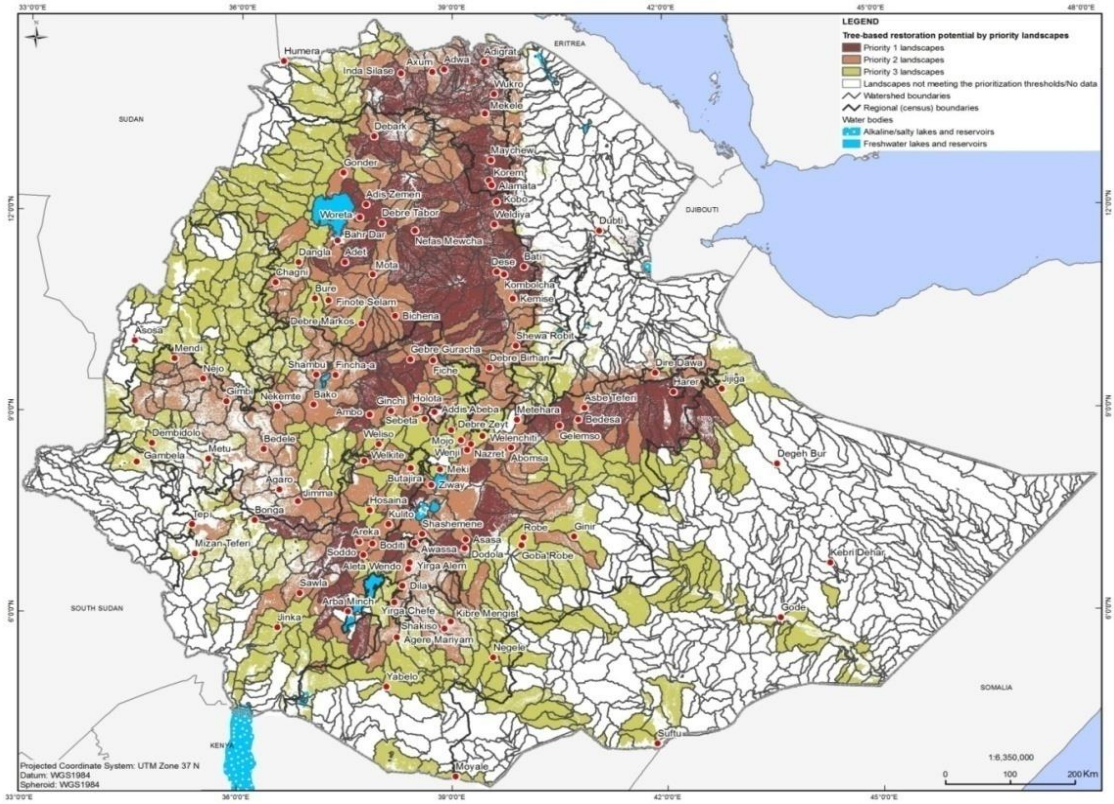
Table A.5. Ethiopia's imports of wood and bamboo products in 2014

Imports	Value in USD
Furniture of bamboo or rattan	10,000
Wood in the rough (including treated and untreated)	1,622,000
Wood pulp (both mechanically and chemically pulped)	3,000
Wood, sawn or chipped lengthwise, sliced or peeled	1,081,000
Wooden frames for paintings, photographs, mirrors …	609,000
Wooden furniture (including office and household furniture)	21,161,000
Wooden server racks	19,000

Source: Compiled based on Ethiopian Revenue and Customs Authority (ERCA) data, 2015

14 **The National Tree-Based Landscape Restoration Potential Map, a collaborative project between the MEFCC and the World Resources Institute, Figure A.4, identified ten Forest Landscape Restoration options[32] and categorized the options by their level of urgency into three priority levels.**

Figure A.4. National priority landscapes (Version 1.0)



Priority 1 (11 M ha): individual ranking ≥ 5 **OR** overall national ranking ≥ 42
Priority 2 (18 M ha): overall national ranking ≥ 34
Priority 3 (25 M ha): overall national ranking ≥ 23

15 **According to Ethiopia's REDD+ Readiness Preparation Proposal (R-PP), the forest sector is responsible for annual emissions of 65 Mt of CO_2e, about 40 percent of the national GHG emissions (Moges and Tenkir, 2014).** This is mainly attributed to deforestation for agricultural land (50 percent of all forestry-related emissions), followed by forest degradation due to fuelwood consumption (46 percent), as well as formal and informal logging (4 percent) (FDRE, 2011). Under BAU, the emissions will grow from 26 Mt CO_2e in 2010 to 44 Mt CO_2e in 2030 due to deforestation for agricultural land expansion, from 24 to 41 Mt CO_2e due to fuelwood consumption, and from 2 Mt CO_2e to 3.5 Mt CO_2e due to logging (FDRE, 2011). Among the main drivers of deforestation and forest degradation identified are: subsistence

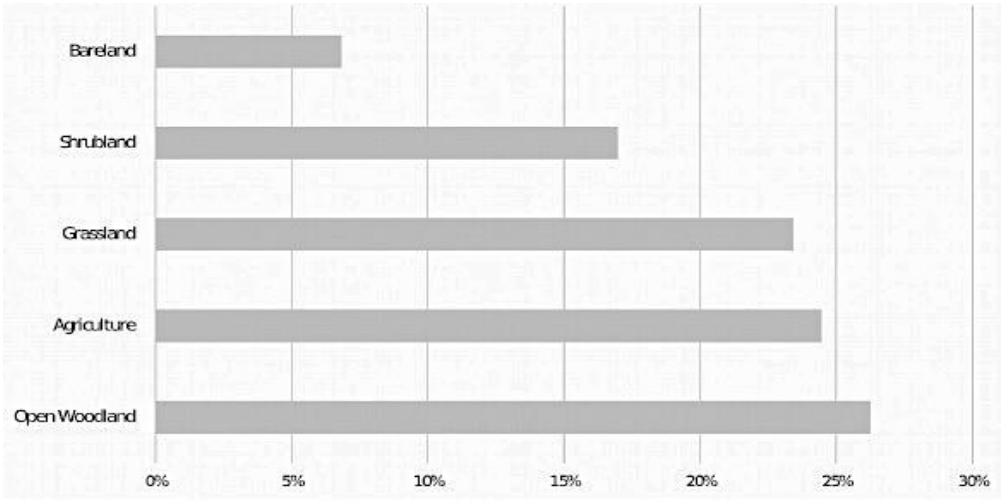
Source: MEFCC, 2016 – National Tree-Based Landscape Restoration Potential and Priority Maps (version 1.0)

