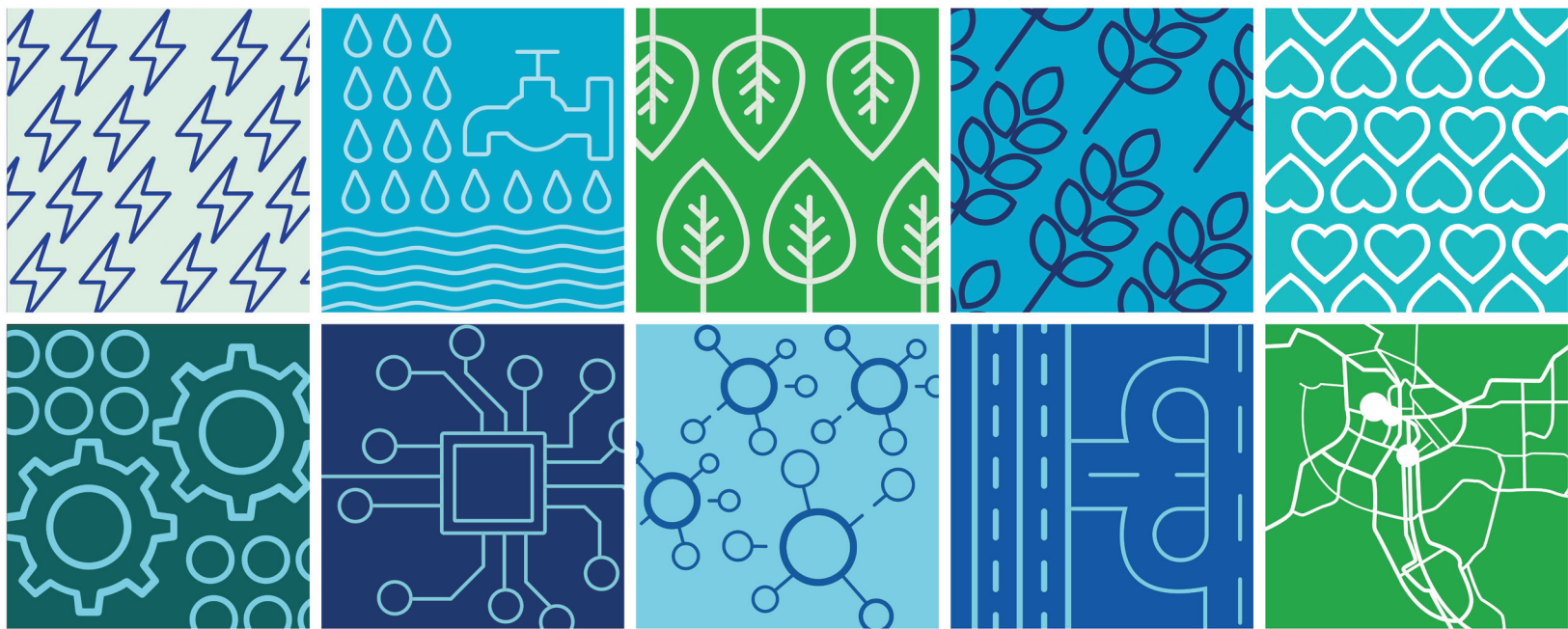


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ETHIOPIA 50
GRAND CHALLENGES AND OPPORTUNITIES

GRAND CHALLENGES AND
OPPORTUNITIES



September 2020
Blue Ribbon Panel (BRP) Report

Submitted to Government of Federal Democratic Republic of Ethiopia

“Never doubt that a small group of thoughtful, committed citizens can change the world, indeed it is the only thing that ever has.”

Margret Mead

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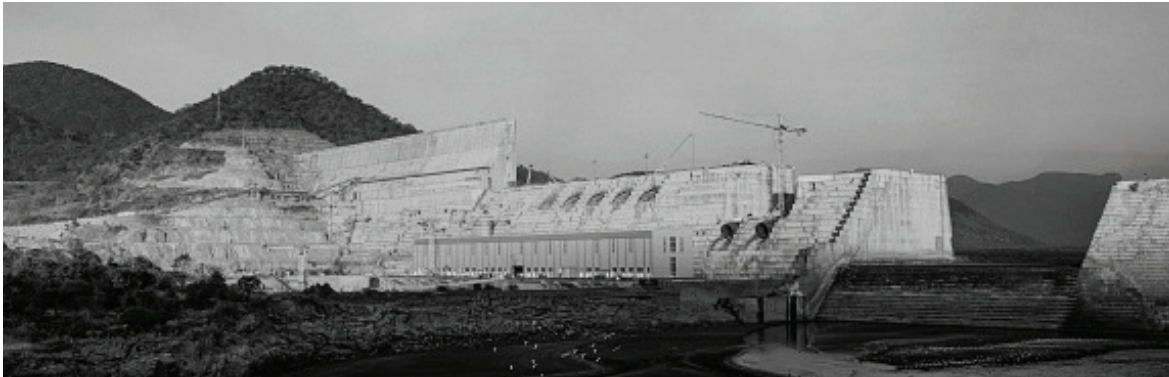
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A special thanks to our Advisory Board members, Dr. Tewelde GebreMariam (Group CEO of Ethiopian Airlines), Ato Zafu Eyesuswork Zafu (Tech & Relations Advisor to CEO – United Insurance SC, Board Chair, United Bank SC, Vice Chair, Raya

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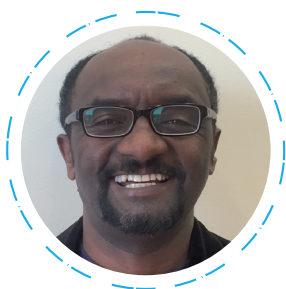
For the hundreds of hours of effort that they volunteered over a period of several months to produce this report, we also would like to extend our sincere and special thanks to each and every member of the Blue Ribbon Panel. We are indebted to Professor Prabhjot Singh, Dr. Hailu Mekonnen, and Dr. Aynalem Adugna who spent several hours in editing and helping shape this document to its final stage. The Technical Advisory Groups who fine-tuned the ideas and recommendations and offered numerous suggestions deserve special recognition along with the Design Team that put a professional touch to this report. Last but not least, our thanks go to the authors and session moderators of the December 2019 Ethiopia 2050 Conference who covered their own expenses and travelled to Addis to share their vision for an Ethiopia of tomorrow. We can never repay that.

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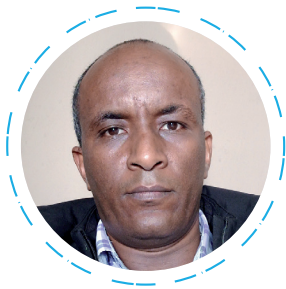
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EXECUTIVE SUMMARY

Ethiopia is in the midst of a remarkable and unprecedented demographic transformation. By 2050, its population is projected to double from 100 million to 200 million people. This powerful demographic transition will also be accompanied by several other transformative natural forces. These forces include pressure from ongoing societal, economical, geo-political, and environmental changes and disruptions. Arguably, the next set of potential conflicts in our region could be driven by the competition for valuable resources such as water and arable land that will be further exacerbated by pressure from population increase and adverse effects of climate change. Taken together, the next thirty years will reshape Ethiopia's identity, character, and its global role, as it navigates both unprecedented challenges and opportunities. Therefore, we must face the full impact of these emerging forces head-on.

To proactively address what were identified as "*Ten Grand Challenges and Opportunities*" associated with this expected generational and historical demographic shift, an Initiative was launched to carefully examine, both the opportunities of demographic dividend and the associated risks. The approach in this Initiative was guided by the consideration of population as a central issue for both the challenges

and opportunities side, because it is people who are the ultimate beneficiaries of development.

This report that comes out of this Initiative was prepared by a Blue Ribbon Panel (BRP) consisting of an independent group of Ethiopian and Ethiopian-origin experts with diverse professional backgrounds. They bring deep expertise across fields as varied as economics, public health, statistics, education, population dynamics, technology, and urban planning. Together, they have formulated a transformative vision to proactively aid Ethiopia on its journey to a better future.

The BRP rests upon a collective vision that is part of the broader ETHIOPIA 2050 Initiative and focuses on the actions that policymakers can take, with broad support of the public. Their insights were generated after extensive and careful vetting of the transformative new ideas presented at an international conference held on December 19th and 20th, 2019 in Addis Ababa which included 450 Ethiopian/Ethiopian origin participants from 10 countries. This report presents a series of bold, feasible, and actionable ideas - with an execution plan - that will have multi-generational impacts.

This report lays out a straightforward and powerful rationale for actions in the following areas:



Rapid Urbanization:

As Ethiopia's population grows, landlessness in the rural areas is increasing with average plot sizes per farm household decreasing at alarming and unsustainable rate, and urbanization accelerating. We recommend proactive strategies to manage growth in the rural areas and aid the urbanization process in the cities and unlock multi-generational opportunities.



Water-Food-Health-Energy Nexus:

Ethiopia has been endowed with significant water and energy resources but limited arable land. If these resources are managed appropriately, they could help ensure that a growing population has enough food and resources to nourish both urban growth and rural revitalization. Our national security depends on it.



Economic Growth:

Job creation across a network of cities and rural areas should emphasize the transition to a knowledge-based and digital economy and transform Ethiopia's transportation, construction, and advanced manufacturing capacities.



Institutional and Civic Development:

Ethiopia will navigate the powerful countercurrents of inequality and social unrest that have stymied other countries by strengthening civic and professional organizations and building fair institutions that are trusted to guide these structural changes in its society.



Gender Equality:

Finally, no demographic dividend can provide full benefits without the equitable participation of girls and women at every level of Ethiopia's society. This requires investment in girls' education and empowering women to lead at every level.

What is being advocated here can be summarized as (a) head-on discussion of the merits of the individual proposals, (b) an investigation of current practices matched against benchmarking to identify gaps, (c) an informed decision on how to incorporate the ideas into the national planning process, and (d) integration of the ideas into the long-term objectives within the plan. The strength of this report lies in the pragmatism, interlinkages, and forward-looking solutions that our contributors brought to ensure that Ethiopia's demographic dividend results in a national advantage. Although there are many specific solutions that we could highlight, the following represent the strength of our country's ability to achieve its goals by broadening its outlook and exploring markets and opportunities everywhere, including outside its borders:

- Create innovative housing solutions and financing, particularly, for the fast growing demographics in the age group of 20-34 which consists of almost 40 percent of urban population in cities like Addis currently predominantly housed in informal housing in unplanned areas.
 - Support secondary city development with comparative advantages in relation to each other. At the same time, all urban-focused plans have associated rural investment and development solutions to strengthen our rural farmers and food production capacity.
 - Expert modeling on the linkages across water, food and energy issues reveal significant advantages and opportunities for Ethiopia to uniquely meet the demands of a growing population who are healthy where other countries have failed. Ethiopia's water and energy surpluses can be used creatively in many sectors.
 - Ethiopia can achieve food security by doubling agricultural productivity. This will reduce the burden on both pastoral and forest resources.
 - Rural agricultural cluster ecosystem models offer efficiency in rural development. Loosely formed agricultural cluster ecosystems have a very significant potential in transforming rural economy in Ethiopia, where pressure from population increase is giving rise to landlessness and conflict between agriculturalists and pastoralists. Such an ecosystem will help co-locate infrastructure for health services, ICT services, farming, water supply, etc. In some of these, such as health services (telemedicine) and ICT services, the underlying technology is common and avoids redundancies and inefficiencies.
 - Ethiopia has a potential to leverage its geographic location to become a major node in regional integration through east-west fiber optics link (Djibouti-Addis-Juba-North DRC) and a nearly parallel east-west railway transport corridor (Djibouti-Addis-Juba-North DRC-Central African Republic).
 - Instead of simply focusing on the quantity of jobs created, contributors focused on the quality of high-skill jobs that would contribute to the advancement of rural agricultural methods and advanced manufacturing capabilities that would yield multiple benefits to other sectors.
 - All contributors saw investments in girl's education and women's full participation in political, civic, and economic spheres as essential to Ethiopia's future. There is no real demographic dividend without the full participation of women at all levels of the Ethiopian society and this requires effective planning and targeted investments.
 - Implementing and enforcing existing laws to prevent corruption and illicit financial flows will be one of the ways to insure adequate funding for these recommendations and the ten-year plan.
- These are only but a few high-level insights from this comprehensive report and they are meant to reflect the potential that Ethiopia has in taking advantage of emerging opportunities and meeting the challenge it faces to achieve its aim to become a middle-income country in the near future and also become a leader in Africa in several areas such as advanced manufacturing, digital economy, AI, and medical tourism. It is also noteworthy that the contributors put together a clear multi-generational execution plan that focuses on the next decade leading to 2050.

I. INTRODUCTION

Background

Population Growth Has Generated Downward Economic Pressure

Currently, Ethiopia is in the middle of the largest and most consequential population growth and demographic change in its long history (Figure 1). Its population was only 35 million in 1980 with an average yearly growth rate of 1.5 percent. However, since 1985 the population has been growing at an average annual rate exceeding 3 percent, with the highest rate observed between 1990 – 1995 at 3.8 percent [1-7]¹. By 2000, its population had nearly doubled to reach 66 million. This represents an increase of 31.2 million in only 15 years. During this period, Ethiopia was struggling to feed, cloth, educate, and create employment opportunities for 31.2 million additional members of a new generation of Ethiopians. The population appears to have grown to an estimated 115 million in the subsequent 20 years (i.e., 2000 – 2020). Of these, almost 50 million are in the 0-20 age group, a large block that requires access to education and healthcare services now, and employment opportunities in the near future. These, in addition to the usual basic requirements of life. In this regard, the country maintained a relatively strong average annual GDP growth of 8.8% between 2000-2019 and reduced

poverty from 30 percent in 2011 to 24 percent in 2016. However, more needs to be done to meet the demand for economic and social services from a population that is growing at the rate of 2.5 million people per year [5-8]. Currently an estimated 78 percent of the population lives on less than USD \$2.00 a day. A subset of this population (23 percent) lives on less than \$1.25 a day [9]. Further, 13 million citizens are currently sustained through food aid and safety net programs [9].

The high rate of population growth continues to have notable impact on the economic, social, and political life of Ethiopians. For example, in rural Ethiopia, farmers and their families continue to be impacted significantly as their plot sizes are decreasing at rates that are making farming unsustainable for the future generations. In southern Ethiopia, for instance, the average plot size per farm household had declined to as low as 0.46 hectares by 2014-2015 (Figure 2) [10-12]. The comparative plot size at the national level is barely a hectare per farm household. Almost 60 percent of farm households in southern Ethiopia (SNNPR) and 36 percent in Tigray own agricultural plots that

1 There are variations in population projections and rate of increases reported by the various sources, mainly because the last census was carried out in 2007. However, the trends are consistent.

are less than 0.5 hectares in size (Figure 2) [10-12]. Therefore, it is clear that land shortage is becoming acute and the average plot size per household in parts of the country could further decline drastically [11]. Sustained population increase will continue to put pressure on the availability of croplands and exacerbate conflicts between agriculturalists and pastoralists, further straining already existing tensions. This population growth and the ensuing land scarcity are leading to landlessness, particularly among the rural youth [12]. Subsequently, in an ironical turn of events from the “*land for the tiller*” movement days that eventually led to the 1974 rural land reform, practices such as land renting and sharecropping are reemerging [12-13]. In many aspects, these destabilizing factors act as a “*push-factor*” and explain the increasing migration of young men and women from various parts of Ethiopia to cities like Addis Ababa, the Gulf Countries, South Africa, and elsewhere to seek better opportunities [14-16].

The Rise of Working Age Adults Could Fuel Growth and Development

A breakdown of the population by age groups shows that in 2020, the size of the working-age population (15-64) stands at about 56 million (50 percent of the population). The remaining 50 percent of the population (i.e., 56 million) depends on the first segment of the population for its livelihood [1-3]. As shown in Figure 3, the share of the working age population (WAP) in the country was on a downward trajectory between 1960 and 2000. It reached a low of about 51 percent in the late 1990s. It then started rising around 2000. If the current growth rate is maintained, its share is expected to reach 63 percent which corresponds to a total population of 100 million in another fifteen years (2035). This will be larger than the dependent population (0-14 and 65+) of 60 million people. In other words, within fifteen years, Ethiopia will have a working-age young population of about 100 million. If this group is given education of high quality (especially for

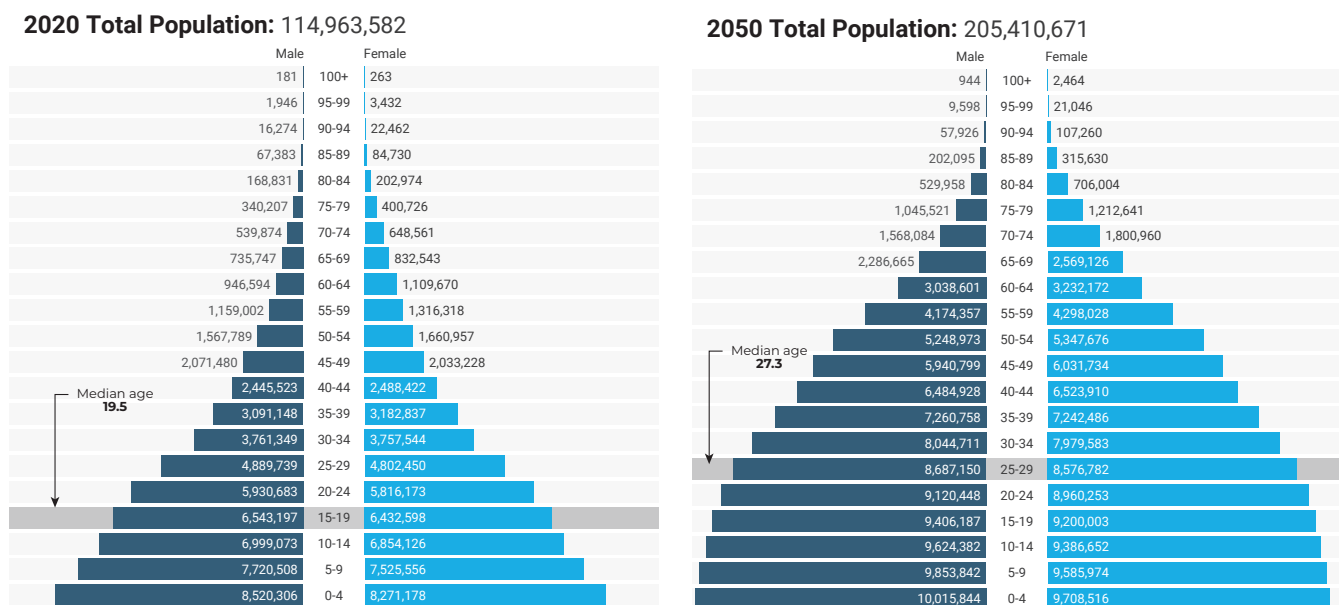


Figure 1. The demographic shift in Ethiopia. Considerable demographic changes that drive large-scale changes in the country have been going on since 1985 [4]. These changes are projected to continue unabated until 2100. The median age in 2000 was 16.6 years, 19.5 years in 2020, and will reach 27.3 years by 2050.

girls), relevant skills, and opportunities for productive employment, it can help Ethiopia achieve its ambitious goal to become a middle-income country (MIC) within this decade [17].

The Speed of Population Growth Offers a Challenge as well as an Opportunity

The accelerated demographic transition that started in 2000 (Figure 3), offers a tangible demographic dividend that, in turn, presents the country with an opportunity to diversify its economy to include an advanced industrial sector and a more developed digital economy. At the same time, this group which is looking for opportunities will face new challenges of the type and magnitude that Ethiopia has not experienced before [12]. In particular, the influx of the young to urban areas presents a formidable challenge. The associated major challenges are that 70 percent of Ethiopia’s population does not have adequate access to electricity, only half of the population has access to clean water, and only 15 percent has access to improved toilets, and only 16 percent has access to the internet [9]. Providing

these essential services and employment opportunities for 2.5 million additional young men and women every year for the next 15 years will require careful planning and implementation [18-19]². As a result, the risks associated with not meeting this unprecedented demand for socio-economic opportunities are a major threat to Ethiopia’s population. If actions are not taken on time and effectively, a restless and unemployed generation of young men and women will be forced to continue migrating to urban areas and outside the country. Young people with no opportunity to migrate may engage in socially undesirable activities, thus creating risks of social and political instability. In addition, large-scale and sustained conflicts over limited resources could ensue. This is likely to be the case with limited and inequitable access to agricultural and grazing lands, essential services such as clean water supply, housing facilities, employment opportunities, and education and health services. Such conflicts could, in turn, endanger the livelihood of the overall population. It is noteworthy that the disrupt-

² Job Creation Commission of Ethiopia estimates that 14 million jobs need to be created between 2020-2025 alone [18].

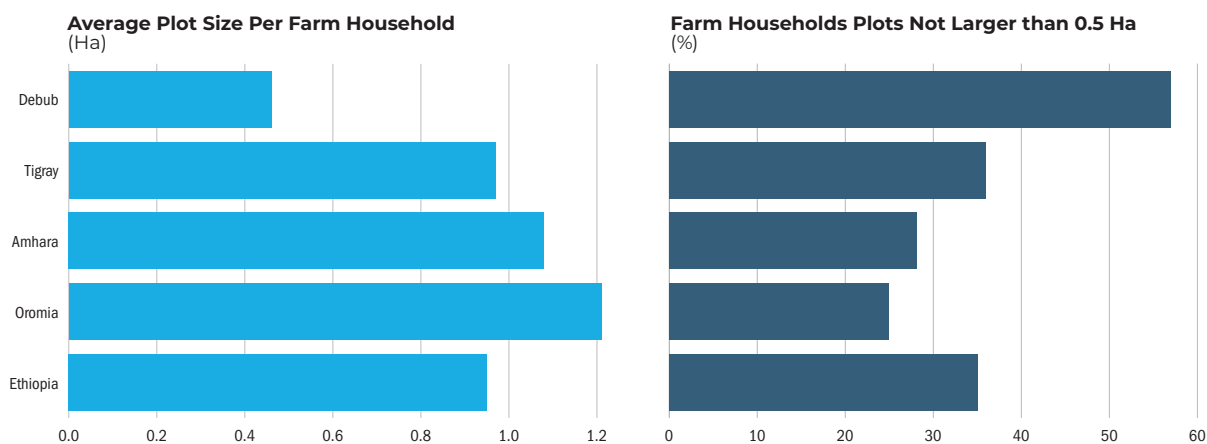


Figure 2. Average plot sizes per farm household in the various regions of Ethiopia in 2014 – 2015 [10-12]. The Debut (SNNPR) region has the lowest at 0.46 hectares per farm household. The average for the country < 1 Ha. At national level, 37% of rural farm households have plots less than 0.5 Ha [10-12].

tions created by limited opportunities will also be acutely felt in the urban areas as the “push factors” from rural areas will, by themselves, add about 50 million people to the cities in the next 30 years.

Ethiopia at the Crossroads

In the meantime, twenty years into the 21st century, Ethiopia finds itself at a crossroad, where an environment of significant structural societal challenges that continue to threaten it intersect with historical opportunities such as an emerging demographic dividend and a shifting favorable geopolitical environment that it can take advantage of. For example, for the short-term, at least, once the coronavirus pandemic is addressed both at the global and national levels, Ethiopia can take advantage of its unique geographical location and a large and growing working-age population which has a high demand for good education, remunerative employment, and a meaningful as well as healthy life. In this respect, the post-pandemic world is likely to be characterized by realignment of the global supply chain with demands for multiple sources of manufactured goods and digital services. Such

realignment is bound to offer substantial economic opportunities for countries like Ethiopia that are planning effectively to benefit from new opportunities. At the same time, in the medium- to long-term horizon, as Ethiopia’s population continues to grow and reach 200 million by 2050 [1-4], the magnitude of the challenges can be enormous. This is especially the case with the growing demand for basic and critical infrastructures in water, food, energy, housing, transportation; sustainable management of natural resources; and a health system that is efficient, equitable and able to withstand epidemic shocks such as the current pandemic. Therefore, it is important to take thoughtful measures to predict the demand for socio-economic services and develop effective strategies to meet this demand. Otherwise, it will be hard to achieve growth that is inclusive, reduces poverty, and benefits from emerging global opportunities. In fact, without a proactive identification of challenges and development of policies and strategies involving critical sectors, Ethiopia is likely to experience social and political instability at scales unimagined before.

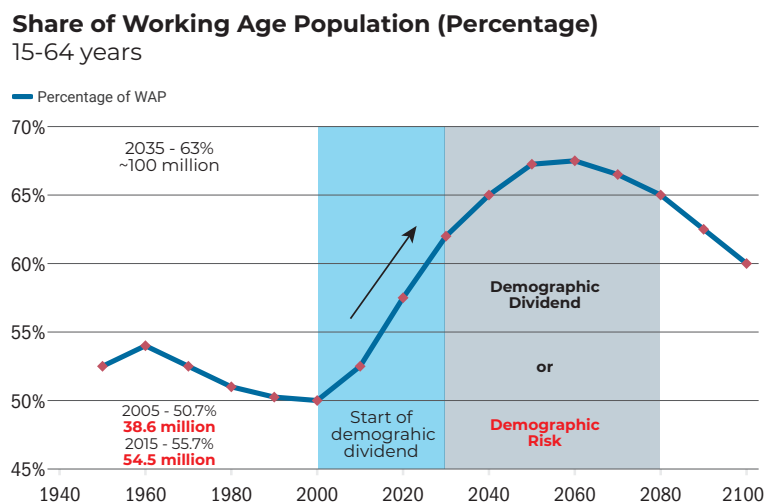


Figure 3. The coming potential demographic dividend. Between 2030 – 2085, more than 62% will be in the working age group [20]. The peak will occur around 2050 where almost 67.5% of the population (i.e., 135 million) will be between the ages of 15-64. Source: United Nations Population Projections (Medium Variant) and [4].

Objective and Approach

The intersection of national and global opportunities with the demographic and societal threats and risks highlighted above generate this question: “Will Ethiopia rise to the occasion and exploit the unique opportunities available to it, or succumb to the threats and risks it faces?” The search for an answer to this question is what prompted a group of like-minded Ethiopians with diverse professional backgrounds, and residing within Ethiopia and abroad, to come together in late 2018 and discuss openly and thoughtfully practical and effective strategies to address the emerging opportunities and challenges around the demographic transition. In this respect, the advent of a reform-minded government in 2018 offered an excellent opportunity to answer the fundamental questions raised above. The broad theme was defined as “ETHIOPIA 2050: Grand Challenges and Opportunities” [21]. To explore these themes fully, an Initiative was

launched to carefully examine, both the opportunities of demographic dividend and the associated risks. Subsequently, an **International Steering Committee (ISC)** was formed in 2019 to implement the Initiative and coordinate the various activities.

The primary objective of this Initiative was to formulate a set of “Big ideas” around 10 major challenges that were identified as part of this historical demographic shift. The 10 Grand Challenge and opportunities that require immediate attention are: (i) food security (ii) water security, (iii) energy security, (iv) health security, (v) digital economy, (vi) advanced manufacturing, (vii) large-scale urbanization, (viii) workforce development & employment, (ix) transportation infrastructure, and (x) sustainability and environmental security (Figure 4 and Annex I).

The approach in this Initiative is guided by the consideration of population as a

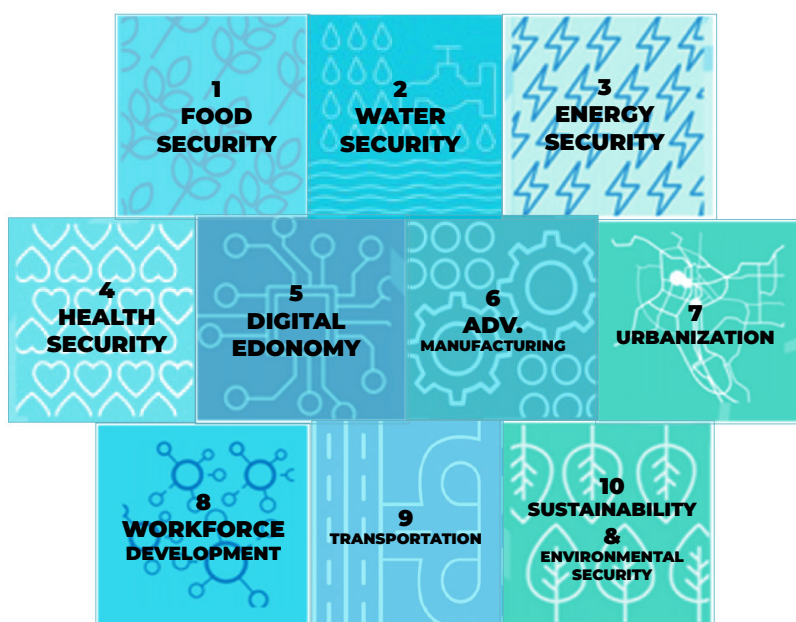


Figure 4. The “Ten Grand Challenges and Opportunities” associated with the expected generational and historical shift in Ethiopia in the next 30 years [21].

central issue for both the challenges and opportunities side, because, ultimately, it is people who are the agents of change and beneficiaries of development. These challenges and opportunities are addressed effectively if development policies are anchored in participatory and inclusive population policy where unconstrained access to education, health services, natural resources, means of production, freedom of movement, and good governance are guaranteed.

