To Ministry of Economy, Trade and Industry

Feasibility Study Project of Overseas Development for High-Quality Energy Infrastructure in FY2020 (State of Eritrea: Study on Domestic Electric Power Development Project)

The Final Report

March 2021
Toyota Tsusho Corporation

Agenda

1. Background and Significance of the Study
2. Overview of the Study
3. Overview of Eritrea
4. Existing Power Facilities
5. Current Development Plans
6. Electricity Demand Forecast
7. Roadmap for Power Generation Development
8. Development Costs
9. CO2 reduction

Photographed with the President of Eritrea when Toyota Tsusho visited Eritrea in January 2020.

1. Background and Significance the Study

＜Background＞

The State of Eritrea (hereinafter “Eritrea”) is located on the Horn of Africa and is an important transportation hub in the East Africa region. The country’s infrastructure has deteriorated over many years of war, including the Eritrean War of Independence against the Federal Democratic Republic of Ethiopia (hereinafter “Ethiopia”) from 1962, and a border conflict with Ethiopia from 1998 to 2018. Eritrea is now in a position to promote various infrastructure developments after the signing of a peace treaty with Ethiopia. However, there was no feasible national development plan and infrastructure development remained untouched. Primary energy sources in Eritrea are currently limited to biomass, such as firewood, and fossil fuels, which are totally dependent on imports. Over the medium- to long-term, there is a significant need for renewable energy infrastructure development, including photovoltaic, wind, and geothermal power generation.
When Representatives of Toyota Tsusho Corporation met with President Afwerki when visiting Eritrea on business in January 2020, he indicated the necessity of feasibility studies (hereinafter “FS”) covering the full scope of development in each sector, and that the country will proceed with various individual projects after that. Therefore, With the country’s situation and the wishes of the Eritrean President in mind, we decided to start by analyzing the state of the electric power infrastructure (including electric power development) as an important piece of infrastructure supporting the lives of Eritreans. Based on this analysis, we would then formulate the Roadmap for power generation development(hereinafter ‘Roadmap’).

＜Significance＞

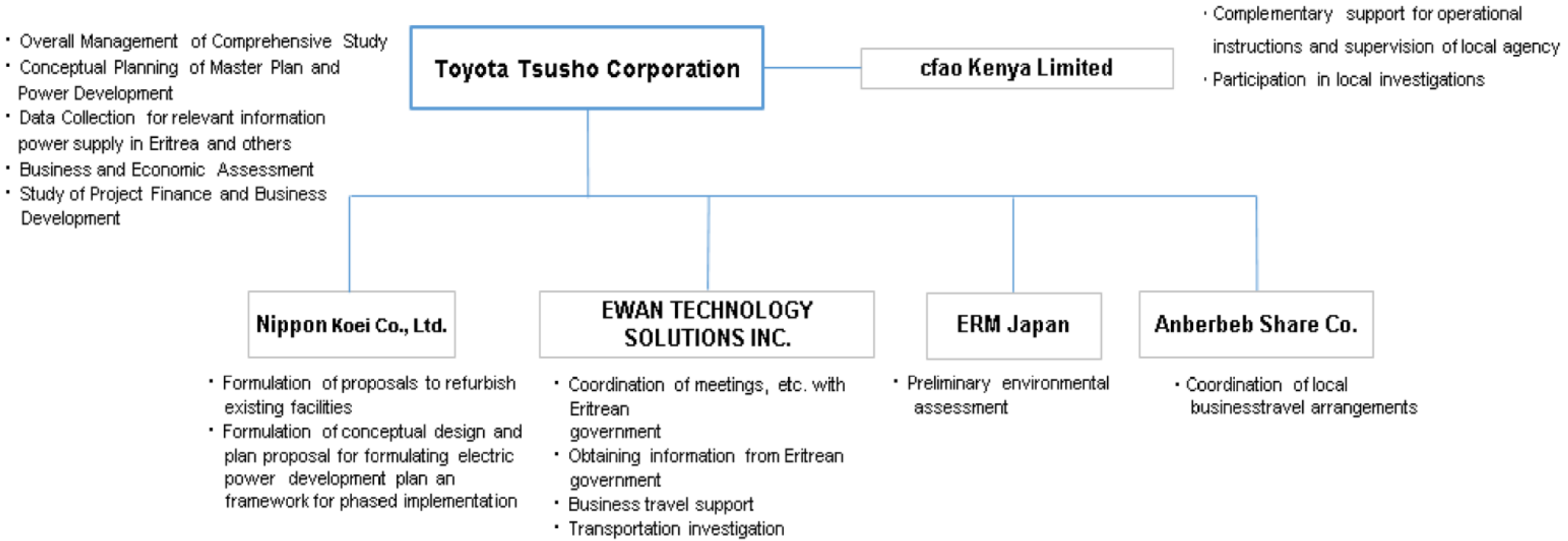
This project is based on the philosophy of the “Free and Open Indo-Pacific” and the aim is to contribute to rapid economic development in Eritrea by formulating the ‘Roadmap’ and prioritizing development activities based on the Roadmap according to urgency and importance.
It is also expected to act as a stepping-stone for Japanese companies to develop and expand business in Eritrea, including the export of infrastructure systems.

2. Overview of the Study

＜Purpose of the Study＞

- ✓ Formulation of the 'Roadmap' based on the energy situation in Eritrea.
- ✓ Proposal of priority projects in short-term (3-5 years) / medium-term (6-10 years) / long-term (11 years-) based on the 'Roadmap'.

