# Efeler GPP Capacity Extension Project

## Environmental and Social Impact Assessment Addendum

October 2018

## Quality information

| Prepared by | Checked by | Approved by |
|---|---|---|
| AECOM Turkey | Burcu Yazgan Kayabali,<br>ESIA and EDD Section Manager | Dr. Hande Yukseler<br>Environment End Market (EM) Director Turkey |

## Revision History

| Revision | Revision date | Details | Authorized | Name | Position |
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| Rev1 | 27.11.2017 | Draft | 27.11.2017 | Dr. Hande Yükseler | Environment End Market (EM) Director Turkey |
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## Prepared for:

Gurmat Elektrik Uretim A.Ş.

## Prepared by:

Aecom Turkey Danışmanlık ve Mühendislik Ltd. Şti
Mustafa Kemal Mahallesi Dumlupınar Bulvarı Tepe Prime
No:266 B Blok
No:50-51 06800
Çankaya
Ankara
Turkey

T: +90 312 4429863
aecom.com

# List of the Individuals that Contributed to Preparation of the SLIP

| Individual/Organization | Position/Expertise | Relevant Stage |
|---|---|---|
| Dr. Hande Yükseler | Project Director<br>Environment End Market Director<br>(Environmental Engineer) | Full ESIA documentation |
| Burcu Yazgan Kayabalı | Project Manager<br>ESIA and ESDD Section Manager<br>(Environmental Engineer) | Full ESIA documentation |
| Taylan Aşkın | Environmental Specialist<br>(Geological Engineer) | Full ESIA documentation |
| Cem Ünüştü | GIS Specialist<br>(Hydrogeological Engineer) | Full ESIA documentation |
| Nilay Aygüney Berke | Senior Project Manager<br>(Biologist, Environmental Scientist) | 4.4. Biodiversity |
| Mustafa İşlek | Senior Social Specialist | 4.7. Labor and Working Conditions, SEP |

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# List of Acronyms

| Acronym | Description |
|---|---|
| AR5 | IPCC Assessment Report 5 |
| CH | Critical Habitat |
| CIA | Cumulative Impact Assessment |
| CSR | Corporate Social Responsibility |
| EBRD | European Bank for Reconstruction and Development |
| EIA | Environmental Impact Assessment |
| EMRA | Energy Market Regulatory Authority |
| ESAP | Environmental and Social Action Plan |
| ESP | Environmental and Social Policy |
| ESIA | Environmental and Social Impact Assessment |
| ESMAP | Energy Sector Management Assistance Program |
| EU | European Union |
| ETL | Energy Transmission Line |
| GEA | Geothermal Energy Association |
| GHG | Greenhouse Gas |
| GIIP | Good International Industrial Practice |

| Acronym | Description |
|---|---|
| GPP | Geothermal Power Plant |
| GWP | Global Warming Potential |
| HR | Human Resources |
| IAIA | International Association for Impact Assessment |
| IAPCR | Industrial Air Pollution Control Regulation |
| IUCN | International Union for Conservation of Nature |
| IBA | Important Bird Area |
| IPA | Important Plant Area |
| IFC | International Finance Corporation |
| IPCC | Intergovernmental Panel on Climate Change |
| KBA | Key Biodiversity Area |
| MoEU | Ministry of Environment and Urbanization |
| NCG | Non-condensable Gas |
| NTS | Non-technical Summary |
| OHS | Occupational Health and Safety |
| PAP | Project Affected People |
| PR | Performance Requirement |
| RAMEN | Regulation on Management and Assessment of Environmental Noise |
| REN21 | the Renewable Energy Policy Network for the 21st Century |
| SEP | Stakeholder Engagement Plan |
| SLIP | Supplementary Lenders Information Package |
| SSC | Species Survival Commission |
| VESC | Valuable Ecosystem Component |
| WBCD | World Business Council for Sustainable Development |
| WRI | World Resource Institute |
| WWF | World Wide Fund for Nature |
| WWTP | Wastewater Treatment Plant |

# Executive Summary

Guris Insaat ve Muhendislik A.S. (“Guris”) was established in 1958 as Guris Kolektif and has been conducting its activities in construction, industry, energy, tourism and mining sectors. The sub-company of Guris involved in energy developments is the Mogan Enerji Yatirim Holding A. S. (“Mogan”), which, as stated in its website, aims to become a leading energy generation company in Turkey, through renewable energy projects. In line with this goal, Mogan is currently operating multiple geothermal power plants (GPPs), wind power plants and hydroelectric power plants, and a multitude of other Mogan renewable energy projects are either under construction or in development. Geothermal energy development of Mogan on the other hand is conducted by Gurmat Elektrik Uretim A.S. (“Gurmat Elektrik” or “the Project Company”), which was established in 1999. It is currently operating the largest GPP in Turkey, referred to as Gurmat-2 GPP throughout this report, in Germencik district of Aydin province.

Gurmat Elektrik is planning to construct and operate the Efeler Geothermal Power Plant Capacity Extension Project (“Efeler GPP Project” or the “Project”) of the existing Gurmat-2 GPP. Existing Gurmat-2 GPPs in operation are Efe-1, Efe-2, Efe-3 and Efe-4 GPPs, whereas the Project consists of Efe-6, Efe-7 and Efe-8 GPPs. Of the Project GPPs, Efe-6 is in operation since August 2017, Efe-7 construction phase is ongoing and Efe-8 is currently in pre-construction planning stage.

For the development of Gurmat-2 Project, Gurmat Elektrik received financing from the European Bank for Reconstruction and Development (EBRD). For this purpose, An ESIA Disclosure Package was prepared by WS Atkins International Ltd. and disclosed on 23 September 2014.

In line with the EBRD’s Environmental and Social Policy (2014), and its associated Performance Requirements (PRs), a project of this type and scale requires a fit for purpose Environmental and Social Impact Assessment (ESIA). Following a review of the previous Environmental Impact Assessment (EIA) reports prepared for Efe-6, Efe-7 and Efe-8 GPPs to meet National requirements, additional supplementary environmental and social studies have been developed to meet the EBRD PRs and international good practice. The Project ESIA, therefore, consists of the previous EIA report and the supplementary studies.

This ESIA Addendum is prepared to provide an additional assessment of the supplementary studies conducted within the Supplementary Lenders Information Package (SLIP).

# 1. Project Description

Efeler Geothermal Power Plant Capacity Extension Project (“Efeler GPP Project” or the “Project”) is planned by Gurmat Elektrik Uretim A.S. (“Gurmat Elektrik” or “the Project Company”), which is a sub-company of Mogan Energy, an investment holding established by Guris Holding for group’s investments in the energy sector.

The Efeler GPP Project is planned in the Germencik geothermal field, which is located to the western part of the Buyuk Menderes Graben in Western Anatolia. Situated in a region of abundant geothermal activity, Germencik field is one of the two hottest geothermal systems in Turkey. Geothermal fields of Germencik include three discrete areas, namely (i) Bozkoy on the northeast; (ii) Camurlu-Kavsak on the northwest; and (iii) Germencik-Omerbeyli on the south, where the latter is the most significant in the area with 220 °C temperature (Faulds, et al., 2009; Efe-6 GPP National EIA Report, August 2016). Map showing the locations of geothermal systems in the Western Anatolia, with a focus onto the geothermal fields of Menderes Graben including Germencik, is provided in Figure 1-1. Over the last three decades, several geothermal power plants have been constructed and operated in the Menderes Graben in order to harness the substantial geothermal potential of the area.