To facilitate a national dialogue around these Grand Themes, the International Steering Committee organized an international conference in Addis Ababa in December 2019. The conference was attended by 450 participants, including 40 speakers and panel moderators of Ethiopian-origin living abroad. Several ideas were presented and fruitful discussions were encouraged under four thematic groups: (i) water, food, health, and energy, (ii) rural development, infrastructure, urbanization, and sustainability, (iii) economic growth drivers (ICT and advanced manufacturing), and (iv) human capital, workforce development, and institution building. Three crosscutting themes were also explored. These crosscutting themes include (i) water, food, health, and energy nexus, (ii) economic growth drivers (technology as crosscutting growth driver), and (iii) the development of a globally competitive workforce.

Over a period of two days, plenary addresses were given by two ministers of the FDRE (H.E. Dagmawit Moges, Minister of Transportation and H.E. Dr. Eng. Seleshi Bekele, Minister of Water, Irrigation, and Energy), along with 60 talks by professionals from inside Ethiopia and abroad. The speakers came from the US, Canada, UK, Norway, Finland, Kuwait, Australia, Eritrea, South Africa, and Ethiopia. Their professional backgrounds varied from profes-

sorships in leading universities around the world to senior executive-level development and management professionals in international institutions such as the World Bank and multi-national companies like Microsoft and Apple (see Annex II and III for the complete list). The audience was also diverse with various parts of the Ethiopian society and professions represented. For example, faculty, staff, and students from the different universities in Ethiopia and high schools from Addis Ababa participated in the conference. Prominent Ethiopians who had served Ethiopia for many years with distinction also honored the conference with their participation.

The conference was successful in that it generated numerous thoughtful and provocative ideas. To follow up on the ideas generated, the International Steering Committee formed a **Blue Ribbon Panel (BRP)** that consisted of an independent group of leading thinkers and professionals from Ethiopia as well as thinkers and professionals of Ethiopian-origin. The mandate of the Blue Ribbon Panel was **to write a comprehensive consensus report** that outlines credible, relevant, and pragmatic ideas and practical strategies to address the 10 Grand Challenges and Opportunities identified by the ETHIOPIA 2050 Initiative. These ideas and strategies will be presented to the Government of Ethiopia. They will also be disseminated widely to Ethiopians in Ethiopia and abroad.

Scope and Structure of Report

The objective of this report by the BRP is to serve as a starting point for national dialogue. In particular, it is designed to enable policy-makers, professionals and various stakeholders to formulate and implement concrete policies and programs that could turn the challenges into opportunities so that Ethiopia realizes its ambition of becoming a middle-income country.

The report consists of:

- a.** Five detailed, specific, and practical recommendations and “*calls-for-action*” for each of the 10 Grand Challenge areas. The top 5 recommendations from each category were selected by the ETHIOPIA 2050 Technical Groups and the BRP,
- b.** Templates for multi-generational timelines for implementing the key recommendations, and
- c.** Specific ideas in funding the recommendations.

As presented above, Section I of this report covers the background and rationale for the establishment of the Ethiopia 2050 Initiative. This part articulates the unique challenges and opportunities Ethiopia

faces in the coming years. The second section describes in detail the sets of recommendations provided in the 10 Grand Challenges. These recommendations are grouped under specific themes. Section III presents templates and proposed timelines for implementing some of the key recommendations. In Section IV, the findings of this Initiative are summarized. Annexes highlight some of the proposed financing mechanisms for these recommendations, the make-up of the technical advisory group, and the extended ETHIOPIA 2050 community.

While preparing the report, the BRP became aware that the Ethiopian Government was preparing a 10-Year Development Plan. Subsequently, the BRP decided to prepare this report to feed into this Plan. The BRP believes that the successful outcome of this report will be measured through its impact in:

- a.** influencing policy making in the years to come, and
- b.** encouraging the subsequent launch of entrepreneurial, public, and government activities around the proposed solutions.

II. Grand Challenges and Overarching Themes

The December 2019 Conference in Addis Ababa explored in detail the original four thematic groups and three crosscutting topics. These themes and topics were then fine-tuned and further focused and organized into **five overarching themes**, which cover the 10 Grand Challenge Areas as follows:

(i) Large-scale and fast urbanization enabled by an ever-increasing “*push-factor*” from the rural areas as a consequence of demographic shift and the associated farming land scarcity,

(ii) Water-food-health-energy (WFHE) nexus as a national security issue,

(iii) Economic growth and job creation driving engines in the form of rural development, world-class workforce training for knowledge-based economy, ICT (digital economy), transportation, construction industry, and sustainable advanced manufacturing,

(iv) Institution building and strengthening through civic and professional organizations for sustainable structural change in society, and

(v) Girls’ education and empowering women who are half the population and hold the key for the demographic dividend through education and equity.

As shown in Figure 5, population growth, climate change, and a changing global economic landscape are the drivers of threats and challenges to Ethiopia’s development. These threats

directly impact urbanization and water-food-health-energy security (i.e., the first two themes). The next set of three themes (economic growth and job drivers, institution building, and girls’ education) represent the tools available in turning these challenges to opportunities. In other words, the continuing large-scale urbanization in Ethiopia is directly impacted by the demographic changes and the ensuing “*push factor*”. Similarly, the demographic changes will have a significant impact on basic needs such as access to water, housing, food, healthcare, and energy. The response to these changes has to come from economic growth and job creation that could address rural *vis-à-vis* urban inequities and help provide universal access to these basic needs. The achievement of these goals depends on organized, orderly, and fair market activity, which requires good governance and excellence from institutions in all sectors. However, none of these objectives can be accomplished without the participation of 50% of the population, i.e., women. Creating a conducive environment for their full participation will ensure the realization of the demographic dividend. As part of the strategy to mobilize financial resources necessary to realize the benefits of the demographic dividend and implement the recommendations, the serious problem of corruption and illicit financial flows is also addressed. In the following sections, these overarching themes, Big Ideas, and recommendations generated at the Conference are discussed in detail.

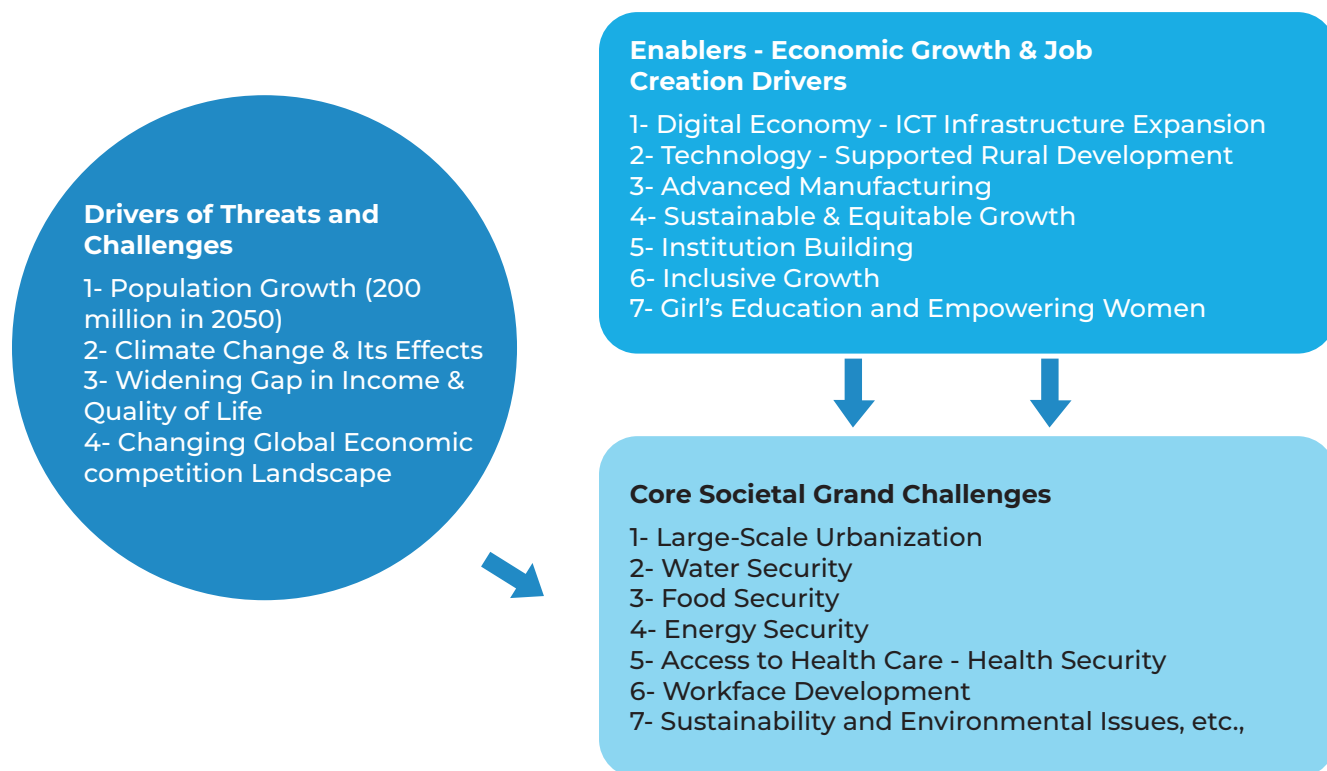


Figure 5. Large population growth, climate change, widening gap in income and quality of life, and rapidly and constantly changing global economic landscape are the driving forces for the key societal grand challenges identified in this report. Enabling areas offer means for tackling these challenges.

A. Urbanization

Given that Ethiopia's urban population is projected to reach 70.5 million by 2050 with an urbanization rate of 37.5 percent - up from its current level of 17 percent -, this grand challenge of urbanization will be one of the most pressing ones [1, 22-25]. The major cities will be among the first to feel the demographic pressure as an additional 50 million Ethiopians will call the urban areas home in the next 30 years. Remedies to the emerging challenges should answer the following questions. Will the cities be ready to absorb such a magnitude of new urban dwellers and provide them with adequate affordable housing and other basic needs? How will these new urban dwellers be integrated into the cities? How does the country plan for urban growth in advance? What are the challenges that these cities will face? What kind of models and related data are available that predict outcomes of a range of urbanization scenarios in Ethiopia?

To be able to answer these questions, it is important to review the baseline and identify some of the major multi-faceted problems in urban areas in the country. In Addis Ababa, for example, shortage of affordable housing, inefficient housing development, poor sewage network (only 14% of households connected to the municipality sewage system), poor transportation infrastructure, poor quality and dilapidated living environment, poor development and utilization of left-over urban spaces are identified as major problems [26]. In the case of cities like Dire Dawa and Hawassa, outdated structural plans, informal housing development, and poor infrastructure have been cited as the obstacles to sustainable urbanization [26].

Therefore, addressing these current and future gaps in housing, infrastructure and services in the urban areas requires

incorporating sustainability, affordability, and quality of life right from the earliest pre-design stage. In addition, the fact that rapid urban transition in terms of improved services and quality of urban life is simultaneously happening with demographic transition presents additional challenge to smart planning in addressing these gaps. Traditionally, the urban structure has been dominated by the capital city Addis Ababa, which currently accounts for 20 percent of the national urban population. The secondary cities, which in 2015, accounted for 80 percent of urban residents, are also experiencing rapid urbanization and urban transition, transforming the nation in visible ways [27]. Therefore, any meaningful discussion and planning to address gaps in access to clean water, housing, healthcare, transportation, energy, and all related infrastructures should consider this bi-modal urbanization model. Currently, there are three well-accepted scenarios for absorbing the growing urban population in Ethiopia in the coming decades [27-29].

Scenario 1: Mega City Model - Mega metropolis regions of 10 million or more inhabitants.

Scenario 2: Secondary Cities Model - Networked towns of at least 10,000 inhabitants.

Scenario 3: Mega City + Secondary Cities Model - A combination of the two, with secondary cities playing a critical role.

Scenario 1 with Mega City Model capitalizes on agglomeration economies and de-concentrates growth away from Addis Ababa but requires building a system of cities to fully leverage urbanization for

economic transformation and radiate growth to the wider rural areas and regions.

Scenario 2 with **Secondary Cities Model** evens out urban development across regions but disperses investment and is inefficient.

Scenario 3 with **Mega City + Secondary Cities Model** maximizes agglomeration economies while expanding the size of the population benefiting from urbanization by creating functionally linked system of cities with secondary cities playing a pivotal role in industrial development. This is also in alignment with the overall orientation recommended in the report of the Ministry of Urban Development and Construction (2015) entitled “*National Urban Development Spatial Plan; Ethiopia’s Urban Development Scenarios*” [27].

In the Ethiopian context, it seems very likely that Scenario 1 is applicable for few urban areas such as Addis metro (Figure 6a). However, over the past few decades, Scenario 2 has emerged as a credible model for an increasing number of cities (Figure 6b) [29-31]. Scenario 3, on the other hand, merges these two scenarios and, over the long term, seems to be the most likely natural growth model of Ethiopian cities as supported by growing amount of evidence [29-31].

RECOMMENDATIONS

The following ideas represent the remedies that are proposed in this Initiative to manage the massive ‘*push-factor*’ that is contributing to urbanization in Ethiopia. Unique and relatively new perspectives on how cities are organically coalescing in Ethiopia is discussed, and visions on how to expedite these are presented.

1. Emerging Mega-Cities - Plan and Build Urban Areas Around a Natural Agglomeration Model

One emerging and compelling phenomenon in urbanization in Ethiopia is the formation of mini-megalopolis – a set of adjacent city agglomerations forming a continuous urban region [25-29]. This is what is described here as Scenario 1. Close observations indicate that beginning of formation of one such mini-megapolis between the cities of Addis Ababa, Dukem, Bishoftu, Mojo, and Adama is already being realized (i.e., Addis-Bishofu-Adama cluster). With the recent introduction of the Addis-Adama Expressway, further evidence is emerging that an increasing number of people are commuting daily between these cities and, in the process, expediting the process towards an inevitable emergence of a new mini-megapolis around the Addis-Bishofu-Adama cluster. The planned new \$5 billion international airport near Bishoftu with 120 million passenger/year capacity, together with the development of supporting infrastructure has significant potential to further speed-up this megapolis formation. This potential megapolis will almost certainly become a “*mega-capital*” with a major part of the country’s economic activity, particularly manufacturing and service, concentrated here. Given this is a rather natural phenomenon driven by a compelling universal forces of agglomeration economies, the formation of this mega-capital stretching across a large area currently divided by federal and regional government boundaries is inevitable, in the long-run. It is very likely, therefore, that key stakeholders will eventually come to establishing agreements and arrangements on how to administer such a large and economically vital entity. As shown in Table 1 and Figure 6a, this same model of city agglomeration – in the long-term - could be an example

for additional urban-clusters around the country such as Gondar-Debarq-Debre Tabor cluster, Bahir Dar-Wereta cluster, Dessie-Kombolcha cluster, and Hawassa-Yirga Alem-Shashemene cluster [25,27,30].

In any practical discussion around the “*agglomeration model*” in the Ethiopian context, three important considerations should be given due attention, i.e., economic growth enabled by these mega-cities, equity and inclusion, and establishment of governance structure for these agglomerations.

a. Mega-Cities are Economic Engines:

As demonstrated around the world, agglomerations are powerful economic engines [28]. Their impact provides insights into how infrastructure plans and economic development policies in Ethiopia should be directed to facilitate regional integration. Properly executed, agglomerations will bring economic activity closer to where people already reside. Governments, consumers, and businesses can share benefits through effective megalopolis integration. Government initiatives in establishing mega-

regional development plans can generate positive benefits from improved transport links, in turn creating more robust housing markets. Better infrastructure (with economies of scale) can open up new markets to businesses and improve mobility of goods, ideas as well as culture, beneficial to all. A bonus in the case of Ethiopia is that agglomerations would reduce urban migration mostly to Addis, thereby reducing unwanted and unplanned urban sprawl, and the competition for “*ownership*”. The implications on workforce development as a result of this model is substantial, with hundreds of thousands of jobs being created in construction, engineering, sewage and clean water supply, transportation, infrastructure development, land development, surveying, IT, banking, and other domestically generated employment. By their very nature, cities are dynamic centers of innovations and economic growth and provide the environment where people, ideas, and capital come together, and hence offer the best forms of a powerful impulse to

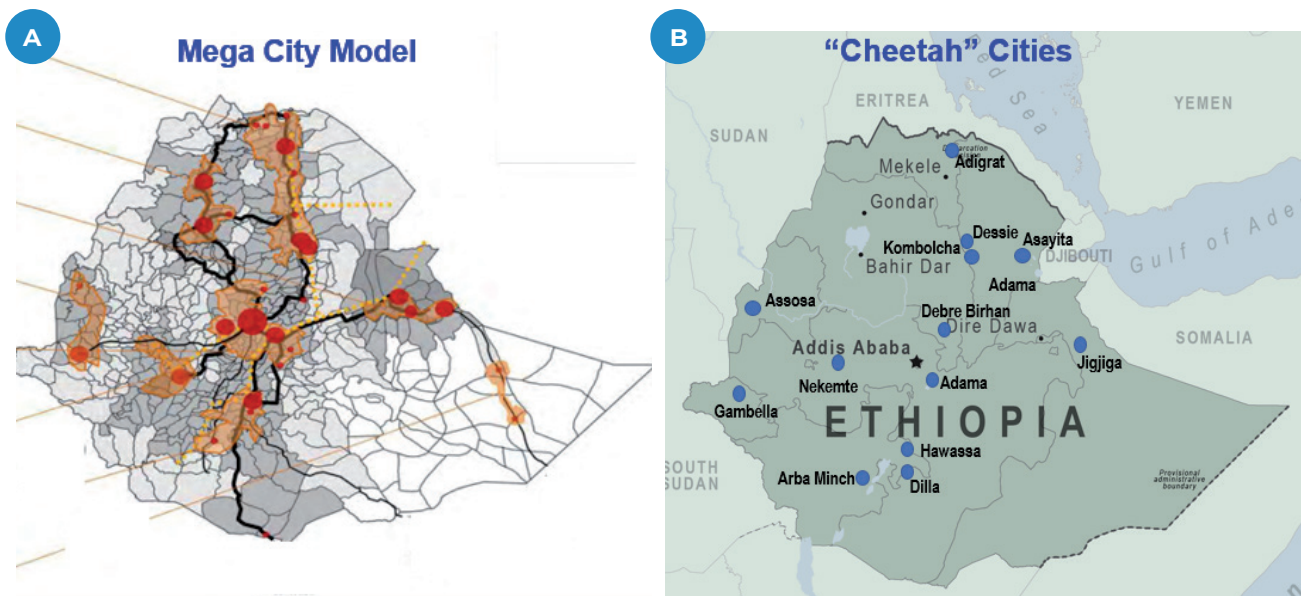


Figure 6. Potential aggregation models in urbanization in Ethiopia. (a) mini-megapolis aggregation model [25-29]. and (b) secondary cities “cheetah cities” where the “youth-bulge” is happening. [16,25,31].

unite people and improve regional integration. In addition, by spreading it over a relatively larger area, this agglomeration model could partially address the current concentration of major economic activities around Addis that has created “center-periphery” dichotomy and interregional inequality [32].

b. Inclusion and Equity for Farmers in Agglomeration Model: As these agglomerations of urban areas evolve naturally, they pose a threat to the farming community in their respective corridors. Therefore, it is important to recognize the farmer’s rights to land in a manner that is inclusive and equitable. In this respect, farmer-friendly policies, strategies, and programs should focus on:

(i) encouraging the continued existence of these farmers and their lands across the corridors through zoning laws and thoughtful planning of roads and other infrastructure,

(ii) Offering fair ownership and sharing of wealth generated where the land is converted to urban areas or infrastructure, and

(iii) involving the concerned communities in the planning process.

c. Develop Effective Institutional Arrangement and Governance System to Manage Emerging Mega-Cities:

As seen in many African countries, cities, especially capital cities, tend to rapidly expand and engulf the urban and peri-urban areas around them. Millions commute every day into the city for jobs and services, while the city’s dependence on the wider region for water and land resources and environmental services intensifies without effective institutional or governance structure to plan, manage and coordinate these complex relationships. In the case of Ethiopia, the interface with regional administrations will give rise to additional challenges to an already complex situation. These challenges, however, are not

Table 1. Potential mega-city clusters in Ethiopia. The estimates for population sizes for the cities rely on the 2007 census, which was used as guideline [1]. By 2050, out of the projected 70 million urban dwellers, almost 25-30 million could potentially be living in these clusters.

Cluster	Estimated Pop. Size (2020) ³	Estimated Pop. Size (2050)
Addis Ababa / Dukem / Bishoftu / Mojo / Adama	6 mil + 170,000 + 324,000 (CIA estimate for Addis = ~ 5 mil); ~ = 6.5 mil	17 million. 4% growth rate for Addis & 3% for others
Bahir Dar / Wereta	750,000 (2016) + 100,000 (estimate of surrounding areas); ~ = 1.0 mil	3 million (assuming 3% rate) 3.25 million (4% rate)
Gondar / Azezo	400,000 + 100,00 (*) ; ~ = 0.5 mil	1.2 million (3% rate) 1.6 million (4% rate)
Dessie / Kombolcha	300,000	1.0 million
Dire Dawa / Harar / Jijiga	440,000 + 160,000 + 200,000 ~ = 1 mil.	3 million (assuming 3% rate) 3.25 million (4% rate)
Hawassa / Yirga Alem / Shashemene	350,000 + 50,000 + 150,000 = 0.5 mil	1.2 million (3% rate) 1.6 million (4% rate)
Sodo / Mirab Abaya / Arba Minch	200,000 + 200,000 ~ = 0.5 mil	1.3 million (3% rate) 1.6 million (4% rate)

3. The data is interpolated from the 2007 CSA census & 2015 CIA estimates. Cities like Hawassa are growing at 5.28% [26].

insurmountable, provided they are approached with a clear purpose and are demonstrated to benefit the cities and municipalities that constitute the metropolitan area. The following are some of the choices available: (i) a one-tier fragmented local government structure, (ii) a two-tier structure that combines coordination of policies and investments at the higher tier with autonomy for local service provision at the lower tier, or (iii) special purpose districts established with limited functional scope (ex: waste management district, transport district, school district, etc.). In some cases, cities within metropolitan areas choose to coordinate through an informal or a horizontal arrangement. Whichever approach is adopted, having an effective governance structure is critical for metropolitan cities to function efficiently and serve as engines of growth by maintaining socio-political stability. Strategic investment in infrastructure like transport, and policies and regulations in urban planning and land use should be harmonized. Mechanisms for sharing revenues and costs should be established, overlapping responsibilities should be clarified. Cities of such scale and complexity should be managed competently and effectively through dialogue and negotiation [26,31].

2. Secondary Cities “The Ethiopian Cheetah Cities” - Empower these as Economic Engines and Potential Nucleus of Metropolitan Areas

Together with the “*agglomeration model*” of Scenario 1, where some of the large neighboring cities are in the process of merging, a separate and significant urbanization trend has been going on for some time in smaller cities. Secondary cities like

Asaita, Assosa, Debre Birhan, Nekempte, Adigrat, and Jijjiga are experiencing double digit population growth [31]. Consequently, these cities have become the epicenters of the “*youth bulge*”, a growing population segment that will potentially form the core of the demographic dividend or the demographic risk [16]. Because of their remarkable fast growth, these cities will be referred to as “*cheetah cities*” in this report.

Evidence is already emerging that these cities are forming the next level of growth in the manufacturing sector [31]. In general, cities with good economic momentum and an existing economic base are the best candidates for the success of manufacturing investments. Investing in secondary cities with growth potential and prospect of becoming metropolitan and economic corridors can balance the Addis-centric migration that is concentrating wealth and power distribution in the capital city [32]. This will require large scale investment in infrastructure and housing projects to absorb growing in-migration and support ongoing economic growth. Lead and second-tier cities in manufacturing include Awash Melkasa, Bishoftu, Burayu, Debre Birhan, Arba Minch, Assosa, Dessie, Dire Dawa, Adigrat, Asaita, Hosaina, Jijjiga and Kombolcha [31]. With regard to tradable services, a number of secondary cities, including Adama, Arba Minch, Assosa, Dessie, Mekele, Asaita, Debre Berhan, Dila, Gambella, Gonder, Harar, Jijjiga, Jimma and Nekemte can be considered as lead cities or have potential to become one. Targeted investments in these cities will need to include education, health, energy, transportation, and industrial parks. Assosa and Asayita could be re-considered as possible industrial park locations [31]⁴.

⁴ The authors drew the list of lead and second tier cities with potential for manufacturing and tradable service sector activities on Kebede and Gauntner [31] and their subsequent research work as part of the team that was engaged with UNECA and the National Planning Commission to help develop a national regional development framework.

In addition, expanding innovation and incubation centers, currently localized around Addis, to these cities can drive entrepreneurial activities and the associated investment and job creation. Building strategically selected secondary cities will also help decongest Addis Ababa and contribute to a more balanced regional development [32]. In general, the success of these secondary cities depends on (i) pairing good urban planning with manufacturing investments to ensure the sustainability of growth and urban productivity and (ii) fostering linkages between industrial areas, the labor force and the rest of the economy. A proposed template for smart urban planning, development, and management growth of these secondary cities is given in Figure 7 highlighting the need for tight integration between national and local level planning.

3. Promote Specialized Cities with Comparative Advantages

The numerous existing tourist sites in regions such as Tigray (Axum, Yeha, etc.), Amhara (Lalibela, Gonder, Bahirdar, the Simien Mountains, etc.), Afar (Eratle, Dallol, etc.), Harar and new tourist routes in southwest Ethiopia (coffee and forest tourism) and south eastern (Sofomar and Sheik Hussien) are endowed with resources that can easily bring economic benefits. For example, as recently recognized by GoE, the city of Arba Minch has a comparative advantage as a tourist destination and a gateway to Nech Sar Park and the Omo Valley. Core urban functions and productive infrastructure vary with economic sectors that drive growth. For example, core urban functions in the tourism areas involve the travel and hospitality industry. On the other hand, in areas with agriculture potential, the

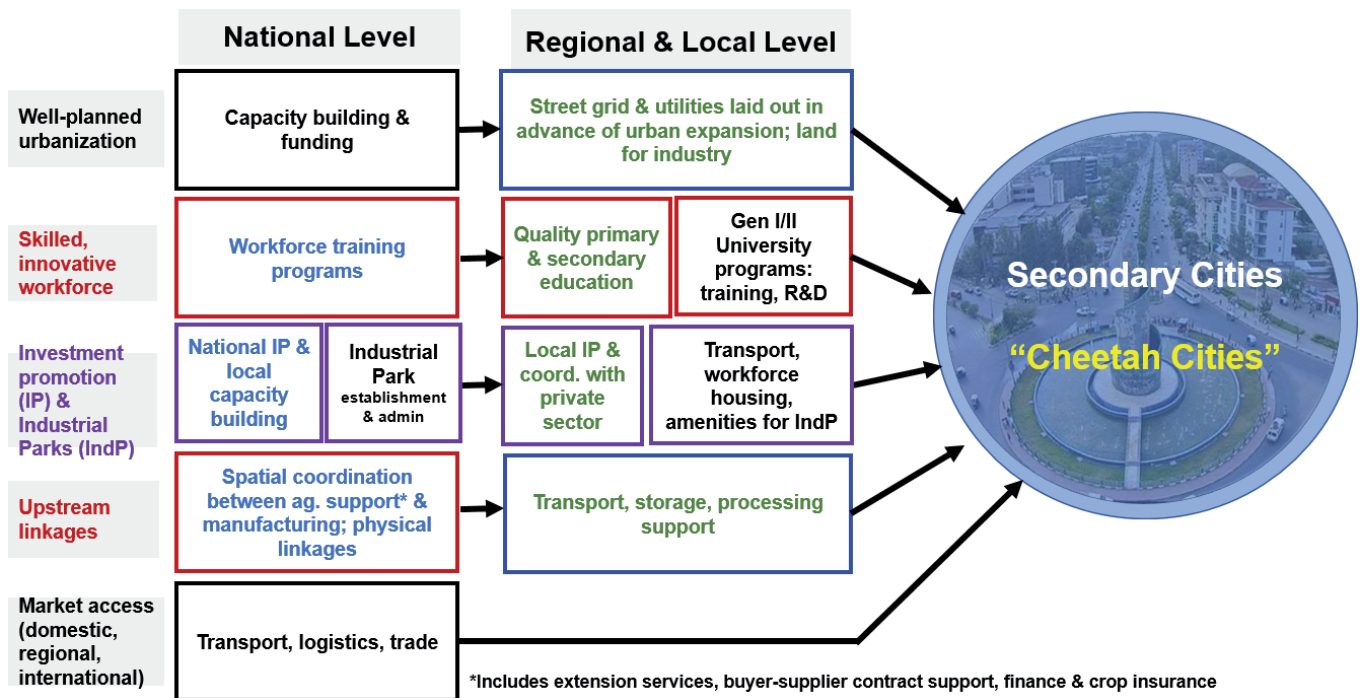


Figure 7. Template for smart urban planning, development, and management growth of secondary cities.

focus should be on agro-processing industry and logistics infrastructure to support food storage, transport and distribution. Such spatially targeted and sector specific projects should be accompanied by energy and connectivity infrastructure to create an enabling environment conducive for investment in the priority agriculture and non-agriculture sectors.