＜Study Team＞



2. Overview of the Study

＜Overview of the Study＞

Analysis of the existing power facilities

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Electricity Demand Forecast

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Current Development Plans

↓

Roadmap for Power Generation Development

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Proposal of priority projects in short-term / medium-term / long-term

Based on the concept of **' Best Energy Mix'** policy that combines the thermal power generation base load with the renewable energies that the Eritrean government wants to adopt

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2. Overview of the Study

＜Study Item and Schedule＞

VC: Virtual Conference

Study Items	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1. Electricity Supply and Demand								
1) Geographical Data								
2) Law and Regulations				VC				
3) Grid Map				VC				
4) Substations and Grid Lines				VC				
5) Distribution Lines				VC				
6) Existing Energy Plants(Thermal/ Wind/ Solar PV/ Others)				VC		VC	VC	
2. Potential in Renewable Energy								
1) Solar PV				VC				
2) Wind				VC				
3) Geothermal				VC				
3.Energy Development Plan								
1) Demographical Data								
Urban and Rural								
2) Future Demand in Electricity				VC				
3) **Short Term Plan**								
Rehabilitation or Upgrade of Existing;						VC	VC	
- Power Plant(s)						VC	VC	
- Substation(s)						VC	VC	
- Distribution Lines						VC	VC	
4) **Medium Term Plan**								
- Solar PV						VC	VC	
- Thermal						VC	VC	
5) **Long Term Plan**								
- Geothermal								
- Wind						VC	VC	
4. Expected Challenges in Development								
1) Importation Material								
- Logistics			VC				VC	
- Taxations								
2) Construction								
- Contractors							VC	
- Equipment							VC	

3. Overview of Eritrea

- **Area** : 11.76 million square kilometers
- **Capital** : Asmara
- **Population** : Approximately 5.5 million people (African Development Bank, 2017)
- **Population growth rate** : 2.4% (African Development Bank, 2017)
- **Electrification rate**: 32% (Eritrea National Energy Policy,2018)
- **Power composition ratio** (GWh base, grid connection):

  (Thermal power) Approximately 96%: (Renewable energy) Approximately 4% (EEC, 2019)

- **Power related organizations**
  - —Ministry of Energy and Mines: responsible for formulation and implementation of energy-related policies, laws, and regulations, formulation and implementation of development plans
  - —Eritrean Electric Corporation(EEC): responsible for managing facilities for generating, transmitting, and distributing electric power.

3. Overview of Eritrea

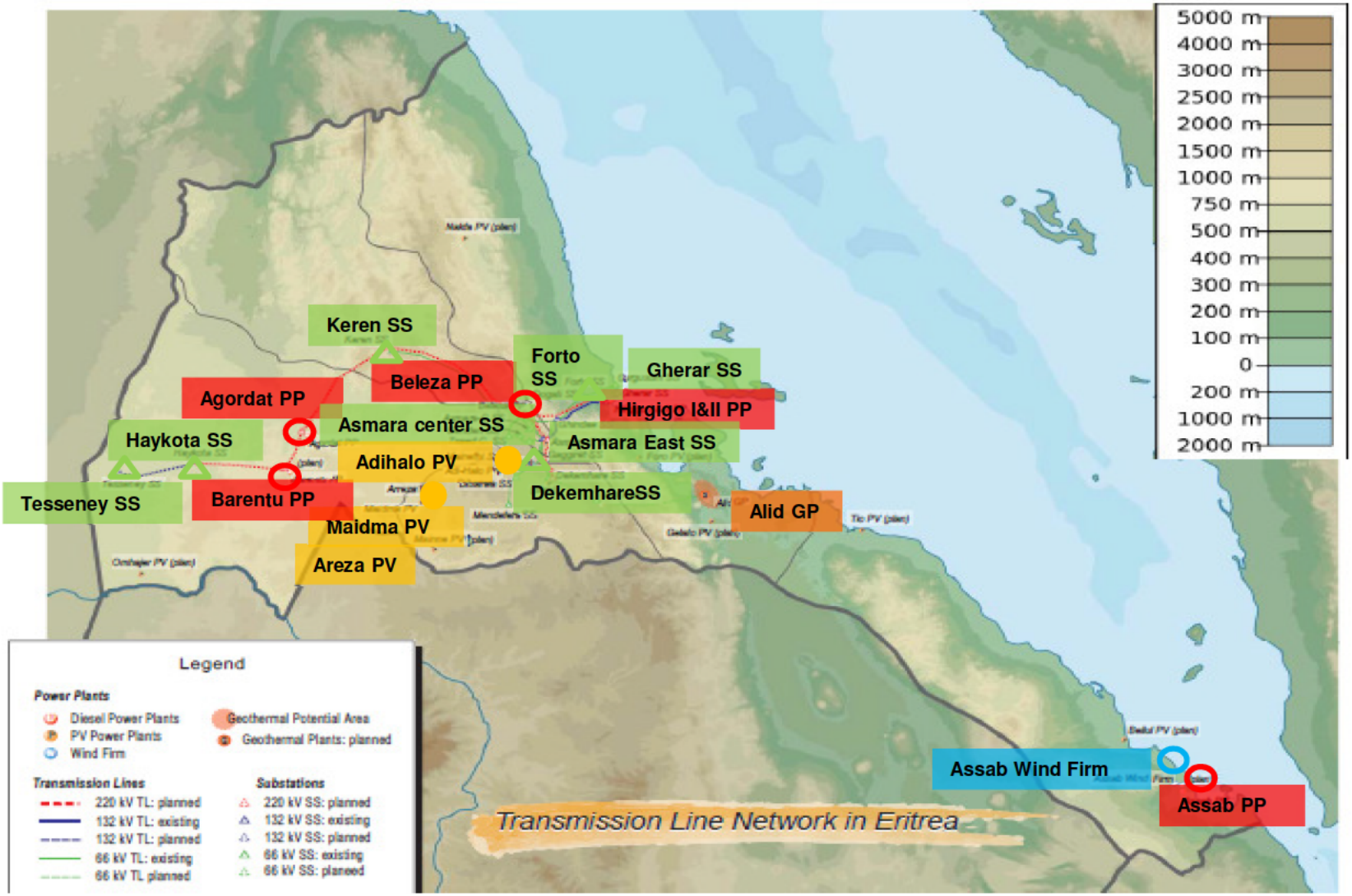
Figure 1:Map of Eritrea

(Source : National Energy Development Framework,2009)

4. Existing Power Facilities

＜Overview of Power Facilities＞

- The power network in Eritrea has a major national transmission network called the “Interconnected System (ICS)” and an independent system called the “Self-contained Systems (SCS)”, which is not connected to the ICS.
- The total installed capacity in 2018 was 222 MW, but the firm capacity was 122 MW（Eritrea National Energy Policy, 2018）



（ Source ： EEC ）　Figure 2:Location of existing and planned electric power facilities in Eritrea

4. Existing Power Facilities

<Thermal Power Plants>

- Only Hirgigo Power Plant(PP)and Beleza PP are connected to the ICS, which comes under the jurisdiction of the EEC.
- All existing thermal power facilities in Eritrea are diesel generators accounting for more than 90% of the total installed capacity.
- Hirgigo PP is a main power plant in Eritrea, located along the Red Sea in Massawa area. There are six units of low-speed diesel engine generator fueled by heavy oil in Hirgigo PP.