Residing in this major geothermal system, the Project Area is located near Omerbeyli neighborhood of Germencik district in Aydin province. At the Project location, Gurmat Elektrik has been operating the existing 47.4 MWe Gurmat-1 GPP since 2009 and 114.9 MWe Gurmat-2 GPP since 2014. Gurmat-1 also referred to as Galip Hoca GPP, consists of one power generating unit (dual flash). Gurmat-2, on the hand, had originally been planned as a GPP consisting of five power generating units, while the Project has then been implemented with four units, namely Efe-1, Efe-2, Efe-3, and Efe-4 (Efe-1 being dual flash; others being binary), making a total installed capacity of 114.9 MWe (Efe-5, with a planned installed capacity of 47.4 MWe, has not been implemented). The Efeler GPP Project, with an installed capacity of 97.6 MWe, aims to increase the existing total operating capacities of Gurmat-2 GPPs from 114.9 MWe to 212.5 MWe.

The Project subject to this Environmental and Social Impact Assessment (ESIA) study is the Efeler GPP Capacity Extension Project, while Gurmat-1 and Gurmat-2 GPPs, even though they are not directly part of the Efeler GPP Capacity Extension Project, will also be taken into consideration in the scope of this ESIA Addendum to cover the cumulative impacts.

Key characteristics of the existing and planned GPPs are listed in Table 1-1 and locations of the existing Gurmat-1, Gurmat-2 and the Efeler GPP Project units are demonstrated on the map given in Figure 1-2.

**Table 1-1. Key Characteristics of Existing and Planned GPPs**

| Facility | Name of the GPP | Process Type | Project Status/Phase | Installed Capacity (MWe) |
|---|---|---|---|---|
| Gurmat-1 | Galip Hoca GPP | Dual flash | Operational since 2009 | 47.4 |
| Gurmat-1 Total | | | | 47.4 |
| Gurmat-2 | Efe-1 GPP | Dual flash | Operational since 2015 | 47.4 |
| | Efe-2 GPP | Binary | Operational since 2014 | 22.5 |
| | Efe-3 GPP | Binary | Operational since 2015 | 22.5 |
| | Efe-4 GPP | Binary | Operational since 2015 | 22.5 |
| | Efe-5 GPP* | Dual flash | Implementation is on hold | |
| Gurmat-2 Total | | | | 114.9 |
| Efeler GPP Project (Capacity Extension) | Efe-6 GPP | Binary | Operational since August 2017 | 22.6 |
| | Efe-7 GPP | Binary | Under construction | 25.0 |
| | Efe-8 GPP | Binary | Pre-construction planning; planned operation date is 2019 | 50.0 |
| Efeler GPP Project (Capacity Extension) Total | | | | 97.6 |
| Cumulative Installed Capacity (incl. operating and planned Gurmat-1, Gurmat-2 and Efeler GPPs) | | | | 259.9 |

** Efe-5 GPP Project, which had a planned installed capacity of 47.4 MWe, has not been implemented and is currently on-hold.*

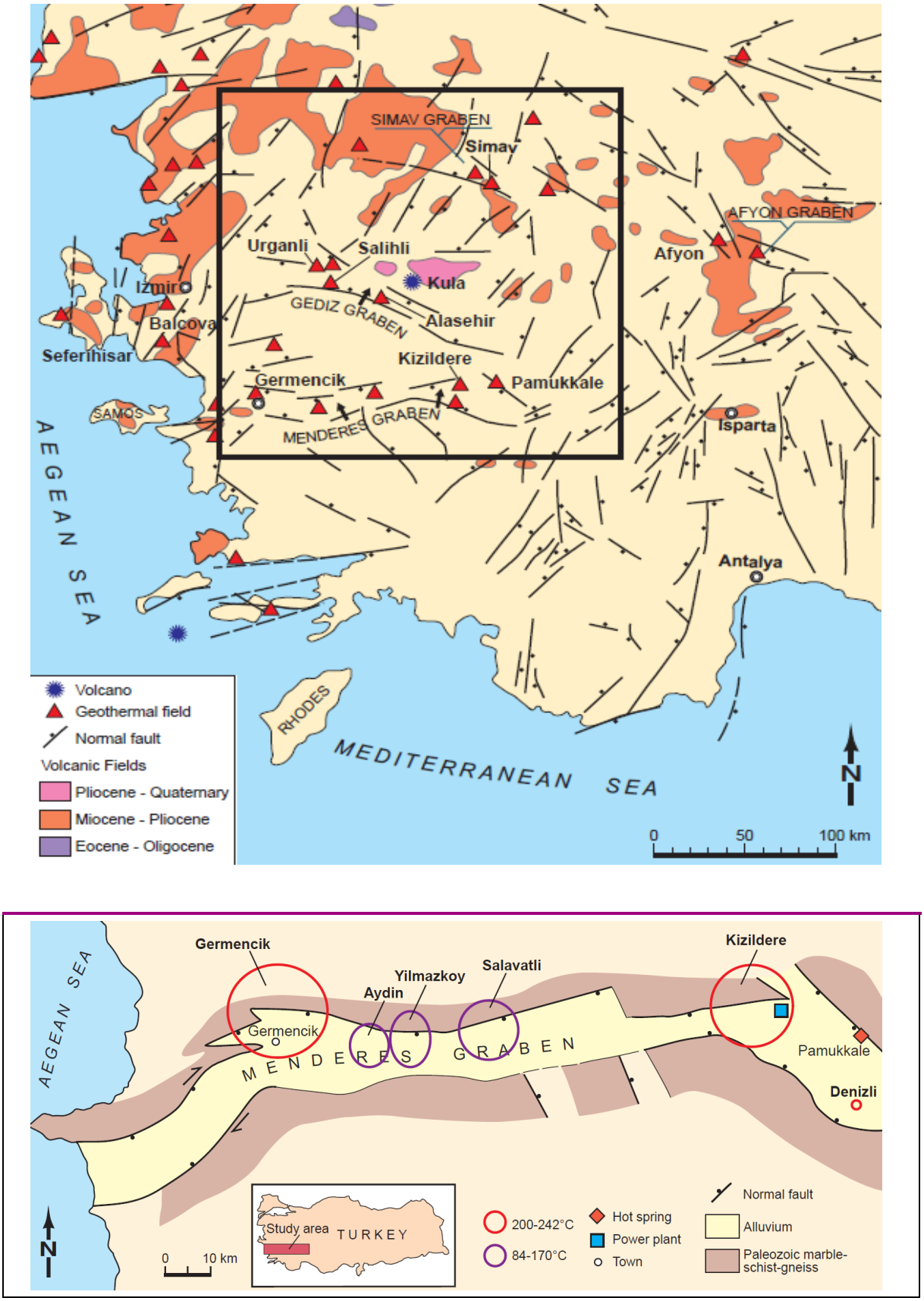



**Figure 1-1. Generalized Geologic Map of Western Turkey Showing Major Fault Zones and Locations of Geothermal System (Upper Figure) and Geothermal Fields of Menderes Graben (Lower Figure)**

Source: Faulds, et. al., 2009.