4. Transform the Informal Economy – Improve Working Conditions and Business Environment

An important feature of urbanization is the significance of informal economic activities. According to the World Bank, in the late 1990's nearly 75% of the global labor force worked in the informal sector [33]. It has also been reported that in forty-three countries in Sub-Saharan Africa, this sector, on average, accounted for 40% of GNP and created jobs 'filling a gap left by the formal wage sector' [34]. This is further corroborated by other studies that provide statistical evidence relating to the size and importance of the non-formal sector (jobs and employment, productivity, and growth) [35].

The main challenge in the informal economy has been the gap in policy instruments to facilitate the transformation of this sector into the formal sector. It will be pivotal to develop policies and related strategies to strengthen and support the informal sector. A transition that involves a gradual and incremental approach to regulate the sector, with limited restrictions, on account of its significance in job creation and addressing poverty will be necessary. The informal economy is largely a poverty alleviator rather than a productivity accelerator, and it is here to stay. It remains a default livelihood source for the unemployed and the under-employed. Though low in productivity, it contributes considerably to employment and national output, thus becoming an integral part of the nation-

al economy. Transforming the informal economy and enhancing its productivity is key for growth, poverty reduction, and, to a certain extent, tax base expansion. However, there is no one-size-fits-all solution to transform the informal economy and enhance its productivity in the short run. The long-term solution is to increase the pace and scale of job creation in the formal economy. The following recommendations are relevant:

- a. In the short and medium term, improved working conditions in a shared and dedicated space should be encouraged. This is like the **"WeWork"** model (wework.com) of shared workspace that has become popular around the world, despite some challenges. In the Ethiopian context, these include workshop type warehouses built by the municipality or by entrepreneurs and rented out to informal businesses. For sectors such as ICT, manufacturing, construction, green economy (solar energy, for example), and service economy that have a potential to grow, this could remove a significant barrier.
- b. Supplement these improvements in working conditions with improved business regulations that are friendly to informal business owners.

5. Plan for Urban Housing, Large-Scale Urban Development Projects, and Growth in Advance

a. Urban Housing to Respond to Demographic Changes

According to data from the 2007 census of Central Statistical Authority of Ethiopia, almost 40 percent of Addis Ababans are between the ages of 20-34 [1]. With Addis Ababa growing at a reported rate of 4.4 percent in 2020, it is clear that a substantial portion of demand for housing will come from this demographics. It is, therefore, reasonable to expect that demand for housing stock for singles will

be substantial. Currently, most young people in Addis Ababa – particularly migrants from the rural areas – tend to depend on informal housing in unplanned areas. Innovative housing solutions in the form of basic “efficiency” apartments, microflats, or dormitory-type accommodations should be considered to meet this demand. Innovative financing interventions such as government-supported building programs, affordable mortgage financing, and housing cooperatives could offer pragmatic solutions. The opportunities available for builders and developers in this sector cannot be overemphasized.

b. Address System Wide Barriers to Scale-up Urban Housing Provisions

Public investment in infrastructure and housing has been a major driver of the economy in the recent past. As the priority shifts to manufacturing and the country strives to become a middle-income economy, the role of the private sector in housing will need to significantly increase. Government focus should be on creating enabling conditions and supporting the development and provision of affordable housing, including pilot models and subsidy schemes. Housing can be addressed effectively only through a concerted effort that simultaneously addresses issues of land, building materials and housing finance. Comprehensive public policies together with large-scale investments are necessary. In the near future, as the rate of urbanization increases, demand for housing will continue to exceed supply. Therefore, mobilizing the private sector and household's savings becomes necessary. Housing should be considered not as a welfare issue, but as part of economic development. An economic lens is critical when planning housing projects. Often, housing proj-

ects are located on the periphery of cities where land prices are low, placing a high commuting burden on residents and constraining them from accessing the existing formal job market, and should be avoided or mitigated.

The housing problem for low income earners is complicated by the lack of access to affordable land, temporary/illegal settlements, rising building costs and limited opportunities for affordable finance. There are also issues related to access to basic services, particularly water, sanitation, energy, and poor environmental conditions. New perspectives are required to introduce innovations and comprehensive policies and programs to provide affordable housing, with easy access to financial services relying primarily on private investment, supported by government incentives and security (including income tax concessions).

c. Continue Investments in Large-Scale New Urban Development Projects

The significant investment in good quality, integrated, and holistic plans and designs of large-scale developments such as Industrial Parks, Special Economic Zones, large-scale housing facilities should continue. These should be located in new nearby urban settlements and around urban centers, or in existing brown field or new green field areas which together improve the urban centers and bring about sustainable developments within a large-scale integrated plan [26].

d. Plan for Urban Growth in Advance

With substantial investment allocation expected in the megapolis clusters and secondary metro cities, planning for economic growth drivers is of paramount importance. For example, good urban planning should be paired with

manufacturing investments to ensure sustainability of growth and urban productivity. Ethiopia's cities are yet to be developed. An additional 50 million people are expected to move to the cities in the next 30 years [23,29]. By planning smart and in advance, the country can avoid the proliferation of slums, urban sprawl, and car-centric urban development, save on infrastructure costs, and maximize on agglomeration economies. On the other hand, retrofitting an unplanned urban development is exceptionally costly. Upgrading slum areas can cost up to 12 times more, compared to service provision in areas with subdivided plots and blocks [36]. Investments in industrial and urban development must go hand-in-hand to achieve sustainable growth. Some of the specific measures that can be taken in planning for growth include:

- (i) Planning at the scale of urban growth and implementing a connected grid of streets in advance of unplanned expansion will be critical for long-term connectivity and mobility. Cities which expand without advanced planning will end up with disconnected and linear developments (the Bishoftu area is a prime example, where there is a single major axis of both industrial and non-industrial development), prematurely congesting and choking industrial competitiveness.
- (ii) As a country that is yet to build the majority of its cities in the coming decades, Ethiopia can take advantage of its massive urban investment to promote green and inclusive cities. New types of urban regulations and standards promoting investment in multi-modal transport systems, energy-efficient buildings and public spaces should be pro-

mulgated and enforced through appropriate planning, administrative, legislative, and financial instruments, thus laying the foundation for smart, green, and resilient cities.

- (iii) Existing and pipeline projects on new cities, urban expansions and urban renewals will require reviewing and updating with a focus on promoting urban quality and sustainability. Planning laws, education and practice should be rethought and rebooted to meet future demands and challenges.

Funding

Considering its current GDP per capita and urbanization level, Ethiopia appears to have some fiscal room to increase investment in cities. Indeed, urban investment is lumpy and capital intensive, but with good planning, investment can be staggered. For example, upfront investment in urban expansion projects can be reduced by initially focusing on securing the requisite land for infrastructure and then leveraging new urban development to finance public investment. Specifically, the following approaches can help secure funds for urban development:

- a. Establish regulatory mechanisms that empower city and municipal authorities to expand their revenue base, improve their revenue collection and use underutilized resources efficiently. This should be accompanied with strengthening data infrastructure for collecting overdue rents, taxes, and other revenues [26]. Land value capture could be one of the sources where currently property taxes that account for only 0.5% of GDP for most African countries could be increased to about 2%, in line with most developed countries. In this regard, taxing the increasing number of new and high property value building assets

in the city can be a significant source of funding,

- b.** Assist urban administrations to access medium-term and long-term loans and grants; enable urban administrations to act as entrepreneurs and corporate entities,
- c.** Strengthen matching and collaborative financing, and
- d.** Promote collaborative and shared financing by urban administrations.

B. Water-Food-Health-Energy (WFHE) Nexus

Some of the most immediate and significant impacts of population growth and climate change are in access to water, food, healthcare, and energy. As the pressure from demographic expansion mounts, fundamental questions arise regarding the challenges that the country faces in meeting the basic needs of its population. Can Ethiopia achieve food, water, healthcare, and energy security by 2050 in a sustainable way? What are the specific options available for it in achieving security in these areas? What sort of technological progress is in the horizon that is relevant to achieving food security at the level of small farm-holds and large mechanized farms? What are the challenges in energy security and also the opportunities in realizing a reliable export market in energy?

At this historical time where Ethiopia has finally made significant progress in realizing the potentials of its largest and most important river **Abay, through the building of the Great Ethiopian Renaissance Dam (GERD)**, these questions become even more pressing and relevant. Access to clean water, nutritious food, sanitation, healthcare, and energy are basic human rights. The primary objective of any government in Ethiopia should be to strive to fulfill these basic needs of its people so that they can contribute to the development of the country. In Ethiopia, where 44 % of the population lives below the poverty line, only 50% of the population has access to clean water, and 15% to improved toilets and over 70% lack electricity, universal access to water, food, healthcare, and energy continues to be a national security issue.

Due to their intrinsic interrelationship, **Water, Food, Health, and Energy** are

evaluated and understood well as part of **WFHE** Nexus. Ideas suggested for water access are also very much relevant to food, health, and energy security. In the Ethiopian context, one can also argue that, while all the 10 Grand Challenges are inter-related, climate is much more closely related to water, food, health, and energy. Therefore, while climate change is not addressed as a separate category in this report, we will address these Grand Challenge collectively. As the “*Ten Grand Challenge*” areas are also interrelated, the planning for water and energy access will be influenced by the urbanization models discussed here. For example, energy security for the mega-cities could be predominately tied to national grids, whereas for small towns and rural areas, off-grid renewable power generation could offer a more pragmatic approach.

Water-Food-Energy Nexus Analysis

Scenario-based WFE (water, food, and energy) Nexus model developed by Semu Moges and Megersa Tesfaye considered three outcomes in the year 2050 that are helpful for assessing the country’s projected need and capacity [37]. The model considers the outcomes influenced by universal access to WFE in equitable and sustainable growth, and resilient productive environment driven by urbanization, population growth, climate change, and global trends (Figure 8). For simplicity, however, the model does not include health security.

Scenario 1 (S1) – Business as Usual - Maintaining the status-quo with per capita WFE consumption remaining the same, but socio-economic drivers continue to grow.

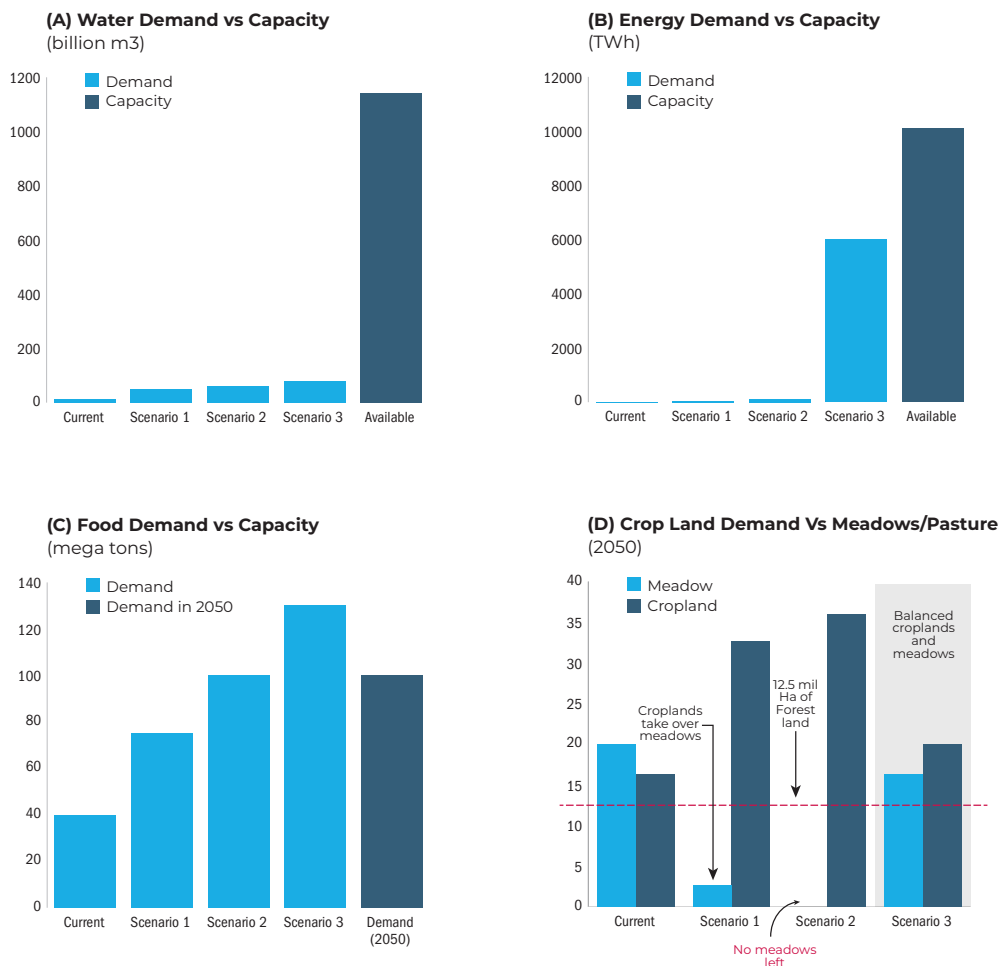


Figure 8. Scenario modeling of water, food, land use, and energy projections for 2050 [37]. The model predicts that Ethiopia will have plenty water (A) and energy resources (B) for its burgeoning population till 2050 and beyond. However, there will not be adequate food (C) and crop land (D) by 2050, unless the country introduces remedial measures. The term “available” indicates the amount of the specific natural resource available in each category in the country. For example, for water, availability is calculated as: 980 BCM (billion cubic meter) from rain, 122 BCM of surface water, and 40 BCM of ground water. The model assumes that only meadows and pastures (no forests) will be affected.

Scenario 2 (S2) – Revised MIC by 2030

- Achieving 100% WFE access + Middle income country (MIC) status achieved by 2030.

Scenario 3 (S3) – Agricultural Intensification Scenario

- Achieving 100% WFE universal access + MIC status by 2030 + Doubling agricultural productivity.

Observations from Scenario Model

1. Ethiopia has adequate renewable energy resources to develop and satisfy growing demand until 2050 and beyond. The energy mix will be dominated by hydropower and shifts to solar energy after 2040. However, energy generation requires significant capital investment.

2. Ethiopia **has adequate water resources** to satisfy growing demand until 2050 & beyond (**1140 billion m³**). However, on per capita basis, it will go down from the current 2000 m³ to 1000 m³ in 2050.
3. Ethiopia has limited land resources for extensive agriculture development (land expansion based agriculture). As shown in Figure 8, if current trends continue, the demand for cropland will far outstrip land left for pastoralists as meadows and pastures. The model corresponding to achieving MIC status in 2030 (S2) will also result in significant risk of conflict between agriculturalists and pastoralists.
4. Scenarios 1 and 2 will continue to induce conflict with pastoralists and forest ecosystems.
5. According to the model, Ethiopia could satisfy its food security by 2050 and beyond by changing the current mode of production and productivity. Doubling of agricultural productivity guarantees food security as well as reduces the burden on both the pastoral and forest resources. Maize crop is found to be the dominant economic crop to grow in Ethiopia. Continuing with extensive agriculture will significantly reduce conflict with pastoral and forest ecosystems.
6. Scenario 3 will reduce crop import from 30 MT to 6 MT by 2050 and also guarantees food security by doubling agricultural productivity. It will also reduce the burden on both the pastoral and forest resources.
7. The biggest threat, however, are the associated high costs which require innovative public/private financing. Maintaining the status quo costs about \$2.75 billion, while \$9 billion is

required for infrastructure investment consistent with Scenario 2 of reaching middle-income status. Annex II presents some of the suggested potential financing vehicles.

The order of the recommendations given below reflects the fact that the above observations highlight food security and dwindling supply of arable land as the dominant areas of concern.

RECOMMENDATIONS:

I. Food Security

1. Establish “National Food, Water, Health & Energy Security Charters”

The guarantee of food, water, health, and energy security in Ethiopia should be based on the recognition of these as a basic human rights, with a goal of achieving universal access in these areas for all rural and urban households [38]. This is consistent with the UN’s Sustainable Development Goals (SDG) that call for universal access to water, food, and clean and affordable energy [39]. It is also consistent with GoE’s stated plan for universal electrical energy access in 2025 [40].

- a. These charters will be the drivers for all government policies and strategic considerations in the **water-food-health-energy nexus**.
- b. Putting these as a cornerstone of Ethiopia’s strategic national security will allow it to frame bilateral and multilateral discussions about the use of its resources such as rivers for water, energy, and food production as national security commitments. As a timely example, since nearly 40% of Ethiopia’s population lives in the Abay river basin and about 32% of the country’s land mass is located in this basin [41], the issue of the GERD and, by extension, the Abay has to be framed around the question of national security.

2. Double Agricultural Productivity

The scenario analysis indicates the doubling of agricultural productivity is required to guarantee food security by 2050 for an increasing population, while allowing the country to reach middle-income status by 2030 and reduce the burden on both pastoral and forest resources. **The analysis also indicates that maize is the most economical crop to grow in Ethiopia to meet food security.**

a. At the farmer's level: Policy and technology supported agronomic inputs as well as effective marketing systems are needed to enhance agricultural productivity and its market value. For example, in 2016, the yield for wheat in Kenya was 6-7.5 tons/ha, while for Ethiopia, it was 2.59 tons/ha [42]. In general, productivity may be doubled by supporting:

- i. Modern agricultural techniques such as **(a)** recent technology advancements promoted by the Agricultural Transformation Agency, i.e., TIRR (**T**eff + **I**mproved variety of Teff + **R**educed seed rate + **R**ow planting) that has reportedly resulted in 3-5 ton/ha yield with an overall average of 2.5 tons/ha for farmers who use the technology versus 1.5 ton/ha for those who do not and **(b)** spaced transplanting of teff that gave 3-5 ton/ha yield vs the current 1-2 ton/ha yield [43-46],
- ii. growing 2-3 crops per year under irrigation to increase productivity per season. The crops can be wheat, teff and rice rotated by a leguminous crop such as dry beans or soybeans. Technology for covered greenhouses, mesh-wire greenhouses, etc. for growing vegetables off-season under drip-irrigation could contribute to this increase in productivity,
- iii. increased acceptance and adoption of maize and rice as staple foods because of their high yield per hectare. While it is

a difficult task to change eating habits of most of the country's population anytime soon, increasing the role maize and rice play towards food security is, nevertheless, an option that will require a serious consideration,

- iv. improved farming equipment for small farmers, appropriate sustainable fertilizer mix, and
- v. better-trained extension service staff that closely work with farmers.

b. Introduce equity and inclusion based large-scale mechanized agricultural development - large-scale mechanized agricultural development is needed to produce basic crops in the low-land areas of Ethiopia (e.g. wheat, maize, teff and rice). It is very encouraging that several irrigation projects are already underway in the lowlands of Afar, Somali, and SNNPR regions for growing wheat. However, important, and consequential lessons from the 1990s and 2000s need to be taken into consideration to make sure that these efforts are successful.

These are:

- i. Providing **equitable access** to schools, health centers, water, power access, transport, etc. for the community,
- ii. Prioritizing production first for local consumption, to address food security threat, and
- iii. Designing policy frameworks and implementation strategies as well as enforcing them in a manner that respects the needs and capacity of the millions of small farmers and producers' cooperatives.

3. Food Security through Leveraging Indigenous Species – “Seeds of Survival”

Several evidence based scientific studies since the 1980s have shown that Ethio-

pia's indigenous species of crops have a remarkable pool of climate-change resilient and high-yield variants. Such species are stored at Ethiopia's Gene Bank and by farmers themselves, especially in the high land areas [47-52]. As the pressure from climate change and reduced availability of farming land further intensifies, it will be even more important to recognize that it is through the maintenance of species and genetic diversity that Ethiopian highland farmers, over the centuries, had coped in difficult terrains in difficult environments [47]. The successful model of the **'Seeds of Survival/Ethiopia'** (SoS/E) program of the 1980s/90s which enhanced both farmer-level storage of indigenous seed stock and also created a national gene bank should be strengthened. This can be done through improved technology for scaled-up long-term storage of such seeds, from farmer-level to community and region levels. There is also potential in the future for such conservation of a rich genetic pool of crops to create marketable component the global market.

While it is true that "seeds of survival" by themselves may not address food security, they are, however, central to a sustainable and climate change resilient food security together with improved seeds and modern agricultural technologies.

4. Promote Massive Irrigation in the Qola Areas (Adds 2 billion m³ of water and 150,000 hectares)

River-corridor irrigation has been identified as a key component of food security by GoE [17]. In addition to the sites identified by GoE, a proposal is forwarded here for realizing **2 billion m³ of irrigation water** sufficient to irrigate **~150,000 hectare** in the Qola areas of Afar using the Jemma River in North Shoa zone [53-54]. Cognizant of the fact that Jemma River is a tributary of a trans-national river, the Abay, its annual flow of 2 bcm which is

only 4% of Abay's 54.4 bcm flow makes it a natural candidate as a focus of the next set of negotiations for equitable use of water with the downstream countries, the Sudan and Egypt. **Its relatively small flow could help build a test case for Ethiopia's right for equitable use of the Nile for its burgeoning population.** The estimated cost of this proposed project is Birr 3.62 billion with design and construction estimated to take 5 years [54]. Proposed activities include:

- a. building dams across some of the small rivers (tributaries of the Awash) located in North Shoa and channeling the water through the Addis Ababa area and discharging it to an artificial lake near Metehara,
- b. diverting the Kesseme and Kebena Rivers (tributaries of the Awash) in East Shoa to the same artificial lake near Metehara that can collectively hold 3 billion m³ of water, and
- c. building channels that provide water to the farmlands in Metehara and the middle Awash areas.

5. Cultivate Teff on Large-scale Commercial Farms

With teff becoming well-known as a superfood and a desired crop around the world, despite its relatively low yield, large-scale commercial farms of teff not only can help meet domestic demands but also be exported [54]. In a typical case, the yield of teff is 15-20 quintal (1.5-2.0 t/ha); 150,000 ha of commercial teff farm could produce 300,000 tons. 1 quintal (0.1 t) typically yields at least 500 injera. With the current cost of one injera estimated at \$1-\$2 (including processing and transportation costs) and exporting 30% of the yield (70% left for domestic consumption for food security), up to ~\$1 billion could be earned. This is a scalable proposition. Furthermore, teff productivity, as shown

above in section 2(a), can potentially be increased to ~3 tons/ha.

There are promising research activities in growing teff in lowland areas under irrigation. Therefore, large-scale irrigation-based teff farming along with improved yield could make teff a competitive crop for not only contributing to food security, but also – as argued above – a cash crop. Given that the areas producing teff in 2018-2019 (2011 EC) totaled 3.1 million hectares, significant improvement in yield (in the range of 3 ton/ha) in most places in the country could potentially satisfy local demand. A similar consideration for export market could be given to other crops such as oilseeds, enset, and spices which could generate substantial amount of revenue and foreign currency.

II. Water Security

1. Addis-Adama Cluster Will Soon Require New Water Supply Sources

Only half of Ethiopia's current population has access to clean water and only 15% have access to improved toilets. With the projected population growth, ensuring fresh and clean water supply to both urban and rural communities becomes a priority. This will ensure a healthy workforce and reduce waterborne diseases which will in turn reduce both child and maternal mortality. Efforts can include well researched rainwater harvesting, groundwater wells, multi-purpose small to large scales reservoirs and affordable sewage systems.

However, to keep up with the large urban population increase, innovative solutions need to be sought case by case. For example, with the population of Addis Ababa projected to reach 10 million by 2035 [1, 8], there is a legitimate concern regarding the availability of adequate drinking water to keep up with the increased

demand. A population of 10 million will require about 2 million cubic meter of water per day (assuming 200 liters/person/day). The Legedadi Dam, Gefersa Dam, Gerbi Dam, and Akaki Wells have a capacity of 260,000, 30,000, 73,000, and 30,000 m³, respectively⁵, which is only about 25 percent of the projected demand. Therefore, for the needs of the future Addis-Adama mega-city cluster, serious considerations should be given to other sources such as Awash river, Jemma river, and smaller rivers in North Shoa. We propose that planning for the use of part of the water of the Jemma river/watershed for drinking purposes will further strengthen Ethiopia's argument for fair share of Abay.

2. Strengthen Watershed Conservation

Watershed conservation will be critical to ensure water, food and energy security in Ethiopia and consists of afforestation, soil and water conservation and headwater protection. Watershed conservation will help increase in flow of streams and volumes of wells in dry season, improve agricultural productivity, flood management, and reduce energy insecurity. With the increasing population and demand for more agricultural and grazing land, the pressure on the ecosystem will be severe where deforestation, soil erosion, land degradation, and desertification could continue in an accelerated rate. In addition to the obvious damage to existing arable land, these degradations will also negatively impact the major hydroelectric power generation and irrigation infrastructure projects that the country is undertaking. Luckily, at the government level, there is an increasing awareness of the dangers of poorly managed watersheds. The massive afforestation efforts of 2019 and 2020 are major steps in the right direction. The following recommendations are proposed to support a sustainable and long-term watershed conservation:

⁵ Addis Fortune, August 18, 2018, "Water Shortage Hits Capital Again".

a. Establish Watershed Management Policy Master-Plans

A national policy for watershed management will be a good start. Each major watershed in the country has its unique properties and land-use practices. While prior government plans such as GTP I and II have made conservation a priority, currently there is no national watershed management masterplan [55].

b. Immediate Remedial Rehabilitation Measures

Afforestation and reforestation efforts should continue to be carried out at a large-scale, as has been done in 2019 and 2020. There is some evidence that such a national-level effort is being reproduced at community levels due to increased awareness.

c. Community-Based Watershed Management

Once a national policy is established, an inclusive and participatory community-level engagement could produce a sustainable watershed management practice by engaging the 12,500 Extension Services in the country. Some of the specific tasks could be reforestation and farming practices that promote land conservation. This will also incorporate, where available, local know-how in conservation coupled with university supported research [56]. One such example is the effort in Choke Mountain watershed management.

III. Health Security

1. Integrate Health Sector Development Program with Other Rural Infrastructures & Technology

There have been notable achievements

towards progress in expanding universal coverage of primary healthcare in the country over the past few decades, particularly through the Health Extension Program (HEP). The woreda-level infrastructure (primary hospitals, health centers, and health posts) that are staffed by Health Extension Workers (HEW) are commendable. However, challenges remain in poor integration with other community infrastructures, participations, and follow-ups [57].

With further investment targeting agglomeration in the rural areas (such as cluster farming), co-locating health services with these emerging institutions and infrastructures offers a convenient, economical, and sustainable option for introducing improvements, particularly technology-supported ones [57-59]. Tele-medicine, mobile phone based health services, and telephone hotlines for medical advice (such as the 8028 hotline for farmers) could be efficiently offered at these locations. Since the underlying technology for offering phone hotlines and mobile solutions for both farming and health information is often similar, hosting the infrastructure in a shared environment will avoid redundancy and waste of resources. Technology training of Health Extension Workers could be done together with Agricultural Extension Workers (AEW), again emphasizing the positive impact cluster environments have on the WFHE nexus.

2. Expand Capacity for Pharmaceutical Manufacturing

Recent data shows that Ethiopia spends more than \$0.5 billion in pharmaceutical imports which constitute about 5% of its imports⁶. With increase in population, this amount is projected to grow significantly. While developing pharmaceutical indus-

⁶ According to the UN COMTRADE database on international trade, Ethiopia imports of pharmaceutical products was US\$545.76 million in 2017, which represents 5.4% of its total imports.

try from scratch is a long-term process, Ethiopia already has some experience. Ethiopian Pharmaceuticals Manufacturing Sh. Co. (EPHARM), for example, was established in the 1960s. Growing this industry has already been identified as a priority area by the government [17] and this should allow for wide-availability of pharmaceutical drugs for both the urban and rural population.

3. Develop Infrastructure for Medical Center Clusters and Medical Tourism

In the long-term, Ethiopia should start thinking of benefitting from the medical tourism industry that has become quite popular around the world. For example, the Gondar region with its world-class tourist attractions, mild weather, and a well-respected medical college (Gondar College of Medical Sciences - GCMS) that was founded in 1954 has the potential to become a medical tourism center. This will not only serve patients from Ethiopia itself but could also be marketed for other countries in general and the neighboring countries of the Sudan, South Sudan, and Somalia, in particular. Competition for medical tourism business is growing around the world. However, Ethiopia's potential as a tourist destination, mild weather, and the extended global reach of Ethiopian Airlines could offer compelling advantages, if the right infrastructure is built.

