Federal Democratic Republic of Ethiopia

MINISTRY OF TRANSPORT

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MINISTRY OF TRANSPORT AND LOGISTICS

Consulting services for national integrated transport master plan study and enhance sector capacity in planning and research & development

TASK 5 – CONSOLIDATED NATIONAL TRANSPORT MASTER PLAN SECTORIAL REPORTS

"SECTOR REPORT 2A – ROAD NETWORK"

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ACRONYMS

Abbreviations	Meaning
AADT	Annual Average Daily Traffic
ACS	Accident Cost Savings
ADT	Average Daily Traffic
AfCFTA	African Continental Free Trade Area
AGP	Agricultural Growth Program
ARCCH	Authority for Research and Conservation of Cultural Heritage
BIM	Building Information Modelling
BOT	Build, Own, Transfer
BPEVs	Battery-Powered Electric Vehicles
BRT	Bus Rapid Transit
COFC	Containers On Flatcars
COMESA	Common Market for Eastern and Southern Africa
CRGE	Climate-Resilient Green Economy
CSE	National Conservation Strategy of Ethiopia
DBSD	Double Bituminous Surface Dressing
EAC	East African Community
EA-SA	East And Southern African Region
ECWC	Ethiopian Construction Works Corporation
EDCs	Economic Development Corridors
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority
EPE	Environmental Policy of Ethiopia
ERA	Ethiopian Road Authority
ESMM	Environmental And Social Management Manual
ETMP	Ethiopian Transport Master Plan
ETRE	Ethiopian Toll Road Enterprise
EU	European Union
FCEV	Fuel Cell Electric Vehicle
FDI	Foreign Direct Investments
FDRE	Federal Democratic Republic of Ethiopia
FTA	Federal Transport Authority
GHG	Greenhouse Gas
GoE	Government of Ethiopia
GRSP	Global Road Safety Partnership
HDM4	Highway Development Management Model
IBC	Institute Of Biodiversity Conservation
ICEVs	Internal Combustion Engine Vehicles
ICT	Information And Communication Technology

Abbreviations	Meaning
MCBRTA	Multilateral Cross-Border Road Transport Agreement
MoARD	Ministry of Agriculture
MoF	Ministry of Finance
MoT	Ministry of Transport
NPV	Net Present Value
NRSP	National Road Safety Policy
NRTSC	National Road Traffic Safety Council
NTMP	National Transport Master Plan
OSM	Open Streetmap Database
PCU	Passenger Car Units
PM	Project Manager
PPPs	Public-Private Partnerships
PSETSE	Public Service Employee's Transport Service Enterprise
PTM	Present Transport Model
RAI	Rural Accessibility Index
RAM	Road Asset Management
REA	Regional Environmental Agency
RF	Road Fund
RG	Regional Government
RPE	Regional Public Enterprises
RRA	Regional Road Authority
RSDP	Road Sector Development Program
SADC	Southern African Development Community
SBSD	Single Bituminous Surface Dressing
SD	Sustainable Development
SDGs	Sustainable Development Goals
SDPRP	Sustainable Development and Poverty Reduction Program
SOEs	State-Owned Enterprises
SPV	Special Purpose Vehicle
TCP	Technical Cooperation Program
TFA	Tripartite Free Area
TOFC	Trailers On Flatcars
TTCS	Travel Time Cost Savings
TTTFP	Tripartite Transport and Transit Facilitation Programme
TYP	Long-Term Transport Planning
ULEVs	Ultra-Low Emission Vehicles
UN	United Nations
UNCTAD	United Nations Conference on Trade And Development

Abbreviations	Meaning
IGAD	Intergovernmental Authority for Development
IRIMP	Regional Infrastructure Master Plan
IRR	Internal Rate of Return
IUCN	International Union for The Conservation of Nature
LGTT	Loan Guarantee Instrument For TEN-T
LIC	Low-Income Countries
MCA	Multi Criteria Analysis

Abbreviations	Meaning
URRAP	Universal Rural Roads Access Program
VOC	Vehicle Operating Costs
VOCS	Vehicle Operating Costs Savings
VoT	Value of Time
WRAs	Woreda Road Authorities
WRO	Woreda Road Offices

1 INTRODUCTION

1.1 REPORT CONTENTS

This Report is the Road Network Report, included in the list of different sectorial reports of the Ethiopia Transport Master Plan. Following is the list of sectorial reports that are presented in separate volumes:

Sector Report 1 – INTEGRATED TRANSPORT MODEL
Sector Report 2A – ROAD NETWORK
Sector Report 2B – RURAL ROADS
Sector Report 3 – RAILWAYS
Sector Report 4 – AVIATION
Sector Report 5 – LOGISTICS
Sector Report 6 – INLAND WATER TRANSPORT
Sector Report 7 – URBAN & PUBLIC TRANSPORT

This road network sectorial report includes:

- Chapter 1 – Report content and a remind of the planning process adopted for the ETMP50 and the relation with the sub-sector medium-term plan (Federal Road Master Plan);
- Chapter 2 – Present institutional set-up for road infrastructures at national and regional level, institutions for road transport and road safety issue;
- Chapter 3 – Road infrastructures at federal and regional levels, road traffic demand and road transport organization, building the Present Transport Model;
- Chapter 4 – Road sector development programs, ongoing road projects, planned expressways development, proposed road classification system and Ten-years federal road master plan;
- Chapter 5 - Economic development alternative scenarios for the next 30 years, switching values of indicators, future transport demand matrices at woreda levels:
- Chapter 6 – Building the road master plan for each time horizon and scenario and calculation of the road network performance in terms of total vehicle x km, x hour, cost;
- Chapter 7 – New expressway evaluation through HDM4 and prioritization;
- Chapter 8 - Road network integration with territory, other modes and regional connections;
- Chapter 9 - Possible and suggested road transport innovation, management and researches, possible road funding alternatives;
- Chapter 10 - Environmental legislation, issues and constraints for road development.
- ANNEXES 1,2,3 – Integrated Transport Model assignments by scenarios and time horizons

1.2 TRANSPORT PLANNING PROCESS

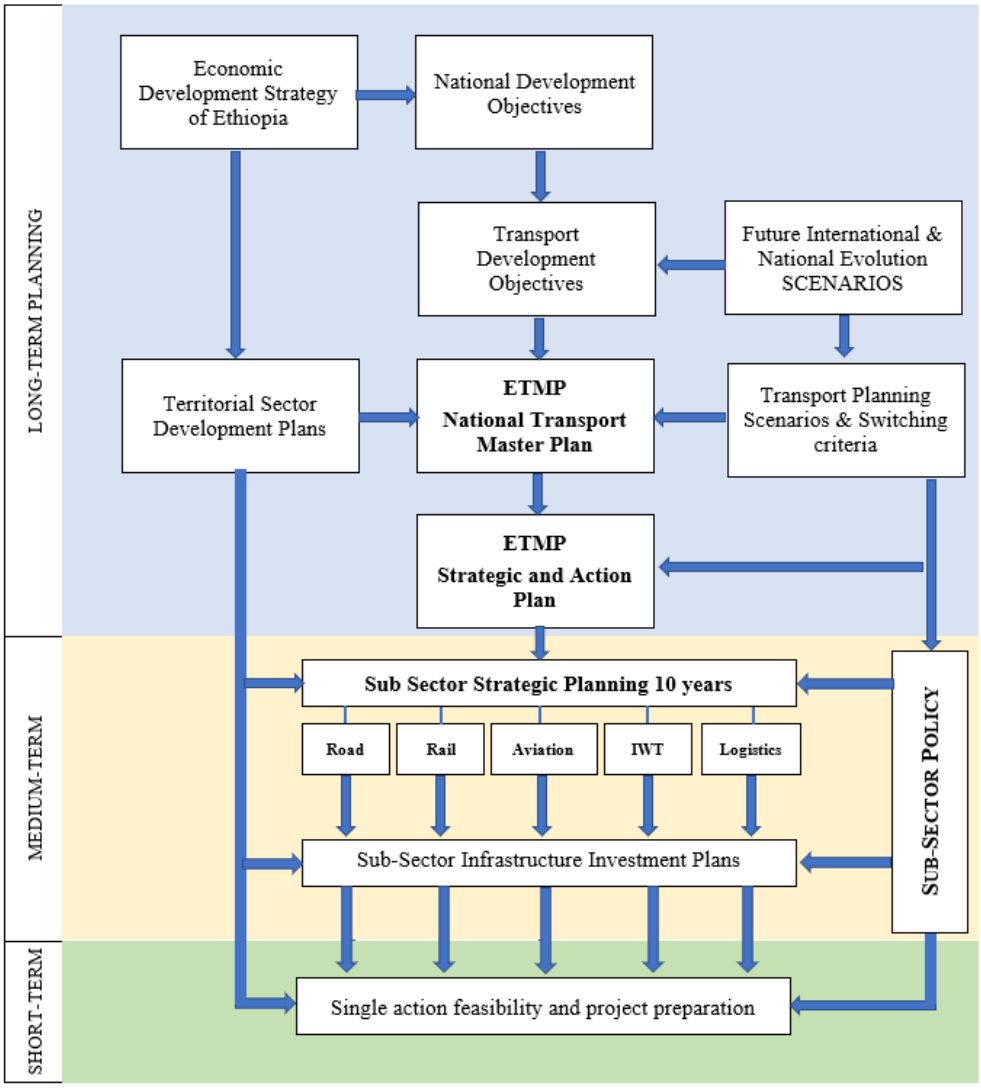
According with the terms of reference, "the Ethiopia Transport Master Plan should constitute a dynamic national long term transport plan that will guide transport planning, management and operations for all the different modes and spheres of government, developing intermodal/multimodal transport network and integration with urban/rural & economic development of the country". The ETMP should also serve for enhancing the capacity of Ministry of Transport and other concerned agencies/institutions on the various transport planning tools and techniques, especially those employing new technology, through training activities and workshops.

To this scope, the Consultant has analysed the international best practices in conducting national transport planning and has acquired the main approach concepts to guide the ETMP as presented in the ISS Report. Major lessons learnt from best practices are: i) Need for a clear and straightforward planning framework (as shown in chapter 7 of the consolidated master plan), ii) Adoption of an Integrated multimodal transport approach (integrated multimodal model used); iii) Considering different evaluation scenarios (go ahead, next generation, limits to growth) and conduct iterative

model assignments; iv) Integrate the national transport master plan with the regional transport system (rural road sector report); v) Make investment decision according with sustainable dimensions (use of economic analyses and MCA); vi) Promote diversified funding sources and sustainable private partnership (to be treated in the Policy & Strategy report); vii) Build technical capacity for institutions and local transport planners (to be finalised in the Policy & Strategy report).

The scope of the Ethiopia Transport Master Plan is then to create the framework for development of each mode of transport (road, rail, aviation, logistics, inland water and urban mobility) for the next 30 years. The following figure represents the overall planning framework, from the long-term national multimodal transport plan, to the subsector medium term infrastructure plan and the specific short-term project preparation procedures, before implementation of the single road infrastructure investment. ETMP50 represent the multimodal long-term plan, while the Federal road network Master Plan, recently completed, represent the medium term plan for the road sub-sector.

Figure 1: Overall Planning Framework



2 INSTITUTIONAL FRAMEWORK

The Road transport system is composed by two main components: the **road infrastructure** (generally public) that supports the **road transport** (generally private vehicles) that use the infrastructure. Both have to be regulated to make the road transport system reliable, efficient and safe. Following we describe the present Ethiopia road network, including the regional road network and the road transport organization.

2.1 ROAD SYSTEM ADMINISTRATION

The road sector is governed both at Federal and Regional States level. At Federal level the governance is based on the chain MoT/MoF → National authorities/agencies → Public enterprises/Market, while at Regional States level the chain is regional governments → Regional authorities → Regional enterprises/Market. Aside the administrative classification, a further distinction is needed according with the kind of public service concerned: infrastructure delivery or services providing. While the Government's responsibility is assigned to the same apical level (respectively, Federal and Regional) authorities and enterprises vary according with the kind of service concerned.

As road infrastructure is concerned, the Ethiopian Road Authority (ERA) and the Road Fund (RF) are the pillars of the road network policy in the country. ERA was re-established in 2011 by Reg. No. 247-2011 as an autonomous office of the federal government with its own legal personality. The purpose of the Authority is far-reaching: to develop and administer roads, to create favourable conditions for road development, to ensure that standards are maintained in road construction. According to this mission, the powers and duties of the ERA are numerous and varied, going from preparation of policies and laws road-related to road development planning, from procurement of civil works, design and constructions to technical support to regional road authorities.

The provision of road infrastructure as a public service mainly consists of the construction and maintenance duty. This in turn implies the need to develop adequate skills capable of planning, designing and managing infrastructures. The road sector development program (RSDP) is the main Ethiopian road development program and, over the years, has achieved very important results, not only in the physical increase of the road network but also in the progressive enhancement of the institutions (ERA first) in charge of the infrastructure providing.

Investment financing for the construction of road networks comes from the national budget or international loans, this means that for this decisive topic the role of the Ministry of Finance is crucial. In fact, ERA is under the jurisdiction of the MoT but receives from the MoF an annual amount assigned to investments on the federal road network according to the plan that the authority itself contributes to processing. This means that ERA is in a crucial point in the development and implementation of sectoral policies. Furthermore, the evolution of ERA's functions from its new institution and by the simultaneous entry into force of the Reg. 248 2011 (Ethiopian Road Construction Corporation Establishment, subsequently repealed by Reg. 366 2015) contributed to concentrating authority on high-level tasks, entrusting its operational activities to a specialized public company.

This re-focusing of the authority's tasks walked side by side during the years with the implementation of a number of capacity building programs, provided jointly with the bigger road development funding programs delivered by the leading development banks. In this way ERA has become a competence centre for the "sisters' authorities" at local level.

Nevertheless, a single well-structured agency cannot solve alone the problem arising from the accelerated growth of the road network and of a systematic maintenance lack. As also arisen from the interviews conducted al MoT's level, and reflected in the official documents aforementioned, maintenance activities, particularly below the Federal level, does not comply not with quantity, nor

with quality standards requested by a growing network. This issue is well known both at MoT and ERA level and the recent reorganization of the ERA Directorate in charge of the implementation of the Road Asset Management System, testifies that the current status of the whole national maintenance process is not satisfying.

In terms of public funding, the maintenance effort is mainly supported by the Road Fund, established in 1997 by the Proc. No. 66. The fund's mission is to finance road maintenance and road safety measures, through the resources deriving from the following sources: a) state budget, b) fuel withdrawal by purpose, c) annual vehicle license fees and d) other road tariffs possibly established. RF governance is entrusted to a Board and a RF Office. The Board is composed of representatives of the Government, Regions and road users, while the Office has an own legal personality. The Fund is accountable to the MOT, while the Board is appointed by the PM and is also accountable to it.

In order to achieve the purpose for which it was established, RF collects road maintenance revenue and assigns it to federal, regional and urban organism in charge of maintenance. Due to the high growth of the road network, the budget allocation criteria have varied over time. In the early years of the 21st century a fixed allocation was followed; later on, the fixed criterion has been replaced by a variable mechanism grounded on the length of the roads managed at each administration level. The criterion is in force for a three years period and is then updated, the current allocation is as follows: Federal roads 65%, Rural Roads 25% and Selected Municipal Roads 10%1.

The RF Board assigns a maintenance budget to each State for the activities under its responsibility (length of roads starting and ending within the State's boundary). This leads to the current budget allocation of about 65% of the total planned amount to ERA, which is responsible for federal roads. Once defined the total amount for each Regional State, the latter provides to RF a detailed program assigning the given budget for specific maintenance works. This program is mandatory and audited by the Federal level; the States cannot divert funds from a maintenance line to another without authorization. In case of lack of funding, States can call the Government for further funds. The Government decides whether assign or not the funds according to the status of public finance and in case of justified needs of further works.

It is easy to understand that the above criterion is based on a pure administrative parameter and does not take into account any diagnosis of the real status of roads. In other words, no asset management system is currently guiding the road maintenance process. Progress on these issues is expected from the outcomes of two projects currently ongoing. The Road Functional Classification study, under review at ERA, is expected to address the allocation of responsibilities of each physical part of the network. Besides, the Federal Roads Master Plan study should identify projects to be implemented at all administrative levels (ERA, regional, and district) for the next ten years.

Next to the development of the Federal Road network, a first nucleus of toll motorways system is operating in the country. The expressways currently open are the terminal sections along the corridor Addis Ababa - Djibouti (sections Addis Ababa - Adama and Dire Dawa - Dewele) while the central sections are under construction and a final decision on the establishment of tolls has to be taken yet.

In case of a toll mechanism adoption these infrastructures should finance their operating cost (first of all maintenance costs) mainly through tolls collection. The introduction of similar schemes is a step which can help the participation of private operators in the financing of road network development, for instance through Public Private Partnership schemes. In this case cost and revenues arising from roads utilisation are bind and devoted both to investment's repayment and operational costs coverage.

The regulatory framework has been consequently enriched by a specific Proclamation (No 843-2014) establishing the Toll Roads, while a related Regulation (No 310-2014) created the Ethiopian

[1] AAAU-EiABC (Ethiopian Institute of Architecture, Building Construction and City Development), Gap Assessment Report for FDRE - Office of Road fund, March 2021

Toll Roads Enterprise under the supervision of MoT. Accordingly, the collection of road tolls fees has been shifted from ERA to ETRE.

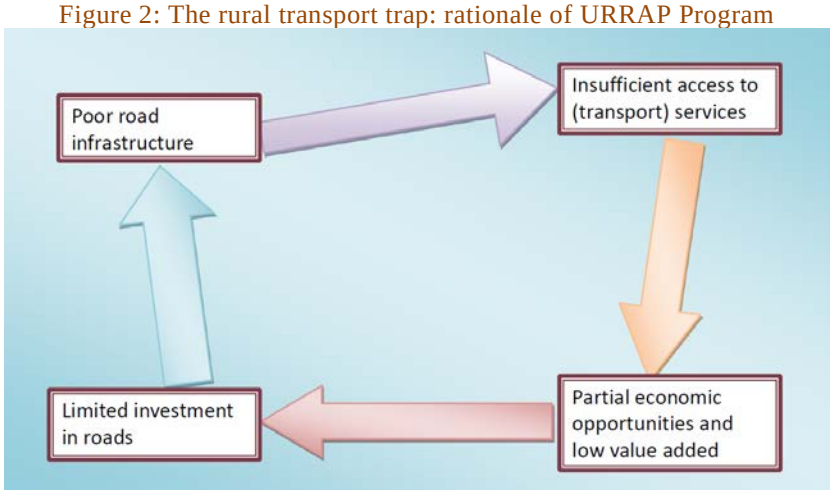
Besides this sectoral intervention, the PPP approach has been introduced into the Ethiopian legal framework (as described in 2.1.3) and ETRE could act as the public part (i.e., the contracting authority) of the PPP contract which regulates rights and duties of the parties.

Coming to the process of infrastructure providing at Regional States level, it has been said that the command chain originates from the regional government and passes through the Regional Road Authorities (RRAs) which has powers on the roads that originate and end within the regional borders. Therefore, these competences are mirroring the ERA's, though on a territorially limited level. Below the regional level (Woreda level) the Woreda Road Offices (WRO) represent the administrative and technical contact point for the rural roads.

The financing of roads constructions at local level comes from Federal budget and from international development banks. As for the domestic budgeting process, in general the Federal level set funding transfers to Regional States without any specific target; each Regional State decides on the bases of its own needs the sectoral budget allocation.

The development of local connectivity is a pillar of the infrastructure delivery. The Universal Rural Roads Access Program (URRAP) has been launched by the Ethiopian Government to connect all Kebeles by standard and affordable all-weather roads to guarantee a yearly based access. The aim of the program is to provide one of the tools to eradicate poverty from the country, by escaping from the "rural transport trap" (see Figure below) that affects many underdeveloped countries[2]. The total amount of rural roads constructed in Ethiopia amount today at more than 55,000 km.

Figure 2: The rural transport trap: rationale of URRAP Program



Source W.T. Consult P.L.C. Consultancy services for impact assessment of URRAP Program

The URRAP program certainly contributed to the growth of road accessibility but, according with ERA, the ability to complete the planned works is, respectively, at 53% (quantity parameter) and 61% (disbursement) of the plan[3]. As maintenance is concerned, the disbursement is at 20% of the planned budget. This very partial accomplishment of the targets is caused by a number of critical factors that hampers the full operability of civil works at local level. These critical factors have been identified and scrutinised both by the interviews and many sources and are reported in the following list:

- Capacity Gap
- Fast turnover of skilled workforce

[2] G. Raballand, P. Macchi, C. Petracco , Rural road investment efficiency: *Lessons from Burkina Faso,* Cameroon*, and Uganda*. The World Bank, 2010

[3] ERA, Road Sector Development Program, 22 Years Performance Assessment Report, 2020.

- Lack of funding
- Failures in procurement process
- Quantity/Quality failures of construction equipment
- Delay of Project Handover
- Relationship between Consultants and Contractors
- Rent Seeking Behaviour
- Community Participation/contribution
- Reporting and Documenting

It is easy to see that the factors can be grouped in three critical areas: i) Financial resources, ii) Capacity skills and iii) Organization/Coordination issues.

Financial resources. The lack of funding seems to have at least two driver factors: cost increasing compared to the planned level (delays in civil works, increasing costs of the equipment/spare parts) and poor quality of works.

Capacity

Workforce skills are a huge factor of inefficiency. This influences all phases of the construction/maintenance process and influences many key roles of the process itself: from design to procurement, from project management to execution. In addition, this scenario is often made worse by a rapid change in the skilled workforce.

Organization/Coordination

Bad functioning of organizational processes and coordination activities (internal and between stakeholders) are among the most widespread critical issues in the field of infrastructures. It is therefore not surprising if they also occur in this case. The lack of coordination, both between central and peripheral entities (ERA, RRAs, Regional Governments) and between different actors with different roles (public officials, consultants, contractors) influence the performance of activities in different ways. For example, in case of new professional figures, they must be trained and framed in the organizations, providing, together with an adequate remuneration level, also an attractive career path.

Summing up the situation for infrastructure providing, the table below describes how the main functions are allocated at federal and regional states levels.

Table 1: Allocation of responsibilities on the road sub sector - Infrastructure

Function	Federal Roads		Regional & Rural Roads	
	Construction	Maintenance	Construction	Maintenance
Overall Supervision	MoT	MoT	RG	RG
Allocating Finance	MoF	RF + MoF	RG	RF + RG
Formulating Policy	MoT, ERA	MoT, ERA	RRA	RRA
Annual Plan & Executions	ERA	ERA	RRA	RRA
Delivery of works	ECWC, Private Companies	ECWC, Private Companies	RPE, Private Companies	RPE, Private Companies

MoT= Ministry of Transport, MoF=Ministry of Finance; ERA = Ethiopian Roads Authority, ECWC = Ethiopian Construction Works Corporation; RF = Road Fund; RG = Regional Government; RRA = Regional Road Authority; RPE = Regional Public Enterprises.

2.2 ROAD TRANSPORT ADMINISTRATION

As Road Transport services are concerned, according with Proclamation No 468-2005, the provision of transport services is allowed to licensed operators, both public and private. They have to act in compliance with the rules issued by the competent authorities, for instance the Proc. No. 547/2007 which states the conditions for the Carriage of Goods by Land, by repealing the old provisions on the matter issued by the Commercial Code of Ethiopia.

The licensing authority is the Federal Transport Authority (FTA), established by the Proc. No 468/2005, originally in charge of all transport modes licensing (excluding air services). Afterwards

FTA has progressively lost its duties as sub sectoral reforms went into force or by the establishing of specialised agencies.

Presently the Authority is in charge of the road transport organization in the country, both for passengers and freight. Its powers and duties are large, covering a large spectrum of issues, from administrative (individual/enterprise authorizations, vehicle registrations, driving license requirements and process, insurance enforcement) to technical ones (certification of technical competences, vehicles compliance and inspections, manufacturing and import, requirements of terminals), from economic (tariffs authorisation, services' organizations) to emergency actions (transport emergency and recovery plans).

As the case of infrastructure providing, for transport services occurs the same division of powers between Federal level and Regional States, the following table describes the allocations of the main function.

Table 2: Allocation of responsibilities on the road sub sector - Services providing

Specific Issue	Federal Government	Regional Governments
› *Driving License*	› *Enacting laws and supervise the proper implementation of same by Regional Governments,* › *Issuing Federal Driving License*	› *Enforcing the laws enacted by the Federal government* › *Issuing Regional Driving Licenses*
› *Vehicle Regulation*	› *Enacting laws* › *Enforcing the law on all imported and locally manufactured vehicles* › *Enforcing the law on Cross Country Public and Fright Transport vehicles*	› *Enforcing the law on those vehicles registered and licensed by them.*
› *Speed*	› *Enacting laws, Enforcing the law on Federal Tall Roads*	› *Enforcing the Law at both Federal and Regional Roads*
› *Axle Load Enforcement and Weight Stations*	› *Enacting laws* › *Enforcing the law on Federal Roads*	› *Enforcing the laws on Regional Roads*
› *Cross Country Public and Freight Transport Services*	› *Both enacting and enforcing laws*	› *None*
› *Regional Public and Freight Transport Services*	› *None*	› *Both enacting and enforcing laws specifically governing the service*
› *General road regulations*	› *Enacting general road Users' Regulation*	› *Enacting additional road users' Regulation and enforcing both the Federal and Regional State Regulations*
› *Safety*	› *Enacting laws and issuing strategies*	› *Planning and executing safety activities*

It is easy to observe a logical division of responsibilities, with each level being responsible for issuing and enforcing the regulations that fall within its scope. However, as mobility phenomena are precisely characterized by flexibility and displacement, some coordination and enforcement issues arise in this administrative area.

The case of the driving licenses is an example. The existence of three kinds of driving licenses (the one issued prior to Proc. No. 600-2008, another one that issued in accordance with Proc. No. 600-2008, and finally the one which is currently been issuing in line with the provisions of Proc. 1074-2018) can generate confusion in law enforcement. At the same time, given the same basic principles for the issuing of a license, some Regional States are tighter than others in applying it. Besides, the States' Traffic Polices often apply the law in different ways. Eventually, the lack of a ICT system able to monitor licenses and penalties on a national scale, is a real hamper to a uniform enforcement of the rules.

As far as passengers' public services are concerned, given the regime of market opening subject to licensing authorization, the role of public enterprises is not so extensive as in other fields. Services of different level of quality/tariffs are provided by public and private operators. The latter are companies or associations which are responsible for the safe and convenient movement of

passengers and their baggage. The association includes private companies and/or individual vehicle owners driving for the purpose of providing transportation services. It is the interface body of the members with the FTA and organizes the requests, the questions, the requests of the members towards the public power. Since associations have offices in each terminal, they are able to follow the services provided by their members.

In the Capital City the Regulation No. 298-2013 (and its amendment by Regulation No. 362-2015) established the Public Service Employee's Transport Service Enterprise (PSETSE) with the aim to provide transport services to federal and Addis Ababa public employees during the public offices' working hour and to provide services to all citizens outside that period. The company is accountable to MoT. PSETSE is now called to serve Addis Ababa surroundings and Oromia towns.

Besides PSETSE there are two public companies providing public transport services, Anbessa City Bus Service Enterprise and Sheger Mass Transport Enterprise, which are accountable to the Addis Ababa City Manager's Office, and the Transport Bureau of Addis Ababa City Administration (a more detailed description is given in 2.8.7).

To complete the picture, it is necessary to mention the "informal" supply of transport services. This is a very widespread phenomenon, in most cities not only in Africa but also in Asia and Latin America, in situations where the structured public transport model is ineffective and/or unattractive. The so called "Paratransit sector" includes formal and informal transportation services provided by operators seeking profit maximization in a non-highly regulated system[4]. In Addis Ababa Paratransit is regulated by the City Administration which set the market entry rules and the routes to be operated.

For international passenger services, Ethiopia has so far signed two agreements with Sudan and Djibouti for providing necessary framework for passenger road transport services between Addis Ababa and their respective capital city. The Agreement signed with Sudan on 4th of December 2013 was ratified by House of People's Representative on 23rd of May, 2017 (Proc. No. 1009-2017). Similarly, the Agreement signed with Djibouti on 7th of February 2015 was ratified on 2nd of November 2017 by Proc No. 1055-2017.

In a broader sense international services have to be considered within the framework of the multi-country treaties inked by the country. This has a particular meaning for road freight transport which is supposed to ensure the commercial flows between Ethiopia and the neighbouring countries. On this matter the reference is the Tripartite Free Area (TFA) which aims at establish a regime of free flows on commercial basis among the common market for Eastern and Southern Africa (COMESA), the East African Community (EAC) and the Southern African Development Community (SADC).

It is easy to understand how crucial can be the role of road freight services to reach the objective of this agreement. In fact, the lack of an integrated and liberalised road transport market in the East and Southern African (EA-SA) region hampers the trade flows by causing severe delays and increased transport costs, as well as challenges to road safety. The tripartite members agreed on the prioritisation of infrastructure development in the region through their respective treaties, protocols and agreement as part of the comprehensive Tripartite Transport and Transit Facilitation Programme (TTTFP). In 2018 a Multilateral Cross-Border Road Transport Agreement (MCBRTA) has been signed. The agreement aims at achieve "the integrated and seamless movement of goods and persons in the Tripartite Region with a view to reducing transportation costs and transit times in order to increase the competitiveness of goods produced in the Eastern

[4] Agence Française de Développement, CODATU, Paratransit: a key element in a dual system, Oct 2015; G. Lesteven, V. Boutueil, Is Paratransit A Key Asset For A Sustainable Urban Mobility System? Insights From Three African Cities. 97th Annual Meeting Transportation Research Board, Jan 2018, Washington, United States.

and Southern African Region for distribution in regional and international markets"[5].

The main obstacle to be faced basically concern a common regulatory framework which requires harmonisation/adjustment actions of the countries involved. The most important issues to be faced are as follows:

- implementation of an Integrated Transport Registers and Information Platform and System,
- harmonization of Vehicle Load Management Standards,
- harmonization of Vehicle and Driver Regulations and Standards.

Given the mixed regime in force in the country (public and private providing) the prices of transport services are established according to the kind of service concerned. In the following table is given an overview of the responsibilities regarding prices and tariffs of the transport services.

Table 3: Tariffs responsibilities for the road transport services

Types of the Service	Tariff establishing
Regular cross-country/International public transport services	Federal Government (FTA)
"Special" cross-country public transport services	Market
Urban and intra-city (within the same regional state) public transport services	Regional Governments
Cross Country Public and Freight Transport Services	Market
Freight transport services	Market
Regional Public and Freight Transport Services	Regional/Municipal Transport Bureaus
Fuel Transport services	Federal Government (Ministry of Trade & Industry)

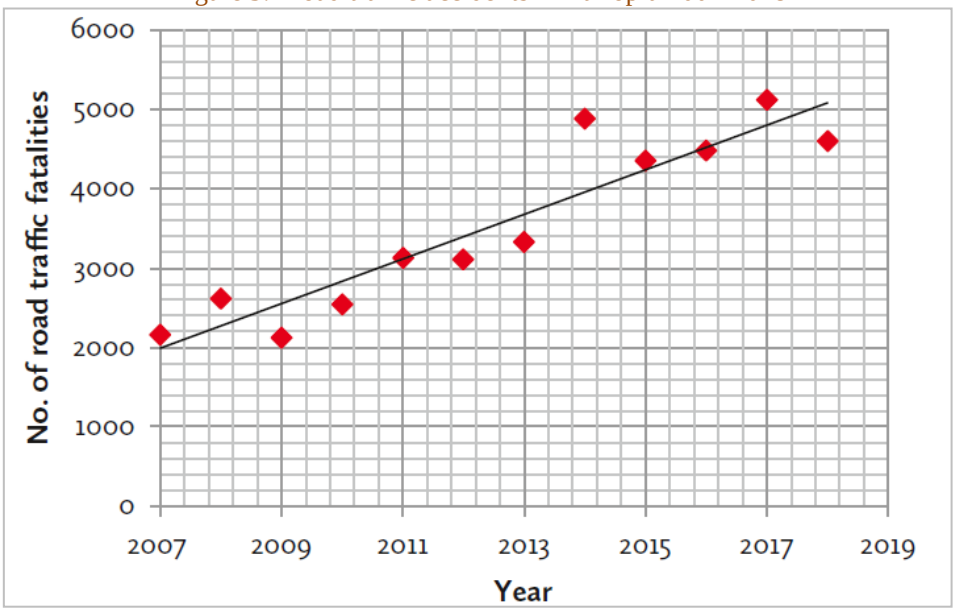
The crucial role of road transport in the country has required the development of an insurance system able of growing at the same speed as vehicles spread and to manage the economic consequences of road accidents. To this purpose the Proclamation No 799-2013 states the Insurance policy of the country and provides a mandatory third-party risk insurance for all registered vehicles. Accordingly, Regulation No 300-2013 establishes the Insurance Fund Administration Agency by replacing the former Office of the Insurance Fund.

2.3 ROAD SAFETY

The safety issue is crucial for the road sector in Ethiopia. The increase of accidents and fatalities that followed the growth of motorization rate in the country, despite the latter it is not as high in absolute terms, called for focused strategies to tackle and, possibly, prevent a huge future increase of accidents. The figure below describes the evolution of road traffic fatalities from 2007 to 2018, based on the data recorded by the Federal Police Commission and published by the UN.

[5] COMESA – EAC – SADC TRIPARTITE, Multilateral Cross-Border Road Transport Agreement (MCBRTA), Rev 3.4 Oct 2018. Somalia is not included in the agreement.

Figure 3: Road traffic accidents in Ethiopia 2007-2018

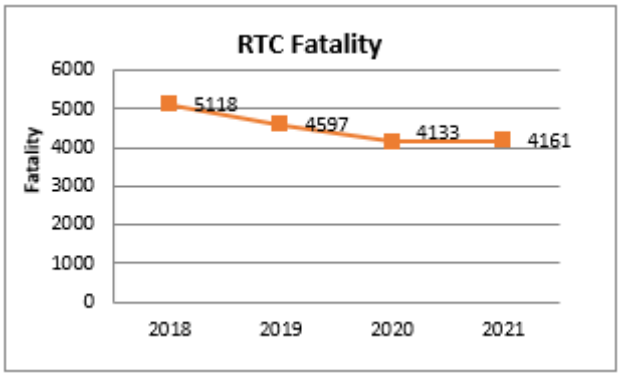


Source: UN Economic Commission for Africa. Road Safety Performance Review - Ethiopia

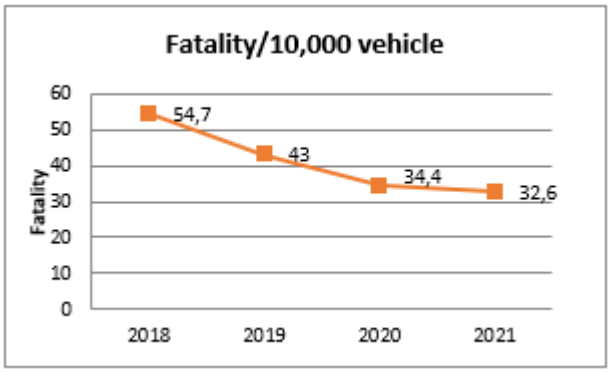
It is easy to see that the victims of road accident increased linearly with a doubling of victims between 2007 and 2015 and further increases in the next years.

In any case, it should be emphasized the significant reduction in fatal accidents in the period 2018-2021 (which from 5118 in 2018 go to 4133 and 4166 in 2020/2021 as well as the death rate per 10,000/ vehicle goes from 54,7 in 2018 to 32,6 in 2021), as shown by the following figures provided by the National Road Safety Council of MOT.

Figure 4: Traffic Crash Fatality Accidents in Ethiopia 2018 - 2021



Actual fatality due to Road Traffic Crash has reduced from 5,118 back in 2018 to 4,161 in 2021



Road Traffic Crash has improved from 54.7 per 10,000 vehicles back in 2018 to 32.6 per 10,000 vehicles in 2021

The table below describes the situation for the two available years, showing something that could be seen as a slowdown in the growth trend.

Table 4: Road accidents in Ethiopia 2018/19 - 2019/20

Ethiopia	Death			Heavy Injury			Light Injury		
	2011	2012	%	2011	2012	%	2011	2012	%
Total	4597	4133	-10,1%	7407	6929	-6,5%	5949	5247	-11,8

Source National Road Safety Council's Office, Ministry of Transport

Apart from the interpretation of the data of the last two years, the number of accidents and deaths due to road traffic are not in line with a country that intends to project itself among the middle-income countries.

There are many converging factors behind this value: beyond the increase in motorization, other factors are vehicle age, poor road conditions, large share of pedestrian mobility, lack of centralized database for registering and regulating drivers and vehicles, low awareness of road safety and regulation by road users, low enforcement capacity due both to lack of capacity and corruption.

In order to cope with this negative trend a focused body has been established. The Reg No. 205/2011 creates the National Road Safety Council (NRTSC) with the aim of develop road safety strategy and coordinate its implementation. The Council acts both as a pivotal expertise centre and monitoring/dissemination centre on road safety issues.

Beside safety issue6 other social/environmental issues need to be treated. The first one is represented by road accessibility that is one of the basic requirements to lead the country outside from poverty. As stated before, the huge increase of RAI testifies the progress of the country along this path, nevertheless the current value of the index (60%) shows that there is an important gap to be filled yet.

As far as mobility is concerned, there are positive data on the significant increase in mileage along the road network with an average annual increase of 10.6%. This increase is more or less the same for both passengers and freight vehicles (see para 5.2 for a discussion about this topic). On the other hand, the private motorization is substantially limited to the Addis Ababa area, so that the role of transport public services is more than crucial to ensure the possibility of all Ethiopian citizens to move from their residence to satisfy their primary needs (health, school, work, etc...).

Under this point of view the ability of the citizens to access a public service is strictly connected with the quantity and the price of service providing. The current regulatory framework let the operators, both public and private, to decide the level of services and its quality level, according with their ability to organize the service without profit loss. The role of the public power is to issue commercial license and approve tariffs schemes for passenger services. At the same time, when public enterprises are involved in service providing, federal or regional powers are free to decide to subsidise them or not.

Such a system seems to ensure the economic equilibrium of the operators but probably does not meet the potential demand of mobility. In this area a further effort of public powers to enlarge the accessibility to mobility services could be reached through the adoption of suitable regulatory measures without hampering the private undertakings to participate to the economic activity.

In addition to traditional motorized mobility, the concept of non-motorized mobility is gaining ground. This is particularly important for a country like Ethiopia because it considers at the same time many issues of primary importance such as the share of the fragile population (like children, women, people with disabilities and others) but also of the share of isolated population in the less habited areas. In Ethiopia the share of pedestrian or animal-drawn mobility is very high, due to morphological and economic factors, a focused strategy aiming at reduce these negative elements has an important role.

This is the case of the Non-Motorized Strategy issued by the Government. The strategy is focused on the urban environment and also considers the quality of road design as one of the key factors to be affected, through an adequate review of road design manuals.

The guiding principles of the strategy prepare a rebalancing of the concept of mobility by designing the spaces for both traditional and non-motorized mobility, instead of considering the latter as an ancillary way of moving. The activities vary from the conceptualisation of non-traditional networks, as Pedestrian, Bicycle and Greenway networks, to the design review of streets, intersections, street lighting, to the management of Parking, Vendor Street, Animal-drawn vehicles.

This kind of strategy is centred on FTA and involves all the chain of public powers, from Governments' level to City level, passing through ERA at national and district offices level, regional administrations, RRA's, Federal and local police.

6 The legal framework of dangerous goods' transport is described in sub chapter 2.5.

3 PRESENT SITUATION

3.1 ROAD INFRASTRUCTURES

The road transport network is the most important infrastructure in Ethiopia, providing access to rural and urban areas and supporting the overall economic growth of the country. Following, the total classified national road network according with ERA official data is presented.

Table 5: Road Network in Ethiopia (2019)

OFFICIAL DATA FROM ERA						
No	Region	Federal Roads (ERA) (km)	Regional RRAs Roads (km)	URRAP Roads (km)	Municipal (Urban) Roads (km)	Total Classified Road Network (km)
1	Tigray	2.588	1.490	2.302	1.271	7.651
2	Afar	1.916	1.124		354	3.394
3	Amhara	6.502	4.786	9.016	5.287	25.591
4	Oromiya	9.081	10.656	35.460	7.042	62.239
5	Somali	2.586	3.305		415	6306
6	SNNP	4.592	10.866	6.070	6.861	28.389
7	Benishangul	735	936	519	155	2345
8	Gambella	602	2.027	33	133	2795
8	Dire Dawa	45	161	280	380	866
10	Harar	52	455	144	101	752
11	Addis Ababa				3.699	3699
	Total	**28.699**	**35.806**	**53.824**	**25.698**	**144.027**

(*) Excluding Expressways

The total extent of the present classified road network of Ethiopia is 144 027 km. The extent of present Expressways is, according with ETRE, equal to 301 km. It is worth underlining that according to the OSM road database, Ethiopia has a road network of over 197,800 Km between trunks, primary, secondary, tertiary, tracks and unclassified roads.

Table 6: Ethiopia Road Network Asset

Road Network	Length (km)
Federal roads	28 699
Regional roads	35 806
URRAP roads	53,824
Municipal roads	25,698
Sub Total (km)	**144,027**
Motorways & Toll Roads	301
Total (km)	**144,328**

According with RSDP V, the current (2020) road conditions of the classified network (144 027 km) are:

- 20.1% are in good conditions;
- 38.5% are in fair conditions;
- 41.4% are in poor conditions.

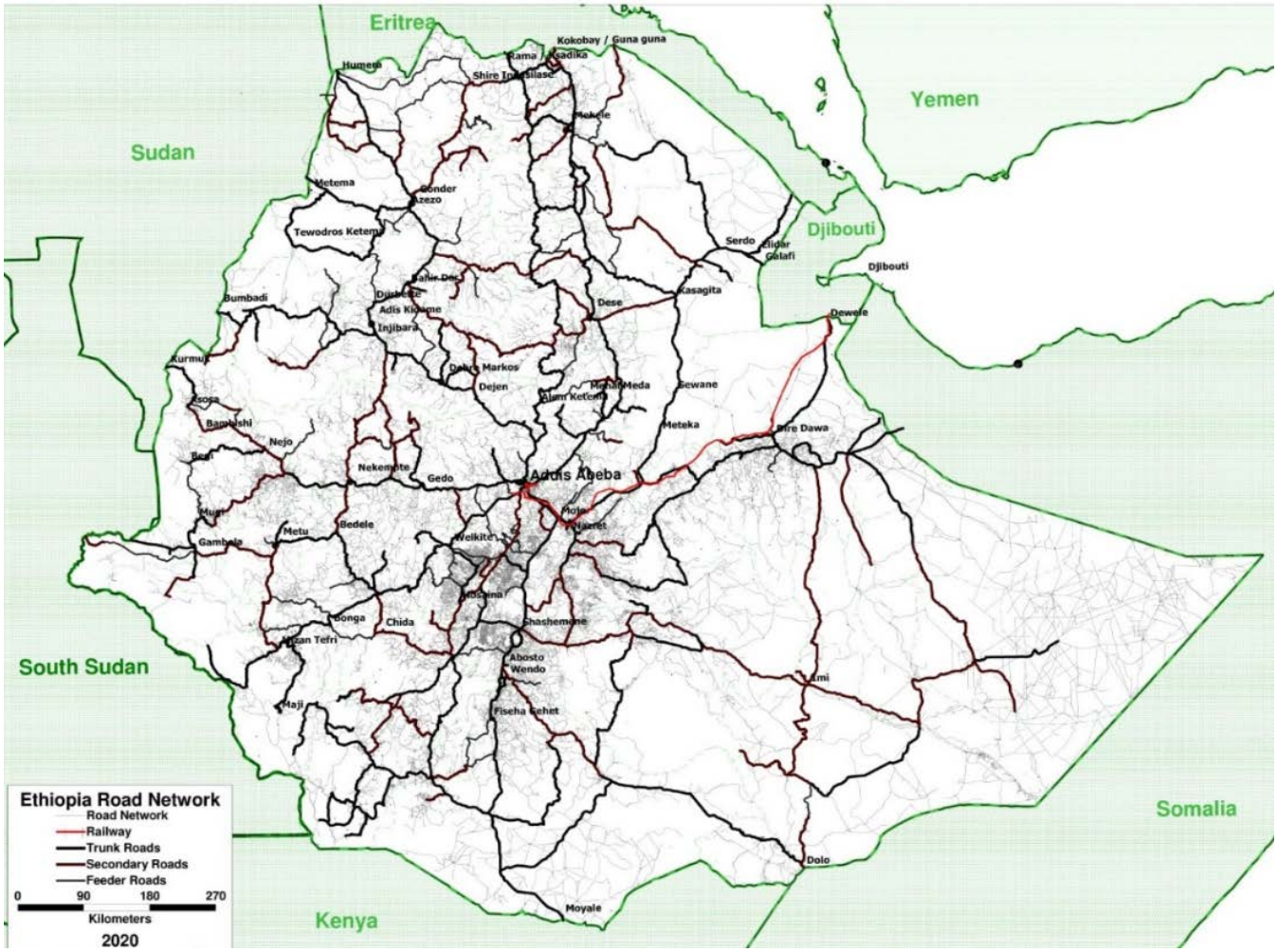
And in terms of road surface type the total classified network is made up by 88% of gravel roads and 12% of asphalt roads. Following is the road conditions:

Table 7: Ethiopia Road Network by Surface Type

Administration	Surface Type (in km)			Road Condition (in %)		
	Gravel	Asphalt	Total	Good	Fair	Poor
ERA	13,361	15,338	28,699	22	40	38
RRAs	35,806	0	35,806	30	20	50
Municipalities	24,416	1,282	25,698	24	30	46
Community/Woredas	53,824	0	53,824	18	37	45
Total	**127,407**	**16,620**	**144,027**	**20**	**38**	**42**
	88%	**12%**				

The current Ethiopia road network is presented in the following map:

Figure 5: Ethiopia Road Network



3.1.1 Federal Road network

The Ethiopian Road Authority (ERA) is managing the federal road network, while the different Regional Road Authorities (RRAs), Woreda Road Authorities (WRAs) and municipalities are managing the secondary, tertiary and urban and local roads.

Following is the length of the federal road network, divided into ERA categories and their status. The total federal road network extension is 28,699 km (15,886 asphalted) and is composed by:

Table 8: Federal Road Network

	Asphalt	Gravel	Total
A - Trunk	5,626	16	5,642
B - Link	4,999	3,683	8,682
C - Main Access	2,431	3,639	6,070
D - Collector	845	2,714	3,559
E - Feeder	1,437	3,309	4,746
Grand Total	**15,338**	**13,361**	**28,699**

Source: ERA

Presently the trunk road network of Ethiopia is represented by five roads departing from Addis Ababa and then articulated into ten branches:

1) A1 - East from Addis Ababa 853 km via Adama and Awash to Galafi on Djibouti border;
2) A2 - North from Addis Ababa 1071 km via Dessie, Mekele and Adigrat to Axum;
3) A3 - North west from Addis Ababa across the Blue Nile (Dejen) and Bahir Dar east of Lake Tana 737 km to Gondar. Designated part of the Cairo-Cape Town Trans-African Highways 4 (TAH 4);
4) A4 - West from Addis Ababa 620 km via Nekemte to Gimbi and Asosa;
5) A5 – South-West from Addis Ababa 510 km via Jimma to Metu;
6) A6 - South west from Jimma 216 km to Mizan Teferi;
7) A7 - South from Mojo 432 km via Shashamane, Sodo to Arba Minch. Part of road between Mojo and Shashamane is designated part of the Cairo-Cape Town Trans-African Highways (TAH 4);
8) A8 - South from Shashamane 214 km via Hawassa to Hagere Mariam. Designated part of the Cairo-Cape Town Trans-African Highways 4 (TAH 4);
9) A9 - South from Adama 77 km to Asella;
10) A10 - East from Awash 572 km via Harar and Jijiga to Degehabur;

Following is the federal road network extension by region:

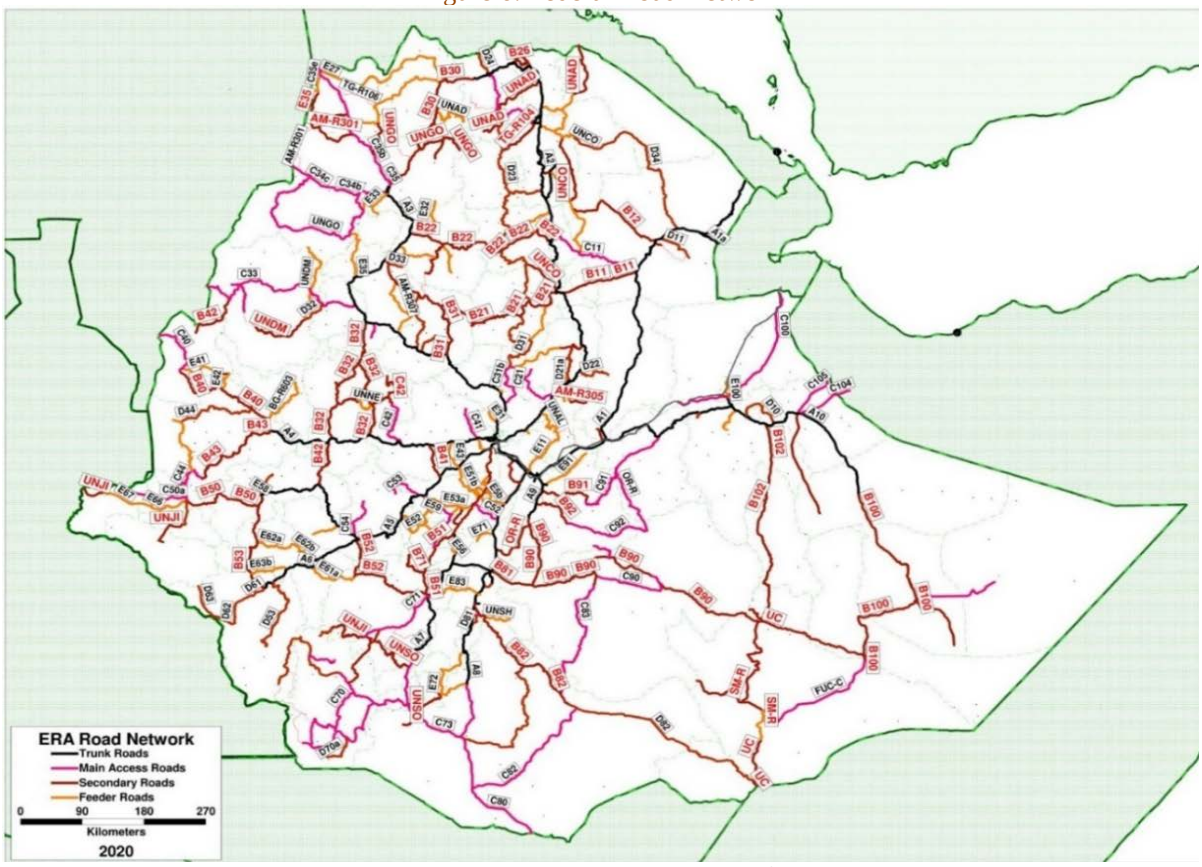
Table 9: Federal network by region

	Asphalt	Gravel	Total
Afar	1,276	613	1,916
Amhara	3,621	2,882	6,502
Benishangul Gumuz	264	471	735
Diredawa	27	18	45
Gambella	242	360	602
Harar	42	10	52
Oromia	4,243	4,864	9,081
Somali	896	1,690	2,586
South	2,588	2,004	4,592
Tigray	2,139	449	2,588
Grand Total	**15,338**	**13,361**	**28,699**

Source: ERA

ERA is undergoing important improvement studies, like the "ERA and Road Sector Modernization and Transformation Initiative" and "Road Functional Classification Study", together with the decentralization of the responsibilities with the Regional Roads authorities.

Figure 6: Federal Road Network



Source: https://vdocuments.mx/road-network-map-of-ethiopia.html

RSDP achievements

Since 1997, five Road Sector Development Programs (RSDPs) have been implemented, consisting of rehabilitation/upgrading of trunk and link roads, construction of new link roads, rural roads & district roads and maintenance of federal and regional roads, carried out by Ethiopian Roads Authority (ERA), Regional Roads Authorities (RRAs), Woreda Road offices (WRO) and the community and municipalities. Also, a series of policy and institutional reforms have been implemented in the sector, which have enhanced implementation capacity of road projects and effectiveness of Road Asset Management.

According with last RSDP (V) - 23 Years Performance Assessment Report, in the twenty-three years, a total of 159,218.4 km of roads have been built and improved, excluding routine maintenance work and community roads works carried out. The total budget for these works amounted to ETB 520.4 billion and the amount disbursed in the same period was ETB 414.7 billion, reaching the 80% of implementation of the plan. In particular, because of this huge investment, the country's road network has increased from 26,550 km in 1997 to 144,027.8 km in 2019 (average growth of 8 percent) and the road density per 1000 sq. km has increased from 24.1 km in 1997 to 130.9 km in 2019. Also; substantial improvement has been registered in the condition of the country's road network, with the proportion of road network in good condition is 20.1%, while the road network in acceptable condition (Good +Fair) is 58.5 % in 2019.

During twenty-three years performance of RSDP, a total 159,218 km of physical work has been carried out, of which 45,794 km was on Federal Roads; 33,618 km was on Regional Roads and 79,806 km of roads were URRAP Roads.

About ETB 414.7 billion was disbursed of which 321.8 billion was on Federal Roads and ETB 47.7 billion was on Regional Roads, 41.9 billion was on URRAP Roads and 3.11 was on Community and Urban Roads.

With regard to the Federal Road Network, 4,105 km of trunk roads were rehabilitated, 12,171 km of trunk and link roads were upgraded, 11,091 km of new link roads were constructed and 158 km of expressway roads were constructed too.

Besides the increase of road efficiency (transport cost reduction) and rural accessibility, a major objective of RSDPs is also to develop the institutional capacity of road sector at central and regional level, like restructuring and modernization of ERA, restructuring of construction contract administration, restructuring of road asset management and ERA management system.

Table 10: Performance by Implementers (in %)

Program	Federal			Regional			Woreda/URRAP			Overall		
	Plan (km)	Actual (km)	%	Plan (km)	Actual (km)	%	Plan (km)	Actual (km)	%	Plan (km)	Actual (km)	%
RSDP I	3,777	2,709	72	5,131	6,000	117				8,908	8,709	98
RSDP II	5,375	7,483	139	2,877	4,106	143				8,252	11,589	140
RSDP III	8,956	7,996	89	5,730	4,399	77				14,686	12,395	84
RSDP IV	14,782	13,633	92	11,212	9,814	88	71,523	62,413	87	97,517	85,860	88
RSDP V	16,786	13,973	83	8,060	9,299	115	90,000	17,394	19	114,846	40,665	35
Total RSDP	**49,676**	**45,794**	**92**	**33,010**	**33,618**	**101.8**	**161,523**	**79,807**	**49**	**244,209**	**159,218**	**65**

Source: ERA, "22 years assessment report"

Even if considerable results have been achieved by the road development programmes, Ethiopia remains below the average of other African countries, in terms of road density and road quality, as shown in the following table.

Table 11: Road Density Comparison

Indicator	Africa Average	Middle Income Countries Average	Sub Saharan Average	Ethiopia performance
Road Density per 1,000 sq.km	204	280	140	130.9
Road Density km per 1,000 people	-	7.0	3.3	1.41
Percentage of Road covered with Asphalt	25	57	25	11.9
Good Quality Road Percentage	75	82	70	20.1

Following is the regional road density:

Table 12: Regional Road Density

Region	Capital	Area (km^2)	Population 2019	Road Network	Road Density / 1000 sq km	Road Density / 1000 pop
Addis Ababa	Addis Ababa	2360	3774000	3.699	1567	1,02
Afar	Asayita	72053	1940000	3.394	47	1,75
Amhara	Bahir Dar	194709	22292000	26.593	172	1,19
Benishangul-Gumuz	Asosa	50699	1157000	2.345	46	2,03
Dire Dawa	Dire Dawa	1559	507000	866	555	1,71
Gambela	Gambela	29783	478000	2.795	94	5,85
Harar	Harer	334	264000	752	2.25	2,85
Oromia	Addis Ababa	284538	38170000	61.239	215	1,60
Somali	Jijiga	279252	6203000	6.306	23	1,02
Tigray	Mekele	84722	5542000	7.651	90	1,38
SNNPR	Awasa	105476	20502000	28.389	269	1,38
	Total	**1.105.485**	**100,829,000**	**147.027**	**130,9**	**1,43**

According with the TYP, Ethiopia will have a substantial increase of all-weather road extension from 144,027 km (2019) to an estimated 225,000 km in 2029, serving all woreda capitals, while the length of the expressway network will pass from the present 301 km to 2960 km by the end 2029.

3.1.2 Regional Road networks

Regional Road Authorities

Eleven Regional Road Authorities have been established, with different names: Addis Ababa (Road Authority), Afar (Road & Transport Bureau), Amhara (Road & Transport Bureau), Benishangul (Road & Transport Bureau), Diredawa (Road Authority), Gambela (Road Authority), Harar (Road Authority), Oromia (Road Authority), Somali (Road & Transport Bureau), SNNP (Road Authority), Tigray (Construction, Transport and Road Development Bureau).

All Regional Road Authorities (RRAs) appear to have different and diverse institutional organizational structures. In some regions the RRAs have extended mandates, hence there are issues as to the determinacy of institutional arrangements and streamlining of administrative and operational procedures and defining of decision-making responsibilities. The new regulations in the Federal Democratic Republic of Ethiopia (FDRE) will share the sovereignty between the federal government and the regional states. This means that the RRAs will get more influence on local matters but simultaneously an increase of responsibilities. The lack of a fixed institutional organizational model means that the road authority in certain regions is divided into different bureaus which causes difficulties for ERA to implement institutional arrangements since it has to be tailor made for each RRA.

Under the Technical Cooperation Program (TCP) for the Ethiopian Road Sector Development Program (V) (RSDP) to improve capacity by providing Institutional Capacity Building to the RRAs, the Government of Federal Democratic Republic of Ethiopia (FDRE) with support from Delegation of European Union to Ethiopia (EU) through Ethiopian Road Authority engaged a consultant to carry out an "Institutional Organizational Setup and Structure of RRAs".

Regional Road Networks

Following is shown the regional road network, extension for each of the 11 Regions:

Table 13: Ethiopia Road Network by Regions

Region	ERA Road in the Region (km)	Regional Rural Gravel Road (km)	URRAP Road in the Region (KM)	Municipality (Urban) Roads (km)	Total Network Found in the Region (km)
Tigray	2,588.0	1,490.0	2,302.0	1,271.2	**7,651.2**
Afar	1,916.0	1,124.0		354.0	**3,394.0**
Amhara	6,502.0	4,786.4	11,000.0	4,304.2	**26,592.7**
Oromiya	9,081.0	10,655.7	35,460.0	6,042.0	**61,238.7**
Somali	2,586.0	3,305.0		415.0	**6,306.0**
SNNP	4,592.0	10,866.0	6,070.0	6,860.6	**28,388.6**
Benishangul	735.0	936.0	519.0	155.0	**2,345.0**
Gambella	602.0	2,027.0	33.0	133.0	**2,795.0**
Dire Dawa	45.0	161.0	280.0	379.6	**865.6**
Harar	52.0	455.3	144.0	101.0	**752.3**
Addis Ababa				3,698.8	**3,698.8**
Total	**28,699.0**	**35,806.4**	**55,808.0**	**23,714.4**	**144,027.8**

Following each regional road network is reported:

ADDIS ABABA REGION

The total road network is equal to 3.699 km on an area of approximately 2360 km2 (about 1.56 km/km2), composed by: 954 km of asphalt roads,1,786 Km of cobble stone roads, and 958 km of gravel roads.

AFAR REGION

The total road network is equal to 3.394 km on an area of approximately 72.052 km2 (about 0,047 km/km2), composed by: ERA is presently managing 1,916 km of Federal Roads, 1,124 km are Regional Rural Roads and 354 Km are Municipality Urban Roads.

AMHARA REGION

The total road network is equal to 26.593 km on an area of approximately 194.709 km2 (about 0,17 km/km2), composed by: ERA is presently managing 6,502 km of Federal Roads, 1,124 km are Regional Rural Roads, about 11,000 Km URRAP Roads and 4,304 are Municipality Urban Roads.

BENISHANGUL – GUM REGION

The total road network is equal to 2.345 km on an area of approximately 50.699 km2 (about 0,046 km/km2), composed by: ERA is presently managing 735 km of Federal Roads, 936 km are Regional Rural Roads, about 519 Km are URRAP Roads and 155 are Municipality Urban Roads.