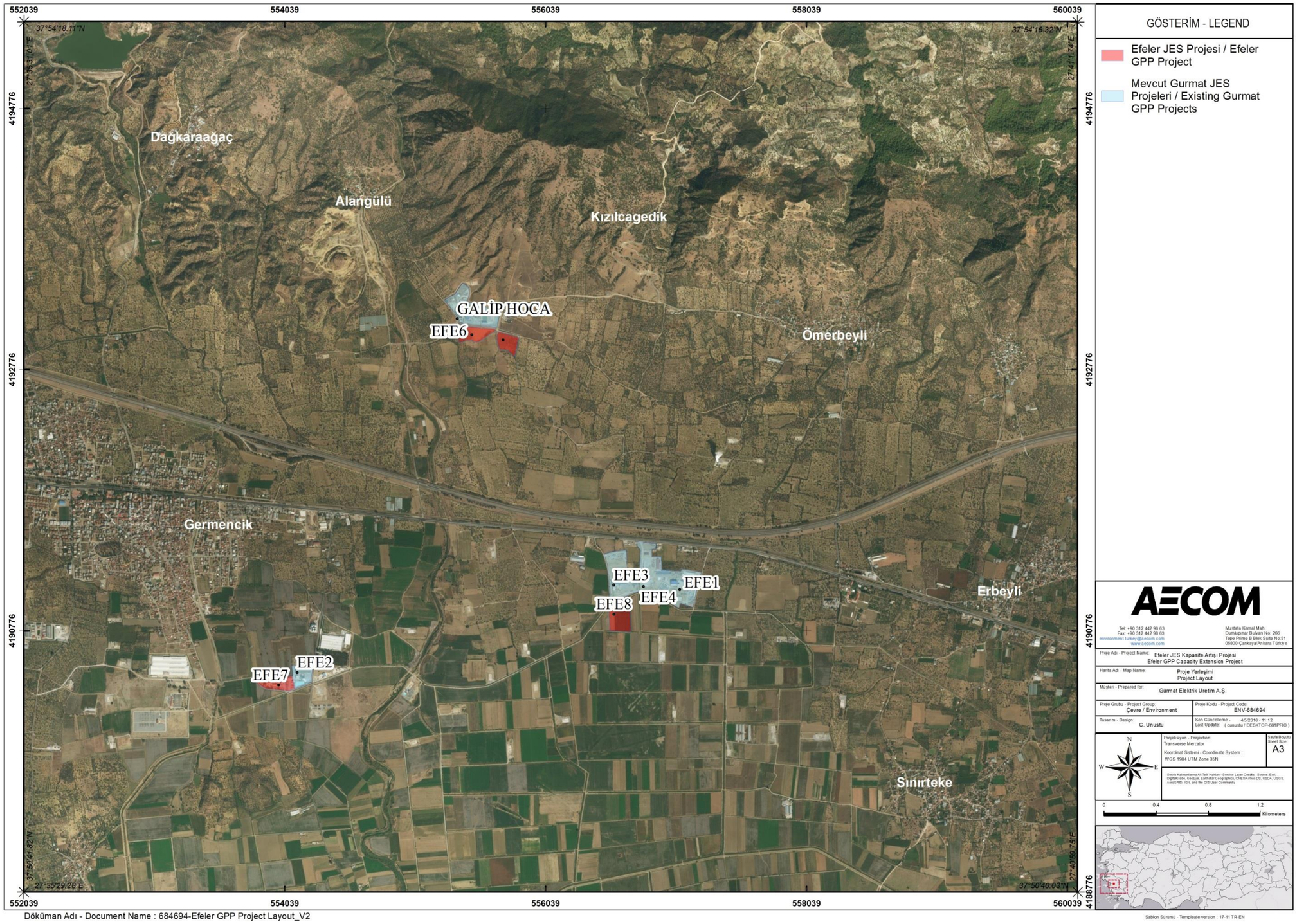



**Figure 1-2. General Layout of the Existing Gurmat Elektrik Facilities and Planned Efeler GPP Capacity Extension Plants**

## 1.1 Project Background

For Gurmat-1 and Gurmat-2 projects, Environmental Impact Assessment (EIA) decisions required under the national EIA Regulation and the Electricity Generation Licenses have been secured from the relevant authorities as necessary in parallel to the development of projects. EIA decisions required for Efe-6, Efe-7 and Efe-8 GPPs, which altogether form the Efeler GPP Capacity Extension Project, have also been obtained in 2016 and 2017. Electricity Generation License for Efe-6 GPP (2017) and Efe-7 GPP (2018) and pre-license for Efe-8 GPP (2017) have also been taken. Status of electricity generation licenses and EIA decisions for Gurmat-1, Gurmat-2, and the Project (Efe-6, Efe-7 and Efe-8) is summarized in Table 1-2 and the key milestones achieved throughout the process is shown in Figure 1-3.

**Table 1-2. Existing EMRA Licenses and EIA Positive Decisions for Gurmat Elektrik Projects**

| Project | GPP | Energy Market Regulatory Authority (EMRA) | | Ministry of Environment and Urbanization |
|---|---|---|---|---|
| | | Pre-License for Electricity Generation | License for Electricity Generation | EIA Positive Decision |
| Gurmat-1 | Galip Hoca | ○ | ● | ● |
| Gurmat-2 | Efe-1, Efe-2, Efe-3, and Efe-4 | ○ | ● | ● |
| Efeler GPP Capacity Extension | Efe-6 | ○ | ● | ● |
| | Efe-7 | ○ | ● | ● |
| | Efe-8 | ● | ○ | ● |