IV. Energy Security

1. Integrate Grid-Scale Energy Storage with Solar, Wind, and Geothermal Generated Power

Renewables are already recognized as having a huge potential in the country (13,000 GW of wind power – 3rd largest in Africa, 1500-2500 KhWh/m² of solar power, 45 GW of hydro power, and 10 GW of geothermal) and form an integral part

of the “*National Electrification Program 2.0*” [60]. In fact, renewables form almost all the power generated in the country. Further, GoE's stated ambition is to make Ethiopia a net energy exporter. However, given the intermittent nature of renewable energy sources, particularly wind and solar energy (wind power could go from maximum capacity to zero in a few hours), grid-scale battery storage during off-peak hours is essential to bridge these periods and establish wind and solar as reliable sources of energy. Frequent blackouts that are common in the country, for a variety of reasons, could also be effectively addressed by the adoption of energy storage systems. Further, the seasonal variation in available water for the country's major hydroelectric power plants causes high variability in the amount of energy generated.

Therefore, the time has come for Ethiopia to seriously consider a national grid-scale energy storage strategy for grid balancing (Figure 9). In fact, we submit that without a significant energy storage capability in the country, the planned ~2GW (peak) worth of solar and wind power generation shown in Figure 9 will not be used economically, extending the return on investment for several more years.

Currently, there are two utility-scale storage technologies that can be considered.

a. Grid-scale battery storage (BESS

– Battery Energy Storage System) is emerging as a competitive technology. For example, Tesla's Mira Loma Battery Storage Facility in California has a rated capacity of 20 MW for 4 hours (80MWh). The larger **Hornsedale wind farm in Australia** is supported by Tesla's grid-scale battery technology (MegaPack) and has 150 MW capacity. This is in the same scale as the Adama 1 & 2 wind farms. Therefore, it is likely that a good portion of the ~2GW power from the planned

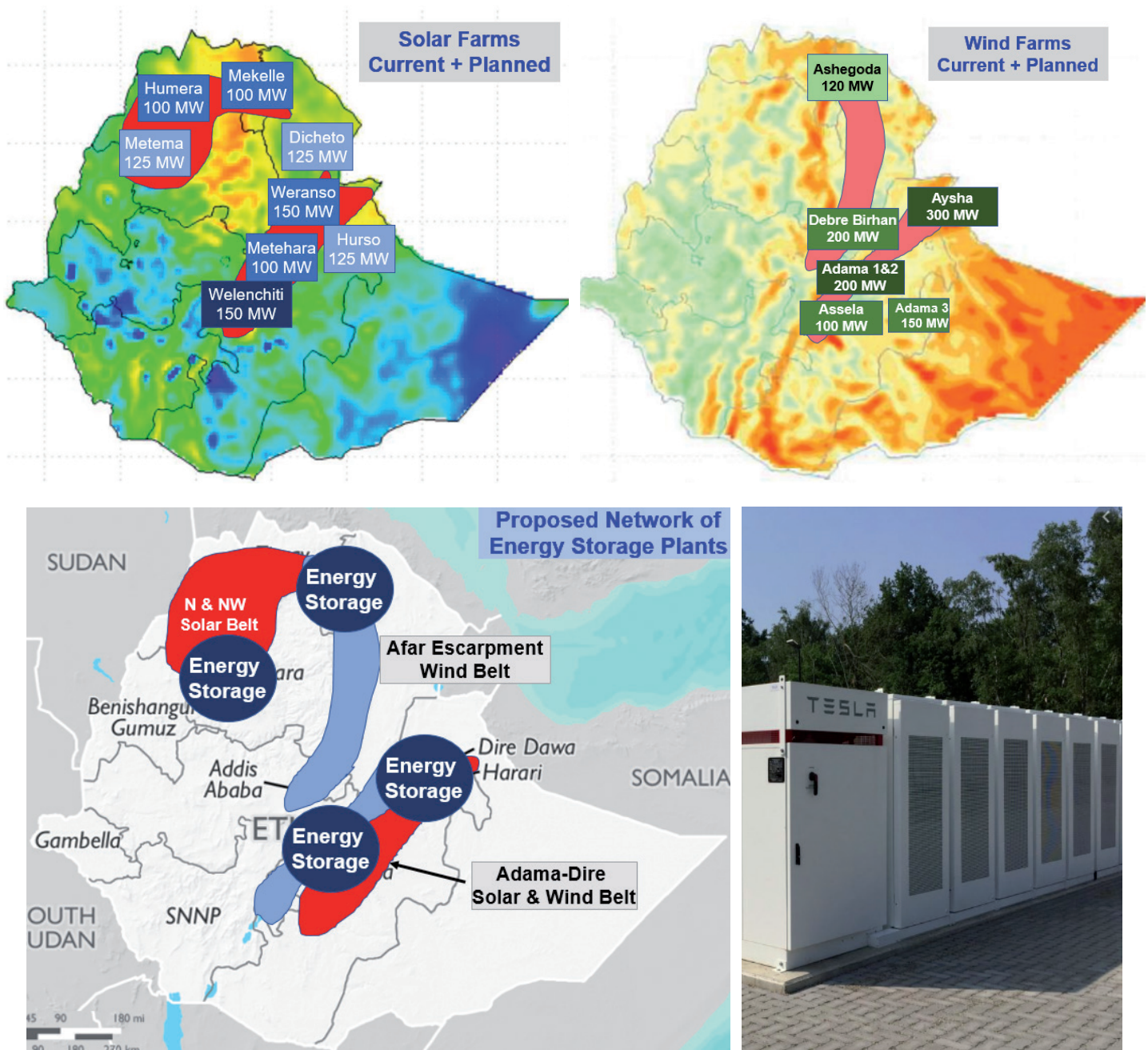


Figure 9. Planned and installed solar and wind farms in Ethiopia [54]. Total planned solar capacity is about 975 MW while total planned wind power generation capacity is at 1.07GW. The majority of the planned solar farms are in two regions: the “North and North West Solar Belt” covering Mekelle, Humera, and Metema and the “Adama-Dire Solar Belt”. The planned wind farms could be grouped in two as well: the “Afar Escarpment Wind Belt” and the “Adama-Dire Solar Belt”. Energy storage will be a major concern where battery storage could offer solution. Based on the locations of these planned and under construction plants, we recommend BESS in the areas shown in the figure (i.e., Dire Dawa, Adama, Metema, and Mekelle). Source: MegaPack Battery – Tesla.

solar and wind farms in Ethiopia could be stored using BESS technology.

b. Hydro-pumping, where the energy from renewable sources is used to pump water to a reservoir with significant head during off-peak hours and then use the head for hydropower generation on demand offers a plausible solution. Given how the Adama area is emerging as a center of solar and wind power generation, hydro pumped storage at Koka Dam looks promising, particularly in the dry season. This may require rehabilitation of Koka Dam; but the return could be substantial.

2. Develop Optimized Power Generation Mix and Grid Balancing

With increasing deployment of solar and wind power generation and the associated variability in the amount of power generated, there is a need for developing an optimized real-time management of power generation across the country between the different mixes. The double digit growth of several secondary cities in Ethiopia (Jigjiga, Debre Birhan, Nekempte, Asaita, etc.) and potential emergence of manufacturing in these cities highlights the need for new planning in national grid design that ties the traditional hydropower with solar and wind power generation. Such a national plan could include decisions on which power plants should be used predominantly for export and which will be used for the domestic market, which currently peaks in the evenings.

3. Adopt Distributed Renewable Energy Systems (Generation and Distribution)

This offers an unprecedented opportunity to address energy poverty and provide the basis for economic empowerment. The future of distribution grid is trending towards active distribution networks. In the Ethiopian context, one of the main advantages of distributed energy generation

is the minimization of line power loss due to transmission. In general, distributed energy generation is a bottom-up approach. Examples are (a) solar cells at the home-stead level and (b) solar farms at cooperative level. This model is more appropriate for the secondary cities and the rural areas where demand is still unmet and there is opportunity for building new renewable power plants.

4. Build Solar Photovoltaic Industry Ecosystem

Photovoltaic power generation carries a huge potential in Ethiopia, particularly in the underserved rural areas. There is already anecdotal evidence that solar cells that power batteries for mobile phone charging and solar lighting systems are slowly becoming common in rural areas. In both the short- and long-term, solar cell installations have compelling advantages since they could help create thousands of jobs in installation and maintenance services. They also have a faster implementation timeline as it is significantly easy to transport equipment compared to other renewable solutions. The value chain in photovoltaic solar industry is quite extensive and offers opportunities of jobs and services conducive to emerging markets. These include module assembly, system integration, testing, and maintenance. Therefore, a whole ecosystem could be created around this with job opportunities made available for thousands of young people.

GoE should take advantage of this by taking several important steps:

- a.** Encourage investments in manufacturing of components like wiring, mounting hardware, and tracking hardware and software for technology transfer and employment opportunities,
- b.** Increase solar penetration of minimum 25% energy mix,

- c. Establish conducive policy environment such as feed-in tariffs and incentives,
- d. Engage Gen I/II/III universities in research and production of solar PV components.
- c. Power Africa Initiatives (USAID) - Part of establishing 30 GW energy generation capacity across Africa. A substantial amount is already earmarked both for on-grid and off-grid power generation.

5. Allow Private Sector Entry into Power Generation

With programs like Power Africa Initiatives (USAID) which targets establishing 30 GW energy generation capacity and 60 million electrical connections across Africa and other PPP projects supported by AfDB and WB, the time has come for private sector entry to energy generation.

Funding

Power generation is a high capital-intensive industry. Energy storage through batteries or hydro-pumping will require significant levels of investment. Some of the funding mechanisms are well-known and engagement has already begun. However, there is some opportunity for non-traditional funding. Some of these are indicated below:

- a. *Marshall Plan Type – Zemecha*. There is a substantial amount of capital in the country. Estimate by thegobaleconomy.com shows money supply of ~\$25 billion in circulation in Q1 of 2019. The Ethiopian culture is receptive to “zemecha” style solution of massive problems that affect everyone. People respond well when they feel that they are part of a movement bigger than themselves. Adding accountability mechanisms to avoid corruption and loss of funds will help develop trust in the process.
- b. Public-Private Partnership (PPP) Projects supported by the World Bank and the African Development Bank. These funds are earmarked for off-grid as well as on-grid power generation.

- d. Tesla has emerged as a strong player in the grid-scale battery storage sector. Currently, they do not have any publicly announced engagement in the African market. As a show-case for the company, Ethiopia could take advantage and negotiate favorable terms. In fact, as a company interested in bundling its product offerings, Tesla may be amenable for deals consisting of battery storage and Starlink, its satellite-based broad band access.

C. Sustainable Economic Growth and Job Creation Drivers

With the immediate impacts of the demographic increase identified in the broad areas of urbanization, water, food, health, and energy security, and recommendations formulated on how to address them, the next obvious task is determining the sectors that could drive job creation and the associated economic growth.

Under the broad areas of economic growth and job creation, the following challenge areas could be addressed in a more holistic manner. These are: (i) rural development, (ii) digital economy, (iii) world-class workforce training, (iv) transportation, (v) construction industry, (vi) advanced manufacturing, and (vii) sustainability and environmental security. For each of these job growth drivers, the report presents specific recommendations that could help transform the 10 Grand Challenges into opportunities through job creation.

This report also identifies the strategic advantages that the **demographic dividend** and emerging technology offer in these areas *vis-à-vis* global trends. For example, digital economy carries tremendous power in creating jobs and facilitating economic development. “*Digital Ethiopia 2025*”, the recently ratified vision for digital economy expansion in Ethiopia offers an excellent starting point [61]. In this report, we identify some additional unique aspects that will supplement this vision. Advanced manufacturing (also known as digital manufacturing) based on emerging technologies such as 3D printing has the potential to provide employment, generate foreign exchange, and build a sustainable innovation ecosystems. Ethiopia’s Industrial Development Strategic Plan (IDSP) (2013-2025) [62] offers

a good starting point.

Related to the discussion on economic growth drivers in Ethiopia, two contemporary events point to exemplary opportunities that the country could realize. These are:

(a) Expected realignment of the global supply chain in the post-pandemic world could offer Ethiopia valuable opportunities. The COVID-19 pandemic has made it clear in dramatic ways that the world had depended – so far – exclusively on a model which concentrated the manufacturing of critical components and systems to a single source. Going forward, there could be an opportunity for Ethiopia in the broader areas of manufacturing where multiple sources are sought. We think two types of industrial set-ups in Ethiopia could benefit from these:

- (i) Industrial Parks** - Industrial parks should use local inputs and, in addition to the markets where they are slowly developing expertise in such as textiles, they should consider a strategic move towards high-end manufacturing. Factors that could speed up this transition include tighter integration with cities, collaboration with universities such as Addama, Hawassa, Arsi, Bahir Dar, Gondar, Jigjiga, Mekelle, etc., and provide major government tax breaks.
- (ii) Private Industry** – Government policies that encourage foreign investment in high-margin and capital intensive manufacturing (including advanced manufacturing) could help the growth of a domestic capability in the private industry.

(b) Rapid and remarkable pivoting by Ethiopian Airlines to cargo delivery

around the world during the current pandemic offers a unique perspective on how Ethiopia could continue to build on its emergence as the “logistics center” of Africa and beyond. The recent press coverage on how Addis Ababa⁷ has “emerged as a key transit hub of much sought medical equipment to Latin America” along with the opening of UN-WFP’s “the Addis Ababa Humanitarian Hub” at Bole International Airport are validating the opportunities available around establishing Addis as a major transit hub. This will be further explored under the digital economy section.

RECOMMENDATIONS:

[C1] RURAL DEVELOPMENT

In 2050, almost 130 million Ethiopians (over 60% of the population) are expected to live in the rural areas, with the majority depending on subsistence farming [63]. Therefore, despite increased urbanization, almost all the population prediction models show that Ethiopia will remain, to a large extent, an agrarian society for the foreseeable future. In fact, one of the largest and fastest growing segment of the Ethiopian population is the rural youth [16]. How educational opportunities in elementary, secondary, and tertiary levels are made available in rural Ethiopia will have a very significant impact in either realizing the benefits of demographic dividend or facing the negative consequences of a demographic risk.

The country’s future will still be largely influenced by what happens in rural Ethiopia which is the current home of some 80% of the population. Therefore, any growth model that the country adopts should make rural development one of its

core objectives. The following recommendations focus on an equitable and inclusive growth approach, specifically for rural Ethiopia.

1. Increase Rural Development Budget to not less than 10% of Annual Federal Budget Consistent with the Maputo Declaration of African Heads of State and Governments in 2003⁸

The budget for agriculture and rural development should be proportional to the size of the rural population and its contribution to the country’s GDP [10]. In the 2019/2020 (2012 E.C) federal budget, the amount allocated for urban development representing some 20 million residents was Birr 56.6 billion, while the corresponding budget for rural development of over 80 million people was only Birr 12.59 billion. The selection of only five crops in the budget year 2019/2020 (2012 E.C) for cluster farming in selected Weredas and the expansion of lowland wheat farming in Afar, southern Ethiopia, and Somali regions may be due to the limited budget allocated for rural development. In real monetary value, the 2019/2020 (2012 E.C) budget for agriculture is less than the same budget of 10 years ago.

It will be difficult, perhaps impossible, to ensure food security, raise hard currency earnings, control inflation, increase export revenue, and enhance urban development while productivity is as low as it is with current backward farming tools and methods used by the preponderant majority of small subsistence farmers. Further, devaluing the Birr to stimulate export, in the absence of surplus agricultural production which has been incapable of satisfying local consumption, may contribute to inflation.

⁷ “Ethiopia steps in to deliver respirators to Latin Americans,” Financial Times, May 21, 2020.

⁸ At African Union meeting in July 2003 in Maputo, African Heads of State and Government endorsed the “Maputo Declaration on Agriculture and Food Security in Africa” where they made “commitment to the allocation of at least 10 percent of national budgetary resources to agriculture and rural development policy implementation within five years”.

Therefore, in addition to modernizing agriculture and improving access to selected seed and fertilizers, efforts in technological improvements of agricultural equipment, local production and subsidized distribution of better seeds and fertilizers are needed. Increasing the federal budget for agricultural development to the prescribed lower limit of 10% may then support this initiative.

2. Enhance Rural Development Around Farmers' Training Centers of Agricultural Extension Service

- a. Strengthen the synergy between Agricultural Extension Services and agricultural research (universities, EIAR, etc.), establish research priorities, increase agricultural productivity, and enable more engaged oversight by regional and federal ministerial cabinets.
- b. Leverage the 12,500 **Farmers' Training Centers** of the **Agricultural Extension Services** and **Farmers' Cooperatives** as well as the 50 Training Centers for Development Agents for **"Small-Scale**

Industrial Park" initiative for non-agricultural enterprises that will serve as centers for the development of rural agro-industry and provide employment to under-employed farmers and unemployed rural youth.

- c. Government guaranteed loans and grants must be given as start-up funds to organized farming households with less than 0.5 hectares of farm plots and unemployed rural youth for starting small-scale agro-industry in "Small-Scale Industrial Parks". However, such development will require careful planning and organization not only to provide the start-up funds but to also assemble, train, and organize rural unemployed youth and farmers to manage such agro-industrial enterprises. Clearly, this will have to be done by highly committed and well-educated professionals, step by step, first on a pilot scale in each region, to ensure that there is an opportunity for learning to build increasingly successful rural enterprises in new parks.

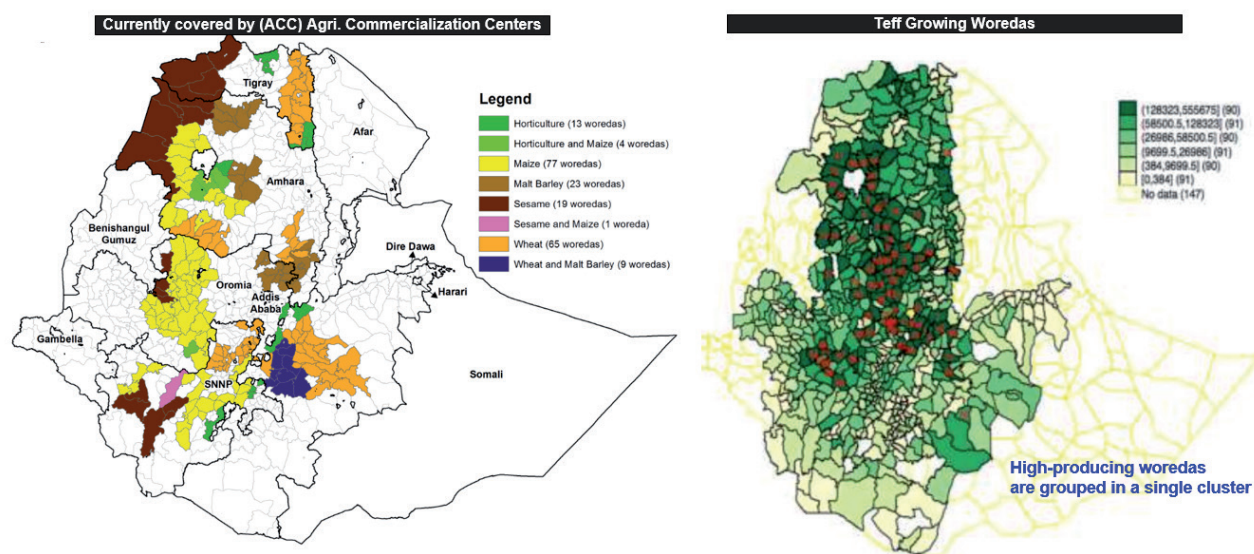


Figure 10. Extending agricultural commercialization cluster (ACC) model to broad cluster farming. For example, the vast majority of teff growing areas are not included in the ACC model and could significantly benefit from cluster farming⁹

3. Expand Broad Cluster Farming Ecosystem– Similar to Agricultural Commercialization Cluster

In this period of unprecedented demographic transition, coupled with decreasing availability of farmlands and increasing landlessness, it is important for the country to directly invest on its farmers in key areas such as better plowing tools, fertilizers and seeds which currently are the most expensive component of farming in the country. The Agricultural Commercialization Cluster (ACC) model has so far shown encouraging results indicating that a clustering model could be sustainable in Ethiopia. Building on ACC's success, we recommend the following:

- a. Expand the formation of clusters of neighboring farmlands to create a loose “cooperative” where they share mechanized farming, seeding, storage, harvesting and marketing (see Figure 10 for teff growing areas that could benefit from cluster farming),
- b. GoE should provide increased direct support to finance the purchase or renting of tractors and other agricultural tools to such farming cooperatives, and
- c. GoE should enable cluster farming units to hire the services of tractors, tractor repair and/or services in the ecosystem from a Government service enterprise or from a private company or semi-private company where costs for such services are strictly regulated by GoE to ensure that the services will not be another area of exploitation for farmers.

4. Transform Rural Areas to Manufacturing-Dominated Economy

This is among the most effective ways of creating economic growth and job opportunities in the rural areas. Keeping jobs in the rural areas will help reduce migration

to the cities. GoE has already stated this as one of its objectives in promoting economic development in the rural areas.

- a. Create jobs at the source and engage people in rural areas in non-agricultural economic activities.
- b. Expand and complete ongoing rural access projects, including electrification and transportation.
- c. Strengthen and promote existing large-scale agriculture, in the form of producers' cooperatives, as well as the establishment of new ones.
- d. Leverage rural agricultural production for processing finished goods. The current low-margin export of raw agricultural products such as sesame, oil seeds, etc. is not sustainable and could be transitioned to high-margin finished goods that can be exported to markets in the Gulf, Middle East and North African countries, China, and the rest of Africa.

5. Integrate Technology to Transform Traditional Farming Methods and Processes

Despite well-known and recognized inefficiencies in the Ethiopian agriculture sector, from ploughing to harvesting, storage and marketing using approaches that have been around over a long period of time, technology-supported progress has, for a variety of reasons, been very minimal [64-65]. Continuing with the same approach will not help in meeting food security goals. Productivity will need to be increased substantially by replacing such inefficiencies. For example, this can be done best if the Ethiopian Agricultural Institute (EAI) works with the new government-funded Agricultural Tools company and/or universities to produce animal-pulled or mechanized plowing tools that are affordable, efficient and easy to

Table 2. Opportunities for improvements in agriculture using technology (AgriTech). Collaboration between the Institute of Agricultural Research (IAR), Agricultural Transformation Agency (ATA) and universities could offer a faster inter-disciplinary solution to some of these indicated in the table. There is huge opportunity here for AgriTech entrepreneurs to make significant contributions.

Farming Activity	Technology Opportunity & Best-Practice Model
Seed/crop selection, storage, acquisition, crop health	<ol style="list-style-type: none"> 1. Sustainable and scalable storage technology of indigenous seed species at farmer, community, and regional level. 2. Access to digital market information (mobile or otherwise)
Soil management	<ol style="list-style-type: none"> 1. Use soil improvement and soil conservation methods like no-till farming with mulching for such crops like maize or sorghum, or the basin technique as in Mozambique 2. Avoid farming hillsides and soil degradation; fertilizer is washed off to underground water or to dams or to lakes to feed copious growth of weeds (for example water hyacinth in Lake Tana) 3. Research shows that it takes 500 or more years to restore an inch of highland top-soil that has been eroded due to deforestation and degradation [66] 4. Avoid slash-and-burn techniques since it depletes soil fertility 5. Intercropping maize or sorghum and beans (legumes) or growing them together in the same field helps to retain soil fertility.
Ploughing (land preparation)	<ol style="list-style-type: none"> 1. Modernize the traditional “<i>mofer-qenber maresha</i>” wooden plow to improve efficiency [67] 2. Create a mechanized pulling system compatible with oxen/horses and the financial resources of today’s subsistence farmers to facilitate transportation to and from farms 3. Develop technology for improved farming techniques and hardware on sensitive ecosystem (steep hillsides, for example).
Seeding	<ol style="list-style-type: none"> 1. Augmenting technology for seeding by manual broadcasting 2. Augmenting technology of spaced planting in rows with reduced seed
Irrigation	<ol style="list-style-type: none"> 1. Introduce affordable solar-powered water pumps (20 - 250 Watts) 2. Introduce affordable solar-powered well pumps (200 – 800 Watts) 3. Introduce innovative solutions for economic use of water.
Weeding	Augmenting technology for weeding and ensure that fertilizer is not washed off to create weeds
Fertilizing	Development of eco-friendly fertilizers locally with no adverse effect. Saves millions of Birr.
Harvesting	<ol style="list-style-type: none"> 1. Augmenting technology for harvesting 2. Automation in harvesting for cooperatives and farmers clusters
Threshing	<ol style="list-style-type: none"> 1. Introduce improvements in the traditional treading by oxen, or flailing since there is a substantial harvest loss, estimated to around 20%. 2. Promote/encourage local production of machine threshers (available technology)
Livestock Agriculture (meat, milk, wool, hides & skins)	<ol style="list-style-type: none"> 1. Introduce affordable solar powered milking machine 2. Enhance control of animal diseases 3. Build an efficient and responsive supply chain management through mobile technology 4. Facilitate access to drugs for animals
Harvest storage	<ol style="list-style-type: none"> 1. Develop solutions to minimize post-harvest storage loss 2. Introduce Innovative and long-lasting crop storage that is within the means of small farmers.
Milling & post-processing	<ol style="list-style-type: none"> 1. Introduce affordable solar-powered water milling 2. Create opportunities for value-added processing of crops as recommended in sections 2b and 2c above 3. Introduce solar powered oil press in areas where oilseed production is significant.
Transportation and marketing of produce	<ol style="list-style-type: none"> 1. Provide guaranteed prices for cereals, pulses, red pepper, oilseeds, and others that are often imported to ensure food security. This will encourage farmers to be more productive. 2. Build grain silos at community, regional, and national levels and organize suitable transport to such silos and efficient mechanisms to pay farmers to ensure food security. 3. Government needs to create and oversee an efficient marketing system that supports the sale of surplus produce at fair market prices.
Habitat (Improving quality of life)	<ol style="list-style-type: none"> 1. Improved sustainable habitat design with simple smoke exhaust systems 2. Create segregated shelters for cattle, poultry, etc. 3. Enhance adoption of lighting using solar lanterns together with battery storage system.
Healthcare	Continue improvements in access to healthcare
Financial transaction	Facilitate access to mobile banking

use by poor farmers in different parts of the country. This Industry-EAI-University synergy should be encouraged by the GoE to introduce better farming tools and methods to revolutionize farm productivity. Table 2, above, provides a summary of the opportunities available for improvements in agriculture using technology. They range from improving antique farming tools to providing innovative solutions, to designing and building healthy habitats that improve the quality of life of over 12 million farming households.

[C2] DIGITAL ECONOMY

1. Establish “Digital Literacy Charter” as the Corner Stone of Digital Policy

Given how critical the digital economy is for the future of the country and its people, access to digital skills should be established as a basic right (universal access). This right could be described in a national “**Digital Literacy Charter**” that ensures social participation. This charter should cover access to at least basic digital skills such as using computers and accessing digital information. Just like the “*Meserete Timhirt*” campaign of the late 1970s that shaped decades of literacy success (reading/writing/arithmetic), job market, and social participation, such a charter will enable the participation of the country’s citizens in the economy of the 21st century [68]. Digital skills framework through a country-wide ICT/Digital policy can help increase the participation of the country in the global community economically, socially, politically, and scientifically.

This proposed “**Digital Literacy Charter**” is consistent with the World Bank’s Digital Economy for Africa (DE4A) Initiative that advocates for digital universal access [69]. Digital literacy levels (e.g. basic, intermediate, advanced) need to cascade from the national ICT policy goals down to skills taught at primary, secondary, TVET (technical and vocational education and training) and tertiary curriculums. Table 3 shows the proposed framework of the skillsets in the Ethiopian context. It is clear that resources required to scale-up the current education model will be unaffordable for the size of the population in 2050, and the years leading to it. Instead, the redesign of education for blended and online teaching, learning, and collaboration efforts could offer a competitive solution. In addition, new opportunities are arising in Ethiopia in the form of the soon to be launched telecom liberalization drive that could allow raising funds in new license issuance/acquisition fees. These funds could then be used to cover the costs associated with Universal Access.

Table 3. Framework for digital skills in the proposed “Digital Literacy Charter”. Basic refers to training in gaining skills in using computers and basic understanding of digital safety. Tertiary level training will encompass all the indicated skill sets from basic to advanced. “X” indicates the skill required in the category shown.