DIRE DAWA

The total road network is equal to 865 km on an area of approximately 1.559 km2 (about 0,55 km/km2), composed by: ERA is presently managing 45 km of Federal Roads, 161 km are Regional Rural Roads, about 280 Km are URRAP Roads and 379 are Municipality Urban Roads.

GAMBELLA REGION

The total road network is equal to 2,695 km on an area of approximately 29.783 km2 (about 0,094 km/km2), composed by: ERA is presently managing 602 km of Federal Roads, 2,027 km are Regional Rural Roads, about 33 Km are URRAP Roads and 133 are Municipality Urban Roads.

HARARE

The total road network is equal to 752 km on an area of approximately 334 km2 (about 0,003 km/km2), composed by: ERA is presently managing 52 km of Federal Roads, 455 km are Regional Rural Roads, about 144 Km are URRAP Roads and 101 are Municipality Urban Roads.

OROMIA REGION

The total road network is equal to 61,339 km on an area of approximately 284,538 km2 (about 0,215 km/km2), composed by: ERA is presently managing 9081 km of Federal Roads, 10,655 km are Regional Rural Roads, about 6070 Km are URRAP Roads and 6860 are Municipality Urban Roads.

SOMALI REGION

The total road network is equal to 6,306 km on an area of approximately 279,252 km2 (about 0,023 km/km2), composed by: ERA is presently managing 2,586 km of Federal Roads, 3,305 km are Regional Rural Roads, and 415 km are Municipality Urban Roads.

SOUTHERN REGION

The total road network is equal to 28,388 km on an area of approximately 105,576 km2 (about 0,269 km/km2), composed by: ERA is presently managing 4,592 km of Federal Roads, 10,866 km are Regional Rural Roads, about 6,070 Km are URRAP Roads and 6,860 are Municipality Urban Roads.

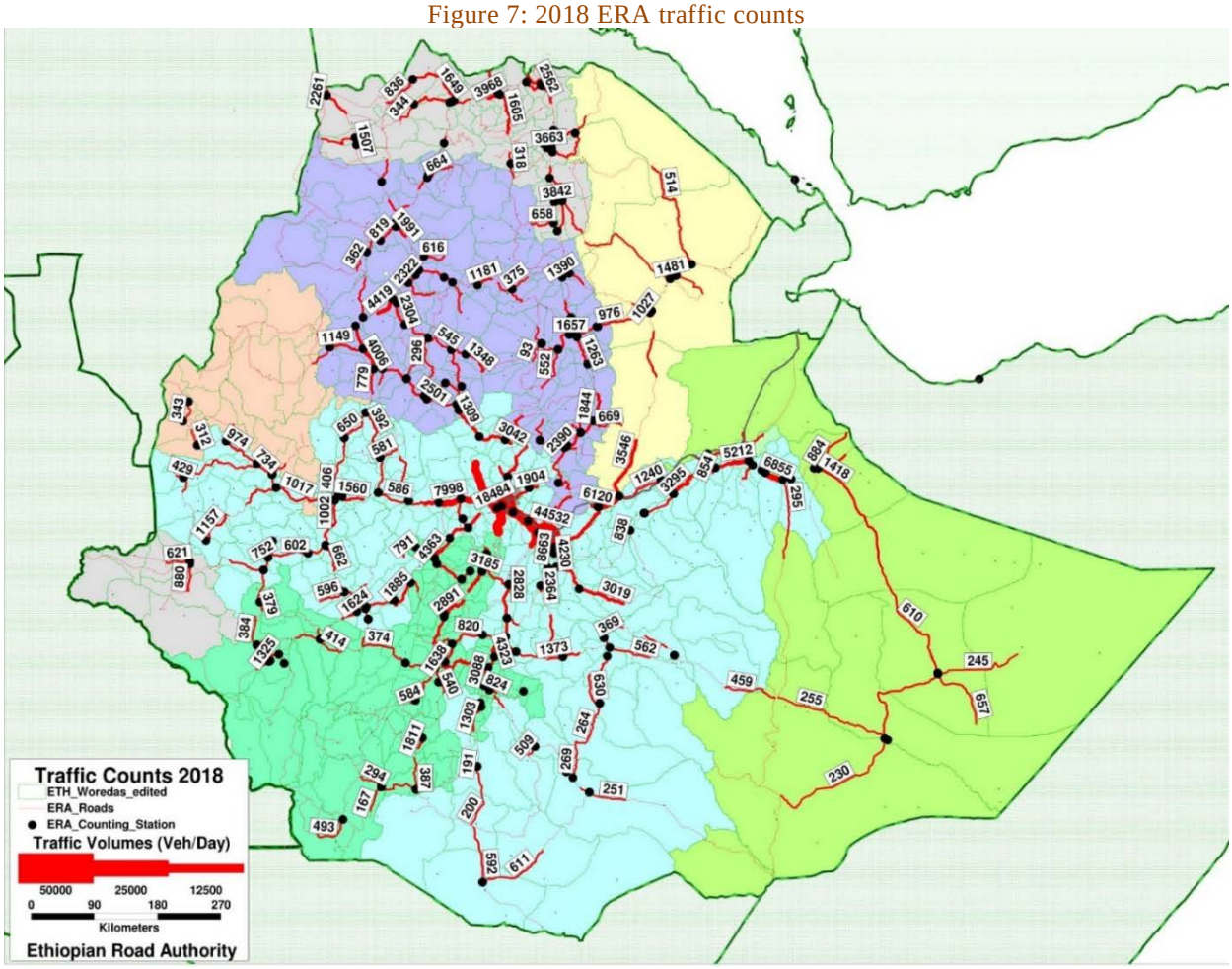
TIGRAY REGION

The total road network is equal to 7,751 km on an area of approximately 84,722 km2 (about 0,09 km/km2), composed by: ERA is presently managing 2,588 km of Federal Roads, 1,490 km are Regional Rural Roads, about 2,302 Km are URRAP Roads and 1,271 km are Municipality Urban Roads.

3.2 ROAD TRAFFIC DEMAND

During 2018, ERA conducted traffic counts on 408 sites distributed throughout the federal road network managed by ERA, which are represented in the following figure.

Figure 7: 2018 ERA traffic counts



Following are the results of 2018 classified traffic counts by road and region:

Table 14: Locations of 2018 classified traffic counts by road and region

REGION	ROAD N.	LINK	Location	Light Vehicles & Pick-ups	Small Bus	Large Bus	Small Trucks	Medium Trucks	Heavy Trucks	Truck & Trailers	TOTAL
OROMIA Selection of Traffic Counts >= 4000	A1	Modjo-Nazreth	Nazreth (North)	10,161	6,529	5,225	5,495	5,501	5,539	6,082	**44,532**
	A5	Alemgena-Weliso	Alemgena	4,804	2,346	2,251	2,315	2,222	2,299	2,247	**18,484**
	A1	Addis-Modjo	Debre Zeit (Air Force)	2,409	3,629	571	1,754	2,743	3,586	2,912	**17,604**
	A1	Addis-Modjo	Akaki (South)	3,523	2,348	1,420	2,049	2,280	2,618	2,756	**16,994**
	A5	Alemgena-Weliso	Alemgena	4,013	2,228	1,877	2,138	2,111	1,955	1,892	**16,214**
	A4	Holeta-Ambo	Holeta (Muger Junc,)	3,846	2,485	622	1,756	2,155	2,442	2,756	**16,062**
	A1	Addis-Modjo	Akaki (South)	2,602	1,623	1,341	1,645	1,897	2,002	2,571	**13,681**
	B51	Alemgena-Butajira	Alemgena	3,383	1,786	1,679	1,768	1,606	1,643	1,488	**13,353**
	C41	Holeta-Muger	Holeta (Muger Junc,)	2,309	1,581	318	1,204	1,597	1,746	2,028	**10,783**
	A9	Nazareth-Asela	Melekasa	3,601	1,214	1,193	1,138	1,153	1,115	1,125	**10,539**
	A4	Holeta-Ambo	Holeta (Muger Junc,)	1,633	1,280	220	916	1,545	1,822	1,954	**9,370**
	A9	Melkasa-Sodore	Melekasa	2,132	1,132	1,127	1,139	1,078	1,047	1,113	**8,768**
	A9	Nazareth-Asela	Melekasa	2,067	1,140	1,118	1,016	1,075	1,065	1,182	**8,663**
	A4	Holeta-Ambo	Kachisa Junction	2,291	1,388	752	427	1,297	1,049	976	**8,180**

REGION	ROAD N.	LINK	Location	Light Vehicles & Pick-ups	Small Bus	Large Bus	Small Trucks	Medium Trucks	Heavy Trucks	Truck & Trailers	TOTAL
	A4	Holeta-Ambo	Kachisa Junction	2,269	1,400	713	434	1,198	1,037	947	**7,998**
	E11	Modjo-Ejere-Arerti-Kesem	Modjo	1,859	1,041	666	861	922	968	1,050	**7,367**
	A7	Modjo-Ziway	Modjo (South)	1,224	1,151	491	804	1,498	1,217	793	**7,178**
	A1	Nazareeh-Metehara	Metehara (West)	650	769	599	582	1,087	1,022	1,411	**6,120**
	A1	Metehara-Awash Junc,	Metehera (East)	933	647	584	601	912	788	1,388	**5,853**
	A10	Dengego(dire dawa)-Harar	Dengego	663	914	118	494	928	800	1,540	**5,457**
	A10	Kulubi-Dengego	Dengego	736	777	138	241	915	991	1,414	**5,212**
AMHARA Selection of Traffic Counts >= 1500	A3	Dangla-Bahirdar	Bahir Dar (South)	864	1,142	394	587	610	408	414	**4,419**
	A3	Bure-Dangla	Kossober	500	2,464	74	111	448	230	179	**4,006**
	B31	Adet -Bahirdar	Tis Isat Junction	546	772	364	159	420	547	98	**2,906**
	A3	Bure-Dangla	Dangila (South)	216	764	199	318	367	329	348	**2,541**
	A3	Dejen -D/Markos	D/Markose (Era Comp,)	344	520	312	241	366	457	261	**2,501**
	A2	Godobert-Debreberihan	Ankober Junction	396	431	123	338	424	358	320	**2,390**
	A3	Bahirdar -Wereta	Woreta (South)	541	729	148	141	295	254	214	**2,322**
	B31	Adet -Bahirdar	Tis Isat Junction	418	604	275	125	348	445	89	**2,304**
	A3	Bure-Dangla	Kossober	483	887	73	91	367	163	132	**2,196**
	A3	Meksegnet-Azezo Airport	Azezo Air Port	237	862	143	291	177	140	141	**1,991**
	A2	Ataye-Robit	Shewa Robit	389	485	79	268	280	229	114	**1,844**
	UNGO	Gonder-Gonder by Pass	Azezo	273	559	130	303	265	190	67	**1,787**
	A3	Wereta -Maksegnet	Woldyia Junction	211	741	166	120	130	194	157	**1,719**
	A2	Godobert-Debreberihan	Ankober Junction	290	303	108	228	283	246	223	**1,681**
	A2	Desse-Kombolcha	Gerado Jun	298	359	113	175	233	257	222	**1,657**
	A2	Addis- Debreberehan	Jihur Junction	253	459	86	205	304	224	98	**1,629**
	A2	Robit -Debre Sina	Shewa Robit	339	389	79	238	232	204	120	**1,601**
	A3	Debremarkos-Bure	D/Markos (A,M,C)	178	551	197	190	203	122	151	**1,592**
	A2	Desse-Kombolcha	Gerado Jun	276	338	113	176	237	231	206	**1,577**
	A2	Debre Sina-Gudo Beret	Tarmaber	260	327	114	216	294	210	114	**1,535**
AFAR	A1	Samera -Sardo	Assaita Junction	236	138	13	138	149	266	541	**1,481**
	A1	Mile-Samera	Semera	230	208	39	68	44	241	361	**1,191**
	A1	Samera -Sardo	Assaita Junction	148	92	10	93	106	229	468	**1,146**
	A1	Adaitu-Mille	Mille Junction	268	140	48	132	22	16	401	**1,027**
	A1	Hundufu -Adayitu	Mille Junction	277	106	44	131	27	29	406	**1,020**
	A1	Mile-Samera	Semera	170	156	22	39	24	239	354	**1,004**
	B11	Eliwuha-Weranso -Mille	Mille Junction	220	96	27	107	25	26	343	**844**
	C11	Mille -Wark River	Mille	74	37	9	79	77	83	272	**631**
	D34	Serdo-Afdera	Serdo	135	60	24	51	62	16	166	**514**
	D11	Aysaita Junction-Aysaita	Assaita Junction	90	49	8	40	38	40	42	**307**
	B12	Semera-DigDig Sala-Yalo	Semera	63	52	18	30	21	7	10	**201**
BENISH ANGUL	C40	Assosa-Kurmuk	Sherkole	51	110	30	67	21	24	40	**343**
	B40	Bambasi-Assosa	Bambashi	57	68	4	55	36	54	38	**312**
	B40	Mendi-Bambasi	Bambashi	48	64	7	50	43	44	40	**296**
	C40	Assosa-Kurmuk	Assosa	42	52	3	52	54	54	3	**260**
DIRE DAWA		Diredawa-Hurso-Erer	Meleka Jebdu	397	339	76	341	280	306	67	**1,806**
	E100	Industry mender, DIRE DAWA-Shinile	Dire Dawa	77	19	0	25	63	119	634	**937**
	C100	Diredawa-Dewole	Deri Dawa	86	41	35	93	113	163	271	**802**
		Diredawa-Hurso-Erer	Meleka Jebdu	81	92	16	82	82	84	85	**522**
GAMBELLA	D51	Gambela-Abobo	Gambella	244	143	51	212	94	73	63	**880**
	C50a	Gambela-Itang	Gambella	151	132	24	130	77	72	35	**621**
HARARE	A10	Harar-Bombas	Harar	1,312	1,043	799	995	1,061	1,049	596	**6,855**
	D10	Harar-Jarso	Harar	397	447	174	323	305	235	165	**2,046**
SOMALI	A10	Jijiga-Degehabour	Jijiga (West)	390	224	183	189	186	173	166	**1,511**
	A10	Jijiga-Degehabour	Jijiga (East)	112	139	177	178	303	258	251	**1,418**
	C104	Jijiga-Togochale	Jijiga (Togo Wuchale Junc	211	167	168	179	171	158	171	**1,225**

REGION	ROAD N.	LINK	Location	Light Vehicles & Pick-ups	Small Bus	Large Bus	Small Trucks	Medium Trucks	Heavy Trucks	Truck & Trailers	TOTAL
	C105	Jijiga-Teferi ber	Jijiga	208	118	103	117	125	119	94	**884**
	B100	Kebridar-Gode	Kebridehare	113	51	24	101	110	121	138	**658**
		Kebridar-Shilabo	Kebridehare	108	66	13	96	107	126	141	**657**
	B100	Degeha Bur-Kebri Dehar-Gode	Kebridehare	104	50	19	95	101	110	131	**610**
		Diredawa-Hurso-Erer	Herer	74	5	21	108	54	17	3	**282**
	UC	Gode to Imey	Gode	48	32	24	55	44	33	19	**255**
	FUC-C	Kebri Dehar-Warder	Kebridehare	46	22	2	44	39	44	48	**245**
	FUC-C	Hargele- Gode	Gode	41	20	3	54	41	50	21	**230**
SOUTHERN Selection of Traffic Counts >= 2500	A5	Giyon-Walkite	Endibir Junction	991	1,022	186	634	653	675	202	**4,363**
	A8	Awassa-Aposto	Tobaco Monopoly	888	775	500	607	688	601	264	**4,323**
	A8	Awassa-Aposto	Tobaco Monopoly	844	756	478	583	655	563	247	**4,126**
	A8	Shashemene-Awassa	Wondo Genet Junction	1,474	999	223	550	359	203	188	**3,996**
	E53b	Bojeber-Butajira	Bojeber Jun	667	544	369	450	468	479	208	**3,185**
	A8	Shashemene-Awassa	Wondo Genet Junction	1,150	863	163	411	265	170	145	**3,167**
	A8	Awassa-Aposto	Morocho	633	638	394	425	390	480	128	**3,088**
	C51a	Welkite-Mazoria	Gubria Junction	455	988	56	414	547	483	62	**3,005**
	B51	Butajira-Hossana	Bojeber Jun	660	500	377	412	409	389	201	**2,948**
	B51	Butajira-Hossana	Hosana (Era Comp,)	711	443	359	449	445	464	20	**2,891**
	B51	Alemgena-Butajira	Zeway Junction	447	353	353	365	393	406	364	**2,681**
TIGRAY Selection of Traffic Counts >= 2000	A2	Adiabun-Axum	Adi Abun (West)	783	805	547	527	457	419	430	**3,968**
	A2	Mehoni -Maychew	Mehoni	715	683	247	790	729	473	205	**3,842**
	A2	Adigudom-Mekele	Quiha	613	771	59	586	614	483	537	**3,663**
	A2	Adigudom-Mekele	Quiha	543	665	55	586	578	549	506	**3,482**
	A2	Adigudom-Mekele	Mekele	635	593	211	529	370	367	334	**3,039**
	B20	Adigrat-Zalanbesa	Adigrat (North)	981	780	91	251	369	43	47	**2,562**
	C35e	Dansha-Humera	Raweyan Jun	266	619	49	434	420	280	193	**2,261**
	A2	Waja-Maychew	Maichew (South)	367	278	201	304	295	281	301	**2,027**

As can be seen from the table above, more than 51% of traffic volumes remains below 1,000 Vehicles/day, about 43% register volumes between 1,000 and 5,000 and only 5% have traffic volumes over 5,000 Vehicles/day.

Table 15: ADT Ranges

Average Daily Traffic Ranges (Vehicles/Day)			Number of counting sites
	ADT	> 10,000	10
10,000 <	ADT	< =5,000	12
5,000 <	ADT	< =2,000	65
2,000 <	ADT	< =1,000	113
1,000 <	ADT	< =500	106
500 <	ADT	< =0	102

At the regional level, the traffic counting sites were: 154 in Oromia region, 104 in Amhara region, 77 in Southern Region 39 in Tigray Region, 11 in Somali Region, 11 in Afar Region, 4 in Benishangul Region, 4 in Dire Dawa Region, 2 in Gambella Region, 2 in Harare Region.

OROMIA REGION

High traffic volumes over 10,000 Vehicles/day were recorded near the capital city Addis Ababa at the roads **A1** Addis - Modjo – Nazreth (44,532 Vehicles/day), **A5** Alemgena – Weliso (18,848 Vehicles/day), **A4** Holeta-Ambo (16062 Vehicles/day), **B5** Alemgena – Butajira (13,353 Vehicles/day) **C4** Holeta – Muger (10,783 Vehicles/day), **A9** Nazareth - Asela (10,539 Vehicles/day), in the Oromia region. Always in the Oromia region, in addition, to the roads A1 and the A4 A9 and A10 were recorded medium-high traffic volumes between 10,000 and 5,000 Vehicles /day.

AMHARA REGION

In the Amhara region, high traffic volumes of approximately 4,500 to 2,500 were recorded at the A3 Dangla - Bahirdar (4,419 Vehicles /day), B31 Adet -Bahirdar (2,903 Vehicles /day) and A2 Godobert-Debreberihan (2,390 Vehicles/day) roads.

SOUTHERN REGION

In Southern region, high traffic volumes of approximately 4,500 to 3,000, were recorded in the A5 Giyon - Walkite (4,363 Vehicles/day), A8 Awassa - Aposto (4,323Vehicles/day), E53 Bojeber - Butajir (3,185 Vehicles/day), C51 Welkite – Mazoria (3,005 Vehicles/day), and B51 Butajira – Hossana (2,948 Vehicles/day).

TIGRAY REGION

In Tigray region medium traffic volumes of approximately 4,000 to 2,000, were recorded in the A2 Adiabun-Axum (3,968 Vehicles /day), B20 Adigrat - Zalanbesa (2,562 Vehicles/day) and C35 Dansha - Humera (2,261 Vehicles/day) roads.

SOMALI REGION

In Somali region medium-low traffic volumes of approximately 1,500 to 900, were recorded in the A10 Jijiga-Degehabour (1,511 Vehicles /day) and C104 Jijiga -Togochale (884 Vehicles /day) roads.

DIRE DAWA REGION

In Dire Dawa region medium-low traffic volumes of approximately 1,800 to 900, were recorded in the Diredawa-Hurso-Erer road (1,806 Vehicles/day), E100 Industry Mender, Dire Dawa -Shinile (937 Vehicles/day) and C100 Diredawa-Dewole (802 Vehicles/day) roads.

HARARE REGION

In Harare region high-medium traffic volumes of approximately 7,000 were recorded in the A10 Harar-Bombas (6,855 Vehicles/day) road. Medium traffic volumes were recorded in D10 Harar-Jarso (2,046 Vehicles /day) road.

AFAR REGION

In Afar region medium-low traffic volumes of approximately 1,500 to 900, were recorded in the A1 Samera -Sardo (1,481 Vehicles /day) and B11 Eliwuha-Weranso -Mille (844 Vehicles /day) roads.

GAMBELLA REGION

In Gambella region medium-low traffic volumes of approximately 900 to 600, were recorded in the D51 Gambela-Abobo (880 Vehicles /day) and C50 Gambela-Itang (621 Vehicles /day) roads.

BENISHANGUL REGION

In Benishangul-Gum region low traffic volumes of approximately 350 to 300, were recorded in the C40 Assosa-Kurmuk (343 Vehicles /day) and B40 Mendi-Bambasi-Assosa (312 Vehicles /day) roads.

3.3 ROAD TRANSPORT ORGANIZATION

In Ethiopia, it is estimated that 90% of freight transportation both in the import and export sectors and 95% of the public transportation services are provided by the road transport. As reports from the Federal Transport Authority indicate, the annual rate of increase in the number of vehicles is below 20%, with only 831,265 vehicles for 2017. Compared to the other African countries, the number of motor vehicles in Ethiopia is very low.

Currently (2020) the total number of vehicles registered in Ethiopia including motor bicycles and the locally assembled are 1,2 million. Over half of the total registered are in the capital Addis Ababa (630,440), followed by Oromia region with 204,026 vehicles, 118,424 registered in Southern region, 106,434 registered in Amhara region, 60,800 in Tigray, 24,510 in Dire Dawa, 19,579 in Somali region, 10,728 in Harar, 10,655 in Benishangul Gumz, 8,277 in Afar and 6,237 in Gambella region.

In the following table the number of registered vehicle types are shown by regions:

Region	Addis Ababa	Amhara	Afar	Ben & Gumuz	Dire Dawa	Somali	Tigray	Gambela	Harar	SNNPR	Oromia	Total
No of vehicles	**630440**	**106434**	**8277**	**10655**	**24510**	**19579**	**60800**	**6237**	**10728**	**118424**	**204026**	**1200110**
- Heavy	255358	12615	1180	688	8028	4919	13382	0	56	6974	13389	316589
- Bus	46139	23150	1171	842	2442	1850	10129	2984	3080	22917	59604	174308
- Light	49140	1835	453	215	513	1193	1469	330	304	207	3475	59134
-Automobile	222683	1786	83	53	2360	648	1994	322	1303	98	5258	236588
- Others	57120	67048	5390	8857	11167	10969	33826	2601	5985	88228	122300	413491
Percentage	**52.5**	**8.9**	**0.7**	**0.9**	**2.04**	**1.63**	**5.07**	**0.5**	**0.89**	**9.87**	**17**	**100**

Recently Ethiopia entered in the automotive industry, with South Korea's Hyundai Motor Company opened a 10,000-a-year vehicle capacity assembly plant in the Ethiopian capital Addis Ababa in February 2019. The total number of vehicles Ethiopia has imported and registered last year (the fiscal year ended July 7, 2019) has surpassed the amount the country imported the previous year by 30,834 vehicles.

The Federal Transport Authority (FTA) regulates transport services (both freight and passenger) throughout the country, while Drivers' Licenses and Vehicle Registrations are managed and issued by the nine regions and two chartered cities, Regional Transport Bureaus. Although there are common procedures, standards and criteria for the issuance of licenses and permits, no means to effectively enforce them within regions, and particularly across regional boundaries.

The Federal Road Transport Authority has its head office in Addis Ababa near Legahar. It has the Drivers and Mechanics Training Center in Kaliti, vehicle maintenance service in the former Ethos Campus. In Megenagna it has a branch office which determines the vehicle weight and size, number of passengers and load of vehicles using the road. It has also an office in Addis Ababa Bus Terminal to determine and ensure the provision of passenger transport services. Its check point in Mille is establish for facilitation of the Djibouti corridor transport. Outside Ethiopia is has a branch office in Djibouti to give support for import and export goods transportation.

A recent study concluded that the current Ethiopian legislation in road transport is generally compliant and comprehensive in terms of the rules of the road and minor changes needs to be made in order to be fully compliant with the requirements of the Vienna Convention, but the main problem is on ensuring that the rules legislated are complied with, through both law enforcement, training of drivers and the general public, and the implementation of quality systems. In fact:

a) The current **vehicle registration process** complies with the requirements of the Convention but the vehicle registration certificate is non-compliant and will need to be amended;
a) Annual **vehicle inspection** is legislated but no legislation dictates the technical requirements of vehicles nor the pass requirements of the vehicle inspection.
b) The current Ethiopian legislation is generally compliant relating to obtaining **learner and driving licences** and regulating the issuing thereof, but the current driving licence card and categories are non-compliant and will need to be amended
c) The declaration to consider **mopeds as motorcycles** should either be applied to all parts of the legislation and a notification made to the UN upon accession, or the unique requirements applicable to mopeds must be legislated

COMMERCIAL ROAD TRANSPORT

Commercial road transport is composed by public passenger transport (urban or rural) and freight transport.

Regarding **passenger transport**, Ethiopia can presently count on 16 regional bus terminals, 13 urban centres with mass-transport services, 224 regular extra-urban bus routes and a total of 772 million annual flow of passenger on public transport.

Following are the bus companies and fleet operating for extra-urban passenger services:

Table 16: Bus companies and fleet

Name of company - Level of service Regional town to regional town City to city	Number of Vehicles		Destinations
Alem Public Transport Company	235		To All Destinations
Andinet Public Transport Company	192		To All Destinations
Abay Public Transport Company	155		To All Destinations
Fikir Public Transport Company	156		To All Destinations
Zemen Public Transport Company	125		To All Destinations
Habesha Public Transport Company	84		To All Destinations
Hedase Public Transport Company	111		To All Destinations
Elshaday Public Transport Company	79		To All Destinations
Hibret Public Transport Company	49		To All Destinations
Yebirhan Fana Public Transport Company	65		To All Destinations
Abisinya Public Transport Company	56		To All Destinations
Aybex Public Transport Company	72		To All Destinations
Fetan Public Transport Company	26		To All Destinations
Ethio-Africa Public Transport Company	8		To All Destinations
Gts Public Transport Company	8		To All Destinations
Tsegaye Public Transport Company	2	Not active currently	
Abrar Public Transport Company	2	Not active currently	

And the special bus lines destinations, companies and length of service:

Table 17: Bus Lines Destinations

No	Regional Town	Km	Fare	Name of private bus company														Remark
				Selam	Limalimo	Golden	Abay	Ethio	Falcon Coach	Geda	Hebasha	Zemen	Yegna	Oda	Ghion	Walia	Air Bus	
1.	Debremarkos	300					√245										√	
2.	Fnote Selam	387					√300											
3.	Bure	411					√310											
4.	Koso Ber	447					√330											
5.	Bahir Dar	563				√	√400				√	√400	√			√	√	
6.	Gondar	738			√500	√		√			√		√			√		
7.	Debretabor	666		-	√450			√										
8.	Dese	401						√			√310							
9.	Woldya	521						√								√		
10.	Kombolcha	376						√										
11.	Mekele	783		√610			√610				√	√	√		√	√		Through Awash
12.	Shere	1087		√														
13.	Adigrat	898		√														
14.	Harer	526		√			√			√	√			√				
15.	Diredawa	515		√				√		√	√	√		√				
16.	Jig Jiga	628						√	√494									
17.	Asosa	675				√				√								
18.	Gambella	766				√					√							
19.	Hawassa	273		√				√200			√	√	√	√	√			
20.	Arba Minch	454		√								√320						
21.	Jimma	346		√		√				√				√			√	
22.	Mizan Teferi	561		√							√						√	
23.	Dembi Dolo	652								√				√				
24.	Metu	600								√				√				
25.	Dila																	
26.	Hosaena																	
27.	Kartum, Sudan	1450																
	TOTAL			**9**	**2**	**5**	**7**	**7**	**1**	**6**	**9**	**5**	**4**	**6**	**2**	**4**	**4**	

Considering **freight transport**, the loading capacity, the number of vehicles with low and midlevel capacities is very limited. The Djibouti corridor has been the main focus of both import and export

road freight operations, but the structure of Ethiopian imports has changed over time, from finished and lightweight products to a combination of light finished products and project-bound bulky cargo. This structural change has not been accommodated by a change in the design of the logistics system. The upgrading of the road network needs to go hand in hand with the acquisition of trucks of the right length and quality. There are much fewer trucks, both private and state-owned, than the required weight of goods to be lifted. However, the existing trucks that are old and light in weight do not match the heavy and bulky cargo. As a consequence, the existing trucks are overloaded, which leads to the destruction of roads and bridges.

The GTP II planned to build 20 state public transport stations in different regions and improve urban public transportation in Addis Ababa and other major cities. The TYP plans by 2029:

- To increase passenger using public transport from 722 million to 1.5 billion;
- To increase public transport routes from 225 to 384;
- To increase bus annual coverage from 96,000 to 118,000 km;
- To introduce mass-transport services in 69 urban centres and increase public mobility share from 37% to 70%.

Like many low-middle-income countries, Ethiopia has an unacceptably large number of road traffic deaths, with approximately more than 25 people per every 100,000 people killed in road crashes. Although Ethiopia has extensive road safety legislation, enforcement is low and there is no application of vehicle standards promoting safety features. According with global Road Safety Partnership (GRSP) of World Health Organization, in 2016 in Ethiopian road network there were 9,636 fatalities and 409,890 serious injuries, with a total cost of 6.48 billion USD, which account for 9.6 fatalities per 100,000 population and 8,9% of national GDP.

3.4 PRESENT TRANSPORT MODEL & LEVEL OF SERVICE

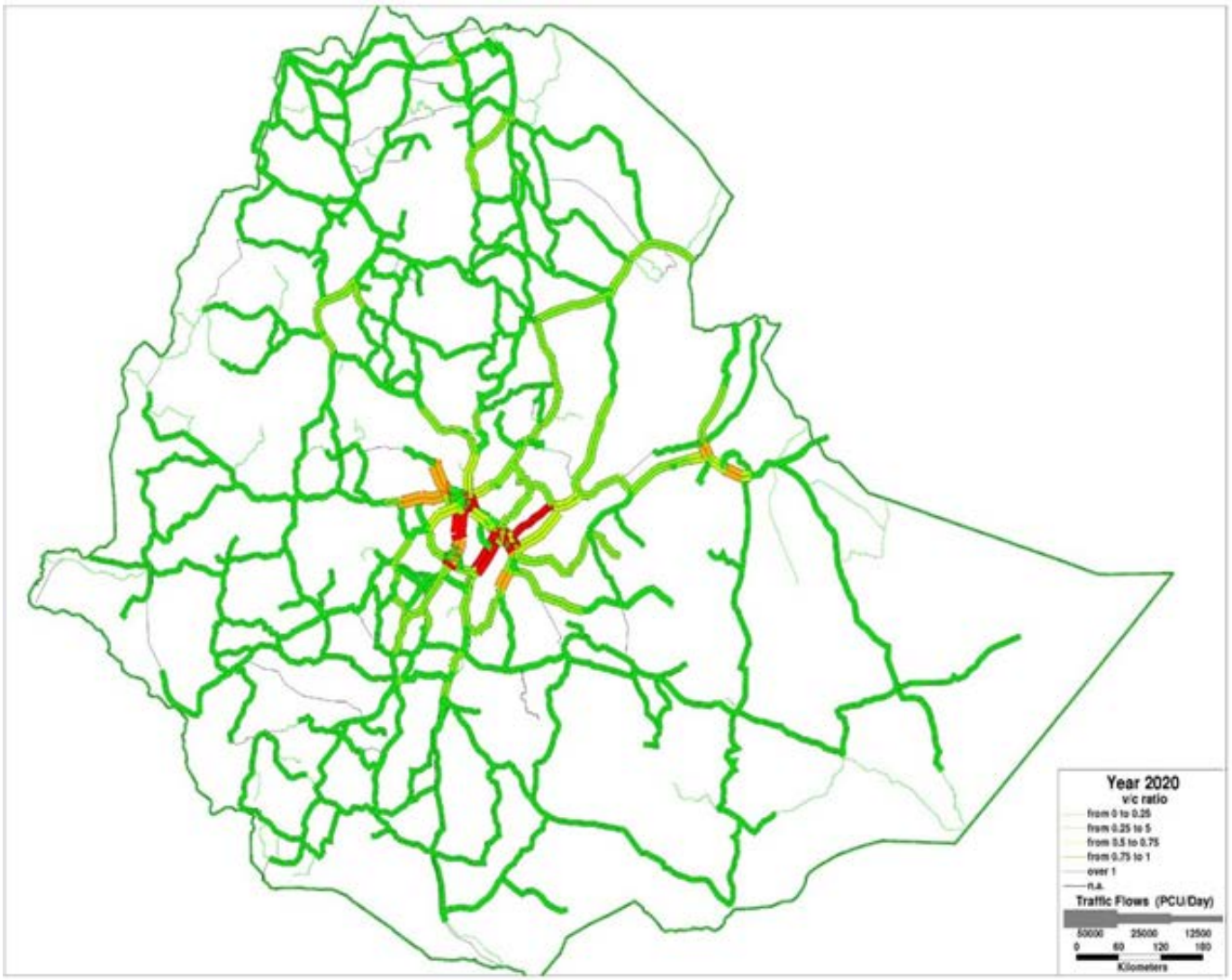
The Transcad runs following the calibration simulation were performed using a more complex approach, based on a two-stage traffic assignment: (1) in the first phase, the freight component was assigned using the average kilometric rate cost as a basic cost factor for road and rail, as well as the real or apparent costs of handling at sea terminals or road/rail and (2) in the second phase the passenger component is assigned in terms of equivalent vehicles, using the pre-assigned freight component as preload to better define the level of network congestion. In both cases, equilibrium algorithms were used. A specific technical document will detail these procedures separately.

The present levels of services were estimated only on the road network by using an approach based on the relationship between flow and capacity. The concept of "service level", in fact, is generally specific to the road transport mode. In order to simplify, the following congestion levels were considered:

- between 0 and 0.25
- between 0.25 and 0.5
- between 0.5 and 0.75
- between 0.75 and 1
- higher than 1

The Figure 8 below gives a representation of the existing levels of service. It must be highlighted how at the moment capacity problems are present only around urban areas (Addis Ababa and partially Dire Dawa). It should also be noted that the model tends, due to the combined effect of the traffic data used, the zoning adopted and the calibration method, to "expand" congestion on the sections entering/exiting the cities. This is an aspect that is being re-evaluated and will be corrected. The figure presents the levels of service with a chromatic scale. Links with colours from green until orange are under capacity level, while links in red are links that may become critical at the corresponding time horizon

Figure 8: Present 2020 levels of service on the road network



According with the Model assignments at present (year 2020):

- High level of congestions appears at Addis urban section, Alemgena – Tiya, Modjo – Ziway, Adama – Metehara, Adama – Dera;
- Moderate congestions in Holeta – Muger, Holeta – Ambo, Tiya – Butajira, Dera – Asela, DireDawa – Cinile and Harar – Babile.

3.4.1 Present road network performance

To evaluate the road network performance at year 2020, a multimodal (road + rail) assignment has been considered. The **transport offer** (multimodal graph) is composed by 30,338 km of road network plus 670 km of rail network. The **transport daily demand** is represented by 370,800 passengers, 884,262 tons of freight, which have been converted in 356,554 passenger car units (PCU).

The performance of the transport system involves daily:

- In terms of time (x h): a total of 893,554 hours is daily spent by the PCUs (composed by 1,499,269 hours spent by passengers and 2,060,113 hours spent for the tons to be transported).

- In terms of distance (x km): a total of 57,646,000 km is daily run by PCUs (composed by 100,422,000 passengers and 131,000,000 tons of freight, as shown in the following table

Table 18: Road Network Performance by Scenario - Existing Condition 2020

2020 Existing situation	Multimodal Network	Road Network	Railway Network
Total PCU x km	57,645,954	56,925,006	720,948
Total PCU x h	893,554	884,407	9,146
Total Pass x km	100,421,948	99,821,542	600,406
Total Pass x h	1,499,269	1,490,728	8,541
Total Tons x km	130,931,109	128,943,693	1,987,416
Total Tons x h	2,060,113	2,035,390	24,722

In terms transport cost (USD) the assignment calculates a daily expenditure of 10,851,000 USD for light and heavy vehicles and a total cost (value of time) of time spent equal to 6,510,000 USD. The total Road User Cost in a day is then 17,461,000 USD.

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4 PLANNED INTERVENTIONS

4.1 ROAD SECTOR PLANNING

As part of the previous and recent economic development programs, road infrastructure expansion, upgrading and regular and periodic maintenance were fostered. According to the sector's indicators, the total length of road construction in the country, including the summer season roads, was planned to increase to 215,000 kilometers (145%) from 110,414 km during the second phase of the GTP period.

Accordingly, the road density in km/1000 km^2 has increased from 100.4 in 2014 to 130.9 in 2019/2020. Considering road density in km/1000 population has increased from 1.23 to 1.41. At the same time, travel from a nearby road is reduced from 5.2 km (1 hour & 40 minutes) to 4.6 km (1 hour & 31 minutes).

Analysing the results of the different RSDP programmes, over the past 23 years, the following table shows the achievement for the federal, regional, woreda, community and urban roads:

Type of Work	Total RSDP 23yrs					
	Planned	Actual	%	Budget	Disbursed.	%
A. Federal Roads						
Rehabilitation of Trunk Roads	4407	4105	**93**	20,622.7	23,625.0	**115**
Upgrading of Trunk Roads	5198	4869	**94**	29,738.1	37,558.9	**126**
Upgrading of Link Roads	9639	7302	**76**	96,174.7	80,101.7	**83**
Construction of New Link Roads	13868	11091	**80**	170,875.3	133,448.7	**78**
Construction of Expressway Roads	414	158	**45**	43,552.1	18,540.9	**43**
Federal Roads Periodic Maintenance	16151	18,241	**113**	11,475.4	9,273.9	**81**
Routine Maintenance				8,857.1	8,277.7	**93**
Performance based Maintenance				931.2	73.4	**8**
Others				14,977.4	10,986.3	**73**
Sub Total Federal Roads	***49,677***	***45,794***	***92***	***397,204.1***	***321,886.4***	***81***
B. Regional Roads						
Construction	33,010	33,617.7	102	40,759.9	42,455.4	**104**
Maintenance				5,042.4	5,217.9	**103**
Others				203	115.4	**57**
Sub Total Regional Roads	***33,010***	***33,618***	***102***	***45,999.4***	***47,788.7***	***104***
C. Woreda Roads						
Construction of URRAP	161,523	79,806.9	49	70,031.4	41,268.4	**59**
Maintenance				3,482.0	671.3	**19**
Sub Total Woreda Roads	***161,523***	***79,806.9***	***49***	***73,513.4***	***41,939.7***	***57***
D.ERTTP/Community Road						
Community Roads				2,642.9	2,295.9	**87**
Sub Total Community Roads				***2,642.9***	***2,295.9***	***87***
Urban Roads						
Sub Total Municipalities Maintenance				***1,006.6***	***829.25***	***82***
TOTAL	**244,210.13**	**159,218.4**	**65.2**	**520,366.3**	**414,739.7**	**80**

In terms of construction, a total of 159,218 km was built or improved, representing the 65,2% of the planned activities. Federal roads increased by 45,794 km or 92% of the planned, regional roads by 102%, URRAP by 49% in respect to the planned.

In terms of road maintenance over the past 23 years, a total of 18,241 km of federal roads has been maintained in comparison with a total planned of 16,151 km, reaching an implementation rate of 113%. Regarding Regional roads the maintenance budget used was 103% in comparison with the planned, while for URRAP roads the expenditures was only 19% over the budget.

According with the MoT FYP - Five-Years Development Plan (2013-2017), the Goal 1 is to increase the total road coverage of the country from 121,052 km to 165,015 km, through 4,429 km of new road construction, 568 km of expressways, 9,218 km of gravel roads and develop 29,747 km of the Universal Rural Road Access Program (URRAP). At the same time the plan includes 13,416 km of roads to be improved and rehabilitated and a program of periodic and routine maintenance over 266,509 km. The plan will be implemented through a Road policy and master plan, identifying the Road Functional Classification, improve the Road Fund information system and distribution, using alternative funding sources and private investors, community participation and appropriate budgetary allocations for URRAP roads and implementation of Woreda Transformation Initiative program.

Following, is shown the list of ongoing road projects included in the 5 Years Development Plan:

Table 19: Ongoing projects - Road development sector

No.	Ongoing projects	Length	Owner of the project	The location of the project	The time it was started (Ethiopian calendar)	Time to Complete (Ethiopian calendar)	Contract Amount Million Birr
Road development sector							
1	Sansusi-Tatek-Kela	14	ERA	Oromia	6/22/2017	12/22/2019	737.00
2	Jimma-Agaro Dedessa River	80	>>	Oromia	1/1/2019	5/30/2022	1,307
3	Ambo-Gedo	65	>>	Oromia	7/1/2017	7/12/2020	484.00
4	Meki-Ziway	37	>>	Oromia	5/9/2016	2/8/2020	1,748.00
7	Ziway-Arsi Negele	57	>>	Oromia	2/23/2018	11/30/2021	937.00
8	Arsi Negele -Awassa	52	>>	Oromia	3/7/2018	9/7/2021	1,020.00
9	Tikur Weha-Awassa	12	>>	Oromia+South P.	11/9/2017	11/8/2019	589
10	Debark-Zarima Limalimo Alternative Road	69	>>	Amhara	1/1/2019	12/30/2022	2142
11	Chiko-Yirga Chefe	60	>>	South People	4/24/2017	6/4/2019	787
12	Iteya-Robe-Seru	76	>>	Oromia	5/8/2017	5/7/2020	1324
13	Ginchi-Km 59	59	>>	Oromia	4/21/2017	1/20/2020	898.3
14	Muke Turi-Kokeb Mesk	58	>>	Oromia/Amhara	5/23/2017	2/7/2020	768.6
15	Kokeb Mesk-Alem Ketema	50	>>	Amhara			1696
16	Melkasa-Sodere-NuraEra-Metehara Junction	94	>>	Oromia	6/27/2017	6/27/2020	1203
17	Tulu Bolo-Kela	80	>>	Oromia+South P.	10/15/2017	4/15/2021	1310
18	Mentamir-Metehbela-Metehara	82	>>	Oromia and Amhara	10/18/2017	4/18/2021	1097
19	Gashena-Bilbila	105	>>	Amhara	2/12/2014	6/25/2020	1723
20	Bilbila-Sekota	100	>>	Amhara	1/12/2015	1/12/2019	2041
21	Iste-Simada	52	>>	Amhara	2/21/2019	2/21/2022	1925
22	Azezo-Gonder	13	>>	Amhara	9/14/2018	9/13/2020	872
23	Jinka-Vilage 1	53	>>	South People	2/5/2016	4/1/2018	1373
24	Sodo-Km 70 (Dinke 2)	85	>>	South People	5/14/2018	5/14/2022	1036.2
25	Km 70-Sawela (Dinke-Sawela)	76	>>	South People			1020
26	Tercha-Chida Harar-Kombolcha-Ehadersa Goro-Fungabira	58	>>	South People	4/1/2017	10/1/2020	1166
27	Bombas	98	>>	Oromia	12/13/2018	12/12/2021	1772
28	Robe-Gasera-Giner Lot 1 (Robe-Gasera)	60	>>	Oromia	11/1/2017	10/30/2020	770
29	Gasera-Giner	61	>>	Oromia	12/9/2018	12/8/2021	842
30	Gedo-Menebegna	80.5	>>	Oromia	3/26/2014	3/25/2017	979
31	Ambo-Weliso	62	>>	Oromia	3/9/2015	1/1/2019	1294
32	Gore-Tepi	140	>>	Oromia	11/3/2018	5/30/2023	4468
33	Tepi-Mizan	48	>>	South People-Oromia	1/1/2018	1/25/2022	1246
34	Deri-Km 78 (Masha Lot 1) Gimbo	62	>>	Oromia	9/1/2017	9/17/2020	780
35	Limu Junction-Kosa-Seka (Merewa-Somedo Seka)	94	>>	>>			2268
36	Nekemet-Bure Lot 1	86	>>	>>	11/9/2016	11/9/2020	1816
37	Nekemet-Bure Lot 2	88	>>	>>	1/9/2019	11/9/2020	1765
38	Nekemet-Bure Lot 3	85	>>	>>	11/9/2016	11/9/2020	2044
39	Dibu River-Baday Cheleleka	44	>>	Oromia	11/8/2017	10/8/2020	726
40	Abomesa-Aseko-Dibu River	61	>>	Oromia	11/8/2017	10/8/2020	992
41	Sodo-Tercha Lot 1	76	>>	South People	6/2/2015	4/27/2019	1325
42	Sodo-Tercha Lot 2 (Omo-Tercha)	83	>>	South People	5/1/2015	11/13/2019	1460

No.	Ongoing projects	Length	Owner of the project	The location of the project	The time it was started (Ethiopian calendar)	Time to Complete (Ethiopian calendar)	Contract Amount Million Birr
43	Dulecha-Awash Arba	53	>>	Afar	7/14/2016	2/9/2020	717
44	Debre Birhan-Ankober	42	>>	Amhara	8/29/2018	10/22/2020	1084
45	Menebegna-Finche-Shambu	66	>>	Oromia	5/1/2017	5/31/2020	999
46	Alem Ketema-Degolo	85	>>	Amhara	4/28/2017	4/27/2020	1281
47	Degolo-Kesela	75	>>	Amhara	4/8/2017	4/7/2020	1300
48	Kesela-Akesta	40	>>	Amhara	1/22/2019	1/21/2021	568
49	Bishoftu-Chefe Donsa-Sendafa	52	>>	Oromia	5/6/2019	5/6/2022	915
50	Bole Junction-Weteredino Horticulture	30	>>	Oromia	10/4/2017	4/3/2020	360
51	Atat Mazoriya-Gunchere-Kose-Geja-Lera	81	>>	South People	10/16/2017	4/13/2021	1165
52	Robe-Agarfa-Ali	54	>>	Oromia	10/30/2018	1/30/2022	2153
53	Robe-Seru (Lot 2)	68	>>	Oromia	1/18/2019	1/17/2022	993
54	Gihur-Deneba- Lemi Junction-Guguftu-Wereilu-Degolo (Lot 2 Guguftu-Wereilu-Degolo)	74	>>	Amhara	8/23/2019	8/22/2021	1395
55	Tarma Ber-Molale-Mehal Meda	119	>>	Amhara	12/24/2018	12/23/2021	1852
56	Bilalo-Kersa-Arsi Negele	93	>>	Oromia	ሙጋቢት 2011	ሙጋቢት 2014	1565.4
57	Mekele-Degolat-Km 70	94	>>	Tigrai	11/1/2016	4/28/2020	1594
58	Mota-Jara Gedo	63	>>	Amhara	7/14/2017	1/12/2021	1620
59	Km 69 Angereb Contract 2	71	>>	Amhara	6/20/2017	10/17/2021	1721
60	Kunzela Junction-Filon Holticulture	24	>>	Amhara	1/24/2018	6/27/2021	554.5
61	Debre Markos-Elias-Kuch	81	>>	Amhara	4/19/2018	1/17/2023	1299
62	Wekro-Neblet	80	>>	Tigrai	11/29/2017	11/28/2020	1251
63	Neblet-Felafel	57	>>	Tigrai	11/29/2017	11/27/2020	1004
64	Tenta Junction-Wegeltena-Kurba	79	>>	Amhara	4/1/2019	3/30/2022	1873.5
65	Rama-Chila-Wekro-Maray	91	>>	Tigrai	1/1/2019	3/29/2022	1480
66	Adishehu-Dila-Samra	77	>>	Tigrai	11/13/2019	7/8/2022	2114
67	Adiarkay-Temlet	76	>>	Tigrai	1/17/2019	1/16/2022	1982
68	Pawi Junction Km 70 Lot 1	69	>>	Benishangul Gumz	6/1/2017	6/2/2020	888
69	Adiremet-Adihirda-Baikel	70	>>	Tigrai	10/16/2017	11/15/2020	1026
70	Kuwiha-Maymekden	24	>>	Tigrai	6/14/2017	12/1/2019	552
71	Wekro-Adbi-Konba	63	>>	Tigrai	12/17/2018	6/14/2022	1746
72	Metema-Abrajira	117	>>	Amhara	10/19/2017	4/19/2021	1548
73	Semema-Indabaguna	83	>>	Tigrai	12/20/2017	6/17/2021	2252
74	Adiabun-Rama	47	>>	Tigrai	9/3/2017	9/30/2020	807
75	Fiyel Weha-Tekeze River Bridge	40	>>	Tigrai	9/26/2017	9/30/2020	1166
76	Abiadi-Semema	87	>>	Tigrai	12/20/2017	6/20/2021	1748
77	Beles River-Mekane Birhan	39	>>	Amhara	10/1/2016	10/1/2019	1019
78	Adiremet-Kulita-Adigoshu	69	>>	Tigrai	7/23/2017	10/25/2020	953
79	Ajre-Keraker-Ketema Nigus Contract 2	57	>>	Amhara/Tigray	9/21/2018	9/20/2021	1159
80	Mekele Industry Park	18	>>	Tigrai	10/20/2017	12/23/2019	992
81	Sawela-Kako Contract 2 (Lot 2)	30	>>	South People	5/11/2017	11/21/2018	293
82	Adaba-Angetu	102	>>	Tigrai	1/3/2015	5/18/2019	1262
83	Daye-Cheri-Nansebo	73	>>	Tigrai	11/27/2017	11/26/2020	1682
84	Oblo-Dermi	63	>>	South People	10/10/2018	10/8/2021	893
85	Omo-Turmi	73	>>	South People	8/3/2017	8/30/2020	897
86	Edo-Surafeta-Warka	73	>>	South People	1/24/2019	1/23/2023	1687
87	Omorate-Omo-Kangaken	74	>>	South People	2/7/2019	2/7/2022	966
88	Morka-Gircha-Chencha	73	>>	South People	3/13/2019	10/12/2022	1967
89	Yabelo City Alernative Road	7	>>	Oromia	5/5/2019	12/11/2019	297
90	Linking Awassa City with the Airlines	34	>>	South People	11/17/2017	5/18/2019	592
91	Fiseha Genet-Soyama-Km 90 (Fiseha Genet-Kele-Nedele)	92	>>	South People	10/19/2017	4/18/2021	1.2
92	Arbarekete-Gelemso	58	>>	Oromia	7/30/2015	5/26/2019	1018
93	Gelemso-Micheta	46	>>	Oromia	11/16/2015	2/14/2019	982
94	Afdera-Earbeti Junction-Km 48 Contract 1	55	>>	Afar	5/2/2017	5/2/2020	1711
95	Km 48-Ertale Junction Ahmedela Contact 2	79	>>	Afar	5/2/2017	5/2/2020	1366
96	Babile-Fik Babile City-Km 33 Contract 1	36	>>	Oromia and Somali	1/12/2017	5/12/2020	408
97	Babile-Fik Km33-km66-Contract 2	30	>>	Somali	1/12/2017	6/20/2020	451

No.	Ongoing projects	Length	Owner of the project	The location of the project	The time it was started (Ethiopian calendar)	Time to Complete (Ethiopian calendar)	Contract Amount Million Birr
98	Babile-Fik Km 66-Km 93 Cotract 3	27	>>	Somali	1/12/2017	6/1/2020	401
99	Babile-Fik Km 1-Km 93 Fik City Contract 4	33	>>	Somali	5/2/2017	5/2/2020	448
100	Fik-Hamero	81	>>	Somali	5/2/2017	5/29/2020	819
101	Kebridehar-Warder	139	>>	Somali	7/6/2019	7/6/2022	1814
102	Chereti-Hager Mekor	90	>>	Somali	4/26/2017	4/26/2019	1300
103	Hager Mekor-Gorobebeksa (Kundi)	102	>>	Somali	12/12/2018	12/11/2021	1552
104	Jijiga-Tuli-Lowanda-Lule Add-Samkab-Haremukal	103	>>	Somali	9/4/2017	9/4/2020	1552
105	Mesel-Kori-Teru	84	>>	Afar	2/11/2019	10/30/2019	1536
106	Mesel-Kori-Teru Lot 2	72	>>	Afar	2/11/2019	2/10/2022	1502
107	Jijiga-Fafen -Gelalshe-Degehamedo Lot 2 ; Gelelsh-Degehamedo	52	>>	Somali	9/4/2017	9/4/2020	1064
108	Hamero-Emi	136	>>	Somali	8/11/2018	11/5/2018	1544
109	Gambela-Eliya	78	>>	Gambella	5/1/2017	5/1/2020	1029
110	Adura Akobo Ina Adura Burbe	126	>>	Gambella	3/16/2009	5/3/2019	833
111	Aysid-Kong (Guba-Begondi)	62	>>	Benishangul	3/10/2015	3/5/2019	521
112	Asosa-Daleti (Contract 2)	69	>>	Benishangul	5/1/2017	4/30/2020	732
113	Gnengnang-Jikawa-Lare	35	>>	Gambella	9/4/2019	45,173.00	1421
114	Km 76-Meti Lot 2	82	>>	Gambella	11/1/2017	5/12/2021	1298
115	Nekemet-Soge-Kamish-Koncho Lot 3 Km 160 Koncho	86	>>	Benishangul	የካቲት 2011	ጥር 2014	1327
116	Shishinda-Tepi	79	>>	South People	10/9/2018	10/8/2022	1250
117	Assosa-Daleti (Contract 1)	36	>>	Benishangul	3/15/2017	3/6/2020	229
118	Yaso-Galasa-Dibate (Lot 1) (Yaso-Km 100)	100	>>	Benishangul	2/15/2019	2/15/2022	2666
119	Ababo-Km 76	76	>>	Gambella	1/7/2017	7/21/2020	960
120	Omo/Say-Maji	34	>>	South People	2/20/2017	2/20/2020	772
121	Gambela-Abobo-Pugnido	103	>>	Gambella	10/17/2017	10/16/2021	1311
122	Dengoro-Kingi-Mekebela	30	>>	Oromia	1/30/2019	1/30/2022	416
In red the projects not identified on the map. Total capital in millions of birr		147,217.70					

Source: 5 Years Development Plan

In the MoT **TYP - *Ten-Years Development Plan (2013-2022***), it is planned to increase the total all-weather road coverage of the country from 144,027 kilometers to 245,942 km.

Following is the ETRE Ten years plan of Expressways.

Table 20: Expressways Development Plan

No	Road Name	Operating Status	Length (Km)	Projected Total Traffic	Projected Total Revenue
1	Addis - Adama	Operating	78	162,909,004.0	5,409,123,552.4
2	Dire - Dewelle	To be completed	223	6,068,644.0	1,095,086,993.5
3	Modjo - Hawassa	To be built	220	44,290,560.0	5,883,557,990.4
4	Addis Ababa - Holeta-Ambo	To be built	118	11,497,309.0	977,271,268.0
5	Addis Ababa-Commando	To be built	110	5,209,977.7	442,848,105.0
6	Addis Ababa - Alemgena-Woliso	To be built	110	8,812,230.6	749,039,598.0
7	Addis Ababa-Debrebirhan	To be built	129	2,698,130.1	229,341,059.0
8	Alemgena-Butajira	To be built	117	2,710,855.0	230,422,675.0
9	Dire Dawa-Dengego-Harar	To be built	50	2,570,695.0	218,509,075.0
10	Awash Junction-Adaitu	To be built	270	773,070.0	65,710,950.0
11	Adaitu-Mille-Semera	To be built	105		
TOTAL		**1,530**	**247,540,475.4**	**15,300,911,266.3**	

4.2 ROAD TRANSPORT SERVICES PLANNING

For local public transport, investments are planned to improve the infrastructure and services. Bus stations, stops and drop-offs, depots and parks are among the most common infrastructure. Most of these infrastructures is built in some of the country's major cities, especially in Addis Ababa.

At national level, 692 1st, 2nd and 3rd level stations are in Tigray 21, Oromia 235, Amhara 231, Addis Ababa 6, Dire Dawa 2, Benishangul 16, South 161, Gambella 7, Harar 1, Somali 6, Afar, and Addis Ababa. In addition, there are 2 depots in Addis Ababa, 7 parking (5 earth, 2 smart), 26.5 km bicycle lane, 995 bus stop shelters, 5.5 km a dedicated bus lane has been built for the bus.

After the National Road safety Strategic Plan (2011 – 2020), the 2018 National Road Safety Policy (NRSP) document sets out the Ministry of Transport's vision, values and priorities in relation to road safety of Federal Democratic Republic of Ethiopia (FDRE). The document also includes a clear recognition of the challenges and opportunities related to road safety improvements to all road user groups. The presented Road Safety Policy for the FDRE shall be governed by the Ministry of Transport (MOT).

Ministry of Transport is working to establish a national road safety performance review, as a base to take the adequate measures to avoid increasing fatality rates and property loss in Ethiopia. Given that lack of national-based road safety performance review has forced the transport authorities to use information and data only collected from police sources, medical centers and other responsible agents.

The TYP is planning to adopt a Road Transport and Road Safety Policy & Strategy, establish a Road safety Commission office, improve post-crash response and compensation to victims and obtain a reduction of the current road fatality rate from 34 to 10 accident/10,000 cars.

The **MoT FYP** foresees to develop Master Plans for each main city, developing mobility plans and non-motor transport strategy, involving public-private partnership funding system, in particular:

- Increase road transport service infrastructures; building 14 public transport centers, 3 freight transport terminals, 536 transport infrastructures in Addis Ababa (1DP, 5 high and low terminals, 505 transit stops, 25 parking), Dedicated Bus Lane, 40 km fast bus (BRT) on 4 corridors and a Bicycle Lane of 194.8 km in Addis Ababa, develop 4 transport technicians' training centers nationwide, build 6 Driver Training and Testing Traffic Cops and Building 4 bus depots in Public Service;
- Increase the number of passengers on public transport nationwide: providing a national transport capacity of 913 million people annually, opening 80 new cross-country public transit routes and delivering 304 service lines, increasing coverage from 67% to 85% on roads built on the Universal Rural Road Access Program, increase the average annual coverage of cross-country bus from 96,000 to 107,000 km, implementation 2,272 Transit and Border Public Transport Vehicles, establishing public transport service links with 5 neighbouring countries, providing 58,500 small and medium public transport services

The main objectives defined by Transport sector's ***10 Years Perspective Development Plan (2013-2022)*** for the public transport in Ethiopia are:

- Increase passengers' number from 722 million/2012 EC/to 1.5 billion in/2022 EC /;
- Increase Annual Routes coverage of public buses from 96,000 to 118,000 km;
- Increase passenger number of PSETSE from 32 million to 52 million;
- Increase Routes of Public Transport from 224 to 384;
- Increase the current single cross-border public transport to 6;
- Increase number of mini and medium size public transport vehicles from 144,000 to 284,000;
- Introduce urban mass transport and non-motorized transport schemes in 69 urban centers;
- Increase passenger mobility share of urban mass transport services from 31% to 70%;
- Increase regular road transport coverage in rural areas from 68% to 100%.

4.3 THE PROPOSED CLASSIFICATION OF ROADS

In March 2021 was presented a report, proposing a new Functional Classification of existing and planned roads at federal and regional level. The functional classification is based on the mobility and access criteria, having identified traffic generators and volumes along the network.

The new classification foresees the following functional system:

1. **Expressways**: Which serves and improves the mobility function of major transport corridors, high economic corridors, and serve as regional integration;
2. **Trunk roads**: Roads mainly connecting Addis Ababa with main transport corridors, regional capitals, and borders with higher Class TGA (Class I);
3. **Link Roads**: Roads connecting two trunk roads or major economic nodes with trunk roads (TGA class II with higher Class TGAs);
4. **Main Access Roads**: Roads which plays significant access role and connecting to major towns and economic nodes (TGA class III with higher Class TGAs);
5. **Collector Roads**: Roads connecting towns and market centers to the nearby higher class roads (TGA class IV with higher Class TGAs); and
6. **Feeder Roads**: These are basically low volume roads connecting small towns, markets and economic nodes to the nearby roads (TGA class V with higher Class TGAs).