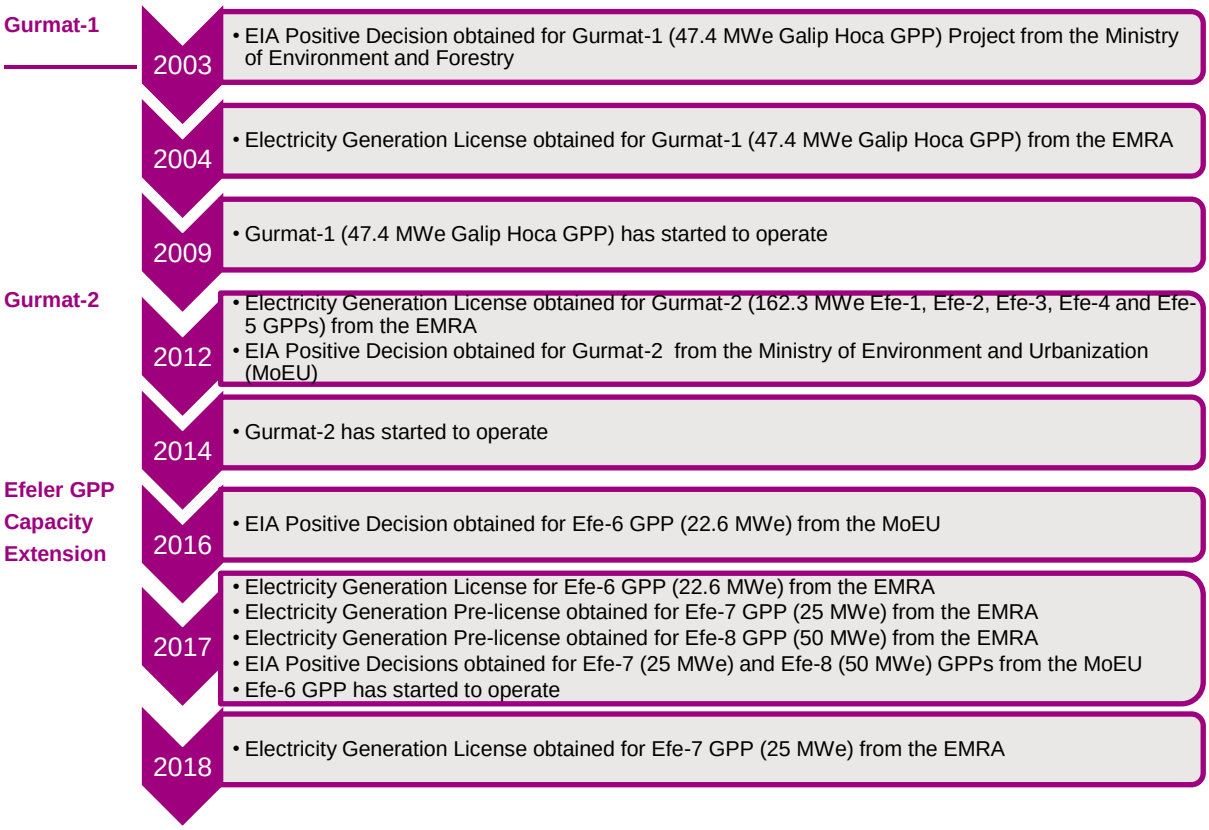



**Figure 1-3. Project Milestones for Existing EIA Decisions, EMRA Licenses and Commissioning of Units**

Generation and preliminary licensed provided by EMRA for the capacity expansion GPPs are provided in Table 1-3. Currently, Efe-6 and Efe-7 GPPs hold generation licenses, whereas a preliminary license is in place for Efe-8 GPP.

**Table 1-3. EMRA Licenses for the Project (Capacity Extension)**

| GPP | License No. | License Beginning Date | Duration |
|---|---|---|---|
| Efe-6 GPP* | EÜ/7152/03692 | 22.06.2017 | 16 years, 9 months, 10 days |
| Efe-7 GPP** | EÜ/7634-38/03844 | 11.01.2018 | 16 years, 2 months, 21 days |
| Efe-8 GPP** | ÖN/7064-2/03688 | 11.05.2017 | 30 months |

*Efe-6 and Efe-7 hold a generation license

** Efe-8 holds a preliminary license

## 1.2 Project Location

The Project is planned in Germencik district of Aydin province. Efe-6, Efe-7 and Efe-8 GPP units are planned in three different EMRA license areas. In the map provided in Figure 1-2, locations of the existing Gurmat-1 and Gurmat-2, planned capacity extension units and the surrounding area are shown, whereas location descriptions of the planned units are provided below:

- Efe-6 GPP is located adjacent to the southern border of Gurmat-1 GPP. Project Area is situated 19 km west of the Aydin city center and 2.5 km northeast of Germencik district center. The closest settlement to Efe-6 GPP is Kizilcagedik neighborhood, which is situated around 1.2 km northeast. Other settlements located in the vicinity include Alangullu neighborhood that is situated in approximately 1.4 km northwest and Omerbeyli neighborhood that is situated 1.8 km east. Access to the Efe-6 GPP Project Area is provided from the Izmir-Aydin State Road (D-550) by using the existing neighborhood road of Alangullu. Parcels corresponding to the Efe-6 GPP License Area are registered as agricultural land and fig gardens. There are other fig gardens and olive groves in the surrounding area.
- Efe-7 GPP is located adjacent to southern border of Efe-2 GPP. The closest settlement to Efe-7 GPP is Germencik, of which the closest point is situated around 400 m northeast of the GPP. Parcels corresponding to the Efe-7 GPP License Area are registered as fig gardens and croplands. There are agricultural areas and other energy generation related facilities in the surrounding area.
- Efe-8 GPP is located adjacent to the southern border of Gurmat-2 plant where Efe-1, Efe-3 and Efe-4 are operating. The closest settlement to Efe-8 GPP is Sinirteke neighborhood, which is situated around 2.2 km southeast. Parcels corresponding to the Efe-8 GPP License Area are registered as agricultural land. There are other agricultural lands in the surrounding area.

The Project Area, covering the Efe-6, Efe-7 and Efe-8 GPP areas, is not located on any legally protected site.

Distances of Efe-6, Efe-7 and Efe-8 GPPs to the nearby settlements are provided in Table 1-4.

**Table 1-4. Distance (km) of the Project to Surrounding Settlements**

| Settlement | Efe-6 GPP | Efe-7 GPP | Efe-8 GPP |
|---|---|---|---|
| Aydin city center | 19 | 20 | 18 |
| Germencik district center | 3 | 1.6 | 3.7 |
| Omerbeyli neighborhood | 2.3 | 5 | 2.5 |
| Kizilcagedik neighborhood | 1.9 | 4.5 | 3 |
| Alangullu neighborhood | 1.5 | 3.8 | 3.7 |
| Hidirbeyli neighborhood | 4 | 4.1 | 5.6 |

| Settlement | Efe-6 GPP | Efe-7 GPP | Efe-8 GPP |
|---|---|---|---|
| Reiskoy neighborhood | 5.1 | 1.8 | 4.5 |
| Turanlar neighborhood | 5.5 | 2.9 | 3.9 |
| Sinirteke neighborhood | 5 | 5.5 | 3 |
| Erbeyli Neighborhood | 4.2 | 5.8 | 3 |

## 1.3 Project Characteristics

Within the scope of the Project;

- The 22.6 MWe Efe-6 GPP is projected to generate an annual 180.8 GWh electricity;
- The 25 MWe Efe-7 GPP is projected to generate an annual 200 GWh electricity; and
- The 50 MWe Efe-8 GPP is projected to generate an annual 400 GWh electricity.

Main Project characteristics are summarized in Table 1-5.

**Table 1-5. Main Project Characteristics**

| | Efe-6 GPP | Efe-7 GPP | Efe-8 GPP |
|---|---|---|---|
| Location | Alangulu neighborhood | Mesudiye neighborhood | Omerbeyli neighborhood |
| Installed Capacity | 22.6 MWe | 25 MWe | 50 MWe |
| Annual Electricity Generation | 180.8 GWh | 200 GWh | 400 GWh |
| Working Hours | 12 month/year; 26 days/month; 8 hours/day* | 12 month/year; 25 days/month; 8 hours/day* | 12 month/year; 25 days/month; 8 hours/day* |
| Number of Shifts | 3 | 3 | 3 |
| Number of Construction Phase Personnel | 50 | 250 | 400 |
| Number of Operation Phase Personnel | 40 | 8 | 12 |
| Construction Period | 24 months | 12 | 12 |
| Secondary Fluid | Pentane | Pentane | Pentane |

*Source: Efe-6 GPP National EIA Report, August 2016; Efe-7 GPP National EIA Report, April 2017; Efe-6 GPP National EIA Report, April 2017*

### 1.3.1 Project Components

Summary descriptions of main components, auxiliary components and auxiliary facilities to be utilized by Project GPPs are provided in this section. Certain facilities/components will be newly built in the scope of the Project, while existing infrastructure of the Gurmat-1 or Gurmat-2 GPPs will be jointly used by Efeler GPP as feasible.