		Basic	Elementary	Secondary	Tertiary
Basic digital skills Ability to access and use digital technologies to perform basic tasks	Functional use of digital/wireless devices	X	X	X	X
	Online communication via emails	X	X	X	X
	Finding, managing, and storing digital information and content	X	X	X	X
Intermediate Digital Skills Ability to use technology to perform work-related tasks	Using professional software for presentations, accounting, project management		X	X	X
	Digital marketing, social media analytics		X	X	X
	Web design, graphic design		X	X	X
Advanced Digital Skills Ability to perform specialist tasks useful for the information and communication technology industry	Computer programming skills			X	X
	Web development, search engine optimization			X	X
	Cloud computing, network management				X
	Artificial Intelligence (AI)				X
	Data Science, big data analytics				X
	Cyber Security (Safety)				X

2. Expand High-Speed and High-Bandwidth Connectivity of National Internet Backbone to Undersea Optical Fiber Cables - Towards Making Access More Universal

A sustained national digital literacy campaign is feasible if, and only if, there is a reliable universal access to digital tools and the internet. Current connectivity penetration in Ethiopia stands at a total of 45.6 million telephone subscribers and 44.03 million mobile subscribers, and 22.74 million overall internet users.¹⁰ Presently, one plausible way to increase internet penetration in a meaningful way in Ethiopia is to expand connectivity to the high-bandwidth and high-speed global submarine fiber cables off-Djibouti, supplemented by connections via Sudan, Kenya and, potentially, other neighboring countries for redundancy. The current redundant satellite link at Sululta offers 400 Mbps downstream and 100 Mbps upstream [70]. Provisioning additional bandwidth in the range of 5G networks (~10 Gbps) using these satellite links will be prohibitively expensive. Consequently, this predominantly satellite-based access approach will continue to contribute towards severely handicapping the growth of ICT services in the country, unless new developments in satellite technology such as starlink of SpaceX offer a reasonably competitive cost.

Consistent with the ambitions of “*Digital Ethiopia 2025*” Initiative, we recommend completing and bringing online a redundant, reliable, and practical high-speed and high-bandwidth optical fiber connectivity to and from Djibouti and other neighboring countries such as Kenya and Sudan (Figure 11). This high-bandwidth connectivity will encourage utilization of cloud computing services already provisioned in the region [70]. Security concern (as well as theft)

have been raised as the main barriers towards physical fiber optics connection to nodes in Djibouti. This risk can be managed by running future fiber optic lines parallel to the railway line. Lessons from other large infrastructure projects in the country and other countries suggest that equity and inclusion and community ownership around the potential fiber optic line will help minimize security and theft risks. We also propose that this connectivity could eventually form the backbone of East-West fiberoptic link from Djibouti to Ethiopia, South Sudan, Central African Republic, and northern DRC (Figure 11). In addition, Ethiopia should work to position itself as the preferred wired fiber connection route in and out of South Sudan as part of an east-west Africa land based fiber highway. Ethiopia should also explore what the next level of Woredanet, SchoolNet, HealthNet, AgriNet should be by factoring this extended fiber optics link, current global technology trends, and the service needs of citizens as outlined in UN sustainable development goals, the country’s own mid average-income earning goals, and the other grand challenges. Understandably this requires an adaptive approach with a dense network for policy formulation, implementation and problem solving which again requires the country to strengthen its policy making approach as a learning ecosystem.

3. Establish Ethiopia as Leader in Artificial Intelligence Technology in Africa

To address the Grand Challenges discussed in this report, realize demographic dividends, achieve gender parity, achieve sustainability, and become a middle-income nation, Ethiopia must systematically leverage emerging technologies, including Artificial Intelligence (AI). The convergence of the exponential growth of

¹⁰ Ethio Telecom half-year (July – December 2019) performance report

data (90% of data produced was created in the last two years), increasing connectivity enabled by 4G (and now 5G) wireless technologies, and advances in computing capabilities have enabled AI to be one of the dominant emerging technologies. In fact, despite some concerns in the potential abuse of the technology, leadership in AI technology is being aggressively pursued by several countries to gain a strategic advantage.

In the Ethiopian context, AI offers significant strategic opportunities in some key emerging areas such as renewable energy generation and management, e-healthcare, rural development, smart agriculture, climate change-resistant seed breeding, and natural resources management. With no complex network of legacy systems that could inhibit leapfrogging to more current technologies, Ethiopia is already taking some critical steps in establishing a digital ecosystem, such as launching its

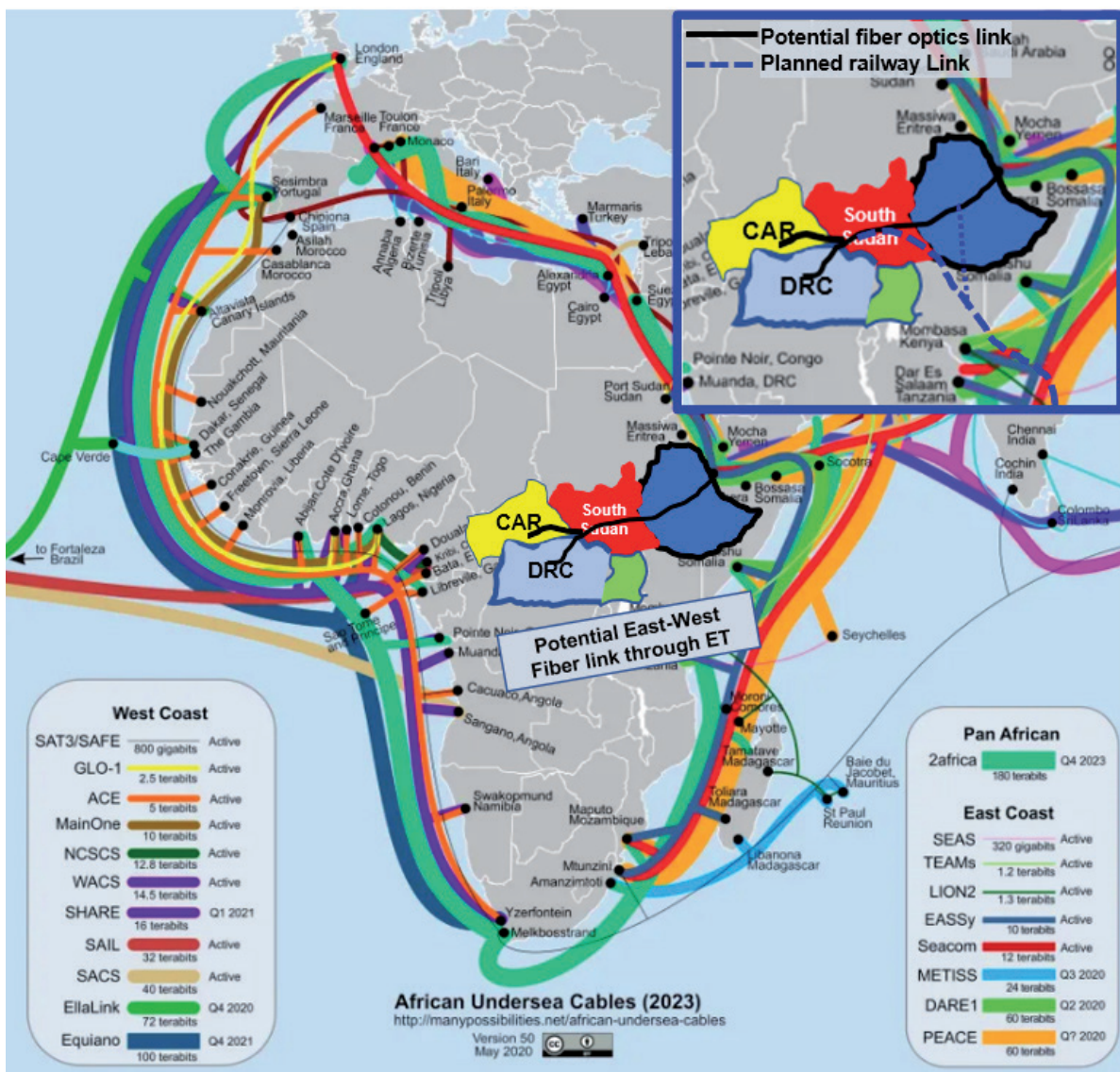


Figure 11. Connecting the country's network infrastructure to the global fiber optics networks through Djibouti and other neighboring countries is critical for ensuring not only Digital Literacy but also to make meaningful progress towards allowing successful growth of the local ICT industry. (Source: Manypossibilities.net).

first satellite (ETRSS-1), a digital ID pilot, e-Customs, e-Tax, government e-Service portal and an e-payment. A national digital strategy was also recently made public. Taken together, these developments are helping to lay the groundwork for formulating forward-looking AI strategy. To establish a strong AI national ecosystem and maintain sustained growth within, a bold vision is needed. This vision must recognize that leadership in AI is now universally considered a matter of national security with several implications and, therefore, an opportunity for Ethiopia to not only secure its own digital destiny but also assume leadership in the African market. The following specific recommendations are forwarded to help realize this unique opportunity.

a. People Readiness: Consistent with the outcomes sought in the *“Digital Literacy Charter”* advocated here, Ethiopia should first establish data literacy and AI literacy roadmaps. These will help policy makers to prepare enabling regulations, AI actors to build a strong national AI ecosystem, and the general public to be data and digitally savvy in AI driven economy.

b. Data Readiness: Formulating a roadmap for strong data lifecycle management practice from creation/acquisition at source, preparation, processing, sharing, publishing, to storage is an important step. Relevant and rigorous regulations and policies, privacy, security and ethical use will need to be in place considering the Ethiopian context. Further, cleaning and digitizing existing data generated over the years in health, agriculture, education by the Central Statistical Authority (CSA) will offer a wealth of useful dataset.

c. Ecosystem Readiness: The vision for positioning Ethiopia as a leader in AI in Africa starts with establishing a strong

AI focused research and development environment in partnership with industry, innovators, investors, academia, diaspora, and the government. The recently established AI research and development center at AAU is an encouraging development. This and similar centers should focus on workforce training in AI at the undergraduate and graduate level. Coupling university-based AI training with the promising start-up ecosystem in AI in Ethiopia (iCOG Lab, singularitynet.io, iceaddis, blueMoon, Gebeya and Ethio Robotics) through regular workshops and hackathons should be encouraged and pursued.

d. Infrastructure Readiness: Infrastructure will be the most capital intensive and challenging aspect of establishing a thriving AI ecosystem in Ethiopia. Hybrid model that balances the need for a practical solution using existing commercial Cloud infrastructure and the other strategic need of Ethiopia in developing its own technology will offer the best outcome. Commercial cloud services provide many advantages, including quick access to mature and up to date ICT ecosystems, flexibility to mix and match types of services, pay-as-you-go model, scaling-up/down anytime, security and business continuity and a diverse cloud structure. Ethiopia should be open-minded in working with leading cloud service providers; but should also make developing its own infrastructure equally important priority. This infrastructure can then be leveraged for serving the regional African market, particularly that of the Horn of Africa.

e. Creating the Momentum: Ethiopia should first focus its initial investments primarily on strategic sectors such as health, agriculture, education, energy generation and management, government services, etc. Some of the specific appli-

cations include leveraging farming data using soil sensors and having connected livestock, weather forecasts, use of smart drones, agrobots (chatbots specific to agriculture), and virtual assistants.

4. Leverage High-Bandwidth Connectivity for Cloud Computing and Large Data Storage Infrastructure – Entering High Margin Markets

The availability of a redundant high-speed and high-bandwidth connectivity will have transformational effect on the digital economy in Ethiopia. With 5G connectivity and IoT (Internet of Things), and Artificial Intelligence (AI) predicted to power the so-called 4th Industrial Revolution and the next wave of innovations around the world, Ethiopia will have a level playing field to benefit from these advancements. For example, by placing Ethiopia as a conduit on the east-west data pipeline that could possibly run to South Sudan and Central African Republic, leveraging the high-bandwidth connectivity of undersea optical fiber cables could offer the country a pathway to entry to high margin ICT sectors. This supplements the thoughtful visions outlined in the recently ratified “*Digital Ethiopia 2025*” document [61].

Cloud computing and data storage are two specific areas where Ethiopia could benefit with job creation and high-margin economic progress. In the broad area of cloud computing, a high-speed and high-bandwidth access will give the necessary hardware infrastructure for developing software in promising applications such as Artificial Intelligence, machine learning, and Blockchain technology, among others. In the area of storage, Ethiopia would be best served by providing reliable and fast network connectivity to large data centers operated by private multi-national cloud computing companies. These companies already possess

very competitive and optimized best-in-class economies of scale to the underlying storage devices with extensive experience in abstractions on top of the raw storage medium.

5. Enter High-Skill Digital Markets that Leverage Unique Strengths that Ethiopia Provides

Ethiopia offers some unique advantages that could make it competitive in building high-skill based digital economy. A critical mass of technology incubators has come online, at least, in Addis Ababa. There is already some promising trend and not infrequent success stories in Fintech, Agritech, Edutech, Healthtech, and eCommerce. Just like what has happened elsewhere, as technology lowers the barriers to entry for starting a business, many young people in Ethiopia will join the ranks of entrepreneurs. Arguably, despite some significant barriers, there is enough evidence to suggest that Ethiopia is entering the “*entrepreneurial age*”. Further, it has also been clear for some time that there are some fundamentals that favor the expansion of this success to digital products high in the food chain such as software development. Some of these factors are:

a. Favorable labor market opportunities.

A large working population combined with the expected opening of the wider African market through **AfCFTA** (African Continental Free Trade Area) could contribute to building a significant and sustainable access to Ethiopian labor and products.

b. Large and growing internal market in addition to the regional and international markets.

This is often overlooked; Ethiopia can potentially scale its tech devices manufacturing output by partly targeting its own large and young consumer base for phones, TVs, and other electronic gadgets.

c. Value proposition of unique labor

force. The country offers an affordable and tech-friendly labor with a peculiar culture of algorithmic thinking that is conducive for software development [68].

In specific terms, the following are examples of high-skill digital product developments where the above discussed enablers will be useful:

a. Contract Manufacturing/Development of Software or High-Tech Products & Prototypes

–With its compelling cost advantage and the value proposition outlined above, there is no overriding reason why some of the high-margin software product developments could not come to Ethiopia. There is already anecdotal evidence to support this.

b. Export-Oriented Market Development.

(i) BPO (Business Process Outsourcing) and KPO (Knowledge Process Outsourcing)

– Ethiopia has compelling cost and demographic advantages in engineering service outsourcing, financial research outsourcing, business research, design and animation, marketing services, publishing outsourcing, legal process outsourcing, and market research outsourcing. Other tasks such as cleaning large data, processing photos, transcribing audio or video are now traded through online platforms and can form part of the BPO opportunities available for Ethiopia.

(ii) **International Tradeshows.** There is evidence that there is market for this, with Addis being the *de facto* gateway between Africa, Gulf Countries, and China. A growing number of Ethiopian event-organizing companies in this area have come online in the past several years.

For example, the international AI (Artificial Intelligence) conference the was planned to be hosted in Addis Ababa in April 2020 - thanks to the efforts of Ethiopian and Ethiopian-origin computer scientists - was a strong validation of the coming to age of Addis as an international conference destination.

For these companies to succeed, however, startup legislation, matching funds and high risk capital, software licensing mechanisms, and regulatory alignments should be in place. Ethiopia should also consider ahead of time the challenge that may be posed by acquisition of potentially competitive start-ups by big tech companies to ensure that benefits and profits generated by Ethiopian/African tech firms are not siphoned back to the parent company outside the continent, with the public and productivity benefits disappearing with them. A regulator to manage and monitor deal acquisitions and regulate when and how global tech companies acquire emerging and competitive Ethiopian companies may be required.

6. Expand Start-up Ecosystem of Innovation and Job Creation to Secondary Cities

As discussed earlier, secondary cities have become the epicenters of the “youth bulge” [16]. At the same time, there has been very modest but nonetheless noticeable increase in manufacturing industry activity in these cities [31]. Therefore, replicating the nascent growth of start-up ecosystems in Addis Ababa to these secondary cities like Adama, Hawassa, Jimma, Dire Dawa, Jigjiga, Sodo, Debre Birhan, etc. will contribute significantly to job growth in these areas. The presence of Gen I and Gen II universities in these cities will be a source of a well-trained manpower.

For example, Debre Birhan, one of the Ethiopian “cheetah cities” which is currently attracting very significant interest from local and international investors is an ideal place to launch an innovation ecosystem and start-up incubation infrastructure due to the presence of a growing university and a thriving industrial park.

7. Leverage Digital Economy and ICT for Unorthodox Exports and Cross-Cutting Challenge Areas

Ethiopia’s economy has been unable to achieve significant progress in export growth in part because of excessive policy focus on traditional commodities, such as manufactured and agricultural products. As the global economic order becomes more insulated and technological advances put further barrier for countries like Ethiopia to compete in the export of some manufactured goods, there is a need to focus attention to new, non-traditional activities for generating foreign currency. These include, for example, export of fashion products and services (e.g. customer service through call centers) that leverage IT and e-commerce. As an example, the tech sector could form synergy with textile industry to be a bigger player in fast fashion. Can consumers from other parts of Africa potentially buy Ethiopian-made apparel and textile outputs while traveling via Ethiopian Airlines through Addis? Yes, we think so.

Funding

Two sources of funds for the digital economy are identified:

- (i) With an increasing number of Addis-based start-up companies succeeding in raising funds from local and outside sources, it is becoming clear that there is confidence in the investment community of the dig-

ital economy. This could be scaled up by introducing a “Strategic ICT Fund” that is operated as an investment and saving vehicle, especially for Ethiopians living abroad. For example, if such investment vehicle that offers competitive interest rates for CD (custom deposits or time deposits) can collect an average of \$10K USD from 100,000 customers, a total of \$1B USD could be raised. This money could be available for GoE for investment in infrastructure for the digital economy. Further, part of this fund could also be available towards investment for start-ups in local currency.

- (ii) The soon-expected telecom liberalization could raise substantial money for GoE to fund initiatives in digital economy. We propose that the government should add “**Universal Access Fund**” to the cost of new license issuance/acquisition process for new entrants.
- (iii) Large international technology companies who have many active users in Ethiopia and gain financially from these users continue to profit from data directly or indirectly. By developing a well-thought policy, Ethiopia should consider taxing these companies appropriately.

[C3] BUILDING WORLD-CLASS WORKFORCE TRAINING

We acknowledge the efforts over the past 15-20 years, where there has been a significant expansion of the number of public and private institutions of higher education in Ethiopia, with enrolment rates reaching 10.2% in 2015/17 [71]. While this is a major milestone, there is plenty of room for improving the quality of education at all levels. In order to be able to train a world-class workforce, therefore, there is need for improving the educational system in a significant way. The starting point should be the primary level. Ethiopia's expenditure for primary education is 79% below the Sub Saharan Africa average. In addition to this low investment, there are two fundamental problems that Ethiopia needs to deal with as a priority. The first is “*learning poverty*”, the inability of children to read and understand simple phrases by age ten. Most children, especially in rural areas, are undernourished, have to walk long distances to school and

cannot pay attention in class. Learning poverty has now been identified globally as urgent for eliminating extreme monetary poverty, as stunting and hunger. The second problem is the deterioration of the quality of education at all levels. In both these areas girls are disproportionately affected than boys. The emphasis put on universal access to the WFHE nexus addressed earlier in this report will have a direct impact on learning outcomes. Increasing expenditure for primary education, at least to the average SSA (Sub-Saharan Africa) level and focusing on the two fundamental problems mentioned above will in the next ten years contribute significantly to world-class work force training.

Thus, it is critical for the higher education community to address these issues while preparing to tackle the challenging task of further increasing student enrolment with the target of reaching 22% by 2025. The Ethiopian Education Development Roadmap 2017-30 report identified many of the gaps and shortcomings in the

Center of Excellence Model Innovation & Workforce Training Ecosystem

- 5-Year Funding decision based on national competition.
- Review Panel (industry, Diaspora volunteers)
- Annual or bi-annual review

Assessment of Outcome

- Skilled Manpower Trained
- Job Creation – Start-ups
- Intellectual Property

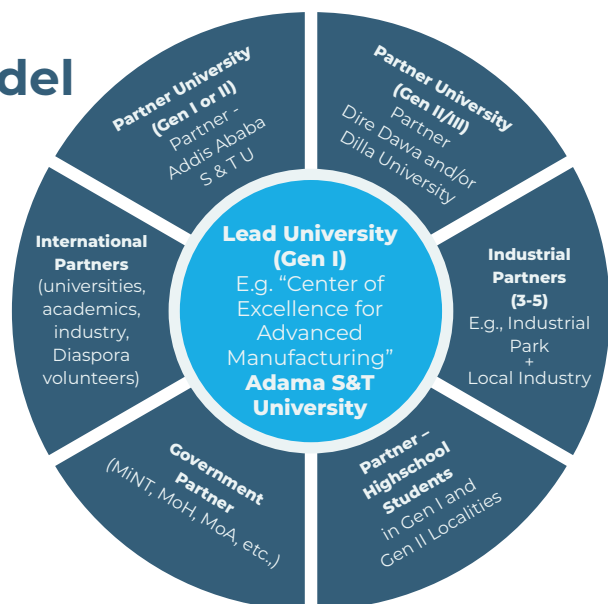


Figure 12. Centers of Excellence models could provide an engine for world-class talent training, entrepreneur-led job creation, and intellectual property development.

current educational system and listed a set of recommendations and aspirational goals [66]. While recognizing ongoing efforts to improve the quality of the educational system at all levels, we offer specific recommendations based on models that have been successful in other countries but tailored towards the unique challenges of Ethiopia. An important prerequisite to the following recommendations is ensuring the quality of the educational system from the primary to the tertiary level.

1. “Centers of Excellence” Model - Focus on World-class Training of Ethiopian Undergraduate and Graduate Students for Global Competitiveness

In this broad approach, we recommend formation of “Centers of Excellence” (CoE) as **inter-disciplinary** collaboration and partnership between **Generation I, II, and III universities, high-schools, government, industry, and international partners** (including Ethiopian Diaspora) to create an ecosystem for innovation and job creation. These centers will integrate teaching, research, and innovation where world-class skills are taught to undergraduate and graduate students and research that is pertinent to solving Ethiopia’s problems in the various challenge areas is conducted. These CoEs will be selected through a nation-wide competition and funded for a period of 5 years with a potential extension for another 5 years. Each CoE will either be interdisciplinary in nature by covering several inter-related Grand Challenges or focus on specific aspects of one of the following areas: food and water security, healthcare, urbanization, renewable energy, advanced manufacturing, or ICT (digital economy). Table 4 as well as Figures 12 and 13 describe a suggested scenario. The current “Center of Excellence” models at Addis Ababa S&T University and Adama S& T Universi-

ty are excellent starting points. However, we recommend that (i) awarding funding to these centers based on a competitive grant application process and (ii) creating multi-institutional ecosystems that bring Generation I, II, and III universities together with industry, government, and secondary schools while building a collaborative interrelationship for the common good will offer a sustainable and more impactful model.

Such competition-based “Centers of Excellence” model will provide an engine for world-class talent training, innovation, entrepreneur-led job creation, and intellectual property development (Figure 12 and 13). They will also act as a hub to bring together Ethiopian academics, professionals, and innovators from within and abroad. An example is shown in Figure 12 where Adama S&T University (ASTU), which is already quite involved in interfacing with the manufacturing industry, could lead the “Center of Excellence in Advanced Manufacturing”, with a focus on 3D printing using materials such as metals that are conducive to Ethiopian and emerging market conditions. The Center activities will help:

- a. Provide opportunities for student research and training in multi-disciplinary areas,
- b. Leverage international relationships, including the Ethiopian Diaspora for international conferences and sabbatical leaves creating new platforms for intellectual engagement, sharing of ideas, and networking with researchers, and
- c. Strengthen collaboration mechanisms with universities and research institutions globally and strengthen research infrastructure such as computational tools, specialized laboratory equipment, etc.

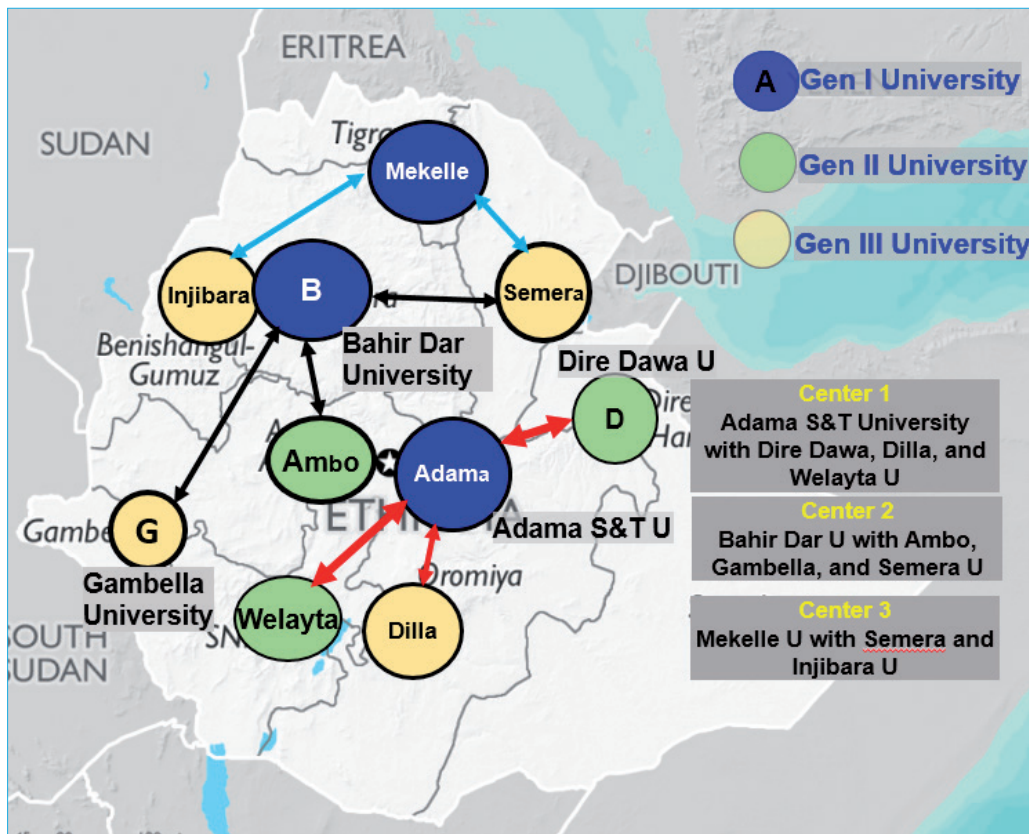


Figure 13. Potential distribution of “Centers of Excellence” that are led by Gen I universities and have Gen II/III partners. Example shows ecosystem with Adama S&T (lead), Dire Dawa, Dilla, and Gambella universities.

To demonstrate how CoEs can address wide-ranging areas and inter-disciplinary problems, we provide some specific examples for planning purposes in the Ethiopian context.

a. Data Science – One area that will create increased demand and, therefore, an opportunity in Ethiopia is Big Data computing. Data Science Center of Excellence can serve as a thriving ecosystem where undergraduate and graduate teaching produce world-class data science professionals and active research, which will lead to start-up companies. In addition to government sources, funding models can be based on exploring domestic or international partnerships with major global IT companies.

b. Global Health Institute – CoE that foster research, training, and global partnerships in healthcare could have significant impact. Investing in such an institute would not only be timely given emerging epidemics such as COVID-19, but also help (re)design health systems that could withstand such epidemic shocks. Several institutions of higher learning in the US and elsewhere are interested in Ethiopia and, in some cases, have already established long-term strategic commitments. For example, Harvard, Emory and Brown universities in the US and others from the EU and UK are engaged with universities in Ethiopia on health related topics. These types of initiatives and twining mechanisms with universities and research Institu-

tions both in the North and South, will enhance knowledge exchange through study abroad programs, joint research initiatives and signature courses or programs. This could attract international students and Ethiopians living abroad

to Ethiopia. Such an initiative has a potential to internationalize local campuses, enhance the quality of infrastructure, teaching, and research, thereby increasing their global standing as an institution for learning and research.

Table 4. Integrating higher education and research with economic growth. One “Center of Excellence” in each of the areas such as ICT, food security etc. could help create innovation ecosystem. As pilot project, 2-3 areas could be considered for the first 5 years.