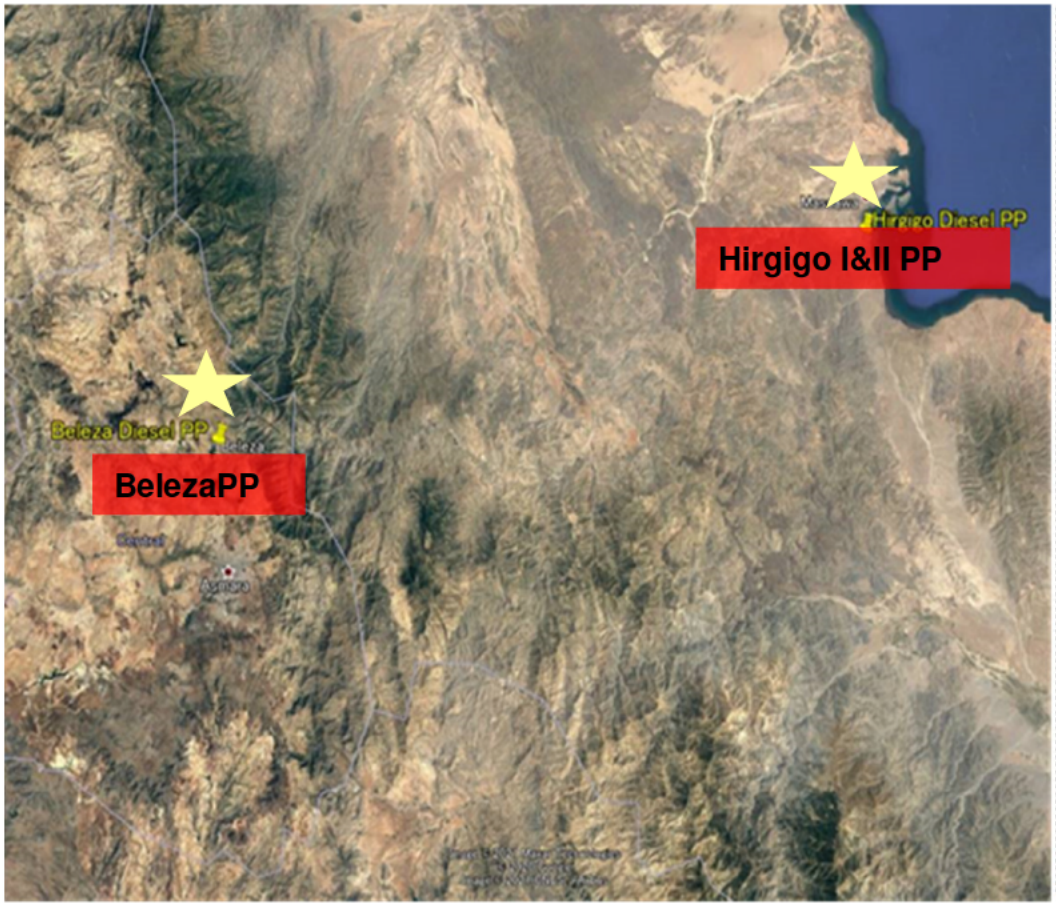


Figure 3: Locations of Major Thermal Power Plant
(Source: Prepared by the Study Team based on Google Earth)

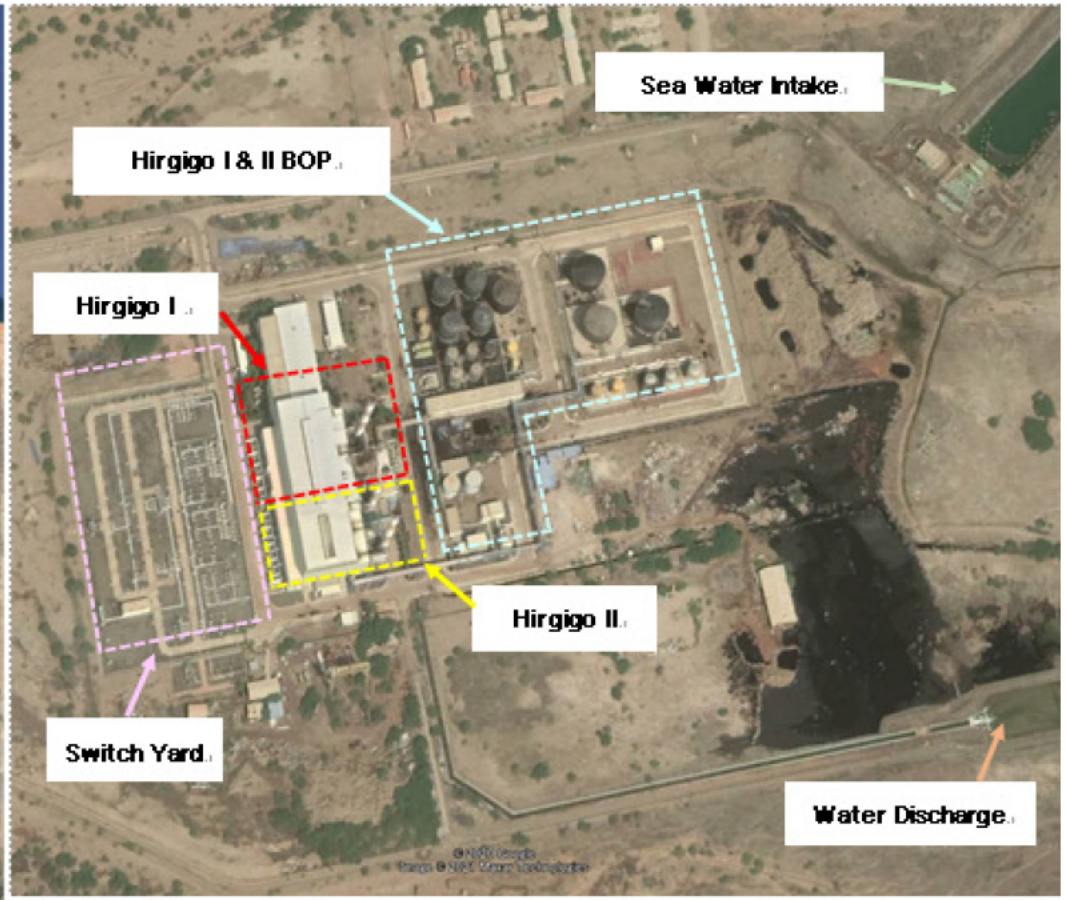


Figure 4:Layout of Hirgigo I & II Power Station
(Source: Prepared by the Study Team based on Google Earth)