[32] FLR options identified are: (i) Restoring degraded forest land, (ii) Restocking of degraded natural forest, (iii) Agro-forestry (agri-silviculture, silvo-pastoralism, agrosilvo-pastoralism), (iv) woodlot, (v) commercial plantation, (vi) tree-based buffer zones along river banks and boundaries of water bodies, (vii) tree-based corridors between biodiversity hotspots, (viii) tree-based corridors around religious forests, (ix) tree-based urban green infrastructure (urban parkland, road-side tree planting, buffer zones around water bodies, protected forest, etc.), and (x) road-side trees (outside of urban areas).

and commercial agricultural expansion, firewood collection, charcoal production, illegal logging, and forest fires. Indirect drivers of deforestation include increased population, cash commodity prices, migration into forested areas, road network expansion and lack of effective land use planning, and insecure land tenure.[33]

16 **Deforestation generated an economic loss of over US$5 billion from 1990 to 2010.** Projections in the CRGE Strategy indicate that, without action to change the country's development path, 9 million ha will be deforested between 2010 and 2030 (FDRE, 2011). Over the same period, annual fuelwood consumption could rise by 65 percent, leading to forest degradation of more than 22 million tons of woody biomass (FDRE, 2011). Ethiopia's Forest Reference Level (FRL) has estimated an annual forest loss of approximately 92,000 ha/yr and an annual forest gain of approximately 19,000ha/yr for the period 2000 to 2013 (FDRE, 2016c).

Figure A.5. Land uses replacing forest over the period 2000-2013 (as percent of the total forest loss over this period)



Source: FDRE (2016c)

17 **Forest fire is an increasingly important factor contributing to the loss of forests, affecting wildlife and their habitat.** Though the extent of damage is not recorded, a vast area of woodland, bushland and high forest areas is affected by fire every year. For instance, the most devastating forest fire that occurred in 2000 covered 151,500 ha of valuable high forests and an estimated 980 ha of natural coffee stands in the southern and eastern parts of Ethiopia (Bekele and Mengesha, 2001). The related cost was more than US$39 million, in the Bale and Borana zones alone (Lemessa, 2001). The wildfires in the year 2000 raised growing concern among government officials as well as international organizations. There is a need to develop national capacity to prevent and handle wildfires, but there is still no clearly defined institutional arrangement responsible for this, and large fires also occurred in 2008 and 2012.

18 **Direct impacts from mining entail deforestation that encompasses the following:** The site covered by roads, mines, excavated minerals and earth, equipment, and settlements associated with the mining activities (Hund, Megevand, Gomes et al, 2013). Compared to other economic activities (for example, agriculture), the area deforested due to mining is limited. However, restoring forest ecosystems is challenging and costly. Mining operations have an indirect impact on Basin forests by bringing infrastructure development to the region which, in turn, could lead to deforestation and forest degradation. Indirect impacts of mining can cover a much larger area and may include road development in the region where the mine exists and hydropower plants to supply the energy-intensive mining industry. Mining operations are also usually accompanied by a large influx of workers. They bring additional socioeconomic activities—such as subsistence agriculture, logging, and poaching—with potentially significant harm to forests.

[33] Study of drivers of deforestation and degradation conducted by Ethiopia's REDD+ secretariat (2015).

19 **Road and railway development could be particularly harmful (Hund, Megevand, Gomes et al, 2013).** Building a new road means direct deforestation by tree cutting, but this impact is generally limited. More important, roads are the major vehicle for forest degradation through incursion into forest areas for agriculture, hunting, artisanal mining, and other potentially harmful activities (see induced impacts in the following section). Road building can also have a significant impact on local wildlife populations through habitat fragmentation. Roads can become a barrier that some species are unable to cross, effectively reducing their available habitat.

20 **Nevertheless, under Ethiopian law, only small- and large- scale mining operations require an Environmental Impact Assessment (EIA) to be done prior to commencement of mining activities.** Artisanal miners are not however, obliged to undertake EIAs (see attached memo on environmental aspects of Proclamation No. 678/2010) (Pact, 2015). In Delanta woreda, opal mining occurs along horizontal seams perched halfway up steep relatively inaccessible slopes, and can go up to 100m into the rock face (Pact, 2015). Artisanal opal mining operations result in:

a. The destabilization of slopes (due to inappropriate support of shafts); -
b. Siltation of watercourses due to indiscriminate tailings disposal;
c. Loss of vegetative cover (chopping of trees for fuelwood and overgrazing by livestock (from influx populations); and
d. Fecal contamination from open defecation by miners and support groups.
e. In Shakisso woreda, gold mining is predominantly alluvial in nature, and consequently results in a run-of-river type process where miners redirect portions of the river to wash and pan for gold (Pact, 2015). These artisanal alluvial gold activities result in:
f. Erosion of the riverbank;
g. Siltation of the watercourse;
h. Potential changes to hydrology and natural drainage systems;
i. Increased sediment loads;
j. Mercury and DDT contamination (abandoned pits become vectors; for malarial mosquitoes);
k. Deforestation; and
l. Loss of productive agricultural land.