Grand Challenge Area	Potential Competitors for Centers of Excellence	Notes
ICT	Addis Ababa University Arba Minch University Bahir Dar University Jimma University Mekelle University	These Gen 1 universities are already strong in this area. Specific examples include AI, data science, security, Software Engineering, Machine Learning etc. where competitive advantage could be gained.
Advanced Manufacturing	Adama S&T University Addis Ababa S&T University Dilla University Hawassa University	The proximity of these universities to industrial clusters with good railway and expressway connection offer advantage. Also consistent with their missions of teaching/research in advanced technologies.
Renewable Energy	Arba Minch University Bahir Dar University Hawassa University Jimma University Mekelle University	Most are near Rift Valley with access to geothermal. Wind/solar relevant for Mekelle U and Arba Minch U. Areas of importance include mechanical or hydraulic-based energy storage, application of advanced manufacturing with solar cell integration, etc.,
Food Security	Bahir Dar University Gondar University Haramaya University Hawassa University Jimma University	Haramaya and Hawassa have strong record in these areas. Jimma, Bahir Dar and Gondar (with Wereta plains) represent areas with strong agricultural activities and potentials.
Water Security	Arba Minch University Dire Dawa or Samarra University Debre Markos University	Arba Minch is well-known leader in water resources. Its graduates have thrived in the rest of Africa, Europe, and the Americas.
Urbanization	Addis Ababa University + EiABC Bahir Dar University Hawassa University	EiABC is a national leader in this. Potential topics include harmonizing urbanization with rural development.
Healthcare Access	Addis Ababa University Gondar University Jimma University	AAU, Gondar, and Jimma are leaders in this area with their graduates working in various part of the world.

c. Institute of Education – Such an institution could focus on excellence in education itself, contributing to continuous improvements in the quality of education and able to produce a globally competitive workforce. The institute would take on the challenge of modernizing and improving the training of teachers and administrators at all levels, advancements in tools and methodologies for assessing and evaluating the impact of their interventions and initiatives.

2. Create Accreditation Program for Government and Private Universities

A well-designed and implemented national accreditation program will introduce significant increase in quality of education at both private and public (government) universities through standard programmatic assessment and evaluation. There are ample examples on how accreditation has helped improve quality and maintain competitiveness. Such accreditation can be done at the department or program level and be renewable every five years. A staggered approach can be used nationally to provide sufficient time to drive lessons on how accreditation is performing in the country. Diaspora academic can be engaged, on a voluntary basis, to be part of such an accreditation program.

3. Introduce National Math and Science Olympiad Competition

There is abundant data around the world that demonstrate regional and national-level competitions in STEM and related areas for high-school students encourage excellence in long-term performance and help in identifying and recruiting talent [72-73]. Such a model is used quite commonly around the globe. Iran, Turkey, Taiwan, and Israel have national Olympiad competitions in STEM. In the US, the National Governors Report (2007) as well as National Science Education Standards

(1996) had highlighted Science Olympiad as a national model for learning science and mathematics with clear linkage between inquiry and assessment [73]. An independent group, preferably overseen by the Ministry of Education, which sets the necessary guidelines and provides oversight, could host these competitions at regional and national levels in Ethiopia.

4. Establish Undergraduate Research and Start-up Incubator Program

Involving undergraduate students in research has demonstrable advantages in creating and maintaining innovation ecosystems. For example, creating a mechanism for students to get capstone (final year project) type real-world experience that are typically gained from internships will better prepare their transition into the workforce. This could be accomplished through providing solutions to problems originating from the faculty, students, community, industry partners etc. The program could include signature courses and/or sustained activities such as research. To be impactful and maximize their effectiveness, such programs will adopt practices that have proven successful, including:

- a. Enhance problem solving skills and opportunities by working in interdisciplinary teams of students and faculty,
- b. Promote an entrepreneurial spirit by supporting students with big ideas that have potential for successful commercialization,
- c. Create apprenticeship models in collaboration with Industrial Parks, major industries, and government institutions to address the gap in technician/artisan class of workers, and
- d. Ensure quality, equal access, and equity throughout.

5. Strengthen Higher Education Research and Administrative Infrastructure and Teaching

The country's universities need to be competitive in research to maintain a healthy standard of higher education that prepares their graduates for the challenges that await them in the industry as well as post-graduate studies. Structural problems with research infrastructure have been identified as an obstacle. The following recommendations are forwarded to improve the research funding infrastructure:

- a. Research needs to be outcome based where qualitative and quantitative assessments are used to evaluate the results.
- b. Follow a Principal Investigator (PI)-centric model.
- c. Respect the autonomy of universities.
- d. Have consistent and enforceable senate policy.
- e. Leverage formalized industry collaboration and funding for R&D to support problem identification, finding solutions, and job creation.
- f. Remove potential bottle necks for receiving and administering research materials and funding.

Regarding teaching, the following recommendations are forwarded:

- a. Review and revitalize the entire educational system, especially at the tertiary level to make sure that it is a more vibrant, politically neutral, relevant, dynamic, and technologically enabled, and produces professionals capable and ready to address current and future challenges and opportunities.
- b. Leverage and maximize the Ethiopian STEM diaspora through potential matchmaking, mentoring and coach-

ing. International engagements benefiting the national interest are critical.

- c. Educational and research institutions, both private and public, should establish a rigorous diversity agenda including hiring practices, creating safe and accommodating environments to fully utilize existing talent pools and have an inclusive working environment.
- d. Introduce competence-based curriculum (Experience – Ethiopian Competence Based Curriculum for Health Science Programs). Continue to leverage curriculum development tools (e.g. DACUM) to have a sustainable way of developing appropriate curriculum.
- e. Enforce the internal and external quality assurances, professionalism, integrity, and ethics, and
- f. Involve private higher education or polytechnic institutions to help in building bridges and preparing students with entrepreneurial skill sets (i.e., job creators instead of job seekers).

Funding

Center-level educational and research activities are long-term strategic investments with very significant return on investment in economic growth and job creation. The US NSF Engineering Research models resulted in returns that were as much as ten times the initial investment [74].

We recognize that the estimated budget for the education sector in Ethiopia for 2019/2020 was about Birr 32 billion, with Birr 5 billion (\$150 million) allocated to tertiary education. The rough estimate for award levels for a single CoE for 5 years is about \$2.5 - \$5 million (as opposed to \$20 million in the case of US NSF Engineering Research Models). We think funding three such Centers for 7 years could cost about

\$20 million (Birr 640 million) each. The return on investment, therefore, could be as high as \$100 - \$200 million with thousands of jobs created.

Total Needed = \$20 million for funding 3 CoEs for 7 years (\$5 million for 5 years and \$7 million for 7 years)

Potential Return on Investment = \$200 million worth of economic output in form of jobs, products, patents.

Funding could come through a combination of:

- a. direct government funding,
- b. bilateral cooperation with friendly countries (Adama S&T U has some support from South Korea),
- c. international partners active in supporting research (CIDA, SIDA, etc.), and
- d. private sector funding (banks, industrial parks, etc.).

[C4] Transportation Infrastructure

Robust transportation infrastructure development will play a critical role in reaching the country's goal of a middle-income country by 2025. It is also a key sector in enabling urban growth and rural transformation by creating access to markets and providing connectivity within and between regions. Ethiopia's current transportation infrastructure system comprises over 116,000 kms of classified roads, two international airports, twelve domestic airports and a few landing strips, a recently completed Addis-Djibouti railway (~765 kms-standard gauge, with double track for the urbanized section between Sebeta and Adama), and Awash-Weldiya railway line which is under construction [75]. Despite this progress, however, there are significant transportation infrastructure gaps, particularly regarding the size, quality, and capacity of the road network. To address these gaps and meet the challenges of an increasing population, we propose a series of visions that provide the framework for developing a long-term transportation plan for Ethiopia. These visions are meant to promote economic development and growth, protect, and enhance the country's cultural heritage, improve quality of life, and serve as aspirational long-term dynamic and flexible planning tool. Five closely related themes are considered as basis for these recommendations, i.e., economy, mobility, environmental resiliency, livability, and stewardship [76]. These are summarized below:

- (i) **Economy** - The development of transportation infrastructure provides an efficient movement of people and goods that are the basis for economic activity and growth. For this to happen, citizens of the country should be given equal and unhindered access to opportunities in transportation, employment, commerce, housing, education, and culture.
- (ii) **Mobility** - A robust transportation system that provides multiple modal options, be it by car, bus, train, bicycle, or foot and high-quality infrastructure is crucial to achieving safe and efficient mobility of people and goods. Planning for a county with a diverse mix of urban and rural areas is challenging but achievable and requires a comprehensive approach to transportation planning and infrastructure development. For this, regional transportation system should be well-connected and serve all modes of safe, reliable, and well-maintained transportation.
- (iii) **Environmental Resiliency** - Climate change and the resulting environmental conditions pose surmounting threats that could impact existing transportation infrastructure assets and disrupt the performance of the system. It is important to anticipate the impact of climate change on the transportation system and prepare for it. This requires integrating environmental considerations in all stages of transportation infrastructure planning and implementation. This includes reducing greenhouse gas emissions and other air pollutants, conserving and enhancing natural, agricultural, and cultural resources, and reduce the risk of hazards created by natural and human interference.
- (iv) **Livability** - A safe and efficient transportation system provides reliable access to places of work, goods and services, and recreation to society. By integrating livability principles into the transportation



Figure 14. There is significant potential in integrating air and railway transport to regional railway, highway, and internet Infrastructure. Not all planned railways are shown.

infrastructure planning a safe and efficient access can be achieved within urban and rural areas. Livability is enhanced when transportation planning is undertaken considering multidimensional issues including land use, environmental protection, public health, and economic well-being.

- (v) **Stewardship** - To achieve the vision and objectives set forth in this plan, a purposeful and regular stewardship is paramount between the federal government, regional and local transportation agencies, and stakeholders. Enhanced stewardship of the transportation resources

through effective planning, efficient decision making, wise investment, built-in accountability, and rigorous performance measurement will result in robust transportation infrastructure development in Ethiopia. This can lead to economic growth and the country attaining a middle-income status.

1. Design of Urban Transportation Infrastructures - Follow Manufacturing & Urbanization Trends

The two current models, i.e., aggregation to megapolis and emergence of fast growing secondary cities (“cheetah cities”) certainly influence the needs in transportation infrastructure. These mod-

els also represent new realities in urbanization in Ethiopia that call for new ideas for long-term transportation planning.

- (i) Emerging Addis Ababa-Bishoftu-Mojo-Adama Megapolis:** The emerging Addis-Bishoftu-Mojo-Adama megapolis that extends for almost 100 kms could significantly alter the urban commuting scene in this cluster region.
- a. The existence of an under-utilized double track railway line in the region (Addis-Djibouti line) could encourage the introduction of daily commuter train services between these urban regions,
 - b. The planned international mega airport in the Bishoftu area also offers an opportunity for fresh thinking in terms of leveraging the railway line for passenger commuting and also freight traffic from nearby industrial parks (Kilinto, Bole Lemi, Adama, and Hawassa),
 - c. With the development of high-density commercial areas in Addis such as the “*financial center*” in the “*senga tera*” area along with further congestion of the usual traffic choke points like H/Gebre Selassie Road, the time for considering underground metro transportation and tunnels in Addis Ababa has come,
 - d. Long-term transportation planning for Addis and its environs should consider emerging opportunities to promote the integrated development of public transit system with emphasis on viable high capacity technologies, based on clear understanding of the interaction between land use and transportation. This will include developing planned pe-

destrian facilities taking safety and convenience into consideration.

- (ii) Secondary Cities:** These are primarily the regional capitals and major commercial centers like Jigjiga, Asaita, Dire Dawa, Hawassa, Bahir Dar, Gondar, Debre Birhan, etc. Their current double digit growth and their early stage of urbanization offer an opportunity for thoughtful planning with a narrowing timeline. Most of these secondary cities are emerging as manufacturing hubs with recent establishment of industrial parks in or near them. A recent study shows that lack of adequate transportation infrastructure was cited (together with access to reliable electrical power) as a bottleneck for further growth [31]. Thoughtful transportation planning that integrates these cities with export destination markets or local markets will remove this bottleneck.

2. Holistic and Inclusive Design of Inter-Urban Road Network

A coherent and integrated policy framework should guide the road sector development strategy and program development. Functional classification and analysis of scenarios which consider traffic and multi-modal interactions is necessary. This is even more important for roads and rail modes on major corridors, to cope with mobility and accessibility needs. This should always be based on equity and inclusion of communities at various levels, i.e., from the wereda to national levels. This also needs to consider the recognized gaps and benchmarking with selected higher and middle income countries in terms of coverage, quality and capacity of the inter-urban road network. The following priority areas are proposed for consideration:

- a. Expand the expressway network significantly in key corridors to address inefficiency of road transport,
- b. Rehabilitate major trunk and link roads in the country. These are characterized by significant deterioration due to high traffic with a large proportion of heavy vehicles,
- c. Improve the overall quality of the road networks, by increasing the proportion of bitumen-surfaced roads in the total network to about 60 percent from the current 20 percent,
- d. Enhance the connectivity of the major road network to improve travel and transport efficiency,
- e. Reduce road network coverage by extending and improving the regional and rural access network, considering tradeoffs between efficiency and equity objectives, and
- f. Introduce sustainable financing with a combination of sources (user charges, tolling fees, private sector financing and public sector resources). These need to be allocated based on project financial feasibility and attractiveness to the private sector, risk (anticipated and actual traffic and potential for “sufficient” revenue), and economic viability and equity objectives as appropriate.

3. Integrate Air and Railway Transport to Regional Railway, Highway, and Internet Infrastructure

Current trends suggest there is credible future for some form of loose integration of regional railway and highway transportation in several corridors in Africa, including Ethiopia’s neighborhood in east and northeast Africa. It is also possible that these loose integration of highways and railways could be leveraged for building a “data highway” consisting of a fiberoptic link between Djibouti, Ethiopia, South Su-

dan, Central African Republic, and northern DRC along these trans-national roadways (Figure 14). The possibility of such an integration of trans-national transportation network will potentially be boosted if the forward-looking common market of **AfCFTA** (African Continental Free Trade Area) becomes a reality sometime in the future.

The idea of pre-planning for integrated air and railway transport in the region finds further support from the success of Ethiopian Airlines in its ambition to be the logistics center of Africa and gateway to cargo traffic to Gulf/Arabia/China. In preparation for such possibilities, Ethiopia should consider:

- a. Improving the efficiency of the existing railway network and the one under construction, considering inter-modality as a viable approach to enhance financial sustainability,
- b. Expanding the railway network based on analysis of external trade movements, structural changes of the economy (prospect for bulk/high density movements on long distance), and results of financial viability and attractiveness to private sector financing, within the framework of sub-regional freight transport integration,
- c. Enhancing the connectivity of the existing domestic airport to reduce cost of passenger and cargo traffic,
- d. Developing new domestic airports, based on traffic analysis and feasibility; and improving the capacity of existing domestic airports to meet anticipated demand (both passenger and cargo), particularly related to industrial parks, commercial agriculture, tourism, etc., and
- e. Tying the secondary “cheetah cities” to these networks.

4. Refocus Urban Transportation with Urban Quality of Life, Sustainability, and Safety as Corner-Stones for Development

Some of these measures include:

- a. Introducing underground urban commuting in Addis.
- b. Reduce pollution by encouraging electrical vehicles by subsidizing registration and related fees.
- c. Promoting the use of technology to improve traffic flow, delivery of public transport, and to enhance safety and utilization of infrastructure.
- d. Increasing provision of facilities such as parking, terminals, loading-unloading etc.
- e. Giving sufficient attention to the interaction between urban land use, transportation infrastructures and efficiency of traffic management to reduce congestion and enhance the environment for walking and cycling, as part of a balanced approach to transport development.

5. Strengthen Institutional Capacity in Transportation

Aside from improving institutional arrangements to achieve efficiency and service outcomes of the relevant transport agencies, enhancing their capacity would be critical to develop technical and management skills. Training programs should be tailor-made to meet current and future needs. Particular emphasis is needed in planning and asset management, alternative financing models such as Public-Private Partnerships (PPP), enhancing transport safety, application of ITS, climate change response, integration of public transport services (technologies), and multi-modal transport planning and management. The priorities for capacity improvement should be related to strategic thrusts.

Funding

There are well-known funding mechanisms that are tentatively finding acceptance in Ethiopia:

- a. Private Sector Participation (PSP) and Public Private Partnership (PPP) should be considered as key instruments of financing major transport infrastructure to reduce the burden on the allocation of public funding, and external borrowing. Public policy framework should be tailored to promote sustainable transport infrastructure development with a paradigm shift towards customer-oriented efficiency outcomes, central to which is asset management.
- b. Toll fees and user charges on high-traffic roads could generate income.

[C5] Construction Industry

The Construction Industry is the backbone and a critical component of almost all of the Ten-Pillar ETHIOPIA 2050 points of discussion and, by extension, that of the country's development agenda. The industry plays significant roles in the development and delivery of a variety of irrigation and power-generation infrastructures, health and education infrastructures, urban development, transportation, overhead and sub-surface communication systems, multi-faceted defense, and multitudes of other constructible infrastructure project deliverables. As an Industry that consumes the lion's share of the capital budget of the country and with a prominent role in the Growth & Transformation Plan as well as the Ten-Pillar Agenda of the National Plan & Development Commission, it is, indeed, a major contributor to the economic growth and job creation.

RECOMMENDATIONS:

1. Well-Planned and Informed Independent Construction Audit (System-Level & Project-Level)

The Construction Industry is dynamic in nature and needs to be founded on the principle of instilling a holistic, and yet, dynamic transformation addressing its development, productivity, sustainability, competitiveness, adaptability, equity, accountability, and transparency. With a fairly comprehensive Construction Industry Development Policy¹¹ which has been in place for nearly seven years, a well-planned and informed independent Construction Audit that spans across both the industry and projects need to be established. As both the Construction Industry and projects are data driven with measurable inputs and outputs as well as established processes and procedures for

quality assurance and quality control, the entire Industry should avail itself for audit operations with potential for providing clear and clean findings and reports of interest.

The Construction Industry involves a variety of stakeholders that facilitate the creation of a self-monitoring, self-auditing, self-controlling, and self-adjusting system. Consequently, these self-monitoring features will form the basis for the creation of all sub-processes and undertakings that contribute to a holistically dynamic transformation of the construction industry itself. Continuous development of monitoring, evaluation and updating of components that respond to emerging technological, societal, (both for local and global scenarios) needs will have a variety of bearings on the Industry. One such major activity that will address and contribute to the transformation will be the auditing of the Industry both at the system- and project levels.

- (i) **Construction Industry Audit** (System-level) and **Construction Projects Audit** (Project-level) The design and execution of system-level and project-level audits could effectively address a multitude of processes and operations. This could be done by addressing the quality of leading and managing the government organ responsible for the industry in terms of their process management system, policy components, stakeholders' engagements, and influences on specific project deliverables. An audit-driven construction industry – with an audit body that is independent and accountable to bodies outside institutions and establishments that are set to lead and manage the Industry – will form an indispensable and a mandatory

¹¹ Ethiopian Construction Industry Development Policy, December 2013.

component. This will fulfill the visions and provisions of the Ethiopian Construction Industry Development Policy 7 not least in addressing and creating the ideas embedded in Art. 3.1.1 and Art. 5.3.1c 10i v, respectively, of the Policy. Such an independent audit body is also a viable and change-making tool and instrument to address the performance and ethical delivery as well as accomplishments of regulatory / controlling bodies within the Industry. Regulatory bodies that are not independently audited and checked will themselves become even stronger breeding grounds for poor performance.

- (ii) The other policy instrument that helps facilitate the self-monitoring system would be that of separating the roles of the various direct actors (consultants and contractors), clearly noted in the appropriate sections of the country's legal codes dealing with Conflict of Interest. In fact, one of the decisive changes that has to be made in the project delivery within the Ethiopian construction industry is a legally-binding separation of design consulting services and construction management services [77]. Furthermore, the various components of the product design services peculiar to the Construction Industry lend themselves to this kind of separation, thereby facilitating the establishment of a self-monitoring and controlling system.

2. Multi Dimensional and Multi-Disciplinary Capacity Building

A sustained multi-dimensional and multi-disciplinary capacity building is among the policy ideas that need to be considered as part of a holistic transfor-

mation in the Construction Industry. In this respect, the Construction Industry Capacity Building Framework & Programs was designed and accepted by the Government¹². While this is a fairly comprehensive undertaking, its implementation has yet to be pursued in a manner that brings positive and measurable change. Construction Industry Capacity Building needs to be planned, implemented, monitored, and periodically reassessed, with the sole objective of bringing about measurable and accountable positive changes towards achieving a holistic industry transformation, both at systemic and/or project levels.

Policy makers should consider an appropriate implementation of capacity-building programs that mainly consider features that make capacity-building a value-adding phenomenon. Capacity building should be based on the principles of capacity audits, capacity deficiency assessments, identification, and desired level of capacity definition. It is necessary to establish sound indicators for the capacity building response, implementation, and monitoring within the various components of the Framework. Assessment of targeted capacity development with accountability in all aspects of the process is mandatory. This is subsequently and continuously practiced following the results of progress measurements as a basis for prioritizing needed capacity building cycles. In fact, the construction industry can be compromised with corruption, unless a well-founded and sound system is built into the Industry [78]. To achieve this goal, Industry policy makers and those assigned to leadership positions must be supported by seasoned professionals who have wide and deep experience in the mechanics of the Industry and its deliverables. These

¹² Construction Industry Capacity Building Framework & Programs, Ministry of Construction, 2017.

entities are responsible for converting the Construction Industry Development Policy document into bylaws, regulations, and procedures.

3. Export Construction Industry Expertise to the Rest of Africa

The Industry needs to be established with the anticipation of its service exportability to sub regional, regional, and global markets, thereby making it a strong economic resource for the country. It is recommended that Ethiopia develops sound planning mechanisms for making its engineers and related technical as well as management personnel engaged in this Industry as exportable products by indirectly addressing the quality of its related institutions of higher learning. The delivery quality of the Construction Industry which, in turn, has a decisive influence on the components of the holistic transformation is the qualification and registration policies of the manpower to be involved as professionals and skilled trade. This is, in turn, strongly influenced by the quality of related educational and research at institutes of higher learning thereby necessitating the need for holistic planning of a variety of other components that would contribute to creating a globally competitive construction industry.

Funding

The following could be sources of funding:

- a.** Auditing expenses could be paid by the industry itself,
- b.** The broader area of capacity building in construction industry can be funded by the government as it is the major client and beneficiary of large construction activities in the country, and
- c.** Local construction companies that are already active in international markets, particularly in the African market.

[C6] Advanced Manufacturing

Capital expenditures and initial investments for traditional manufacturing such as semi-conductors, automobiles, steel, and aluminum machined products, etc. are prohibitively expensive. New technologies in the broader areas of advanced manufacturing offer an opportunity for leapfrogging for emerging economies like Ethiopia. For example, 3D printing (also called digital manufacturing) requires significantly less capital expenditure as compared to traditional manufacturing, particularly when coupled with government supports like tax credits or public/private partnerships. In general, the preferred model around the world in advanced manufacturing involves collaborations with universities, as they are more driven by cutting-edge technology than massive capital. This emerging age of manufacturing that is gaining traction around the globe is a key component of Industry 4.0. For countries like Ethiopia, advanced manufacturing opens up further possibilities in fintech, big data analytics, advanced robotics, cybersecurity, artificial intelligence, precision medicine, and

agritech. The following recommendations are meant to point out some key steps that Ethiopia could take to be a beneficiary of Industry 4.0, particularly in advanced manufacturing.

1. Launch Advanced Manufacturing Center for Metals – A Government/ Industry Consortium

Over the years, a pervasive problem that had contributed to inefficiencies and delays in completion of important infrastructure projects in Ethiopia has been the lack of spare parts. Prohibitive expenses, as well as delays in importing materials, have had significant negative impacts in several sectors such as the manufacturing industry, freight and passenger transportation infrastructure, and agricultural equipment. We propose that with additive manufacturing, particularly 3D printing technology, the time has come for Ethiopia to address the spare parts problem by building an infrastructure for 3D printing. This will save foreign currency, time, and also encourage innovation in metal manufacturing within Ethiopia. In the model that we recommend, a consortium of

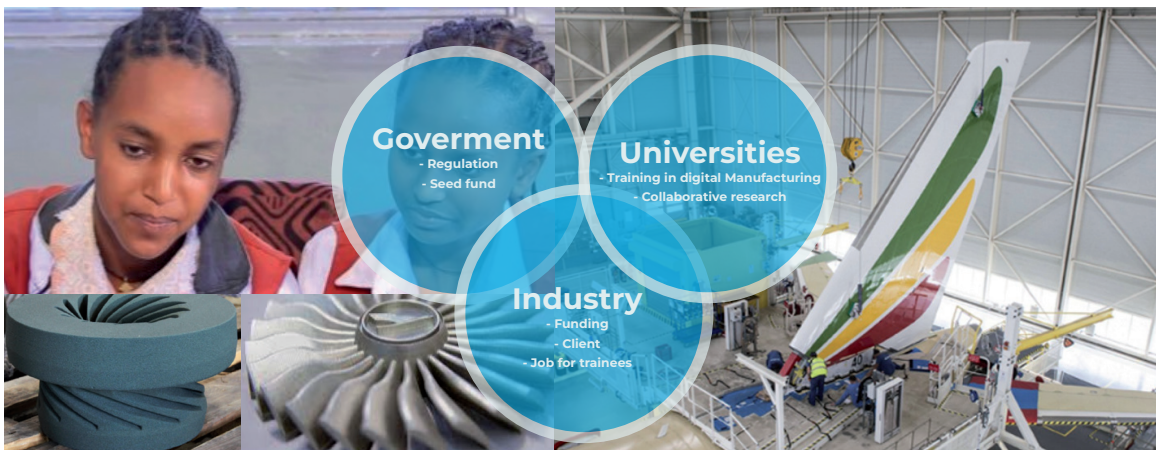


Figure 15. Digital Manufacturing for spare parts could have a significant market in Ethiopia. For example, Airbus A350 XWB jetliner, 14 of which Ethiopian Airlines is in the process of acquiring contains over 1000 3D printed parts [81-82]. As evidenced by the recent MoU that the Airline had signed, this technology can be transferred to Ethiopia with relative ease and then leveraged for building an additive manufacturing ecosystem. Photo Source: P. Masclat, Airbus. Inset photos: Voxeljet and Hawassa STEM Center.

government (particularly the military) and industries could take the lead. This will be a for-profit entity charging for services rendered. Recycled metal can be used, significantly reducing the costs. There are several examples in Africa where such technology is being effectively leveraged [79-80]. While its current status is unknown, Ethiopian Airline's plan announced in 2016 to collaborate with a South African company Aerosud Aerospace for establishing a digital manufacturing center in Addis is a possibility worth mentioning [81-82]. Figure 15 shows a model digital manufacturing consortium between government, industry, and universities. Ethiopia which is currently aggressively investing on textile manufacturing infrastructure also faces a risk of automation that could significantly compromise opportunities as this industry could move back to Europe or the US [83]. Therefore, developing such additive manufacturing capability at this early stage could help hedge this and similar risks.

2. Create Centers of Excellence in Advanced Manufacturing in Association with Universities

This is similar to what was recommended earlier, except the focus here is advanced manufacturing. As explained in Figure 12, one could consider for example, Adama S&T University (ASTU) - which is already involved in interfacing with manufacturing industries - as the lead institution for "Center of Excellence in Advanced Manufacturing" which focuses on 3D printing using innovative materials such as wood fiber, construction waste, and metals which are conducive to Ethiopian and emerging market conditions. Materials for biomedical applications such as 3D printed prosthetics (one estimate puts the number of patients who require such devices in Ethiopia at almost 0.5 million and only 5 – 15% of this need is met through current levels

of service provision [84]), sustainable construction materials, post-processed mining products, and materials for agriculture (spare parts for pumps, etc.) are some of the examples where the availability and accessibility for such supplies remains a serious challenge.

In such CoE, the lead institutions ASTU could recruit Generation II universities like Dire Dawa or Jigjiga as partners. This ecosystem will train undergraduate and graduate students in additive manufacturing and also create a conducive environment for entrepreneurial ventures. Twining with international collaborators as well as local industry will enrich the opportunities available to students, faculty, the private sector, and government.

3. Promote Pharmaceutical Industry for Leadership in the African Market

Ethiopia has positioned itself as a destination for the pharmaceutical industry for some time. The demographic dividend has been cited as one of the compelling reasons, together with access to the sizable African market. The government had also identified pharmaceutical manufacturing as a priority sector [17] and the Kilinto Industry Park has been identified as a hub. Therefore, together with the proposed initiatives for center-level university/industry/government ecosystems to train a globally competitive workforce, there is ample opportunity in this area.

4. Expand Eco-Industrial Parks that have Strong Vertical and Horizontal Integration

The concept of Eco-Industrial Parks where there is a well-planned cooperation among businesses and the local community with the goal of achieving sustainable growth and efficiently share resources is emerging as a popular model.

We think such model will have a natural fit for Ethiopia where there is strong need for developing growth models that

include the community as strong and key stake-holders. This integration with the local community should also be reflected at the national level in both vertical and horizontal integration.

The current industrial park model is an excellent initiative that is already showing measurable success. Its success will be complemented by the following considerations to maintain sustainability and scalability:

- a. Adopt powerful lessons in “inclusion, equity, and participation” from 1990s and 2000s Ethiopia:** provide equity for the local community at the sites (schools, water, healthcare, power access, etc.). The policy framework has to be designed to enforce this.
- b.** Enter into products that are high in the value chain. For example, both the maintenance of existing machinery and production of modified machinery should be done at the local level. This could have a good synergy with the “Advanced Manufacturing Centre for Metals” model suggested above.
- c.** Partner with higher learning institutions. As higher value products are sought, trained manpower will be in high demand. Partnering with 4-year universities in apprenticeship programs for hard-sought skillsets like electro-mechanical machinery and controller programming can address this.