4. Existing Power Facilities

- Table1 shows rated capacity and the specifications of Hirgigo PP.
- Hirgigo I needs to be repaired because its available power generation capacity is much lower than the rated power generation capacity.

Table 1:Rated Capacity Specifications of Hirgigo PP

	Engine	Rated Capacity (Gross) [MW]	Available Capacity [MW]	R.P.M	Engine Type	Fuel	COD	Manufacturers
Hirgigo I	No.1	22.68	12.00	142.9	MAN B & W, 12K60MC-S	HFO 380 - 420 Cst, Light Fuel	2003	DOOSAN Heavy Industies, Korea
	No.2	22.68	0	142.9				
	No.3	22.68	0	142.9				
	No.4	22.68	0	142.9				
Hirgigo II	No.1	23.05	23.00	150.0			2017	QINGDAOHAI XI MARINE DIESEL CO. Ltd,v China
	No.2	23.05	23.00	150.0				

(Source: Prepared by the Study Team based on the materials provided by Eritrea side)

<Rehabilitation required for Hirgigo I>

- ✓ Engine overhaul
- ✓ Replacement of spare parts
- ✓ DCS upgrade etc.

4. Existing Power Facilities

＜Photovoltaic (PV) Power Plants＞

- There are three PV power plants connected to the ICS in Eritrea, including under construction, with outputs ranging from 2.0 MW to 4.0 MW.（Table 2）
- Each of the PV plants is relatively new. Even Asmara East PV power plant which is the oldest plant having been in operation for only two years. With proper maintenance, the plants can continue to operate for 25 years, which is the general durable life.

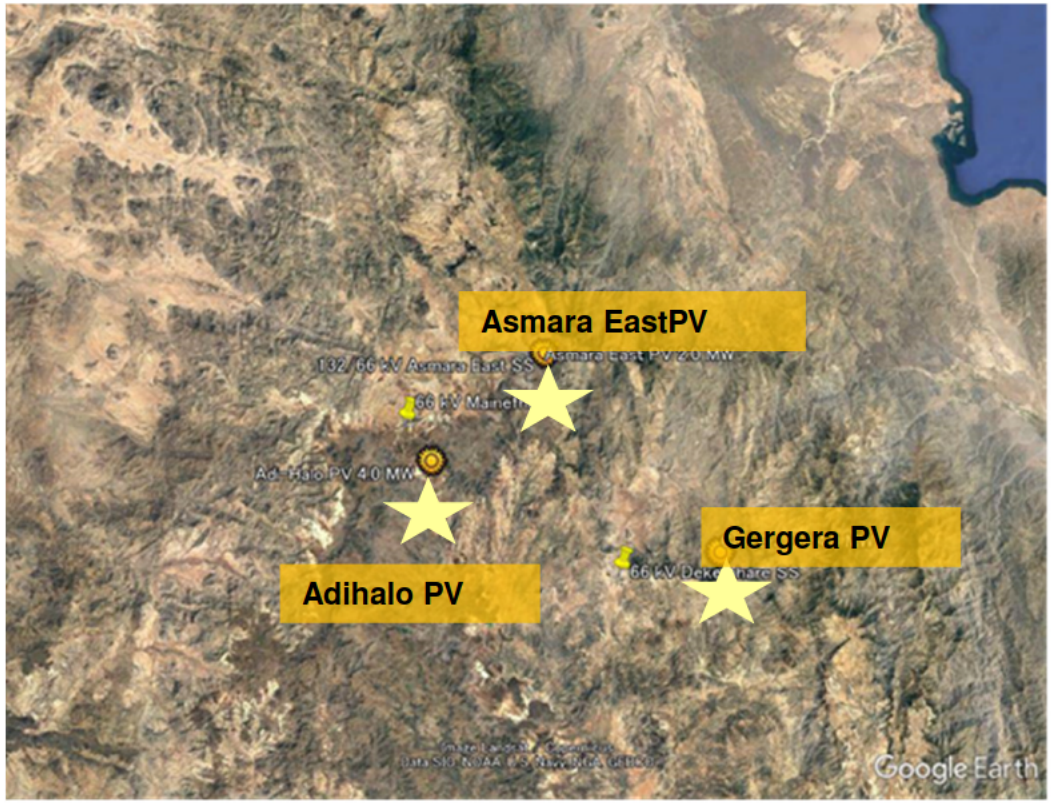


Figure 5:Locations of PV Plants connected to the ICS

(Source: Prepared by the Study Team based on Google Earth)

Table 2:Existing and Under Construction PV Plants of ICS

Name	Installed Capacity	Coom. year	Existing /planned	Owner (EEC/IPP)
Asmara East	2.0 MW	2018	Operational/ existing	EEC
Adihalo	4.0 MW	2020	2 MW operational 2MW under-construction	IPP
Gergera	4.0 MW	N/A	Under construction	IPP
Total	10.0 MW			

(Source: Prepared by the Study Team based on the materials provided by Eritrea side)

4. Existing Power Facilities

＜Wind Power Plants＞

- The existing wind turbines was installed under the "Wind Energy Applications in Eritrea" Project financed by GEF(Global Environmental Facility / UNDP/GoE(Government of Eritrea)
- The project includes Assab wind firm, with an output of 750 kW, and seven small-scale wind turbines to supply electricity to local factories and residents. However, all these wind turbines are out of service. Especially, Assab wind firm operated only for two years from 2010, but is now out of service due to a lack of spare parts.（Table3）