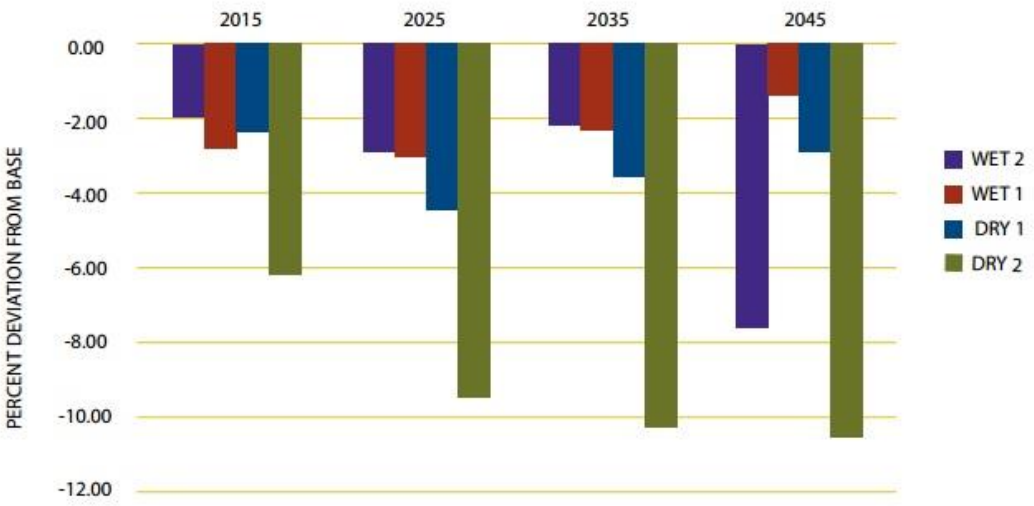
21 **In both Delanta (and Wadla) and Shakisso woredas, artisanal miners have little to no environmental risk mitigation measures in place (Pact 2015).** These could include anything from bunds, gabions and terracing to reforestation, backfilling, and area closures. Perhaps more important however is awareness raising and training on existing environmental regulations and effective enforcement of these.

22 **While expanding irrigation projects, efficient management of irrigation needs to be a priority** because it can reduce land degradation and environmental challenges such as water logging and salinization. In addition, the environmental consequences of large-scale irrigation projects need to be assessed through environmental and social impact studies, as required by the laws of the country. Lessons should be drawn from past projects such as the Amibara irrigation project, where 34 percent of the 15,256 ha has been abandoned due to salinity build-up, the main cause being poor irrigation water management (Abebe et al., 2015).

23 **The negative impacts of climate change, under an extreme scenario of higher temperatures and increased intensity and frequency of extreme events, could cost Ethiopia 10 percent or more of its GDP by 2050** (FDRE 2015). The worst impacts are caused by droughts, with recent droughts having negatively impacted GDP by between 1 percent and 4 percent. Using four IPCC-vetted Global Circulation Models (GCMs), a World Bank report (2010), estimated the impacts of climate change on GDP, based on four climate change scenarios. The extreme wet scenario (Wet2) is particularly damaging

in the final decade due to extreme floods, with GDP loss close to 8 percent. Under the extreme dry scenario (Dry2), a reduction of nearly 10 percent in GDP is projected by 2050 (Figure A.6).

Figure A.6: Deviation of GDP from base scenario



Source: World Bank, 2010

24 **Using a crop model, the World Bank (2010) predicts variation in crop and livestock production under various climate scenarios, with more pronounced effects likely to materialize in later decades.** It found large yield deviations in barley, wheat, maize and sorghum for the various scenarios. The simulations indicate that many regions of Ethiopia will face decreases in crop production. While crop yields decrease in general, the wet scenarios tend to be better than dry scenarios, though floods become damaging, especially in the final decade considered, i.e., 2045 (World Bank 2010, p. 59). In all the scenarios considered, severe impacts on livestock incomes are projected, with falls in income ranging from 55 to 80 percent of baseline levels (World Bank 2010, pp. 34-5).

25 **Other estimates also show reduction in crop yield in the Central Rift Valley and Blue Nile Basin of Ethiopia.** Kassie et al. (2015) evaluated climate impacts and adaptation options using three General Circulation Models (GCMs) in combination with two Representative Concentration Pathways (RCPs) and two crop models for maize production in the Central Rift Valley of Ethiopia. They find that maize yield decreases on average by 20 percent in the 2050's relative to the baseline (1980–2009) due to climate change. Based on farm data from Ethiopia, Deressa and Hassan (2010) estimate a 15 percent reduction in revenues per hectare by 2050 due to climate change using the Parallel Climate Model scenario.

26 **Climate change can severely affect the water flow and the dynamics of sediments in the Blue Nile basin of Ethiopia** (Wagena et al. 2016). The study analyzed the impact of climate change for two future time periods (2041-2065 and 2075-2099). The Tana and Beles basins will experience increases in both mean annual flow (22-27 percent) and sediment concentrations (16-19 percent). In addition, the monsoon season in the Tana and Beles basins will lengthen by approximately four (Tana) to six (Beles) weeks, a result very significant for water availability and hydropower development.

27 **Power interruption is common in years of severe drought when water shortages disrupt hydroelectric power generation.** For example, the 2002/03 drought caused power interruptions that lasted for about four months, with a one-day-per-week complete interruption throughout the country. A one-day interruption was estimated to result in a loss of 10-15 percent of the GDP for the day (EPAE 2003). During flooding time, high sediment loads in rivers can reduce power generation capacity, interfere with irrigation, contribute to flood risk, and affect clean water supplies. Ethiopia's annual average sediment yield ranges from 10 tons per square kilometer to about 1,500 tons per square kilometer (World Bank, 2006). When sediments settle in reservoirs, the capacity for power generation is reduced in proportion to the amount of

sediment in the reservoir. In addition, concentration of sediment at the power inlets has hampered operation of dam bottom outlets as well as power intakes.