5. Revive Machine Building Capacity

The Akaki Spare Parts Factory (ASPF) has served as a model where machine building in Ethiopia was explored, with mixed results. There are several data points that demonstrate that this model can succeed, since the market for manufacturing equipment has now grown [85].

The ASPF can be rehabilitated for current and future market conditions through a well-planned and sustainable machine building program whose objectives are to:

- a.** Assess current strengths and challeng-

es and explore alternatives, including partnering with others to establish a core machine building group of engineers and technicians, equipment, and supplies.

- b.** Design and manufacture reliable machines with high local growth in demand and related parts, and progressive scaling to more complex designs and production systems.
- c.** Support and continuously strengthen local suppliers and standard parts manufacturers, while establishing multiple external suppliers where local capacity is not yet available.
- d.** Build partnerships with government, research institutions, private sectors, innovators, and investment institutions to build and enhance the national machine production and maintenance capacity that addresses the growing local demands, and progressively be able to supply regional and global markets

Funding

The following could be sources of funding for these suggested centers.

- a.** Local industry contribution as founding members or membership fees for Center such as Advanced Manufacturing for Metals,
- b.** Government could provide tax breaks and start-up funds for these Centers, and
- c.** Tie-in with international players in advanced manufacturing could generate some fund. For example, the South African company Aerosud Aerospace could be engaged as it already has signed MoU with an Ethiopian entity expressing interest.

[C7] Sustainability and Environmental Security

The broader areas of sustainability and environment security form one of the key societal challenges considered in this report. Here, sustainability is considered as a policy framework for pursuing integrated and balanced economic growth, social wellbeing, and protection of the environment from degradation. These include protection of air, water, and forest resources from contamination with pollutants and solid waste [86].

In order for the country to build a participatory and inclusive sustainable national economy, the following recommendations are proposed.

1. Manage Ecological Infrastructures

The attainment of sustained economic growth, eradication of poverty and the development of a knowledge society, i.e., well-educated and informed, healthy and well-nourished, fully-engaged and productive citizens are dependent on the country's capacity to properly manage its natural resources [87-88]. A critical component of the sustainability endeavor is the proper management of national parks and protected areas, including those designated as World Heritage Sites by the UNESCO. Ethiopia has designated about ten percent of its land to national parks and protected areas. However, with the current population growth, the pressure on non-farming lands such as grazing land and protected ecosystems will continue to intensify. In fact, landlessness in rural Ethiopia is fast becoming a major crisis. To address this in an interim basis, there is an effort to increase the allocation of grazing land and land in fragile ecosystems (steep hillsides) to landless farmers [13,89].

Therefore, there is strong need for developing strategies to reduce threats to grazing lands, national parks, protected

areas, and sensitive ecosystems. Some of these strategies are:

- a. increasing agricultural productivity on existing farms to significantly reduce the pressure on grazing land and forest resources,
- b. expanding agro-manufacturing sector in these ecologically sensitive areas to absorb the surplus labor,
- c. providing resettlements to people residing inside parks and offering them alternative livelihoods outside parks and sensitive ecosystems,
- d. promoting community-based environmental conservation awareness and education, and
- e. providing innovative and equitable compensation to the communities living near such parks. For example, building elementary schools, clinics, and other facilities for people who will be either moved out of the park or who already live next to the national parks could bring a buy-in and sense of stake-holder equity by the farmers and pastoralists.

2. Expand Ecosystem Restoration Initiatives

The Green Legacy initiative that aims to plant as many as 20 billion trees in the next four years is a highly commendable effort by GoE. This initiative has already raised wide-spread national pride and participation.

To complement this important initiative, we propose comprehensive ecosystem restoration programs to reduce the adverse impacts of frequent drought and natural resource disasters, including flooding and erratic rainfall. These programs include:

- a. restoring degraded ecosystem through expanded soil and water conservation,

- b. expanding agro-biodiversity through climate smart agriculture,
- c. incorporating climate smart city concepts to planning of new and existing cities,
- d. developing climate smart transportation systems, and
- e. considering well-planned resettlement schemes for population living in fragile ecosystems to areas where there is better access to water and other natural resources that can support the population.

3. Build Sustainable Energy Infrastructure

Renewable energy sources should form the core of energy infrastructures in Ethiopia, with a good mix of on-grid and off-grid energy systems [40]. The current plan as stipulated by GoE's National Electrification Program (NEP 2.0), where the target of 35% off-grid access by 2025 is a step in the right direction [40].

4. Promote Sustainable and Inclusive Business Practices

The practice of doing business are rapidly changing as companies are increasingly expected to go beyond profit-making to adopting corporate social responsibility and address grand challenges. Ethiopia too should adapt its codes and norms of doing business to encourage private businesses to tackle poverty, inequality, and environmental degradation. Ethiopia's collectivist culture is in fact more in tune with these new business approaches, emphasizing the collective well-being of employees and communities. The government should continue to actively promote inclusive and sustainable business practices through legislation (such as B-Corps in the US); tax benefits for social enterprises; certification schemes, and through

disclosure requirements for sustainability and social performance. The government can also employ media awareness, training, awards, prizes, and competitions to encourage private businesses to take up social issues that empower communities and alleviate poverty. The Green Legacy initiative is one very good example.

5. Incorporate Sustainability Transition

This should have a mandate and capabilities to facilitate new modes of governance within reconfigured inclusive polities [87-88]. In specific terms, we note:

- a. Ethiopia has a huge potential for leapfrogging into an inclusive, climate-resilient and resource efficient economy that effectively contributes to the improvement of the wellbeing of its people,
- b. This would require avoiding possible infrastructural lock-in that may result in stranded assets that may have least investment return at best or significant socio-economic and/or socio-ecological damage at worst,
- c. Emerging technologies and knowledge systems create more favorable conditions for combining top-down strategic planning with bottom-up operational planning that create more jobs and reduce poverty, and
- d. Ethiopia's ability to succeed in transformative development is dependent on its ability to create a dynamic innovation space that is responsive to specific contexts of resources and demand of its people.

Funding

With GoE's promotion of tourism as one of its strategic investment areas for revenue generation, tourist fees could offer a significant amount of funds to finance ecological infrastructures.

D. Institution Building

Institution building was identified as a critical and key component, for all the recommendations for the Grand Challenges to be successful and have long-lasting impact. The lack of strong and empowered civic and professional institutions has the potential to hold back any meaningful growth in a country and stifle progress. The presence of strong civic and professional institutions that outlive political changes are important for maintaining sustained and inclusive economic growth, social cohesion, and political stability. These institutions contribute to progress towards building a strong social-capital. To implement the country's Ten-Pillar Priority Sectors (based upon **the SDGs**) as well as address the **10 Grand Challenges**, strong institutions that are capable, accountable, effective, productive, sustainable, and inclusive are essential. These institutions should promote equity, respect for human rights, and effective rule of law and good governance at all levels [17].

RECOMMENDATIONS:

1. Establish a “Good Governance Charter”

Consistent with Ethiopia's own Ten-Pillar Priority Sectors outlined by the National Plan & Development Commission, that are in turn based upon UN SDGs, establishing “Good Governance” as a core and basic human right of every Ethiopian should be at the center of building durable institutions in the country [86,90].

Good governance charter guarantees:

a. Capable, efficient, and democratic state that is guided by a democratic, development-focused, and a competent, ethical, accountable, and responsible civil service that is committed to equal opportunity for all citizens,

b. Data and knowledge-driven administration at local and federal level.

This includes responsibility to generate reliable, accurate, and verifiable data and creating capacity for natural capital wealth accounting (water, forest, ecosystem services, etc.),

c. Rule of law where peace and stability prevail, personal freedom of Ethiopians are fully respected with full and equal access to justice for all citizens,

d. Inclusive growth and sustainable development that is guided by the planned pursuit of a balanced and integrated economic, social, and ecological well-being across generations and territories. Such an approach nurtures people-centered development, where economic, social, cultural and religious rights of every citizen is fully respected and where every citizen is engaged both as beneficiary and contributor to the development process under a common destiny and shared values to build an Ethiopia where citizens are free from poverty, hunger, unemployment, poor quality education, and inadequate health and other social services.

2. Introduce Voluntary National Service

Data from countries that have a strong culture of national services like Singapore, Korea, and Israel clearly show that national services contribute significantly towards nation building and innovation [91]. We propose a similar initiative in Ethiopia with some unique characteristics that factor in the current conditions of the country. The “National Service” will be voluntary and will be available to the young (18-25), after secondary school or after completion of a tertiary education. It will have the following components:

a. It will last for a period of 18 months,

b. The public and government bodies that volunteers can join are:

- (i)** Elementary and secondary schools - high-school graduate volunteers can teach in elementary schools while tertiary education graduates can teach some classes in secondary schools,
- (ii)** Defense industry - where they will receive training in electronics, avionics, machining, and mechatronics, and
- (iii)** Agriculture Extension Service (12,500 exist in the country now) - where they could work in such efforts like watershed management (afforestation and reforestation).

c. The volunteers are to be provided with basic stipends.

3. Strengthen Professional Organizations and Rebuild Ethically Responsible Public Service Sector

Currently, the strongest and longest-surviving establishments in the country that impact people's lives are social units such as *Idir*, *Mahber*, *Iqub* and other religious and cultural institutions. These institutions are based on trust and a social contract, providing essential services that are not typically covered by city, regional, or federal governments. Similarly, professional organizations (be it in medicine, engineering, chambers of commerce, etc.) should play important roles and should be strengthened to assume more impactful roles that are independent and transcend political changes. At the same time, the civil service sector has to be rebuilt to reflect high professional and ethical standards. To achieve these objectives, we propose the following:

a. Develop government policies that encourage formation and strengthening of professional organizations in all pro-

fessions as desired by its practitioners. Currently, while some professions have good representation, several professions such as teaching, journalism, manufacturing, and farming seem to lack representation.

- b.** Strengthen the civil/public sector culture towards one that is recognized for, and nurtures professionalism, integrity, diversity, accountability, and respect for universal rights for all,
- c.** Draw lessons learnt from countries like Singapore, Rwanda, etc. on public/service leadership,
- d.** Review and strengthen the public service talent requirements and modernize the management process, and
- e.** Appraise the capacity of the civil/public service sector to implement policies and plans recommended, identifying potential gaps and options to address them.

4. Empower Women for Meaningful Transformation of the Country

Focusing on women and girls that make up half the population of Ethiopia will ensure achievement of the demographic dividend. Women and girls are at the core of many of the 10 Grand Challenges, be it with regards to clean water, food security or health services. The health and well-being of families and future development of the country depend mainly on investing in girls' education and empowerment of women. Recognition is due for the recent steps taken by the government in setting the tone and example to empower women particularly in the political realm, including women making up half the cabinet and naming the first woman president of the country. In line with this, we propose to:

a. Establish an overarching and well-grounded national policy that ensures girls remain in school and be able

to better themselves while addressing the challenges they and their families face. This should include a set of strategies to remove economic, religious, and cultural barriers to close the gender gap at all levels,

- b. Develop** a realistic and deliberate plan and accountability tied to the national policy indicated above,
- c. Create** safe ecosystems that enable women and girls to grow and become productive, including increasing girl's schools both in rural and urban areas, women's colleges, etc.
- d. Develop Strategy** to increase the number and visibility of women within 4th Industrial Revolution, including artificial intelligence and digital technology,
- e. Call to Action** to all political parties to have a sustainable development agenda that includes a commitment to have a policy to ensure girls remain in school and to achieve gender equality, and
- f. Establish Diversity Agenda:** Private as well as public educational and research institutions should establish a rigorous diversity agenda, including hiring practices, creating safe and accommodating environments to fully utilize existing talent pools and have an inclusive working environment for girls and women.

5. Establish Sound and Participatory Development Planning

We applaud the efforts of the GoE in preparing a forward-looking Ten-Year Perspective Plan. Indeed, there is no better instrument than a government led sound short- and medium-term planning based on a pragmatic national vision to bring the country together; propel growth and transformation; harness their political will toward a common and clearly defined goal. We encourage GoE to continue tak-

ing the Plan through a multi-stakeholder participatory process that instills hope and ensures every Ethiopian to have a sense of ownership of the national vision, hence his/her destiny.

Funding

The funding for National Service, whether the service is in teaching, defense industry, or agriculture, will be covered by the government. In this regard, the findings of a 2014 study are noteworthy: "for every dollar invested in national service programs for youth and seniors, almost \$4 are returned to society in future benefits."

¹³ Consideration of a national service is, therefore, a financially sensible proposition.

¹³ The Economics: Why National Service Is Worth It by Clive Belfield, 2014, Democracy – Journal of Ideas.

E. Girls' Education and Empowerment of Women

We started this report with the demographic challenge and opportunity that Ethiopia faces in the coming three decades. To complete the picture, we give special focus to girls' education and empowerment of women to emphasize the critical role that they play in Ethiopia's development. Women constitute just over half of the Ethiopian population, with 85% residing in rural settings. They are the backbone of the society, nurturing and ensuring the well-being of the society, often at the expense of their well-being, toiling - on average - 16 hours a day (as opposed to 8-10 hours for men). Women face cultural, structural, legal, and financial barriers in their daily lives and are denied an equal footing within society. About half of the girls enrolled in school reach grade five, and only 5.2% complete high school (10.9% for boys). Delay in preparing women's talent pool translates to low employment performance as well as wider gender gap in wages and income (51% and 42% respectively).

Access to education for all, and in particular girls' education and empowerment of women, is central to a meaningful transformation of the country. Investing in women is smart economics. Health and education investments in women help women themselves, children, and society at large in three critical ways. First, in their roles as mothers, educated women pass on the benefits of higher education to their children. Second, children born to more educated mothers are less likely to die in infancy. Third, children of educated women are more likely to have higher birth weights and be immunized. Girls' education and empowerment have direct and proven impact on development and family

planning, poverty reduction, good governance and realizing the benefits of the demographic dividend. For example, an increase of 1% in the number of girls with secondary education boosts annual per capita income growth by 0.3% and four-years additional schooling lowers fertility rates [92]. Like many developing countries, Ethiopia has adopted the principle of universal primary education. However, the main challenge is the ability to keep girls in school until they reach secondary school or enroll in colleges and universities. Keeping girls at school by providing them with family planning, good health care, employment opportunities, good policies and laws to protect them will lead the whole society to a better future and development. There is need for high quality education, starting with elementary level that is accommodating to and addresses challenges for girls staying in school. These include the creation of a safe and flexible learning environment, equal treatment and opportunities for emotional and physical self-care including free access to hygiene products and appropriate girl-friendly bathroom facilities.

To become a lower middle-income country, 70% of women in Ethiopia have to at least complete high school [17]. Vietnam is a good model to compare with Ethiopia [93]. Vietnam focused on increasing female enrollment in schools, particularly high-school. This helped "*raise the median age*". Another example is China where, according to Amartya Sen, the reason China was ahead of India in development is China's heavy investment in education, especially girls' education, and health and provision of services to its rural population while India lagged behind in all these areas¹⁴.

14 <https://www.nytimes.com/2013/06/20/opinion/why-india-trails-china.html>

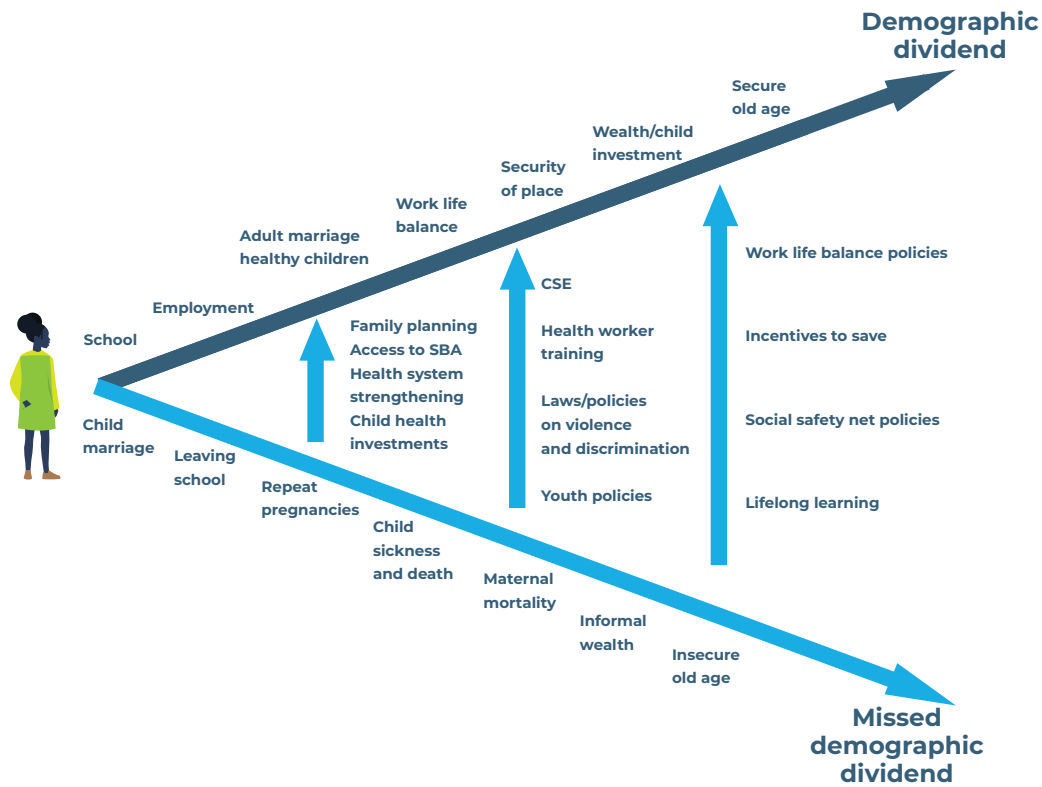


Figure 16. Girls' education is perhaps among the most consequential factor in converting population growth to demographic dividend [20].

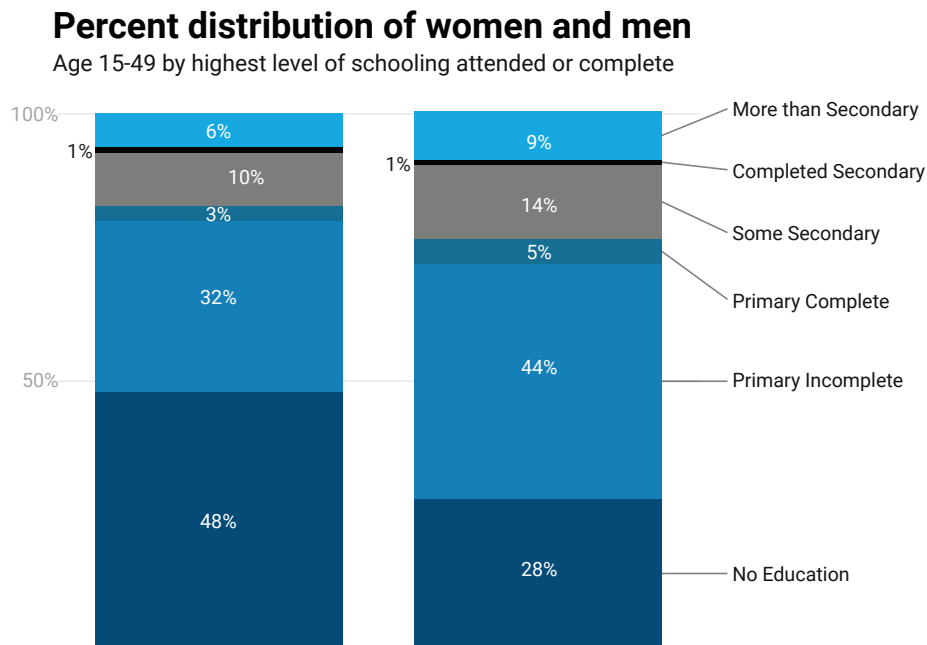


Figure 17. Educating Ethiopian women and girls is perhaps the most straight forward path to the creation of demographic dividend [17].

Measures to improve girls' education will require a wholistic and long-term approach. In this regard, the essential measures should start from the elementary level, where creating a safe and flexible ecosystem for them to remain in school and, realize their full potential becomes paramount. Removing economic, cultural, and religious barriers that prevent girls from attending schools and providing them with proper health care with family planning, childcare, employment opportunities will ensure their progress to high school and beyond. These efforts must also be supported through laws and policies that ensure women's rights, to a better future that enables them to lead productive and meaningful lives as well as contribute to socio-economic developments [20]. As shown in Figure 16, school enrollment of girls translates to their own empowerment, delaying childbearing to a later stage, which in turn translate to low maternal and child mortality.

Sustained collaboration, at all level, between the government, the private sector and not for profit institutions (including professional and religion institutions) is critical to untangle cultural, religious, structural, legal, and financial barriers. Lessons learned from successes and failures within and in other countries in their effort to narrow the gender gap, be it in health, education and economic participation and political power, need to be leveraged (e.g. Iceland, Norway, Sweden, Rwanda, Vietnam). The World Economic Forum has proposed a National public-private collaboration platform - accelerators - to identify, scale and accelerate such initiatives and offers a Global accelerator learning network [94].

RECOMMENDATIONS:

1. Ensure Gender Equality and Female Empowerment at All Levels

Gender equality is a basic human right

which expands freedom to women and girls and improves overall quality of life. Therefore, it is a critical component of promoting an inclusive and equitable society. The first priority to achieve gender equity is to improve the quality and access to education for all. Improved access to education does not mean taking it away from boys. It just means making sure that both genders are seen equally and removing the burden of household chores and harmful traditional practices (Figure 16) from girls so that they can join their brothers at school. In addition, we need to capitalize on female role models in all areas and at all levels [20]. Recent developments in Ethiopia, including the progress to women making up 50% of the Federal cabinet, the appointment of the first woman President, and the first head of the Federal Supreme court, certainly provide a positive foundation to build the momentum. In specific terms, for ensuring gender equality, men and boys, women and girls should be educated to bring about changes in attitudes, behaviors, roles, and responsibilities at various levels from homes to the workplace [20,95].

Women are empowered when *"they acquire the power to act freely, exercise their rights, and fulfill their potential as full and equal members of society. While empowerment often comes from within, and individuals empower themselves, cultures, societies, and institutions create conditions that facilitate or undermine the possibilities for empowerment"* [95]. Women have to be included in all decision-making processes at all levels of government, as well as in choices relating to marriage, education and health, family planning, household resource utilization and income distribution.

Government accountability in the enforcement of women's human rights, including development related rights, is vital. Implementing these measures now,

will speed up the Age Structure Transformation (AST) and contribute to successes in meeting the 10 development goals [95].

2. Increase Girls School Enrollment from Current 7 Percent to 70 Percent

Educating Ethiopia's women and girls is perhaps the most straight forward path to the creation of a demographic dividend sustained by near-full employment made possible by a flourishing 21st century economy. In a survey done in 2016 (Figure 17), it was reported that the proportion of women with no education in Ethiopia was a staggering 48 percent while the proportion of men with no education was 28 percent [89]. This is unacceptably high and needs to be remedied urgently so that the country does not miss out on the demographic dividend and the ability to effectively leverage half of its human capital. Specifically, it is critical to quickly raise the proportion of girls completing secondary school and higher, to 70% from the current 7 percent [96]. This is the target set by GTP II to make Ethiopia a lower middle-income country [17]. Creating a safer ecosystem to enable women to grow and be productive is vital.

3. Increase Women's Participation in Technology

Over the past several decades, it has become apparent that STEM is an important determinant of a country's economic development and security. Many Sub-Saharan African countries, including Ethiopia, have historically fallen behind other regions of the world in STEM knowledge. This, in many cases, is due to the well-documented lack of educational infrastructure. Staff shortages, lack of electricity and water supply, low student attendance in schools, weak governance, and lack of materials are some of the challenges that

have continued to act as barriers to developing solid STEM programs. According to UNESCO's 2018 Global Education Monitoring Report, only 22 percent of primary schools in sub-Saharan Africa have access to electricity. In addition, Internet access is still a luxury in many regions. Only 24 percent of primary schools in Ethiopia have access to electricity and Internet penetration is at merely 18 percent. Lack of basic and critical infrastructure has meant that resource allocation to higher-level STEM education has been a challenge.

Due to its demographic asset, Ethiopia has immense potentials to improve its economy, if it can empower a generation of young and gender-balanced professionals to take charge of the development of their country. This is why it is critical for education in Ethiopia to reach new levels, particularly with skills that can promote more STEM jobs. Countries that have invested in STEM have experienced global prominence. While non-African countries dedicate up to 4% of their GDP to scientific research, African countries including Ethiopia, have allocated little to no funding to science, thus increasing the gap between Africa and other countries in STEM performance and therefore economic development¹⁵.

There is an urgent need to increase the number, and visibility, of women in the broader areas of the 4th Industrial Revolution such as AI, digital technology, and STEM education. Not doing so has the potential to cause retractions in the gains realized towards closing the gender gap. Women and girls are at the core of the response to many of the 10 Grand Societal Challenges. Leveraging innovative solutions and technology to improve the lives of women (e.g. solar stoves, solar power, affordable water filter) is a positive step.

¹⁵ STEM education in Africa- past, present and Future, December 2, 2019

Empowering them with the right skills and knowledge to make a difference in their family's lives, and society as a whole, will multiply societal dividends. Collaborative and sustained efforts by government, academics, industry, NGOs, and professional associations will help substantially increase women's participation, and their visibility, in STEM and emerging technologies, thereby building a foundation for the creation of women's talent pool in emerging markets.

4. Require Political Platforms to have Women's Empowerment Agenda

It is critical that the current government of Ethiopia and all political parties in Ethiopia have a sustainable development agenda that includes a commitment to have policies and programs in place to ensure gender equality in health, educational attainment, economic participation and opportunity as well as political empowerment. Any government that is to form private or public educational and research institutions should establish a rigorous diversity agenda, including hiring practices, creating safe and accommodating environments to fully utilize existing talent pools and have an inclusive working environment.

Funding

The funding for these programs will be covered by re-programming the budget already allocated to the education sector.

F. Funding and Good Governance

This report has given examples for funding each recommendation. We have also included ideas for funding under Annex II. In addition to these, we would like to bring to the attention of policy makers the issue of corruption and illicit financial flows (IFF) which has depleted the much needed financial resources of African countries including Ethiopia. According to the World Bank, SSA loses \$50 billion/year in IFF, \$90 Billion in money laundering and \$20-49 billion in corruption. It is to be noted that the amount of resources taken illegally from SSA in various forms is more than all the aid money that has come to the continent. Ethiopia is one of the top four emitters of illicit flows. South Africa, the Democratic Republic of the Congo, Ethiopia, and Nigeria together emit over 50 percent of total illicit financial flows from Africa. Ethiopia and DRC are found in both the top 10 emitters of total illicit flows and the top 10 emitters of illicit flows as a percent of trade [97].

The average annual illicit outflows from SSA were 5.5 percent of its GDP [98]. According to the same report, Ethiopia lost anywhere between \$1.26 - \$3.15 billion every year from 2005-2014. This translates to 11% to 29% of the country's total trade; 40% to 97% of the total aid inflows to the country (OECD 2016) and 10% to 30% of the government's total revenue (IMF 2016). This translates to an estimated \$12.6 - \$30 billion over this period, a remarkably high amount by any measure.

In 2010, for example, overseas development assistance for Ethiopia was \$ 4 billion while the illegal financial flow amounted to an estimated \$ 5.6 billion, indicating illegal capital flight surpasses even AID money [99]. According to Alema-yu and Addis [100], capital flight from the

country had led to a loss of 2.2 percent of its GDP per year; the same amount could have been used to decrease poverty by 2.5 percent in the last decade. The absence of coherent, consistent, and well-designed laws as well as lack of coordination among different government organs in implementing and enforcing the laws, is seen as one of the main reasons for the increasing illicit financial transfers [101].

As highlighted above, the growth in IFFs deprives African countries in general and Ethiopia in particular the financial resources necessary to fund public services involving agriculture, education, gender equity, health, jobs for the youth, and water supply; improve infrastructure; and promote inclusive growth. In this regard, while IFF is a development bottleneck recognized by both rich and poor countries, the absence of good governance in many parts of SSA including Ethiopia is at its core. Therefore, we hope that a transparent and people-centered government will mobilize domestic financial resources by stopping internal corruption and addressing the issue of IFFs consistently and systematically. Finally, we are convinced that tackling internal corruption and the IFF will enable Ethiopia to mobilize most of the financial resources necessary to fund the recommendations of this report, implement its Ten Year Development Plan, and realize its dream of becoming a middle income country in the near future.

III. Multi-Generational Execution Plan

As established in the previous sections, Ethiopia faces Grand Challenges and opportunities driven by a massive demographic change which in turn require a thoughtful and immediate response. We acknowledge the low base the country is starting from. Based on the data presented, it is very clear that the year 2020 is a critical year to start accelerating the transition to realize the benefits of the demographic dividend.