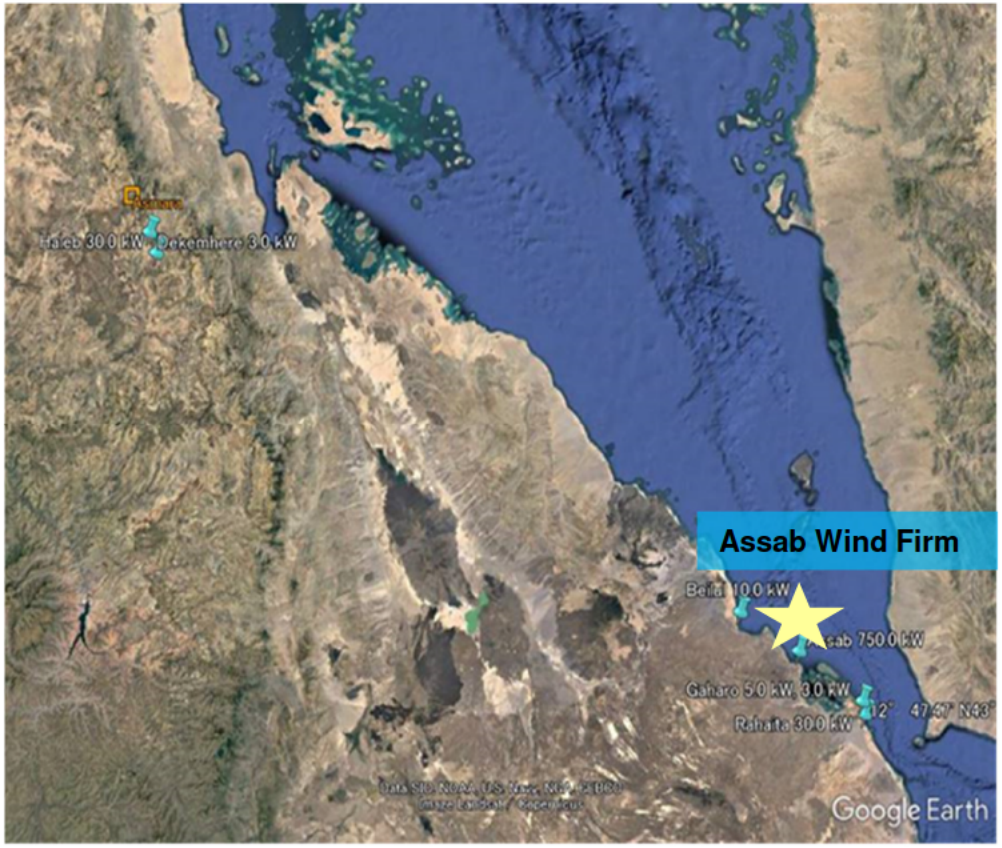


Figure 6： Location of Existing Wind Power Plants
(Source: Prepared by the Study Team based on Google Earth)

Table 3:Existing Wind Power Plants

Name	Location	Installed Capacity	Coom. Year	Existing /planned	Owner (EEC/IPP)	ICS / SCS	Purpose
Berasole	-	30.0 kW	N/A	Not Commussioned	EEC	SCS	Household electricity, icemaking, desalination
Rahaita	Rahaita	30.0 kW	N/A	Not Commussioned	EEC	SCS	Household electricity, services
Haleb	Segheneyti	30.0 kW	N/A	Not Commussioned	EEC	SCS	Fish processing plant
Beilul	Beilul	10.0 kW	N/A	Not Commussioned	EEC	SCS	Household electricity, icemaking, services
Gaharo	Habero	5.0 kW	N/A	Not Commussioned	EEC	SCS	Household electricity, services
Gaharo	Beilul	3.0 kW	N/A	Not Commussioned	EEC	SCS	Water pumping
Dekemhere	Dekemhere	3.0 kW	N/A	Not Commussioned	EEC	SCS	Water pumping
Assab	Assab	250.0 kW 250.0 kW 250.0 kW	2010	Existing (inactive undermaintenance)	EEC	SCS	Grid support
Total		861.0 kW					

(Source: EEC, Wind and Solar Monitoring Network Summary Report, Kibret Solomon)

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5. Current Development Plan

National Energy Development Framework（2009）

- Prepared by Ministry of National Development. The framework for energy development in the country (current energy situation, future prospects, etc.) is described.
- 'Long term, however, Eritrea's renewable energy resource potential could provide a basis for improving the lives of its citizens, enhancing relationships with neighboring countries, and offering significant opportunity for economic development.' (partial excerpt)

Eritrea National Energy Policy（Draft)（2018）

- Prepared by the Ministry of Energy and Mines. The overarching goal of the ENEP-2018 is to provide access to affordable, reliable, sustainable, and modern energy for all and to provide the energy infrastructure to support the achievement of the Government of Eritrea's social and economic objectives.
- 'Increase the electrification rate across the whole country and supply 20% of electric power demand through renewable energies by 2030'(partial excerpt)
- 'A deep commitment to moving away from excessive reliance on fossil fuels for diesel and other power generation, which account for more than 90% of currently installed power generation capacity, and instead to actively pursue renewable energies like photovoltaic, wind, and geothermal power generation.' (partial excerpt)

6. Electricity Demand Forecast

Table 4:Electricity Power and Energy Demand Forecast

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	(average)
ICS demand in MW	188.0	197.9	208.1	230.2	243.3	257.4	282.5	298.7	316.1	334.8	335.5	377.3	
growth ratio		5.3%	5.2%	10.6%	5.7%	5.8%	9.8%	5.7%	5.8%	5.9%	0.2%	12.5%	6.6%
ICS demand in GWh	1,010.4	1,060.7	1,112.7	1,243.0	1,307.9	1,377.8	1,523.2	1,603.5	1,689.8	1,782.7	1,884.5	1,994.0	
growth ratio		5.0%	4.9%	11.7%	5.2%	5.3%	10.6%	5.3%	5.4%	5.5%	5.7%	5.8%	6.4%

(Source : EEC)

- This demand forecast, which was officially provided by the Eritrean side, targets until 2030 and there is no data after 2031.Therefore, in consultation with the Eritrean side, the Study Team has agreed to accept the demand projections as conditional in the preparation of the electric power development Roadmap.
- This forecast shows the electricity demand within ICS of the EEC and does not include the demand for SCS.