#### 1.3.1.1 Production and Reinjection Wells

Efe-6, Efe-7 and Efe-8 will collectively use 22 production wells to tap into the reservoir for utilizing high temperature geothermal fluid for energy generation. Following energy generation at the GPP sites, the spent geothermal fluids will be reinjected back into the reservoir via 20 reinjection wells, which will avoid reservoir depletion and related impacts such as decrease in energy generation capacity and risks such as subsidence. Wellhead facilities will include inhibitor dosing system, control valves, separator, equalization tank, filters, pumps, gauging equipment, automation panels, frequency control equipment, transformer and drainage systems.

#### 1.3.1.2 Pipelines

A network of pipelines will be used which will provide for connection of the production wells to the GPPs and following energy generation, the GPPs to reinjection wells. The pipeline routes are selected to ensure shortest and safest routes to minimize decrease in generation performance, which potentially occurs as a result of thermal loss, since the geothermal fluids are cooled in long distances. In addition, the routes design minimizes risks to local communities and wild life that may be sourced from failures or contact with hot surfaces. Insulated pipes are used also for the same purposes.

Since multiple controlled drainage and irrigation channels are located in the Project vicinity, potential impacts on water resources were also taken into account for pipeline design and construction methods consideration. The pipelines will be installed on pylons to be located every 10 meters. The pylon diameter will not exceed 90 cm.

The pipeline routes are selected to follow cadaster roads and parcel boundaries to minimize impacts on land use. In addition, public access and wild life mobility is ensured by design, where these pipelines cross over roads or access to plots are required.

#### 1.3.1.3 Power Plants

Geothermal fluids transported via the pipelines will be utilized in the GPPs for energy generation. All of the Project GPPs will use binary systems. Process description for the Project GPPs is provided in Section 1.3.2. The power plant components consist of the following:

- Separators
- Evaporators
- Turbines and generators
- Heat exchangers, recirculation pumps and recuperators
- Air-cooled condenser
- Non-condensable gases (NCG) discharge system

In addition to the main facilities, auxiliary facilities of the binary system include power plant control system, surveillance instruments, control valves and panels, air system (compressors, dryers and tanks) for control valves, wellhead facilities, the water supply system and fire-fighting system.

#### 1.3.1.4 Switchyards

Within the scope of the Project, high voltage switchyards will adjust the voltage level of the generated energy to the national grid levels prior to connection. A new switchyard has been constructed for Efe 6 and is currently in operation. Similarly, a new switchyard will be constructed for Efe 8, whereas no switchyard is required for Efe-7. None of the Project GPPs will jointly use the existing switchyards of Gurmat-1 and Gurmat-2 (Efe-1, Efe-2, Efe3 and Efe-4) GPPs.

#### 1.3.1.5 Energy Transmission Lines

Existing Gurmat-1 and Gurmat-2 GPPs connect to the national electricity grid by using 154 kV Energy Transmission Lines (ETLs) that provide connection between the GPPs and the Germencik 154kV Main Transformer Station. The GPPs to be constructed in the scope of the Efeler GPP Project will connect to the same Main Transformer Station.

ETL information for the Project GPPs is provided below:

- The grid connection of Efe-6 GPP is being provided by the existing 154 kV, 3.9 km overhead ETL of Gurmat-1 GPP.
- Efe-7 GPP will connect to Germencik Transformer Centre, via a 31.5 kV, approximately 0.9 km underground cable system, instead of an overhead ETL.
- Grid connection of Efe-8 GPP will be provided by the existing 154 kV ETL of Gurmat-2.

#### 1.3.1.6 Emergency Ponds

The Project will utilize impermeable emergency ponds to collect geothermal fluids in case of equipment failure and other emergencies such as well blow-outs or pipeline failures. The collected fluids will later be reinjected to the reservoir and no discharge will be made to receiving environments. In case of emergencies that may potentially last longer than the time it takes for these emergency ponds to reach their capacities, all generation activities will be stopped.

Information on emergency ponds to be utilized by Project GPPs is provided below:

- Efe-6 will jointly use the existing 12,500 $m^3$ capacity emergency pond of Gurmat-1 for reinjection related emergencies. In addition, a separate 7,500 $m^3$ capacity emergency pond is also constructed, which is used only by Efe-6.
- Efe-7 GPP will use the existing 9000 $m^3$ capacity emergency pond of Efe-2 GPP and no additional emergency ponds will be constructed.
- Efe-8 will use the existing 7500 $m^3$ capacity emergency pond of Efe-1 GPP and no additional emergency ponds will be constructed.

#### 1.3.1.7 Fire Systems

The fire extinguishing systems consist of fire hydrants and sprinkler systems for transformers and pentane tanks. Within the scope of the Project, new fire extinguisher systems are designed for Efe-6 GPP, and this system will connect to the existing fire hydrant line of Gurmat-1 GPP. On the other hand, fire systems for Efe-7 GPP is designed for this GPP to use the fire systems of existing Efe-2 GPP, whereas fire systems for Efe-8 are designed for this GPP to use the fire systems of existing Efe-1, Efe-3 and Efe-4 GPPs.

### 1.3.2 Process Description

There are five different types of geothermal power plants: binary, single flash, double flash, back pressure and dry steam. At the utility scale, conventional steam turbines (single or double flash plants) and binary plants are used to generate electricity depending on the characteristics of the geothermal resource. Dry steam technology can be used in very specific areas where geothermal reservoir produces pure hot steam and back pressure units, with their lower efficiency relative to other technologies, are normally used for a limited time as tests units or wellhead generators until a better solution can be found (World Bank Energy Sector Management Assistance Program-ESMAP, June 2012).

General types and uses of geothermal resources depending on the resource temperature and geographical and geological locations are presented in Table 1-6. High temperature fields are all related to volcanism whereas low temperature fields draw heat from the general heat content of the crust and from the heat flow through the crust. Another temperature subdivision has been proposed, an intermediate or medium temperature system between the two main categories. Medium temperature fields have temperatures between 150° and 200°C.

**Table 1-6. General Types and Uses of Geothermal Resource**

| Resource Type Based on Temperature | | Geographical and Geological Location | Use/Technology |
|---|---|---|---|
| High | : >200°C | Globally around boundaries of tectonic plates, on hot spots and volcanic areas | Power generation with conventional steam, flash, double flash, or dry steam technology |
| Medium | : 150-200°C | Globally mainly in sedimentary geology or adjacent to high temperature resources | Power generation with binary technology |
| Low | : <150°C | Exist in most countries (average temperature gradient of 30°C/km means that resources of about 150°C can be found at depths of about 5 km) | Direct uses (space and process heating, etc.) and, depending on location and power tariff offered, power generation with binary power plants |

*Source: ESMAP, June 2012.*

As conventional systems, single flash steam plants are usually the most economical choice for high-enthalpy liquid dominated resources. The hot water or liquid vapor mixture coming from the wellhead is directed into a separator, where the steam is separated from the liquid. The steam is expanded through a turbine and then usually reinjected, together with the separated brine, back into the reservoir. The brine could, however, be used by a bottoming unit, which utilizes the residual heat from the main power plant to generate additional power, or in another application, such as heating, cooling, or multiple use. A double flash steam cycle differs from a single flash cycle in that the hot brine is passed through successive separators, each at a subsequently lower pressure.