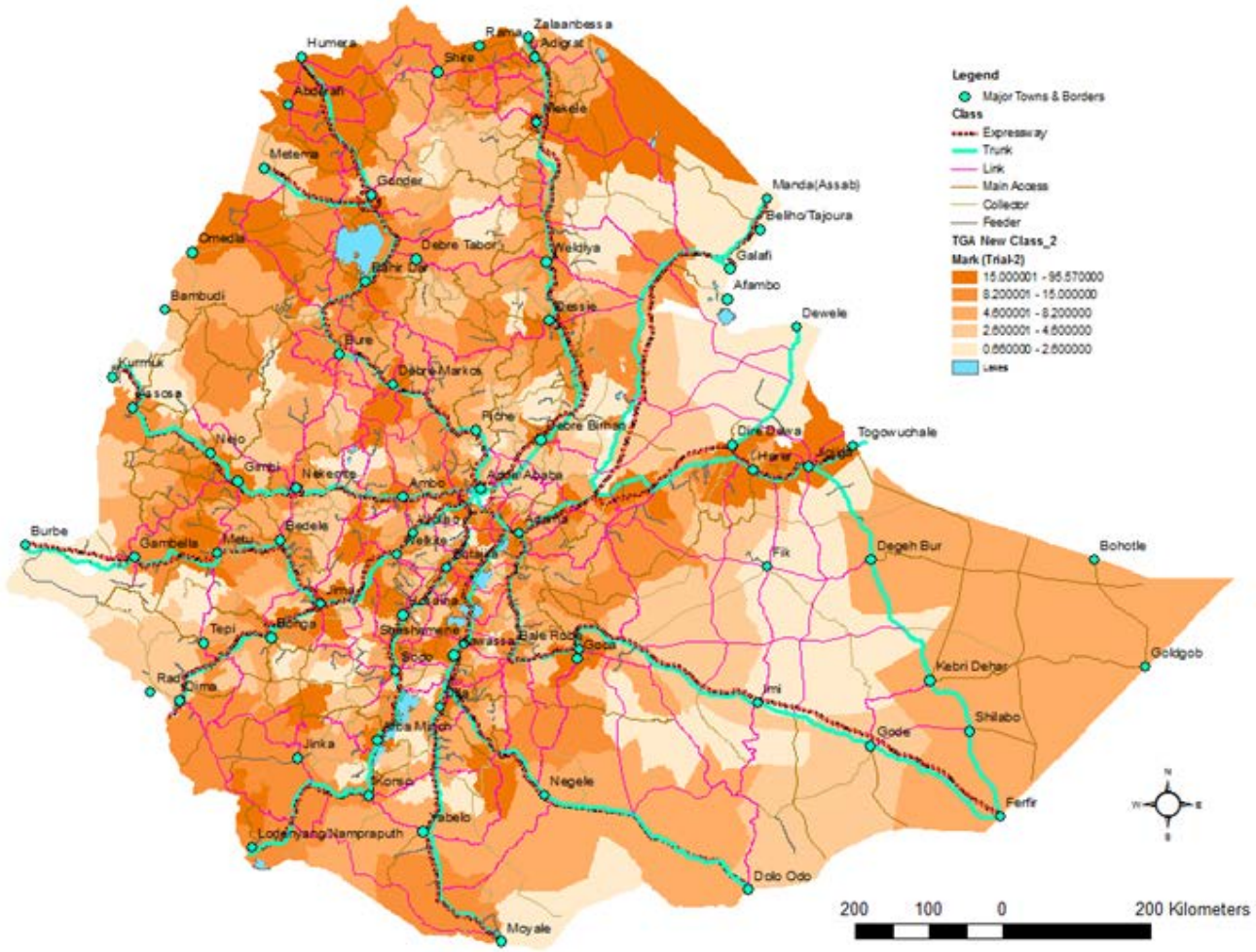
This brings the classification to six classes to serve the three broad functions and travel characteristics of roads as shown in Table .. below.

Table 21: Relationship between Proposed Functional Classification and Travel Characteristics

Proposed Road Classes	Functional Classification of roads	Main purpose	Significance	Distance Served (& length of route)	Distance Between Routes	Speed & Access point	Usage (Traffic flow/AADT)
Expressway	Freeway/ Principal Arterial	Mobility	State-wide	Longest	Longest	Highest speed & Few access	Highest
Trunk	Major Arterial						
Link	Sub Arterial	Integration/ Connection	Medium	Medium	Medium	Medium speed & Medium access	Medium
Main Access	Major Distributor/ collector						
Collector	Local/ Minor collector	Local Access	Local	Shortest	Shortest	Lowest speed & Many access	Lowest
Feeder	Local access roads						

As part of this exercise, the Ethiopian road network has been classified into six. When roads are connecting TGA centers with another road, the class of the road to be connected and the role of the road on the network are taken into consideration.

Figure 9: Functional Classification of Expressway, Trunk, Link, Main Access, Collectors and Feeder Roads



4.4 THE 10-YEARS FEDERAL ROAD NETWORK MASTER PLAN

In May 2021 was presented an updated 10-years Federal Road Network Master Plan that has identified:

a) An **optimum total country road network of 234,995 km**, established just assuring to Ethiopia the same road density shown by similar middle-income countries (205 km/1,000 sq. km). This assumption will require to increase the present 144,027 km of existing network of additional 90,968 km at country level.

b) The total required 90,968 km is **distributed to regions** proportionally based on land area of the region to the total land area of the country.

c) Out of the additionally required 90,968 km of new roads, 8.42% (7,664 km including 4,704 km **new missing links** and 2,960 km **expressway**) are estimated to be constructed by ERA while the regional governments and Woredas will construct the remaining 91.58% (83,304 km) of the network.

d) In details, 16,022.5 km of missing links (4,704 km to be constructed by ERA), 8,567 km of Expressways, 392 km of outer rings on selected towns and 10,458 km of external Rings connecting the proposed expressways and major towns were identified.

e) The five external rings are proposed in a certain interval distance from the capital Addis Ababa outwards to major towns, regional capitals and borders. The alignments are best chosen using route selection tools in GIS to get a more realistic length and minimized cost of construction. The Consultant has performed multi criteria analysis using socio economic and network connectivity criterion to set priority considering various scenarios.

f) Investment priority of 193 routes were defined allotting points to different attributes mainly to: population and number of towns, surplus and cash crop production criterion, road density (remoteness), improve connectivity by linking to better standard roads;

g) The study also assessed the benefits of construction of additional lanes along the existing routes and rehabilitation of existing lanes or construction of separate expressways.

The Consultant established a new network for the overall territory, enhancing the connectivity among regions and supporting international open-door strategies as the foundation of national development and inter-regional unification. In addition, a number of external ring networks are proposed to provide detour for selected major towns of high population and high network connectivity. This helps vehicles to maintain design speed and avoid congestion which will be created from traffic entering to the towns from different directions. The new proposed Expressway and Ring networks are stated as below.

5 DEVELOPMENT SCENARIOS

As described in the Consolidated Master Plan delivered in September 2021, in order to increase the ETMP50 resilience to different future uncertainties and have dynamic responses to different future situations, the Consultant has identified three general development scenarios for the country, that will influence a different distribution and modal split of transport demand in the next 30 years.

Appropriate "switching values" for passing from one scenario to another have been identified. It is anyway recommended, due to the future uncertainty situation, that the ETMP50 be monitored in its projection validity with a fixed frequency, that can be stated in every five years, in order to check the status of the key uncertainties and, if the case, to switch to the other reference scenario.

5.1 SCENARIOS CONSIDERED

The adoption of a dynamic planning and possible switching between different scenarios, is particularly important for the road transport infrastructures. Following the three-scenario adopted are described and the "switching" conditions.

5.1.1 The "Go-Ahead" Scenario

This is the scenario characterized by the continuity with the policies and the planning expressed by the government of Ethiopia in recent times. The macro-economic conditions hypothesized are the ones of the Base Scenario described in the paragraph 6.1.4.

International Conditions. There will be a smooth recovery from pandemic of the most developed countries, that recuperate the pre-Covid levels in two-three years, also thanks to a strong injection of public-funded investments in the economies. The trend toward globalisation will take new strength, with new records of world trade and progressive improvement of the LIC (Low Income Countries), that start experimenting autonomous growth, ignited by the Foreign Direct Investments (FDI).

National Conditions. In this frame the "*Homegrown Economic Reform Plan*" of Ethiopia keeps its objectives, even though the objectives are reached with years of delay. The International Organizations like FMI and WB express a strong support to the national objectives. Ethiopia is able to leverage on its points of strength, as to be the logistic hub of the Continent for the air transport, and becomes a preferred destination of the Foreign direct investments, with significant injection of know-how and new technologies.

Transport sector Conditions. The railway reform is implemented and the commercial performance substantially improved. As a logical consequence, international investors and operators show interest in entering the sector and position themselves through their investments. In a mix of PPP initiatives and of direct investments by the public rail operator, the reformed Railway is able to integrate and implement the Ethiopian Railway National Network.

This scenario can, in principle, fully incorporate the "Ten years Perspective Plan" of the transport sector.

In road sector a substantial number of infrastructures are built, in order to avoid the bottlenecks and to improve the service ratios.

International corridors are opened for the logistic integration of the horn of Africa, to connect Ethiopia to the ports of Berbera and Lamu via road, and to the ports of Port Sudan, Assab and again Lamu via rail.

Here the economic forecasts and the traffic demand for this scenario:

Table 22: GDP forecast

Year	ET GDP (constant 2010 US bn $)	Year over Year %	CAGR of the period %
2003	14,06	-	
2004	15,97	13,6	
2005	17,86	11,8	
2006	19,8	10,8	
2007	22,06	11,5	
2008	24,44	10,8	
2009	26,6	8,8	11,2
2010	29,93	12,6	
2011	33,28	11,2	
2012	36,16	8,6	
2013	39,98	10,6	
2014	44,09	10,3	10,6
2015	48,67	10,4	
2016	52,56	8	
2017	57,92	10,2	
2018	62,38	7,7	
2019	68	9	9,1
2020	69,29	1,9	
2021	69,29	0	
2022	71,09	2,6	
2023	73,51	3,4	
2024	75,45	4	2.4
2025	79,5	4	
2026	82,68	4	
2027	85,99	4	
2028	89,43	4	
2029	93,01	4	4
2030	98,59	6	
2031	104,5	6	
2032	110,78	6	
2033	117,42	6	
2034	124,47	6	6
2035	133,18	7	
2036	142,5	7	
2037	152,48	7	
2038	163,15	7	
2039	174,57	7	7
2040	185,04	6	
2041	196,15	6	
2042	207,92	6	
2043	220,39	6	
2044	233,61	6	6
2045	245,29	5	
2046	257,56	5	
2047	270,44	5	
2048	283,96	5	
2049	298,16	5	5

Table 23: Transport demand forecast

Year	GDP Year over Year %	ETA PASSENGERS	Passenger Transport Demand Year over year %	ETA FREIGHTS	Freights transport Demand Year over year %
2020					
2021					
2022					
2023					
2024	2,4	1,09	2,62	1,12	2,69
2025					
2026					
2027					
2028					
2029	4	1,09	4,36	1,12	4,48
2030					
2031					
2032					
2033					
2034	6	1,09	6,54	1,12	6,72
2035					
2036					
2037					
2038					
2039	7	1,09	7,63	1,12	7,84
2040					
2041					
2042					
2043					
2044	6	1,09	6,54	1,12	6,72
2045					
2046					
2047					
2048					
2049	5	1,09	5,45	1,12	5,6

5.1.2 The "Next Generation" Scenario

International conditions. The guiding idea under this scenario is that the technologies and the energy sources used in motorizing the transport means have shown in the last months an astonishing acceleration, thanks to the political actions in response of the global warming, and the major economies will invest unprecedented amounts of money in the re-conversion of their transport systems in order to reduce emissions. The Recovery plan of EU, financed with 1.800 billion Euro, will support many of these re-conversions in view of the new challenging objectives of EU and this will give momentum to the new technologies to evolve from the research and development phase to the mass production phase.

It is now clearer which technologies will dominate the next phase: electric and hybrid engines for the small and medium land vehicles and Hydrogen fuel cell engines for the large vehicles and for the sea vessels.

About Hydrogen engines for heavy trucks, it is a matter of fact that during 2020 almost all the leading world producers have announced the commercialisation of a new Hydrogen model:

- **Hunday** has already started to deliver its first fleet to Switzerland, where this kind of vehicle has total fiscal exemption.
- **Iveco** will start the production of its Fuel Cell Electric Vehicle (FCEV) in 2023, in partnership with Nikola
- **Bosch** will start the series production of its hydrogen engine in 2022-23;
- **Toyota** has announced the production in 2021 and the experimental use is already started
- **Daimler** trucks has announced its hydrogen model, with 1.000 km of autonomy for 2023.
- **Scania** has announced four new cell fuel vehicle and its partner ASKO has started building the network of the hydro-gas stations in Norway.

National Conditions. The production of the hydrogen as fuel will require high amounts of electricity, and the nations with relative abundant electric generation through green sources will have a comparative advantage in competition. Ethiopia, thanks to its hydroelectric massive investments, will be in that position.

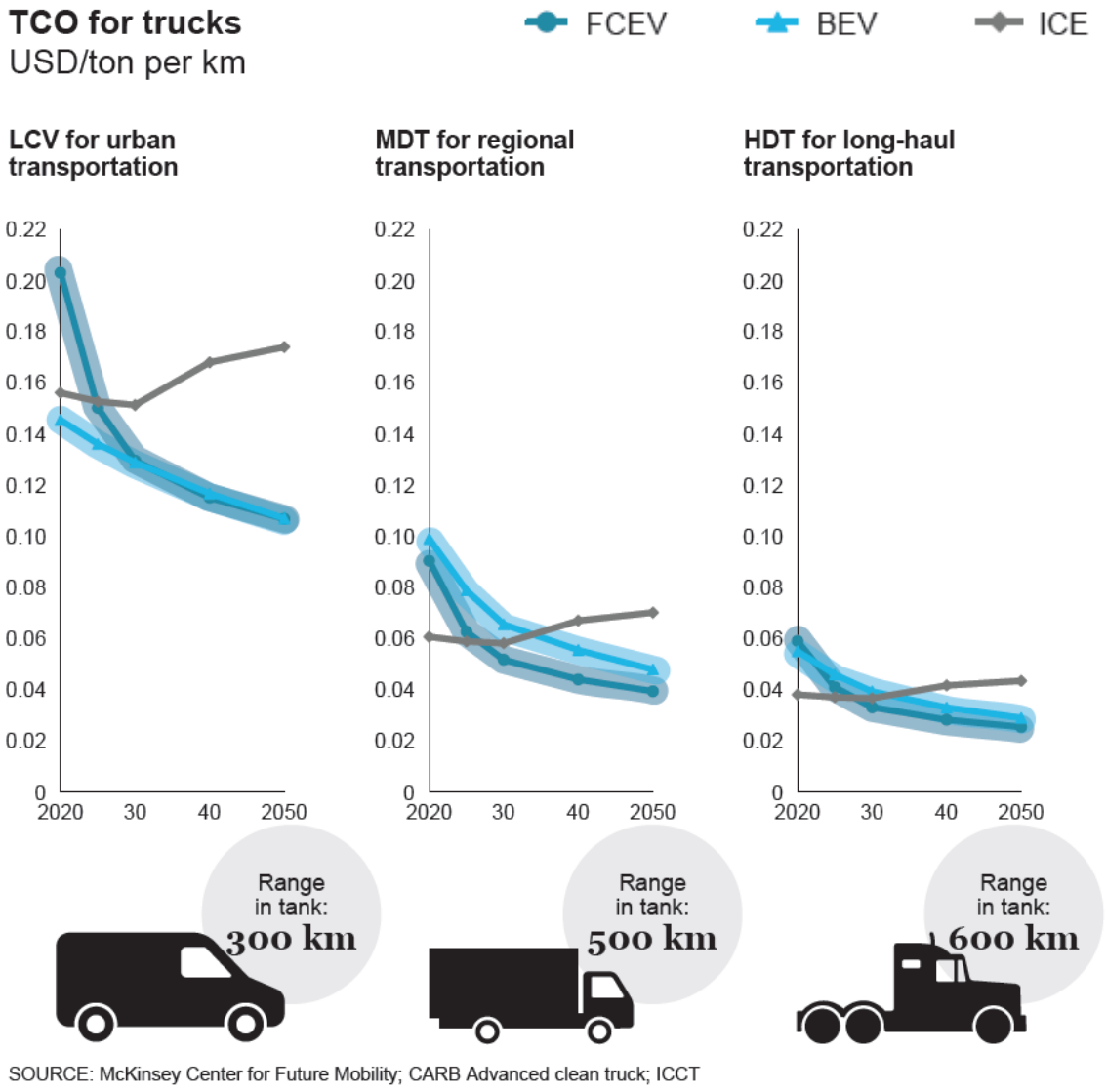
Transport Sector Conditions. The Ethiopian approach to the de-carbonisation, declared in Paris in occasion of the COP 21- Hydroelectric generation and electrified railway- has also the road alternative of zero emission via the use of coaches and trucks with fuel cell engines. This can reduce the risk of the start-up of new railways lines and better capitalize the recent and future investments in roads.

This scenario is based on a policy that is anyway coherent with previous initiatives of the government: the always declared approach to zero emissions policy and the start of the production in the Ethiopian transplant that produces electric cars as a initiative in cooperation between the Ethiopian Government and the Korean corporation Hunday.

It must be also considered that recent forecasts, done by Mc Kinsey and Co. locate in the Masterplan horizon the cost neutrality between the road freight traditional internal combustion vehicles (ICE) and Fuel Cell Electric Vehicles (FCEV), that use Hydrogen as fuel and produce zero emissions.

In particular, as the following picture shows, in the case of the Heavy-Duty Trucks (HDT), the total cost of operation is calculated as being four USD Cents per ton/km for ICE and six for FCEV in 2020. The projection to 2050 brings to invert the convenience: it will be 4,5 cents for ICE and just 3,5 cents for FCEV.

Figure 10: Total Cost of operations for ICE; BEV and FCEV Trucks



SOURCE: McKinsey Center for Future Mobility; CARB Advanced clean truck; ICCT

In these conditions, the investment plan will be much more focused on the road infrastructures, that become more efficient and far more environmentally friend. The railways investment is reduced and focused on the strategic lines, like the ones for the main international corridors.

The GDP forecast and the transport demand forecasts of this scenario coincides with the ones of the previous scenario:

Table 24: GDP forecast

Year	ET GDP (constant 2010 US bn $)	Year over Year %	CAGR of the period %
2003	14,06	-	
2004	15,97	13,6	
2005	17,86	11,8	
2006	19,8	10,8	
2007	22,06	11,5	
2008	24,44	10,8	
2009	26,6	8,8	11,2
2010	29,93	12,6	
2011	33,28	11,2	
2012	36,16	8,6	
2013	39,98	10,6	
2014	44,09	10,3	10,6
2015	48,67	10,4	
2016	52,56	8	
2017	57,92	10,2	
2018	62,38	7,7	
2019	68	9	9,1
2020	69,29	1,9	
2021	69,29	0	
2022	71,09	2,6	
2023	73,51	3,4	
2024	75,45	4	2.4
2025	79,5	4	
2026	82,68	4	
2027	85,99	4	
2028	89,43	4	
2029	93,01	4	4
2030	98,59	6	
2031	104,5	6	
2032	110,78	6	
2033	117,42	6	
2034	124,47	6	6
2035	133,18	7	
2036	142,5	7	
2037	152,48	7	
2038	163,15	7	
2039	174,57	7	7
2040	185,04	6	
2041	196,15	6	
2042	207,92	6	
2043	220,39	6	
2044	233,61	6	6
2045	245,29	5	
2046	257,56	5	
2047	270,44	5	
2048	283,96	5	
2049	298,16	5	5

Table 25: Transport demand forecast

Year	GDP Year over Year %	ETA PASSENGERS	Passenger Transport Demand Year over year %	ETA FREIGHTS	Freights Transport Demand Year over year %
2020					
2021					
2022					
2023					
2024	2,4	1,09	2,58	1,12	2,66
2025					
2026					
2027					
2028					
2029	4	1,09	4,36	1,12	4,48
2030					
2031					
2032					
2033					
2034	6	1,09	6,54	1,12	6,72
2035					
2036					
2037					
2038					
2039	7	1,09	7,63	1,12	7,84
2040					
2041					
2042					
2043					
2044	6	1,09	6,54	1,12	6,72
2045					
2046					
2047					
2048					
2049	5	1,09	5,45	1,12	5,6

5.1.3 The "Limits to Growth" scenario

International Conditions. This scenario could materialize if the economic effect of the pandemic will be much worse than the ones assumed in the World economic Outlook of October 2020 by IMF.

This would reflect in a deep economic, fiscal and employment crisis in the most developed western countries –particularly EU and USA – that would take years to recuperate the pre-Covid levels. In turn, the necessary measures to reduce the fast-growing public debt would resolve in cutting resourced for the bilateral cooperation and in reluctance to grant growing financial resourced to the international Development banks. The world trade growth rates would be hit by the reduction both of consumptions and of investments, and, in general, the interaction between developed and developing countries would decrease.

In this situation, the crisis would be quickly transferred to the Low-Income Countries (LIC).

National Conditions. For what concerns Ethiopia, the "*Homegrown Economic Reform Plan*" that continued to be vulnerable to external shocks, would see these vulnerabilities materialize.

In particular, it was already declared that potential shocks due to rising protectionism and weaker-than-expected global growth would negatively affect exports further exacerbating FX and debt vulnerabilities. Also, international air transport market, that brings relevant amounts of FX to Ethiopia, would see its perspectives worsening.

Under this scenario, the PPP attractiveness for international investors would be much reduced, and at the same time the public-owned transport and infrastructure Companies would have limited resources to be invested, in a general situation of shortage of FX and consequent difficulty to introduce foreign technologies to improve the national infrastructures and transport services.

Transport Sector Conditions. In this situation, it would be perfectly logic for the central Government to abandon the Go-Ahead scenario Master Plan and to recur to a Contingency Plan, coherent with the present Scenario.

The rational strategic approach to this Contingency Plan is to concentrate the investment spending to the ongoing projects, in order to complete them and avoid that the relevant investment expenses already borne would remain without benefits.

The new investment projects would be limited to the ones that can really make a strong difference and open a new business perspective. To finance these projects, the central Government should be able to provide the sovereign guaranties. A stronger investment activity can be borne in the second decade and third decade, when the conditions for a new growth phase will have been restored.

Furthermore, the investments less impacting in the short run on the FX need would have more possibility to be approved and carried on not incurring in the typical stop-and-go situation.

The Investment Plan accelerates after the first ten years, in parallel with the recovery.

Here the economic forecasts and the traffic demand for this scenario

Table 26: GDP forecast

Year	ET GDP (constant 2010 US bn $)	Year over Year %	CAGR of the period %
2003	14,06	-	
2004	15,97	13,6	
2005	17,86	11,8	
2006	19,8	10,8	11,2
2007	22,06	11,5	
2008	24,44	10,8	
2009	26,6	8,8	
2010	29,93	12,6	
2011	33,28	11,2	
2012	36,16	8,6	10,6
2013	39,98	10,6	
2014	44,09	10,3	
2015	48,67	10,4	
2016	52,56	8	
2017	57,92	10,2	9,1
2018	62,38	7,7	
2019	68	9	
2020	69,29	1,9	
2021	69,29	0	
2022	70,12	1,2	
2023	70,96	1,2	
2024	71,81	1,2	1,1
2025	72,68	1,2	
2026	73,55	1,2	
2027	74,43	1,2	2,3
2028	77,41	4	
2029	80,50	4	
2030	85,33	6	
2031	90,45	6	
2032	95,88	6	6
2033	101,64	6	
2034	107,73	6	
2035	115,27	7	
2036	123,34	7	
2037	131,98	7	7
2038	141,22	7	
2039	151,10	7	
2040	160,17	6	
2041	169,78	6	
2042	179,96	6	6
2043	190,76	6	
2044	202,21	6	
2045	212,32	5	
2046	222,93	5	
2047	234,08	5	5
2048	245,78	5	
2049	258,07	5	

Table 27: Transport Demand forecast

Year	GDP Year over Year %	ETA PASSENGERS	Passenger Transport Demand Year over year %	ETA FREIGHTS	Freights Transport Demand Year over year %
2020					
2021					
2022					
2023					
2024	1,1	1,09	1,4	1,12	1,23
2025					
2026					
2027					
2028					
2029	2,3	1,09	2,52	1,12	2,59
2030					
2031					
2032					
2033					
2034	6	1,09	6,54	1,12	6,72
2035					
2036					
2037					
2038					
2039	7	1,09	7,63	1,12	7,84
2040					
2041					
2042					
2043					
2044	6	1,09	6,54	1,12	6,72
2045					
2046					
2047					
2048					
2049	5	1,09	5,45	1,12	5,60

5.1.4 The key Uncertainties and their timing

The first key uncertainty to face in the time scale will be about the depth of the global economic crisis deriving from the pandemic and the recovery times at international and national level.
Within year 2023 it will be already time to ask the following question:

- *will economic growth recover and Homegrown economic reform plan can be respected?*

As a matter of fact, if the national GDP growth has not restored and reached a yearly rate of at least 3-4%, the transport infrastructure investment planned in the go-ahead Scenario will hardly be financially sustainable by the State Treasury, and will be necessary to reduce the investment plan, or, in other words, to switch to the Limits-to-growth Scenario. In that scenario the stagnation will last about seven years, probably coupled with general instability, and then the path of growth will be restored and a more significant amount of infrastructure investments can be performed.

In the hopefully case that the *Homegrown economic reform plan* can be respected, then the next key uncertainty will materialize around the year 2025, a time span sufficient to understand if the complex process of railway reform, at present under study by the MOT, will have started having encouraging results, both in terms of institutional capacity and in terms of commercial and production performance of the operating railway lines, particularly the Addis- Djibouti one.
So, the question to be answered around year 2025 is the following:

- *will Ethiopian railway reform be successful and its commercial performance accelerates?*

If the answer will be positive, then the Go-Ahead Scenario will still be on and its policies and investment plan, with a huge part dedicated to railway lines, can continue. If the answer, at the opposite, will be negative, to invest very relevant resources in a modality that still has institutional, organization and technical problems unresolved will be a hazard. In this case it will be logical to bet more on the road modality, and, in order to mitigate the environmental impact of this policy, it will be opportune to structure a policy of incentives and of direct intervention by the SOE to anticipate the introduction of less impacting vehicles. In other words, it will be the case to switch to the Next Generation Scenario.

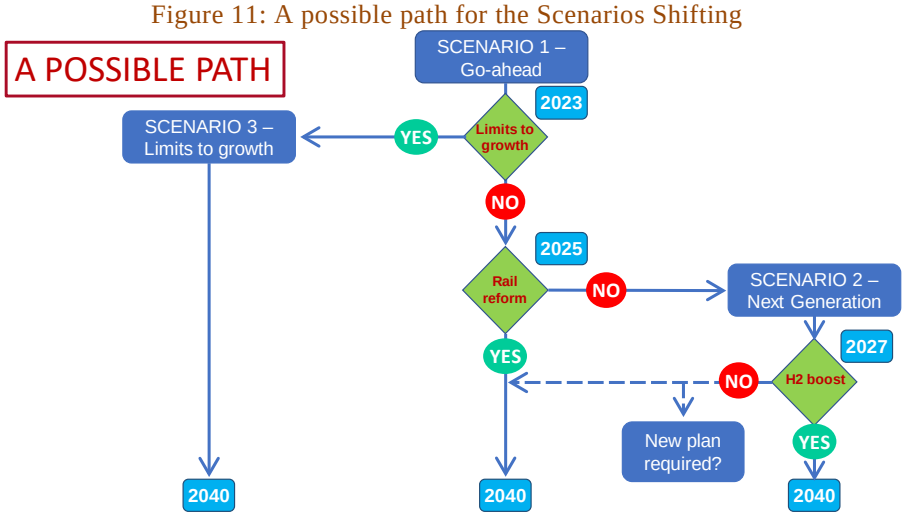
Also, in this scenario a key uncertainty will be faced, presumably around the year 2027. At that period, it will be much easier to answer the question about the third key uncertainty:

- *is the "energy transition" and the Hydrogen technologic shift materializing?*

In case of positive answer, the relevant road investments can be effectively complemented with the incentives policy, and the effect in the medium-long term will be a significant development of the road transport in a framework of economic and environmental sustainability. In case of negative answer, it will be necessary to make a technology assessment and coherently define a "road vehicles strategy", that can assume as "bridge policy" an intermediate stage of promotion of more mature and low impacting technologies, as hybrid motorization and/or LNG engines.

At the same time the status of the railway sector can be re-evaluated. At that point an "extraordinary maintenance" of the NTMP can be recommended.

Figure 11: A possible path for the Scenarios Shifting



In general, to find the right path, and to make the right shift between scenarios, a monitoring procedure of the plan projections and implementation. It will be proposed by the Consultant within the capacity-building part of the assignment. As anticipated, a five-years revision of the hypotheses underlying the Plan is opportune. The results of this revision should guide any decision to switch to another scenario as baseline, or eventually to reformulate the Scenario and to have a new run of the Master Plan Model with different value of the variables exogenous to the model itself.

5.1.5 The key Uncertainties Indicators

In order to anticipate the understanding of the phenomenon about the key uncertainties, it is hypothesized here a number of indicators to be monitored for each key uncertainty. A precise list, together with the guiding values, will be supplied within the procedure for the ETMP five-years revision. It will be preferred to select a main indicator, in order to have precise threshold values and minor ambiguities in the data interpretation. A number of ancillary indicators can complete the picture.

Indicators for Key Uncertainty 1: will economic growth recover and *Homegrown economic reform plan* can be respected? The grow rate of GDP should be the principal indicator. Ancillary positive indicators can be a good FX availability, the export of goods increase, the balance of trade improvement, the foreign exchange stability.

Indicators for Key Uncertainty 2: will Ethiopian railway reform be successful and its commercial performance accelerates? The main indicator should be the percentage of increase in Tonnes-km transported on the Addis-Djibouti line, that nowadays is below the expected results and needs to be almost doubled to allow a better profitability of the line.

Ancillary variable as positive indicators can be:

- Good organization integration and clear command-and-control-line-between the former ERC, EDR and CDE;
- Full institutional implementation of the Railway Safety Regulatory Body;
- Start of private investments in railway sector in accordance of approved schemes of PPP.
- Indicators for Key Uncertainty 3: is the "energy transition" and the Hydrogen technologic shift materializing?

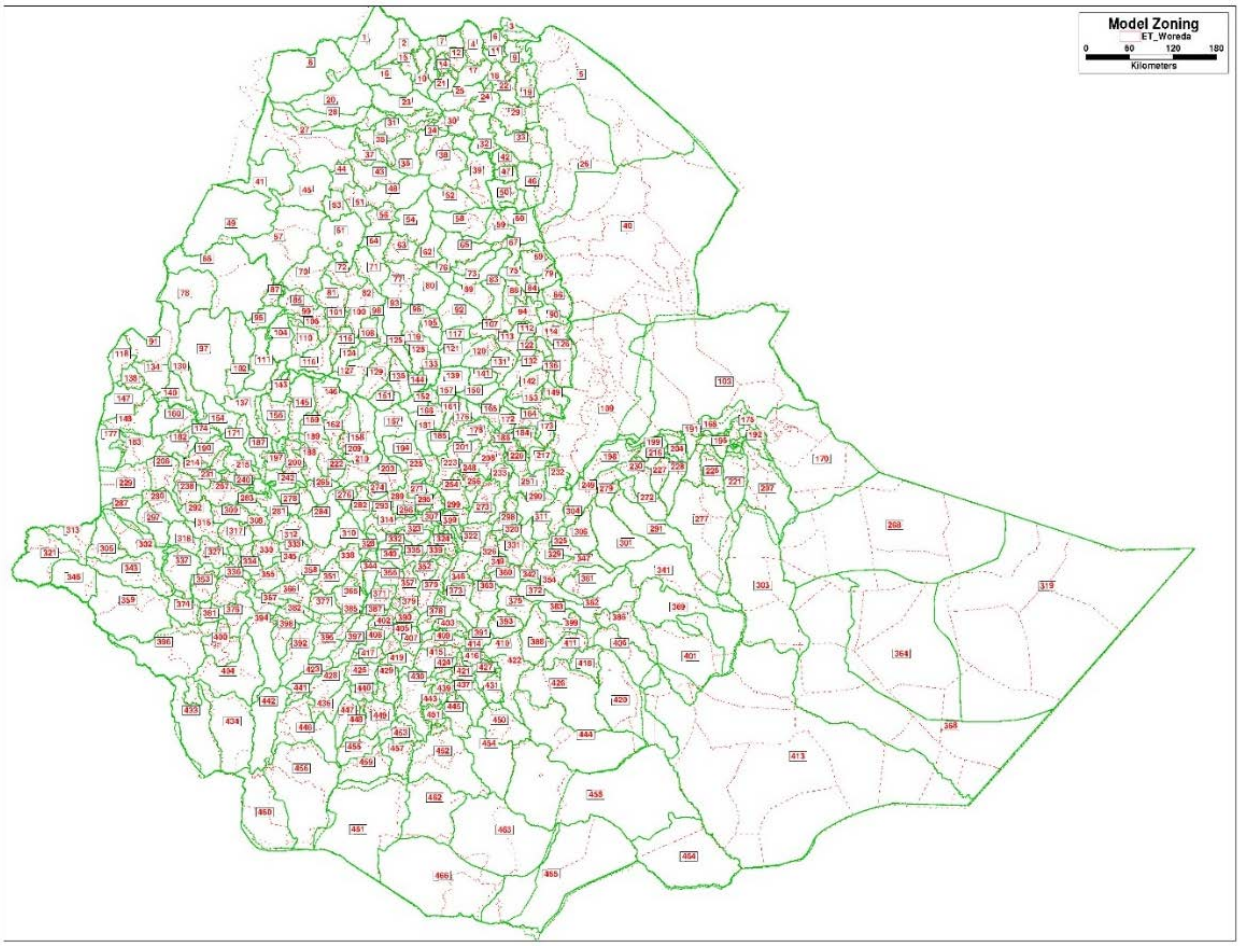
The main indicator should be the Hydrogen Fuel cell engines as percentage of the delivery of new heavy trucks in Developed countries. Ancillary variable as positive indicators can be:

- delivery of new electric cars (battery electric + Hydrogen fuel cell) in the Developed countries become more than the 50% of the total in the period.
- GOE officialises its own "Hydrogen Strategy"
- Ethiopia start using part of the surplus of hydroelectric energy to produce "green hydrogen

5.2 FUTURE TRANSPORT DEMAND MATRICES

The Present Transport Model (PTM) has been calibrated for all modes of transport, using the present freight, passengers and vehicle Origin/Destination Matrix and a detailed zoning of Ethiopia territory at woreda level, as shown in the following figure, with each zone ID numbering.

Figure 12: Model Zoning



In order to build the Future Transport Model at different horizons (2025, 2035 and 2050), different socio-economic and territorial development foreseen in the short and medium-long term have been considered, increasing or decreasing the average traffic demand growth calculated in the preceding paragraph. A specific traffic demand growth factor has been calculated for each woreda, in accordance with its foreseen territorial development, building new Future Origin/Destination Matrix for freight, passengers and vehicles at the different time horizons considered.

In this way the future transport demand will be integrated with the future need of mobility for passengers, freight and vehicles. To expand the traffic demand matrices to the future, the Consultant has taken into consideration the different territorial socio-economic developments foreseen, in terms of urban, population, industrial, agricultural, mining, tourist and trade development foreseen.

Following are the considerations made for each territorial development aspects considered.

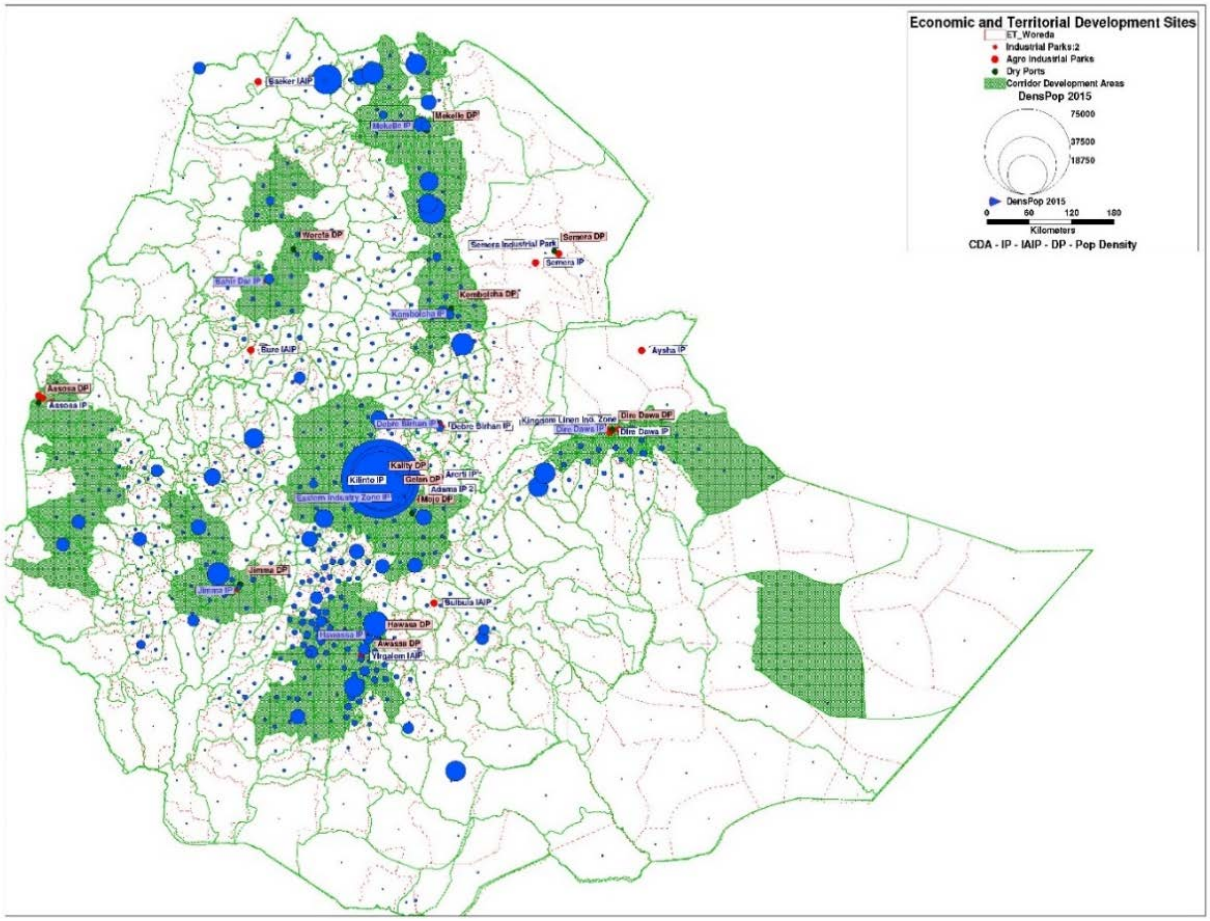
5.2.1 Urban development & population density areas

As shown in the Urban Development Sector Report, the spatial planning of the country will enhance urbanization and industrial development in strategic development corridors, like Mekele-Kombolcha industrial corridor, Jimma agricultural corridor, Gambela export corridor, DireDawa-

Jijjiga trade corridor, Lake Tana agricultural area, Hawassa economic corridor, Degehabur-Kebridehar pastoralist corridor and Addis Ababa and surrounding towns development area.

The following figure show the location of areas with more than 1,000 inhabitants per sq. km, that are to be considered as urban areas with high potential for development and attracting and generating additional traffic demand and the location of the spatial development areas where industrial and agro-industrial areas are concentrated.

Figure 13: Economic development areas

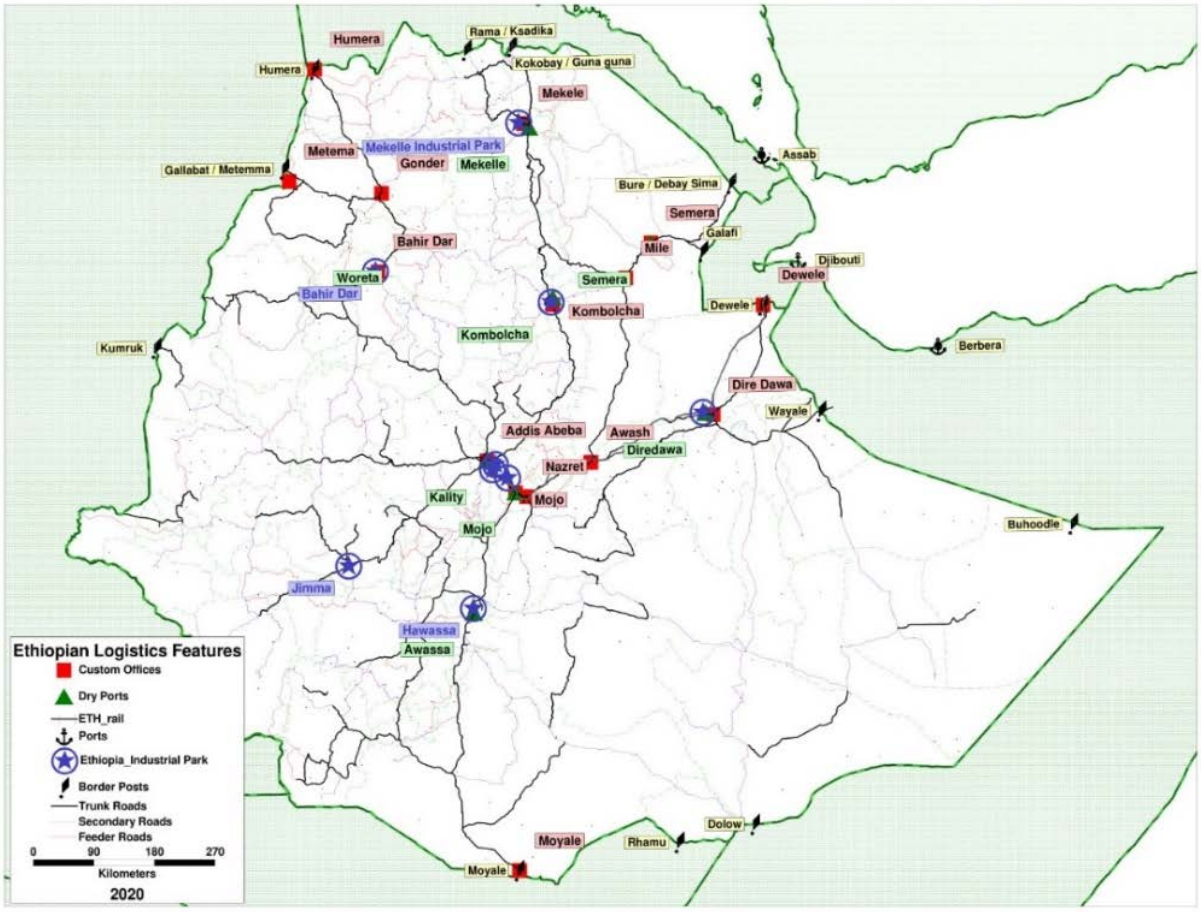


Belonging to a development corridor, the woreda is estimated to generate/attract a surplus of transport demand of 25% annually on the base demand growth, both for passengers and freight. At the same time the dynamic of progressive urbanization in Ethiopia will concentrate transport demand in urban areas with a surplus increase of 50% for passengers and 30% for freight.

5.2.2 Industrial Parks & Logistics

According with paragraph 4.5 of the Consolidated Report, a number of industrial parks and agro-industrial parks are programmed in different parts of the country, together with additional dry ports to serve for related import/export products. The location of these parks will generate/attract a surplus of transport demand of 25% annually for freight and 10% annually for passengers.

Figure 14: Industrial Parks



5.2.3 Agricultural surplus production & Agro-centres

On the base of the Agricultural Growth Program (AGP) shown in paragraph 4.4 of Consolidated Report, the foreseen surplus crop areas and agro-centers of the country are shown in the following figures. Belonging to a crop surplus area, the woreda is estimated to generate/attract a surplus of transport demand of 1% annually for passengers and of 15% for freight. At the same time the location of agro-centers will increase by 2% the passenger demand and 25% the freight demand.

Figure 15: Agricultural surplus areas

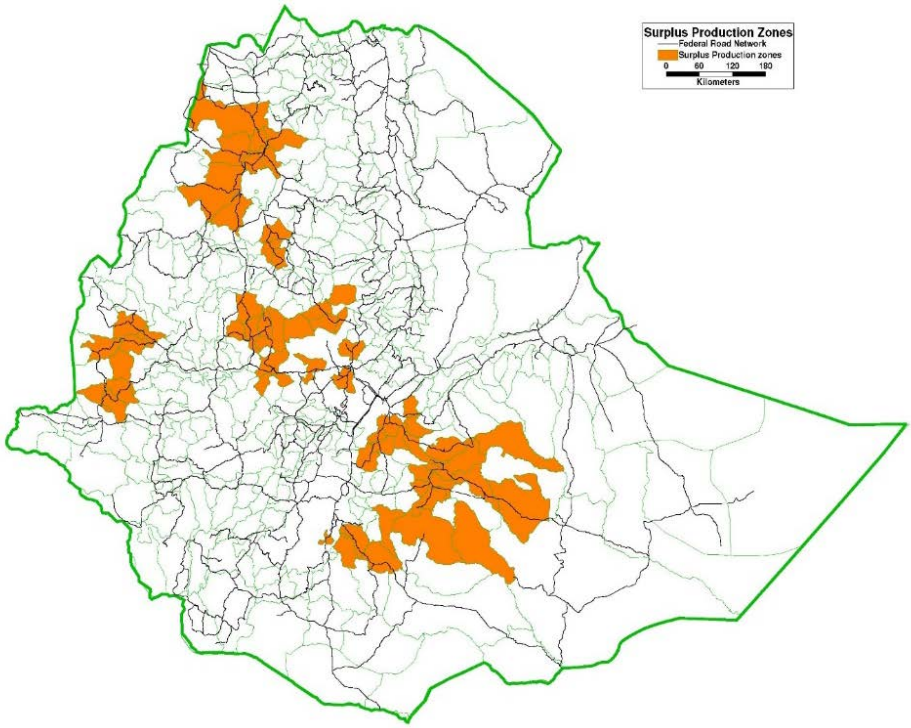
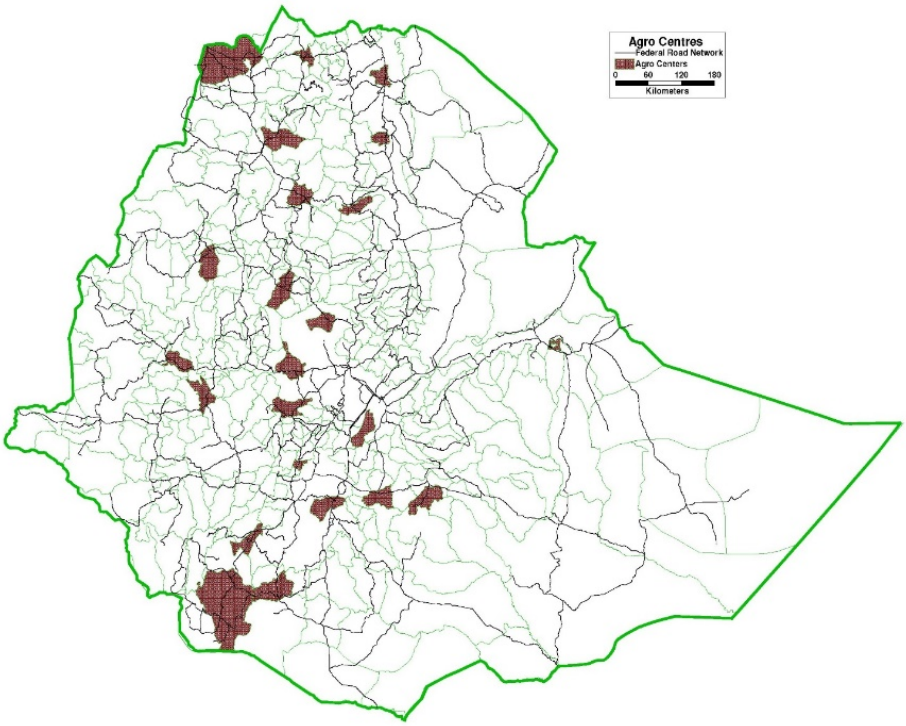


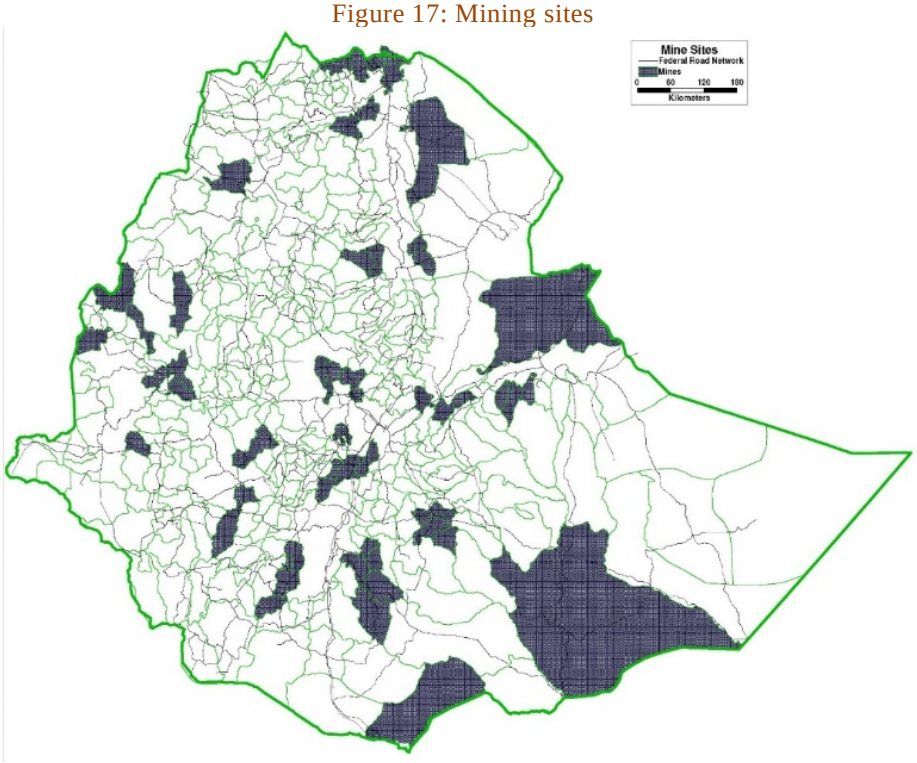
Figure 16: Agricultural Centres



5.2.4 Mining sites

In consideration of the mining development described in paragraph 4.7 of Consolidated Report, and the location of mining sites shown in the following figure, the areas with mining potential have been received a surplus of 1% for passengers and 25% for freight demand.

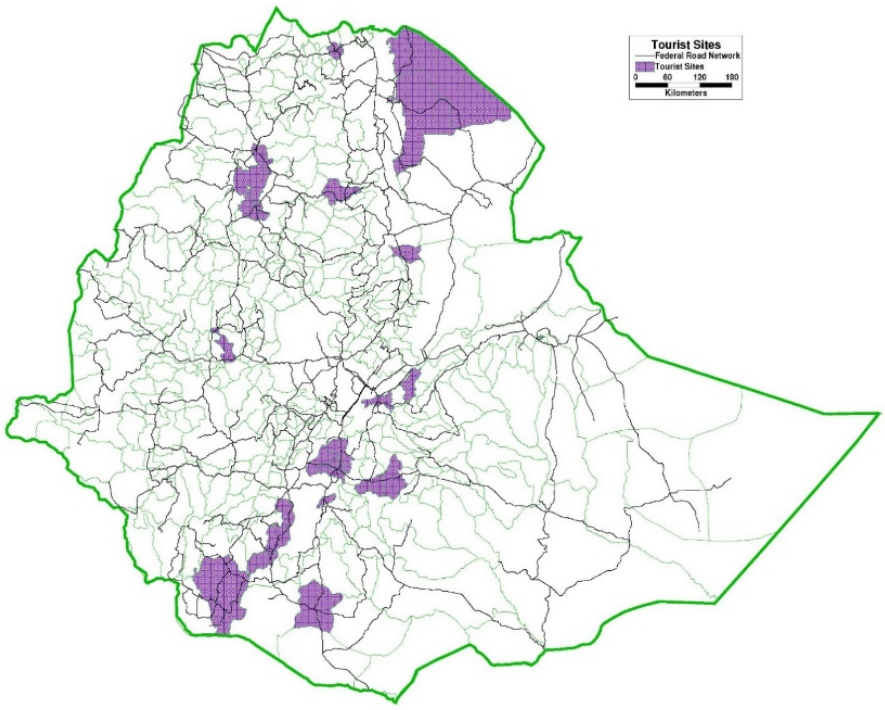
Figure 17: Mining sites



5.2.5 *Tourist sites*

In consideration of the tourist development areas of the country, described in paragraph 4.8 of Consolidated Report and shown in the following figure, the areas with tourist potential have been received a surplus of 5% for passengers' transport demand.

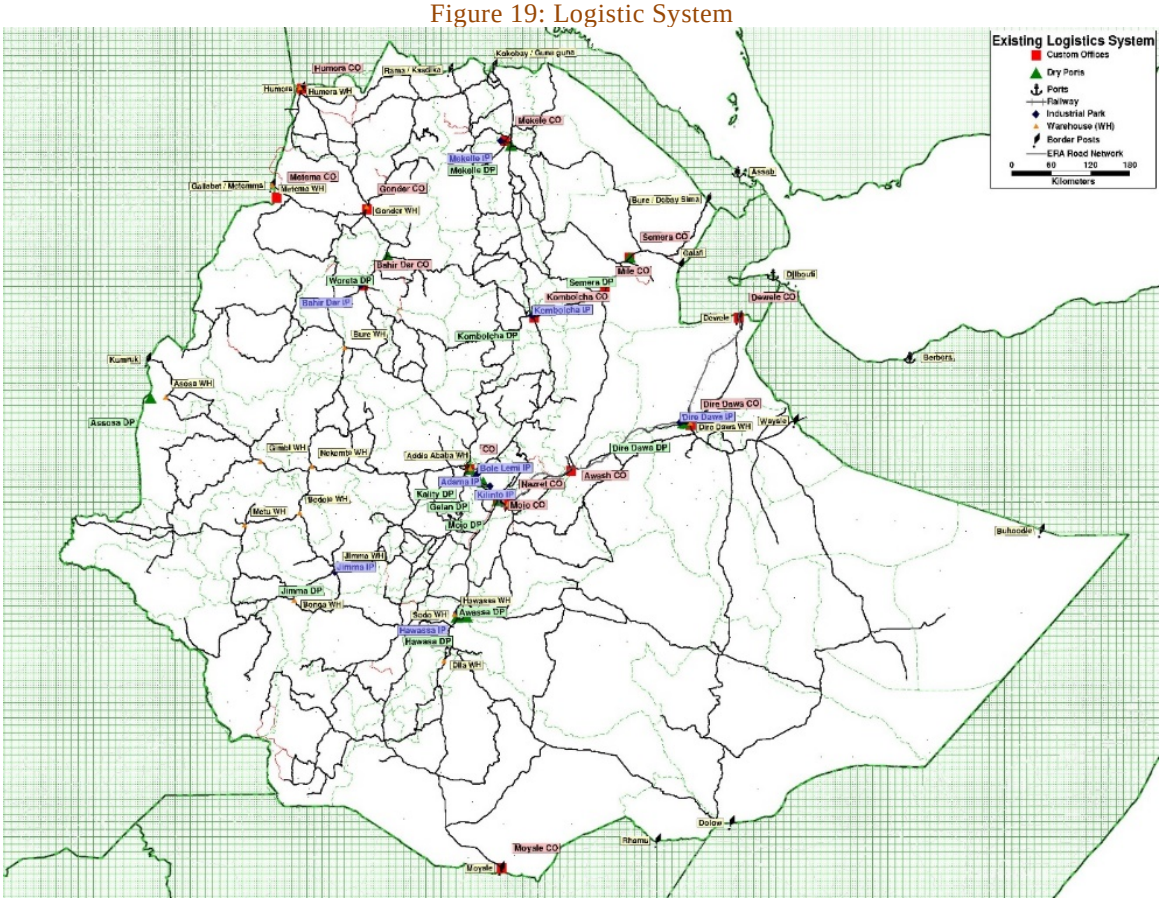
Figure 18: Tourist Areas



5.2.6 Trade centres

The regional transit corridors are the main access to international trade of the country and are to be considered, together with custom areas and dry ports as main generating/attraction poles. (see paragraph 2.5 of consolidated Report) the woreda that are located in border crossing and custom areas have been given a 20% surplus of freight transport demand.

Figure 19: Logistic System



The following table show the number of woredas where there is a specific development foreseen and the kind of surplus growth attributed.