7. Roadmap for Power Generation Development

Formulate the 'Roadmap' based on '**Best Energy Mix**' policy that combines the thermal power generation base load with the renewable energies that the Eritrean government wants to adopt.

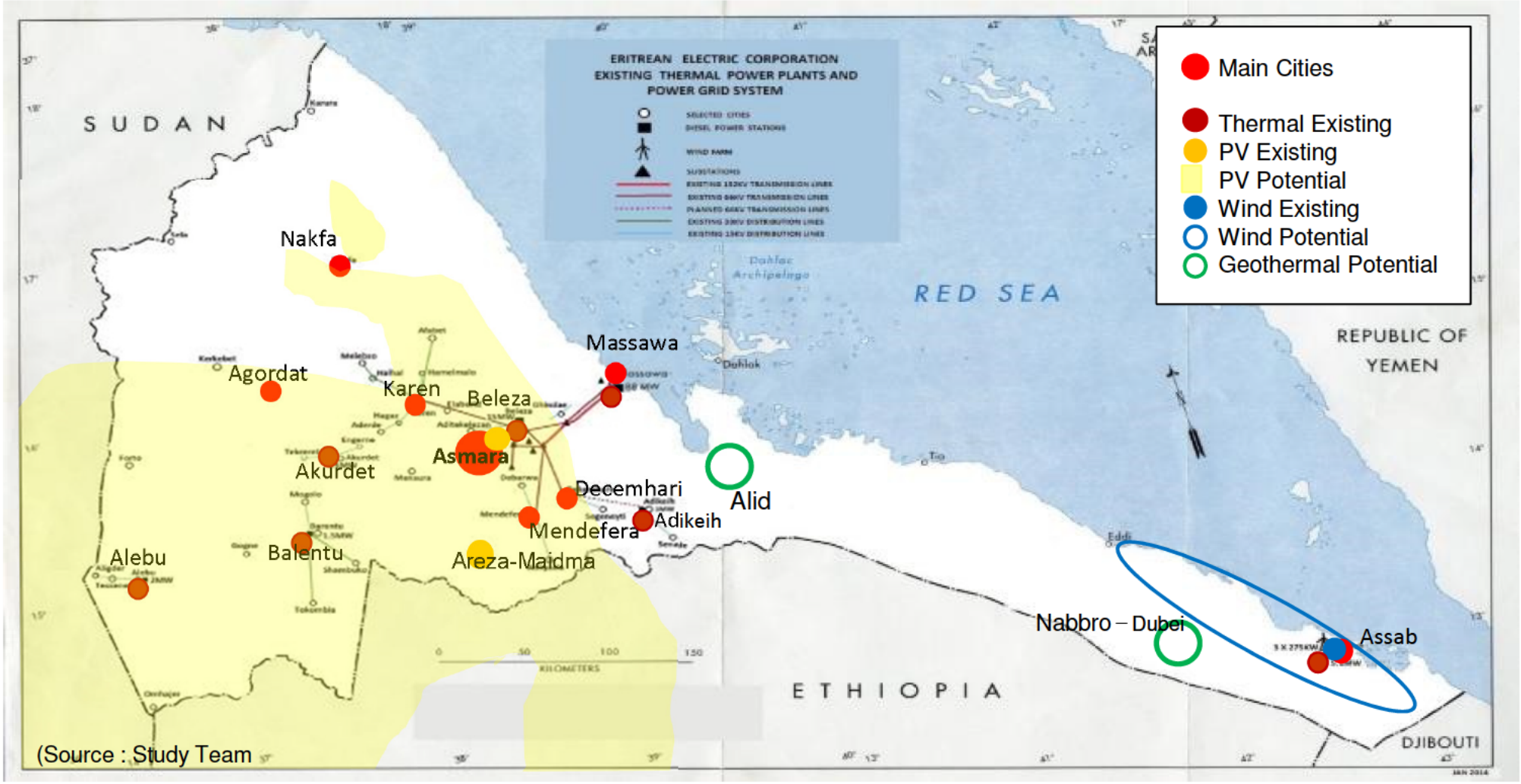

Figure 7:Existing major power facilities and potential areas for each renewable energy

7. Roadmap for Power Generation Development

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<Precondition>

- Formulate based on 6. Electricity Demand Forecast (until 2030) provided by the Government of Eritrea
- Generators owned by the EEC and IPP connected to the ICS will be considered for the 'Roadmap'. SCS generators that are planned to be connected to the ICS in the future will also be considered.

The cells colored in yellow indicate the new or renewed power generation facilities and the capacity