In the scope of the Efeler GPP, where temperature of the resource is about 220 °C all the power generating units to be constructed and operated will use binary technology, which utilize a secondary working fluid, an organic fluid (n-pentane) with a low boiling point and high vapor pressure at low temperatures as compared to steam. In this process, the geothermal fluid coming from the geothermal resource (production wells) will be first separated to steam and liquid phases. Afterwards, geothermal fluid will be diverted to the evaporators to convert the pre-heated secondary fluid (pentane) into steam by yielding its heat without any direct contact. Vaporized pentane will then be sent to the turbines for energy generation through the generators. Pentane coming out of the turbines in the form of exhaust steam will be sent to the heat exchangers. Pentane will pass through the heat exchangers as separate liquid and steam forms. Pentane in steam form will transfer some of its heat to the liquid form and then lead to the cooling tower for condensation.

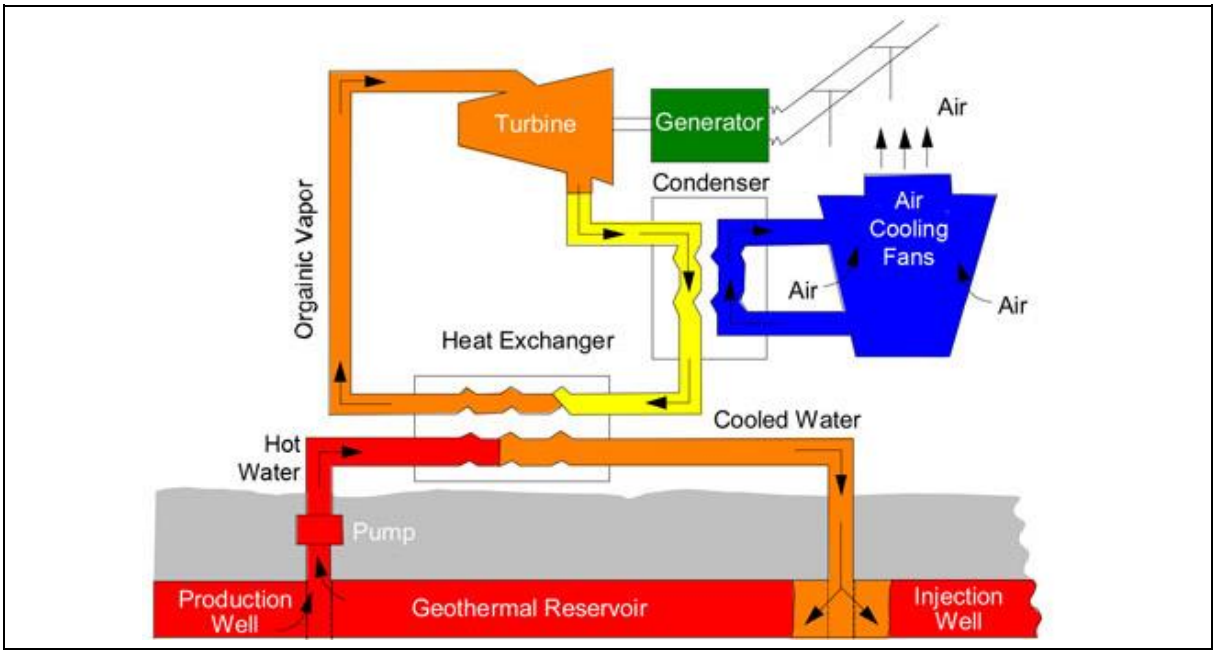



**Figure 1-4. Typical Binary Power Plant Process (Source: Colorado Geological Survey website)**

### 1.3.3 Chemicals Use

The main chemicals use in binary systems is the secondary fluid used for generation of electricity. This fluid, namely pentane, is supplied from international sources and delivered on-site in special containers by means of trucks or trailers under special security measures. Pentane storage is not conducted on site and pentane is directly fed to the system, which is a closed loop system where pentane is continuously recirculated. Only emergency storages for collection of pentane gas are/will be available. Other main hazardous material required for Project activities are inhibitors that are used to prevent carbonate and sulphate accumulating and creating a crust on inner walls of pipes, which if allowed may lead to leakages and failures in addition to decreased generation efficiency. The remaining hazardous materials use is mainly associated with maintenance.

According to the BEKRA declarations provided by the Project Company, Biocide and Microbiocide, Sodium Hypochlorite, inhibitor, Pentane, Isopentane, Metilbuton, turbine oil and gear oil are used by Gurmat-1 and Gurmat-2 GPPs. The amount of chemicals are reported to the Ministry of Environment and Urbanization through the System for Reducing Major Industrial Accident Risks (i.e. BEKRA declarations).

No additional hazardous materials will be required during operation phases of Efe-7 and Efe-8 GPPs.

## 1.4 Land Ownership

All land acquisition processes for the Project GPPs are completed and title deeds/ right of way title deeds are obtained. Land acquisition was based on willingness and no expropriation or physical displacement occurred. The title deed information for Gurmat-1 GPP, Gurmat-2 GPPs, the Project GPPs and the pipeline/well locations for these GPPs are summarized in Table 1-7.

**Table 1-7. Title Deed Information for the Projects**

| Facility | Name of the GPP | Location (Neighborhood) | | Corresponding Lots/Parcels | Total Title Deed Area (m2) | Land Ownership |
|---|---|---|---|---|---|---|
| | | Neighborhood | Locality | | | |
| Gurmat-1 | Galip Hoca GPP | Alangullu | Aktas | 0/893 | 67,874.25 | Indsutrial facility having an administrative building (with 2 storeys), industrial building (with 2 storeys), industrial building (with 1 storey) and a pond |
| Gurmat-2 | Efe-1 GPP | Omerbeyli | Izgar | 0/2038 | 136,934 | Building plot |
| | Efe-1 GPP | Omerbeyli | Izgar | 1338 | 4,800 | Degraded orchard |
| | Efe-2 GPP | Mesudiye | Seyrekkovalik | 245/147 | 48,569 | Building plot |
| | Efe-3 GPP | Omerbeyli | Izgar | 0/1821 | 27,200 | Fig garden and agricultural land |
| | Efe-4 GPP | Omerbeyli | Izgar | 0/1365 | 9,660 | Agricultural land |
| Efeler GPP (Capacity Extension) | Efe-6 GPP | Alangullu | Degirmencivari | 0/926 | 16,083 | Geothermal Power Plant Site |
| | | Omerbeyli | Ozici | 0/603 | 20,270 | Fig garden |
| | Efe-7 GPP | Mesudiye | - | 141/121 | 6,115 | Agricultural land |
| | | Mesudiye | Seyrekkovalik | 141/133 | 4,008 | Fig garden and agricultural land |
| | | Mesudiye | Seyrekkovalik | 141/97 | 1,463 | Agricultural land |
| | | Mesudiye | Seyrekkovalik | 141/102 | 407,32 | Agricultural land |
| | | Mesudiye | Seyrekkovalik | 141/119 | 6,345 | Agricultural land |
| | | Mesudiye | Seyrekkovalik | 245/147 | 48,569 | Building plot |
| | Efe-8 GPP | Omerbeyli | Izgar | 115/5 | 7,507 | Agricultural land |
| | | Omerbeyli | Izgar | 115/6 | 9,880 | Agricultural land |
| | | Omerbeyli | Izgar | 115/7 | 19,317 | Agricultural land |
| | Efe-6 Pipeline Route* | Omerbeyli | Ozici | 0/604 | 7,260 | Fig garden |
| | | Omerbeyli | Ozici | 0/609 | 4,960 | Fig garden |
| | | Omerbeyli | Ozici | 0/674 | 4,800 | Fig garden |
| | | Omerbeyli | Ozici | 0/680 | 27,560 | Fig garden |
| | | Omerbeyli | Yaylakuyu | 0/1449 | 6,260 | Fig garden |
| | | Omerbeyli | Ozici | 0/605 | 7,060 | Fig garden |
| | | Omerbeyli | Ozici | 0/687 | 39,210 | Fig garden |
| | | Omerbeyli | Ozici | 0/607 | 7,180 | Agricultural land |