28 **Hydrological variability, using a hydro-economic model, costs the Ethiopian economy 38 percent of its potential growth rate and causes a 25 percent increase in poverty rates, clearly demonstrating the extraordinary impact of drought, and particularly variability** (World Bank, 2006). A single drought event in a 12-year period will decrease average GDP growth rates by 7–10 percent. If historical levels of variability and the partial impacts of floods are incorporated, GDP growth rates fall by 20–43 percent. Floods are also becoming important issues with significant costs, including loss of human life, with examples as recently as 2016.

29 **Several air pollutants are also emitted from industrial production activities in Ethiopia**. Using a Life Cycle Assessment approach for the ELICO leather and glove manufacturing industry, Bekele (2007) indicated that the company emitted about ten main pollutants. Similarly, textile and fabric production processes emit pollutants into the air. According to MOI (2015), only ten textile and garment industries emitted more than 105,000 105,447tons of GHG in a year.

30 **Industries in Ethiopia lack facilities for onsite treatment, and subsequently discharge effluents into adjacent streams.** According to Gebre et al, 2009, about 90 percent of industries dump their wastes in nearby water bodies for this reason. Ethiopia's fast economic growth has been accompanied with increasing emissions of water pollutants. This is generated by various industries. This implies that expansion of the manufacturing sector will aggravate the pollution level in the country unless remedial actions are taken. Based on the 2013 World Bank report, the food and textile industries contribute the majority of biochemical oxygen demand (BOD) emissions (Ademe and Alemayehu, 2014). Similarly, the leather and footwear industries discharged 547,860 M3 of wastewater to the Akaki River in Addis Ababa in 1999 (Asfaw, 2007). While there is limited evidence on the health impacts of such pollution, inhabitants close to the Akaki River attribute a series of health problems to the river's pollution (Aregawi, 2014). Ethiopia's tanneries produce substantial liquid wastes, which can pollute rivers and soil (Reda, 2015). Coffee processing plants discharge effluents (wastewater) into rivers, harming aquatic ecosystems and downstream water users (Tekle et al., 2015). Moreover, the emissions of organic water pollutants from the existing industries in Ethiopia, as measured by biochemical oxygen demand, has increased from 18, 543 to 32, 182 kg per day (WDI, 2013).

31 **Ethiopia's textile and leather industries discharge harmful liquid waste to the environment, and most of them lack acceptable treatment facilities.** According to Asfaw (2007), in 1999 only, the textile industries in Addis Ababa generated a total of about 2 million m3 of wastewater, which entered the Akaki River. Similarly, Aberra (2014) investigated liquid wastes in case of Yirgalem Textile factory and showed that dye house wastewaters containing reactive dyes that are hazardous to the environment because their COD, BOD, TS and pH values are higher than the free discharge limit values.

32 **Cement production is a main contributor to Ethiopia's industrial CO_2 emissions.** The main GHG emissions from cement industries include particulate matter (PM2.5 and PM10), nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), CO_2, volatile organic compounds (VOC), ammonia (NH_3), chlorine, and hydrogen chloride (HCl). CO_2 emissions in cement manufacturing come from combustion of fossil fuels and from the limestone calcinations process. Roughly half of the emitted CO_2 originates from the fuel and half originates from the conversion of the raw material, i.e., from the calcinations process. (EPCC, 2015).

33 **The bulk of the emissions from the cement industry are process related.** The Ministry of Industry (MOI) has measured the composition of the baseline GHG emissions for seven selected cement factories. The result showed that 3.7 million tons of CO_{2e} are emitted from these factories in a year. Out of the total, 2.4 million tons (75 percent) come from production processes, whereas the remaining 1.3 million tons (25 percent) are associated with fuel consumption. This indicates high leverage for green industrialization through greening the cement production processes (MOI, 2015).

34 **Green energy will play an important role in reducing emissions in the cement sector.** Fuel associated emissions increase with the intensity of energy consumption. The cement sector consumed 7 PJ of primary energy; the energy intensity of local cement facilities is higher compared to the international best practice. The average electricity intensity and fuel intensity of the operating cement plants are 34 percent and 36 percent respectively higher than the international standards. This indicates that there is an opportunity to reduce emissions from Ethiopia's cement industries through reducing energy intensity (Tesema and Worrell, 2015).

35 **The leather and textile subsectors also produce significant CO_2 emissions.** The MOI measured baseline GHG emissions from eight selected tanneries (Elico/Awash, Sheba, Modjo, Pittards/Ethiopian), China African, East African, Friendship and Farida) indicated that about 6,600 tons of CO_2 equivalent GHG is emitted in a year (MOI, 2015).

36 **Soda ash (sodium carbonate, Na_2CO_3), used as raw material for chemical industries in Ethiopia, including glass, pulp, paper and soap manufacturing, is one of the sources of GHG emissions.** CO_2 is emitted from the production of soda ash from mined trona ore (MOI, 2015). In addition to emissions from raw material, production processes in the chemical industry emit GHG to the environment. MOI (2015)'s baseline GHG emissions measurement showed CO_2 equivalent fuel and process associated emissions of 14,000 ton a year from four chemical industries (Abijata Soda Ash SC, AMSASSC, Caustic Soda SC and Adami Pesticide Company).