Table 5:Roadmap for Power Generation Development

								2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
							ICS in MW	188.00	197.90	208.10	230.20	245.30	257.40	282.50	298.70	316.10	334.80	335.50	377.30
							balance	-105.55	-115.45	-114.65	-59.75	36.05	69.95	108.89	107.69	105.29	118.59	100.29	42.49
							ICS total	82.45	82.45	93.45	170.45	279.35	327.35	391.39	406.39	421.39	453.39	435.79	419.79
Power Plants	type	unit #	installed capacity (MW)	comm. year	existing / planned	ICS / SCS	Owner (EEC/IPP)	available output / firm capacity (MW)											
Diesel Power Plants																			
Hirgigo I	D	1	22.70	2003	existing	ICS	EEC	12.00	12.00	12.00	12.00	12.00	25.00	25.00	25.00	25.00	25.00	25.00	20.00
	D	2	22.70	2003	existing	ICS	EEC	0.00	0.00	0.00	0.00	0.00	25.00	25.00	25.00	25.00	25.00	25.00	20.00
	D	3	22.70	2003	existing	ICS	EEC	0.00	0.00	0.00	25.00	25.00	25.00	25.00	25.00	25.00	20.00	20.00	20.00
	D	4	22.70	2003	existing	ICS	EEC	0.00	0.00	0.00	25.00	25.00	25.00	25.00	25.00	25.00	20.00	20.00	20.00
Hirgigo II	D	1	23.00	2017	existing	ICS	EEC	23.00	23.00	23.00	23.00	18.40	18.40	18.40	18.40	18.40	18.40	16.10	16.10
	D	2	23.00	2017	existing	ICS	EEC	23.00	23.00	23.00	23.00	18.40	18.40	18.40	18.40	18.40	18.40	16.10	16.10
	D	3	25.00	2023	New	ICS	EEC					25.00	25.00	25.00	25.00	25.00	25.00	20.00	20.00
	D	4	25.00	2023	New	ICS	EEC					25.00	25.00	25.00	25.00	25.00	25.00	20.00	20.00
	D	5	25.00	2025	New	ICS	EEC							25.00	25.00	25.00	25.00	25.00	25.00
	D	6	25.00	2025	New	ICS	EEC							25.00	25.00	25.00	25.00	25.00	25.00
Belesa	D	1	5.70	1995	existing	ICS	EEC	1.40	1.40	0.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	4.00
	D	2	5.70	1995	existing	ICS	EEC	1.30	1.30	0.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	4.00
	D	3	5.70	1995	existing	ICS	EEC	1.30	1.30	0.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	4.00
Assab	D	1	12.60	1991	existing	SCS	EEC	1.90	1.90	1.90	1.90 to be discarded								
new diesel #1	D	1	15.00	2023	planned	SCS	EEC					15.00	15.00	15.00	15.00	15.00	15.00	12.00	12.00
new diesel #2	D	2	15.00	2028	planned	SCS	EEC										15.00	15.00	15.00
Adi-Keih	D	N/A	5.60	1984	existing	SCS	EEC	3.00	3.00	3.00 to be connected to ICS and DG is to be removed									
Agordat	D	N/A	4.00	N/A	existing	ICS	EEC	2.00	2.00	2.00	2.00	2.00	2.00	1.60	1.60	1.60	1.60	1.60	1.60
additional units	D	2	5.00		planned	ICS	EEC					10.00	10.00	10.00	10.00	10.00	10.00	10.00	8.00
Tesseney	D	N/A	0.00	N/A	existing	ICS	IPP	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
additional units	D	2	5.00		planned	ICS	IPP					10.00	10.00	10.00	10.00	10.00	10.00	10.00	8.00
Barentu	D	N/A	4.60	N/A	existing	ICS	EEC	2.80	2.80	2.80	2.80	2.80	2.80	2.24	2.24	2.24	2.24	2.24	2.24
additional units	D	2	5.00		planned	ICS	EEC					10.00	10.00	10.00	10.00	10.00	10.00	10.00	8.00
PV Plants																			
Asmara East	PV	1	2.00	2018	existing	ICS	EEC	2	2	2	2	2	2	2	2	2	2	2	2
Adihalo	PV	1	4.00	N/A	existing	ICS	EEC	4	4	4	4	4	4	4	4	4	4	4	4
Gergera	PV	1	4.00	N/A	existing	ICS	EEC	4	4	4	4	4	4	4	4	4	4	4	4
New PV #1	PV		15.00		planned	ICS	EEC			15	15	15	15	15	15	15	15	15	15
New PV #2	PV		15.00		planned	ICS	EEC				15	15	15	15	15	15	15	15	15
New PV #3	PV		15.00		planned	ICS	EEC					15	15	15	15	15	15	15	15
New PV #4	PV		15.00		planned	ICS	EEC						15	15	15	15	15	15	15
New PV #5	PV		15.00		planned	ICS	EEC							15	15	15	15	15	15
New PV #6	PV		15.00		planned	ICS	EEC								15	15	15	15	15
New PV #7	PV		15.00		planned	ICS	EEC									15	15	15	15
Wind Plants																			
Assab	W	1-3	0.75	2010	existing	SCS	EEC	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
new wind #1	W	1	5.00	2024	planned	SCS	EEC						5.00	5.00	5.00	5.00	5.00	5.00	5.00
new wind #2	W	2	5.00	2028	planned	SCS	EEC										5.00	5.00	5.00
Geothermal																			
Alid Geothermal	G	1	25	2028	planned	ICS	EEC										25.00	25.00	25.00

Electric Power Balance in ICS	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Diesel	71.70	71.70	67.70	129.70	223.60	251.60	300.64	300.64	300.64	302.64	285.04	269.04
Renewable (PV+wind+geothermal)	10.75	10.75	25.75	40.75	55.75	75.75	90.75	105.75	120.75	150.75	150.75	150.75
Renewable energy ratio in total output	13.0%	13.0%	27.6%	23.9%	20.0%	23.1%	23.2%	26.0%	28.7%	33.2%	34.6%	35.9%

(Souce：調査団作成)

7. Roadmap for Power Generation Development

Short-term（3-5 years）

- Rehabilitation / replacement of existing Hirgigo power plant
- Rehabilitation of substations around Asmara
- Expansion of Hirgigo I power plant (short-term to medium-term)
- Strengthening the grid from Massawa to Asamara (short-term to medium-term)
- Construction of new PV power plants around Asmara (short-term to medium-term)
  - with a photovoltaic facility alone if a place is chosen that connects to the grid, or with a hybrid photovoltaic and small diesel facility for a standalone operation.

Mid-term（6-10 years）

- Construction of new wind power plant in Assab
  - assume a standalone power plant
- Construction of new PV power plants continuously
- Construction of a new geothermal plant around Alid area
  - it is critical that a source of funds (donors) be selected for the next step, which includes test drilling

Long-term(11 or more years)

- Development of geothermal, solar and wind power continuously

8. Development Cost

＜Precondition＞

➢ Thermal Power Generation Facilities

- New construction: $2.2 million / MW (from Erinews Issue No. 74, 2017)
- Replacement: $1.5 million / MW (from OPEC FUND HP)

➢ PV Facilities

- There are two types of PV installations planned: one for the stand-alone PV system, and the other for the system with diesel generator and batteries. The capacity ratio of these two types of installations is approximately 7:3. The total capacity planned for each year, 15 MW, is to be divided proportionally according to this capacity ratio, and the respective unit prices are to be applied.
- Stand-alone: $1.32 million/ MW (from Renewable Power Generation Costs in 2019)
- With Diesel and batteries: $6.44 million/MW (from Maidma/Arreza project)

➢ Wind Power Generation Facilities

- The unit price of wind power generation facilities is set as follows from the average price in Africa, not including the battery cost.
- $1.95 million/ MW (from Renewable Power Generation Costs in 2019)