| Facility | Name of the GPP | Location (Neighborhood) | | Corresponding Lots/Parcels | Total Title Deed Area (m2) | Land Ownership |
|---|---|---|---|---|---|---|
| | | Neighborhood | Locality | | | |
| | | Omerbeyli | Ozici | 0/686 | 39,920 | Fig garden |
| | | Omerbeyli | Ozici | 0/610 | 9,720 | Fig garden |
| | | Omerbeyli | Koyici | 0/611 | 25,080 | Agricultural land and fig garden |
| | | Omerbeyli | Kadiyeri | 0/598 | 82,467 | Fig garden |
| | | Omerbeyli | Ozici | 0/618 | 77,735.83 | Fig garden |
| | | Omerbeyli | Alangullu Cayi | 0/1255 | 1,454.71 | Fig garden |
| | | Alangullu | Kilisealani | 0/662 | 1,315 | Fig garden |
| | Efe-6 Wells | Omerbeyli | - | 0/1592 | 2,645 | Fig garden |
| | | Omerbeyli | Ozici | 0/1591 | 11,645 | Fig garden |
| | | Omerbeyli | Ozici | 0/642 | 12,180 | Fig garden |
| | | Omerbeyli | Ozici | 0/641 | 2,980 | Fig garden |
| | | Omerbeyli | Kadiyeri | 0/591 | 16,640 | Fig garden |
| | | Hurriyet | Kilisealani | 121/1 | 4,680 | Fig garden |
| | | Hurriyet | Kilisealani | 121/64 | 3,760 | Fig garden |
| | | Alangullu | Cayalani | 0/846 | 11,479.34 | Fig garden |
| | | Alangullu | Kilisealani | 0/332 | 6,360 | Fig garden |
| | | Alangullu | Kilisealani | 0/678 | 3,080 | Fig garden |
| | | Alangullu | Kilisealani | 0/683 | 2,800 | Fig garden |
| | Efe-7 Wells | Omerbeyli | Alangullucayi | 0/1125 | 6,520 | Fig garden |
| | | Omerbeyli | Alangullucayi | 0/1128 | 5,370 | Fig garden |
| | | Mesudiye | - | 415/1 | 24,513.60 | Agricultural land |
| | | Mesudiye | Seyrek Kovalik | 86/91 | 23,214 | Agricultural land and fig garden |
| | | Camikebir | - | 44/97 | 19,889.97 | Agricultural land |
| | Efe-8 Wells | Omerbeyli | Izgar | 0/1821 | 27,200 | Fig garden and agricultural land |
| | | Omerbeyli | Yaylakuyu | 0/1452 | 10,800 | Fig garden |
| | | Erbeyli | Yaylakuyu | 171/17 | 10,643.08 | Fig garden |
| | | Erbeyli | Kasikci | 164/21 | 4,005.55 | Fig garden |
| | | Erbeyli | Kasikci | 164/22 | 4,206.59 | Fig garden |
| | | Erbeyli | Kasikci | 164/23 | 4,133.81 | Fig garden |
| | | Akcesme | Kasikci | 120/11 | 12,023.15 | Garden / Orchard |
| | | Erbeyli | Piynarlik | 105/27 | 6,397.40 | Fig garden |

## 1.5 Project Schedule

Schedule of the permitting, design, procurement and construction activities for Efe-6, Efe-7 and Efe-8 GPPs are jointly presented in Figure 1-5.

| Milestones/Tasks | 2014 | 2015 | 2016 | 2017 | | | | | | | | | | | | 2018 | | | | | | | | | | | | 2019 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | January | February | March | April | May | June | July | August | September | October | November | December | January | February | March | April | May | June | July | August | September | October | November | December | January | February | March | April | May | June |
| **Efe-6 GPP Project** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1. Permitting Process | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.1. Pre-license for Electricity Generation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2. EIA Positive Decision | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.3. Zoning Plan Approval | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.4. Construction Permit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.5. License for Electricity Generation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2. Design, Procurement and Construction | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.1. Construction Works | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2. Materials Supply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.3. Mechanical Works | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4. Electrical Works | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.5. Ministry Acceptance | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Efe-7 GPP Project** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1. Permitting Process | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.1. Pre-license for Electricity Generation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2. EIA Positive Decision | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.3. Zoning Plan Approval | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.4. Construction Permit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.5. License for Electricity Generation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2. Design, Procurement and Construction | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.1. Construction Works | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2. Materials Supply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.3. Mechanical Works | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4. Electrical Works | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.5. Ministry Acceptance | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Efe-8 GPP Project** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1. Permitting Process | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.1. Pre-license for Electricity Generation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2. EIA Positive Decision | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.3. Zoning Plan Approval | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.4. Construction Permit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.5. License for Electricity Generation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2. Design, Procurement and Construction | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.1. Construction Works | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2. Materials Supply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.3. Mechanical Works | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4. Electrical Works | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.5. Ministry Acceptance | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**Figure 1-5. Project Schedule for Efeler GPP (Efe-6, Efe-7, and Efe-8)**

# 2. Project Alternatives

Currently, geothermal energy constitutes less than 1% of world's electricity generation output (World Energy Council, 2016). However, it is an immense renewable energy source that can actually contribute up to 8.3% of the total world electricity, which is estimated to be sufficient to supply 17% of the world population (World Energy Council, 2013). Turkey's potential geothermal energy capacity is 31,500 MWt (Ministry of Energy and Natural Resources website, http://www.enerji.gov.tr/). Annual geothermal installations, total capacity and global rank of Turkey in terms of geothermal energy are provided in Table 2-1. As can be seen, Turkey's rapid build-up of geothermal energy capacity is ongoing for the past 3 years, with the country rank in terms of total installed capacity increasing from 10 to 7 in the given years. However, it is clear that even just based on the total potential of 31.5 MW and the utilized potential of only 0.8 GW, geothermal energy is still one of the most viable renewable generation technologies for Turkey.