37 **GHG emissions from the food and beverage industry sector mainly result from energy use and non-combustion activities.** Energy is used in food and beverage manufacturing for heating, cooking, drying, cooling, freezing, and other common processes. Emission sources from the food and beverage industry include boilers, steam and hot water generation units, cogeneration operations, engines, flares, fugitive emissions, generators, heaters/cooling units and wastewater treatment plants. According to the MoI (2015) about 35,000 tons of CO_2 equivalent emissions in a year come from seven food and beverage industries (Addis Modjo Edible Oil, Zenith Gebes-Eshet Ethiopia Ltd, Ethiopian Pharmaceutical Manufacturing, National Alcohol Factory, Awash Winery, Petram Factory and IMCO-Agro-industry PLC.

38 **The metal industry could be a major contributor of industrial emissions in the future due to its expansion and intensity.** Metal industries in Ethiopia mainly use metal scraps as raw materials and produce durable and strong metals used for many purposes: as building materials and supports, vehicle bodies, nails, fencing nets, leaf springs, aluminum products, casting different products, appliance parts, tools, and heavy equipment. Manufacturing of metal products requires a significant amount of heat and electricity to achieve high furnace temperatures. Direct emissions result from onsite fossil fuel combustion, in addition, other sources of GHG emissions include utilization of electrodes, acetylene, carbon dioxide and the scrap itself. MOI (2015) estimated direct emission of about 173,000 tons of CO2 equivalent GHG in a year from eight metal industries (Habesha Steel Mills PLC, Ethiopian Iron and Steel, Pagric Ethiopia, Inter Africa Aluminum Extrusion, Nigat Mechanical Engineering, C&E Brothers Steel Mills PLC, Steel R.M.I PLC, Ethiopian Leaf Spring).

39 **Ethiopia leverages its natural resource advantage by creating fertiliser industry. Ethiopia has the third largest potassium deposit in the world (Deloitte, 2014).** A recent deal signed with Israeli Chemicals Limited (ICL) Africa, will see the development of Ethiopian Allana Potash's Danakhil deposit, expected to produce one million tonnes of potash per year. This will help to introduce the new fertiliser to farmers in Ethiopia, boosting yields, and introducing a new product for export. The Allana-ICL partnership has already invested US$ 25 million of a planned US$ 642 million total investment. As the Allana-ICL partnership is supported by IFC, environmental and social compliances will have to be followed. However, the activities of the potash mining industry potentially result in a wide variety of adverse environmental effects (UNEP 2001). Typically, these effects are quite localized, and in most cases, confined to the mine site; Afar, however, will most likely have 3 or 4 mining operations so the cumulative impacts must be considered.

40 **At a specific site, the type and extent of environmental effects may depend on factors such as:** the characteristics of the ore and overburden; the surface land profile (wetlands, plains, hills, and mountains); the local climate; the surrounding ecosystem (UNEP 2001). However, of greater importance may be; the mining methods and equipment; the beneficiation and concentration processes; the waste disposal methods; the scale of the operation and the site's location to existing population centers and infrastructure.

41 **Water quality can be affected by the release of slurry brines and contaminants into process water (UNEP 2001).** Surface waters may be contaminated by: the erosion of fines from disturbed ground such as open-cut workings, overburden dumps and spoil piles and waste disposal facilities; the release or leakage of brines; the weathering of overburden contaminants, which may then be leached. Large volumes of water are typically required by mining and beneficiation activities (UNEP 2001). This water consumption may lead to a fall in the level of the water table, affecting the surrounding ecosystem and potentially resulting in competition with other users. The land surface and subsurface is disturbed by activities such as: the extraction of ore; the deposition of overburden; the disposal of beneficiation wastes and the subsidence of the surface. These activities could result in wide range of potential impacts on the land, geological structure, topsoil, aquifers and surface drainage systems (UNEP 2001). Additionally, the removal of vegetation may affect the hydrological cycle, wildlife habitat and biodiversity of the area. In some instances, sites of archaeological, cultural or other significance may be affected.

Box B.3. Water pollution threats from Ethiopia's mining industries

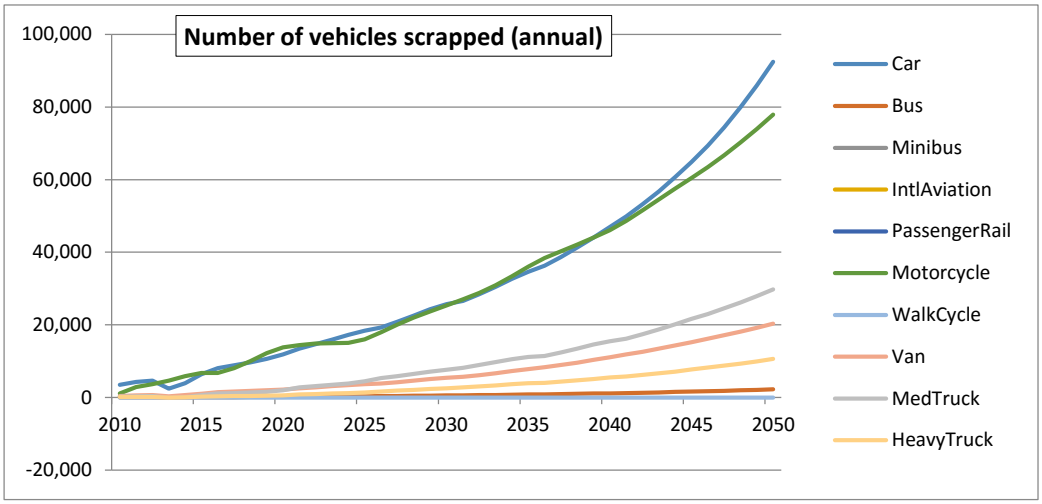
Ethiopia has ample resources of potash, a resource that is extracted by highly water-intensive methods. The central part of the Danakil Depression in Afar is covered by a thick evaporite succession (salt formation), which is partially covered by Quaternary volcanic rocks (Mineral Resources of Ethiopia, 2012). Several potash horizons are recognized, although only the uppermost have been explored. Afar has a potential of 1.3 billion tons of potash (Geological Survey of Ethiopia, 2012). Exploration work carried out so far by various companies has revealed the presence of two ore bodies at the Danakil Depression (Mineral Resources of Ethiopia, 2012). Known potash ore bodies have been estimated to be 10-12 million tons, with other ore estimated up to 66 million tons 'proven' and 32 million tons 'probable'. Two companies are currently active in Afar: Sarkam Mineral UK; and the Norwegian company Yara International ASA (Ethiopian News Agency, March 28th, 2016). The activities of the potash mining industry can potentially result in a wide variety of adverse environmental effects (UNEP, 2001). Typically, these effects are quite localized, and in most cases, confined to the mine site.