➢ Geothermal Power Generation Facilities

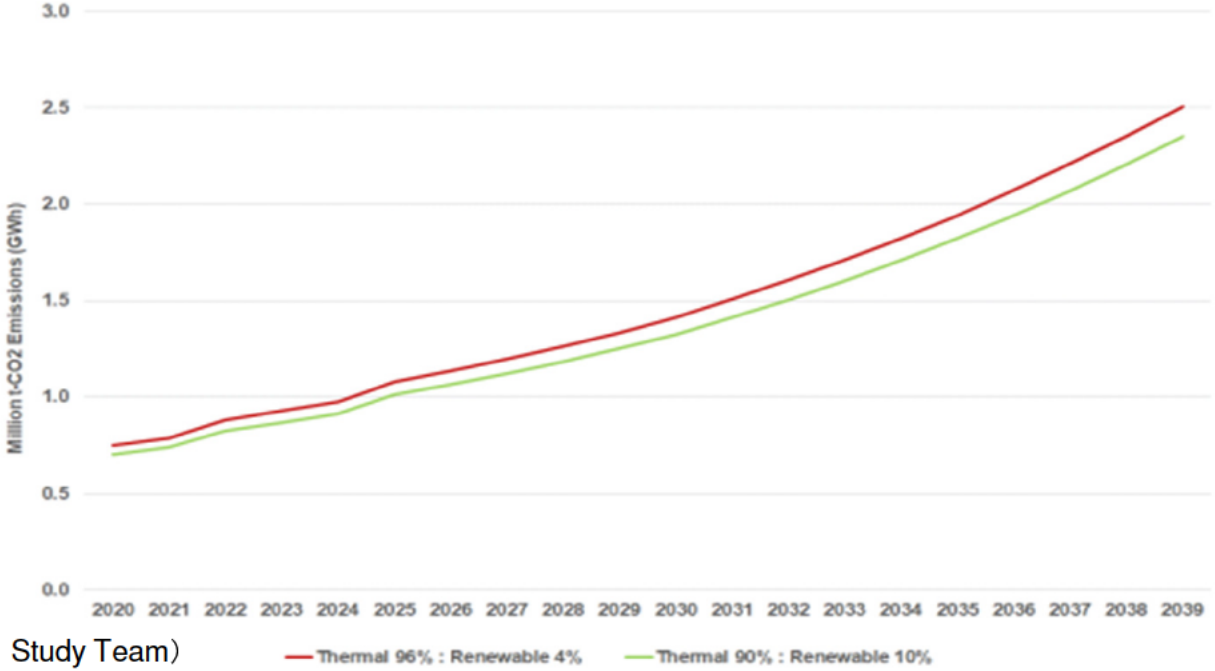
- The estimated costs of geothermal development in the Alid area, including the cost of drilling geothermal exploratory wells, are as follows;
- Drilling of test wells 3 years: 3 wells x $10 million = $30 million
- Drilling of appraisal wells 3 years: 5 wells x $10 million = $50 million
- Construction of geothermal power plant 4 years: 25 MW, $38 million

Table 6:Estimated Development Costs to 2030

	units	capacity	year	replace/new	unit costs	costs
Diesel						
Hirgigo I	1	25.00	2024	replace	1.50	37.50
	2	25.00	2024	replace	1.50	37.50
	3	25.00	2022	replace	1.50	37.50
	4	25.00	2022	replace	1.50	37.50
Hirgigo II	3	25.00	2023	new	2.20	55.00
	4	25.00	2023	new	2.20	55.00
	5	25.00	2025	new	2.20	55.00
	6	25.00	2025	new	2.20	55.00
Belesa	1	5.00	2022	replace	1.50	7.50
	2	5.00	2022	replace	1.50	7.50
	3	5.00	2022	replace	1.50	7.50
Assab	1	15.00	2023	new	2.20	33.00
	2	15.00	2028	new	2.20	33.00
Agordat	1	5.00	2023	replace	1.50	7.50
	2	5.00	2023	replace	1.50	7.50
Tesseney	1	5.00	2023	replace	1.50	7.50
	2	5.00	2023	replace	1.50	7.50
Barentu	1	5.00	2023	replace	1.50	7.50
	2	5.00	2023	replace	1.50	7.50
PV						
PV#1	without	10.50	2021	new	1.32	13.87
	w. D&B	4.50	2021	new	6.44	28.98
PV#2	without	10.50	2022	new	1.32	13.87
	w. D&B	4.50	2022	new	6.44	28.98
PV#3	without	10.50	2023	new	1.32	13.87
	w. D&B	4.50	2023	new	6.44	28.98
PV#4	without	10.50	2024	new	1.32	13.87
	w. D&B	4.50	2024	new	6.44	28.98
PV#5	without	10.50	2025	new	1.32	13.87
	w. D&B	4.50	2025	new	6.44	28.98
PV#6	without	10.50	2026	new	1.32	13.87
	w. D&B	4.50	2026	new	6.44	28.98
PV#7	without	10.50	2027	new	1.32	13.87
	w. D&B	4.50	2027	new	6.44	28.98
Wind						
Assab	1	5.00	2024	new	1.95	9.75
Assab	2	5.00	2028	new	1.95	9.75
Geothermal						
Alid	1	25.00	2028	new	118.00	118.00
(Source:Study Team)				***Total***	**mil. $**	**940.95**

9. CO2 Reduction

Figure 8 shows the trend of CO2 emissions, and Table 7 shows the CO2 emissions and their reduction rate every five years.If thermal power : renewable energy = 90:10 is achieved and maintained and power sources are developed, CO2 emissions can be expected to be reduced by approximately 6.3% after 2030 compared to 2020.



(Source: Study Team)

Figure 8:CO2 Emissions by Power Source Ratio

Table 7:CO2 Emissions and Reduction Ratio

	2025	2030	2035	2039
Thermal : Renewable = 96 : 4 [mill. ton]	0.8	1.4	1.9	2.5
Thermal : Renewable = 90 : 10 [mill. ton]	0.7	1.3	1.8	2.4
Reduction Ratio	6.2%	6.3%	6.3%	6.3%

(Source : Study Team)