Table 28: Presence of socio-economic development factors in the woredas

Incremental Growth Factors	Passengers		Freight	
	Surplus factor	Numb. of zones	Delta factor	Numb. of zones
Base Zones	negative	87	negative	87
Corridor Development	positive	159	positive	159
Urbanization	positive	52	positive	52
Industrial & Agro-Industr.	positive	15	positive	15
Crop Surplus Production	positive	58	positive	58
Agro Centres	positive	22	positive	22
Mines	positive	54	positive	54
Tourist Site	positive	26	nul	26
Internat. Trade	nul	14	positive	14

Finally, the table below reports for each woreda the kind of development included:

Table 29: Woredas with sustained transport generation/attraction growth

ID	Region	Zones	WOREDA	Corridor Develop.	Urbanization	Industrial & Agro Ind. Parks	Crop Surplus - tons	Agro-centres	Mines	Tourist Sites	International Trade
1	Tigray	Western	Tahtay Adiabo								
2	Tigray	Western	Laelay Adiabo								
3	Tigray	Eastern	Erob	Mekelle UA					MINE		
4	Tigray	Central	Adi Ahferom	Mekelle UA					MINE		
6	Tigray	Eastern	Gulo Mekheda						MINE		
7	Tigray	Central	Mereb Lekhe						MINE		
8	Tigray	Western	Kafta-Humera		Humera	IAIP Baeker		Humera			Humera CO
9	Tigray	Eastern	Saesie-Tsaedaem	Mekelle UA					MINE		
11	Tigray	Eastern	Ganta Afe Shum	Mekelle UA	Adi Girat Town						
12	Tigray	Central	Adwa	Mekelle UA	Adwa Town					Aksum	
14	Tigray	Central	Laelay Maichew		Akisum Town						
15	Tigray	Western	Tahtay Koraro		Shire EnidanSilase						
16	Tigray	Western	Asgede-Tsimbila								
17	Tigray	Central	Werii Lekhe	Mekelle UA							
18	Tigray	Eastern	Hawzien	Mekelle UA							
19	Tigray	Eastern	Atsbi-Wenberta	Mekelle UA							
20	Tigray	Western	Wolkait								
22	Tigray	Eastern	Wukro	Mekelle UA	Wekere Town			Wukro			
23	Tigray	Western	Tselemti								
24	Tigray	Central	Degua Tembien	Mekelle UA					MINE		
25	Tigray	Central	Kolla Tembien	Mekelle UA	Abiyi Adi Town						
28	Tigray	Western	Tsegedie								
29	Tigray	Southern	Enderta	Mekelle UA	Mekelle Town	IP Mekelle+Mekelle DP					Mekele CO
30	Tigray	Central	Abergelle	Mekelle UA					MINE		
32	Tigray	Southern	Samre-Seharti	Mekelle UA							
33	Tigray	Southern	Hintalo-Wajirat	Mekelle UA							
42	Tigray	Southern	Alajie	Mekelle UA							
46	Tigray	Southern	Raya Azebo	Mekelle UA							
47	Tigray	Southern	Enda Mekhoni	Mekelle UA	Maychew Town			Maychew			
50	Tigray	Southern	Ofla	Mekelle UA	Korem Town						
55	Tigray	Southern	Alamata	Mekelle UA	Alamata Town						
309	Southern Region	Gurage	Soddo	Addia Abab					MINE		
314	Southern Region	Gurage	Gorro					Tumi			
315	Southern Region	Gurage	Kokir Gedebano	Addia Ababa UA							
332	Southern Region	Gurage	Cheha		Welkite Town						

ID	Region	Zones	WOREDA	Corridor Develop.	Urbanization	Industrial & Agro Ind. Parks	Crop Surplus - tons	Agro-centres	Mines	Tourist Sites	International Trade
336	Southern Region	Keficho Shekich	Gesha								
339	Southern Region	Gurage	Silti		Butajira Town						
350	Southern Region	Gurage	Lanfaro						MINE		
353	Southern Region	Keficho Shekich	Masha Anderacha								
367	Southern Region	Keficho Shekich	Gimbo	Jimma UA							
370	Southern Region	Kembata Alaba T	Alaba	Hawassa Southern					MINE		
371	Southern Region	Hadiya	Soro		Hoaena Town						
376	Southern Region	Keficho Shekich	Chena								
379	Southern Region	Kembata Alaba T	Kedida Gamela	Hawassa Southern							
380	Southern Region	Kembata Alaba T	Angacha					Hosaina			
382	Southern Region	Keficho Shekich	Menjiwo	Jimma UA							
390	Southern Region	Hadiya	Badawoch	Hawassa Southern	Kedida Town						
392	Southern Region	Semen Omo	Ela						MINE		
396	Southern Region	Bench Maji	Sheko								
398	Southern Region	Keficho Shekich	Tello		Bonga Town						
400	Southern Region	Bench Maji	Bench		Miza Aman Town						
402	Southern Region	Semen Omo	Boloso Sorie	Hawassa Southern							
403	Southern Region	Sidama	Awassa	Hawassa Southern	Shashemene Town					Hawassa	
405	Southern Region	Semen Omo	Damot Gale	Hawassa Southern							
407	Southern Region	Semen Omo	Damot Weidie	Hawassa Southern							
409	Southern Region	Sidama	Shebedino	Hawassa Southern	Shebediro Town						
412	Southern Region	Semen Omo	Sodo Zuria	Hawassa Southern	Sodo Town						
415	Southern Region	Sidama	Dale	Hawassa Southern				Dila			
416	Southern Region	Sidama	Arbegona								
417	Southern Region	Semen Omo	Offa	Hawassa Southern							
419	Southern Region	Semen Omo	Humbo	Hawassa Southern							
421	Southern Region	Sidama	Hula	Hawassa Southern							
423	Southern Region	Semen Omo	Melekozza								
424	Southern Region	Sidama	Aleta Wondo	Hawassa Southern						Yrgalem	
425	Southern Region	Semen Omo	Kucha								
427	Southern Region	Sidama	Bensa						MINE		
428	Southern Region	Semen Omo	Gofa Zuria								
429	Southern Region	Semen Omo	Boreda Abaya	Hawassa Southern					MINE	Rift Valley Lakes 1	
431	Southern Region	Sidama	Aroresa						MINE		
432	Southern Region	Sidama	Yirga Dera	Hawassa Southern	Aleta Wonda Town						
435	Southern Region	Gedeo	Wenago	Hawassa Southern	Dila Town						
436	Southern Region	Semen Omo	Zala Abamale					Sawla			
438	Southern Region	Semen Omo	Chencha	Hawassa Southern					MINE		

ID	Region	Zones	WOREDA	Corridor Develop.	Urbanization	Industrial & Agro Ind. Parks	Crop Surplus - tons	Agro-centres	Mines	Tourist Sites	International Trade
439	Southern Region	Gedeo	Bule	Hawassa Southern							
440	Southern Region	Semen Omo	Deta Daramalo	Hawassa Southern							
441	Southern Region	Semen Omo	Basketo								
442	Southern Region	Debub Omo	Silamago								
443	Southern Region	Gedeo	Yirga Chefe	Hawassa Southern			150,000				
446	Southern Region	Debub Omo	Bako Gazer					Jinka			
447	Southern Region	Semen Omo	Kemba	Hawassa Southern							
448	Southern Region	Semen Omo	Bonkie	Hawassa Southern							
449	Southern Region	Semen Omo	Arbaminch Zuria	Hawassa Southern	Abra Minch Town				MINE	Chamo Lake	
451	Southern Region	Gedeo	Kocherie	Hawassa Southern							
453	Southern Region	Amaro	Amaro	Hawassa Southern							
455	Southern Region	Derashie	Derashie						MINE	Riflt Valley Lakes 2	
456	Southern Region	Debub Omo	Hamer Bena							Omo and Mago Natinal Pakks	
459	Southern Region	Konso	Konso					Konso			
460	Southern Region	Debub Omo	Kuraz								
103	Somali Region	Shinile							MINE		Dewele CO
170	Somali Region	Jigjiga		Dire Dawa UA							
364	Somali Region	Korahe		Dega Habour							
413	Somali Region	Afder							MINE		
139	Oromia	North Shoa	Dera				undefined				
143	Oromia	East Welega	Ebantu								
145	Oromia	East Welega	Gida Kiremu								
146	Oromia	East Welega	Amuru Jarte				150,000,00				
152	Oromia	North Shoa	Were Jarso	Addia Ababa UA			150,000,00				
156	Oromia	East Welega	Limu								
157	Oromia	North Shoa	Hidebu Abote	Addia Ababa UA							
158	Oromia	East Welega	Guduru				150,000				
159	Oromia	East Welega	Abay Chomen				150,000				
160	Oromia	West Welega	Menesibu	Gambella UA			150,000				
161	Oromia	North Shoa	Degem	Addia Ababa UA			150,000				
162	Oromia	East Welega	Jimma Horo		Shambu Town		150,000				
163	Oromia	North Shoa	Girar Jarso	Addia Ababa UA	Fiche Town						
166	Oromia	North Shoa	Kuyu	Addia Ababa UA			150,000	Gabre Guracha			
167	Oromia	West Shoa	Ginde Beret	Addia Ababa UA			undefined				
169	Oromia	East Welega	Abe Dongoro				150,000				
174	Oromia	West Welega	Nejo				150,000				

ID	Region	Zones	WOREDA	Corridor Develop.	Urbanization	Industrial & Agro Ind. Parks	Crop Surplus - tons	Agro-centres	Mines	Tourist Sites	International Trade
175	Oromia	East Harergie	Jarso (2)	Dire Dawa UA							
176	Oromia	North Shoa	Yayagulelena De	Addia Ababa UA							
179	Oromia	East Harergie	Kombelcha	Dire Dawa UA							
181	Oromia	West Shoa	Meta Robi	Addia Ababa UA					MINE		
182	Oromia	West Welega	Jarso (1)	Gambella UA			150,000				
183	Oromia	West Welega	Begi (2)	Gambella UA			800,000				
185	Oromia	West Shoa	Adaa Berga	Addia Ababa UA					MINE		
188	Oromia	East Welega	Sibu Sire							Oromiya National Park	
189	Oromia	East Welega	Billa Seyou								
190	Oromia	West Welega	Boji						MINE		
191	Oromia	East Harergie	Metta	Dire Dawa UA							
192	Oromia	East Harergie	Gursum	Dire Dawa UA							
193	Oromia	East Harergie	Gorro Gutto	Dire Dawa UA							
194	Oromia	West Shoa	Jeldu	Addia Ababa UA							
195	Oromia	East Harergie	Kersa	Dire Dawa UA							
196	Oromia	East Harergie	Haremaya	Dire Dawa UA							
197	Oromia	East Welega	Sasiga								
198	Oromia	West Harergie	Miesso								
199	Oromia	West Harergie	Dobba	Dire Dawa UA							
200	Oromia	East Welega	Guto Wayu		Nekemte Town						
201	Oromia	North Shoa	Mulona Sululta				undefined		MINE		
203	Oromia	West Shoa	Ambo	Addia Ababa UA	Ambo Town			Ambo			
204	Oromia	East Harergie	Deder	Dire Dawa UA							
206	Oromia	West Welega	Gawo Dale	Gambella UA			800,000				
207	Oromia	East Harergie	Babile								
208	Oromia	North Shoa	Berehna Aletu		Sendafa Town						
209	Oromia	East Welega	Jimma Rare								
210	Oromia	West Shoa	Chelia				300,000				
212	Oromia	East Harergie	Kurfa Chele	Dire Dawa UA							
213	Oromia	East Harergie	Bedeno						MINE		
214	Oromia	West Welega	Aira Guliso	Gambella UA							
215	Oromia	West Welega	Gimbi		Gimbi Town			Gimbi	MINE		
216	Oromia	West Harergie	Tullo	Dire Dawa UA							
221	Oromia	East Harergie	Fedis								
222	Oromia	West Shoa	Bako Tibe								
223	Oromia	West Shoa	Welmera	Addia Ababa UA	Holeta Town						
224	Oromia	West Shoa	Ejere	Addia Ababa UA					MINE		

ID	Region	Zones	WOREDA	Corridor Develop.	Urbanization	Industrial & Agro Ind. Parks	Crop Surplus - tons	Agro-centres	Mines	Tourist Sites	International Trade
225	Oromia	West Shoa	Dendi	Addia Ababa UA			undefined				
226	Oromia	East Harergie	Girawa								
227	Oromia	West Harergie	Messela						MINE		
228	Oromia	East Harergie	Melka Bello						MINE		
230	Oromia	West Harergie	Chiro		Chiro Bedesa Town						
232	Oromia	East Shoa	Fentale						MINE		
233	Oromia	East Shoa	Gimbichu								
238	Oromia	West Welega	Dale Lalo	Gambella UA							
242	Oromia	East Welega	Diga Leka								
249	Oromia	West Harergie	Guba Korcha		Bedesa Town				MINE		Awash CO
264	Oromia	West Shoa	Alem Gana	Addia Ababa UA			150,000				
265	Oromia	East Welega	Wama Boneya								
266	Oromia	East Shoa	Akaki	Addia Ababa UA		Kilinto IP					
271	Oromia	West Shoa	Dawo	Addia Ababa UA							
272	Oromia	West Harergie	Kunni								
273	Oromia	East Shoa	Adaa Chukala	Addia Ababa UA	Bishoftu Town	Adama IP Adma I Park 2 +Eastern Ind. Zone					
274	Oromia	West Shoa	Tikur	Addia Ababa UA			300,000				
275	Oromia	West Shoa	Illu	Addia Ababa UA							
276	Oromia	West Shoa	Dano				undefined				
277	Oromia	East Harergie	Gelo Odana Meyo								
278	Oromia	East Welega	Jimma Arjo								
279	Oromia	West Harergie	Habro								
280	Oromia	West Welega	Hawa Welel	Gambella UA			800,000				
281	Oromia	Illu-Aba-Borra	Bedele	Jimma UA				Bedele			
283	Oromia	Illu-Aba-Borra	Dega	Jimma UA							
284	Oromia	Jimma	Limu Seka								
285	Oromia	East Welega	Nunu Kumba								
286	Oromia	East Shoa	Lomie	Addia Ababa UA		Modjo DP					Mojo CO
287	Oromia	West Welega	Anfilo	Gambella UA			150,000				
288	Oromia	Arsi	Merti							Fentale	
289	Oromia	West Shoa	Wenchi	Addia Ababa UA							
290	Oromia	East Shoa	Boset	Addia Ababa UA							
291	Oromia	West Harergie	Bokie								
292	Oromia	Illu-Aba-Borra	Darimu								
293	Oromia	West Shoa	Ameya	Addia Ababa UA							
294	Oromia	West Shoa	Tolle	Addia Ababa UA							

ID	Region	Zones	WOREDA	Corridor Develop.	Urbanization	Industrial & Agro Ind. Parks	Crop Surplus - tons	Agro-centres	Mines	Tourist Sites	International Trade
295	Oromia	West Shoa	Becho	Addia Ababa UA							
296	Oromia	West Shoa	Welisona Gorro	Addia Ababa UA	Welise Town						
297	Oromia	West Welega	Seyo	Gambella UA	Dembi Dolo Town		800,000				
298	Oromia	East Shoa	Adama	Addia Ababa UA	Adama Town						Nazaret CO
299	Oromia	West Shoa	Kersana Kondelt	Addia Ababa UA							
301	Oromia	West Harergie	Daro Lebbu								
304	Oromia	Arsi	Aseko								
306	Oromia	Arsi	Golelcha								
307	Oromia	West Shoa	Kokir	Addia Ababa UA							
308	Oromia	Illu-Aba-Borra	Chora	Jimma UA							
310	Oromia	Jimma	Limu Kosa						MINE		
311	Oromia	Arsi	Jeju				200,000				
312	Oromia	Illu-Aba-Borra	Gechi	Jimma UA							
316	Oromia	Illu-Aba-Borra	Metu		Metu Town						
317	Oromia	Illu-Aba-Borra	Yayu								
318	Oromia	Illu-Aba-Borra	Burie						MINE		
320	Oromia	Arsi	Dodotana Sire	Addia Ababa UA						Sodere	
322	Oromia	East Shoa	Dugda Borra	Addia Ababa UA							
325	Oromia	Arsi	Chole								
326	Oromia	Arsi	Zway Dugda	Addia Ababa UA				Ziway	MINE		
327	Oromia	Illu-Aba-Borra	Alie								
328	Oromia	Jimma	Sekoru								
329	Oromia	Arsi	Sude				100,000				
330	Oromia	Jimma	Setema								
331	Oromia	Arsi	Hitosa	Addia Ababa UA			100,000				
333	Oromia	Illu-Aba-Borra	Dedesa	Jimma UA							
334	Oromia	Jimma	Sigmo								
337	Oromia	Illu-Aba-Borra	Nono								
338	Oromia	Jimma	Tiro Afeta								
341	Oromia	Bale	Legehida				200,000				
342	Oromia	Arsi	Tena				100,000				
345	Oromia	Jimma	Goma	Jimma UA	Agaro Town						
346	Oromia	East Shoa	Kombolcha		Zeway Town				MINE		
347	Oromia	Arsi	Amigna Adami Tullu Jido								
349	Oromia	Arsi	Tiyo	Addia Ababa UA	Asela Town		100,000				
351	Oromia	Jimma	Kersa	Jimma UA							
354	Oromia	Arsi	Robe				100,000				
355	Oromia	Jimma	Gera	Jimma UA							

ID	Region	Zones	WOREDA	Corridor Develop.	Urbanization	Industrial & Agro Ind. Parks	Crop Surplus - tons	Agro-centres	Mines	Tourist Sites	International Trade
358	Oromia	Jimma	Mana	Jimma UA							
360	Oromia	Arsi	Degeluna Tijo				200,000				
361	Oromia	Arsi	Seru				100,000				
362	Oromia	Bale	Gaserana Golelc				undefined				
363	Oromia	Arsi	Munesa				200,000				
365	Oromia	Jimma	Omo Nada	Jimma UA							
366	Oromia	Jimma	Seka Chekorsa	Jimma UA		Jimma IP					
369	Oromia	Bale	Seweina								
372	Oromia	Arsi	Shirka								
373	Oromia	East Shoa	Arsi Negele							Langano Lake	
375	Oromia	Arsi	Bekoji			IAIP Bulbula					
377	Oromia	Jimma	Dedo	Jimma UA					MINE		
378	Oromia	East Shoa	Siraro	Hawassa Southern						National Park Abijatta Shalla	
383	Oromia	Bale	Agarfa				undefined				
386	Oromia	Bale	Ginir				undefined				
388	Oromia	Bale	Adaba							Bale National Park 2	
389	Oromia	East Shoa	Shashemene	Hawassa Southern						Wondo Genet	
391	Oromia	Arsi	Kofele								
393	Oromia	Arsi	Gedeb								
399	Oromia	Bale	Sinanana Dinsho				undefined		MINE		
401	Oromia	Bale	Raytu				150,000				
406	Oromia	Bale	Gorro (2)								
410	Oromia	Bale	Dodola					Dodola		Bale National Park 1	
411	Oromia	Bale	Goba		Robe Goba Town		100,000	Goba	MINE		
414	Oromia	Bale	Kokosa								
418	Oromia	Bale	Berberie						MINE		
420	Oromia	Bale	Gura Demole				200,000				
422	Oromia	Bale	Gonsebo				200,000				
426	Oromia	Bale	Menana Harena B				200,000				
430	Oromia	Borena	Gelana Abaya	Hawassa Southern							
437	Oromia	Borena	Bore	Hawassa Southern			150,000		MINE		
444	Oromia	Bale	Meda Welabu								
445	Oromia	Borena	Uraga				150,000				
450	Oromia	Borena	Adolana Wadera		Adola Town		200,000		MINE		
452	Oromia	Borena	Hagere Mariam								
454	Oromia	Borena	Odo Shakisso						MINE		
458	Oromia	Borena	Liben		Negele Town						

ID	Region	Zones	WOREDA	Corridor Develop.	Urbanization	Industrial & Agro Ind. Parks	Crop Surplus - tons	Agro-centres	Mines	Tourist Sites	International Trade
461	Oromia	Borena	Teltelie								
462	Oromia	Borena	Yabelo							Yabelo National Park	
463	Oromia	Borena	Arero								
465	Oromia	Borena	Moyale						MINE		Moyale CO
466	Oromia	Borena	Dire								
202	Harar	Harar	Rural Harar	Dire Dawa UA				Harar			
211	Harar	Harar	Woreda 3	Dire Dawa UA						Harar 1	
218	Harar	Harar	Woreda 2	Dire Dawa UA						Harar 2	
219	Harar	Harar	Woreda 1	Dire Dawa UA						Harar 3	
302	Gambella	Zone 1	Gambella	Gambella UA	Gambela Town						
343	Gambella	Zone 2	Abobo	Gambella UA							
348	Gambella	Zone 2	Jor								
359	Gambella	Zone 2	Gog								
374	Gambella	Leiyu Zone	Godere								
168	Dire Dawa	Diredawa	Rural Diredawa	Dire Dawa UA	Dire Dawa	Dire Dawa IP+DP and Kingdom IZ					Dire Dawa CO
180	Dire Dawa	Diredawa	Diredawa Town	Dire Dawa UA							
91	Benishangul-Gum	Assosa	Sherkole						MINE		
102	Benishangul-Gum	Metekel	Bulen						MINE		
111	Benishangul-Gum	Metekel	Dibatie								
130	Benishangul-Gum	Kemashi	Arba Abay						MINE		
138	Benishangul-Gum	Assosa	Komsha	Gambella UA							
147	Benishangul-Gum	Assosa	Assosa	Gambella UA		Assosa IP			MINE		
148	Benishangul-Gum	Assosa	Bambasi	Gambella UA							
171	Benishangul-Gum	Kemashi	Kemashi						MINE		
27	Amhara	Semien Gonder	Sanja				undefined				
37	Amhara	Semien Gonder	Dabat	Lake Tana UA							
41	Amhara	Semien Gonder	Metema								Metema CO
43	Amhara	Semien Gonder	Wegera	Lake Tana UA			150,000	Gondar			
44	Amhara	Semien Gonder	Lay Armachiho	Lake Tana UA			350,000				Gonder CO
45	Amhara	Semien Gonder	Chilga				undefined		MINE		
49	Amhara	Semien Gonder	Quara								
51	Amhara	Semien Gonder	Gonder Zuria	Lake Tana UA	Gondar Town		undefined			Gondar	
53	Amhara	Semien Gonder	Denbia	Lake Tana UA			undefined				
56	Amhara	Debub Gonder	Kemkem	Lake Tana UA							
57	Amhara	Semien Gonder	Alefa				350,000				
60	Amhara	Semien Wello	Kobbo	Mekelle UA							
61	Amhara		Lake Tana							Lake Tana	

ID	Region	Zones	WOREDA	Corridor Develop.	Urbanization	Industrial & Agro Ind. Parks	Crop Surplus - tons	Agro-centres	Mines	Tourist Sites	International Trade
63	Amhara	Debub Gonder	Farta	Lake Tana UA				Debre Tabor			
64	Amhara	Debub Gonder	Fogera	Lake Tana UA		Woreta DP					
65	Amhara	Semien Wello	Mekiet							Lalibela	
67	Amhara	Semien Wello	Guba Lafto	Mekelle UA							
69	Amhara	Semien Wello	Habru	Mekelle UA							
70	Amhara	Mierab Gojam	Achefer				700,000				
71	Amhara	Debub Gonder	Dera	Lake Tana UA							
72	Amhara	Mierab Gojam	Bahir Dar	Lake Tana UA	Bahr Dar Town	Bahir Dar IP				Bahir Dar	Bahir Dar CO
73	Amhara	Semien Wello	Dawint Delanta								
74	Amhara	Semien Wello	Wadla					Gashena			
75	Amhara	Debub Wello	Ambassel	Mekelle UA							
77	Amhara	Debub Gonder	Estie								
79	Amhara	Debub Wello	Werebabu	Mekelle UA					MINE		
80	Amhara	Debub Gonder	Simada								
81	Amhara	Mierab Gojam	Merawi	Lake Tana UA							
82	Amhara	Mierab Gojam	Adet	Lake Tana UA			150,000				
83	Amhara	Debub Wello	Tenta						MINE		
84	Amhara	Debug Wello	Tehulederie	Mekelle UA		Kombolsha DP+IP					
85	Amhara	Agew Awi	Dangla								
86	Amhara	Oromia Zone	Bati	Mekelle UA					MINE		
88	Amhara	Debub Wello	Kutaber	Mekelle UA							
89	Amhara	Debub Wello	Mekdella						MINE		
90	Amhara	Debub Wello	Kalu	Mekelle UA							
92	Amhara	Debub Wello	Saint								
93	Amhara	Misrak Gojam	Hulet Ej Enesie								
94	Amhara	Debub Wello	Dessie Zuria	Mekelle UA	Dese Town						Kombolsha CO
96	Amhara	Misrak Gojam	Goncha Siso Enesie								
98	Amhara	Misrak Gojam	Bibugn								
99	Amhara	Agew Awi	Fagta Lekoma								
100	Amhara	Mierab Gojam	Quarit				150,000				
101	Amhara	Mierab Gojam	Sekela								
104	Amhara	Agew Awi	Guangua					Chagni			
106	Amhara	Agew Awi	Banja								
107	Amhara	Debub Wello	Legambo								
108	Amhara	Mierab Gojam	Dega Damot				150,000				
110	Amhara	Agew Awi	Ankasha								
112	Amhara	Debub Wello	Albuko	Mekelle UA							
113	Amhara	Debub Wello	Were Illu	Mekelle UA							

ID	Region	Zones	WOREDA	Corridor Develop.	Urbanization	Industrial & Agro Ind. Parks	Crop Surplus - tons	Agro-centres	Mines	Tourist Sites	International Trade
114	Amhara	Oromia Zone	Chefie Golana Dawe Rahmedo		Kemise Town					Kemise	
115	Amhara	Mierab Gojam	Jabi Tehnan		Finote Selam Town						
116	Amhara	Mierab Gojam	Burie Wemberma								
117	Amhara	Debub Wello	Debre Sina								
120	Amhara	Debub Wello	Kelala								
121	Amhara	Debub Wello	Wegdie								
124	Amhara	Mierab Gojam	Dembecha								
127	Amhara	Misrak Gojam	Machakel								
129	Amhara	Misrak Gojam	Gozamn		Debre Markos Town			Debtre Markos			
131	Amhara	Debub Wello	Jamma								
132	Amhara	Semien Shewa	Gera Midirna Keya Gebriel								
142	Amhara	Semien Shewa	Lalo Midirna Mama Midir								
153	Amhara	Semien Shewa	Mafud Mezezo Mojana Wadera								
155	Amhara	Semien Shewa	Moretna Jiru								
164	Amhara	Semien Shewa	Debre Birhan Zuriana Keyit			Debre Birhan IP					
184	Amhara	Semien Shewa	Angolela Terana Asagrt								
217	Amhara	Semien Shewa	Berehet								
5	Afar	Zone 2								Erta Ale	
26	Afar								MINE	Danakil Depression	
40	Afar	Zone 1				Semera IP+DP					Mile CO and Semera CO
248	Addis Ababa			Addia Ababa UA	Addis Ababa Kaliti Kolfe Nefas ..	Bole lemi IP+Bole Lemi Park2+ Kaliti DP			MINE		Kaliti CO

6 BUILDING ROAD MASTER PLAN UNDER DIFFERENT SCENARIOS

Following is the process of building the Road Master Plan under the various development scenarios (Go Ahead, next Generation and Limits to Growth) and the 3-time horizons (2025, 2035, 2050).

6.1 IDENTIFICATION OF ROAD INVESTMENTS

The necessary road investments to be made in the different horizons (2025, 2035, 2050) for each particular scenarios, have been identified through repeated assignments of the multimodal transport network in the situation "without" and "with" project conditions. The assignments in the "without" situation identifies all the links that will enter in congestions if there will be no intervention in that particular time horizon, so determining the necessary road intervention to be implemented in that time horizon.

In particular traffic processing in the situation with and without project interventions was carried out by adopting a criterion defined as "progressive interventions". For each scenario, the interventions to be implemented are those that solve the criticalities that emerged from the without project assignment, but considering the infrastructures identified for the previous timing scenario.

6.1.1 Congestion factor

The parameter used to evaluate the service level of the road links in the different scenarios was the **congestion factor** (Fc). This parameter, according to international procedure, is calculated by dividing the Average Hourly Traffic by the effective capacity of each road links. Moreover, the average hourly traffic is obtained dividing the daily traffic volume (taken as the bidirectional assigned traffic), by 16. This represents the hourly traffic volume to be compared with the effective capacity of the links, estimated on the basis of International Capacity Manual.

Annex 1, 2 and 3 report the list of more than 1,850 road links traffic flow and capacity factors in each scenario considered (Go Ahead, Next generation, Limits to Growth) and the 3-time horizons considered (2025, 2035, 2050).

The road investments identified by the ETMP for each assignment are constituted by the following categories:

- Links with insufficient capacity (**missing-capacity links**) that need alignment and cross-section improvement. These links are identified by the flow/capacity ratio > 1
- Construction of **new expressways** along those corridors that show a marked increase of transport demand. These new links are identified along the territorial development and regional corridors, presenting a high increase of transport demand which cannot be accommodated with an increase of capacity of the federal road.
- Construction of **connecting Ring Road**s between the main transport corridors, in order to distribute traffic demand in the different radial directions to the gravitation centre of Addis Ababa.

6.2 GO AHEAD SCENARIO

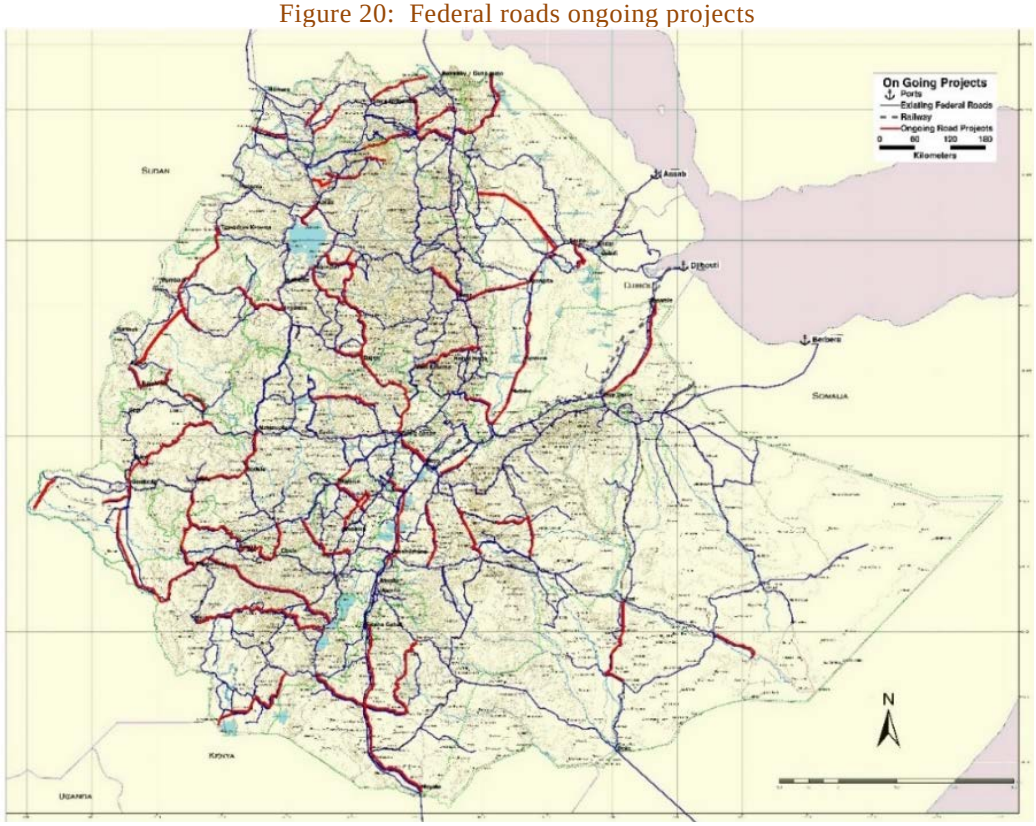
Following are the traffic assignments, under the "go-ahead" scenario, in the situation "without" and "with" the ETMP actions in the defined time limits: 2025, 2035, 2050.

6.2.1 Go Ahead Scenario 2025

I - WITHOUT PROJECT SITUATION

At year 2025 it is assumed that all ongoing projects listed in chapter 4 (Table 19) will be implemented, as shown by the following figure:

Figure 20: Federal roads ongoing projects



In the situation without new projects, the increased demand matrices assigned to the road network, will give the following traffic distribution, creating congestion in the sections indicated in Table 30. In red are the links with congestion factor and need to be improved in terms of transport capacity.

Figure 21: 2025 Road Congestions without intervention

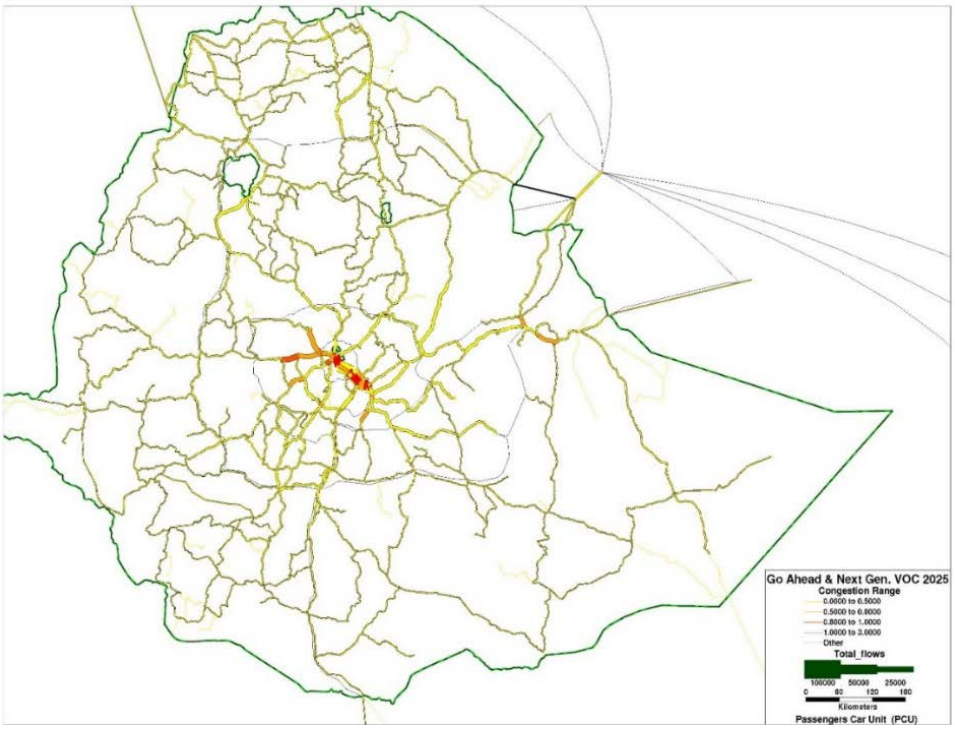


Table 30: 2025 Go Ahead-List of congested road sections without intervention

GO AHEAD 2025 Without Project					
ID	LINK_NAME	LENGTH	Congestion Factor	Existing Capacity	2025 Daily Traffic Flow
2739	Addis - Adama (Toll Road)	5.09	0.6061	8000	77507
2783	Addis - Adama (Toll Road)	18.12	0.5302	8000	67777
1386	Addis - Adama (Toll Road)	3.23	0.5116	8000	65406
974	Addis - Modjo	21.25	1.4779	1738	41107
2781	Addis - Modjo	9.87	1.4548	1819	42339
973	Addis - Modjo	1.71	1.2231	1817	35554
1449	Addis - Modjo	13.89	1.1655	1829	34109
1448	Addis - Modjo	20.96	0.6316	1817	18359
2506	Addis-Commodo	1.46	1.5031	1487	35756
2509	Addis-Commodo	0.03	1.0577	1103	18659
1446	Addis-Commodo	0.05	0.7284	1099	12805
2508	Addis-Commodo	1.82	0.6736	1624	17506
595	Addis-Holeta	12.72	0.7609	1832	22303
640	Alemgena - Butajira	0.69	0.5751	1824	16781
628	Alemgena - Butajira	5.47	0.5114	1820	14888
1327	Alemgena - Weliso	0.02	0.8324	1831	24385
2992	Alemgena - Weliso	8.18	0.8298	1831	24312
590	Alemgena - Weliso	13.25	0.7763	1830	22724
584	Alemgena - Weliso	0.09	0.6890	1830	20170
1525	Alemgena - Weliso	33.73	0.6138	1817	17841
650	Bui - Midirekebd - Meki	1.42	0.5556	2009	17856
2782	Connection Addis Adama Toll Rd	2.71	1.7944	1833	52612
1008	Dengego(dire dawa) - Harar	20.57	0.5761	1565	14426
925	Dengego-Harar	1.22	0.5835	1644	15347
926	Dengego-Harar	1.05	0.5449	1800	15689
452	Diredawa - Dewole	1.19	0.6021	1742	16785
162	Harar-Bombas	33.89	0.6050	1709	16543
929	Harar-Bombas	16.84	0.5394	1747	15075
60	Holeta - Muger	46.62	0.7675	1805	22163
2525	Holeta - Muger	9.55	0.6450	1812	18698
591	Holeta-Ambo	1.09	1.5411	1741	42917
594	Holeta-Ambo	0.76	0.9704	1714	26616
2996	Holeta-Ambo	31.7	0.8699	1802	25085
58	Holeta-Ambo	4.27	0.8594	1824	25085
582	Holeta-Ambo	0.17	0.7980	1829	23355
593	Holeta-Ambo	43.02	0.6946	1804	20049
2734	Koka-Adulala-D/zeit	0.45	1.0846	1111	19272
1384	Modjo - Ejere - Arerti - Kesem	2.89	0.7368	1803	21259
980	Modjo - Nazreth	1.56	1.8891	1823	55099
1364	Modjo - Nazreth	5.61	1.6907	1800	48687
981	Modjo - Nazreth	1.05	1.6639	1829	48687
647	Modjo - Nazreth	1.57	1.2151	1829	35554
1363	Modjo - Nazreth	10.41	0.9978	1818	29024
979	Nazareth - Asela	4.51	1.0261	1996	32776
989	Nazareth - Asela	0.7	0.6892	1978	21809
990	Nazareth - Asela	4.71	0.5895	1739	16402
1526	Nazareth - Asela	4.74	0.5658	1812	16402
3019	Nazareth - Asela	6.78	0.5555	1806	16033
653	Nazareth - Asela	18.91	0.5525	1814	16033
2507	Tatek-Kolfe	2.66	1.3748	1626	35756
1447	Tatek-Kolfe	17.26	0.5369	1831	15732

II - WITH PROJECT SITUATION

To solve the different congestions at year 2025, the following interventions are envisaged:

A. Improved capacity of the road section that have a congestion factor > 1

B. Construction of the following expressways

- Mojo-Awassa Expressway completion
- Dire Dawa – Dewele Expressway completion
- Addis Ababa - Holeta-Ambo Expressway
- Addis Ababa - Alemgena-Woliso Expressway
- Dire Dawa-Dengego-Harar Expressway
- Melkasa - Metehara - Awash Junction Expressway

C. Construction of the following connecting Ring Roads

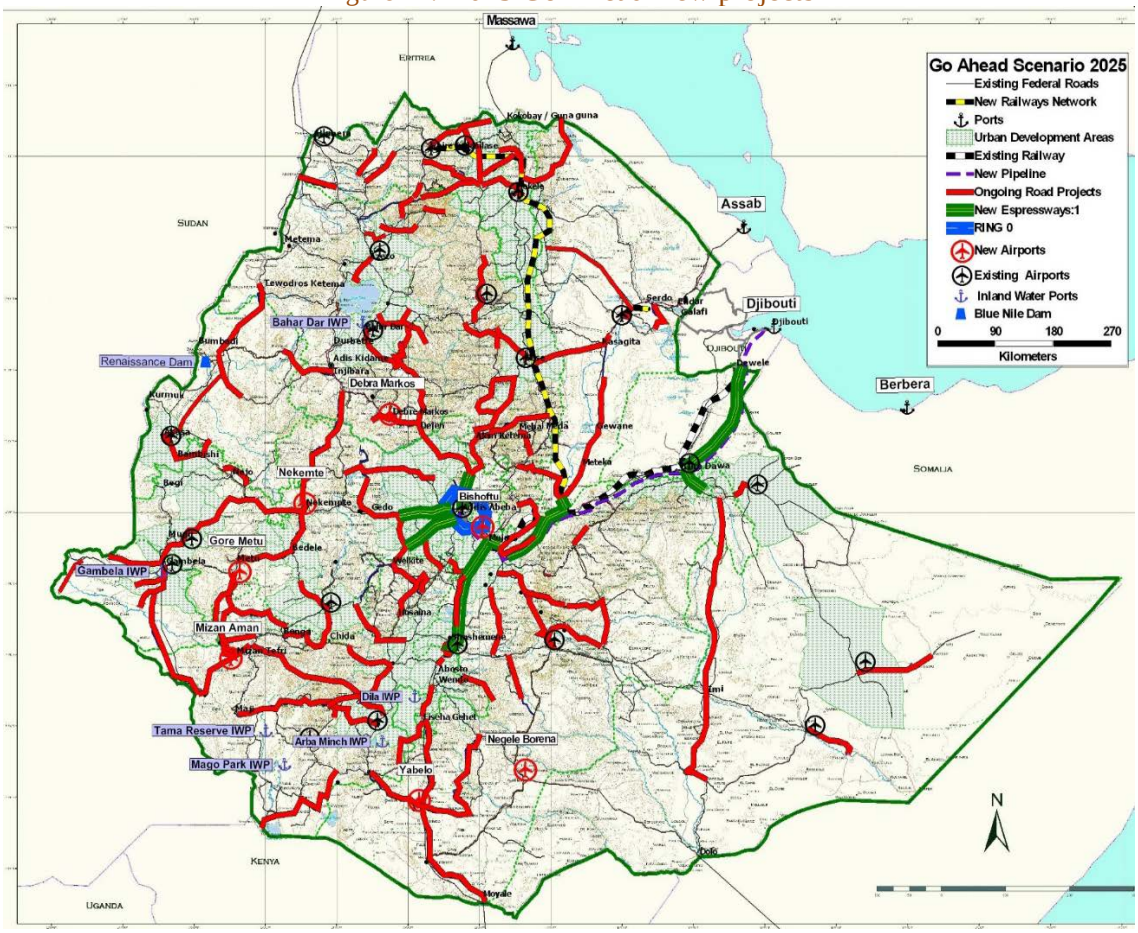
- Ring 0: Addis Abeba Outer Ring Road – passing through Holeta – Sebeta – Bishoftu – Sendafa – Sululeta. This ring road is to be considered as necessary in the short term and should also be validate by the ongoing Addis Ababa Transport Master Plan.

D. Construction of the following railway line

- Mekelle – Aragaba & Awash – Kombolcha – Haragaria

The interventions are represented in the following figure

Figure 22: 2025 Go Ahead New projects



Following is the list of new roads, expressways and increased capacity to be implemented at year 2025:

Table 31: 2025 Go Ahead- List of road section with interventions

GO AHEAD 2025 With Project						
ID	LINK_NAME	Length	Congestion Factor	Existing Capacity	Project Capacity	2025 Daily Traffic Flow
2739	Addis - Adama (Toll Road)	5.09	0.4568	8000	8000	58430
2783	Addis - Adama (Toll Road)	18.12	0.3562	8000	8000	45555
1386	Addis - Adama (Toll Road)	3.23	0.3771	8000	8000	48234
974	Addis - Modjo	21.25	1.1700	1738	1741	32598
2781	Addis - Modjo	9.87	1.1606	1819	1819	33777
973	Addis - Modjo	1.71	1.0174	1817	1816	29562
1449	Addis - Modjo	13.89	1.0329	1829	1829	30231
1448	Addis - Modjo	20.96	0.5393	1817	1817	15677
2506	Addis-Commodo	1.46	1.1778	1487	1489	28052
2509	Addis-Commodo	0.03	0.9743	1103	1109	17295
1446	Addis-Commodo	0.05	0.645	1099	1109	11441
2508	Addis-Commodo	1.82	0.5676	1624	1634	14843
595	Addis-Holeta	12.72	0.1462	1832	8000	18714
640	Alemgena - Butajira	0.69	0.5174	1824	1825	15107
628	Alemgena - Butajira	5.47	0.4669	1820	1821	13601
1327	Alemgena - Weliso	0.02	0.1555	1831	8000	19903
2992	Alemgena - Weliso	8.18	0.1554	1831	7994	19876
590	Alemgena - Weliso	13.25	0.1454	1830	7999	18609
584	Alemgena - Weliso	0.09	0.1321	1830	8000	16909
1525	Alemgena - Weliso	33.73	0.1181	1817	8000	15117
650	Bui - Midirekebd - Meki	1.42	0.1411	2009	8000	16422
1008	Dengego(dire dawa)-Harar	20.57	0.0958	1565	8000	12258
925	Dengego-Harar	1.22	0.0997	1644	8000	12764
926	Dengego-Harar	1.05	0.1075	1800	8000	13761
452	Diredawa - Dewole	1.19	0.1191	1742	8000	15245
162	Harar-Bombas	33.89	0.1124	1709	8000	14388
929	Harar-Bombas	16.84	0.1043	1747	8000	13353
60	Holeta - Muger	46.62	0.1594	1805	8000	20402
2525	Holeta - Muger	9.55	0.1348	1812	8000	17251
591	Holeta-Ambo	1.09	0.3031	1741	8000	38792
594	Holeta-Ambo	0.76	0.1888	1714	8000	24055
2996	Holeta-Ambo	31.7	0.1592	1802	8000	20376
58	Holeta-Ambo	4.27	0.1592	1824	8000	20376
582	Holeta-Ambo	0.17	0.1571	1829	8000	20107
593	Holeta-Ambo	43.02	0.1363	1804	8000	17440
2734	Koka-Adulala-D/zeit	0.45	1.0696	1111	1111	19013
1384	Modjo-Ejere-Arerti-Kesem	2.89	0.5382	1803	1803	15530
980	Modjo - Nazreth	1.56	1.5586	1823	1823	45459
1364	Modjo - Nazreth	5.61	1.3693	1800	1800	39435
981	Modjo - Nazreth	1.05	1.3476	1829	1829	39435
647	Modjo - Nazreth	1.57	1.0108	1829	1828	29562
1363	Modjo - Nazreth	10.41	0.9978	1818	1818	29024
979	Nazareth - Asela	4.51	0.2555	1996	8000	29741
989	Nazareth - Asela	0.7	0.1396	1978	8000	17678
990	Nazareth - Asela	4.71	0.1047	1739	8000	13400
1526	Nazareth - Asela	4.74	0.1047	1812	8000	13400
3019	Nazareth - Asela	6.78	0.1071	1806	8000	13714
653	Nazareth - Asela	18.91	0.1071	1814	8000	13714
2507	Tatek-Kolfe	2.66	0.2192	1626	8000	28052
1447	Tatek-Kolfe	17.26	0.4141	1831	1833	12143

6.2.2 2025 road network performance

Following is the calculation of the performance of the road master plan in terms of time, distance and cost in the two situations of "without" and "with" implementation of the road investment proposed.

Situation without proposed investments

To evaluate the road network performance at year 2025, a multimodal (road + rail) assignment has been considered. The **transport offer** (multimodal graph) is composed by about 30,338 km of road network plus 1,233.4 km of rail network. The **transport daily demand** is represented by 440,386 passengers, 1,024,794 tons of freight, which have been converted into 414,996 passenger car units (PCU).

The performance of the transport system involves daily:

- In terms of time (x h): a total of 1,277,862 hours is daily spent by the PCUs, containing 2,644,285 hours spent by passengers and 2,679,301 hours spent for the tons to be transported.
- In terms of distance (x km): a total of 85,540,550 km is daily run by PCUs, containing 178,212,155 km travelled by passengers and 178,706,809 Km by Tons of freight, as shown in the following table

Table 32: Road Network Performance by Scenario – Go Ahead Scenario WoP 2025

2025 Go Ahead Without Project	Multimodal Network	Road Network	Railway Network
Total PCU x km	85,540,550	83,596,481	1,944,069
Total PCU x h	1,277,862	1,244,700	33,162
Total Pass x km	178,212,155	175,884,198	2,327,957
Total Pass x h	2,644,285	2,589,904	54,381
Total Tons x km	178,706,809	173,726,480	4,980,328
Total Tons x h	2,679,301	2,602,163	77,138

In terms of transport cost (VOC) the assignment calculates a daily expenditure of 16,234,416 USD for light and heavy vehicles and a total cost (value of time) of time spent equal to 9,889,931. USD. The total Road User Cost in a day is then 21,124, 347 USD.

Situation with proposed investments

Considering the proposed investments, the **transport offer** (multimodal graph) is composed by 31,234
km of road network plus 1,233.4 km of rail network. The **transport daily demand remains** the same of the without situation.

The performance of the transport system involves daily:

- In terms of time (x h): a total of 1,061,512 hours is daily spent by the PCUs, containing 1,608,377 hours spent by passengers and 2,541,463 hours spent for the tons to be transported.
- In terms of distance (x km): a total of 74,933,324 km is daily run by PCUs, containing 114,838,022 km travelled by passengers and 178,942,774 Km by Tons of freight, as shown in the following table

Table 33: Road Network Performance by Scenario – Go Ahead WP 2025

2025 Go Ahead with Project	Multimodal Network	Road Network	Railway Network
Total PCU x km	74,933,324	73,127,633	1,805,691
Total PCU x h	1,061,512	1,041,424	20,088
Total Pass x km	114,838,022	113,069,502	1,768,519
Total Pass x h	1,608,377	1,582,207	26,171
Total Tons x km	178,942,774	173,726,480	5,216,294
Total Tons x h	2,541,463	2,489,101	52,362

In terms transport cost (USD) the assignment calculates a daily expenditure of 12,115,157 USD for light and heavy vehicles and a total cost (value of time) of time spent equal 6,137,283. USD. The total Road User Cost in a day is then1 8,252,440 USD.

Advantages of the application of the proposed road investments:

- In terms of time (x h): a total of 216,351 daily hours are saved by the PCUs, while 1,035,908 hours are saved by passengers and 137,838 hours for the tons transported.
- In terms of distance (x km): a total of 10,607,226. km is daily saved by PCUs, while 63,374,133 kms are saved by passengers and freight increase of about 235,966 km are carried by the railway system.

Table 34: Road Network Performance comparison – Go Ahead WoP minus WP 2025

2025 Go Ahead WOP - WP	Multimodal Network savings	Road Network savings	Railway Network savings
Total PCU x km	10,607,226	10,468,848	138,378
Total PCU x h	216,351	203,276	13,075
Total Pass x km	63,374,133	62,814,696	559,438
Total Pass x h	1,035,908	1,007,697	28,210
Total Tons x km	0	0	-235,966
Total Tons x h	137,838	113,062	24,776

In terms transport cost (VOC) the assignment calculates a daily savings of 4,119,259 USD for light and heavy vehicles and a total cost savings (value of time) of time spent equal to 3,752,648 USD. The total Road User Cost Savings in a day is then 7,871,907 USD.USD.

6.2.3 Go Ahead Scenario 2035

I - WITHOUT PROJECT SITUATION

At year 2035 it is assumed that all projects identified for year 2025 have been implemented. In the situation without new projects, the increased demand matrices assigned to the road network, will give the following traffic distribution, creating congestion in the sections indicated by Table 35.

Figure 23: 2035 Road Congestions without intervention

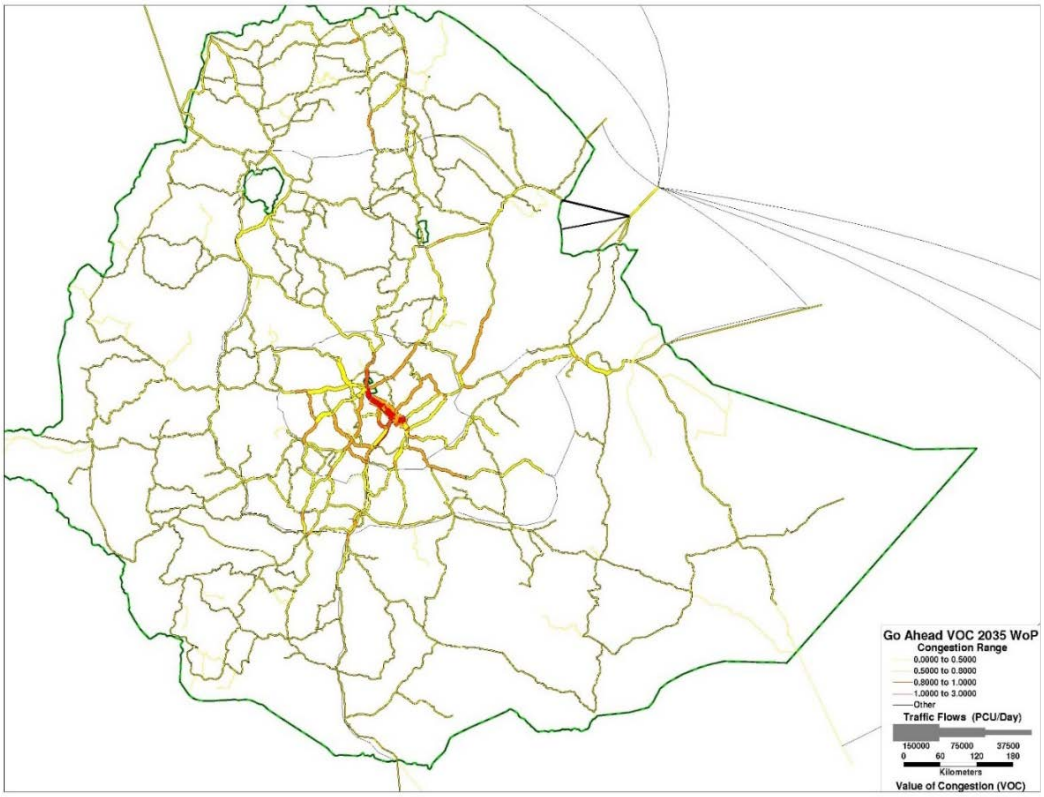


Table 35: 2035 Go Ahead- List of congested road sections without intervention

GO AHEAD 2035 Without Project					
ID	LINK_NAME	Length	Congestion Factor	Existing Capacity	2035 Daily Traffic Flows
973	Addis - Modjo	1.71	2.1412	1817	62,249
2781	Addis - Modjo	9.87	1.8105	1819	52,693
1449	Addis - Modjo	13.89	1.5537	1829	45,467
974	Addis - Modjo	21.25	1.2877	1737	35,788
1448	Addis - Modjo	20.96	1.1461	1817	33,319
2509	Addis-Commodo	0.03	1.6837	1103	29,714
2506	Addis-Commodo	1.46	1.5589	1485	37,039
1446	Addis-Commodo	0.05	1.2532	1100	22,056
2508	Addis-Commodo	1.82	0.9438	1624	24,524
1000	Addis-Commodo	3.17	0.8821	1731	24,431
2511	Addis-Commodo	34.13	0.8689	1708	23,745
1444	Addis-Commodo	38.73	0.6969	1706	19,023
2782	Connection Addia Adam Toll r	2.71	1.6549	1832	48,508
647	Modjo - Nazreth	1.57	2.1271	1829	62,247
1363	Modjo - Nazreth	10.41	1.9228	1818	55,930
980	Modjo - Nazreth	1.56	1.8135	1823	52,896
1364	Modjo - Nazreth	5.61	1.2654	1800	36,444
981	Modjo - Nazreth	1.05	1.2454	1829	36,445
649	Modjo - Ziway	39.46	1.1153	1829	32,638
1452	Modjo - Ziway	21.49	0.8850	1822	25,800
1030	Morocho - Yirba-Dimtu-Dilbo	5.42	0.6028	1633	15,750
1382	Nazareeh - Metehara	5.54	1.0364	1807	29,964
982	Nazaret-Awash Melkassa	3.55	0.5728	1795	16,451
979	Nazareth - Asela	4.51	0.6515	7273	75,814
1365	Addis - Adama (Toll Road)	6.64	0.8796	7993	112,490
2986	Addis - Adama (Toll Road)	2.14	0.7519	7991	96,135
976	Addis - Adama (Toll Road)	2.33	0.7511	7992	96,045
2783	Addis - Adama (Toll Road)	18.12	0.7311	7988	93,440
2739	Addis - Adama (Toll Road)	5.09	0.7274	7991	93,002
2989	Addis - Adama (Toll Road)	6.46	0.6066	7987	77,519
1385	Addis - Adama (Toll Road)	27.60	0.6039	7987	77,174
1386	Addis - Adama (Toll Road)	3.23	0.5876	7986	75,081
1384	Modjo - Ejere - Arerti - Kesem	2.89	1.0368	1804	29,926
984	Modjo - Ejere - Arerti - Kesem	3.73	0.6549	1741	18,243
1383	Modjo - Ejere - Arerti - Kesem	28.23	0.6306	1808	18,242
116	Robe - Seru	70.59	0.5518	1815	16,024
1515	Addis- Debreberehan	38.47	0.6542	1730	18,108
988	Addis- Debreberehan	13.36	0.6313	1802	18,202
987	Addis- Debreberehan	5.12	0.6254	1794	17,951
217	Addis- Debreberehan	32.45	0.6223	1803	17,952
1002	Addis- Debreberehan	33.31	0.5470	1798	15,736
1441	Addis- Debreberehan	2.88	0.5454	1803	15,734
640	Alemgena - Butajira	0.69	0.8530	1824	24,894
59	Alemgena - Butajira	42.04	0.7956	1802	22,939
1343	Alemgena - Butajira	1.16	0.7332	1741	20,424
1503	Alemgena - Butajira	1.17	0.7052	1810	20,423
628	Alemgena - Butajira	5.47	0.6878	1819	20,018
1322	Alemgena - Butajira	12.74	0.6771	1800	19,500
1326	Alemgena - Butajira	0.28	0.6564	1744	18,316
1359	Alemgena - Butajira	16.97	0.6149	1811	17,817

II - WITH PROJECT SITUATION

To solve the different congestions at year 2035, the following interventions are envisaged:

A. Improved capacity of the road section that have a congestion factor > 1

B. Construction of the following expressways

1. Addis Ababa-Debrebirhan Expressway
2. Awash Junction-Adaitu Expressway
3. Awash Junction-Dire Dawa Expressway
4. Addis Ababa-Commando Expressway

C. Construction of the following connecting Ring Roads

- **Ring 1**: passing through Metehara – DebreBerhan – Fiche - Ambo – Woliso Butajira – Meki – Dera, to be implemented in the medium term (2035).

A. Construction of the following railway line

- Mekelle – Assab port railway
- Modjo – Awasa -Moyale
- Aisha – Berbera
- Rejii -Holeta

Figure 24: 2035 Go Ahead New Projects

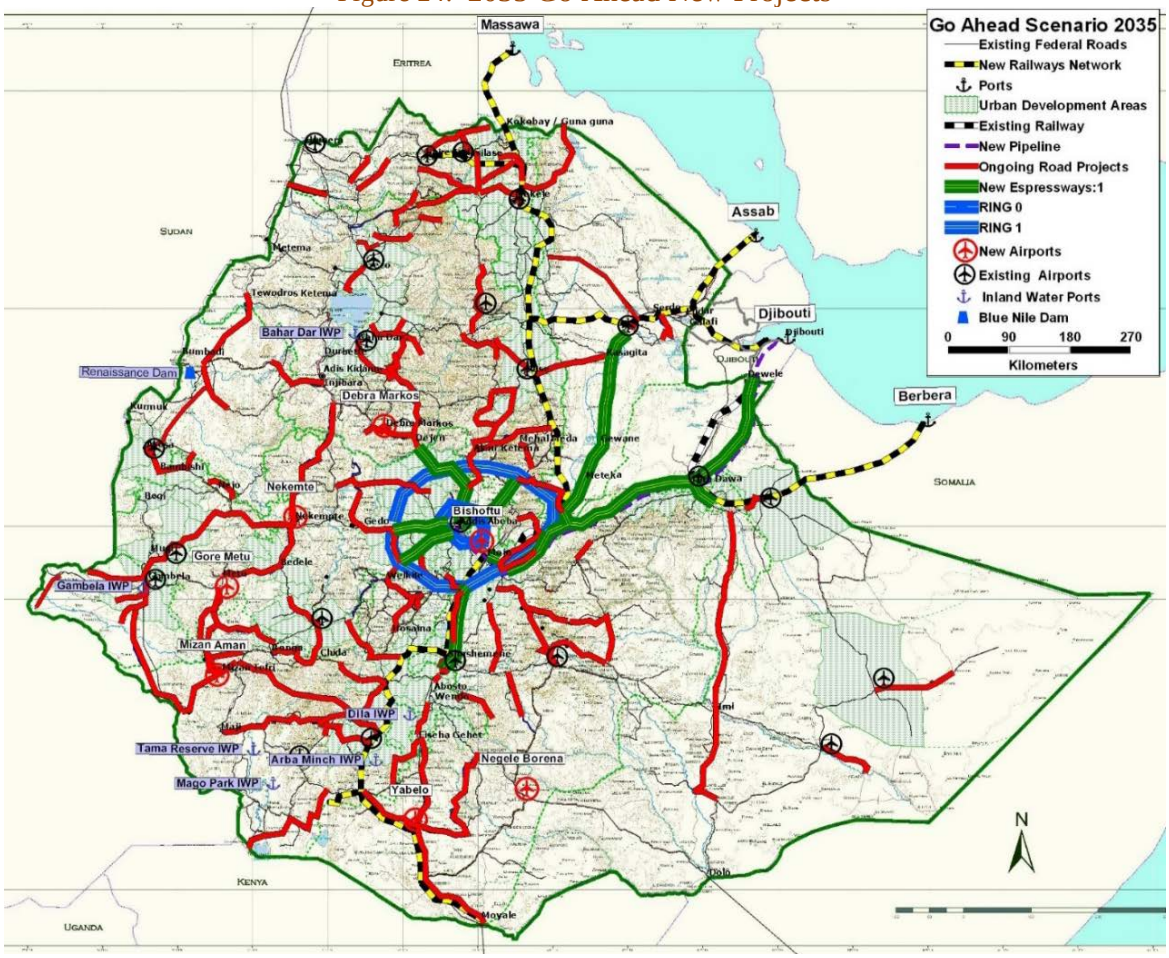


Figure 25: 2035 Road Congestions with intervention

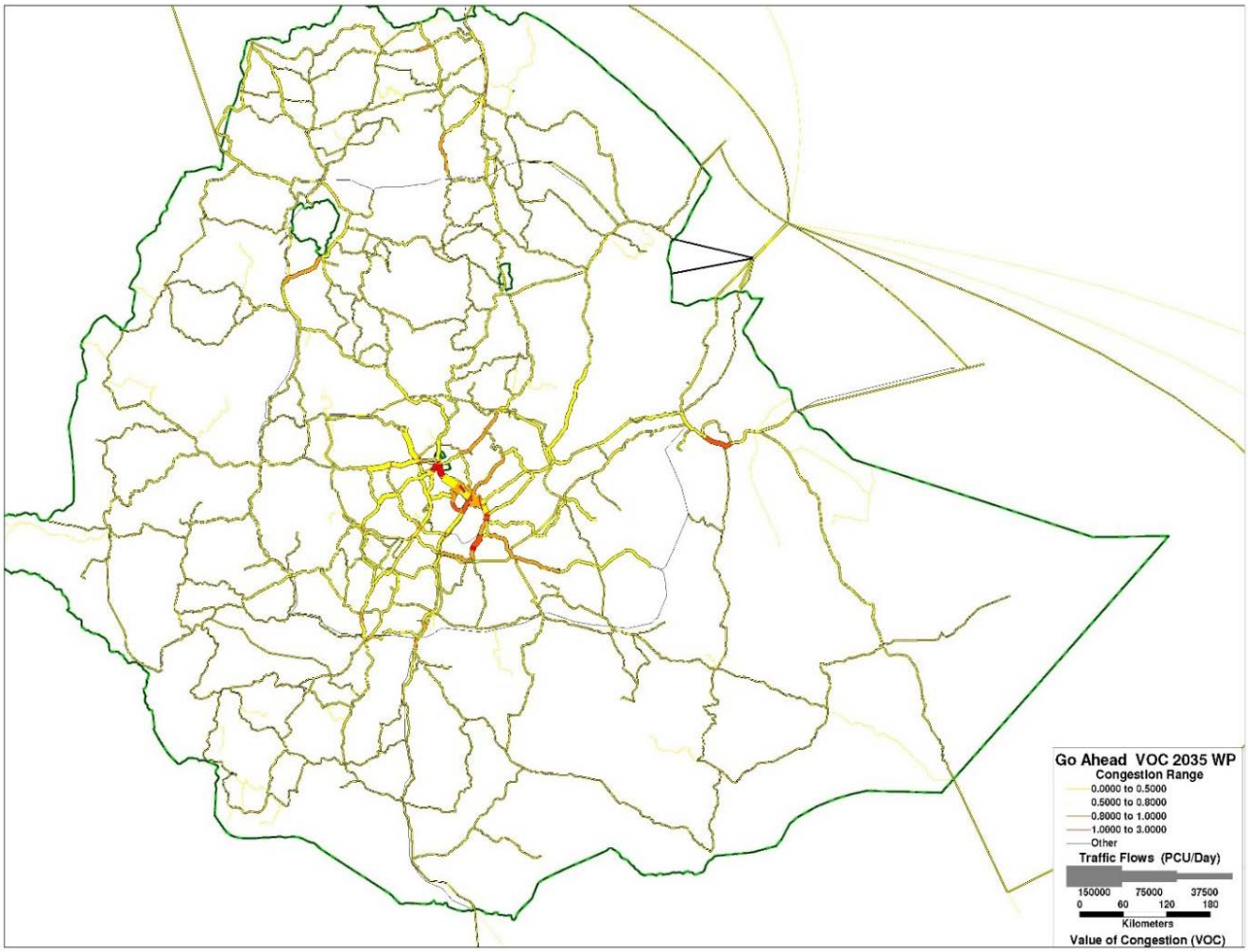


Table 36: 2035 Go Ahead- List of road sections with intervention

ID	LINK_NAME	Length	Congestion Factor	Existing Capacity	Project Capacity	2035 Daily Traffic Flow
973	Addis - Modjo	1.71	0.3038	1817	8000	38875
2781	Addis - Modjo	9.87	0.6552	1819	8000	83827
1449	Addis - Modjo	13.89	0.3632	1829	8000	46449
974	Addis - Modjo	21.25	0.2870	1737	8000	36761
1448	Addis - Modjo	20.96	0.4312	1817	7993	55144
2509	Addis-Commodo	0.03	0.2130	1103	8000	27256
2506	Addis-Commodo	1.46	0.2730	1485	8000	34947
1446	Addis-Commodo	0.05	0.1720	1100	8000	22075
2508	Addis-Commodo	1.82	0.7438	1624	1620	19280
1000	Addis-Commodo	3.17	0.1843	1731	8000	23457
2511	Addis-Commodo	34.13	0.1690	1708	8000	21496
1444	Addis-Commodo	38.73	0.1419	1706	8000	18036
2782	Connect. Addis Adama Toll road	2.71	0.4040	1832	8000	51664
647	Modjo - Nazreth	1.57	0.3040	1829	8000	38875
1363	Modjo - Nazreth	10.41	0.2936	1818	8000	37583
980	Modjo - Nazreth	1.56	0.7120	1823	8000	91118
1364	Modjo - Nazreth	5.61	0.5037	1800	8000	64458
981	Modjo - Nazreth	1.05	0.5040	1829	8000	64458

ID	LINK_NAME	Length	Congestion Factor	Existing Capacity	Project Capacity	2035 Daily Traffic Flow
649	Modjo - Ziway	39.46	0.5597	1829	1829	16379
1452	Modjo - Ziway	21.49	0.8370	1822	1820	24380
1030	Morocho - Yirba-Dimtu-Dilbo	5.42	0.4230	1633	1633	11053
1382	Nazareeh - Metehara	5.54	0.2621	1807	8000	33535
982	Nazaret-Awash Melkassa	3.55	0.4574	1795	8000	58539
989	Nazareth - Asela	0.7	0.3010	1798	8000	38485
979	Nazareth - Asela	4.51	0.3545	7273	8000	45371
1365	Addis - Adama (Toll Road)	6.64	0.5817	7993	8000	74378
2986	Addis - Adama (Toll Road)	2.14	0.3751	7991	8000	47927
976	Addis - Adama (Toll Road)	2.33	0.3734	7992	8000	47719
2783	Addis - Adama (Toll Road)	18.12	0.6258	7988	8000	80000
2739	Addis - Adama (Toll Road)	5.09	0.7918	7991	8000	101255
2989	Addis - Adama (Toll Road)	6.46	0.2382	7987	8000	30365
1385	Addis - Adama (Toll Road)	27.6	0.2374	7987	8000	30264
1386	Addis - Adama (Toll Road)	3.23	0.6620	7986	8000	84601
1384	Modjo - Ejere - Arerti - Kesem	2.89	1.0064	1804	1802	29018
984	Modjo - Ejere - Arerti - Kesem	3.73	0.5861	1741	1741	16323
1383	Modjo - Ejere - Arerti - Kesem	28.23	0.5643	1808	1808	16323
116	Robe - Seru	70.59	0.5130	1815	1996	16383
1515	Addis- Debreberehan	38.47	0.4083	1730	1729	11297
988	Addis- Debreberehan	13.36	0.5862	1802	1801	16891
987	Addis- Debreberehan	5.12	0.5804	1794	1793	16649
217	Addis- Debreberehan	32.45	0.5775	1803	1802	16649
1002	Addis- Debreberehan	33.31	0.5211	1798	1797	14981
1441	Addis- Debreberehan	2.88	0.5196	1803	1802	14981
640	Alemgena - Butajira	0.69	0.1860	1824	8000	23779
59	Alemgena - Butajira	42.04	0.1439	1802	8000	18411
1343	Alemgena - Butajira	1.16	0.5768	1741	1740	16061
1503	Alemgena - Butajira	1.17	0.5548	1810	1809	16061
628	Alemgena - Butajira	5.47	0.7109	1819	1819	20688
1322	Alemgena - Butajira	12.74	0.1591	1800	8000	20336
1326	Alemgena - Butajira	0.28	0.6572	1744	1744	18335

6.2.4 2035 road network performance

Following is the calculation of the performance of the road master plan in terms of time, distance and cost in the two situations of "without" and "with" implementation of the road investment proposed.