Water quality can be affected by the release of slurry brines and contaminants into process water (UNEP 2001). Surface waters may be contaminated by: the erosion of fines from disturbed ground such as open-cut workings, overburden dumps and spoil piles and waste disposal facilities. Large volumes of water are typically required by mining and beneficiation activities (UNEP, 2001). This water consumption may lead to a fall in the level of the water table, affecting the surrounding ecosystem and potentially resulting in competition with other users. These activities could result in a wide range of potential impacts on aquifers and surface drainage systems (UNEP 2001). This is particularly relevant in arid areas such as the Afar region, where Ethiopia's potash mining projects are currently being developed.

42 **Solid and liquid waste problems are major issues in urban Ethiopia, with households being the main sources.** Regassa (2011) estimated that households contributed 76 percent of Ethiopia's solid wastes. Current sanitation and waste management in urban Ethiopia is poor, and fraught with many operational challenges (JSI, 2015). Addis Ababa is the only city with a municipal sewerage system, which serves only 5 percent of the population. About 35 percent of the solid waste generated in Addis Ababa is dumped on open sites, drainage channels, rivers, valleys and streets, thereby greatly contributing to the pollution of rivers and streams in and around the city (Alebel et al., 2011). Solid waste discharge from industries also is a growing problem. For example, tannery and footwear production produce solid waste, which goes into landfills. Ayalew (2005) assessed solid wastes in the case of Addis Ababa Tannery and reported that the leather production process generates dusted curing salts, trimmings, and splittings, shavings, buffing and packaging materials.

43 **The number of "End of Life" vehicles (ELVs) will increase exponentially (Figure B.7).**

Figure A.7. Projection of the increase in vehicles



44 **Ethiopia also strives to become a regional renewable energy hub in East Africa, and started exporting electricity to Djibouti in 2011 and to Sudan in 2012**. Together with domestic network expansion, in the coming years, exports to Sudan, Djibouti, and Kenya could boost the country's energy export revenue potential, estimated to be as much as US$500 million per year by the end of the decade. By 2020, Ethiopia could achieve as much revenue from power export as it does from domestic sources. Table B.6 summarizes the achievements and targets of GTP I and GTP II.

Table B.6. Summary of GTP I and GTP II energy-related targets and accomplishments

Category	GTP I	GPT II		
	2010	2015 Target	2015 Actual	Target - 2020
Distribution network (km)	126,038	258,038	166,967	295,939
Customer connections (millions)	2.03	4	2.58	6.955
Electricity access (towns)	1,402		7,000	17,295
Electricity access (towns)	41%	75%	55%	90%
Solar Home Systems Installed (number)	12,000	165,500	41,000	400,000
Solar lanterns (millions)			1.9	3.9
Mini-grids (number)		no target	-	105
Improved cookstoves (millions)	7	9.4	8.9	11.45

Source: MoWIE (2015b), NRECA (2016)

45 **Outdoor air pollution from the transport sector is a growing problem in Ethiopia's urban areas**. Particulate matter (PM2.5) pollution is becoming a prevalent problem in urban areas of Ethiopia, particularly in Addis Ababa. The main reasons for outdoor air pollution are Ethiopia's roads and the aging fleet of vehicles, which in turn is related to Ethiopia's customs regulations.

46 **Indoor air pollution from use of biomass fuel is a major problem in both rural and urban areas.** Indoor air pollution from biomass fuel used for cooking–often referred to as "the killer in the kitchen"–has severe impacts. Ethiopia is among the 10 worst affected countries (WHO, 2004) and accounts for nearly 5

percent of the national burden of disease (Sanbata et al., 2014; WHO, 2007). According to WHO (2007) estimates, 50,320 children under 5 years of age die annually due to Acute Lower Respiratory Infections (ALRI), and 6,140 adults above 30 years of age die per year due to chronic obstructive pulmonary disease (COPD), with these deaths attributable to solid fuel use. According to a survey conducted in Addis Ababa, there is a prevalence of 24 percent acute respiratory infections among children under 5 years old (Worku et al, 2014), also attributable to urban particulate matter pollution (both outdoor and indoor). The fact that dining, living, and cooking are commonly done in the same room in much of rural Ethiopia exacerbates the problem (MoWIE, 2013).

47 The imbalance between supplies of clean energy and effective demand has resulted in the consumption of unsustainable and unhealthy primary energy sources. The share of clean electricity sources–hydro, wind, solar and geothermal energy–in total energy use is not more than 2 percent. The lack of availability of electricity for lighting and other purposes, and the lack of affordable access to clean cooking alternatives, leads to the high dependence on fuelwood and agricultural residues as well as kerosene as sources of energy, particularly in rural areas.