As indicated in Figure 3 (share of working age population \approx 57.5%), the time to act on the demographic dividend is now when the productive age group is starting to increase. If in the next five years, Ethiopia invests in quality education and make progress towards creating a conducive environment for job creation, it can take advantage of the working-age workforce which is estimated to be 60% of the total population by as early as 2025. This will speed up the transition to demographic dividend and achieve a sustainable and equitable development, a goal that has eluded the country for the past several decades.

A template to guide implementation of some of the recommendations is provided in Section III.A (Figure 18). In Section III.B, a broad qualitative assessment of the potential for each of the recommendations in job creation and economic growth is presented. Section III.C is a template for implementing some of the recommendations in “*Advanced Manufacturing Con-*

sortium for Metal Spare Parts” and “*Advanced Manufacturing Center of Excellence*”.

III.A - Multi-Generational Plan for Ethiopia 2050 Grand Challenges

The set of actions we recommend for implementation are better executed if done in a multi-generational approach. Figure 18 offers a template for broad generational implementation strategy starting from the current baseline (Gen 0), with its timeline based on (i) urgency of the Grand Challenge and the risks involved in not acting early and (ii) availability of potential funding sources.

The template is divided into three distinct segments:

- (i) **“Action Tunnel”** – The segment shown in the middle of the chart represents outlines of proposed timelines for action on each recommendation. It is in cone shape to highlight front-loading of actionable recommendations in the next few years, with a gradual narrowing towards 2030.
- (ii) **“Opportunity Valley”** – This segment located at the top of the chart above the “*Action Tunnel*” represents unique opportunities in the horizon that could benefit the country significantly. For example, the potential WTO membership of Ethiopia at the end of the current ascension talks could bring significant op-

portunity for export-oriented industries in Ethiopia such as software development. The opportunities that could become available with the implementation of AfCFTA (in some form) are also indicated here. As a result, some recommendations that could directly benefit from this membership are placed within few years of that timeline.

(iii) “Socio-Political Instability Valley”

– This segment at the bottom of the chart highlights some of the key and consequential sober choices we face as these demographic transitions continue unabated. Conflicts between agriculturalists and pastoralists and continued and sustained social unrest fueled by unemployment and exacerbated by existing fault lines could cause severe damage and societal instability. Growing youth population that does not have opportunity for good education and employment and, hence, cannot benefit from any economic activity will represent the largest demographic risk that the country will continue to face. In addition, continued IFF and ethnicity-driven centrifugal forces will pose significant risks.

The intent is, of course, to avoid the “*socio-political instability valley*” and invest time and resources on the “*action tunnel*” while keeping an eye on the “*opportunity valley*”. Here, we propose that recommendations dealing with job creation and WFHE (water-food-health-energy) nexus be addressed immediately. The next 5 years have been identified as critical. The Ethiopian government is already doing commendable work in these areas, which are synergetic with these recommendations. These will be followed by the next set of actions 2-3 years from now and comprising of such initiatives like Centers

of Excellence, Advanced Manufacturing Centers (that need an initial 2 year of planning starting from now), voluntary national service, expanding cluster farming, increasing rural development budget to the 10% mark, etc. The next set of activities require substantial funding and are pushed to 2025.

Gen 0 – Baseline

This starts with the 10 Grand Challenges where Ethiopia is reporting a double digit economic growth, but still 78% of the population is living in with less than \$2/day and universal access to basic needs such as food, water, energy, healthcare, etc. are yet to be realized.

Gen I – Immediate Steps (2020 – 2025) – This coincides with GTP II MIC Aspirations by 2025

As an example, the following initiatives will be launched:

- Establish food, water, energy, digital literacy, and good governance charters
- Raise rural development budget to at least 10%, as agreed at the Maputo Conference of 2003.
- Undertake the transformation of currently outdated agricultural tools and farming methods using locally produced tools.
- Expand massive irrigation projects towards food security
- Create Advanced Manufacturing Center for Metals
- Create Centers of Excellence
- Transform the informal economy in urban areas
- Expand high-speed fiberoptic link in a redundant manner and lay the ground-

work for East-West data highway in Ethiopia, South Sudan, Northern DRC.

- Promote growth of secondary cities (“cheetah cities”) that could absorb the “youth bulge”, etc.

Desired Outcomes:

- Achieve 80% of the goal towards increasing girls’ school enrollment to 70%
- An improved education system capable of supporting a modern economy
- Improved tools for ploughing, harvesting, transportation, storage, and marketing at the peasant farming level
- Improved federal budget and strong technical and material support to small farmers
- Agro-industrial enterprises at farmers training centers and at cooperatives to provide employment and enhance rural industrialization
- Significant improvement in water and soil use and management to ensure food security and soil fertility.

Gen II – (2025 – 2030) – The Initiatives started in Gen I continue. Some of the main outcomes start being realized.

- Implement grid-scale energy storage
- Transform rural areas to manufacturing-dominated economy
- Promote specialized secondary cities
- Scale-up urban housing
- Digital economy to enter high-margin software development industry.

Desired Outcomes:

- Girls’ school enrollment reaches 70%
- 80-90% have access to basic infrastructure
- 80 – 90% of those between age 15 - 64 are educated & employed ¹⁶
- Transparency index for Ethiopia is between 7 – 10, etc.

Gen III – (2040 – 2050)

This stage represents the period where the outcomes of the initiatives taken in Generation I and II are realized. For example, jobs will be created in advanced manufacturing, export-oriented software industry, and unorthodox sectors, among others. Food security, good governance, empowerment of women, universal access to water and energy will be realized.

III.B - Assessing Potential Impact of Recommendations

We established the expansion of education and employment opportunities for the new generation of young men and women as the most important tasks that the country faces now. Successful achievements of these two tasks determines whether the opportunities offered by demographic dividend are realized or not. In this section, we assess the comparative potential impacts of the recommendations. The purpose of the analysis is only for guidance. For each of the top five recommendations under each thematic group, we give an estimate of the effects they have in training skilled manpower and creating jobs. We also provide a color coded ranking in terms of the impact of these in workforce training and creating jobs.

¹⁶ These are only suggested numbers to be used as guideline. GoE sets its own targets; but we expect that they will be consistent with the expected outcomes such as MIC status and universal access to basic needs.

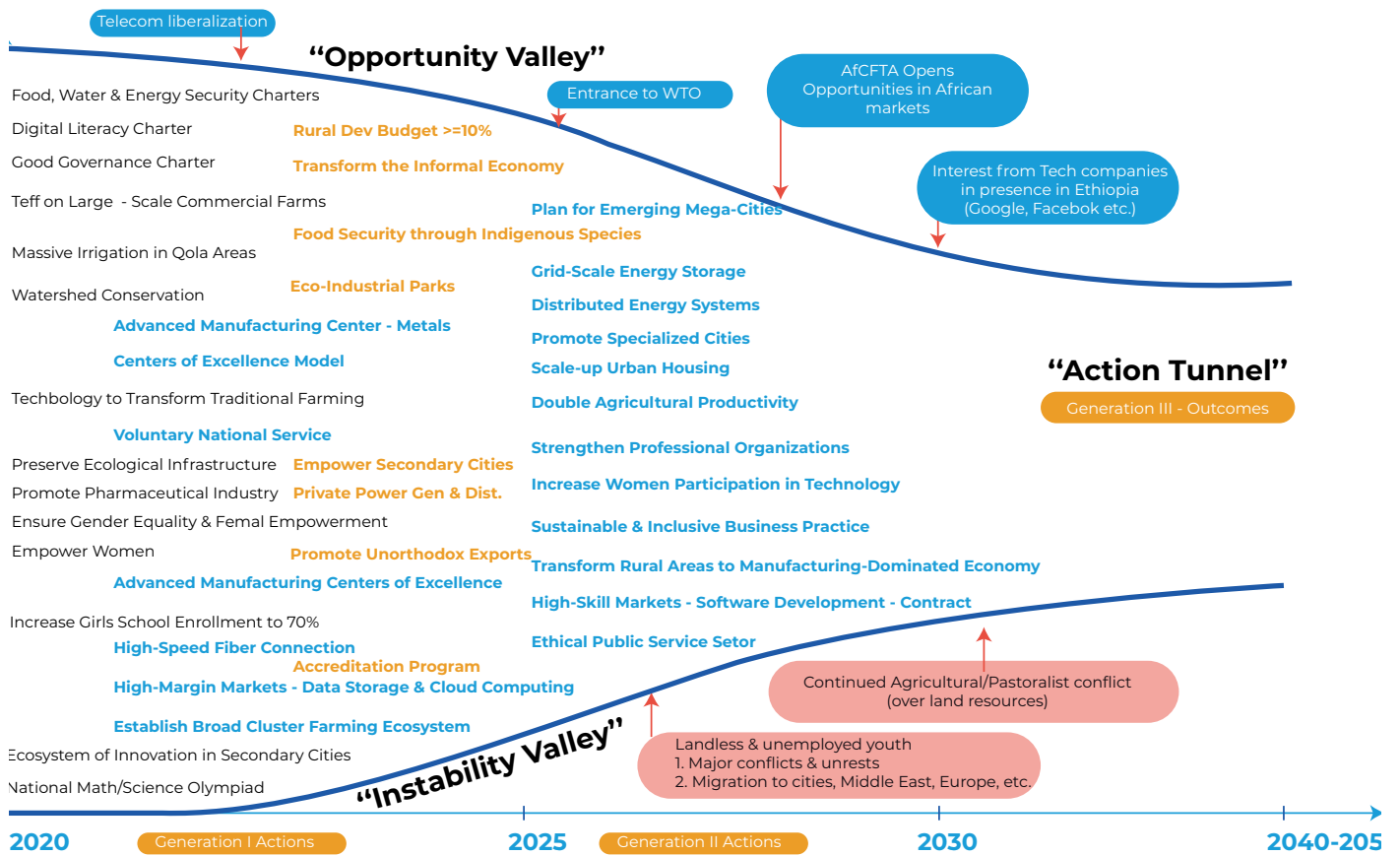


Figure 18. Timeline for generational implementation strategy for addressing Grand Challenge areas. Risks are identified as well as potential opportunity accelerators. Entrance to WTO, the implementation of AfCFTA (African Continental Free Trade Area), and further telecom liberalization will open the country to more and substantial opportunities. Three distinct segments describe actions needed to be taken (Action Tunnel), potential opportunities (Opportunity Valley), and destabilizing risks (Instability Valley).

Table 5. Assessment of impact of recommendations on job creation, workforce training, and economic growth. Green boxes show that the specific recommendation makes a direct contribution in the corresponding area. Lighter green boxes suggest that the direct contribution is modest.

Grand Challenge	Top 5 Recommendations	Potential Outcomes		
		Skilled Labor Trained	Job Creations	Economic Growth
Urbanization	1. Plan and build around mega-cities			
	2. Empower secondary metro cities			
	3. Promote specialized cities			
	4. Transform informal urban economy			
	5. Plan for urban housing, large-scale dev. projects & growth.			
WFHE Nexus	1. National Food, Water, & Energy Security Charter			
	2. Double agricultural capacity			
	3. Food security through indigenous species			
	4. Massive irrigation in Qola areas			
	5. Cultivate Teff on large-scale commercial farms			
	6. Scale-up clean water supply			
	7. Strengthen watershed conservation			
	8. Integrate health sector dev program with rural infrast + tech			
	9. Expand capacity for pharmaceutical manufacturing			
	10. Medical center clusters for medical tourism			
	11. Grid-scale energy storage (hydro/solar/wind/geothermal)			
	12. Distributed renewable gen & dist			
	13. Build solar photovoltaic industry ecosystem			
	14. Private sector entry to power gen.			
Economic Growth Drivers Rural Development	1. Increase rural dev budget ≥ 10%			
	2. Enhance rural dev with Ag Extension Services			
	3. Expand cluster farming ecosystem			
	4. Transform away from Ag-dominated economy			
	5. Apply technology to farming			
Digital Economy	1. Digital Literacy Charter			
	2. Connectivity to Undersea High-Speed Fiber Network – 5G			
	3. Leverage High-bandwidth connectivity for high-margin ebusiness			
	4. Build high-skill digital markets that leverage strength of Ethiopia			
	5. Expand innovation centers to emerging secondary cities			
	6. Leverage ICT for unorthodox exports			

Grand Challenge	Top 5 Recommendations	Potential Outcomes		
		Skilled Labor Trained	Job Creations	Economic Growth
Workforce Training	1. Centers of Excellence Model			
	2. Create accreditation program for government and private universities			
	3. National math and science Olympiad competitions			
	4. Undergraduate research & start-up incubator programs			
	5. Strengthen higher ed research and admin infrastructure			
Transportation Infrastructure	1. Design around 2 urbanization models			
	2. Holistic & inclusive design of inter-urban road network			
	3. Integrate regional air, railway, and internet infrastructure			
	4. Urban transportation with quality of life and sustainability considered			
	5. Strengthen institutional capacity			
Construction Industry	1. Independent construction audits			
	2. Multi-dimensional and multi-disciplinary capacity building			
	3. Export construction industry expertise to rest of Africa			
Advanced Manufacturing	1. Launch advanced manufacturing center for metals			
	2. Create centers of excellence in advanced manufacturing			
	3. Promote pharmaceutical industry			
	4. Expand Eco-Industrial parks with vertical & horizontal integration			
	5. Revive machine building capacity			
Sustainability & Environmental Security	1. Manage ecological infrastructure			
	2. Expand ecosystem restoration initiatives			
	3. Build sustainable energy structure			
	4. Promote sustainable and inclusive business practices			
	5. Incorporate sustainability transition			
Institution Building	1. Establish Good Governance Charter			
	2. Voluntary national service			
	3. Strengthen professional organizations			
	4. Empower women for meaningful transformation of the country			
	5. Establish sound and participatory development planning			
Women & Girls Education	1. Ensure gender equality & female empowerment at all levels			
	2. Increase girls' school enrollment from 7 to 70%			
	3. Increase girl's participation in technology			
	4. Women empowerment agenda – Political Platforms Req'd. to address			

III.C – Timeline for Implementing Grand Challenge Recommendations

Templates for implementation timelines of the recommendations are given below.

“Advanced Manufacturing Consortium for Metal Spare Parts” and “Advanced Manufacturing Center of Excellence” are given as examples.

Table 6. Template for implementation timeline of some of the Grand Challenge recommendations. The example adopted here is that of “Centers of Excellence” (CoE). Broken lines represent extension by another 5 years.

Years	20	25	30	35	40
Task 1: Establish organizational structure, policy, & mission for administering CoE (2020-2021).	→				
Task 2: Run RFP for Gen I Centers. Fund 3 centers for 5 years (2022-2027).		→	→	
Task 3: Assess Gen I performance & Prepare for Gen II Centers. Fund 3 more Centers (2025-2030)		→	→	
Task 4: Assess Gen II performance & Prepare for Gen III Centers. Fund 3 more Centers (2030-2035)			→	→

Table 7. Template for timeline for implementing recommendations for Advanced Manufacturing Infrastructure.

Years	20	25	30	35	40
Task 1: Establish organizational structure, policy, & mission for administering Consortium (2020-2021).	→				
Task 2: Run RFP for Consortium in Adv. Manufacturing. Fund Center for 5 years (2022-2027).		→	→	
Task 3: Run RFP for CoE in Adv. Manufacturing. Fund 1 Center for 5 years (2022-2027). Assess Consortium performance. Adjust funding.		→	→	
Task 4: Revive machinery building capacity			→	→

IV. CONCLUSION

This report is an outcome of a two-year long thoughtful process. During this period, critical socio-economic issues were identified. These issues include challenges involving the growing population that is projected to double by 2050, the accompanying opportunities in terms of the benefits that demographic dividend provides, and changing global geopolitical scene that Ethiopia should be aware of. The report offers insights and a way forward to address the Ten Societal Grand Challenges.

This Report focuses on the large demographic change that Ethiopia has been undergoing since 1985 and the challenges and opportunities it is likely to face between now and 2050. These opportunities and challenges are:

- (i) the demographic dividend of a large working age population that is projected to reach 100 million in 2035 and
- (ii) the need to educate and generate jobs for such a large segment of Ethiopia's population.

The findings and recommendations of this report are highlighted below:

A. Integrated Analysis and Recommendations

Since the "Ten Societal Grand Challenges" identified in this report are interrelated, the analyses, the predictions, and the accompanying recommendations are also

interrelated. For example, the recommendations for energy security and transportation infrastructure should take into consideration the emerging urbanization models.

B. Overarching Themes of Grand Challenges and Recommendations

In general, this Panel believes that the most effective drivers that turn challenges to opportunities could be summarized under five themes. These themes are: (i) large-scale and fast urbanization, (ii) water-food-health-energy nexus as national security issue, (iii) economic growth as a driver of rural development, world-class workforce training, ICT, transportation, construction industry, and sustainable advanced manufacturing, (iv) Institution building through civic and professional organizations for sustainable structural change in society, and (v) empowering of women and girls who hold the key for the demographic dividend through education and equity.

C. High Population Growth Rate is Causing Downward Economic Pressure and Landlessness

In rural Ethiopia, farmers and their families continue to be impacted significantly as their plot sizes are decreasing at rates that are making farming unsustainable for the future generations. In southern Ethiopia, for instance, the average plot size per farm household had declined to as low as 0.46 hectares. Land shortage is becoming acute

and the average plot size per household in parts of the country could further decline drastically.

D. Major Drivers for Opportunities are Education and Job Creation

The report highlights that the key component for realizing the demographic dividend is the promotion of education of high quality that leads to the creation of remunerative jobs. In this regard, it is clear to the Ethiopian government that the majority of these jobs will have to be created by the private sector. This is because of the fact that the supply of such jobs is beyond the Government's capacity to absorb them. With these in mind, the report outlines its recommended timelines and specific milestones for steps to be taken in tertiary education as well as jobs to be created by entrepreneurs.

Higher learning institutions will play a critical role in expanding opportunities for the effective utilization of highly demanded skills. The expansion of such opportunities includes the training of a new generation of young men and women who are entrepreneurship oriented. This will happen by creating a culture of innovation at these institutions through vehicles like “Centers of Excellence” – that have worked very well in several countries around the world.

The expansion of innovation and incubation ecosystem in the digital economy that is flourishing in Addis to other fast growing cities like Adama, Mekelle, Gondar, Jigjiga, Bahir Dar, etc. will create significant opportunities for innovation, job creation, and growth for young men and women. There are already several examples of entrepreneurial successes in Addis Ababa in the digital economy. Examples of innovations include the rideshare companies such as RIDE Ethiopia and ZayRide.

E. Rural Development Will Still be Critical in 2050

BY 2050, about 130 million Ethiopians (more than 60% of the population) are expected to live in the rural areas, with the majority depending on subsistence farming. Sustainable and inclusive economic growth cannot be achieved without the effective participation of the rural population. Consistent with the Maputo Declaration, the budgetary allocation for the agricultural sector in Ethiopia should be around 10%. In particular, resources should be earmarked to ensure universal access to food, water, energy and education. Such efforts should enhance inclusive economic growth and improve the standard of living of Ethiopians in general and the rural population, in particular.

F. Rural Agricultural Cluster Ecosystem Models Offer Efficiency

Loosely formed agricultural cluster ecosystems have a very significant potential in transforming rural economy in Ethiopia. Such an ecosystem will help co-locate infrastructure for health services, ICT services, farming, water supply, etc. In some of these, such as health services (telemedicine) and ICT services, the underlying technology is common and avoids redundancies and inefficiencies.

G. Establish “National Food, Water & Energy Security Charters”, “Digital Charter”, and “Good Governance Charter”

Consistent with the SDGs and Ethiopian's own aspirations, food security, water security, energy security, education, and access to healthcare should be treated as fundamental human rights of every Ethiopian.

Universal access to water, food, and energy should be at the center of Ethiopia's strategic national security program. This will allow it to inform the discussions about the use of its resources such as

rivers as national security commitments. Since nearly 40% of Ethiopia's population lives in the Nile river basin and about 32% of its land mass is located in this basin, the GERD and, by extension, the Nile has to be considered as a national security issue.

H. Ethiopia Can Achieve Food Security by Doubling Productivity – Maize and Rice Will Play Significant Roles

Doubling agricultural productivity guarantees food security. It also reduces the burden on both the pastoral and forest resources. However, the pressure to significantly supplement teff which is a stubbornly relatively low-yield crop with high-yield crops such as maize and rice will increase. Continuing with intensive agriculture will significantly reduce conflict with pastoral and forest ecosystems

I. Women and Girls Education is Strategic in All Aspects

Focusing on empowerment of women and girls' education will be key to achieve Ethiopia's socio-economic transformation effectively. For example, the promotion of girls' education and empowerment of women have direct and proven impact on family planning, poverty reduction, good governance, and the full realization of the benefits of the demographic dividend.

J. Invest on Urbanization using Two Models – Clusters and “Cheetah Cities”

Two types of urbanization models will dominate, and it is prudent to invest accordingly. The agglomeration model will have a remarkable effect on the growth of major metropolitan cities. The emergence of secondary cities as centers of significant economic activity and population growth will have a notable effect on Ethiopia. The education of its population at all levels and the creation of jobs should focus on these emerging urban areas.

K. Pursue Advanced Manufacturing for High-Margin Products

New technologies in the broader areas of advanced manufacturing offer an opportunity for leapfrogging for emerging economies like Ethiopia. Advanced manufacturing opens possibilities in fintech, big data analytics, advanced robotics, cybersecurity, precision medicine, and agrotech. It is time for Ethiopia to seriously consider additive manufacturing, particularly 3D printing technology, for building infrastructural capacity for 3D printing for much needed spare parts.

L. Invest on Institution Building

To meet the country's Ten-Pillar Priority (Development) Sectors (and Goals) based on **SDGs** as well as address the **10 Grand Challenges**, *accountable, effective, productive, sustainable and inclusive institutions that promote equity, respect for human rights, effective rule of law and good governance at all levels* are needed. These could be guaranteed through “Good Governance Charter” that establishes basic human right for every Ethiopian.

M. Introduce Voluntary National Service for the Youth

High-school and college graduates should be encouraged to participate in a national service as teachers and volunteers in the agricultural extension services, and the army where they learn highly valuable lessons and skills and also develop appreciation for civic duties as part of institution building.

N. Ethiopia Should Look Outward to Assume Leadership in Several Emerging Areas.

With a projected working age population of 100 million by 2050, Ethiopia has a credible opportunity to plan wisely for leveraging this demographic dividend for assuming leadership position in Africa

in emerging technologies that require a large pool of well-trained workforce. Such technologies include advanced manufacturing, artificial intelligence (AI), smart agriculture, renewable energy generation and management, and the like. An outward looking aspiration and confidence could help motivate an export-oriented high-productivity economy.

O. How Do We Execute These?

The report offers a generational implementation scheme for the sets of recommendations.

P. How Do We Finance All These?

One obvious question may be how all these could be financed. In addition to funding proposals after recommendations in each section and a funding section, Annex II, offers some of the funding mechanisms available together with the estimate of the financial resources that need to be mobilized. Strictly enforcing anti-corruption laws and taking steps to stop internal losses and plugging all leaks of illicit financial flows which alone will provide much needed resources for implementation of activities proposed on this document.

Q. What is Next?

The ETHIOPIA 2050 Initiative was designed to be a sustainable initiative with clear goals and a long term commitment of the members. The first step was the conference where papers were presented, and ideas generated followed by the writing of this report that summarizes these ideas. The report will be presented to the government. The next step will be to complete the picture, we working with the government and different stakeholders in Ethiopia and outside in helping convert these recommendations into operationally relevant policies and programs. Ensuring the involvement of the youth that are at

the center of the demographic dividend or demographic risk to turn the challenges into opportunities will be critical. Options varying from venture-capital-backed business plans and start-up competitions to follow-up conferences to assess the challenges and what has been done, are considered.

As a follow-up, the Panel recommend that another ETHIOPIA2050 Conference be held in 2022. At this conference government policy-makers and Ethiopian professionals from diverse backgrounds will engage in dialogue to assess the status of the initiative, evaluate the impact of the recommendations implemented, specify the persistent challenges encountered, and identify the necessary adjustments to be made to broaden and deepen the activities under the Initiative.

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Appendix

Annex I – Ten Grand Challenges

1. Food Security

How do we increase agricultural productivity to keep pace with this increase? How can we achieve food availability, food access and food adequacy? How do we leverage science, technology, and innovation to achieve and maintain food security?

2. Access to Clean Water and Equitable Water Distribution

Supply of water to urban areas like Addis is dwindling. The competition for water access in arid areas like the Afar and Ogaden will eventually reach crisis stage as pressure from increasing populations mounts.

3. Energy Security

How do we scale-up energy generation and distribution, with particular focus on sustainability and renewable resources in mind? How do we develop an integrated approach to sustainable energy management?

4. Access to Health Care

How do we build a scalable healthcare system that will reach people in remote areas? What are the best practices to develop and sustain an accessible and affordable health care system that can withstand epidemic shocks? What are the innovative approaches and the role of preventative health services?

5. ICT Infrastructure Expansion (Digital Economy)

How do we increase internet and wireless access/penetration to 70-90%? How do we build the physical and software infrastructure? What technologies and innovative approaches can we leverage to attain a strong and reliable

infrastructure? What innovations and solutions are available to make internet access affordable to the masses?

6. Advanced Manufacturing

How do we prepare Ethiopia for Industry 4.0 with advances in intelligent manufacturing, additive manufacturing, and related manufacturing technologies?

7. Large-Scale Urbanization.

How do large cities like Addis Ababa grow and at the same time address displacement of farmers? What is the role of technology here?

8. Education, Workforce Development & Employment

How do we scale-up access to higher education and find employment to the tens of graduating young men and women? How do ensure the quality and type of education will enable the next generation better equipped to succeed?

9. Transportation Infrastructure

What is the optimum combination of transport modes that scales well and performs efficiently for the Ethiopian case?

10. Sustainability and Environmental Security

How do we address pollution and climate change pressures on the Rift Valley Lakes, Lake Tana, and the major rivers?

Annex II – Funding Mechanisms

Idea	Notes
<p>1. Marshall Plan Type – Zemecha</p> <p>a. There is substantial amount of capital/cash in the country. Estimate by thegobaleconomy.com shows ~\$25 billion (USD) in circulation in Q1 of 2019 (money supply).</p> <p>b. The Ethiopian culture is receptive to “zemecha” style solution of massive problems that affect everyone.</p> <p>c. People respond well when they feel that they are part of a movement bigger than themselves.</p> <p>d. Add accountability mechanism to avoid corruption and loss of funds and trust in the process</p>	<p>According to study by S. Moges and M. Tesfaye, the country needs an estimated \$335 Billion USD of infrastructure investment to join upper middle income countries by 2050, which is equivalent to investing over \$9 Billion/year. Even to maintain the current level of water and energy infrastructure development for expanding population, Ethiopia needs to invest an estimated 99 Billion USD or an average of \$2.75 Billion/year.</p>
<p>2. PPP – Private Public Partnership</p> <p>a. Ethiopia has already passed a law to support PPP and codify it.</p> <p>b. The PPP Law reads: <i>“framework with a view to promoting privately financed infrastructure projects by enhancing transparency, fairness, value for money and efficiency through the establishment of specific procedures. PPP projects may be for either new or existing facilities and include design, financing, construction, rehabilitation, expansion, modernization, operation, maintenance, administration and/or management.”</i></p>	<p>1. Alternative vehicles for mobilizing resources to fund the much-needed infrastructure and to deliver on quality public services, 2. PPP is at early stage in Ethiopia and some piloting has been done in the past 3. Mobilize significant local and international financial resources under public-private partnership (PPP) and providing strong policy guarantee and enforcement mechanism to protect investors and investments.</p>
<p>3. Public Sector Revenue (Tax)</p> <p>Tax to GDP ratio = 13.4% in 2015 which is way below the Sub Saharan Average of about 18%, 20% for emerging economies and 30% for developed economies. (UNDP Working Paper)</p>	<p>With IMF projection of \$104 billion as GDP of Ethiopia for 2020, At current rate, est. tax = \$13.4 Bil. At 20%, est. tax = \$20 Bil. At 25%, est. tax = \$25 Bil.</p>
<p>4. Strategic ICT Fund -</p> <p>investment and saving vehicle, especially for Ethiopian Diaspora.</p> <p>For example, 100,000 Diaspora invest on average \$10K USD (\$1B USD could be raised).</p>	<p>\$ 1 billion for ICT-Specific Start-ups</p>
<p>5. Strategic Distributed Water Access and Energy Generation Fund</p> <p>This fund can be established by mobilizing international and local banks (along with existing funding mechanism such as Power Africa) to provide with minimum loans for rural associations without collaterals for resources (e.g. a new NGO in Ethiopia tried this scheme and is becoming successful).</p>	<p>Estimate: \$2.5 Billion.</p>

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