Situation without proposed investments

To evaluate the road network performance at year 2035, a multimodal (road + rail) assignment has been considered. The **transport offer** (multimodal graph) is composed by 31,234 km of road network plus 3,051 km of rail network. The **transport daily demand** is represented by 906,218 passengers, 1,908,074 tons of freight, which have been converted in 787,061 passenger car units (PCU).

The performance of the transport system involves daily:

- In terms of time (x h): a total of 2,180,722 hours is daily spent by the PCUs, containing 3,096,943 hours spent by passengers and 5,327,061 hours spent for the tons to be transported.
- In terms of distance (x km): a total of 149,278,160 km is daily run by PCUs, containing 217,352,497 km travelled by passengers and 361,714,656 Km by Tons of freight, as shown in the following table

Table 37: Road Network Performance by Scenario – Go Ahead Scenario WoP 2035

2035 Go Ahead Without Project	Multimodal Network	Road Network	Railway Network
Total PCU x km	149,278,160	146,805,430	2,472,730
Total PCU x h	2,180,722	2,142,145	38,577
Total Pass x km	217,352,497	214,046,455	3,306,042
Total Pass x h	3,096,943	3,035,584	61,360
Total Tons x km	361,714,656	355,637,724	6,076,932
Total Tons x h	5,327,061	5,236,301	90,760

In terms of transport cost (VOC) the assignment calculates a daily expenditure of 29,844,225 USD for light and heavy vehicles and a total cost (value of time) of time spent equal to 16,919,561 USD. The total Road User Cost in a day is then 46,763,786 USD.

Situation with proposed investments

Considering the proposed investments, the **transport offer** (multimodal graph) is composed by 31,911 km of road network plus 3,051 km of rail network. The **transport daily demand remains** the same of the without situation.

The performance of the transport system involves daily:

- In terms of time (x h): a total of 1,988,821 hours is daily spent by the PCUs, containing 2,950,258 hours spent by passengers and 4,805,046 hours spent for the tons to be transported.
- In terms of distance (x km): a total of 142,240,831km is daily run by PCUs, containing 212,233,226 km travelled by passengers and 343,553,199 Km by Tons of freight, as shown in the following table

Table 38: Road Network Performance by Scenario – Go Ahead WP 2035

2035 Go Ahead With Project	Multimodal Network	Road Network	Railway Network
Total PCU x km	142,240,831	137,746,292	4,494,539
Total PCU x h	1,988,821	1,941,640	47,181
Total Pass x km	212,233,226	207,273,228	4,959,998
Total Pass x h	2,950,258	2,871,079	79,179
Total Tons x km	343,553,199	330,137,955	13,415,244
Total Tons x h	4,805,046	4,682,398	122,649

In terms transport cost (USD) the assignment calculates a daily expenditure of 22,971,782 USD for light and heavy vehicles and a total cost (value of time) of time spent equal11,485,891 USD. The total Road User Cost in a day is then1 34,457,672 USD.

Advantages of the application of the proposed road investments:

- In terms of time (x h): a total of 191,901 daily hours are saved by the PCUs, while 146,685 hours are saved by passengers and 522,015 hours for the tons transported.
- In terms of distance (x km): a total of 7,037,329. km is daily saved by PCUs, while 5,119,270 kms are saved by passengers and18,161,457km by freight that increase of about 7,338,3127km are carried by the railway system.

Table 39: Road Network Performance comparison – Go Ahead WoP minus WP 2035

2035 Go Ahead WOP - WP	Multimodal Network savings	Road Network savings	Railway Network savings
Total PCU x km	7,037,329	9,059,138	-2,021,809
Total PCU x h	191,901	200,505	-8,604
Total Pass x km	5,119,270	6,773,227	-1,653,957
Total Pass x h	146,685	164,504	-17,819
Total Tons x km	18,161,457	25,499,769	-7,338,312
Total Tons x h	522,015	553,903	-31,889

In terms transport cost (VOC) the assignment calculates a daily savings of 6,872,444 USD for light and heavy vehicles and a total cost savings (value of time) of time spent equal to 5,433,670 USD. The total Road User Cost Savings in a day is then 12,306,114 USD.

6.2.5 Go Ahead Scenario 2050

I - WITHOUT PROJECT SITUATION

At year 2050 it is assumed that all projects identified for year 2035 have been implemented. In the situation without new projects, the increased demand matrices assigned to the road network, will give the following traffic distribution, creating congestion, as shown in the following table 34.

Figure 26: 2050 Road Congestions without intervention

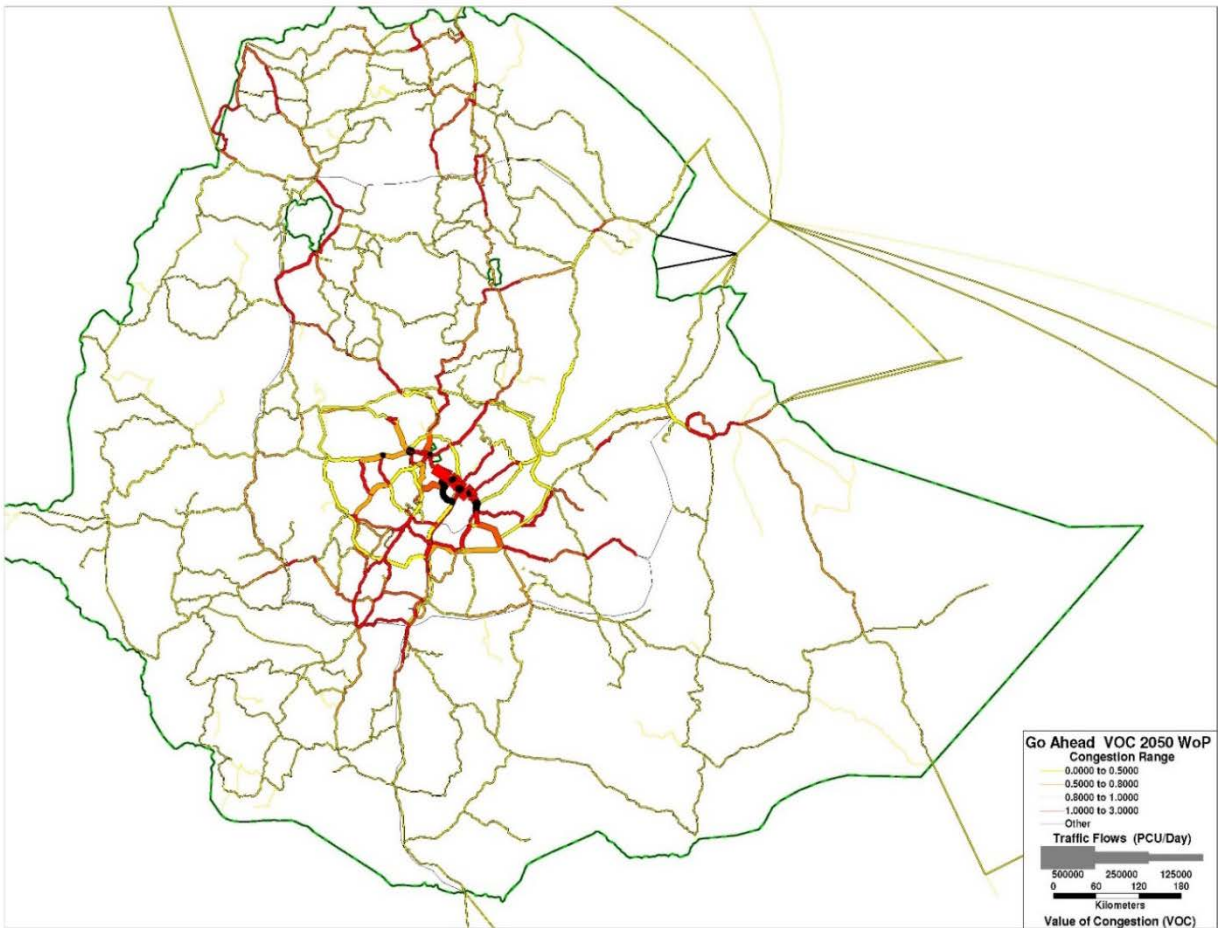


Table 40: 2050 Go Ahead- List of road section without intervention

ID	LINK_NAME	Length	Congestion Factor	Existing Capacity	2050 Traffic Flow
2739	Addis - Adama (Toll Road)	5.09	2.7504	8000	351599
1365	Addis - Adama (Toll Road)	6.64	2.6805	8000	342745
1386	Addis - Adama (Toll Road)	3.23	2.1923	8000	280166
2783	Addis - Adama (Toll Road)	18.12	2.0353	8000	260303
2986	Addis - Adama (Toll Road)	2.14	1.4745	8000	188014
976	Addis - Adama (Toll Road)	2.33	1.4718	8000	187657
2989	Addis - Adama (Toll Road)	6.46	1.4425	8000	184241
1385	Addis - Adama (Toll Road)	27.60	1.4417	8000	184141
977	Addis - Adama (Toll Road)	6.57	1.1092	8000	141872

ID	LINK_NAME	Length	Congestion Factor	Existing Capacity	2050 Traffic Flow
974	Addis - Modjo	21.25	2.1148	1742	57704
1448	Addis - Modjo	20.96	1.8473	1817	234786
2781	Addis - Modjo	9.87	1.7319	1819	220085
1449	Addis - Modjo	13.89	1.6803	1830	214757
973	Addis - Modjo	1.71	1.1252	1817	143834
647	Modjo - Nazreth	1.57	4.9216	1829	143834
981	Modjo - Nazreth	1.05	4.2323	1829	123855
980	Modjo - Nazreth	1.56	2.2117	1823	282006
1364	Modjo - Nazreth	5.61	0.9676	1800	123855
1363	Modjo - Nazreth	10.41	0.8992	1818	115001
649	Modjo - Ziway	39.46	2.5793	1829	75481
648	Modjo - Ziway	26.29	1.9246	1831	62019
1452	Modjo - Ziway	21.49	1.2521	1822	36461
1030	Morocho - Yirba-Dimtu-Dilbo	5.42	1.4864	1634	38653
2824	Morocho - Yirba-Dimtu-Dilbo	90.28	1.0385	1710	28296
999	Mukaturi - Lemi	48.49	1.2694	1741	38436
993	Nazareeh - Metehara	9.46	2.1972	1801	63229
1382	Nazareeh - Metehara	5.54	1.0562	1807	135122
1381	Nazareeh - Metehara	77.70	1.0033	1995	31936
982	Nazaret-Awash Melkassa	3.55	1.4125	1795	179705
988	Addis- Debreberehan	13.36	1.5892	1802	45810
987	Addis- Debreberehan	5.12	1.5891	1794	45602
217	Addis- Debreberehan	32.45	1.5811	1803	45602
1515	Addis- Debreberehan	38.47	1.4961	1731	41437
1002	Addis- Debreberehan	33.31	1.4894	1798	42843
1441	Addis- Debreberehan	2.88	1.4853	1803	42843
1388	Addis- Debreberehan	2.02	1.4113	1801	44722
2509	Addis-Commodo	0.03	5.1157	1111	89651
1446	Addis-Commodo	0.05	4.8819	1111	85541
2506	Addis-Commodo	1.46	2.4921	1489	59326
2508	Addis-Commodo	1.82	1.9164	1637	48910

II - WITH PROJECT SITUATION

To solve the different congestions at year 2050, the following interventions are envisaged:

A. Improved capacity of the road section that have a congestion factor > 1

Table 41: Go Ahead 2050 - Road capacity increase

ID	Link name	Possible intervention at year 2050
2509	Addis-Commodo	Main upgrade (additional lanes)
980	Modjo - Nazreth	
591	Holeta-Ambo	
1330	Sebeta-Holeta	
1326	Alemgena - Butajira	
979	Nazareth - Asela	Main/General upgrade (partially additional lanes)
1382	Nazareeh - Metehara	Main upgrade (additional lanes)
973	Addis - Modjo	
650	Bui - Midirekebd - Meki	Main/General upgrade (partially additional lanes)
2507	Tatek-Kolfe	Main upgrade (additional lanes)
1335	Shashemene - Alaba	Main/General upgrade (partially additional lanes)
982	Nazaret-Awash Melkassa	Main upgrade (additional lanes)
80	Butajira - Ziway	
60	Holeta - Muger	
505	Sodo - Selam Ber	

ID	Link name	Possible intervention at year 2050
1502	Bojeber - Butajira	
584	Alemgena - Weliso	
1333	Ziway - Shashemene	Main/General upgrade (partially additional lanes)
162	Harar-Bombas	Main upgrade (additional lanes)
1032	Awassa - Aposto	Main/General upgrade (partially additional lanes)
20	Harar - Jarso	Main upgrade (additional lanes)
645	Asela - Bekoji - Dodola	
1384	Modjo - Ejere - Arerti - Kesem	
2734	koka-Adulala-D/zeit	
607	Butajira - Hossana	
1037	Aposto - Dilla	Main/General upgrade (partially additional lanes)
944	Mehoni - Maychew	Main upgrade (additional lanes)
1445	Bombas - Jijiga	
579	Giyon - Walkite	Main/General upgrade (partially additional lanes)
615	Welkite - Mazoria	
1515	Addis- Debreberehan	Main upgrade (additional lanes)
1050	Shashemene - Awassa	Main/General upgrade (partially additional lanes)
596	Addis-Holeta	Main upgrade (additional lanes)
612	Alaba Alemgebeya - Wulberg	Main/General upgrade (partially additional lanes)
77	Langano-Kersa-Bilalo	Main upgrade (additional lanes)
195	Bizet - Adiabun	General upgrade (increase of capacity about 50%)
2986	Addis - Adama (Toll Road)	
654	Eteya-Diksis-Robe	Main upgrade (additional lanes)
1418	Adigudom - Mekele	General upgrade (increase of capacity about 50%)
319	Dangla - Bahirdar	Main/General upgrade (partially additional lanes)
606	Mazoria - Hossana	
345	Adiabun-Axum	Main upgrade (additional lanes)
87	Dera - Sire	
1516	Ambo-Gedo	
1027	Hossana - Areka	
71	Shashemene - Dodola	
218	Km 35 - Arerti - Gobensa - Gendober	
623	Tulubolo - Robgebeya	Main/General upgrade (partially additional lanes)
1505	Dodola-Robe	Main upgrade (additional lanes)
996	Sembo-Kesem River	Main/General upgrade (partially additional lanes)
1026	Alaba - Sodo	General upgrade (increase of capacity about 50%)
1209	Adet - Bahirdar	Main/General upgrade (partially additional lanes)
638	Kella - Dugda	Main upgrade (additional lanes)
86	Huruta-Dera	
625	Beke - Zemute	
1425	Waja - Maychew	Main/General upgrade (partially additional lanes)
648	Modjo - Ziway	
1030	Morocho - Yirba-Dimtu-Dilbo	
2999	Gedo-Bako	Main upgrade (additional lanes)
508	Areka - Sodo	General upgrade (increase of capacity about 50%)
205	Negash - Adigrat	
111	Robe - Delosebro - Ginir	
57	Tulubolo-Ginchi	
1390	Godobert - Debreberihan	
1536	Kombolcha - Bati	
2777	Gedo - Ficha	
2774	Leme - Alem Ketema	
140	Sontom - Abay River Bridge	
1318	Chitu-Haro Wenchi	
599	Dejen - D/Markos	

ID	Link name	Possible intervention at year 2050
1207	Zema R. Bridge - Adet	
1539	Awash Junc-Arebereketi	Main/General upgrade (partially additional lanes)
889	Abay River - Gida	General upgrade (increase of capacity about 50%)
313	Bure - Sontom	
1179	Combolcha - Mekaneselam- Abay River Bridge	
88	Sire - Chole	
324	Bahirdar - Wereta	
1202	Bure - Dangla	
238	Kulubi-Dengego	
1254	Debre Sina - Gudo Beret	
960	Abiy Adi - Adwa	
999	Mukaturi - Lemi	
1396	Desse - Kombolcha	
1456	Saja-Jimma	
613	Atat Junction-Gunchere-Kese-Geja-Lera	Main/General upgrade (partially additional lanes)
1246	Mekele - Abiy Adi	General upgrade (increase of capacity about 50%)
163	Jarso - Bombas	
589	Tera - Amoute	
43	Mazoria - Durgi	
1540	Gelemso - Arba reketi	
269	Shashemene - Wondogenet	
893	Debremarkos - Bure	
116	Robe - Seru	
1227	Samera - Sardo	
1018	Mile - Samera	
1324	Tiya - Gereno - Amote	
268	GemetoMazoria - Wondo Genet	
227	Ankober - Dulecha	
723	Chole - Magna - Mechara	
1413	Azezo Airport - Gondar	
2837	Seru - Shekhusen	
263	Lesho Jun - Shishicho - Durame - Mazoria	

B. Construction of the following expressways

- Alemgena-Butajira Expressway
- Adaitu-Mille-Semera Expressway
- Semera - Djibouti/Eritrean border Expressways
- Debre Berhan - Mekele - Eritrea border Expressway
- Commando - Bahir Dar - Metema - Sudan border Expressway
- Gimbi - Gambela - South Sudan border Expressways
- Woliso - Jimma - Mizan Teferi - South Sudan Border Expressway
- Awassa - Moyale - Kenya border Expressway

C. Construction of the following railway line

- Woldiya – Wereta – Metem – Sudan border
- Wereta – Finote - Selam
- Sebeta – Jimma – Bedele – Booma – SudSudan border
- Adama - Gasera
- Ejaji – Kurmuk
- Finote – Selam - Sebeta

CONSTRUCTION OF THE FOLLOWING EXPRESSWAYS

Figure 27: 2050 Go Ahead New Project

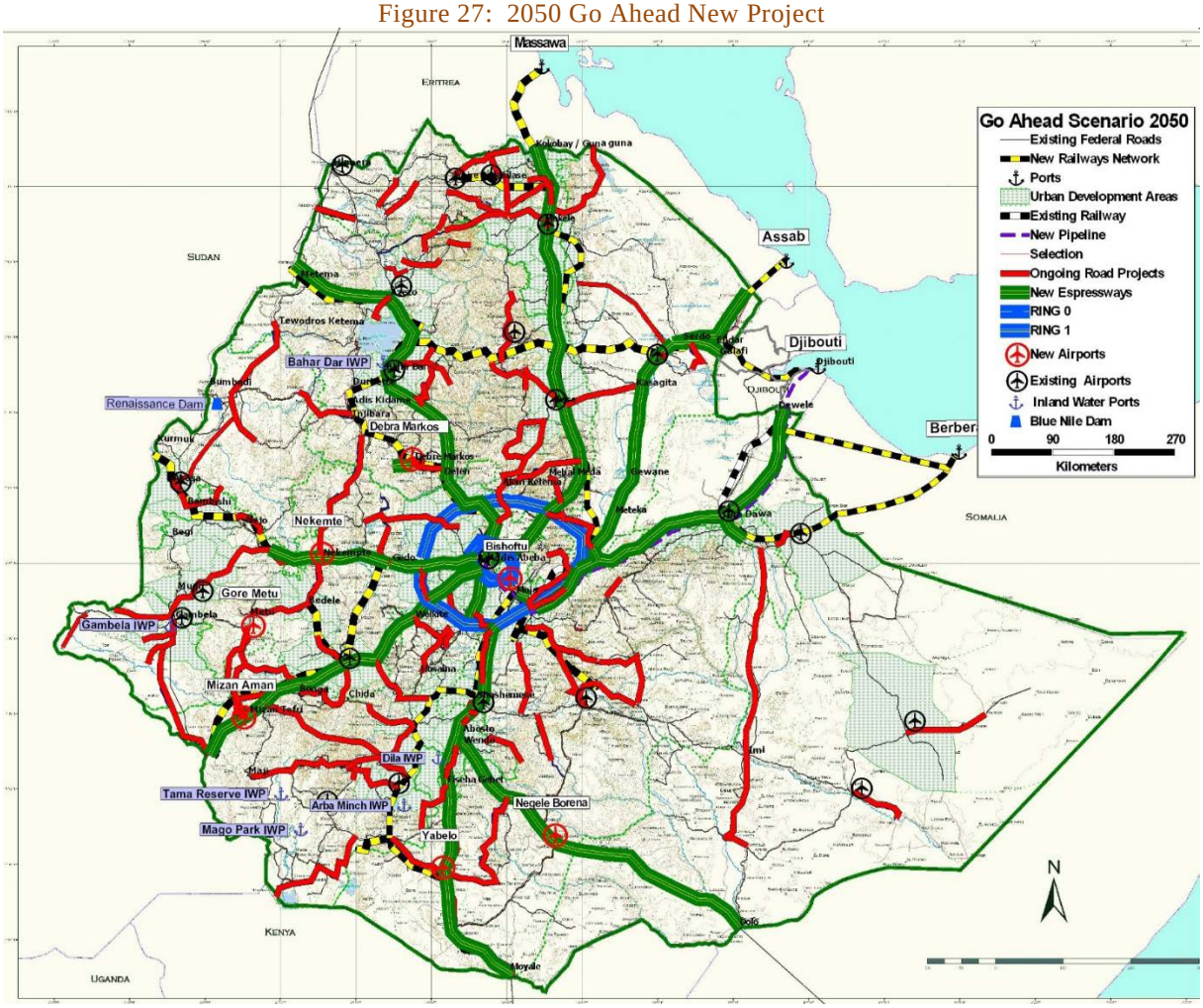


Figure 28: 2050 Go Ahead Road Congestion with intervention

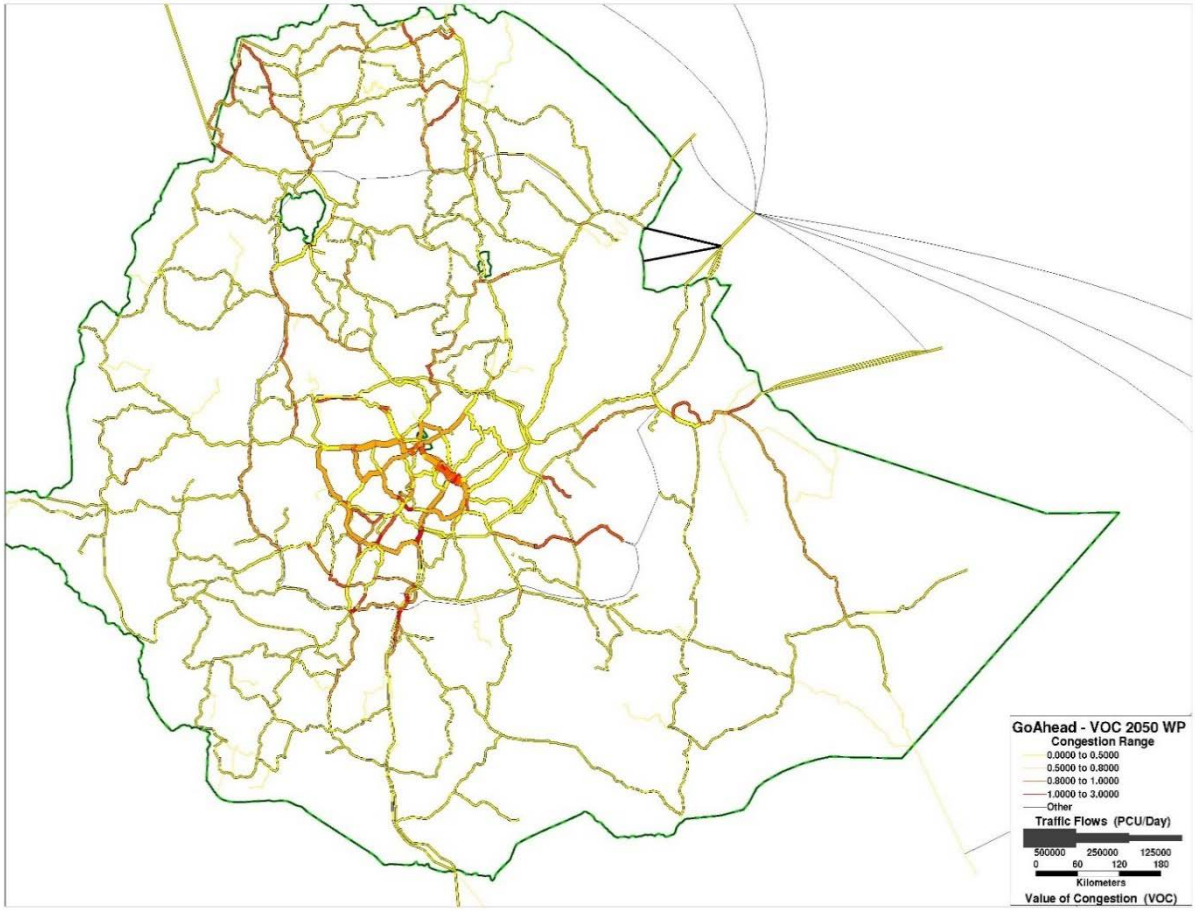


Table 42: 2050 Go Ahead- List of road sections with intervention

ID	LINK_NAME	Length	Congestion Factor	Existing Capacity	Project Capacity	2050 Daily Traffic Flow
2739	Addis - Adama (Toll Road)	5.09	1.4126	8000	12000	271040
1365	Addis - Adama (Toll Road)	6.64	1.1660	8000	12000	223541
1386	Addis - Adama (Toll Road)	3.23	1.1667	8000	12000	223681
2783	Addis - Adama (Toll Road)	18.12	0.9525	8000	12000	181274
2986	Addis - Adama (Toll Road)	2.14	0.8982	8000	12000	172036
976	Addis - Adama (Toll Road)	2.33	0.8964	8000	12000	171690
2989	Addis - Adama (Toll Road)	6.46	0.7997	8000	12000	151975
1385	Addis - Adama (Toll Road)	27.6	0.8101	8000	12000	154034
977	Addis - Adama (Toll Road)	6.57	0.8187	8000	12000	157030
974	Addis - Modjo	21.25	0.6625	8000	8000	82175
1448	Addis - Modjo	20.96	0.7391	8000	12000	141403
2781	Addis - Modjo	9.87	1.2206	8000	12000	233774
1449	Addis - Modjo	13.89	1.0431	8000	12000	199699
973	Addis - Modjo	1.71	1.3748	8000	12000	263247
647	Modjo - Nazreth	1.57	1.3748	8000	12000	263247
981	Modjo - Nazreth	1.05	1.3586	8000	12000	260589
980	Modjo - Nazreth	1.56	1.5815	8000	12000	312457
1364	Modjo - Nazreth	5.61	1.3586	8000	12000	260589
1363	Modjo - Nazreth	10.41	1.1119	8000	12000	213088
649	Modjo - Ziway	39.46	0.6912	1829	8000	84950
648	Modjo - Ziway	26.29	0.3807	1831	8000	51528

ID	LINK_NAME	Length	Congestion Factor	Existing Capacity	Project Capacity	2050 Daily Traffic Flow
1452	Modjo - Ziway	21.49	0.7829	1822	8000	98235
1030	Morocho - Yirba-Dimtu-Dilbo	5.42	0.3320	1634	8000	41602
2824	Morocho - Yirba-Dimtu-Dilbo	90.28	0.1385	1710	1703	3634
999	Mukaturi - Lemi	48.49	1.2763	1741	1892	39052
993	Nazareeh - Metehara	9.46	0.3544	1801	12000	65195
1382	Nazareeh - Metehara	5.54	0.9687	1807	8000	133777
1381	Nazareeh - Metehara	77.7	1.1054	1995	12000	20686
982	Nazaret-Awash Melkassa	3.55	1.1912	1795	8000	156515
989	Nazareth - Asela	0.7	0.8466	1802	12000	161962
990	Nazareth - Asela	4.71	0.5883	1741	12000	104736
1526	Nazareth - Asela	4.74	0.5646	1814	12000	104736
656	Nazareth - Asela	2.66	0.5275	1807	12000	97494
3019	Nazareth - Asela	6.78	0.7571	1806	8000	96474
653	Nazareth - Asela	18.91	0.5192	1814	12000	96440
979	Nazareth - Asela	4.51	0.7358	1816	12000	141229
975	Nazareth - Asela	12.05	0.8446	1819	12000	161962
657	Nazareth - Asela	19.36	0.3072	1828	12000	57413
652	Nazareth - Asela	1.6	0.3019	1832	12000	57431
988	Addis- Debreberehan	13.36	0.5217	1802	8000	66487
987	Addis- Debreberehan	5.12	0.5174	1794	8000	65946
217	Addis- Debreberehan	32.45	0.5174	1803	8000	65946
1515	Addis- Debreberehan	38.47	0.4829	1731	8000	61532
1002	Addis- Debreberehan	33.31	0.4574	1798	8000	58259
1441	Addis- Debreberehan	2.88	0.4574	1803	8000	58259
1388	Addis- Debreberehan	2.02	0.4563	1801	8000	59014
2509	Addis-Commodo	0.03	0.8968	1111	8000	108798
1446	Addis-Commodo	0.05	0.8520	1111	8000	105687
2506	Addis-Commodo	1.46	0.7503	1489	8000	85135
2508	Addis-Commodo	1.82	0.5740	1637	8000	70586
595	Addis-Holeta	12.72	0.5056	1833	8000	64698

6.2.6 2050 road network performance

Following is the calculation of the performance of the road master plan in terms of time, distance and cost in the two situations of "without" and "with" implementation of the road investment proposed.

Situation without proposed investments

To evaluate the road network performance at year 2050, a multimodal (road + rail) assignment has been considered. The **transport offer** (multimodal graph) is composed by 31,911 km of road network plus 5,665 km of rail network. The **transport daily demand** is represented by 3,378,856 passengers, 5,993,864 tons of freight, which have been converted in 2,561,097passenger car units (PCU).

The performance of the transport system involves daily:

- In terms of time (x h): a total of 15,828,960 hours is daily spent by the PCUs, containing 15,819,464 hours spent by passengers and 42,216,125 hours spent for the tons to be transported.
- In terms of distance (x km): a total of 513,223,906 km is daily run by PCUs, containing 755,419,765 km travelled by passengers and 1,235,493,568 Km by Tons of freight, as shown in the following table

Table 43: Road Network Performance by Scenario – Go Ahead Scenario WoP 2050

2050 Go Ahead Without Project	Multimodal Network	Road Network	Railway Network
Total PCU x km	513,223,906	498,246,424	14,977,481
Total PCU x h	15,828,960	15,565,442	263,518
Total Pass x km	755,419,765	745,625,161	9,794,604
Total Pass x h	15,819,464	15,601,094	218,370
Total Tons x km	1,235,493,568	1,194,953,024	40,540,544
Total Tons x h	42,216,125	41,489,248	726,877

In terms of transport cost (VOC) the assignment calculates a daily expenditure of 92,555,517 USD for light and heavy vehicles and a total cost (value of time) of time spent equal to 54,429,667. USD. The total Road User Cost in a day is 146,985,185 USD.

Situation with proposed investments

Considering the proposed investments, the **transport offer** (multimodal graph) is composed by 35,737 km of road network plus 5,665 km of rail network. The **transport daily demand remains** the same of the without situation.

The performance of the transport system involves daily:

- In terms of time (x h): a total of 7,595,804 hours is daily spent by the PCUs, containing 9,445,119 hours spent by passengers and 19,277,722 hours spent for the tons to be transported.
- In terms of distance (x km): a total of 525,403,656 km is daily run by PCUs, containing 666,973,124 km travelled by passengers and 1,320,994,306 Km by Tons of freight, as shown in the following table

Table 44: Road Network Performance by Scenario – Go Ahead WP 2050

2050 Go Ahead with Project	Multimodal Network	Road Network	Railway Network
Total PCU x km	525,403,656	494,224,777	31,178,879
Total PCU x h	7,595,804	7,194,865	400,938
Total Pass x km	666,973,124	613,461,572	53,511,551
Total Pass x h	9,445,119	8,691,722	753,397
Total Tons x km	1,320,994,306	1,252,226,922	68,767,384
Total Tons x h	19,277,722	18,388,389	889,333

In terms transport cost (USD) the assignment calculates a daily expenditure of 81,028,430 USD for light and heavy vehicles and a total cost (value of time) of time spent equal 40,779,014. USD. The total Road User Cost in a day is then1 121,807,443 USD.

Advantages of the application of the proposed road investments:

- In terms of time (x h): a total of 8,233,156 daily hours are saved by the PCUs, while 6,374,345 hours are saved by passengers and 22,938,403 hours for the tons transported.
- In terms of distance (x km): a total of 12,179,750 km is daily increased by PCUs, while 88,446,641 kms are saved by passengers. The freight transport is increased 85,500,737 km, whom 57,273,898 along the railway system and 28,226,839 along the road network.

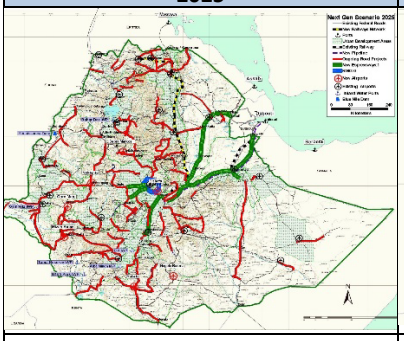
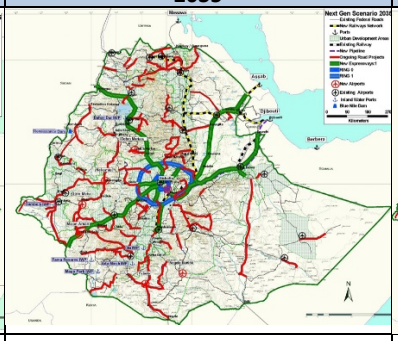
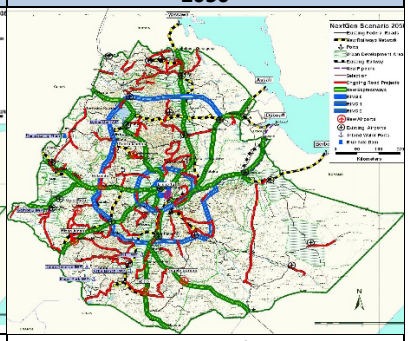
Table 45: Road Network Performance comparison – Go Ahead WoP minus WP 2050

2050 Go Ahead WOP - WP	Multimodal Network savings	Road Network savings	Railway Network savings
Total PCU x km	-12,179,750	4,021,648	-16,201,398
Total PCU x h	8,233,156	8,370,576	-137,420
Total Pass x km	88,446,641	132,163,589	-43,716,948
Total Pass x h	6,374,345	6,909,372	-535,027
Total Tons x km	-85,500,737	-57,273,898	-28,226,839
Total Tons x h	22,938,403	23,100,858	-162,456

In terms transport cost (VOC) the assignment calculates a daily savings of 11,527,088 USD for light and heavy vehicles and a total cost savings (value of time) of time spent equal to 13,650,654 USD. The total Road User Cost Savings in a day is then 25,177,741 USD.

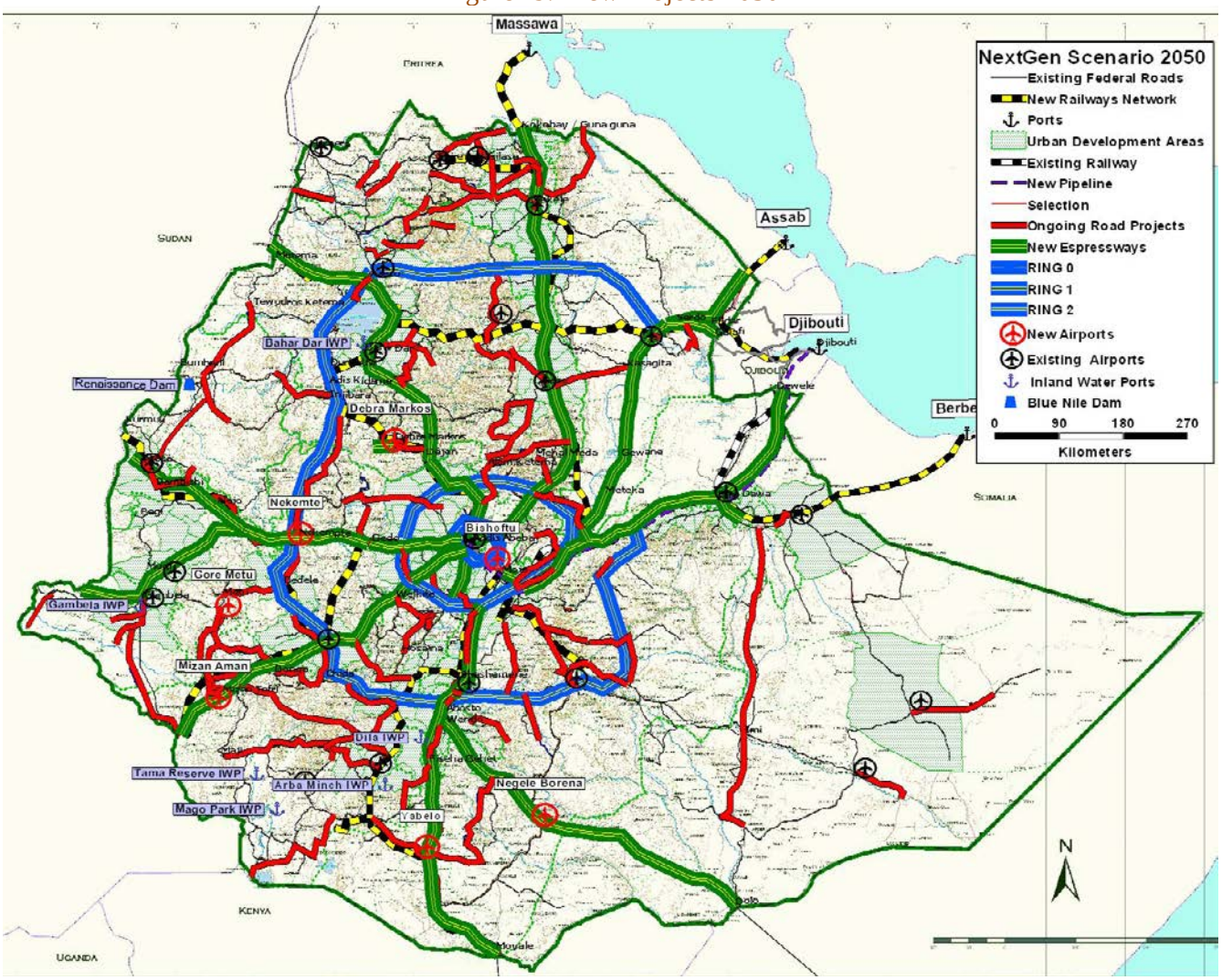
6.3 NEXT GENERATION SCENARIO

In the Next Generation scenarios, the building of Road Master Plan brings to the following identification of new expressways and ring roads.

2025	2035	2050
		
› FYP - Ongoing Road Projects List › Mojo-Awassa Expressway › Dire Dawa – Dewele Expressway Completion › RING ROAD 0 › Addis Ababa - Holeta-Ambo Expressway › Addis Ababa - Alemgena-Woliso Expressway › Dire Dawa-Dengego-Harar Expressway › Awash Junction – Adaitu - Mile – Semera Expressway › Melkisa – Metera Expressaway › Road capacity improvement interventions on other road sections	› Alemgena-Butajira Expressway › Addis Ababa-Debrebirhan Expressway › Awash Junction-Dire Dawa Expressway › Addis Ababa-Commando Expressway › RING ROAD 1	› Semera - Djibouti/Eritrean border Expressways › Debre Berhan - Mekele - Eritrea border Expressway › Commando - Bahir Dar - Metema - Sudan border Expressway › Ambo - Gimbi - Asosa - Sudan border Expressway › Gimbi - Gambela - South Sudan border Expressways › Woliso - Jimma - Mizan Teferi - South Sudan Border Expressway › Awassa - Moyale - Kenya border Expressway › Awassa - Bilata - Filtu - Somalia border Expressway › Road capacity improvement interventions on other road sections › RING ROAD 3

In particular at year 2050, the following new expressways and Ring Roads need to be implemented:

Figure 29: New Projects 2050



- Semera - Djibouti/Eritrean border Expressways
- Debre Berhan - Mekele - Eritrea border Expressway
- Commando - Bahir Dar - Metema - Sudan border Expressway
- Ambo - Gimbi - Asosa - Sudan border Expressway
- Gimbi - Gambela - South Sudan border Expressways
- Woliso - Jimma - Mizan Teferi - South Sudan Border Expressway
- Awassa - Moyale - Kenya border Expressway
- Awassa - Bilata - Filtu - Somalia border Expressway
- Road capacity improvement interventions on other road sections
- RING ROAD 3

6.3.1 2050 Next Generation network performance

Following is the calculation of the performance of the road master plan in terms of time, distance and cost in the two situations of "without" and "with" implementation of the road investment proposed.

Situation without proposed investments

To evaluate the road network performance at year 2050, a multimodal (road + rail) assignment has been considered. The **transport offer** (multimodal graph) is composed by 32,811 km of road network plus 4,959 km of rail network. The **transport daily demand** is represented by 3,378,856 passengers, 5,993,864 tons of freight, which have been converted in 2,561,097passenger car units (PCU).

The performance of the transport system involves daily:

- In terms of time (x h): a total of 7,644,224 hours is daily spent by the PCUs, containing 10,544,563 hours spent by passengers and 18,838,228 hours spent for the tons to be transported.
- In terms of distance (x km): a total of 487,333,016 km is daily run by PCUs, containing 719,005,856 km travelled by passengers and 1,173,072,109 Km by Tons of freight, as shown in the following table

Table 46: Road Network Performance by Scenario – Next Generation Scenario WoP 2050

2050 Next Generation Without Project	Multimodal Network	Road Network	Railway Network
Total PCU x km	487,333,016	459,952,439	27,380,577
Total PCU x h	7,644,224	7,314,366	329,858
Total Pass x km	719,005,856	645,591,923	73,413,933
Total Pass x h	10,544,563	10,069,491	475,073
Total Tons x km	1,173,072,109	1,125,864,543	47,207,567
Total Tons x h	18,838,228	18,035,989	802,239

In terms of transport cost (VOC) the assignment calculates a daily expenditure of 91,556,372 USD for light and heavy vehicles and a total cost (value of time) of time spent equal to 53,847,975. USD. The total Road User Cost in a day is 145,414,347 USD.

Situation with proposed investments

Considering the proposed investments, the **transport offer** (multimodal graph) is composed by 37,545 km of road network plus 4,959 km of rail network. The **transport daily demand remains** the same of the without situation.

The performance of the transport system involves daily:

- In terms of time (x h): a total of 6,997,878 hours is daily spent by the PCUs, containing 9,160,702 hours spent by passengers and 17,438,883 hours spent for the tons to be transported.
- In terms of distance (x km): a total of 502,040,554 km is daily run by PCUs, containing 665,051,704 km travelled by passengers and 1,243,575,119 Km by Tons of freight, as shown in the following table

Table 47: Road Network Performance by Scenario – Next Generation WP 2050

2050 Next Generation with Project	Multimodal Network	Road Network	Railway Network
Total PCU x km	502,040,554	484,111,421	17,929,133
Total PCU x h	6,997,878	6,776,159	221,718
Total Pass x km	665,051,704	616,547,982	48,503,722
Total Pass x h	9,160,702	8,520,324	640,377
Total Tons x km	1,243,575,119	1,214,504,302	29,070,817
Total Tons x h	17,438,883	17,139,936	298,947

In terms transport cost (USD) the assignment calculates a daily expenditure of 77,472,104 USD for light and heavy vehicles and a total cost (value of time) of time spent equal 38,989,229. USD. The total Road User Cost in a day is then1 116,461,333 USD.

Advantages of the application of the proposed road investments:

- In terms of time (x h): a total of 646,346 daily hours are saved by the PCUs, while 1,383,862 hours are saved by passengers and 1,399,345 hours for the tons transported.
- In terms of distance (x km): a total of 14,707,538km is daily increased by PCUs, while 53,954,153 kms are saved by passengers. The freight transport along the railway system are saved 18,136,750 km, while are increased 88,639,760 Km by road network, for an overall increase of 70,503,010 Km.

Table 48: Road Network Performance comparison – Next Generation WoP minus WP 2050

2050 Next Generation WOP - WP	Multimodal Network savings	Road Network savings	Railway Network savings
Total PCU x km	-14,707,538	-24,158,982	9,451,444
Total PCU x h	646,346	538,206	108,140
Total Pass x km	53,954,153	29,043,941	24,910,211
Total Pass x h	1,383,862	1,549,166	-165,305
Total Tons x km	-70,503,010	-88,639,760	18,136,750
Total Tons x h	1,399,345	896,053	503,292

In terms transport cost (VOC) the assignment calculates a daily savings of 14,094,268 USD for light and heavy vehicles and a total cost savings (value of time) of time spent equal to 14,858,746 USD. The total Road User Cost Savings in a day is then 28,953,015 USD.

6.4 LIMIT TO GROWTH SCENARIO

In the Limits to Growth scenarios, the building of Road Master Plan brings to the following identification of new expressways and ring roads.

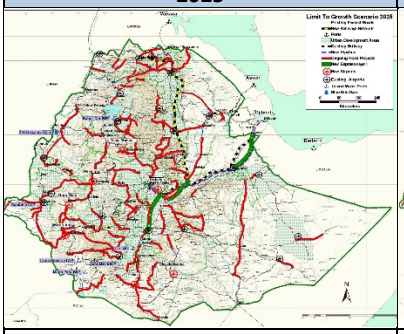
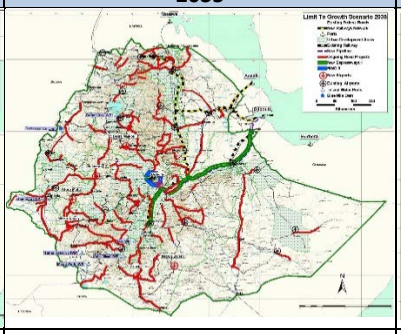
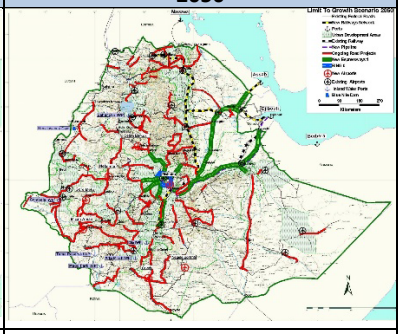
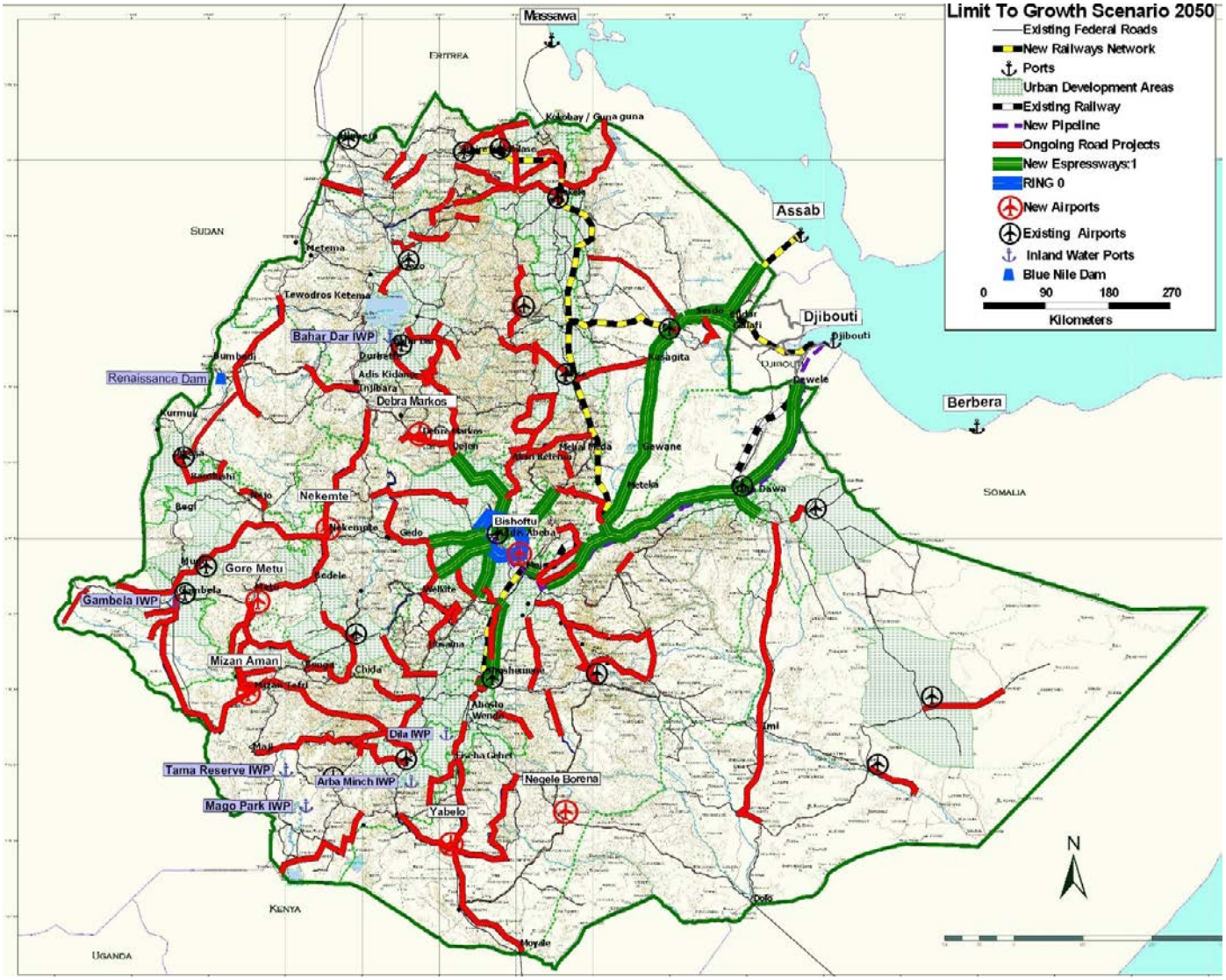
2025	2035	2050
		
› FYP - Ongoing Road Projects List › Mojo-Awassa Expressway › Dire Dawa – Dewele Expressway Completion	› Ring Road 0 › Awash Junction – Dire Dawa Expressway	› Addis – Holeta – Ambo Expressway › Addis – Alemgena - Woliso Expressway › Addis - Debrebirhan Expressway › Alemgena - Butajira Expressway › Dire Dawa – Dengego - Harar Expressway › Awash Junction – Adaitu Expressway › Adaitu – Mile – Semera Expressway › Addis – Commando Expressway

Figure 30: New Projects 2050



- Addis – Holeta – Ambo Expressway
- Addis – Alemgena - Woliso Expressway
- Addis - Debrebirhan Expressway
- Alemgena - Butajira Expressway
- Dire Dawa – Dengego - Harar Expressway
- Awash Junction – Adaitu Expressway
- Adaitu – Mile – Semera Expressway
- Addis – Commando Expressway

6.4.1 2050 Limit to Growth road network performance

Following is the calculation of the performance of the road master plan in terms of time, distance and cost in the two situations of "without" and "with" implementation of the road investment proposed.

Situation without proposed investments

To evaluate the road network performance at year 2050, a multimodal (road + rail) assignment has been considered. The **transport offer** (multimodal graph) is composed by 31,128 km of road network plus 2,635 km of rail network. The **transport daily demand** is represented by 2,718,726 passengers, 4,983,784 tons of freight, which have been converted in 2,117,716passenger car units (PCU).

The performance of the transport system involves daily:

- In terms of time (x h): a total of 13,275,343 hours is daily spent by the PCUs, containing 16,786,602 hours spent by passengers and 33,528,714 hours spent for the tons to be transported.
- In terms of distance (x km): a total of 414,265,322 km is daily run by PCUs, containing 628,368,585 km travelled by passengers and 990,088,902 Km by Tons of freight, as shown in the following table

Table 49: Road Network Performance by Scenario – Limit to Growth Scenario WoP 2050

2050 Limit to Growth Without Project	Multimodal Network	Road Network	Railway Network
Total PCU x km	414,265,322	405,037,673	9,227,648
Total PCU x h	13,275,343	12,383,243	892,100
Total Pass x km	628,368,585	625,694,136	2,674,449
Total Pass x h	16,786,602	16,580,132	206,470
Total Tons x km	990,088,902	962,312,411	27,776,491
Total Tons x h	33,528,714	30,784,109	2,744,605

In terms of transport cost (VOC) the assignment calculates a daily expenditure of 81,864,576 USD for light and heavy vehicles and a total cost (value of time) of time spent equal to 48,142,583. USD. The total Road User Cost in a day is 130,007,159 USD.

Situation with proposed investments

Considering the proposed investments, the **transport offer** (multimodal graph) is composed by 32,103 km of road network plus 2,635 km of rail network. The **transport daily demand remains** the same of the without situation.

The performance of the transport system involves daily:

- In terms of time (x h): a total of 6,557,898 hours is daily spent by the PCUs, containing 8,651,271 hours spent by passengers and 16,390,918 hours spent for the tons to be transported.
- In terms of distance (x km): a total of 404,217,454 km is daily run by PCUs, containing 568,989,762 km travelled by passengers and 994,172,905 Km by Tons of freight, as shown in the following table

Table 50: Road Network Performance by Scenario – Limit to Growth WP 2050

2050 Limit to Growth with Project	Multimodal Network	Road Network	Railway Network
Total PCU x km	404,217,454	394,969,751	9,247,704
Total PCU x h	6,557,898	6,407,732	150,167
Total Pass x km	568,989,762	565,316,415	3,673,348
Total Pass x h	8,651,271	8,585,306	65,965
Total Tons x km	994,172,905	962,312,411	31,860,493
Total Tons x h	16,390,918	15,926,316	464,602

In terms transport cost (USD) the assignment calculates a daily expenditure of 67,248,812 USD for light and heavy vehicles and a total cost (value of time) of time spent equal 33,862,090. USD. The total Road User Cost in a day is then1 101,146,502 USD.

Advantages of the application of the proposed road investments:

- In terms of time (x h): a total of 6,717,445 daily hours are saved by the PCUs, while 8,135,331 hours are saved by passengers and 17,137,796 hours for the tons transported.
- In terms of distance (x km): a total of 10,047,868 km is daily increased by PCUs, while 59,378,823 kms are saved by passengers. Along the railway system are increased 4,084,003 km for the freight.

Table 51: Road Network Performance comparison – Limit to Growth WoP minus WP 2050

2050 Limit to Growth WOP - WP	Multimodal Network savings	Road Network savings	Railway Network savings
Total PCU x km	10,047,868	10,067,923	-20,055
Total PCU x h	6,717,445	5,975,512	741,933
Total Pass x km	59,378,823	60,377,722	-998,899
Total Pass x h	8,135,331	7,994,826	140,505
Total Tons x km	-4,084,002	-	-4,084,003
Total Tons x h	17,137,796	14,857,793	2,280,003

In terms transport cost (VOC) the assignment calculates a daily savings of 14,580,164 USD for light and heavy vehicles and a total cost savings (value of time) of time spent equal to 14,280,493 USD. The total Road User Cost Savings in a day is then 28,860,657 USD.