Annex B: Supplement to regulatory framework for environmental management

Policy and legal framework for environmental management

1. **The main text is the 1995 Constitution, which contains important provisions for development and poverty alleviation while providing for citizens' rights to a clean and healthy environment.** The environmental provisions in the Constitution's fundamental rights section, and the environmental duties in the economic development and policy section, strike a balance between development and environment – specifically, the right of individuals to a clean and healthy environment, as well as the protection of natural resources for the benefit of the present and future generations. Major provisions are as follows: (i) Articles 89 and 92, which set out the economic and environmental objectives of the country, impose a duty on the government to ensure sustainable economic development and the protection of the environment, including citizens' participation in environmental decision-making and the duty of the public to protect the environment; and (ii) Article 43, which provides for public participation and consultation in the decision-making processes for projects that are likely to affect their livelihood in pursuit of meeting "their basic needs."

2. **These provisions provided the basis for the development and adoption of the Environmental Policy of Ethiopia (EPE), which was prepared by the Environmental Protection Authority[34] (EPA) and adopted by the Government in 1997 through a proclamation.** The EPE expresses the principles and objectives of the Conservation Strategy of Ethiopia (CSE),[35] including: (i) ensuring that natural resources, both renewable and non-renewable, are used sustainably; (ii) preventing pollution in a cost-effective manner; (iii) organizing public participation in environmental management, including improvement of the environment of human settlement areas; and (iv) enhancing public awareness, education about and participation in the national effort for sustainable development and environmental protection. The EPE takes into consideration the existence of other sectoral and cross-sectoral policies[36] related to natural resources and the environment, for which it provides the main environmental policy guidelines. Though some of the policies and guidelines were issued before the enactment of the EPE, they pay attention to environmental protection and sustainable development issues.[37] The GoE has announced that it is in the process of amending and enhancing the content of the EPE to include principles, rules and standards to address climate change and other issues.[38]

3. **Following the adoption of the EPE, the GoE adopted two major environmental laws in 2002 related to Environmental Impact Assessment (EIA) and pollution.** Many implementing regulations were then developed, including those related to environmental quality standards, which were approved by the Environmental Protection Council (EPC) in 2008.[39] In addition to these core environmental laws, the

34 The EPA was established by Proclamation No 9/1995and is now superceded by the MEFCC.
35 The CSE was adopted in 1996 and is described in five volumes covering different aspects of conservation: Volume 1 on "resources base utilization and planning for sustainability"; Volume 2 on "natural resources policy and the environment"; Volume 3 on "the institutional framework and operational arrangements"; Volume 4 related to "the action plan for the federal policy on natural resources and the environment"; and Volume 5, which describes a compilation of projects supporting the investment program for the federal policy on natural resources. The contents of the Conservation Strategy documents have been reflected to an extent in the policy documents and laws that have subsequently been adopted.
36 Ethiopia has several policies on specific issues, including the National Population Policy (1993), the National Biodiversity Policy (1997), the Conservation Strategy of Ethiopia (1997), the Economic Policy (1998), the Federal Water Resources Management Policy (1998), Agricultural and Rural Development Policies and Strategies (2002), and the Forest Development, Conservation and Utilization Policy and Strategy (2007).
37 Theoretically, all these policies are based on principles that promote protection, prevention, precaution, and conservation approaches in their respective areas. Grounded on these sectoral policies, a wide array of environmental laws and regulations has been developed to include environmental aspects of sector-specific laws and regulations to define the specific statutory mandates, environmental quality standards and norms, processes and institutional frameworks to implement and enforce the EPE objectives.
38 However, no draft has been circulated yet and therefore this report refers to the original EPE as enacted in 1997.
39 These include standards related to emission to the atmosphere, emission to water, and noise. These standards apply to the industrial and other sectors, including: (i) tanning and the production of leather goods; (ii) the manufacture of textiles; (iii) the extraction of mineral ores, and the production of metals and metal products; (iv) the processing of food products, including beverages, meat and meat products; (v) the manufacture of cement and cement products, (iv) the preservation of wood and the manufacture of wood products, including

GoE adopted a wide array of sectoral laws and regulations connected to natural resources management and conservation, including land, biodiversity, water and forests, among others. Finally, consistent with the federal nature of Ethiopia's government, the regional states enacted numerous environmental laws, regulations, standards and guidelines,[40] which may be similar to the federal laws, regulations and standards or more stringent.[41]

4. **As part of its regulatory requirements for environmental management and protection, Ethiopia has adopted two instruments**: (i) the Environmental Impact Assessment (EIA) system to regulate the siting and approval of projects that may have detrimental impacts on the environment,[42] and (ii) the generally required licenses and permits to establish, develop and operate projects and facilities related to the respective sector.[43] It is generally used along with the other regulatory instruments (permitting and licensing activities and investments) applicable to their respective sectors.

5. Currently, agriculture and natural resources (land use planning and policy, small-scale irrigation, major and micro watershed management, soil, agroforestry) are handled by the MOANR; livestock and aquaculture are under the Ministry of Livestock and Fisheries (MoLF); forestry, cookstoves, agroforestry, and biodiversity issues as well as environmental management are dealt with by the MEFCC; wildlife, conservation, and protected areas are under the Ministry of Culture and Tourism (MoCT), specifically, the Ethiopia Wildlife and Conservation Agency (EWCA); urbanization issues are under the Ministry of Urban Development and Housing; oil, gas, mining and biofuels are under the Ministry of Mines, Petroleum and Natural Gas (MMPNG); and basin management, medium and large irrigation, groundwater, and electricity are under the Ministry of Water, Irrigation and Electricity (MOWIE). The Ministry of Transport (MoT) deals with road related issues, among others. The Ministry of Industry (MOI), meanwhile, is responsible for private sector development for at least some of the above sectors, including forest products.

furniture; (v) the production of pulp, paper and paper products; and (vi) the manufacture and formulation of chemical products, including pesticides.

40 For example, the Amhara Regional National State (ARNS) has adopted its own EIA guidelines based on the 2001 federal guideline, but "simplified" for easier use (Bureau of Environmental Protection, Land Administration and Use (BoEPLAU), Simplified General Environmental Impact Assessment Guideline, 2006).