7 PROJECT EVALUATION

The single expressway project evaluation has been carried out using the HDM4 model described in the following paragraphs

7.1 ACTIONS BY SCENARIOS

GO AHEAD - ROAD NETWORK PROJECTS

ACTIONS	Short Term 2025	Medium Term 2035	Long Term 2050
FYP - Ongoing Road Projects List	X		
Mojo-Awassa Expressway	X		
Dire Dawa – Dewele Expressway Completion	X		
Addis Ababa - Holeta-Ambo Expressway	X		
Addis Ababa - Alemgena-Woliso Expressway	X		
Addis Ababa-Debrebirhan Expressway		X	
Alemgena-Butajira Expressway			X
Dire Dawa-Dengego-Harar Expressway	X		
Awash Junction-Adaitu Expressway		X	
Awash junction – Dire Dawa Expressway		X	
Adaitu-Mille-Semera Expressway			X
Addis Ababa-Commando Expressway		X	
Melkasa - Meteara - Awash Junction Expressway	X		
Semera - Djibouti/Eritrean border Expressways			X
Debre Berhan - Mekele - Eritrea border Expressway			X
Commando - Bahir Dar - Metema - Sudan border Expressway			X
Ambo - Gimbi - Asosa - Sudan border Expressway			
Gimbi - Gambela - South Sudan border Expressways			X
Woliso - Jimma - Mizan Teferi - South Sudan Border Expressway			X
Awassa - Moyale - Kenya border Expressway			X
Awassa - Bilata - Filtu - Somalia border Expressway			
Enlarging 3+3 lanes Addis – Nekemte Expr.			
Enlarging 3+3 lanes Modjo – Ziway Expr.			
Enlarging 3+3 lanes Ziway - Awassa Expr.			
Enlarging 2+2 lanes Harar -Bombas Expressway	X		
Enlarging 2+2 lanes Bombas - Giggiga Expressway			X
Giggiga - Kebridehar - Somaliland border Expressway			
RING ROAD 0: Addia Ababa New Ring Road	X		
RING ROAD 1: Ambo - Weliso - Welkite - Butajra - Ziway - Sagure - Asela			X
RING ROAD 2: Semera -Maychew –Gondar –Nekemte -Jimma-Awassa- Shikhussein-Dodoma			
Enlarging 3+3 lanes Addis Ababa - Modjo Exprssway.		X	
Enlarging 2+2 lanes Dire Dawa - Dewelle- Djibouti border,			X
Enlarging 2+2 lanes Holeta - Muger	X		
Enlarging 2+2 Lanes Commando - Bahir Dar - Metema - Sudan border			
Enlarging 2+2 lanes Adama -Melkasa - Asela	X		
Interventions for road capacity adaptation			X

NEXT GENERATION - ROAD NETWORK PROJECTS

ACTIONS	Short Term 2025	Medium Term 2035	Long Term 2050
FYP - Ongoing Road Projects List	X		
Mojo-Awassa Expressway	X		
Dire Dawa – Dewele Expressway Completion	X		
Addis Ababa - Holeta-Ambo Expressway	X		
Addis Ababa - Alemgena-Woliso Expressway	X		
Addis Ababa-Debrebirhan Expressway		X	
Alemgena-Butajira Expressway		X	
Dire Dawa-Dengego-Harar Expressway	X		
Awash Junction-Adaitu Expressway	X		
Awash Junction-DireDawa Expressway		X	
Adaitu-Mille-Semera Expressway		X	
Addis Ababa-Commando Expressway		X	
Melkasa - Meteara - Awash Junction Expressway	X		
Semera - Djibouti/Eritrean border Expressways			X
Debre Berhan - Mekele - Eritrea border Expressway			X
Commando - Bahir Dar - Metema - Sudan border Expressway			X
Ambo - Gimbi - Asosa - Sudan border Expressway			X
Gimbi - Gambela - South Sudan border Expressways			X
Woliso - Jimma - Mizan Teferi - South Sudan Border Expressway			X
Awassa - Moyale - Kenya border Expressway			X
Awassa - Bilata - Filtu - Somalia border Expressway			X
Enlarging 3+3 lanes Addis – Nekemte Expr.			X
Enlarging 3+3 lanes Modjo – Ziway Expr.		X	
Enlarging 3+3 lanes Ziway - Awassa Expr.			X
Enlarging 2+2 lanes Harar -Bombas Expressway	X		
Enlarging 2+2 lanes Bombas - Giggiga Expressway			X
Giggiga - Kebridehar - Somaliland border Expressway			X
RING ROAD 0: Addia Ababa New Ring Road	X		
RING ROAD 1: Ambo - Weliso - Welkite - Butajra - Ziway - Sagure - Asela		X	
RING ROAD 2: Semera -Maychew –Gondar –Nekemte -Jimma-Awassa- Shikhussein-Dodoma			X
Enlarging 3+3 lanes Addis – Butajira Expressway			X
Enlarging 3+3 lanes Addis Ababa - Modjo Exprssway.		X	
Enlarging 2+2 lanes Dire Dawa - Dewelle- Djibouti border,			X
Enlarging 2+2 lanes Holeta - Muger	X		
Enlarging 2+2 Lanes Commando - Bahir Dar - Metema - Sudan border			X
Enlarging 2+2 lanes Adama -Melkasa - Asela	X		
Interventions for road capacity adaptation			X

LIMITS TO GROWTH - ROAD NETWORK PROJECTS

ACTIONS	Short Term 2025	Medium Term 2035	Long Term 2050
FYP - Ongoing Road Projects List	X		
Mojo-Awassa Expressway	X		
Dire Dawa – Dewele Expressway Completion	X		
Addis Ababa - Holeta-Ambo Expressway			X
Addis Ababa - Alemgena-Woliso Expressway			X
Addis Ababa-Debrebirhan Expressway			X
Alemgena-Butajira Expressway			X
Dire Dawa-Dengego-Harar Expressway			X
Awash Junction-Adaitu Expressway			X
Awash Junction-Dire Dawa Expressway		X	
Adaitu-Mille-Semera Expressway			X
Addis Ababa-Commando Expressway			X
Melkasa - Meteara - Awash Junction Expressway			
Semera - Djibouti/Eritrean border Expressways			
Debre Berhan - Mekele - Eritrea border Expressway			
Commando - Bahir Dar - Metema - Sudan border Expressway			
Ambo - Gimbi - Asosa - Sudan border Expressway			
Gimbi - Gambela - South Sudan border Expressways			
Woliso - Jimma - Mizan Teferi - South Sudan Border Expressway			
Awassa - Moyale - Kenya border Expressway			
Awassa - Bilata - Filtu - Somalia border Expressway			
Enlarging 3+3 lanes Addis – Nekemte Expr.			
Enlarging 3+3 lanes Modjo – Ziway Expr.			
Enlarging 3+3 lanes Ziway - Awassa Expr.			
Enlarging 2+2 lanes Harar -Bombas Expressway			
Enlarging 2+2 lanes Bombas - Giggiga Expressway			
Giggiga - Kebridehar - Somaliland border Expressway			
RING ROAD 0: Addia Ababa New Ring Road		X	
RING ROAD 1: Ambo - Weliso - Welkite - Butajra - Ziway - Sagure - Asela			
RING ROAD 2: Semera -Maychew –Gondar –Nekemte -Jimma-Awassa- Shikhussein-Dodoma			
Enlarging 3+3 lanes Addis – Butajira Expressway			
Enlarging 3+3 lanes Addis Ababa - Modjo Exprssway.			
Enlarging 2+2 lanes Dire Dawa - Dewelle- Djibouti border,			
Enlarging 2+2 lanes Holeta - Muger			
Enlarging 2+2 Lanes Commando - Bahir Dar - Metema - Sudan border			
Enlarging 2+2 lanes Adama -Melkasa - Asela			
Interventions for road capacity adaptation			

7.2 SINGLE PROJECT EVALUATION

The HDM4 analysis has been applied for all the 16 new expressways proposed. In this chapter we report the entire analysis for 3 representative new expressways at the different years and the results of all the expressways proposed.

7.2.1 The HDM4 model

HDM-4 is a computer software, developed by the World Bank, for Highway Development and Maintenance Management System. It is a decision-making tool for checking the Engineering and Economic viability of the investments in road projects.

HDM can be used for single Project Analysis, road Program Analysis and Road Strategic Analysis. HDM analysis allows the users to assess the physical, functional and economic feasibility of specified project alternatives by comparison against a base case (do nothing). The cost is the construction or maintenance costs, while the benefits are the Vehicle Operating Costs Savings (VOCS), the Travel Time Cost Savings (TTCS) and the Accident Cost Savings (ACS). HDM can calculate the economic indicators like NPV, IRR etc for every option of the maintenance strategies for the projected analysis period. The most beneficial maintenance option will be one that gives the maximum economic return.

The **Project analysis** can be done for: i) Maintenance of Existing roads (crack sealing - pothole patching - seal coat - Single Bituminous Surface Dressing (SBSD) - Double Bituminous Surface Dressing (DBSD) - Carpeting – Overlay - Pavement strengthening); ii) Improvement of existing roads (Pavement reconstruction - Pavement upgrading - Road widening and geometric improvements – Realignment); iii) New construction (entirely new construction): iv) Stage construction (Planned improvements at fixed stages, say from HBB to Bituminous pavement); v) Project evaluation (Assessment of the performance of the completed project to see if objectives set out during appraisal have been met).

The **Program Analysis** serves to prepare a multi-year rolling program for road network through maximization of NPV/Cost ratio. It deals primarily with the prioritisation of a defined long list of candidate road projects into a one-year or multi-year work programme under defined budget constraints. The Programme analysis as it is termed, is the analysis for doing the yearly maintenance programme or for the multi-year rolling programme. The programme analysis tool has been incorporated in HDM-4 for easy analysis of the whole road network for identifying the candidate road sections for the maintenance for a particular budget period. For the constraint budget, the economic criteria for selecting the candidate road is the maximisation of NPV/Cost.

The **Strategic Analysis** serves for the analysis of whole network for long term planning under different budget scenarios. The analysis is done on the entire road network for long term budget planning or for optimising the maintenance strategies. In any case whole network is subdivided into several network according to the key attributes that influence the pavement performance.

7.2.2 Inputs to the Model

The following inputs have been used for HDM4 application:

Table 52: HDM IV Inputs – Vehicle Fleet Data

Items	Economic costs							
New vehicle price (USD)	16,924	37,248	29,316	53,546	25,315	30,393	66,125	120,497
Tyre price (USD)	68	174	252	380	252	380	380	380
Fuel (USD/lit)	0.54	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Lubricant (USD/lit)	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
Maintenance Labour cost (USD/hr)	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Crew cost (USD/hr)	-	-	0.49	1.37	0.53	0.72	1.02	1.33
Annual Overhead (USD)	158.68	286.65	349.62	556.42	376.75	1833.77	2893.21	4029.75
Passenger time cost (USD/hr)	0.57	0.57	0.24	0.24	-	-	-	-
Annual Interest rate (%)	10	10	10	10	10	10	10	10

7.3 INVESTMENTS AT YEAR 2025

7.3.1 Holeta – Ambo Expressway

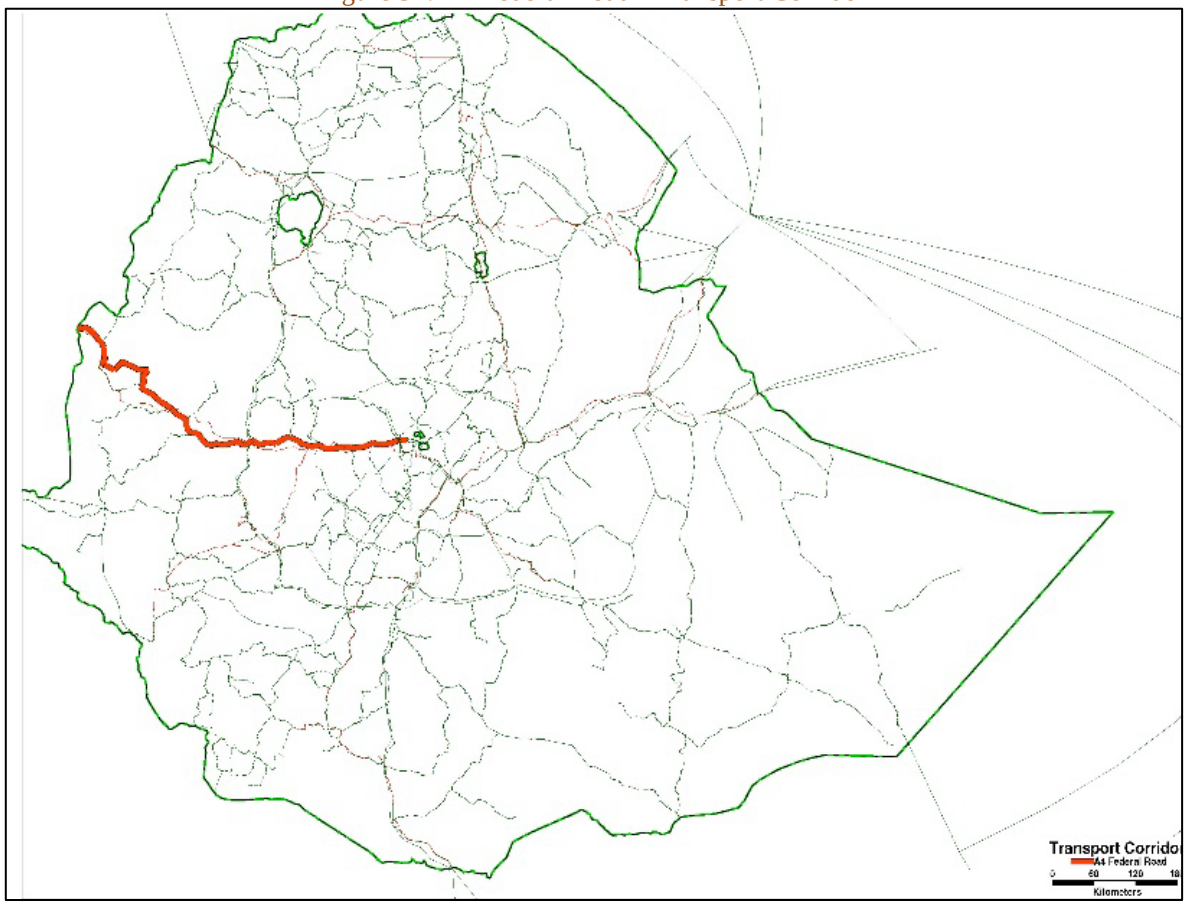
PROPOSED ALIGNMENT

The Holeta Ambo Road section is part of the A4 federal road and belongs to the transport corridor which runs west from Addis Ababa through the localities of Holeta, Ginchi, Ambo Nekemte, Gimbi up to the border with Sudan. (Figure 31)

The Holeta Ambo expressway project foresees the widening of the carriageway to 2 + 2 lanes, the improvement of the alignment and the construction of new sections where this is not possible.

The reference scenario of the Holeta Ambo project is **Go Ahead 2025**. It is therefore expected to be completed in 3 years 2003-2025 and open to traffic in 2026.

Figure 31: A4 Federal Road - Transport Corridor



The road section Holeta- Ambo has a length of **84 km** with a cross section of two lanes of 3.5 meters with shoulders of maximum width of 1.5 mt (Figure 32). The road has an average altitude of about 2200 meters and an altitude profile that varies between 2100 and 2400 meters. **(**Figure 33**)**

Figure 32: A4 Holeta – Ambo Road Section

Figure 33: A4 Holeta – Ambo Plan/Profile scheme

TRAFFIC STUDY

A traffic study was conducted to define the traffic currently affecting the road and to estimate the traffic in the 2025, 2035 and 2050 development scenarios.

Present Situation

A current annual daily traffic volume (AADT) of approximately **9200*** (weighted average) was defined on the basis of the 2019 traffic counts carried out on some sections along the A4 Holeta Ambo.

Table 53: Holeta Ambo Traffic Counts 2019 by section

Link name	Counting Station	Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer	Total Vehicles
Holeta-Ambo	0015A	1028	1150	1896	622	1256	2050	2042	2556	**12600**
Holeta-Ambo	0015B	645	988	1280	220	916	1545	1822	1954	**9370**
Holeta-Ambo	0016A	1048	1243	1388	752	427	1297	1049	976	**8180**
Holeta-Ambo	0016B	1078	1191	1400	713	434	1198	1037	947	**7998**

*On the sections without data, the adjacent traffic volumes were considered.

Traffic Composition

Table 54: Holeta Ambo Traffic composition

Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer
11%	12%	16%	6%	8%	16%	15%	16%

Road Section	Light Vehicles	heavy tracks
Holeta - Ambo	45.6%	54.4%

Future Traffic Demand

The future traffic and the relative growth rates, for all time horizons, were defined on the basis of the results provided by the multimodal traffic model reported in the Sectorial Report 1 – Integrated Transport Model.

The following table shows the Traffic Growth rate for each time horizon.

Table 55: Holeta Ambo Traffic Growth

2020- 2025	2025- 2035	2035-2050
1.58%	5.90%	8.28%

Traffic Volumes (Weighted Average) 2020 – 2025 – 2035 – 2050

Table 56: Holeta Ambo Traffic Flows by Scenario

Years	Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer	Total Vehicles
2020	1023	1235	1459	554	728	1356	1355	1391	9102
2025	**1107**	**1335**	**1578**	**599**	**787**	**1467**	**1466**	**1504**	**9843**
2035	1962	2368	2798	1063	1396	2601	2599	2667	17456
2050	8512	10273	12138	4609	6055	11284	11274	11569	75715

The following figure and table show the traffic flows assigned by the multimodal traffic model to **2025** in terms of PCU equivalent car units (see Sectorial Report 1 – Integrated Transport Model), divided between passenger vehicles (cars, 4-wheel drive, mini-Bus, Bus) and heavy vehicles (small, medium, large vehicles and trailers).

Figure 34:A4 Holeta – Ambo Traffic Assignment 2025

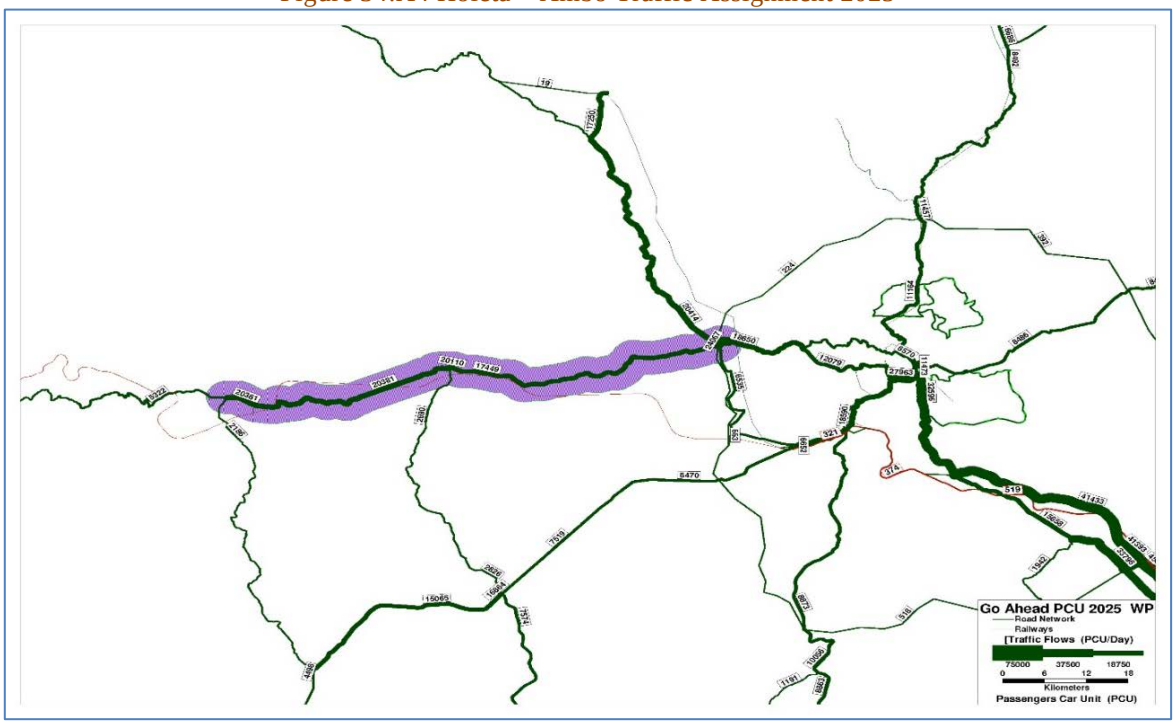


Table 57: Holeta Ambo Traffic Model Assignment 2025

ID Model	LENGTH Km	LINK NAME	Light Vehicles PCU/Day	Heavy Vehicles PCU/Day	TOTAL FLOW PCU/Day
593	53.02	Holeta-Ambo	4737	12713	17449
2996	31.70	Holeta-Ambo	6751	13630	20381

ECONOMIC ANALISIS

To define the economic feasibility for the Holeta - Ambo (84 Km), the Consultant has applied the World Bank HDM-4 model that simulates road conditions and user costs according with traffic flows and maintenance operations conducted. The Cost Benefit analysis considers the investment and maintenance cost estimates and the savings from decreased vehicle operating costs (VOC) and time savings (VoT). The economic analysis compares the "without" project and the "with" project situation, all through the project life (30 years of operation) of the alternative considered.

For the construction of the Holeta - Ambo Expressway, in the scenario Go-Ahead-2025, three years of construction are planned (2022-2025) with 2026 opening year to traffic.

HDM 4 Analysis

Main phases of the economic analysis are:

1. Calculation of Investment Costs
2. Maintenance Activity and Costs.
3. Simulation of the "traffic-maintenance-user costs" interrelationship along the project life of the "with" and "without" scenarios.
4. HDM 4 Results in terms of Internal Rate of Return (IRR) and Net Present Value (NPV) and NPV / CAP.

INVESTMENT COSTS

Taking into account the preliminary phase of the analysis, a maximum investment cost of 1.8 million USD/km was considered for the upgrading of the existing road into a 4-lane expressway. The investment cost, even if closer to a Green Filed construction than to a Brown Filed, takes into account possible new road sections and alignment improvements.

Total Investment cost in the period 2023-2025: 156.10 million of USD

Table 58: Holeta Ambo Expressway Investment Cost

Year	Investment Costs (million USD)
2023	52.03
2024	52.03
2025	52.03
Total Amount	**156.10**

MAINTENANCE ACTIVITY AND COSTS

As regards the maintenance activities, the situations with and without are project were considered:

Without Project:

- 2022-2070:
  - Routine maintenance (Patching/Potholing, Edge Repair, Drainage)
  - Surface dressing overlay at IRI 10: than at 2032, 2044 and 2055

For a total maintenance cost 2022-2070 of 40 Mln USD.

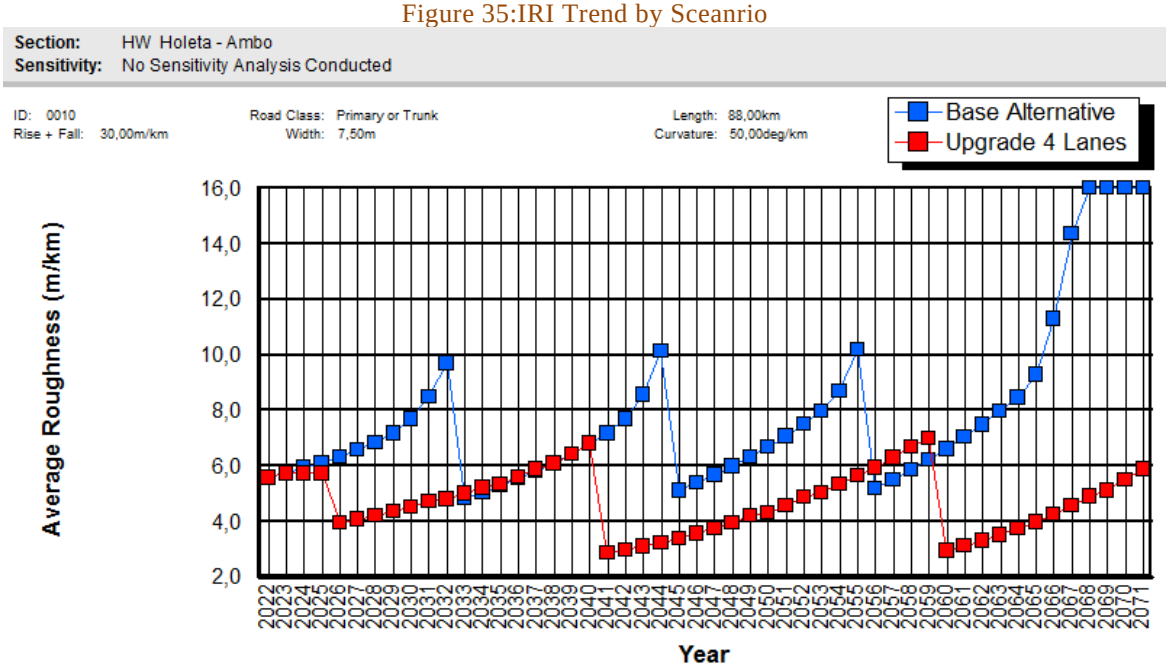
With Project

- 2022-2025:
  - Routine maintenance Patching/Potholing, Edge Repair, Drainage)
- 2026- 2070:
  - Routine Maintenance (Patching/Potholing, Edge Repair, Crack Sealing, Drainage)
  - Surface dressing overlay at IRI 8: then at 2040 and 2059

For a total maintenance cost 2022 – 2070 of 205 million USD.

The following figure shows the IRI trend in the period 2022 - 2070 for the scenarios without Project (Blue line) and with Project (Red line).

Figure 35:IRI Trend by Sceanrio



HDM4 RESULTS

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2025 GoAhead, is expected in 2023-2025. The total investment cost is 156 million of USD, while the global maintenance cost 2022-2070 is equal to 205 million of USD.

The results of the economic analysis are;

- an IRR equal to 26.6%, a very good value that allows us to obtain a Discounted Net Present Value of USD 976 million in the period under review.
- Overall discounted VOC saving equal to 421,8 million of USD
- Overall discounted VoT saving equal to 692 million of USD
- NPV / Capital Costs ratio equal to 6.74

The summary of the HDM4 results is:

Table 59: Holeta Ambo Expressway Economic Results (HDM4)

EIRR %	NPV million USD	NPV / Costs Ration (NPV/CAP)
26.6	976.95	6.74

HDM-4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **4a 2025 HW Addis - Holeta - Ambo**
Run Date: **26-11-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Holeta - Ambo
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	153,66	11,50	0,00	3,881.71	7,213.59	0,00	0,00	0.00	10,930.15
Discounted	135,38	2,17	0,00	421,88	692,62	0,00	0,00	0,00	976,95

Economic Internal Rate of Return (EIRR) = 26,6% (No. of solutions = 2)

7.3.2 Addis Alem Gena - Woliso Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2025 GoAhead, is expected in 2023-2025. The total investment cost is 192.9 million of USD, while the global maintenance cost 2022-2070 is equal to 62 million of USD.

The results of the economic analysis are;

- an IRR equal to 22.1%, a very good value that allows us to obtain a Discounted Net Present Value of USD 761 million in the period under review.
- Overall discounted VOC saving equal to 357 million of USD
- Overall discounted VoT saving equal to 568 million of USD
- NPV / Capital Costs ratio equal to 4.48

The summary of the HDM4 results is:

Table 60: Alem Gena - Woliso Expressway Economic Results (HDM4)

EIRR %	NPV million USD	NPV / Costs Ration (NPV/CAP)
22.1	761	4.48

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **4b 2025 HW Addis AlemGena - Woliso**
Run Date: **28-11-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Addis- Alemgena - Tulobolo - Woliso
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	167,59	13,64	0,00	3,504.15	6,418.91	0,00	0,00	0.00	9,741.82
Discounted	160,29	2,82	0,00	357,00	567,86	0,00	0,00	0,00	761,75

Economic Internal Rate of Return (EIRR) = 22,1% (No. of solutions = 1)

7.3.3 Dengengo – Harar Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2025 GoAhead, is expected in 2023-2025. The total investment cost is 49.6 million of USD, while the global maintenance cost 2022-2070 is equal to 15.8 million of USD.

The results of the economic analysis are;

- an IRR equal to 17.8%, a very good value that allows us to obtain a Discounted Net Present Value of USD 108 million in the period under review.
- Overall discounted VOC saving equal to 64 million of USD
- Overall discounted VoT saving equal to 86 million of USD
- NPV / Capital Costs ratio equal to 2.45

The summary of the HDM4 results is:

Table 61: Dengengo-Harar Expressway Economic Results (HDM4)

EIRR %	NPV million USD	NPV / Costs Ration (NPV/CAP)
17.8	108	2.45

H D M - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **4c 2025 HW Dengengo - Harar**
Run Date: **28-11-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Dengego- Harar
Alternative: Upgrande 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	43,09	3,51	0,00	594.52	821.76	0,00	0,00	0.00	1,369.67
Discounted	41,29	0,73	0,00	64,03	86,13	0,00	0,00	0,00	108,14

Economic Internal Rate of Return (EIRR) = 17,8% (No. of solutions = 1)

7.3.4 Adama Awash Junction Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2025 GoAhead, is expected in 2023-2025. The total investment cost is 211.2 million of USD, while the global maintenance cost 2022-2070 is equal to 73.3 million of USD.

The results of the economic analysis are;

- an IRR equal to 22.3%, a very good value that allows us to obtain a Discounted Net Present Value of USD 946 million in the period under review.
- Overall discounted VOC saving equal to 377 million of USD
- Overall discounted VoT saving equal to 747 million of USD
- NPV / Capital Costs ratio equal to 5.02

The summary of the HDM4 results is:

Table 62: Adama Awash Expressway Economic Results (HDM4)

EIRR %	NPV million USD	NPV / Costs Ration (NPV/CAP)
22.3	946	5.02

H D M - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **4d 2025 HW Adama Awash Junct**
Run Date: **29-11-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: Adama - Awash Junction
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	183,55	14,96	0,00	1,659.14	8,248.17	0,00	0,00	0.00	9,708.80
Discounted	176,17	3,11	0,00	377,74	747,86	0,00	0,00	0,00	946,32

Economic Internal Rate of Return (EIRR) = 22,3% (No. of solutions = 2)

7.4 INVESTMENTS AT YEAR 2035

7.4.1 Awash - Adaytu Expressway

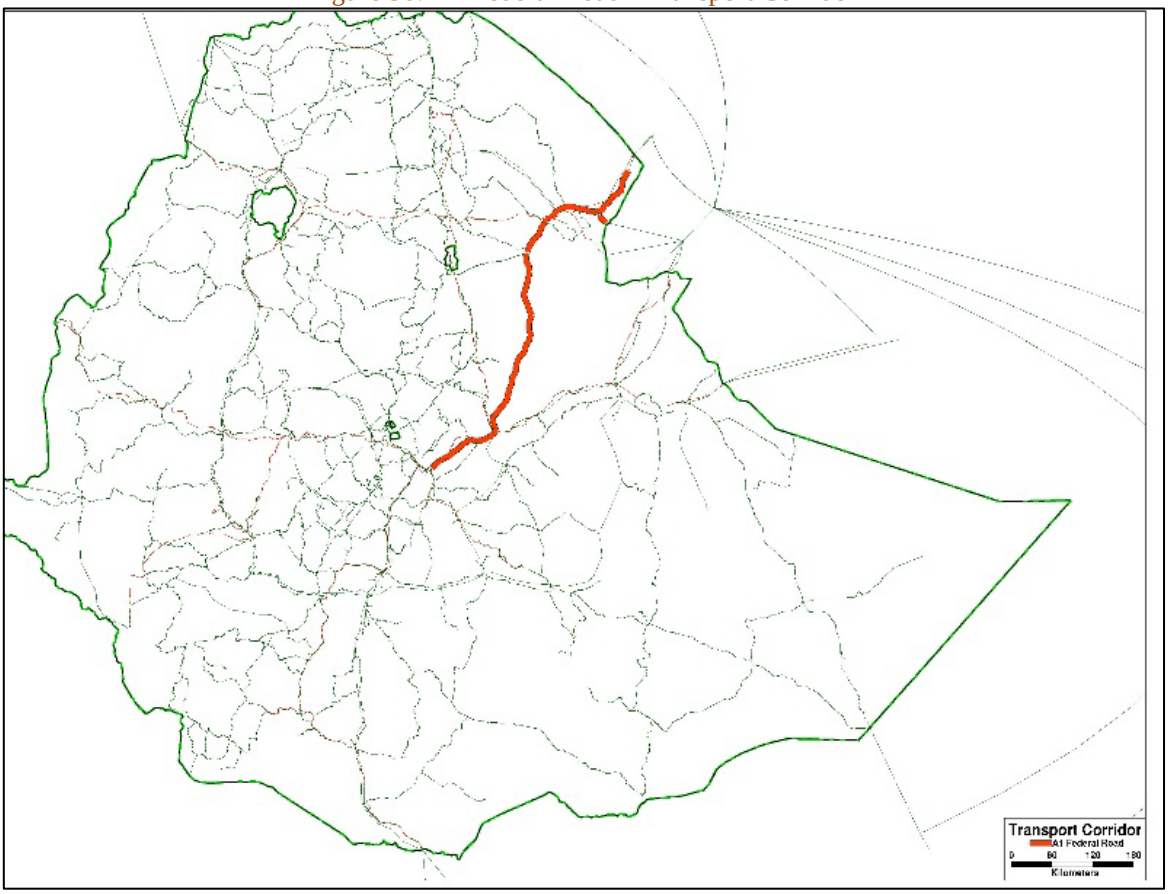
PROPOSED ALIGNMENT

The Awash Junction - Adaytu road section is part of the A1 federal road and belongs to the northern transport corridor from Addis Ababa through the localities of Adama - Awash - Mile - Semera up to Eritrean Border towards north or Dijbouti Border towards East . **(**Figure 36**)**

The Awash Junction - Adaitu expressway project foresees the widening of the carriageway to 2 + 2 lanes, the improvement of the alignment and the construction of new sections where this is not possible.

The reference scenario of the Awash Junction - Adaytu expressway project is **Go Ahead 2035**. It is therefore expected to be completed in 5 years 2030-2035 and open to traffic in 2036.

Figure 36: A1 Federal Road - Transport Corridor



The road section Awash - Adaytu has a length of 265 km with a cross section of two lanes of 3.5 meters with shoulders of maximum width of 1.5 mt (Figure 38). The road has an average altitude of about 650 meters with a longitude profile that varies between 900 and 550 meters. **(**Figure 38**)**

Figure 37: A1 Awash – Semera Road Section

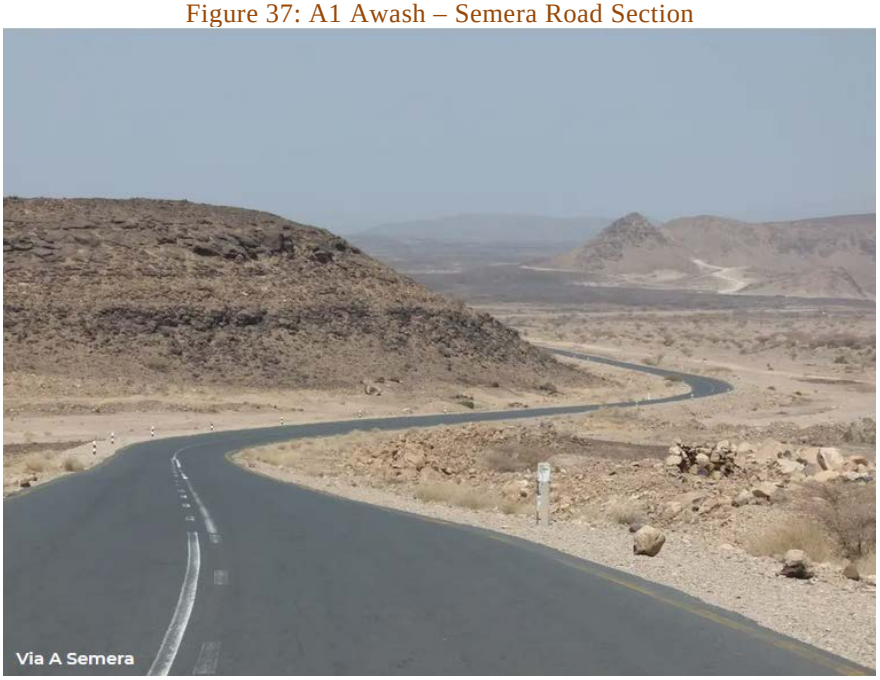
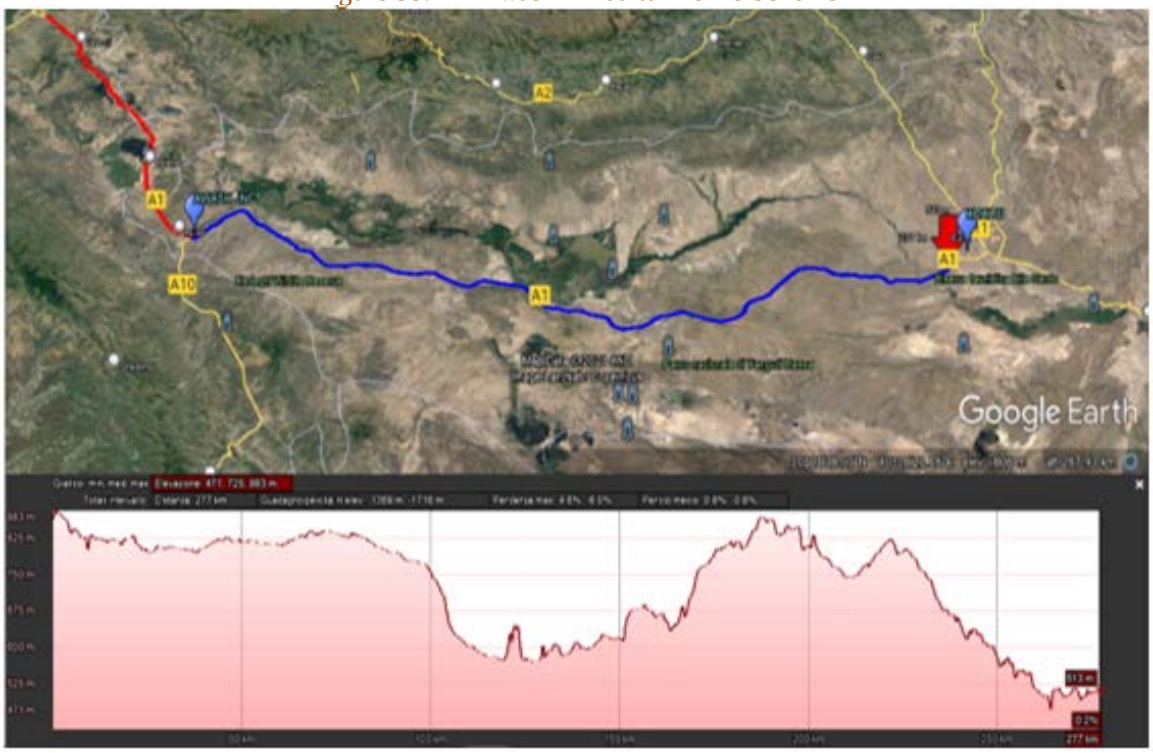


Figure 38: A1 Awash – Adaitu Profile Scheme



TRAFFIC STUDY

A traffic study was conducted to define the traffic currently affecting the road and to estimate the traffic in the 2025, 2035 and 2050 development scenarios.

Present Situation

A current annual daily traffic volume (AADT) of approximately 2700* (weighted average) was defined on the basis of the 2019 traffic counts carried out on some sections along the A1 Awash Junction - Adaytu.

Table 63: Awash Junction - Adaytu Traffic Counts 2019 by section

Link name	Counting Station	Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer	Total Vehicles
Awash junction-Gedamitu	0601C	66	199	399	119	331	237	150	2045	3546
Hundufu - Adayitu	0306C	134	143	106	44	131	27	29	406	1020

*On the sections without data, the adjacent traffic volumes were considered.

Traffic Composition

Table 64 Awash Junction - Adaytu Traffic composition

Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer
3.4%	9.0%	11.9%	4.9%	10.3%	9.7%	6.5%	44.3%

Road Section	Light Vehicles	heavy tracks
Holeta - Ambo	29.2%	70.8%

Future Traffic Demand

The future traffic and the relative growth rates, for all time horizons, were defined on the basis of the results provided by the multimodal traffic model reported in the Sectorial Report 1 – Integrated Transport Model.

The following table shows the Traffic Growth rate for each time horizon.

Table 65: Awash Junction - Adaytu Traffic Growth

2020- 2025	2025- 2035	2035-2050
2.79%	4.49%	5.15%

Table 66: Awash junction - Adaytu Traffic Volumes (Weighted Average) 2020 – 2025 – 2035 – 2050

Years	Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer	Total Vehicles
2020	94	245	325	133	280	265	177	1210	2729
2025	108	281	373	153	322	304	203	1388	3131
2035	**167**	**437**	**578**	**237**	**499**	**472**	**315**	**2154**	**4859**
2050	356	928	1228	503	1060	1002	668	4574	10318

The following figure and table show the traffic flows assigned by the multimodal traffic model to **2035** in terms of PCU equivalent car units (see Sectorial Report 1 – Integrated Transport Model), divided between passenger vehicles (cars, 4-wheel drive, mini-Bus, Bus) and heavy vehicles (small, medium, large vehicles and trailers).

Figure 39:A1 Awash Junction - Adaytu Traffic Assignment 2035

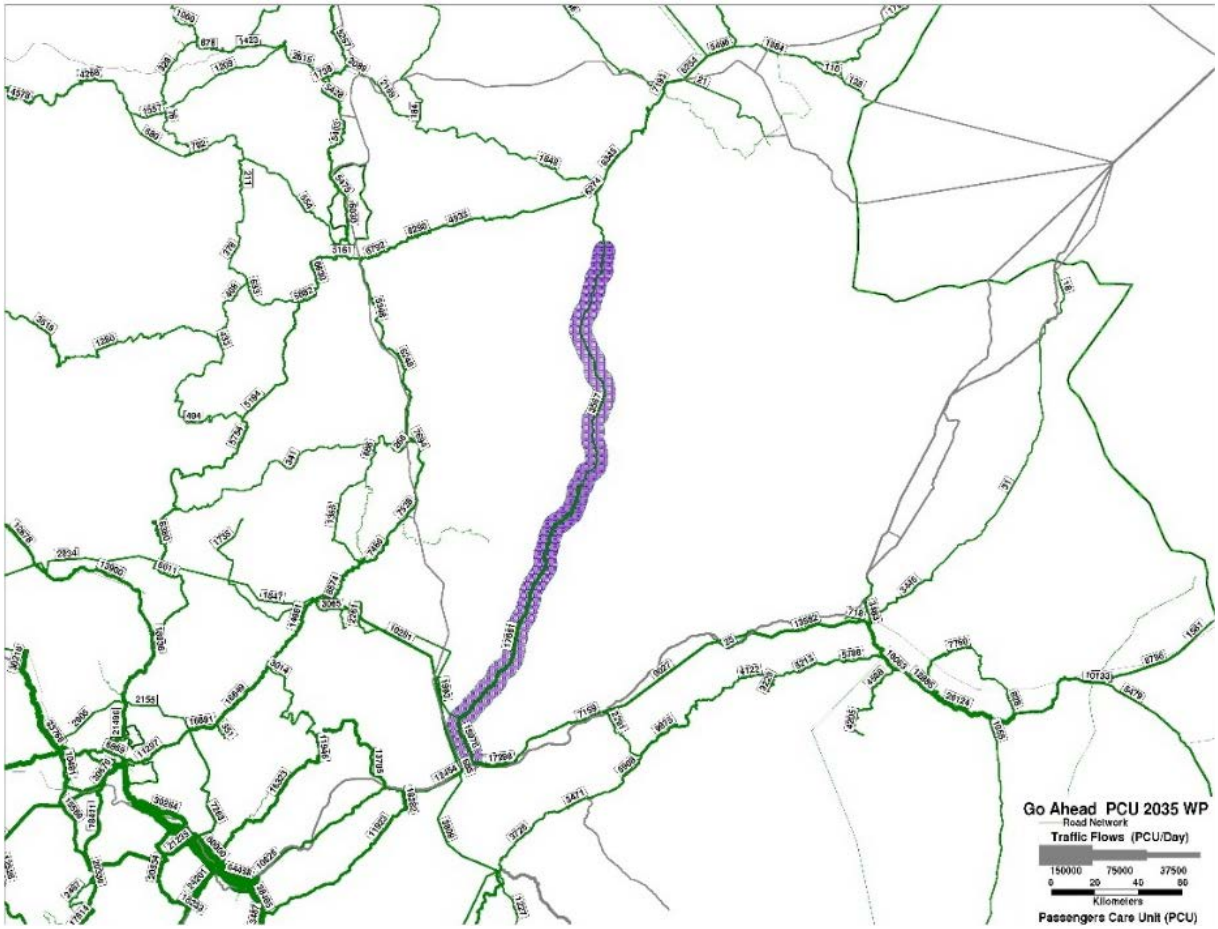


Table 67: Awash junction - Adaytu Traffic Model Assignment 2035

ID Model	LENGTH Km	LINK NAME	Light Vehicles PCU/Day	Heavy Vehicles PCU/Day	TOTAL FLOW PCU/Day
2768	71.14	Awash junction-Gedamitu	2029	15632	17661
185	20.20	Awash junction-Gedamitu	2023	13954	15976
230	55.56	Gedamitu-Gewane	2029	15632	17661
231	47.90	Gewane - Undufo	1197	2370	3567
244	46.12	Hundufu - Adayitu	1197	2370	3567
2765	23.83	Hundufu - Adayitu	1197	2370	3567

ECONOMIC ANALISIS

To define the economic feasibility for the Awash junction - Adaytu Expressway (265 Km), the Consultant has applied the World Bank HDM-4 model that simulates road conditions and user costs according with traffic flows and maintenance operations conducted. The Cost Benefit analysis considers the investment and maintenance cost estimates and the savings from decreased vehicle operating costs (VOC) and time savings (VoT). The economic analysis compares the "without" project and the "with" project situation, all through the project life (30 years of operation) of the alternative considered.

For the construction of the Awash junction - Adaytu Expressway Expressway, in the scenario Go-Ahead-2035, Five years of construction are planned (2030-2035) with 2036 opening year to traffic.

HDM 4 Analysis

Main phases of the economic analysis are:

1. Calculation of Investment Costs
2. Maintenance Activity and Costs.
3. Simulation of the "traffic-maintenance-user costs" interrelationship along the project life of the "with" and "without" scenarios.
4. HDM 4 Results in terms of Internal Rate of Return (IRR) and Net Present Value (NPV) and NPV / CAP.

INVESTMENT COSTS

Considering the preliminary phase of the analysis, a maximum investment cost of 1.8 million USD/km was considered for the upgrading of the existing road into a 4-lane expressway. The investment cost, even if closer to a Green Field construction than to a Brown Filed, considering possible new road sections and alignment improvements.

Total Investment cost: 505.4 million of USD

Table 68: Awash junction-Adaytu Expressway Total Investment Costs

Year	Investment Costs (million USD)
2030 - 2031	101.01
2031- 2032	101.01
2032 -2033	101.01
2033 - 2034	101.01
2034 - 2035	101.01
Total Amount	**505.04**

MAINTENANCE ACTIVITY AND COSTS

As regards the maintenance activities, the situations with and without are project were considered:

Without Project:

- 2022-2070:
  - Routine maintenance (Patching/Potholing, Edge Repair, Drainage)
  - Surface dressing overlay IRI 10 at 2036, 2051 and 2065 (Surface Restoration)

For a total maintenance cost of 128 Mln USD about 8,400 USD /Km by year (Undiscounted)

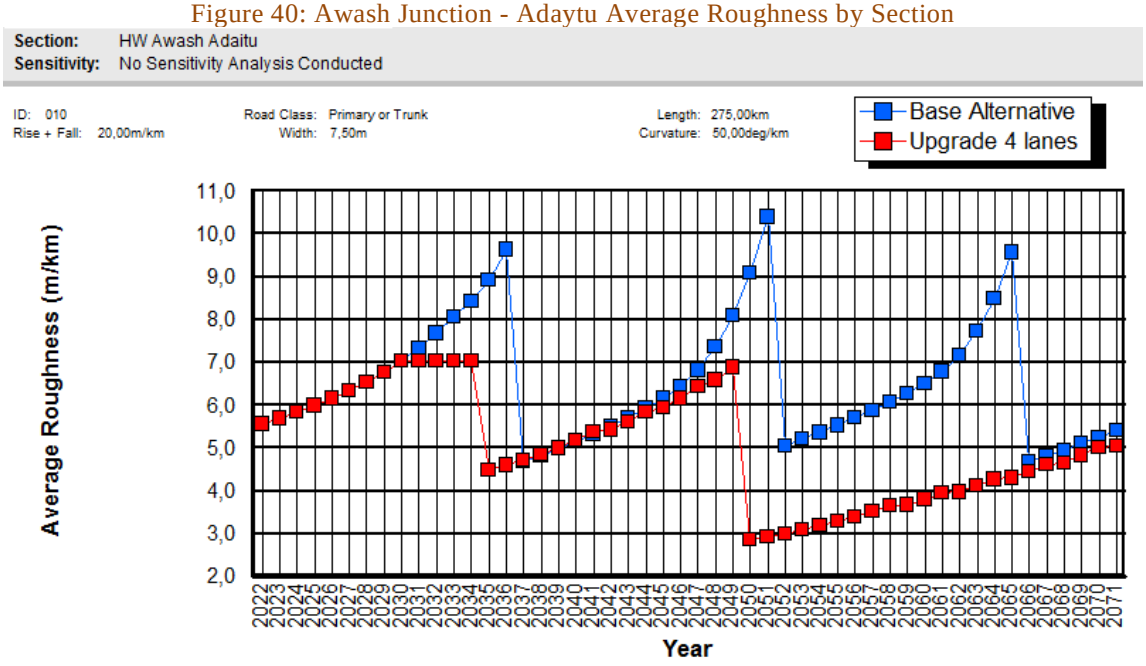
With Project

- 2022-2030:
  - Routine maintenance Patching/Potholing, Edge Repair, Drainage)
- 2036- 2070:
  - Routine Maintenance (Patching/Potholing, Edge Repair, Crack Sealing, Drainage)
  - Surface dressing overlay at IRI 8 at 2049 (Surface Restoration)

For a total maintenance cost of 110 million USD.

The following figure shows the IRI trend in the period 2022 - 2070 for the scenarios without Project (Blue line) and with Project (Red line).

Figure 40: Awash Junction - Adaytu Average Roughness by Section



HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2035 GoAhead, is expected in 2030-2035. The total investment cost is 505.04 million of USD, while the global maintenance cost is equal to 110 million of USD.

The results of the economic analysis are;

- an IRR equal to 17.5 %, a very good value that allows us to obtain a Discounted Net Present Value of 399.9 million of USD in the analysis period.
- Overall discounted VOC saving equal to 223,8 million of USD
- Overall discounted VoT saving equal to 406,9 million of USD
- NPV / Capital Costs ratio equal to 1.65

The summary of the HDM4 results is:

Table 69: Awash junction - Adaytu Economic Analysis Results

EIRR %	NPV (million USD)	NPV / Costs Ration (NPV/CAP)
17.5	399.97	1.65

HDM-4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **5a 2035 HW Awash Jct - Adaitu**
Run Date: **26-11-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Awash Adaitu
Alternative: Upgrade 4 lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	418,30	44,26	0,00	2,131.07	3,856.34	0,00	0,00	0.00	5,524.85
Discounted	222,70	8,05	0,00	223,78	406,94	0,00	0,00	0,00	399,97

Economic Internal Rate of Return (EIRR) = 17,5% (No. of solutions = 1)

7.4.2 Awash - Dire Dawa Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2035 GoAhead, is expected in 2030-2035. The total investment cost is 523.4 million of USD, while the global maintenance cost is equal to 166 million of USD.

The results of the economic analysis are;

- an IRR equal to 21.0 %, a very good value that allows us to obtain a Discounted Net Present Value of 1,320.4 million of USD.
- Overall discounted VOC saving equal to 598 million of USD
- Overall discounted VoT saving equal to 963 million of USD
- NPV / Capital Costs ratio equal to 5.17

The summary of the HDM4 results is:

Table 70: Awash junction – Dire Dawa Economic Analysis Results

EIRR %	NPV (million USD)	NPV / Costs Ration (NPV/CAP)
21.0	1,320	5.17

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **5b 2035 HW Awash Jct - Dire Dawa**
Run Date: **26-11-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Awash DireDawa
Alternative: UpGrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	497,64	33,11	0,00	8,928.96	15,821.12	0,00	0,00	0.00	24,219.33
Discounted	232,98	7,44	0,00	597,99	962,86	0,00	0,00	0,00	1.320,43

Economic Internal Rate of Return (EIRR) = 21,0% (No. of solutions = 1)

7.4.3 Addis Ababa - Debre Brihan Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2035 Go Ahead, is expected in 2030-2035. The total investment cost is 238.7 million of USD, while the global maintenance cost is equal to 52.4 million of USD.

The results of the economic analysis are;

- an IRR equal to 15.3 %, a very good value that allows us to obtain a Discounted Net Present Value of 224.9 million of USD.
- Overall discounted VOC saving equal to 142 million of USD
- Overall discounted VoT saving equal to 192 million of USD
- NPV / Capital Costs ratio equal to 1.97

The summary of the HDM4 results is:

Table 71: Addis Ababa – Debre Brihan Economic Analysis Results

EIRR %	NPV (million USD)	NPV / Costs Ration (NPV/CAP)
15.3	224.9	1.97

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **5c 2035 HW Addis Ababa - Debre Birihan**
Run Date: **26-11-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Addis DebreBrihan
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	197,74	20,66	0,00	1,945.33	3,212.71	0,00	0,00	0.00	4,939.63
Discounted	105,58	3,83	0,00	142,02	192,35	0,00	0,00	0,00	224,96

Economic Internal Rate of Return (EIRR) = 15,3% (No. of solutions = 1)

7.4.4 Addis Ababa - Commodo Abay River Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2035 Go Ahead, is expected in 2030-2035. The total investment cost is 382 million of USD, while the global maintenance cost is equal to 181 million of USD.

The results of the economic analysis are;

- an IRR equal to 22.8 %, a very good value that allows us to obtain a Discounted Net Present Value of 224.9 million of USD.
- Overall discounted VOC saving equal to 581 million of USD
- Overall discounted VoT saving equal to 853 million of USD
- NPV / Capital Costs ratio equal to 7.03

The summary of the HDM4 results is:

Table 72: Addis Ababa – Debre Brihan Economic Analysis Results

EIRR %	NPV (million USD)	NPV / Costs Ration (NPV/CAP)
22.8	1,249	7.03

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **5d 2035 HW Addis Ababa - Commodo Abay River**
Run Date: **26-11-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Addis Coomando -Abay River
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	300,79	177,51	0,00	11,720.08	14,219.71	0,00	0,00	0.00	25,461.49
Discounted	162,85	21,25	0,00	580,66	852,30	0,00	0,00	0,00	1.248,86

Economic Internal Rate of Return (EIRR) = 22,8% (No. of solutions = 1)

7.5 INVESTMENTS AT YEAR 2050

7.5.1 Awassa Moyale Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2050 Go Ahead, is expected in 2045-2050. The total investment cost is 916.4 million of USD, while the global maintenance cost is equal to 158 million of USD.

The results of the economic analysis are;

- an IRR equal to 34.6 %, a very good value that allows us to obtain a Discounted Net Present Value of 1,509 million of USD.
- Overall discounted VOC saving equal to 786 million of USD
- Overall discounted VoT saving equal to 857 million of USD
- NPV / Capital Costs ratio equal to 9.41

The summary of the HDM4 results is:

Table 73: Awassa – Moyale Expressway Economic Analysis Results

EIRR %	NPV (million USD)	NPV / Costs Ration (NPV/CAP)
34.6	1,509	9.41

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **6b. 2050 Highway Awassa Moyale**
Run Date: **30-11-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Awassa - Moyale
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	954,59	37,47	0,00	21,374.71	21,238.48	0,00	0,00	0.00	41,621.14
Discounted	130,48	2,38	0,00	785,66	856,75	0,00	0,00	0,00	1.509,54

Economic Internal Rate of Return (EIRR) = 34,6% (No. of solutions = 1)

7.5.2 Adaitu Mile Semera Galafi Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2050 Go Ahead, is expected in 2045-2050. The total investment cost is 325.06 million of USD, while the global maintenance cost is equal to 75 million of USD.

The results of the economic analysis are;

- an IRR equal to 22.7 %, a very good value that allows us to obtain a Discounted Net Present Value of 142 million of USD.
- Overall discounted VOC saving equal to 121 million of USD
- Overall discounted VoT saving equal to 112 million of USD
- NPV / Capital Costs ratio equal to 1.4

The summary of the HDM4 results is:

Table 74: Adaytu-Semera-Galfi Expressway Economic Analysis Results

EIRR %	NPV (million USD)	NPV / Costs Ration (NPV/CAP)
22.7	142	1.4

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **6. 2050 Highway Adaitu - Galafi**
Run Date: **30-11-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Adaitu Semera Galafi
Alternative: Upgrade 4 lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	1.108,55	-0,18	0,00	2,457.67	2,362.40	0,00	0,00	0.00	3,711.69
Discounted	90,93	-0,01	0,00	120,75	111,88	0,00	0,00	0,00	141,71

Economic Internal Rate of Return (EIRR) = 22,7% (No. of solutions = 1)

7.5.3 AlemGena Butajira Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2050 Go Ahead, is expected in 2045-2050. The total investment cost is 214.87 million of USD, while the global maintenance cost is equal to 48 million of USD.

The results of the economic analysis are;

- an IRR equal to 27.4 %, a very good value that allows us to obtain a Discounted Net Present Value of 756 million of USD.
- Overall discounted VOC saving equal to 349 million of USD
- Overall discounted VoT saving equal to 442 million of USD
- NPV / Capital Costs ratio equal to 9.5

The summary of the HDM4 results is:

Table 75: Alem gena Butajira Expressway Economic Analysis Results

EIRR %	NPV (million USD)	NPV / Costs Ration (NPV/CAP)
27.4	756	9.5

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **6c. 2050 Highway Alemgena Butajira**
Run Date: **30-11-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Alegmgena - Butajira
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	241,37	7,71	0,00	5,737.37	8,097.47	0,00	0,00	0.00	13,585.76
Discounted	34,29	0,92	0,00	349,09	442,79	0,00	0,00	0,00	756,68

Economic Internal Rate of Return (EIRR) = 27,4% (No. of solutions = 2)

7.5.4 Debre Brihan Mekelle - Eritrean Border Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2050 Go Ahead, is expected in 2045-2050. The total investment cost is 1,454 million of USD, while the global maintenance cost is equal to 454 million of USD.

The results of the economic analysis are;

- an IRR equal to 32.7 %, a very good value that allows us to obtain a Discounted Net Present Value of 1,713 million of USD.
- Overall discounted VOC saving equal to 805 million of USD
- Overall discounted VoT saving equal to 1,115 million of USD
- NPV / Capital Costs ratio equal to 6.8

The summary of the HDM4 results is:

Table 76: Debre Brihan Mekelle Eritean Border Expressway Economic Analysis Results

EIRR %	NPV (million USD)	NPV / Costs Ration (NPV/CAP)
32.7	1,713	6.8

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **6d. 2050 Highway Debre Brihan mekelle**
Run Date: **01-12-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW DebreBrihan - Mekele - Eritrean Border (Kokobay)
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	1.396,30	45,03	0,00	16,748.10	26,152.98	0,00	0,00	0.00	41,459.76
Discounted	204,71	3,02	0,00	805,31	1.116,07	0,00	0,00	0,00	1.713,64

Economic Internal Rate of Return (EIRR) = 32,7% (No. of solutions = 1)

7.5.5 Commodo Abay River - Bahir Dar Metema Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2050 Go Ahead, is expected in 2045-2050. The total investment cost is 1,204.7 million of USD, while the global maintenance cost is equal to 295 million of USD.

The results of the economic analysis are;

- an IRR equal to 34.3 %, a very good value that allows us to obtain a Discounted Net Present Value of 1,513 million of USD.
- Overall discounted VOC saving equal to 358 million of USD
- Overall discounted VoT saving equal to 1,326 million of USD
- NPV / Capital Costs ratio equal to 7.2

The summary of the HDM4 results is:

Table 77: (Commando) Abay River-Bairh Dar-Metema Expressway Economic Analysis Results

EIRR %	NPV (million USD)	NPV / Costs Ration (NPV/CAP)
34.3	1,513	7.2

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: 6e. 2050 Highway Coomando - BaharDar
Run Date: 01-12-2021
Currency: US Dollar (millions)
Discount: 8,00%
Analysis Mode: Analysis-by-Section

Section: HW Commando-BahirDar-Metema-Sudan Border (
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	1.156,53	37,37	0,00	4,489.28	30,981.41	0,00	0,00	0.00	34,276.79
Discounted	168,52	2,51	0,00	358,50	1.325,85	0,00	0,00	0,00	1.513,31

Economic Internal Rate of Return (EIRR) = 34,3% (No. of solutions = 2)

7.5.6 Gimbi Gambela SouthSudan Border Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2050 Go Ahead, is expected in 2045-2050. The total investment cost is 752 million of USD, while the global maintenance cost is equal to 189 million of USD.