41 Art 6 (4) of the Pollution Control Proclamation states that: "National regional states may, based on their specific situation, adopt environmental standards that are more stringent than those determined at the Federal level. However, they shall not adopt standards which are less rigorous than those determined at the Federal level." Generally, regional governments are: (i) requested to mirror, in their own legislation, the provisions of the federally adopted laws and regulations, and (ii) allowed to adopt environmental protection standards that may be more stringent than the federal standards.

42 The EPE recognizes a central place for Environmental Impact Assessments (EIA) of development projects and related activities as the major instrument to be used in decision-making processes related to development activities. The EIA process is established as such through a 2002 proclamation, discussed below.

43 At the international level, these instruments typically are used by governments to ensure that development projects are sound, contribute to the overall development strategy, and will not negatively impact the country's natural resource base and overall environment.

Box B1: Ethiopia's major environmental laws, regulations and guidelines

Major Proclamations

- Proclamation 197/2000: Water Resources Management
- Proclamation No. 295/2002: Environmental Protection Organs Establishment
- Proclamation 315/2003: Fisheries Development and Utilization
- Proclamation No. 299/2002: Environmental Impact Assessment
- Proclamation No. 300/2002: Environmental Pollution Control
- Proclamation 375/2003: Investment[44]
- Proclamation 406/2005: Rural Land Administration and Use
- Proclamation 482/2006: Access to Genetic Resources and Community Knowledge and Community Rights
- Proclamation No. 513/2007: Solid Waste Management
- Proclamation 541/2007: The Development, Conservation and Utilization of Wildlife,
- Proclamation 534/2007: River Basin Councils (RBCs) and River Basin Authorities (RBAs)
- Proclamation No 575/2008: The Establishment of the Wildlife Development and Conservation Authority
- Proclamation No 571/2008: Radiation Protection,
- Proclamation No 574/2008: Urban Planning
- Proclamation No 655/2009: Biosafety
- Proclamation No. 678/2010 to promote sustainable development of mineral resources
- Proclamation 691/2010: Definition of Powers and Duties of the Executive Organs of the Federal Democratic Republic of Ethiopia, as amended by Proclamation No. 803/2013 to specify the mandates of the MoEFCC

Regulations and Guidelines

- Regulation No.159/2008: Prevention of Industrial Pollution Regulation
- Regulation No. 163/2009: Wildlife Development, Conservation and Utilization
- EPA Environmental Impact Assessment Guideline Document, May 2000
- EPA Directive No.1 to Determine Projects Subject to EIA
- EPA Environmental Impact Assessment Procedural Guidelines, Series 1, including (1) Guidelines for Review Approach; (2) Guidelines for Content and Scope of Report; (3): Checklist of Environmental Characteristics; (4) Review Criteria, November 2003, revised in 2006
- EPA Guideline Ambient Environmental Standards. 2004.
- EPA Environmental Management Plan (EMP) for the Identified Sectoral Developments in the Ethiopian Sustainable Development and Poverty Reduction Program (ESDPRP) (draft 2004)
- EPA EIA Guidelines on Irrigation, Crop Production, Fertilizer, Pesticides, Fisheries and Forestry 2004
- EPA Standards for Industrial Pollution Control (Specified Sectors).
- EPA Draft Guidelines on Sustainable Industrial Zone/Estate Development. 2004.
- EPA ESIA Guidelines on Dams and Reservoirs, Hydropower, Water Supply, and Livestock and Rangeland Management. 2004.
- EPA Guideline on Composting. 2004.
- EPA Technical Guidelines on Household Waste Management. 2004.

44 Issuance of an investment license requires evidence of environmental clearance (Article 24.5 of the proclamation).

Box B2: Mandates of the MEFCC

The Ministry of Environment, Forest and Climate Change (MEFCC), which replaced the EPA in 2013, has a stronger role and mandate for policy development but also greater challenges to address. Major functions of the MEFCC include a wide range of responsibilities, the most important being the following:

(i) The preparation, review, and updating of environmental programs, plans, policies and laws in consultation with concerned organs and the public at large, and monitoring and enforcement of their implementation,
(ii) The setting of environmental standards and monitoring compliance with them,
(iii) The formulation of laws and policies relating to hazardous substances, wastes, and genetically modified organisms,
(iv) The proposal of incentives and disincentives to discourage practices that hamper the sustainable use of natural resources and to encourage practices that prevent environmental degradation or pollution,
(v) The implementation of EIA requirements and other environmental protection measures. In this respect, it is empowered to:
    a. establish an environmental impact assessment (EIA) system for projects, programs, strategies, laws, and policies,
    b. review EIA reports; audit and regulate their implementation,
    c. carry out inspections, and take samples as deemed necessary to ensure compliance with environmental protection requirements,
    d. promote and assist in the preparation of environmental action plans and projects,
    e. prepare directives to implement environmental protection laws and ensure the implementation of approved directives.
(vi) The promotion, development and implementation of programs for the overall national capacity for environmental management, and to support environmental capacity development of relevant national and regional agencies,
(vii) The research, analysis, and collection of information on environmental issues facing the country, including environmental cost-benefit analyses for development plans and investment programs, monitoring their application, and preparing and making available to the government and the public a periodic report on the state of the environment,
(viii) The establishment of an environmental information system that promotes efficiency of environmental data collection, management, and use,
(ix) The handling of international negotiations on environmental issues and monitoring implementation of, and compliance with, the international environmental conventions, agreements and treaties to which Ethiopia is a party.

Excerpt from the Proclamation No. 803/2013 on the Definition of Powers and Duties of the Executive Organs of the Federal Democratic Republic of Ethiopia (Amendment)