The results of the economic analysis are;

- an IRR equal to 27.7 %, a very good value that allows us to obtain a Discounted Net Present Value of 799 million of USD.
- Overall discounted VOC saving equal to 403 million of USD
- Overall discounted VoT saving equal to 506 million of USD
- NPV / Capital Costs ratio equal to 6.2

The summary of the HDM4 results is:

Table 78: Ambo Gimbi Gambela SS Border Expressway Economic Analysis Results

EIRR %	NPV (million USD)	NPV / Costs Ration (NPV/CAP)
27.7	799	6.2

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: 6f. 2050 Highway Ambo - Nekemte- Mekanajo
Run Date: 02-12-2021
Currency: US Dollar (millions)
Discount: 8,00%
Analysis Mode: Analysis-by-Section

Section: HW Ambo Nekemte Mekanajo
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	784,33	29,39	0,00	11,426.13	13,312.75	0,00	0,00	0.00	23,925.17
Discounted	108,34	1,66	0,00	402,63	506,22	0,00	0,00	0,00	798,86

Economic Internal Rate of Return (EIRR) = 27,7% (No. of solutions = 1)

7.5.7 Woliso Jimma Mizan Teferi Expressway

HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2050 Go Ahead, is expected in 2045-2050. The total investment cost is 1,000.9 million of USD, while the global maintenance cost is equal to 251 million of USD.

The results of the economic analysis are;

- an IRR equal to 19.7 %, a very good value that allows us to obtain a Discounted Net Present Value of 377 million of USD.
- Overall discounted VOC saving equal to 228 million of USD
- Overall discounted VoT saving equal to 292 million of USD
- NPV / Capital Costs ratio equal to 2.2

The summary of the HDM4 results is:

Table 79: Woliso Jimma Mizan Teferi Expressway Economic Analysis Results

EIRR %	NPV (million USD)	NPV / Costs Ration (NPV/CAP)
19.7	377	2.2

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **6g. 2050 Highway Weliso Gimma**
Run Date: **02-12-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Woliso-Jimma-Mizan Teferi-South Sudan Border
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	960,84	38,86	0,00	5,061.43	7,485.76	0,00	0,00	0.00	11,547.50
Discounted	140,96	2,20	0,00	228,15	291,62	0,00	0,00	0,00	376,61

Economic Internal Rate of Return (EIRR) = 19,7% (No. of solutions = 1)

7.5.8 Aposto Dolo Expressway

PROPOSED ALIGNMENT

The Aposto Junction – Dolo road section is part of the Trunk road connecting the Southeast side of the country with the others parts through the transport corridor south- north. The localities along the road section are of Aposto - Bore – Konkoma – Kersa Dek - filtu – Dolo up to Somali Border. **(**Figure 36**)**

The Aposto Junction – Dolo expressway project foresees the widening of the carriageway to 2 + 2 lanes, the improvement of the alignment and the construction of new sections where this is not possible.

The reference scenario of the Awash Junction - Adaytu expressway project is **Go Ahead 2050**. It is therefore expected to be completed in 5 years 2045-2050 and open to traffic in 2051.

Figure 41: Trunk Road Aposto - Dolo - Transport Corridor

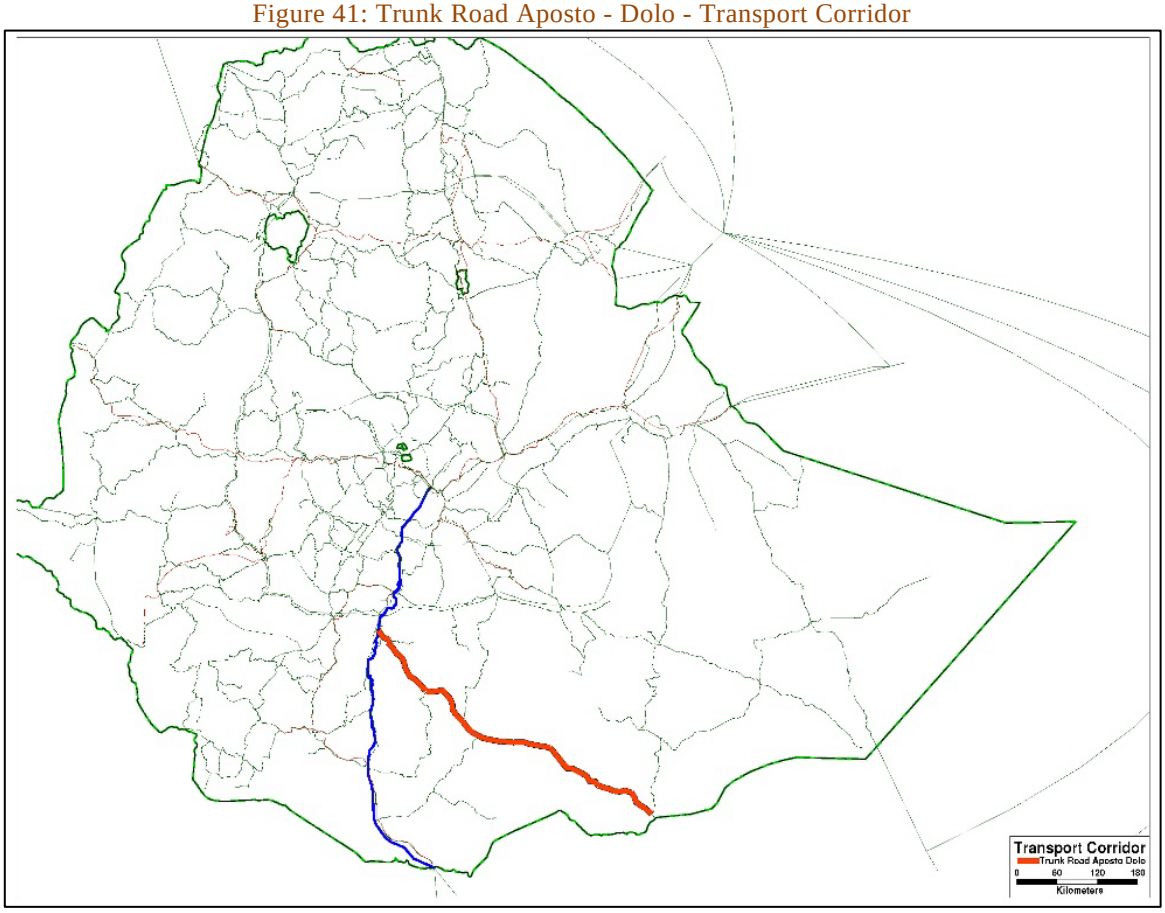
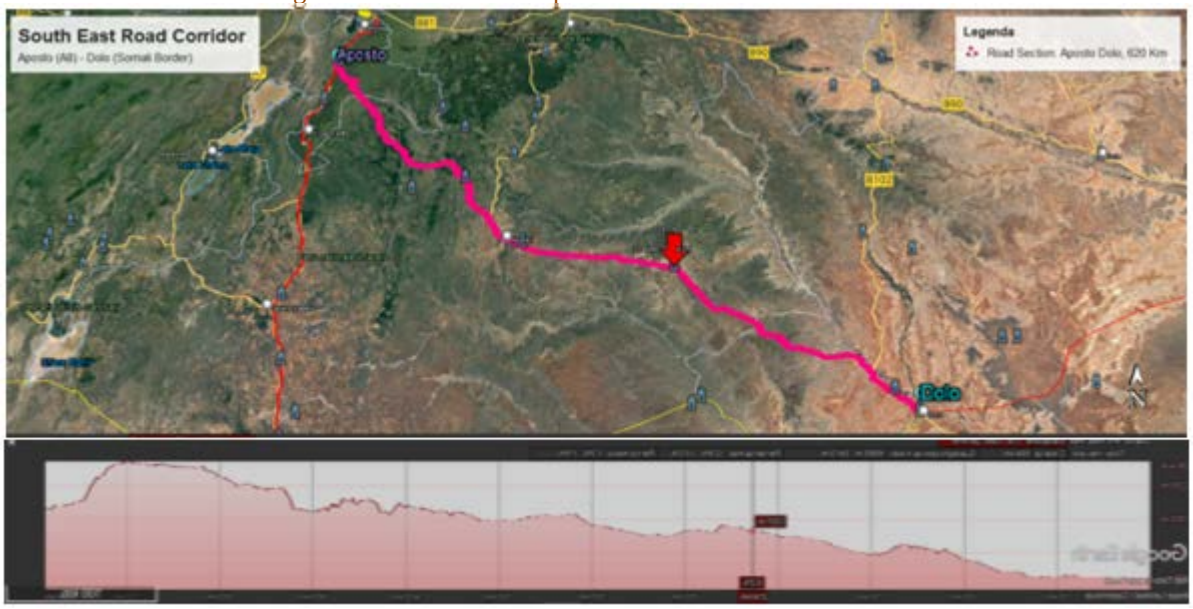


Figure 42: Trunk Road Aposto - Dolo Plan/Profile scheme



TRAFFIC STUDY

A traffic study was conducted to define the traffic currently affecting the road and to estimate the traffic in the 2025, 2035 and 2050 development scenarios.

Present Situation

A current annual daily traffic volume (AADT) of approximately **389*** (weighted average) was defined on the basis of the 2019 traffic counts carried out on some sections along the Trunk road Aposto Dolo

Table 80: Aposto Dolo Traffic Counts 2019 by section

Link name	Counting Station	Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer	Total Vehicles
Negele-Filtu	0712A	7	35	5	7	40	44	54	38	230
Aposto - Kebremengist	0710A	3	39	112	33	79	58	82	42	448
Kebremengist-Negele	0718A	3	33	54	11	35	35	36	34	241
Aposto - Kebremengist	0709A	25	165	380	69	165	123	85	55	1067
Aposto - Kebremengist	0709B	20	118	305	53	124	97	61	46	824
Negele-Filtu	0712B	4	40	6	6	42	46	50	57	251
Kebremengist-Negele	0718B	1	28	50	8	35	34	35	31	222

* on the sections without data, the adjacent traffic volumes were considered.

Table 81: Aposto Dolo Traffic Composition

Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer
1.9%	14.0%	27.8%	5.7%	15.8%	13.3%	12.3%	9.2%

Road Section	Light Vehicles	heavy tracks
Aposto - Dolo	49.3%	50.7%

Future Traffic Demand

The future traffic and the relative growth rates, for all time horizons, were defined based on the results provided by the multimodal traffic model reported in the Sectorial Report 1 – Integrated Transport Model.

The following table shows the Traffic Growth rate for each time horizon.

Table 82: Aposto Dolo Traffic Growth

2020- 2025	2025- 2035	2035-2050
2.58%	5.80%	7.00%

Table 83: Aposto – Dolo Traffic Volumes (Weighted Average) 2020 – 2025 – 2035 – 2050

Years	Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer	Total Vehicles
2020	7	54	108	22	62	52	48	36	389
2025	9	63	125	26	71	60	55	42	451
2035	15	111	221	45	126	106	98	73	795
2050	42	303	604	124	344	289	267	201	2174

The following figure and table show the traffic flows assigned by the multimodal traffic model to 2050 in terms of PCU equivalent car units (see the Sectorial Report 1 – Integrated Transport Model), divided between passenger vehicles (cars, 4-wheel drive, mini-Bus, Bus) and heavy vehicles (small, medium, large vehicles and trailers).

Figure 43: 2050 Aposto Dolo Traffic Assignment

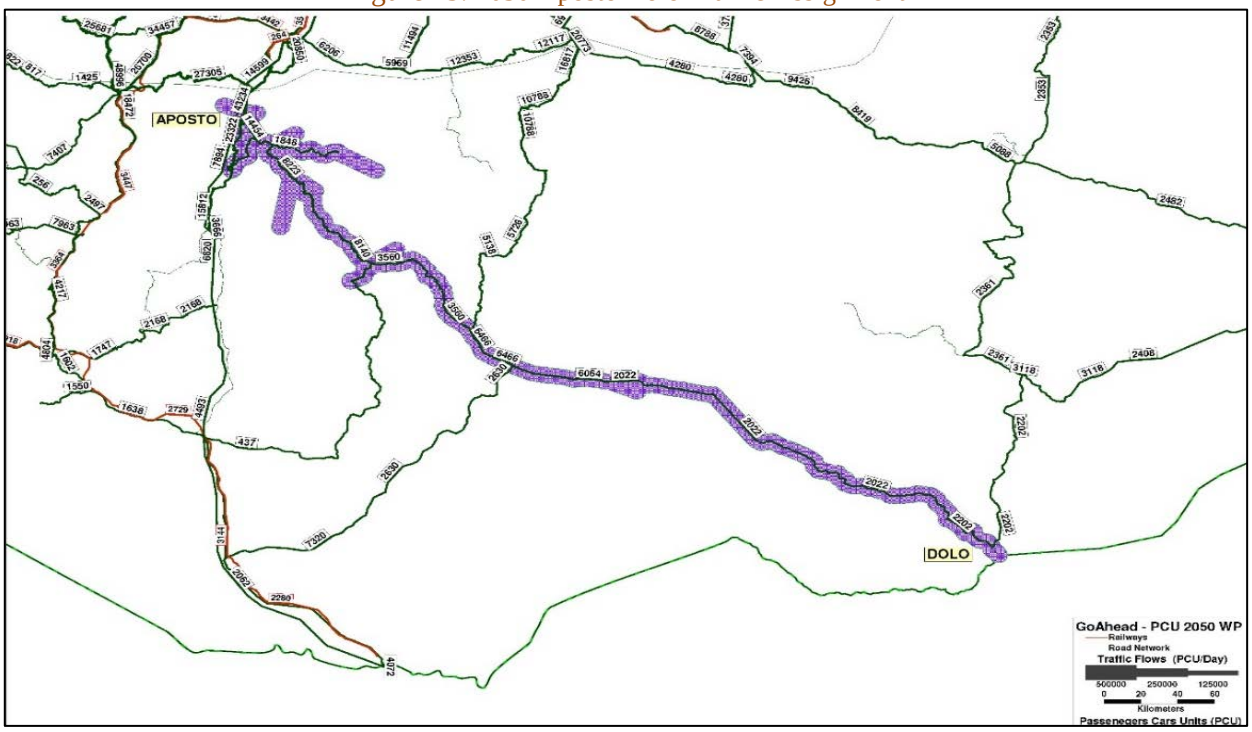


Table 84: Aposto – Dolo Traffic Assignment 2050 PCU by section

ID Model	LENGTH Km	LINK NAME	Light Vehicles PCU/Day	Heavy Vehicles PCU/Day	TOTAL FLOW PCU/Day
94	54.92	Filtu - Dolo	145	2109	2254
92	103.92	Filtu - Dolo	203	1862	2065
91	101.36	Filtu - Dolo	203	1862	2065
89	57.88	Negele-Filtu	203	1862	2065
1492	55.22	Negele-Filtu	363	5672	6035
1024	21.22	Kebremengist-Negele	490	6940	7430
1023	30.45	Kebremengist-Negele	955	3886	4841
1478	53.11	Kebremengist-Negele	955	3886	4841
255	85.68	Aposto - Kebremengist	1469	7336	8805
1042	16.37	Aposto - Kebremengist	5520	9594	15114
266	24.90	Aposto - Kebremengist	1732	7155	8887

ECONOMIC ANALISIS

In order to define the economic feasibility for the Aposto- Dolo Expressway (610 Km), the Consultant has applied the World Bank HDM-4 model that simulates road conditions and user costs according with traffic flows and maintenance operations conducted. The Cost Benefit analysis considers the investment and maintenance cost estimates and the savings from decreased vehicle operating costs (VOC) and time savings (VoT). The economic analysis compares the "without" project and the "with" project situation, all through the project life (30 years of operation) of the alternative considered.

For the construction of the Aposto - Dolo Expressway, in the scenario Go-Ahead-2050, Five years of construction are planned (2045-2050) with 2051 opening year to traffic.

HDM 4 Analysis

Main phases of the economic analysis are:

1. Calculation of Investment Costs
2. Maintenance Activity and Costs.
3. Simulation of the "traffic-maintenance-user costs" interrelationship along the project life of the "with" and "without" scenarios.
4. HDM 4 Results in terms of Internal Rate of Return (IRR) and Net Present Value (NPV) and NPV / CAP.

INVESTMENT COSTS

Considering the preliminary phase of the analysis, a maximum investment cost of 1.8 million USD/km was considered for the upgrading of the existing road into a 4-lane expressway. The investment cost, even if closer to a Green Filed construction than to a Brown Filed, takes into account possible new road sections and alignment improvements.

Total Investment cost: 1,144.5 million of USD

Table 85: Aposto Dolo Expressway Total Investment Cost

Year	Investment Costs (million USD)
2045 -2046	228.8
2046 - 2047	228.8
2047 - 2048	228.8
2048 - 2049	228.8
2049 - 2050	228.8
Total Amount	**1,144.15**

MAINTENANCE ACTIVITY AND COSTS

As regards the maintenance activities, the situations with and without are project were considered:

Without Project:

- 2022-2070:
  - Routine maintenance (Patching/Potholing, Edge Repair, Drainage)
  - Surface dressing overlay IRI 10 at 2046 and 2062 (Surface Restoration)

For a total maintenance cost of 195 Mln USD about 6,400 USD /Km by year (Undiscounted)

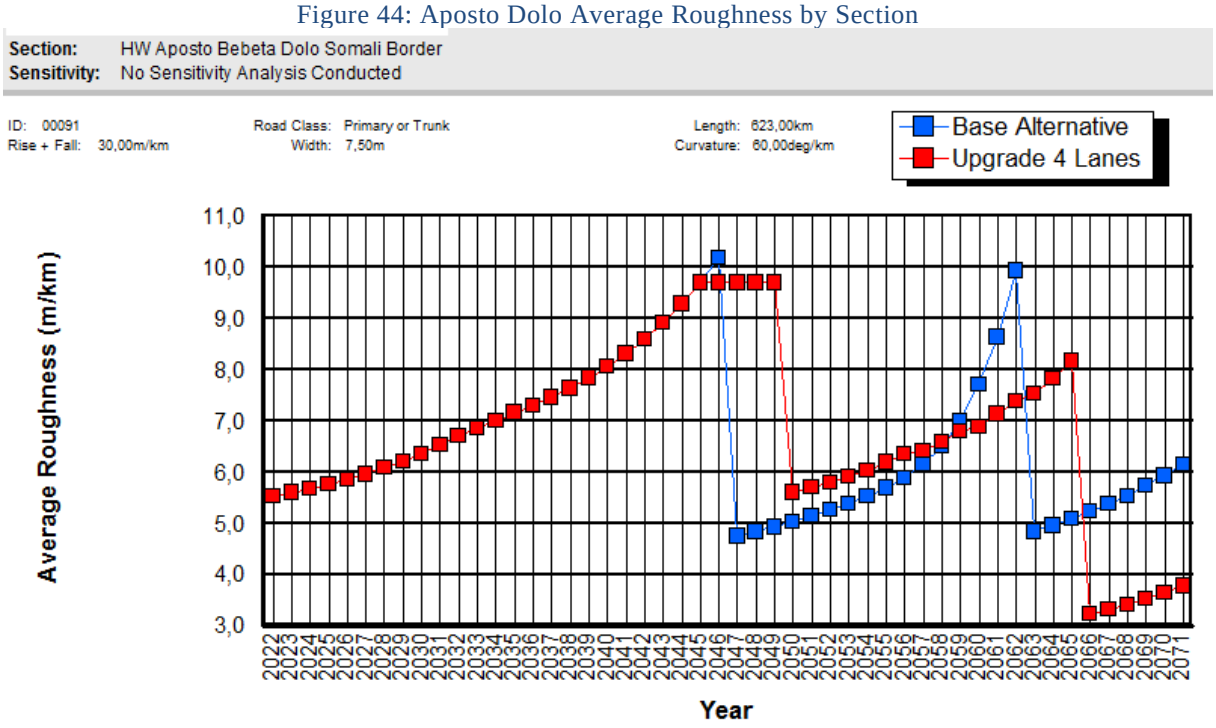
With Project

- 2022-2044:
  - Routine maintenance Patching/Potholing, Edge Repair, Drainage)
- 2051- 2070:
  - Routine Maintenance (Patching/Potholing, Edge Repair, Crack Sealing, Drainage)
  - Surface dressing overlay at IRI 8 at 2065 (Surface Restoration)

For a total maintenance cost of 232 million USD.

The following figure shows the IRI trend in the period 2022 - 2070 for the scenarios without Project (Blue line) and with Project (Red line).

Figure 44: Aposto Dolo Average Roughness by Section



HDM4 Results

The upgrading of the existing road to 4 lanes expressway, according to the scenario 2050 GoAhead, is expected in 2045-2050. The total investment cost is 1.144 million of USD, while the global maintenance cost is equal to 232 million of USD.

The results of the economic analysis are;

- an IRR equal to 6.6%, a value slightly below the discount rate adopted and therefore a negative global balance Net Present Value equal to - 35 million of USD in the analysis period.
- Overall discounted VOC saving equal to 21,8 million of USD
- Overall discounted VoT saving equal to 105,9 million of USD
- NPV / Capital Costs ratio equal to – 0.202

The summary of the HDM4 results is:

Table 86: Aposto Dolo Economic Analysis Results

EIRR %	NPV million USD	NPV / Costs Ration (NPV/CAP)
6.6	-35.05	-0.202

HDM-4
HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: **6h. 2050 Highway Aposto Dolo**
Run Date: **06-12-2021**
Currency: **US Dollar (millions)**
Discount: **8,00%**
Analysis Mode: **Analysis-by-Section**

Section: HW Aposto Bebeta Dolo Somali Border
Alternative: Upgrade 4 Lanes vs Base Alternative
No Sensitivity Analysis Conducted

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Social / Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	1.098,35	82,51	0,00	1,036.03	2,469.30	0,00	0,00	0.00	2,324.47
Discounted	154,28	8,56	0,00	21,86	105,92	0,00	0,00	0,00	-35,05

Economic Internal Rate of Return (EIRR) = 6,6% (No. of solutions = 1)

7.6 GO AHEAD SCENARIO - PROJECT PRIORITIZATION

Project prioritization for each year considered can be made according with the NPV/Cost value. More complete prioritization will involve the use of a Multi-Criteria Analysis.

Table 87: Hdm4 Results

Scenario Go Ahead 2025	Length	Traffic				Upgrade 4 Lanes Investment Costs	Disc Rate 8% EIRR	ENPV	NPV/Cost
		2022	2025	2035	2050				
	Km	AADT	AADT	AADT	AADT	Million USD	%	Million USD	Million USD
Holeta - Ambo Expressway	85	9,392	9,843	17,456	75,715	156.10	26.6	10,930	6.74
Alem Gena - Woliso Exp	105	6,889	4,954	10,508	42,715	192.99	22.1	9,741	4.48
Dengengo - Harar	27	5,284	3,258	6,339	18,282	49.59	17.8	1,369	2.45
Adama - Awash Junction	115	3,990	8,019	12,064	38,353	211.20	22.3	9,708	5.03

Scenario Go Ahead 2035	Length	Traffic				Upgrade 4 Lanes Investment Costs	Disc Rate 8% EIRR	ENPV	NPV/Cost
		2022	2025	2035	2050				
	Km	AADT	AADT	AADT	AADT	Million USD	%	Million USD	Million USD
Awash - Adaitu Exp.	275	2,884	3,131	4,859	10,318	505.0	17.5	5,524	1.65
Awash - Dire Dawa Exp.	285	5,002	4,092	3,837	11,484	523.4	21.0	24,219	1.97
AddisAbaba - Debre Brihan Exp.	130	2,779	3,492	5,442	28,546	238.7	15.3	4,939	1.90
Addis Ababa - Commodo Abay River Exp.	208	4,289	4,301	8,298	26,951	382.0	22.8	25,461	7.03

Scenario Go Ahead 2050	Lenght	Traffic				Upgrade 4 Lanes Investment Costs	Disc Rate 8% EIRR	ENPV	NPV/Cost
		2022	2025	2035	2050				
	Km	AADT	AADT	AADT	AADT	Million USD	%	Million USD	Million USD
Awassa - Moyale Exp.	499	1,377	1,251	3,293	10,536	916.42	34.6	41,621	9.60
Adaitu Mile Semera Galafi Exp.	177	1,476	1,419	2,307	5,386	325.06	22.7	3,711	1.40
Alem Gena - Butajira Exp.	117	5,539	6,411	9,810	22,555	214.87	27.4	13,585	19.50
Debre Brihan Mekelle - Eritrean Border Exp.	792	1,707	1,834	3,060	11,177	1,454.52	32.7	41,459	6.7
Commodo Abay River - Bahir Dar Metema Exp.	656	1,604	2,025	3,831	14,867	1,204.75	34.3	34,276	7.2
Ambo Nekemte Mekanajo Exp.	410	1,274	1,459	2,857	10,872	752.97	27.7	23,925	6.19
Woliso Jimma Mizan Teferi Exp.	545	1,416	1,497	2,421	7,649	1,000.90	19.7	11,547	2.2
Aposto - Bitata - Dolo Somali Border Exp.	623	409	451	795	2174	1,144.15	6.6	2,324	-0.202

8 ROAD NETWORK INTEGRATION

Transport and land use are inextricably linked: transportation infrastructure attracts land use development, while land use development is unlocked by the provision of high-quality, integrated transport infrastructure and services. The main objective of land use planning is to ensure that economic development is stimulated and that the spatial locations of activities, people and amenities, in turn, have a positive impact on the local, regional and national economy. These objectives can only be achieved with the support of transport services.

Transport integration is then a fundamental prerequisite to reach the social, economic and sustainable development of a country in the most efficient way. The ETMP 2050 is considering horizontal and vertical integration, in particular as explained below.

8.1.1 Horizontal Integration

The ttransport system has to accompany and support the desired social and economic development of the country **(transport-spatial development integration**), according with the declared national objectives and different sector planning instruments. The economic, social, spatial, trade, agricultural, industrial, tourism, mining development in Ethiopia, will create passenger and freight transport demand growth and diversification, that has to be accommodated by adequate, efficient and safe transport offer in terms of infrastructure, services and vehicles. In the next 30 years, the desired increase of per-capita income, together with the expected demographic increase will ask for an improved urban mobility system and an organized extra-urban public transport service. Rural areas development will need a more capillary all-weather rural roads to facilitate transport accessibility and **rural-urban integration**.

The new spatial corridor developments, including industrial and agro-industrial parks, will involve a **substantial increase of passengers and freight transport demand** and should be satisfied with modern and mass transport, like expressways and railway links.

The increase of regional and overseas trade will ask for an organized, effective and competitive logistic system, modern and well-managed truck industry and efficient infrastructures, using diversified trade corridors to different transit ports (**regional integration**).

Increased tourism demand, especially from abroad visitors, will ask for air and road **capillary accessibility** and comfortable local transport including inland waterways. Mining sector development will ask for specific road accessibility and, in case of large quantities of products, for railway link.

The **spatial-transport integration** in the ETMP50 is obtained serving appropriately the different spatial development corridors identified in paragraph 4.9, where, according with the different scenarios and the assignments of the transport model, a modern capable infrastructure is assigned (railway or expressway).

8.1.2 Vertical Integration

The ttransport system, for passenger and freight, is to be conceived and used as an **integrated transport network**, using the most appropriate, efficient and effective multimodal/intermodal connections, avoiding duplications of offer but ensuring free market access to different transport operators for each mode at the same time. The integration of transport modes is to be applied at national and local level, but also at the wider Africa regional level.

Both passenger and cargo transport can benefit from Intermodal transport. Intermodal transport is a complex transport system, where two or more different transport modes are used, efficiently connected and coordinated.

Intermodal passenger transport, also called mixed-mode commuting, concerns the use of two or more modes of transportation in a journey. Mixed-mode commuting is often used to combine the

strengths (and offset the weaknesses) of various transportation options. A major goal of modern intermodal passenger transport is to reduce dependence on the automobile as the major mode of ground transportation and increase use of public transport. Automobiles or taxicabs are conventionally used as a single-mode form of transit, but they also find use in a variety of mixed-mode scenarios, like to provide a short commute to bus stations, train stations, airports, and piers, where all-day "park and ride" lots are often available. Used in this context, cars offer commuters the relative comfort of single-mode travel, while significantly reducing the financial and environmental costs.

The main objective of a passenger intermodal terminal is the integrated and efficient transfer of passengers between various routes and different modes of transport. In order to ensure the effectiveness of this essential function, a terminal should provide:

- reliable and adequate level of service of the means involved in the operation of the terminal
- satisfactory level of facilities serving the transfer
- provision of low-cost travel (less than or equal to the cost of travel without transfers)
- adequate accessibility of the site for all users (especially the disabled)
- reduced travel time compared to that needed for the same trip without transfer
- direct access between two different platforms of different modes of the terminal

Intermodal/multimodal freight transport (in logistics and inland distribution) involves the transportation of freight in an intermodal unit (container) or vehicle, using multiple modes of transportation (e.g., ship, rail, truck, ferry), without any handling of the freight itself when changing modes. The method reduces cargo handling, and so improves security, reduces damage and loss, and allows freight to be transported faster. Reduced costs over road trucking is the key benefit for inter-continental use. This may be offset by reduced timings for road transport over shorter distances. Crucial importance is assumed by the **freight intermodal terminals**, a location for the transfer of freight from one transport mode to another, for example transhipment terminals from between road - rail, ports, airports.

There are three major types of **intermodal terminals**, each having their own locational and equipment requirements:

- **Port terminals**. They are the most substantial intermodal terminals in terms of traffic, space consumption and capital requirements. A **container sea terminal** provides an interface between the maritime and inland systems of circulation.
- **Rail terminals**. For inland intermodal chains rail terminals are linked with port terminals. Rail terminals can be on-dock and a near-dock rail facility, depending from the terminal clearance: while for an on-dock rail terminal containers can be moved directly from the dock (or the storage areas) to a railcar using the terminal's own equipment, accessing a near-dock facility requires clearing the terminal's gate (delays), using the local road system (congestion) and clearing the gate of the near-dock rail terminal (delays). On dock terminals tend to be designed to only handle containers on flatcars (COFC). Near-dock facilities tend to have more space available and can thus play a significant role in the maritime/rail interface, particularly if they are combined with transloading activities. The satellite terminal, the load center and the transmodal terminal all qualify as a form of inland port, commonly designed to handle both COFC and trailers on flatcars (TOFC).
- **Dry Ports**. Represent a distinct category of intermodal terminals performing an array of value-added functions, with transmodal operations dominantly supported by trucking. Distribution centers can perform transloading facility mainly transfers the contents of maritime containers into domestic containers or truckloads (or vice-versa. Warehousing is a standard function still performed by a majority of distribution centers that act as buffers and points of consolidation or deconsolidation within supply chains.

8.1.3 Regional Integration

The ETMP50 should be harmonised with the wider regional development plans, in order to connect Ethiopian spatial development corridors and trade corridors with the regional or neighbouring countries infrastructure development plans. COMESA, Africa Agenda 2063, One-Belt Initiative and Trans-Africa Highways are initiative that are expected to ensure smooth movement of goods and people and are therefore considered in the master plan.

Inside the Agenda 2063 flagship projects, the establishment of the African Continental Free Trade Area (AfCFTA) is a very important step taken by the 18th ordinary Session of Assembly of Heads of State and Government, held in Addis Ababa in January 2012. The AfCFTA aims at accelerating intra-African trade and boosting Africa's trading position in the global market by strengthening Africa's common voice and policy space in global trade negotiations. As at 5 February 2021, 36 countries have deposited their instruments of ratification., 36 countries have ratified the AfCFTA agreement.

The general objectives of the AfCFTA are to:

- Create a single market for goods, services, facilitated by movement of persons in order to deepen the economic integration of the African continent and in accordance with the Pan African Vision of "An integrated, prosperous and peaceful Africa" enshrined in Agenda 2063;
- Create a liberalised market for goods and services through successive rounds of negotiations;
- Contribute to the movement of capital and natural persons and facilitate investments building on the initiatives and developments in the State Parties and RECs;
- Lay the foundation for the establishment of a Continental Customs Union at a later stage;
- Promote and attain sustainable and inclusive socio-economic development, gender equality and structural transformation of the State Parties;
- Enhance the competitiveness of the economies of State Parties within the continent and the global market;
- Promote industrial development through diversification and regional value chain development, agricultural development and food security; and
- Resolve the challenges of multiple and overlapping memberships and expedite the regional and continental integration processes.

8.1.4 IGAD Regional Infrastructural Master Plan

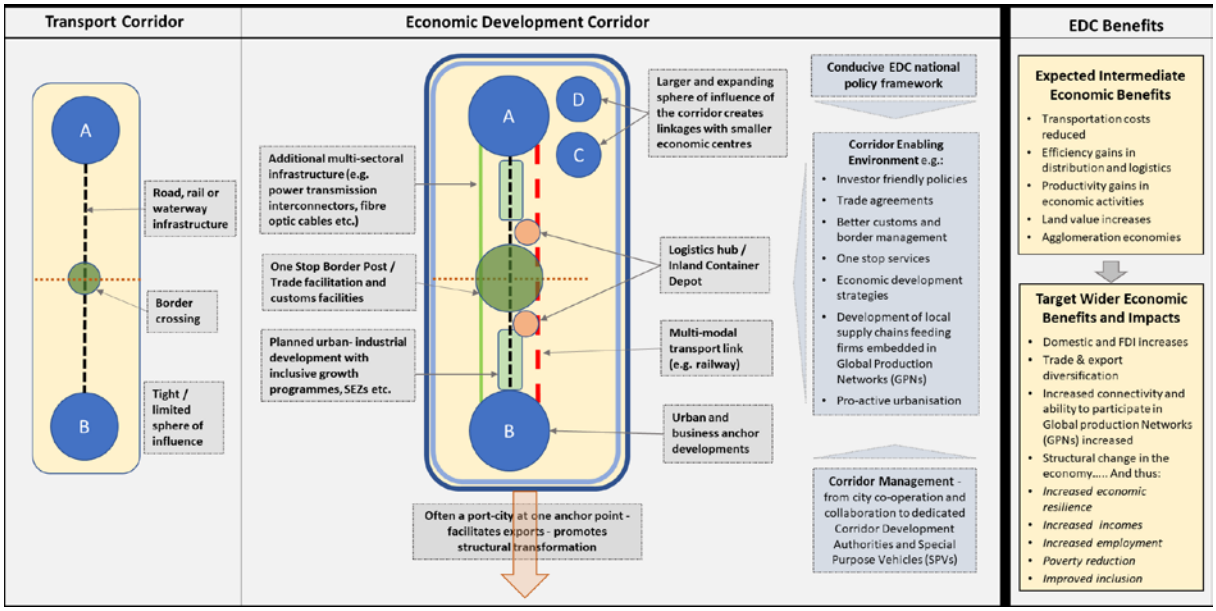
Recently (May 2020), IGAD produced an ambitious Regional Infrastructure Master Plan (IRIMP). This plan is aligned with AU Agenda 2063 and aims to accelerate the region's growth and structural transformation. The Plan consists of policy initiatives and infrastructure investments which will significantly strengthen the process of regional economic cooperation and integration.

The IRIMP plan covers infrastructure in Transport, ICT, Energy and Transboundary Water Resources. The IGAD region is unfortunately characterized by the low stock of infrastructure, particularly in transport and energy, and the inadequate development of the ICT sector and digital economy. Studies have shown that inadequate infrastructure shaves off at least 2% of Africa's annual economic growth. Adequate infrastructure would lead to productivity gains by African firms of up to 40%.

The objectives of the plan are 4, i.e., to: a) Develop a strategic framework for infrastructure development in the Transport; Energy; ICT and Water sectors. B) Facilitate intra-regional and inter-continental trade, and the flow of goods, services, and the movement of people across borders of the region. c) Support regional economic growth that is inclusive, resilient, and sustainable; and d) Reduce isolation and promote regional integration and stability.

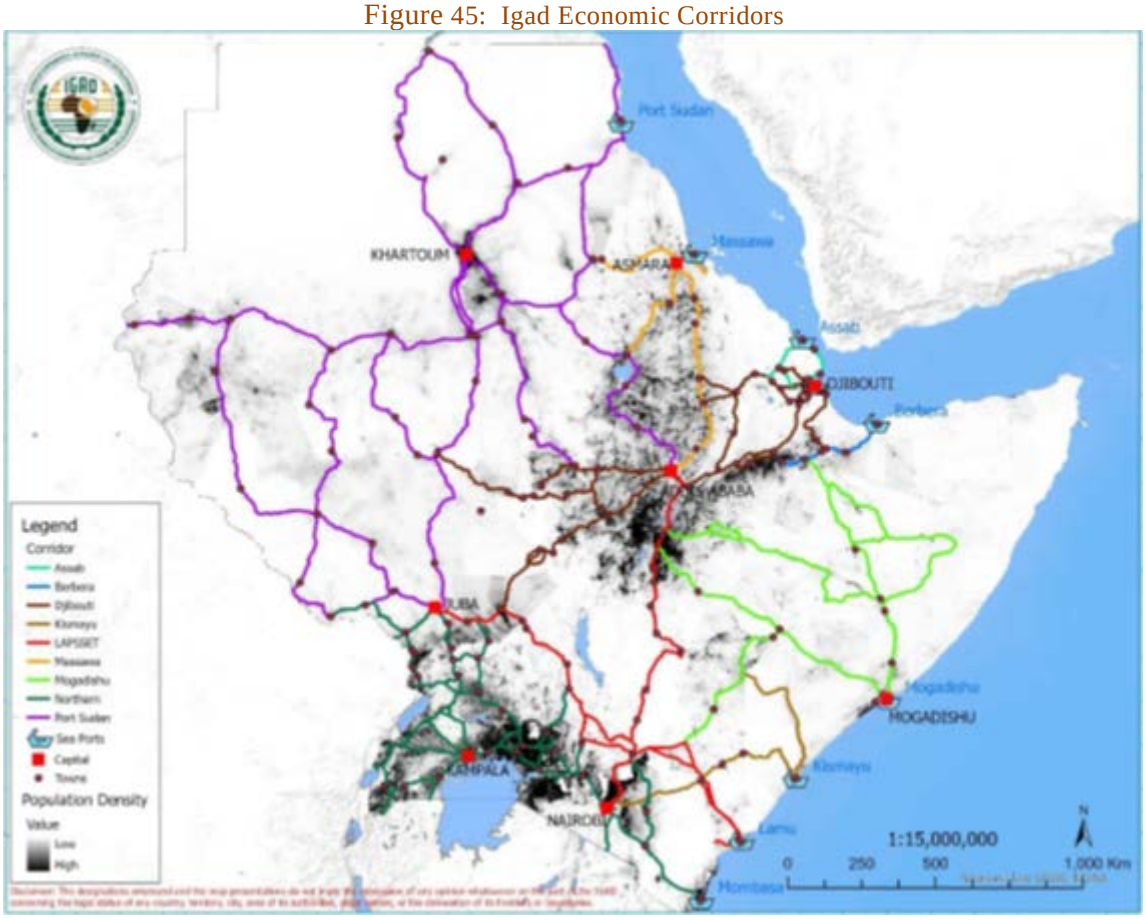
The primary principle guiding the regional plan is to transition the present transport corridors into economic development corridors (EDCs) that maximize job creation, are resilient to climate change, are people-driven and strengthen the role of women through gender-sensitive infrastructure development. Corridors develop is conceived through four stages: 1) basic transport corridor; 2) multi-modal/multi-sectoral corridor; 3) logistics corridor; 4) EDC, as illustrated in following figure.

The EDC framework is widely used by international development organizations and national governments to direct resources to promote economic growth. An EDC most commonly contains a transportation corridor (generally a road, railway or waterway) but is much more than a linear area connecting two countries, regions or cities through which goods and people pass. An EDC is an instrument of development that is used to ensure that the transportation hard infrastructure generates important economic and social development impacts. Transforming a transport corridor into an EDC, however, is often not a straight-forward task. It demands political commitment and stakeholder involvement from all levels of government and can often require the establishment of a special purpose vehicle (SPV) to co-ordinate, direct and manage the infrastructure and policy-type initiatives required for the success of an EDC.



There are nine potential EDCs in the IGAD region (see following figure). At present, however, just three are functioning effectively as regional transport corridors, and these have not yet become clear drivers of economic development and structural transformation. The Northern Corridor is the most developed (Corridor Authority and Observatory is in place) and is a functioning logistics corridor, while the Djibouti Corridor and Port Sudan Corridor are multi-modal/multi-sectoral corridors.

Figure 45: Igad Economic Corridors



It is recommended that the IGAD region follows a Phased Corridor Development pathway, with emphasis on the following: 1. Transform the Northern, Djibouti and Port Sudan Corridors into EDCs by 2030 that are important drivers of growth, regional integration, and prosperity in the IGAD region. 2. Develop the LAPSSET, Berbera and Massawa Corridors into functional logistics corridors by 2030 that have the potential to integrate the region and serve as conduits for intra-regional and international trade; 3. Complete missing links on the Mogadishu, Kismayo and Assab Corridors to ensure functional transport corridors by 2030.

Following are the foreseen situation at year 2050, for the major corridor interesting Ethiopia:

Figure 46: Djibouti Corridor Infrastructure (2031-2050)

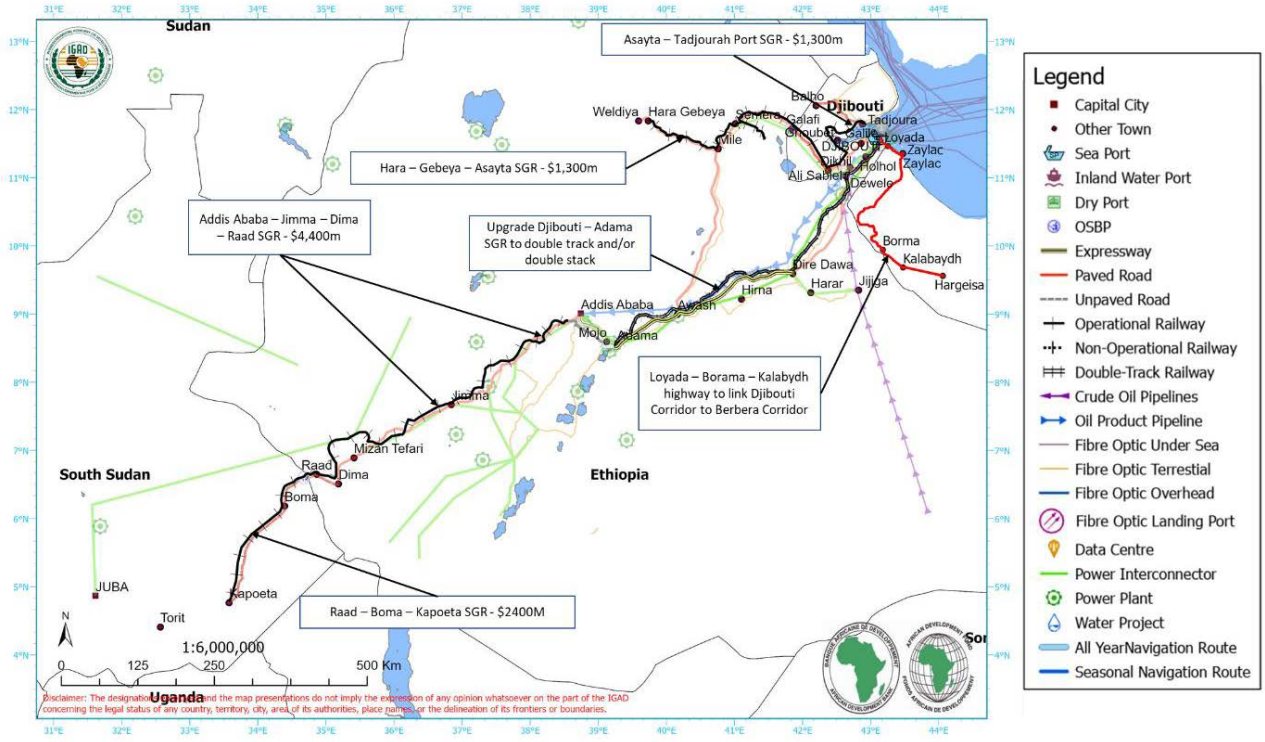


Figure 47: Port Sudan Corridor Transport (2031-2050)

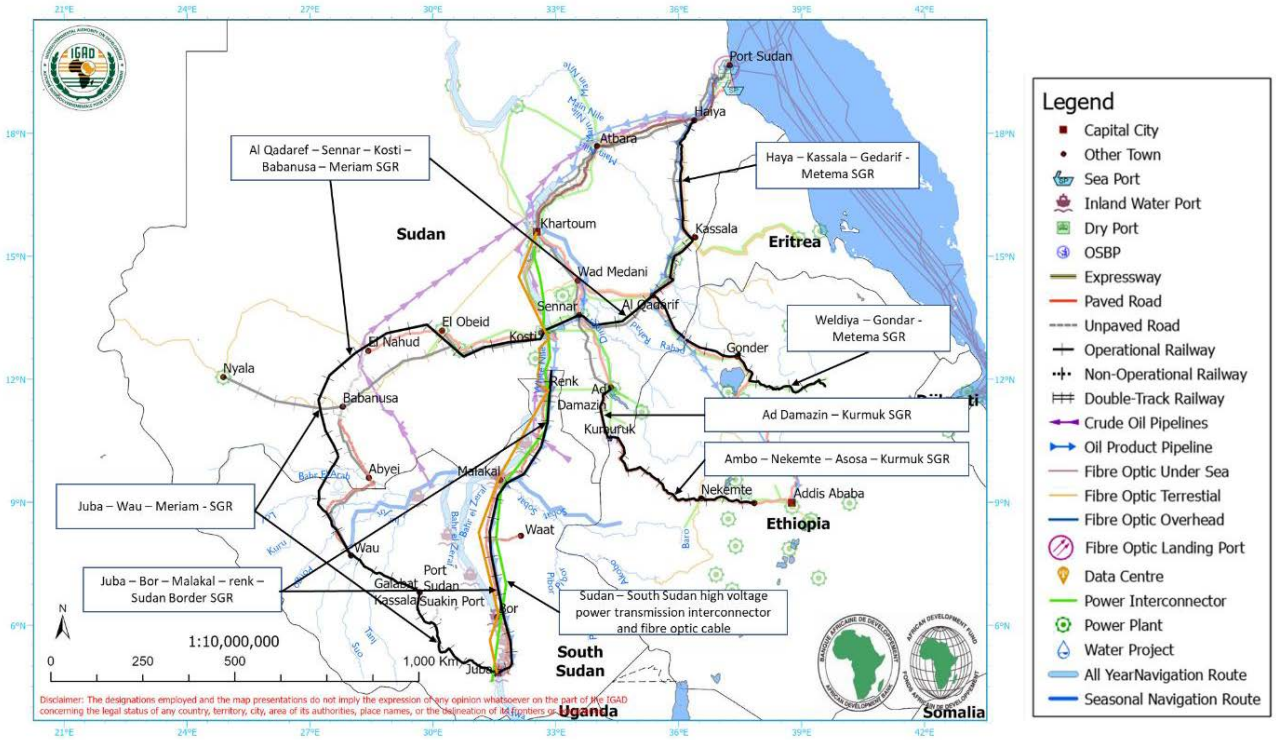


Figure 48: Berbera Corridor Infrascture (2031-2050)

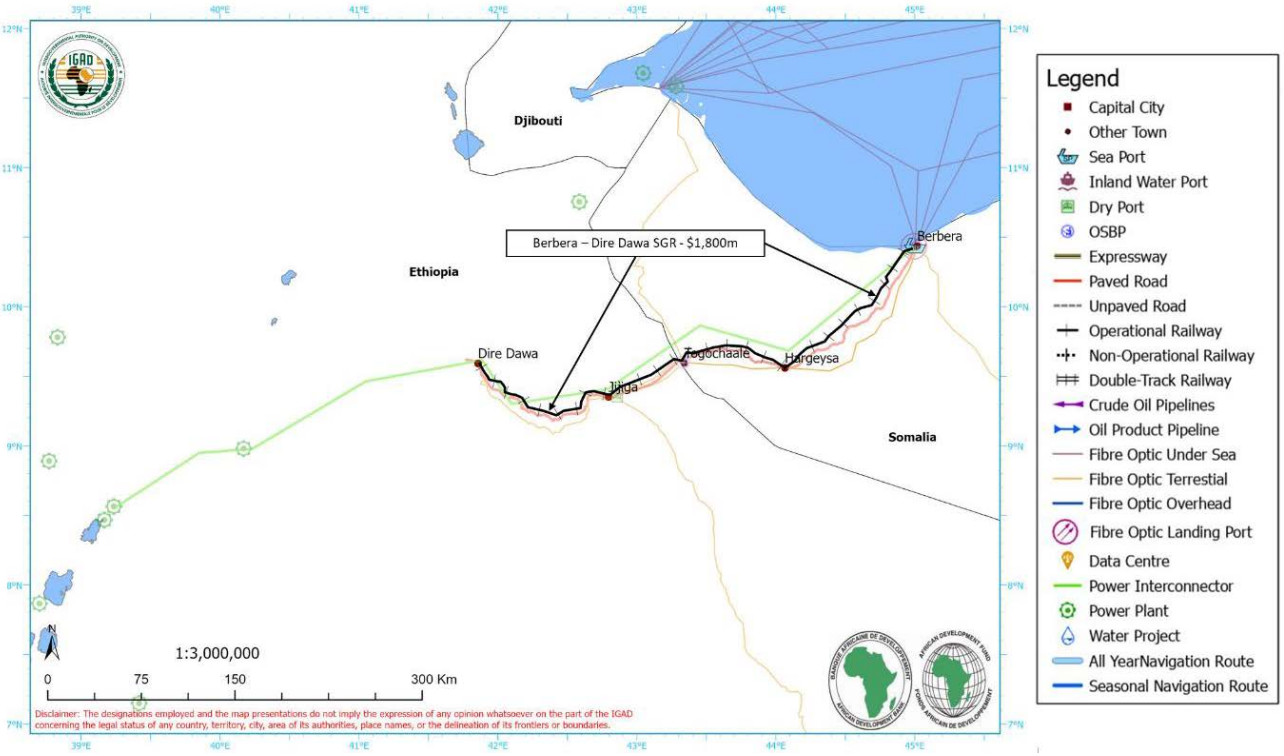


Figure 49: Massawa Corridor Infrastructure (2030-2050)

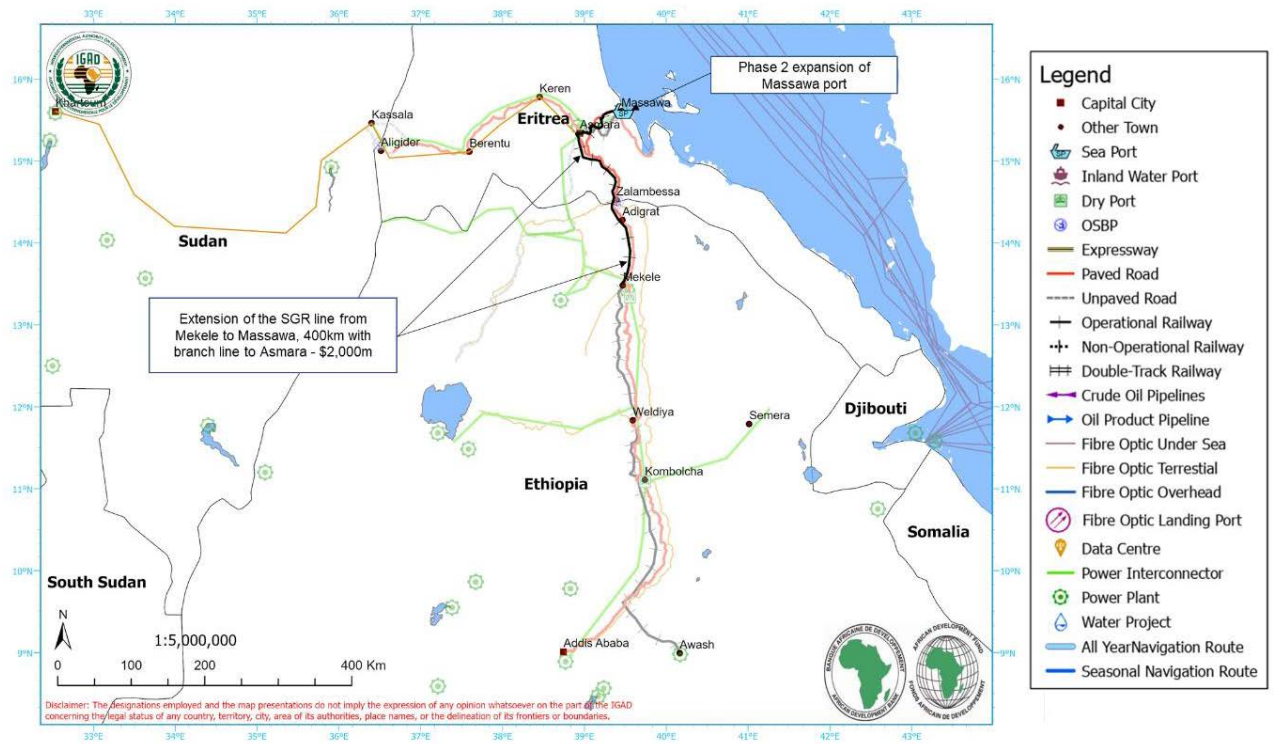


Figure 50: Assab Corridor Infrastructure (2025-2030)

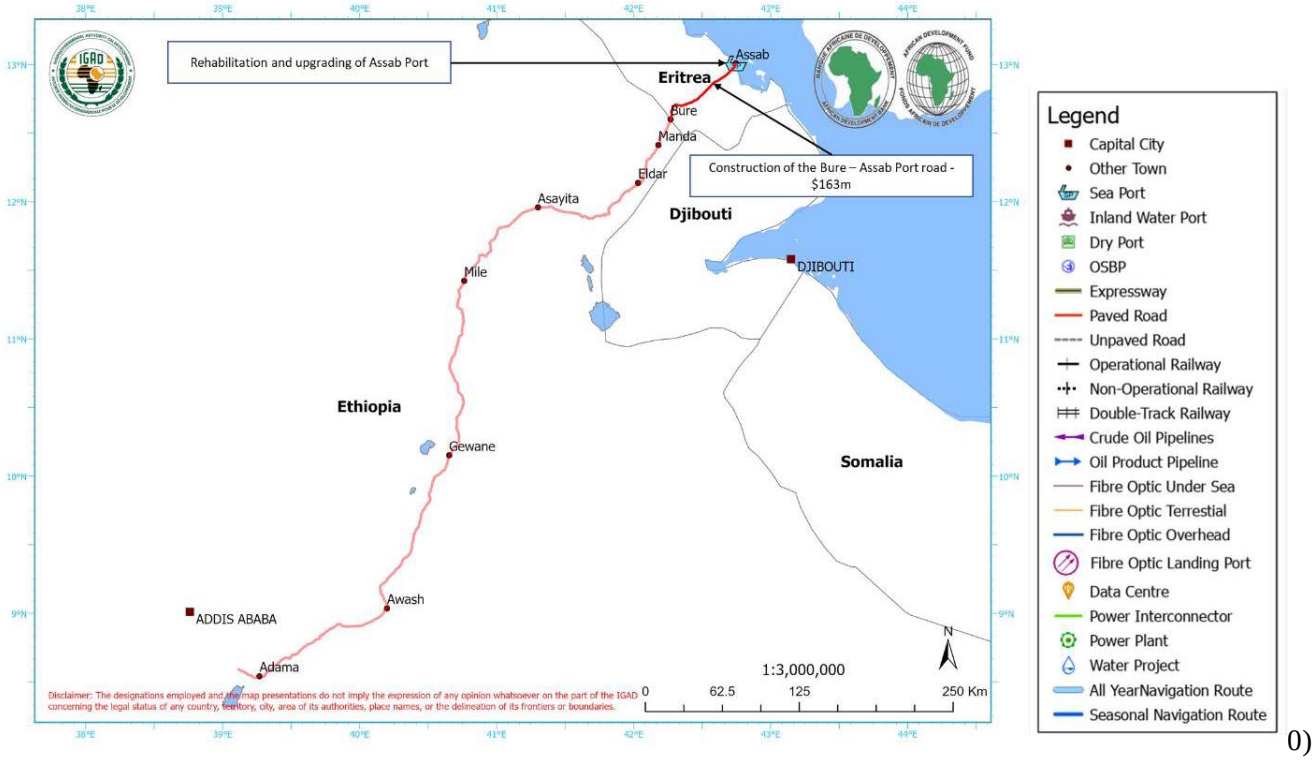


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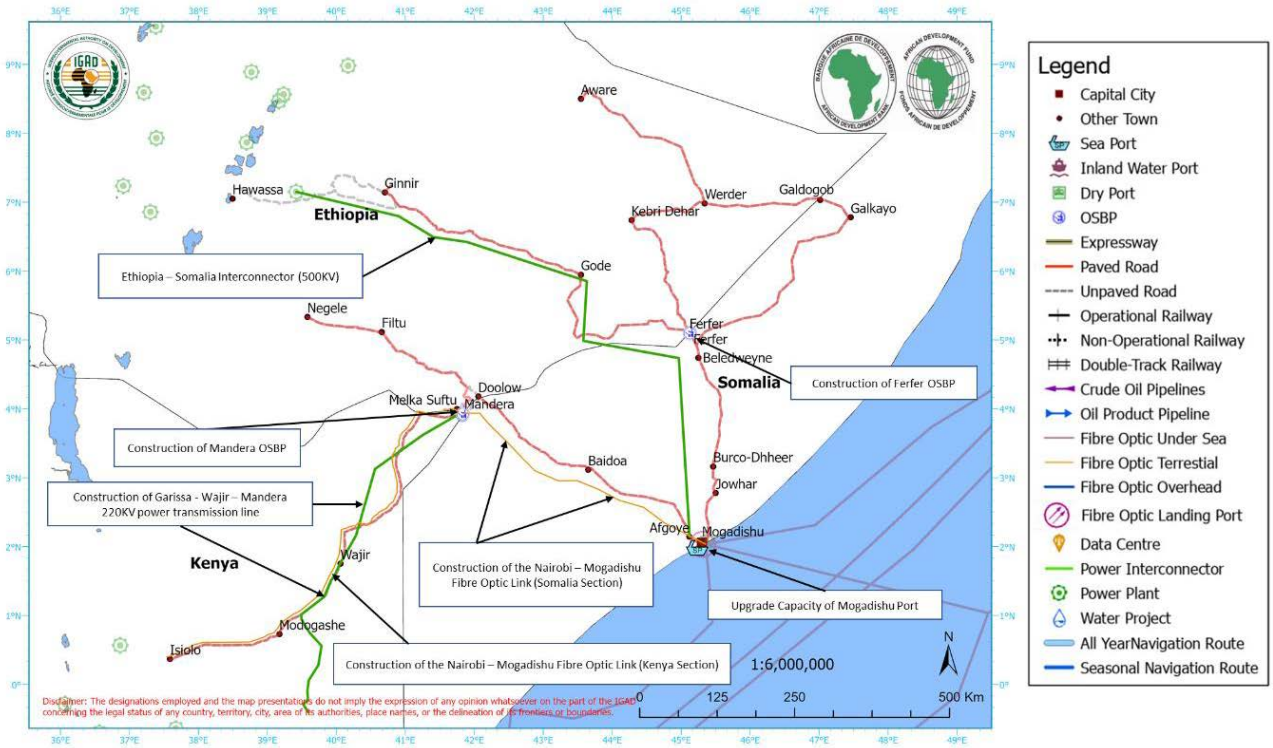
Figure 51: Mogadishu Corridor Infrastructure (2031-2050)



9 ROAD SECTOR INNOVATION

9.1 NATIONAL POLICY FOR TRANSPORT INNOVATION

The Ethiopia Ministry of Innovation and Technology has recently prepared, with UNCTAD assistance, a **Science, Technology and Innovation Policy Document**, in order to create innovation systems in the country, implementing the Sustainable Development Goals (SDGs) and develop the export-oriented and manufacturing sector-based industrialization strategy.

Moreover, the **Digital Ethiopia 2025 – A strategy for Ethiopia inclusive prosperity**, aims to connect Ethiopia to the world global transformation driven by new technologies such as: Artificial Intelligence, Internet of Things, Nanotechnology, and Big Data, amongst many others that offer new models for production, communication, and lifestyle. For Ethiopia, a digital transformation strategy needs to be aligned with critical Homegrown documents i.e., the 2019 Homegrown Economic Reform Agenda and the Ten -Year Development Plan (2020-2030) as well as with international commitments such as the Sustainable Development Goals and the African Union's Continental Digital Strategy.

The TY Perspective Plan puts a lot of emphasis on Innovation & Technology Development, like building and organizing infrastructures that support the development of innovation and research activities; building human resource capacity; creating, supporting and enabling key institutions, and establishing operating procedures; building a national data centre that would help increase economic and social benefits through the creation and consolidation of a digital economy; enhancing institutions' use of public services through online systems by improving internet connectivity and use; introducing a standardized national system of addresses; developing computational technologies and national databases; and enhancing the use of electronic means for accessing public services.

The following main targets have been set to achieve the objectives of the innovation and research development plan for the coming ten years (2020/21-2029/30):

- To expand infrastructures for innovation and technology development;
  - build 9 infrastructural installations, 20 new innovation, research and technology incubation centers and 8 technology centers in order to enhance the modernization of space science and technology research;
  - build, in view of implementing the Treaty on the Prohibition of nuclear weapons, one radionuclide station and 50 non-stop remote sensing satellite ground stations;
  - build 450 basic (Zero Order) ground data control points, 1,000 first order ground information control points, one geospatial laboratory and one geospatial server room.
- To build innovation and technological capacity and improve service delivery;
  - build the human resources capacity to increase the potential workforce in the innovation, technology and research subsector to 5.7 million;
  - increase the number of national data centers from 1 to 3;
  - increase the number of towns that use standard system of addresses to 73;
  - raise the coverage of public institutions to be included in the government's electronic network system to 95%;
  - launch into space 2 remote sensing satellites and 1 communication satellite;
  - increase the types of electronically delivered public services from 176 to 2,500;
  - raise the number of institutions that utilize electronic marketing service to 3,500 by increasing the electronic service coverage from 2% to 85%;

- To increase access to mobile and internet services from 37.2% and 18.6%, respectively, to 100%;
- To expand and strengthen innovation and technology development enterprises:
  - establish 20 enterprises and space technologies in the area of generating and disseminating satellite data;
  - establish 36 enterprises in the area of technology adoption and transfer;
  - induce 50 emerging technology enterprises with various start-up and innovative initiatives to commence production and service delivery;
- Provide support to 3,000 selected tech start-ups with high economic and social impacts and, of these, promote the most promising 2,100;

Raise the share of private sector jobs in the areas of technology and digitalization from 50% to 80%.

9.2 INNOVATION IN TRANSPORT

It is clear that the future of transportation infrastructure is a future of change. Demands, threats, capabilities and costs will be different over the next 30 years. Demographic shifts will lead to an aging but more capable population. Values, particularly those of millennials, will change toward less interest in owning and a stronger focus on use of technologies and services. These changes are likely to emphasize experiences and outcomes rather than processes and mechanism.

Sustainability may become a paramount goal. Technological change will accelerate – information and computer technologies, automated vehicles, imbedded systems for more effective and pervasive monitoring and control of infrastructure systems will deliver more timely information about facility condition, support more efficient allocation and utilization of capacity, and provide the opportunity to act, protect, and prevent failures. Automation will change the cost and the experience of travel. Together, these changes will modify the demand for mobility, with a mix of reductions (through tele-work/-shop/-play) and increases (in product shipments and personal mobility) as costs and capability barriers are eroded. Threats from natural and unnatural hazards can be expected to increase, demanding a new kind of resilience in transportation services, as well as increased reliance on ICT to work around temporary transportation disruptions.

Resources, competition and energy costs will change. Currently, trends are favorable – prices are lower because availability is high. But types and sources of energy are shifting, and this alone is changing the demand for transportation of energy materials. The future can be expected to be different still, affected by national and global pressures on CO2 emissions from fossil fuels, international competition and conflict, and technological innovation. There will be a premium on a skilled workforce, and global competition will broaden the market place and change – likely increase – the demand for the mobility of both people and freight.

The rate of change of almost everything can be expected to increase because of synergies between values, technologies, and competition. Not surprisingly, public policies will likely lag market-driven changes. The larger the lag, the less efficient will be the functioning of society and its economy. Stated differently, places where public policies move swiftly to coordinate with and support market changes will benefit more quickly and strongly from change and will do a better job of avoiding negative consequences. The future will be better to the extent that change is anticipated, positive change supported, and negative change defended. But anticipation calls for prediction, and the future is hard to predict, especially in the face of multiple and rapid changes. The alternative, perhaps the only path to a successful future is through flexible and responsive decision making, which tracks changes, adjusts forecasts, and takes appropriate actions to ensure the condition and performance of transportation infrastructure and other core infrastructure systems.

There are at least three requisites for that kind of decision making:

1. **Timely and accurate data and information** to track changes, assess system condition and performance, and measure outcomes to provide a basis for informed actions. Navigating the future requires more than opinions and hunches. That means constructing and supporting data programs to track trends, detect problems and opportunities early, and provide a sound basis for making decisions.

2. **Sustaining, sufficient and reliable resources** to support necessary actions. This means the funds necessary to protect and adapt transportation infrastructure to meet changing needs and take advantage of new opportunities. It also means having the people with the skill sets necessary to use that information to decide, to act and to implement. A robust and reliable transportation infrastructure requires the people to build, operate and manage it.

3. **The will and the ability to make decisions**, to take the actions necessary to ensure the future of transportation infrastructure and services. This calls for skilled leaders and managers, supported by data and information and supplied with sufficient resources to do the job. It also requires efficient institutional structures with the mandate to manage and develop transportation infrastructure networks to carry goods and people seamlessly from origin to destination. Effective strategic decision making to support transportation infrastructure demands a shared understanding of needs, threats and opportunities; agreement on the need for coordinated, collective actions; and a mandate to act.

Meeting all of these requisites is not a simple task. **Financial resources** are critical, but it must be used, and used effectively, if transportation infrastructure is to meet the future head on. The need for effective and resilient transportation systems and services must and will change in the coming decades. External forces, markets, and public and political pressures will cause some of that change. The challenge is to be proactive, to drive the changes systematically and positively, and thus to actualize scenarios that lead to a strong economy, an equitable society, and a sustainable balance of resources. This means assuring a future transportation system that is goes beyond the essential to be a force for advancing national goals.

The ETMP 2050 is the right chance to make the **transport system sustainable** in terms of environment, safety, adapt to climate change, maintainable and congruent with transport demand, avoiding over-offering of transport infrastructure/services. It is also the chance to introduce innovative themes in transport planning, administration, management and operation, using the most appropriate and effective tools and IT systems.

In terms of **transport planning**, a holistic approach is suggested, coordinating the different vertical levels: national, regional, woreda and municipal levels and including the different modes of transport. In terms of administration, the use of transport demand management to reduce vehicular traffic and encourage the use of public and non-motorized transport, with the adoption of SUMPs - **Sustainable Urban Mobility Plans and smart city concepts** for Ethiopia cities and with the development of integrated rapid public transport network plans and transit-orientated developments (TOD) in development corridors.

In terms of **transport technology**, Ethiopia should introduce different modes of transport of passengers (cable cars) where technically and economically justified, pipeline transport for the import of fuel liquid or gas and take advantages of the Internet of Things (IoT) in all transport modes and follow the ***futuribles innovations*** in terms of autonomous vehicles, hydrogen vehicles, advanced driver assistance for reduction of accidents, e-vehicles, low carbon emissions, e-logistics, aviation simulations, drones, urban mobility on demand, smart cities etc.

9.3 INNOVATION IN THE ROAD SECTOR

Following are suggested and innovative solutions for the improvement of road planning, feasibility, investment decision, design, financing, construction, maintenance, road safety and innovative road transport to be monitored.

9.3.1 Road Planning & Investment Decision

Ethiopia road network carries more than 90% of passengers and freight of the country's overall traffic and plays a crucial role in encouraging economic development of the country. It is very important that the planning and decision-making capability reflects the role of the network in **unlocking economic potential as part of a wider, integrated transport system.** Traffic appraisal modelling and mode-integration are fundamental for the correct investment in road construction and maintenance. Models should be applied at national, regional and urban levels. This will provide a more holistic and robust appraisal process for economic growth, also applying innovative approaches for public consent development, utilising technology to speed up and better communicate scheme and planning information.

As shown in the chapter one, the **ETMP50 represents the main multimodal long-term framework for the development of transport in the country** and to be used in the road sector, mostly for the planning and analysis of the main road strategic corridors. New expressways, trunk roads and federal roads improvements, should be planned according to a medium-term Road Master Plans (like the recent Ten-Year Plan) in accordance with the overall ETMP50 framework.

The **specific federal road investment decision should be made according to the Road Master Plan** and building a local model, which simulates transport demand and competitive offers and calculates the economic, road safety, vehicles' emissions impact through the HDM4 model.

The Highway Design and Maintenance Standards Model (**HDM-4**), developed by the World Bank, is a software package which serves as the primary tool for analysis, planning, management, maintenance of road investments, improvements and maintenance decisions. HDM4 provides a powerful system for: road management, programming road works, estimating funding requirements, budget allocations, predicting road network performance, project appraisal and policy impact studies. HDM-4 has four main areas of application: Strategic Planning, Roadwork Programming, Project Analysis, Research and Policy Studies.

Project analysis can be used to estimate the economic or engineering viability of road investment projects by performing life cycle analysis of pavement performance, maintenance and/or improvement effects together with estimates of road user costs. The main outputs include:

- Pavement maintenance and road improvement effects
- Road user costs and benefits, including road safety
- Estimates of environmental effects
- Standard economic indicators; NPV, EIRR

9.3.2 Road Design & Construction

Government agencies in the road construction and management industry sector aim to achieve value for their investment as they procure road construction industry services. As Government announces any road construction project and seeks procurement for services, several contractors apply, and it is complex to assess innovation in these proposals on a comparative basis. This requires several factors such as: clear project definition, what is new (innovation), previous experience for the proposed project. However, it is not easy to assess innovation on a comparative tender assessment basis.

Over the last several years, there has been an increased use of **Building Information Modelling (BIM)** related technologies to improve the project delivery process for highway construction.

Building Information Modelling (BIM) is an intelligent 3D model-based approach that gives engineering and construction professionals the insight and tools to more efficiently plan, design, and build highways and bridges. The days of sharing documents with via copy plan sets and files from silo to silo through an asset's life are diminishing. With BIM, all project data from planning to decommissioning is shared electronically with ready access for all involved in the planning, building, and maintenance processes, providing more efficient data exchange.

BIM integrates many technologies and practices that bring digital tools and a data-centric approach for improving lifecycle delivery and management of highway assets. However, the approach for deploying BIM has been typically siloed at each function of the organization or at the project level. BIM implementation to date typically has had a heavy focus on deliverables for construction, rather than data to inform decisions during and after project delivery, but there is so much more to making it a truly lifecycle integration of valuable asset data. This means going beyond the current industry connotation of BIM as synonymous to 3D models.

The uses of building information modelling (BIM) have initially focused on buildings, but starts to be used now also for infrastructure and roads in particular, where it applies in pre-construction activities (planning, design, site layout and logistics, material management, engineering analysis: & verification, etc.), in construction (Construction inspection, human resource management and progress tracking, quality assurance, safety onsite, cost control: constructability reviews) and in post-construction activities (planning maintenance, system analysis, asset management, emergency plan, transportation management).

ERA should start the analysis of this powerful tool that covers all aspects of road planning, design, construction, control, maintenance, management and operation.

9.3.3 Road Financing

Traditionally road infrastructure funding has been primarily borne by the public sector either using money from the general budget or funds from other particular sources (local taxes, fuel taxes, taxes on new vehicle acquisitions, and vehicle registration licenses). Given the shortage of funding because of the impact of the global financial crisis (reduction of taxes), the role of the private sector has been steadily increasing. Many countries turn to tolling as a primary way to raise funding, and advancement in technology are opening the way for future financing methods (extending tolling to the full network, "free-flow", user-charging models based on road use).

Public-Private Partnerships (PPPs) has been the major solution identified. PPPs comprise various schemes (BOT, DBFO) differentiating on financial and contractual obligations, but the key common feature is the sharing of the risks between the public and the private entity. PPPs may also generate improvements in operative efficiency through better management. They are however, complex, heavily dependent on traffic and revenue forecasts and so often successful only if applied to main road projects.

Generally, the cost of private financing (and expected equity rates) is decreasing, but there are still difficulties in accessing credit. It seems as if different financing mechanisms and guarantees are to be put in place by governments or financial institutions in order to enlarge and secure private financing. Innovative financing mechanisms can consider capital instruments (investment funds, development banks, and state infrastructure banks), debt instruments (credit assistance, corporate bonds, and guarantees) or other innovative methods (value capture).

The objective is to provide risk capital or bank credit to projects of common interest. For example, in the EU, it is pursued by the use of project bonds and principal risk-sharing instruments such as LGTT (loan guarantee instrument for TEN-T projects) to finance transport projects involving investors in the long term. PPPs and other private sector financing mechanisms ought to be seen as a supplement to traditional public funding rather than as a substitute. Finding the perfect balance between public

and private funding will be the greatest challenge worldwide over the coming decades.

Ethiopia has already introduced Public Private Partnerships through the enactment of the Ethiopian Federal Government Procurement and Property Administration Proclamation No. 649/2009 in September 2009, but the legislation did not provide for the legal framework for the implementation of Public Private Partnerships – except that it defined the meaning of such a partnership. It is almost a decade later that the Ethiopian government formulated its policy toward Public Private Partnerships in August 2017 and further enacted Public Private Partnership Proclamation No. 1076/2018 in February 2018.

Since then, Ethiopia is trying to develop Public Private Partnership projects in energy and toll roads projects, but needs to better streamline the process by which private parties that will develop public infrastructure in partnership with the government are selected and the manner in which Public Private Partnership projects are expected to be implemented.

9.3.4 Road Maintenance Organisation

Roads provide large benefits to the society and represent a huge financial public asset, but roads are now in danger because of the accumulated maintenance backlog, that requires substantial funding and spending to be recuperated.

The adoption of a Road Asset Management (RAM) offers a solution, based on:

- Establishing a complete inventory of all road network with all its elements
- Providing a clear picture of current condition/performance of the road network
- Estimating the value of the asset
- Predicting future demand of traffic and service needs
- Estimating maintenance needs and costs
- Prioritising objectives related to desired quality/performance of the road network
- Setting funding scenarios for regular/timely maintenance/upgrade of road assets
- Defining the maintenance strategy and programming plan (HDM4)
- Facilitating single intervention evaluation (HDM4)

ERA is already using a Road Asset Management System, but it needs to be fully integrated in the maintenance planning and organization and maybe increased with innovative tools, like exploiting the "Internet of Things", where vehicles and other technology, such as smart sensors monitoring the road assets can communicate with each other without human input. This includes using new developments such as analysis of the chemical composition of the road surface to provide information on its condition. All this work to improve the way to gather and use information about road assets will support ERA ability to manage the associated risks to safety, serviceability, availability and environmental outcomes. This will strengthen the capacity to deliver a resilient national infrastructure system.

9.3.5 Road safety

The safety and welfare of all those who use, work on, or are indirectly impacted by the road network, should be the first priority for the road agency, aspiring to reduce the number of people killed or injured on the network as close as possible to zero by 2040. Using innovative technologies, new road and junction design approaches, and separate roadside for walking and cycling shall be made available on appropriate routes.

Road safety actions should concern:

Safer roads - Improve the inherent safety and the protective quality of the network for the benefit of all road users.

Safer Vehicles - Deployment of improved vehicle safety technologies on the network. This includes connected and autonomous vehicles that could be the breakthrough innovation to be achieved

Safer people – Putting in place intelligence led, innovative programmes to improve road user behaviour and ensuring innovative ways to make people safer when they work on the roads.

9.3.6 Innovative Road transport

Road transport will undergo substantial innovation in the very near future in terms of ***automotive energy*** and use of ***ICT in traffic management***.

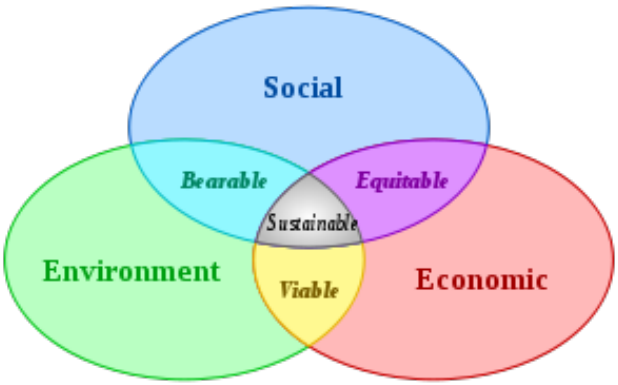
Delivering better environmental outcomes - The development of Ultra Low Emission Vehicles (ULEVs), will play an important part in meeting the aspiration of better environment and living. Innovation and research into measures that mitigate the environmental impact of vehicles and on measures to encourage innovative solutions to improve overall air quality. Energy carriers based on **hydrogen** (the ETMP has conceived on that the Next-generation scenario) **and renewable energy sources** in battery-powered electric vehicles (BPEVs), fuel-cell electric vehicles (FCEVs), hybrid electric vehicles (HEVs) and internal combustion engine vehicles (ICEVs) is advancing rapidly and will constitute a reality in a few years.

Supporting the smooth flow of traffic - There is huge potential to use "Big data" (the massive volumes of data accumulated in internet) to improve the understanding of customers' expectations and their travel patterns. By making smarter use of this data, it is easier to make the right decisions about the services to deliver and how to invest in the network. The next generation of smart motorways will achieve smoother, more controlled flow, advanced incident detection technology, improvement journey performance on the busiest roads.

10 ENVIRONMENTAL ISSUES IN TRANSPORT

10.1 ENVIRONMENTAL CONSIDERATION: GENERAL

The overarching objective of the whole exercise of undertaking the Ethiopian Transport Master Plan (ETMP) is to contribute to the country's sustainable development. Sustainable development (SD)7 is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for generations to come (sometimes taught as ELF-Environment, Local people, Future). The field of sustainable development can be conceptually broken into three constituent parts: environmental sustainability, economic sustainability and social sustainability. The scheme of sustainable development-at the confluence of three constituent parts- is depicted in the Figure below.



Transport infrastructures, like other development projects, pose impacts on the environment in different ways and levels. That is, depending on the mode, they have impacts on the air, soil, water, vegetation and wildlife. In the process of achieving their primary objectives, transport projects contribute several benefits (positive impacts) that foster development at different levels mainly in the form of: creating/enhancing accessibility and mobility, creating employment opportunity, and contributing to induced development.

However, beside its benefits, the transport sector has also posed detrimental impacts especially on the environment. That is, the construction or upgrading of transport infrastructures involves impacting the physical, biological and socio-economic environments regardless of the extent of the impacts. Each of the impacts associated with road works may be positive or negative, short- or long-term, localized or widespread, etc. The risks to the physical environment include: soil erosion in the longitudinal and transverse directions in the road route/corridor; slope instability when the road cuts through mountainous areas; decreased water quality due to both pollutants and sediment loads linked to soil erosion; soil and water pollution from hazardous wastes such as used oil and lubricants; and decreased air quality due to emissions from construction machinery and traffic volume (there are also stationary sources of emissions). The risks to biological environment include: loss of natural vegetation and of wildlife habitat due to land clearing, and the impact of road activity on wildlife migration patterns (due to ecosystem fragmentation). The risks to the socio-economic environment include: loss of fertile land and cash (perennial) crops, loss of residential houses, loss of business, etc.

As construction of transport infrastructures impact the environment, the environmental impacts in turn affect communities, including their health and livelihoods. That is, decreased water and

7 Sustainable Development is "development which meets the needs of the present generation without compromising the ability of future generation to meet their own needs" (UN World Commission on Environment and Development, 1987)

air quality affects households' environmental health. Loss of properties like land, crops, residential houses and other businesses affects the livelihoods of communities.

During the operation phase of transport system, the performance of the system could also be related to environment. That is, the status of transport system performance and quality affects the environment; for example, in the form of air pollution (possible emissions from vehicles, aircrafts, vessels, railway locomotives etc.); and soil and water pollution from spillages of fusels due to accidents. Wildlife resources could also be affected mainly in the form of accidental killing of animals by vehicles or trains.

In Ethiopia, several legal documents and provisions have been issued to ensure environmental sustainability. The legal documents have been issued at different levels ranging from the Constitution of the Federal Democratic Republic of Ethiopia (FDRE) to sectoral guidelines and manuals. On this basis, the following sections present the major legal and policy provisions related to environment and relevant to the Transport Sector within the overall legal framework of the country.

10.2 CROSS-SECTORAL ENVIRONMENTAL LEGISLATIONS

The Constitution of the Federal Democratic Republic Ethiopia (FDRE), issued in August 1995, forms the fundamental basis for enactment of specific legislative instruments governing environmental protection matters at national level. The Constitution has several provisions which have direct policy, legal and institutional relevance for appropriate implementation of environmental protection and rehabilitation action plans targeted to avoid mitigate or compensate the adverse effects of development actions.

The Constitution thus contains a number of articles which are relevant to social and economic issues/objectives (such as, rights of women, children, labour & employment), environmental matters in connection with development projects in general, and the prominent Articles relevant for the proposed Subproject include the following:

- Article 44 states that all person have the right for a clean and healthy environment;
- Article 92, which sets out national policy principles and objectives, includes the following significant environmental objectives:
  - Development projects shall not damage or destroy the environment, People have the right to full consultation and the expression of views in the planning and implementation of environmental policies and projects that affect them directly,
  - Government and citizens shall have the duty to protect the environment;

The Conservation Strategy of Ethiopia (CSE) is an important policy document, which views environmental management from several perspectives. In particular, it recognizes the importance of incorporating environmental factors into development activities from the outset, so that planners may take into account environmental protection as an essential component of economic, social and cultural development. The CSE takes a holistic view of natural, human-made and cultural resources, and their use and abuse. It seeks to integrate into a coherent whole existing and future federal and regional government planning in all sectors that impinge on the environment, including agriculture, forestry, wildlife, fisheries, soils, water, minerals, energy, urban planning and cultural heritage conservation. A sound partnership has been sought between planners, decision makers and the Ethiopian people to manage Ethiopia's natural resources for the Ethiopian people and their children. Most sections, groups and classes of people have been consulted and have participated in the formulation of this strategy. The policy-making phase encompassed broad ranging discussions and a full debate at both federal and regional levels in order to arrive at a consensus. (See annex)

10.3 CROSS SECTORAL NATIONAL ENVIRONMENTAL POLICIES

The Environmental Policy of Ethiopia (EPE was approved by the Council of Ministers in April 1997. Its conceptual framework was based on the findings and recommendations of the National Conservation Strategy of Ethiopia. This policy document, along with CSE was developed with the assistance from the International Union for the Conservation of Nature (IUCN). EPE includes 9 policy objectives, 19 guiding principles, 10 sectorial and 10 cross-sectorial policies.

The EPE supports Constitutional Rights through its guiding principles. The overall policy goal is to improve and enhance the health and quality of life of all Ethiopians, and to promote sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the environment as a whole, so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs.

The sectorial environmental policies are; Soil husbandry and sustainable agriculture, Forest woodland and tree resources, Genetic species and ecosystem bio-diversity, Water, Energy, Mineral resources, Human settlement, urban environment and environmental health, Pollution from industrial waste and hazardous materials, Atmospheric pollution and climatic change, and Cultural and natural heritage.

The cross-sectorial environmental policies cover the following main areas/theme, such as, Population and the environment, Community participation and the environment, Tenure and access rights to land and natural resources, Land use plans, Social and gender issues, Environmental economics, Information systems, Research, Environmental impact assessment and Environmental education and awareness.

The implementation of transport infrastructures and operation of the system has a direct relation and impact on the sectoral environmental policies stipulated in the EPE.

Environmental Impact Assessment (EIA) policies are included in the cross-sector environmental policies. The EIA policies emphasize the early recognition of environmental issues in project planning, public participation, mitigation and environmental management and capacity building at all levels of administration. The policy establishes the Environmental Protection Authority (EPA) as the body to harmonize Sector Development Plans and to implement an environmental management program for the country. It also imparts political and popular support to the sustainable use of natural, human-made and cultural resources at the federal, regional, zonal, woreda and community levels.

The Environmental Policy of Ethiopia (EPE) and the 2002 Sustainable Development and Poverty Reduction Program (SDPRP) attribute the prevalence of poverty in part to low growth and low productivity of agriculture and to the populace's dependence on agriculture and natural resources. The EPE states that agriculture is the main source of variability and stagnation in economic growth (1997). As one of the most dependent countries on foreign aid, limited fiscal resources impact Ethiopia's ability to address these issues (ICNL, 2011). At the same time, as the current government of Ethiopia has only been in place since 1995, Ethiopia faces not only the economic development challenges of any low-income country, but also the challenge of creating a new government institutional structure so that it can best serve its citizens' needs. The manner in which environmental issues are addressed in the coming years will have a significant influence on the well-being of the Ethiopian people, and on surrounding nations whose ecosystems are "dynamically interlinked" with Ethiopia (McKee, 2007). In this context, the development of strong institutions and networks is a necessity to address environmental degradation and management of natural resources.

National and Regional Conservation Strategies

Since the early 1990s, the Federal Government has undertaken a number of initiatives to develop regional, national and sectoral strategies to ensure better environmental conservation and protection. Paramount amongst these was CSE, approved by the council of ministers, which provided a strategic framework for integrating environmental planning into new and existing policies, programs and projects. The CSE is an important strategy document which views environmental management from several perspectives. The CSE itself provides a comprehensive and rational approach to environmental management in a very broad sense, covering national and regional strategies, sectoral and cross-sectoral strategy, action plans and programs, as well as providing the basis for development of appropriate institutional and legal frameworks for implementation.

The plan comprehensively presented the exiting situation within the country and gave a plan of priority actions on the short and medium term. In particular, it recognizes the importance of incorporating environmental factors into development activities from the outset, so that planners may take into account environmental protection as an essential component of economic, social and cultural development.

Policy on Biodiversity Conservation and Research and Development

One of the priority areas of national action towards the effective conservation, rational development and sustainable utilization of genetic resources is a national commitment to set out an appropriate government policy and subsequent action. To this end, the national policy on Biodiversity Conservation and Development is formulated based on the rationale that the conservation of biodiversity is one of the conditions of the overall socio-economic development and sustainable environmental management goals. Hence, because of its vital importance in the socio-economic wellbeing of the Ethiopia people, the conservation, proper management and the use of biodiversity need to be supported by policy, legislation and national capacity building. Based on that policy initiative, national biodiversity strategy and action plan was prepared by the Institute of Biodiversity Conservation (IBC) in 2007 to translate the policy objective in to action.

Cultural Policy of Ethiopia

Article 51/3 of the constitution of the FDRE declares that the Federal Government 'shall establish and implement national standards and basic policy criteria for the protection and preservation of cultural and historical heritage'. Based on this, the Council of Ministers of FDRE endorsed the cultural policy of Ethiopia in October 1997 and subsequently issued the Research and Conservation of Cultural Heritage Proclamation (Pro. No. 209/2000).

Protection and conservation of cultural heritage from manmade and natural hazards is one of the goals of the Authority for Research and Conservation of Cultural Heritage. Article 42 of the same proclamation states under "Reserved Area" that the Authority has the power of issuing building permission for any work to be carried out in an area declared reserve by the Council of Ministers. There is also an article that states the removal of any cultural ruins is to be carried out under strict supervision of the responsible authority, ARCCH in this case.

Ethiopia's Green Development Initiatives

Building on the positive development of recent years, Ethiopia aims to achieve middle-income countries status by 2025 while developing a green economy. To this end, boosting agricultural productivity and strengthening the industrial base will be essential to reach to the intended goal.

Following the conventional development path would, among other adverse effects, result in a sharp increase in greenhouse gas (GHG) emissions and unsustainable use of natural resources. To avoid such negative effects, the government has developed a strategy to build a climate-

resilient green economy (CRGE). The CRGE initiative follows a sectoral approach and aims at overcoming the challenges of developing a green economy. This strategy focuses on four pillars (including renewable and clean sources of power) that will support Ethiopia's developing green economy. These are:

- Adoption of agricultural and land use efficiency measures.
- Increased GHG sequestration in forestry, i.e., protecting and re-establishing forests for their economic and ecosystem services including using them as carbon stocks.
- Deployment of renewable and clean power generation.
- Use of appropriate and advanced technologies in industry, transport, and buildings.

It is believed that establishing these pillars within the relevant parts of the economic development plan will prevent the economy from being locked into an unsustainable pathway and can help to attract the investment required for their development.

Environmental Protection Organs Establishment Proclamation; (Proc. N°295/2002)

The objective of this Proclamation (Proc. No. 295/2002) is to assign responsibilities to separate organizations for environmental development and management activities on the one hand, and environmental protection, regulations and monitoring on the other, in order to ensure sustainable use of environmental resources, thereby avoiding possible conflicts of interest and duplication of efforts. It is also intended to establish a system that fosters coordinated but differentiated responsibilities among environmental protection agencies at federal and regional levels.

The Proclamation stated that each regional state shall establish an independent regional environmental agency or designate an existing agency that shall be based on the Ethiopian Environmental Policy and Conservation Strategy, be responsible for:

- Ensuring public participation in decision-making processes
- Coordinating the formulation, implementation, review and revision of regional conservation strategies
- Undertaking environmental monitoring, protection and regulation.

Environmental Impact Assessment Proclamation (Proc. N°299/2002)

The main objective of this Proclamation is to make EIA mandatory for specified categories of activities undertaken either by the public or private sectors. Among other things, the proclamation defines the different legal organizations concerning Environmental Impact Assessment, outlines the contents of EIAs, and determines the duties of different parties concerning EIAs. The general provisions of the Proclamation include:

- Implementation of any project that requires EIA, as determined in a directive, is subject to an environmental clearance or authorization from the EPA or Regional Environmental Agency (REA).
- The EPA or the relevant REA, depending on the magnitude of expected impacts, may waive the requirement for an EIA.
- Any licensing agency shall, prior to issuing an investment permit or operating license for any project, ensure that the EPA or the relevant REA has authorized its implementation.
- A licensing agency shall either suspend or cancel a license that has already been issued in the case that the EPA or the REA suspends or cancels the environmental an EIS or the granting of authorization by the EPA or the REA does not exonerate the proponent from liability for damage.

To effect this Proclamation, the EPA issued an EIA Guideline Document, which provides details of the EIA process and its requirements. As detailed in Appendix 1, activities that may be treated for EIA process are listed in three schedules depending on the likely impacts on environment.

Schedule 1 are projects which may have adverse and significant environmental impacts, and therefore require full EIA; Schedule 2 are those projects whose type, scale or other relevant characteristics have potential to cause some significant environmental impact but not likely to warrant an environmental impact study; Schedule 3 are projects which would have no impact and does not require EIA.

The transport projects are highlighted in Schedule 1 (major urban roads, rural road programmes, rail infrastructure and railways, trans-regional and international high way, upgrading or rehabilitation of major rural roads, airports with basic runway.

Procedures that must be followed in the EIA process are describe in the proclamation.

- A proponent shall ensure that an environmental impact assessment is conducted and an environmental impact study report prepared by experts that meet the requirements specified under a directive issued by the authority.
- The Authority or regional environmental agency shall, after evaluating environmental impact study report by taking in to account any public comment and expert opinions.

The authority or relevant regional governmental agency shall audit the implementation of authorized project in order to ensure compliance with all the commitments made by, or obligations imposed on, the proponent during the approval of an environmental impact study report. (See annex)

Environmental Pollution Control Proclamation (Proc. N°300/2002)
The proclamation on Environmental pollution control No. 300/2002 is mainly based on the right of each citizen to a healthy environment, as well as on obligation to protect the environment of the country. The primary objective of the proclamation on environmental pollution control is to provide the basis from which the relevant ambient environmental standards applicable to Ethiopia can be developed, and to make the violation of these standards a punishable act. The proclamation states that the "polluter pays "principle will be applied to all persons. Under the proclamation the EPA is given the mandate for the creation of the function of the environmental inspectors. Article 7(1) of this proclamation gives the authority to ensure implementation and enforcement of environmental standards and related requirements to inspectors (to be assigned by EPA or regional environmental agencies). (See annex)

Proclamation 94/1994 for the conservation, development and utilization of forest
Proclamation no. 94/1994 includes provision for the conservation, development and utilization of forest resources. The objective of the proclamation is to provide the basis for sustainable utilization of the country's forest resources. The proclamation categorizes types of forest ownership (state, regional and private forests). It provides the power for designation, demarcation, and registration of forests to the Ministry of agriculture (now MoARD) and Regional Government. One of the objectives of establishment of State Forest is to conserve genetic resources and/or conserve the ecosystem. The law prohibits cutting and utilization of protected tree species such as Hagenia abyssinica (Koso Zaf), Cordia Africa (Wanza), Podocarpus falcatus (Zigiba), Prunus Africana (Tikur Inchet) and Juniperus procera (Yeabesha Tid) from either State or Regional Forests. Sub-article 4 of article 13 of this proclamation states that prior consultation and approval is required from the appropriate regional body in order to conduct construction of any projects within federal and regional forests. (See annex)

Research and Conservation of Cultural Heritage Proclamation (Proc. N°209/2000)
The following objectives have been given to the Research and Conservation of Cultural Heritage Authority by the proclamation no. 209/2000:

- Carry out scientific registration and supervision of Cultural Heritages so that, cultural Heritage as bearing witnesses to history, may be handed down from generation to generation;

- Protect Cultural Heritage against man-made and natural disasters;
- Enable the benefits of cultural Heritage assist in the economic and social development of the country; and
- Discover and study cultural Heritage.

Regarding the registration of Cultural Heritage, the proclamation states that:
- Any person who holds Cultural Heritage in ownership shall get registered it in accordance with the directives issued by the Minister,
- The Authority shall register Cultural Heritage using codes appropriate for their custody and preservation; and expense incurred in connection with the registration of cultural heritage shall be borne by the Authority.

Regarding conservation and restoration of Cultural Heritage, the proclamation states that:
- Any conservation and restoration work on Cultural Heritage shall be carried out with the prior approval of the authority and
- Where the expenses required for the conservation and restoration are beyond the means of the owner, the government may grant the necessary assistance to cover part of such expenses.

Concerning to removal of Cultural Heritage, the proclamation states that:
- Any immovable cultural heritage may not be removed from its original site without the prior written approval of the Authority,
- Any person shall notify the authority before removing registered movable cultural Heritage from its original site, and
- About trading Cultural Heritages, it says that: no person may engage in the purchase and sale of cultural heritage for commercial purposes.

Concerning fortuitous discovery of Cultural Heritage, it states that:
- Any person who discovers any Cultural Heritage in the course of excavation connected with mining explorations, building work, road construction or other similar activities or in the course of any other fortuitous event, shall forthwith report it to the Authority, and shall protect and keep it intact until the Authority takes delivery thereof, and the Authority upon receipt of report submitted, shall take appropriate measures to examine, take delivery of, and register the Cultural Heritage so discovered
- Where the Authority fails to take appropriate measures within six months, the person who has discovered the Cultural Heritage may be released from his responsibility by submitting a written notification with a full description of the situation to the regional government officials
- The Authority shall ensure that the appropriate reward is granted to the person who has handed over a Cultural Heritage discovered fortuitously and such person shall be entitled to reimbursement of expenses, if any, incurred in the course of discharging his duties.
- Any person who holds permit to conduct construction works in a reserved area and who discovers Cultural Heritage in the course construction activities shall stop construction and shall forthwith report it in writing to the Authority.

Proclamation to Promote the Development of Mineral Resources (Proc. N°52/1993)
The Proclamation No. 52/1993 is proclaimed to ensure the conservation and development of the mineral resources for the benefit of the people; and to ensure that prospecting, exploration and exploitation of mineral resources are carried out in accordance with the appropriate technology and sound principles of resource conservation and develop national expertise in the mining industry.

It further states that any person produces and use for non-commercial purpose without charge and with prior permission of the Licensing Authority, construction minerals for the construction and maintenance of roads, dams, airports, schools, hospitals and other non-commercial public works. However, the licensee shall take proper precaution not to interfere with the other legitimate occupants of the license area, the land covered by a lease and adjacent land. (See annex)

10.4 SECTORAL POLICIES AND GUIDELINES

The sectoral policies in this case refer to the policies and guidelines related to the Transport Sector.

Transport Proclamation (Proc. N°468/2005)

The Proclamation No. 468/2005 is proclaimed to ensure that:

- The economic and social development of the country requires that transport service be regulated to make it more competitive, safe and efficient;
- The transport sector has to be restructured in a manner to create favorable conditions for the smooth and effective implementation of the government transport policy;
- It has become necessary to clearly define the powers and duties of the executive organs at the federal and state levels with regards to transport.

The Proclamation is subdivided in four parts:

- Part one: general;
- Part two: transport authority;
- Part three: public commercial road transport activities and public commercial road transport associations;
- Part four: miscellaneous provisions.

Scope of application:

- To the use of any road within Ethiopia, vehicle using the roads and their drivers;
- To the use of any railways within Ethiopia, trains using the railways and their operators;
- To Ethiopia ships and seafarers; and
- to all matters related to land and water transport. (See annex)

Transport Policy of Ethiopia

The National Transport Policy of Ethiopia was issued in May 2020 by the Council of Ministers. The Policy is structured into five major parts. In relation to environmental and social consideration by the Policy, it is observed:

- In Section 1.6, major principles of the Policy, it is stated that the Transport Policy shall be in harmony with environmental (natural) ecology;
- In section 2.1.3, the Policy has made inputs of the following with due attention and consideration:
  - Climate-resilient Green Economy (CRGE);
  - Reduction in Greenhouse Gases (GHGs);
  - Forest development and protection (management);
  - Attention to energy-efficiency technologies;
- Section 2.1.8 of the Policy is dedicated to the Policy and the Natural Ecosystem
- Under section 4, Implementation Strategy of the Policy, Section 4.6 deals with Transport and the Environment

10.4.1 Road Sector Policies and Guidelines

Proclamation on Establishment of the Ethiopian Roads Authority

The Ethiopian Roads Authority (ERA) was established in 1951 through proclamation No.63/1963 as "Imperial Highway Authority" with responsibilities for the construction, improvement and maintenance of the Country's major road network. However, the Organization has undergone through different areas of jurisdiction and the current entity was re-established with Proclamation No. 80/1997 with major responsibilities of initiating policies,

determining design standards, road classification, short- and long-term plan preparation, preparation of feasibility studies and other studies as found appropriate, maintaining highways through appropriate body, contract management, enforce vehicle size and weight, training of manpower, determine the extent of land requirement for roads, uses free of charge material production sites, etc. The highest body in the management hierarchy is the Board of Management.

Ethiopian Roads Authority (ERA) Environmental and Social Management Manual (ESMM), 2008

ERA has issued this Environmental Manual for the road sub-sector to instruct different parties involved with road sector environmental activities. The main objective of the document is to provide specific guidelines on how to integrate environmental concerns associated with road works into planning, design and implementation. It is not a legal document, but rather an official guideline to serve the activities of the Ethiopian Roads Authority (ERA) and its relations with other organizations in environmental issues.

10.4.2 Carriage of Goods by Land

Proclamation N°547/2007

- The focus of proclamation () is mainly based on the following items:
  - freight transport services play vital role in enhancing our country's development, for the general growth of the trade service sector of the economy and for integration of the peoples of Ethiopia;
  - laws of our country governing any node of transport should be harmonized and interlinked to facilitate transport services and thereby play part in the economic development of our country;
  - the law governing carriage of goods by land enacted in the 1960 Commercial code of Ethiopia, in particular, the basis of liability, limitation of liability and other rights and obligations should have to be made compatible with the new enacted Multimodal transport of goods proclamation and thereby facilitate door-to-door transport services, and to this end amending the existing law has become necessary.
- Scope of application:
  - The provisions of this Proclamation shall apply to every contract for the carriage of goods by land and internal waters and if the carriage is undertaken for reward;

The provisions of this Proclamation shall apply also where carriage coming' within its scope is carried out by State or Government institutions;

  - Without prejudice to Sub-Article (1) (2) of this Article, the provisions of this Proclamation shall not apply to:
    - Carriage performed under the terms of postal relations
    - Household removal.
  - For the purposes of this Proclamation the carrier shall be responsible for the acts and omissions of his agents and servants and of other persons of whose services he makes use for the performance of the carriage, when such agents, servants or other persons are acting within the scope of their employment, as if such acts or omissions were his own.

10.5 ENVIRONMENTALLY SENSITIVE AREAS IN ETHIOPIA

Simien Mountains National Park

This national park of 17,900ha occupies a broad undulating plateau of open grassy plains, and includes a wide altitudinal range between 1900m and 4624m, the highest peak in Ethiopia. The World Heritage Site covers an area of 22,000ha. Thepark was set up primarily to conserve the resident population of Walia ibex Capra walie, the spectacular scenery and principal catchment area of the Mayshasha River. Vegetation is a complex of Afro-alpine woodlands, heath forest and montane moorland, with high levels of plant endemism.

Abijatta-Shalla Lakes National Park

Over half of this park of 88,700 ha consists of lakes, including the shallow Lake Abijatta (19,600ha) and 260m deep Lake Shalla (43,200ha). The latter is an important wetland. Over 300 bird species occur, including lesser flamingo and a large breeding colony of threatened great white pelicans. Vegetation consists mainly of Acacia and Ficus savanna, with small areas of riverine forest; some lakes are edged with a nearly continuous bank of reeds.

Awash National Park

This is a 75,600 ha park completely surrounded by the Awash West Wildlife Reserve, and is located at the foot of the Shoa escarpment on the eastern edge of the Rift Valley where this opens out into the Danakil plains. The plains are traversed by the Awash River, and most of the area is covered by open, semi-arid savanna. In the south-west is a dormant volcano. Mount Fantalle (2005m), and hot springs surrounded by palm forest exist. Large herds of ungulates use the area, and threatened mammals include Grevy's zebra Equus grevyi, Swayne's hartebeest Alcelaphus buselaphus swaynei, leopard and cheetah. Lion occur, and the park also supports the Somali wild ass.

Babile Elephant Sanctuary

Covering an area of 698,200ha, this sanctuary was established in 1970 and was formerly known as Harar Elephant Sanctuary. Part has been proposed as a World Heritage site covering 650,000, 400km west of Addis Ababa between 1000m and 1788m above sea level. Semi-arid xerophilous woodlands are inhabited by elephant, possibly a distinct subspecies Loxodonta africana orleansi.

Bale Mountains National Park

This is a high, rugged, once-glaciated mountain area of 247,100ha completely surrounded by Bale Wildlife Reserve, at elevations up to 4317m. It is an important water catchment area for four major rivers, and includes a high-altitude plateau dotted with permanent lakes. The park's main purpose is to provide a refuge for mountain nyala Tragelaphus buxtonii, and to preserve the area's outstanding natural beauty. The vegetation is extremely varied, ranging from Afro-alpine moorland at high altitudes (the largest area in Africa) through ericaceous moorlands and juniper-Hagenia forest to grassland and marshes.

Kuni-Muktar Mountain Nyala Sanctuary (lUCN Category II)

Montane dry evergreen forest, dominated by Juniperus/Podocarpus, high altitude grassland and heath. Important for the conservation of Mountain Nyala and Menelik's Bushbuck.

Mago National Park

Part of the Omo-Tama-Mago complex of contiguous protected areas, Mago National Park covers an area of 216,200 ha. Much of the park is a flat valley floor where open broadleaf savanna predominates, whilst thorn bush growing on the dryer valley floor merges into riverine forest in the south. The Park was created mainly to conserve the large numbers of plains wildlife in the area, and is particularly important for buffalo and Beisa oryx. Endangered mammals include

elephant, leopard and African wild dog. Access is difficult, and recent information on the status of the area is scarce.

Nechisar National Park

Covering 51,400 ha this park primarily comprises grassy plains transected by several rivers, areas of rocky ridges and Lake Haro Robi. Some savanna woodland and lakeshore riverine forest occurs, as does highland forest in the east. The area was set up because of its prolific wildlife.

Omo National Park

Part of the Omo-Tama-Mago complex of contiguous protected areas, Omo covers an area of 406,800ha. The park is dominated by three open grassy plains, separated by rocky ridges and drained by tributaries of the Omo. The vegetation is mainly Acacia scrub savanna. The park was set up to preserve this extensive area of wilderness and the prolific plains wildlife, especially common eland and elephant. There are large herds of buffalo, and giraffe, leopard, lion and African wild dog occur.

Senkelle Swayne's Hartebeest Sanctuary

This 5400ha area consists mainly of open grassland with some Acacia stands, and was set up to save the most viable population of the endemic and endangered Swayne's hartebeest Alcelaphus buselaphus swaynei, which numbered over 2000 in 1989.

Yabello Sanctuary

Established in 1985, this sanctuary covers 253,700ha about 550km south of Addis Ababa. Altitudes range firom 1430m to 1800m. Situated in the savanna of the south-east highlands, it was established to protect Swayne's hartebeest Alcelaphus buselaphus swaynei.

Yangudi-Rassa National Park

This is a low-lying area of 473,100ha located between Gewane and Mille Sardo wildlife reserves and Afdem-Gewane Controlled Hunting Area. Most of the area is flat, and covered with open grassland, savanna and riverine forest. It was set up primarily to conserve a population of Somali wild ass. Other mammals include Grevy's zebra, cheetah and leopard.

10.5.1 Other Managed Areas

The following Table depicts the list of other managed environmentally sensitive sites in the country.

Protected Area	Area, ha	Remark
Abeiti Gibe National Forest Priority Area	10,000	
Adaba Dodola Lajo National Forest Priority Area	59,000	
Afdem-Gewane Controlled Hunting Area	593,200	Borders with Yangudl Rassa National Park in Hararghe and Wello Regions
Akobo Controlled Hunting Area	504,900	
Akobo Gog National Forest Priority Area	218,000	
Alledeghi Wildlife Reserve	183,200	Contiguous to Awash National Park and Awash West Wildlife Reserve,
Aloshe Batu National Forest Priority Area	40,000	
Anferara Wadera National Forest Priority Area	50,000	
Arba Gugu National Forest Priority Area	21,000	
Arero Yabelo National Forest Priority Area	40,000	
Arsi Controlled Hunting Area	l,087,600	Podocarpus-Juniperus forest

Protected Area	Area, ha	Remark
Awash West Controlled Hunting Area	913,600	It comprises grasslands important for game, and Pistacia chinensis woodlands.
Awash West Wildlife Reserve	178,100	Completely surrounds Awash National Park and is contiguous to Alledeghi Wildlife Reserve. It includes grasslands which are important for game, and Pistacia chinensis woodlands
Babiya FoUa National Forest Priority Area	74,000	
Bale Controlled Hunting Area	300	
Bale Wildlife Reserve (Bale Mountains)	176,600	With a particular need to conserve montane forest in Bale
Belete Gera National Forest Priority Area	174,000	
Bonga National Forest Priority Area	52,000	
Borana Controlled Hunting Area	4,536,600	
Bore National Forest Priority Area	50,000	
Boyo Swamp Controlled Hunting Area		
Bulki Malakoza National Forest Priority Area	ll,000 ha	
Butajira National Forest Priority Area	15,000	
Butugi Melka Jebdu National Forest Priority Area	19000	
Chato Sengi Dengeb National Forest Priority Area	63,000	
Chercher and Arba Gugu Controlled Hunting Area	304,500	
Chew Bahr Wildlife Reserve	421,200 (Includes the seasonal 112,500ha Chew Bahr Lake)	Within the wildlife reserve in Acacia-*Combretum* scrub country
Chillalo-Gallena National Forest Priority Area	22,000	
Chillimo Gaje National Forest Priority Area	22,000	
Dabus Valley Controlled Hunting Area	212,700	
Deme Laha National Forest Priority Area	30,000	
Denkoro National Forest Priority Area	8000	
Eastern Hararghe (Harar-Wabi Shebelle) Controlled Hunting Area	2,378,800	
Erer-Gota Controlled Hunting Area	238,600	
Gambella National Park	506,100	Deciduous woodland predominates, some of it very dense, whilst other areas comprise open savanna, grassland and marshes. The Park is of particular importance for the migration of large herds of white-eared kob and Nile lechwe Kobus megaceros. Threatened mammals include a remnant population of elephant and also black rhinoceros, leopard and cheetah. Lion occurs.
Gara Muleta National Forest Priority Area	7000	
Gewane Wildlife Reserve.	243,900	Borders with Yangudi Rassa National Park in Hararghe and Welo regions, 350km north of Addis Ababa
Godere National Forest Priority Area	160,000	
Jikawo Controlled Hunting Area	337,500	Borders with north of Gambella National Park

Protected Area	Area, ha	Remark
Maze Controlled Hunting Area		
Menagesha Suba National Forest Priority Area	15,000	
Shire Wildlife Reserve	75,300	
Arero Forests		Forest patches dominated by Juniperus procera, at an elevation of about 1800m in the upper Dawa and Ganale Dorya valleys near Arero and Neghelli. Prince Ruspoli's turaco Tauraco ruspolii is endemic to these forests
Asaita Lakes		These consist of the Gamari, Gargori, Afambo and Bario Lakes, north-west of Lake Abbe. Riverine forest supports bushpig, whilst Nile crocodile, hippopotamus and water birds occur in and around the lakes
Asale Lakes	7000	125m below sea-level in the Danaldl (Afar) Depression, these consist of two lakes, 2.5km apart, fed by underground water; their biology is little known
Hawasa Lake	12,000	It supports extensive fringing marshes, wet grassland and reed beds, and is an important bird habitat, favourable for flamingo
Chamo Lake	45,000	It supports extensive lakeshore marshes, swampy woodlands and wet grasslands. Dominant lake fish include Bagrus docmac and LcUes niloticus, whilst there are some hippopotami, a large population of Nile crocodile and a rich avifauna, including flamingo.
Danakil Depression		A gap in the system of faunal protection occurs here
Lake Abbe	34,000	The biology of the lake is unknown, and there is little direct human impact apart from water diversion
Lake Afdera	12,500	It is saline and fed by subterranean thermal water. Its biology is unknown, and it is little used by humans
Lake Langano	24,000	There is commercial fishing and a hotel business
Lake Tana	315,600	It supports numerous species of fish, including the endemic Clarias tsanensis. Birdlife is varied, and small mammals such as otter occur. The lake is fished, and used for recreation
Menagasha State Forest, National Park	3460	Situated on the south-west slopes of Mt Wachacha in the Shoa region, 30km south-west of Addis Ababa. Limited areas of dry montane, coniferous, mixed broadleaved and Hagenia abyssinica plateau forests occur. Fauna includes spotted hyena, colobus monkey, common and black-backed jackals, and aardvark
Zeway Lake	65,400	Its margins are flat and swampy, except on the south and south-eastern sides. The lake is important for flamingo and pelican. There is commercial fishing

10.5.2 Areas of protected areas

The summary of Protected Areas including: **Controlled Hunting Areas, National Parks, Sanctuaries, Wildlife Reserves, and World Heritage Sites**, is presented, along with a locational map, as shown hereunder:

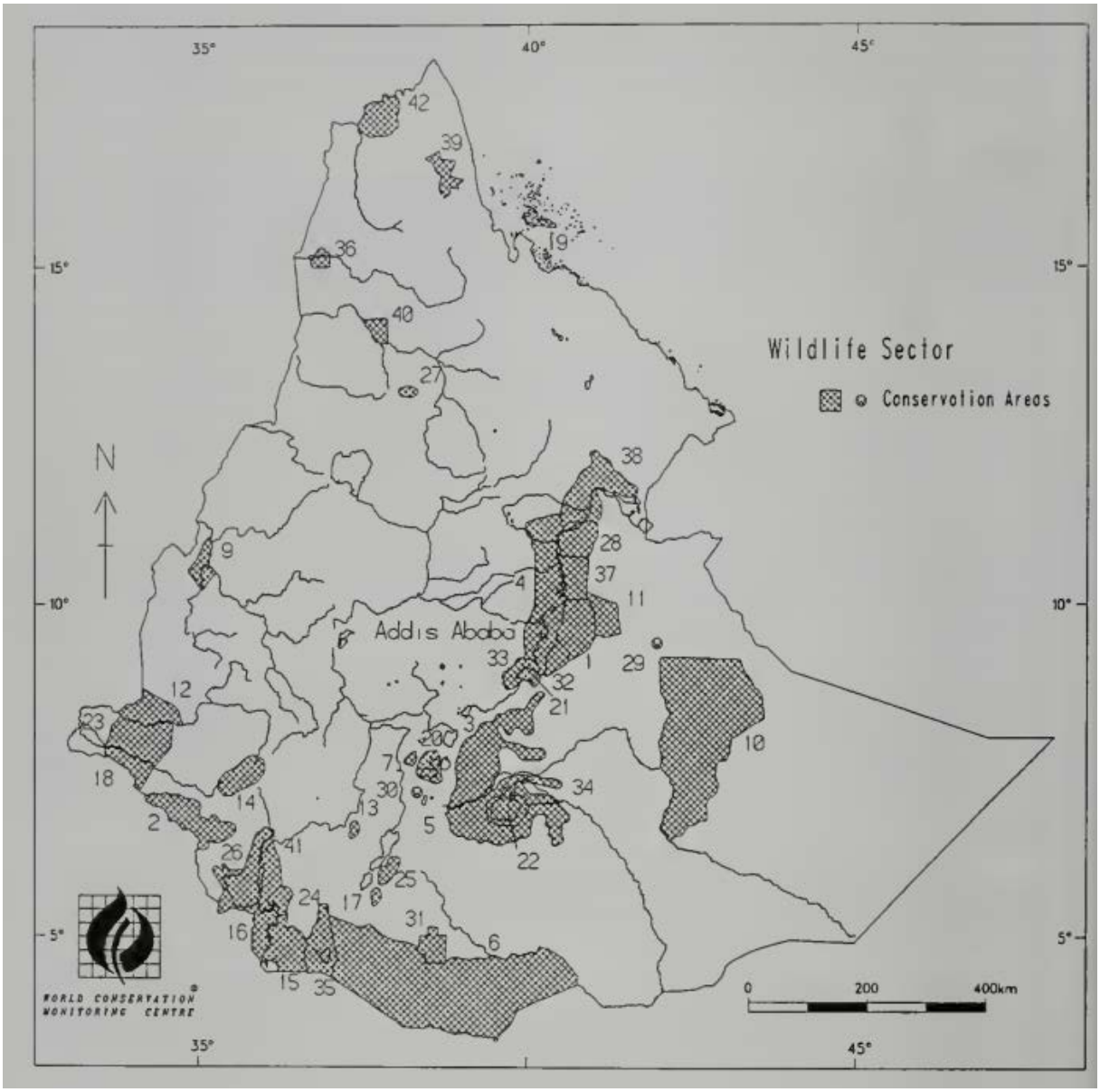
Figure 52: Summary of Ethiopian [Environmentally] Protected Sites

ETHIOPIA - PROTECTED SITES

National/international designations

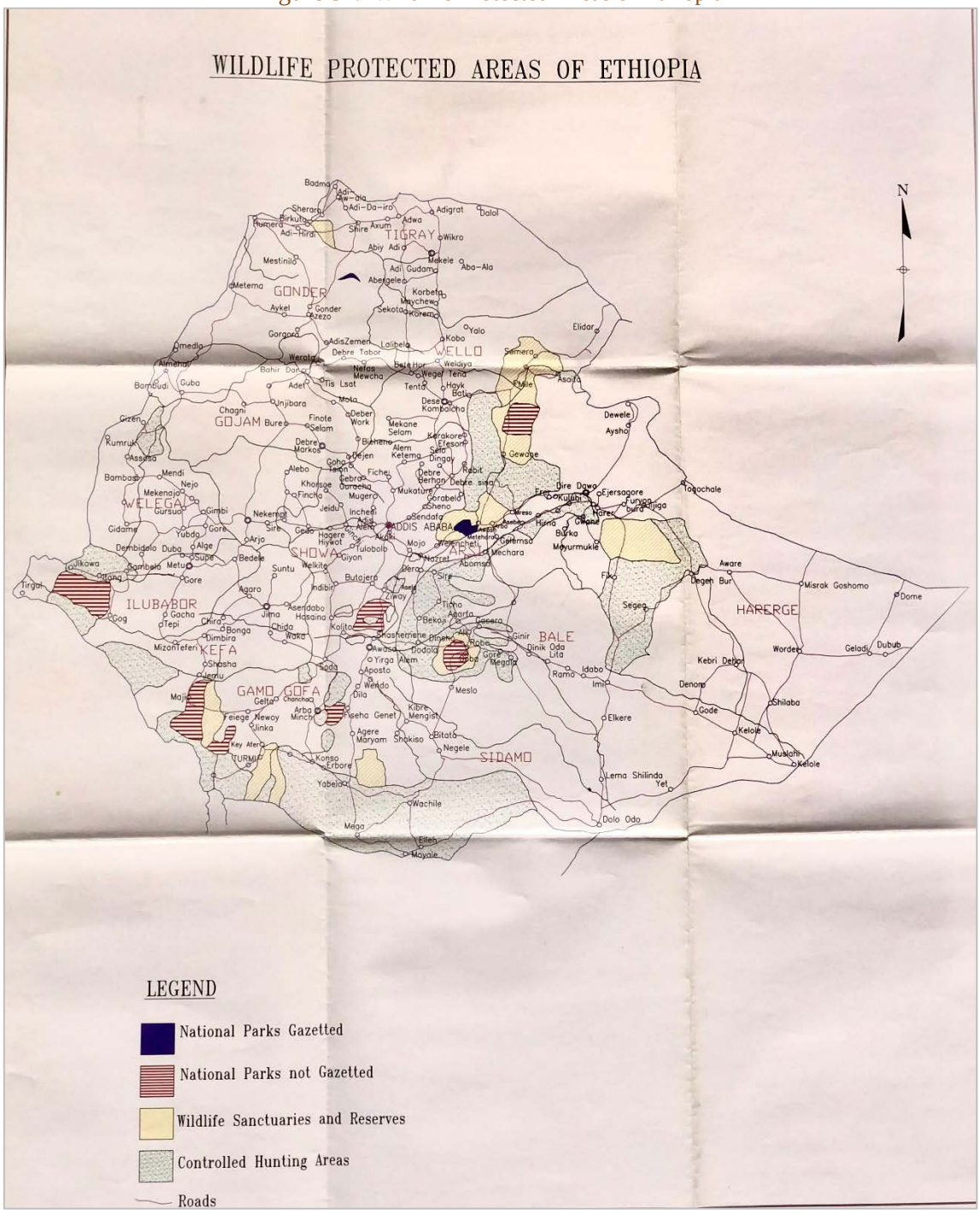
Name of area and map reference (see Fig. 1.1)	Management area (ha)	Year notified
Controlled Hunting Areas		
1 Afdem-Gewane	593,200	1973
2 Akobo	504,900	1973
3 Arsi	1,087,600	1973
4 Awash West	913,600	1973
5 Bale	966,300	1973
6 Borana	4,536,600	1973
7 Boyo Swamp		1983
8 Chercher & Arba Gugu	304,500	1973
9 Dabus Valley	212,700	1973
10 Eastern Hararghe (Harar-Wabi Shebelle)	2,378,800	1973
11 Erer-Gota	238,600	1973
12 Jikao	337,500	1973
13 Maze		1983
14 Mizan-Teferi		1985
15 Murle	417,200	1973
16 Omo West	456,100	1973
17 Segen Valley		1983
18 Tedo	234,700	1973
Marine National Park		
19 Dahlac	200,000	1969
National Forest Priority Areas		
National Parks		
20 Abijatta-Shalla Lakes	88,700	1970
21 Awash	75,600	1966
22 Bale Mountains	247,100	1969
23 Gambella	506,100	1974
24 Mago	216,200	1975
25 Nechisar	51,400	1973
26 Omo	406,800	1966
27 Simen Mountains	17,900	1966
28 Yangudi Rassa	473,100	1976
Sanctuaries		
29 Babile Elephant	698,200	1970
Kuni-Muktar Mountain Nyala		1990
30 Senkelle Swayne's Hartebeest	5,400	1972
31 Yabello	253,700	1985
Wildlife Reserves		
32 Alledeghi	183,200	1973
33 Awash West	178,100	1973
34 Bale	176,600	1973
35 Chew Bahr	421,200	1973
36 Gash-Setit	70,900	1959
37 Gewane	243,900	1973
38 Mille-Sardo	876,600	1973
39 Nakfa	163,900	1959
40 Shire	75,300	1973
41 Tama	326,900	1973
42 Yob	265,800	1959
World Heritage Sites		
Aksum		1980
Fasil Ghebbi, Gondar region		1979
Lower Valley of the Awash		1980
Lower Valley of the Omo		1980
Rock-hewn churches of Lazibella		1978
Simen National Park	22,000	1978
Tiya		1980

Figure 53: Ethiopia: Protected Ecologically Sensitive Sites



An alternative Wildlife Protected Areas map (relatively recent and produced by a Consultant) is also shown below.

Figure 54: Wildlife Protected Areas of Ethiopia



11 ANNEXES

11.1 ANNEX 1: INTEGRATED MODEL ASSIGNMENT- GO AHEAD

11.2 ANNEX 2: INTEGRATED MODEL ASSIGNMENT – NEXT GENERATION

11.3 ANNEX 3: INTEGRATED MODEL ASSIGNMENT – LIMIT TO GROWTH