**Table 2-1. New Installations, Total Installed Capacity and Global Rank in Installed Capacity for Geothermal Energy in Turkey**

| Year | Added Capacity (MW) | Total Installed Capacity (GW) (Approximate) | Global Rank in Installed Capacity |
|---|---|---|---|
| 2015* | 107 | 0.4 | 10 |
| 2016** | 159 | 0.6 | 8 |
| 2017*** | 197 | 0.8 | 7 |

*Source: * REN21, 2016; REN21, 2017; REN21, 2018*

This is also reflected in the Turkish Energy Policy, which draws attention to concentrating on domestic resources for meeting the increasing energy demands through use of resource diversity. The Strategic Plan (2015-2019) of the Ministry of Energy and Natural Resources aims to encourage use of renewable energy potential in Turkish economy. With this regard, following main goals are set by the National Renewable Energy Action Plan (Ministry of Energy and Natural Resources, 2014):

- Increasing the share of renewable energy in general energy consumption to 20% by 2023;
- Reaching total installed capacities of; 34,000 MW hydropower, 20,000 MW wind power, 1,000 MW geothermal power, 5,000 MW solar power (photovoltaic and concentrated) and 1,000 MW biomass power.

## 2.1 Site Location

Selected site for a geothermal power plant is required to be in the same place with the location of the geothermal resource in terms of feasibility and EHS performance of a GPP investment. Locating a GPP close to the geothermal resource it will utilize minimizes the costs, increases efficiency due to smaller losses of heat, increases environmental safety and decreases occupational and community health and safety risks, since the required length of pipelines between the plant and the wells can be significantly reduced, which in turn reduces potential of pipeline failures and associated occupational and community health and safety risks such as exposure to hot surfaces or soil/ surface water/ groundwater contamination risk. For site selection of the Project GPP units, the following aspects were considered:

- Proximity to identified production wells and reinjection wells for each unit.
- Elevation difference between the power plant sites and the production wells, which affect fluid pressures and pump suction pressure.
- Proximity to energy transmission lines or existing switchyards.
- Structure of land and land acquisition.
- Transportation and community safety (including increased traffic load and related community health and safety risks).

The selected sites for Efeler GPP Project units contributed to EHS safety by following means:

- Efe-6's location is adjacent to existing Gurmat-1 GPP, Efe-7's location is adjacent to Efe-2 unit of Gurmat-2 and Efe-8's location is adjacent to Efe-1 unit of Gurmat-2, which eliminated the need for construction of multiple additional access roads, resulting in decreased associated impacts in terms of environment and especially occupational and community health and safety.
- The shortest and most secure pipeline routes design ensured minimum interaction with communities and wild life.
- The pipeline routes were designed to minimize potential risks to irrigation channels in the area.
- For Efe-7, no new switchyard is required, which also minimizes associated E&S impacts. However, Efe-6 has its own switchyard and a new switchyard will be constructed for Efe-8, adjacent to Efe 1-3 and 4 GPPs, to provide for the additional capacities.

## 2.2 GPP Technology

Geothermal power plants today utilize one or a combination of three categories of power cycles: dry-steam, flash-steam, or binary, with final technology selection based mainly on geothermal fluid temperature and reservoir conditions. Therefore, a detailed evaluation of the data produced from test wells is fundamental for specification of the process technology and plant design, including production and reinjection wells' locations and the pipeline routes.

Based on exploration phase studies, existing data of currently operational GPPs and further feasibility studies considering the estimated enthalpy, chemical characteristics and capacity of the resource, binary system has been selected as the most feasible alternative for all Project units. Binary system allows for generation with fluid temperatures considerably lower than temperatures required for flash systems.

One of the key factors for selecting and designing components (turbines, condensers, gas removal systems, hydrogen sulfide abatement systems, etc.) for GPPs is non-condensable gases (NCG) content: In dry and flash steam cycles, the plant condenser separates the NCGs from the steam coming from the turbines. The nontoxic NCGs are either discharged to the atmosphere or removed by an abatement system. For binary systems, the system selected for Efeler GPP Project units, NCGs can be retained in a closed loop system. However, if the reservoir contains high NCG values, a closed loop is not applicable. Since the Germencik Geothermal Resource, the resource to be utilized by the Project, has a significantly high NCG% (see Section 4.2 for details), a closed loop system will not be used by any of the Efeler GPP Project units.

All GPPs within the scope of the Project will utilize a re-injection system, where the reject fluids are reinjected back into the reservoir, with no discharge to receiving environments. Therefore, impacts on soil, surface water and groundwater environments are avoided completely. In addition, drainage channels are constructed/will be constructed under the pipeline network. Together with the multiple emergency ponds either to be used jointly by units of Gürmat-1 and Gürmat-2 GPPs or separately for the Project units, these drainage channels will collect geothermal fluids in case of equipment failure. The collected fluids will also be reinjected. Reinjection practice also minimizes impacts on geothermal resource in terms of resource sustainability and any potential subsidence risk that may occur due to reservoir depletion.

## 2.3 Other Energy Generation Alternatives

Each energy generation technology has its own advantages and challenges in terms of construction and operation aspects (including costs, availability and flexibility) and the management of potential environmental and social impacts. Geothermal resources and hence geothermal power plants provide renewable and sustainable energy capabilities that are implemented for various areas of use (e.g. heating, greenhouse cultivation, energy generation etc.). Considering the overall impacts of energy projects, geothermal power plants are known to bring several benefits compared to its potential alternatives such as natural gas or coal plants.

As suggested by the illustrative comparison of the alternative energy generation technologies provided in Figure 2-1, electricity generation based on geothermal energy is considered a green technology as far as land use, $CO_2$ emissions, other air emissions and waste generation are concerned:

- Land use: Studies show that the geothermal development activities result in lower long-term land disturbance than other technologies such as coal, solar and wind energy. Over 30 years (the period of time commonly used for comparison of life cycle impacts of various power generation technologies), a geothermal facility uses 404 m2 of land per gigawatt hour, while a coal facility uses 3632 m2 per gigawatt hour (GEA, 2016). The activities that will be carried out in the sites include exploration, drilling and construction for which the significant portion of the site can be reclaimed after the construction phase.
- GHG Emissions: The case of very low global GHG emissions average of GPPs is not valid for the Project, due to high carbonate content of the Project reservoir rocks and subsequent high $CO_2$ content in the NCGs (See Section 4.2 for further GHG assessments).
- Waste Generation: As they do not involve waste products associated with energy generation, such as coal ash, the life time waste requirement for GPPs is significantly small.

Although lower than most conventional fossil fuel thermal plants and nuclear plants, water requirements for GPPs are considered to be relatively high. This is also not the case for the Project, since energy will be generated by binary systems in all three Project units, where water use requirements are very limited, especially when air cooling systems are used, as in the case of the Project GPPs.

Since GPPs utilize deep geothermal waters, the reservoir is of primary importance. Within the scope of the Project, geothermal fluid is pumped from the geothermal system and reinjected back to the reservoir to maintain the underground pressure and prevent the depletion of the source.

In addition, it can also be seen in Figure 2-1 that construction costs of GPPs are relatively high, mainly due to requirement of deep drills during both exploration and construction phases. However, in terms of availability to generate electricity when needed and in terms of operational flexibility based on demand, GPPs are highly advantageous, since utilizing geothermal as a base-load operation is typical and since they can also be used as flexible operations. With their very high capacity factors for energy generation, GPPs require much less transmission capacity to deliver the same amount of energy as other types of renewable resources. In addition, once the plant is operational it can be expected to provide electricity for many decades with proper maintenance in place (GEA, 2013).

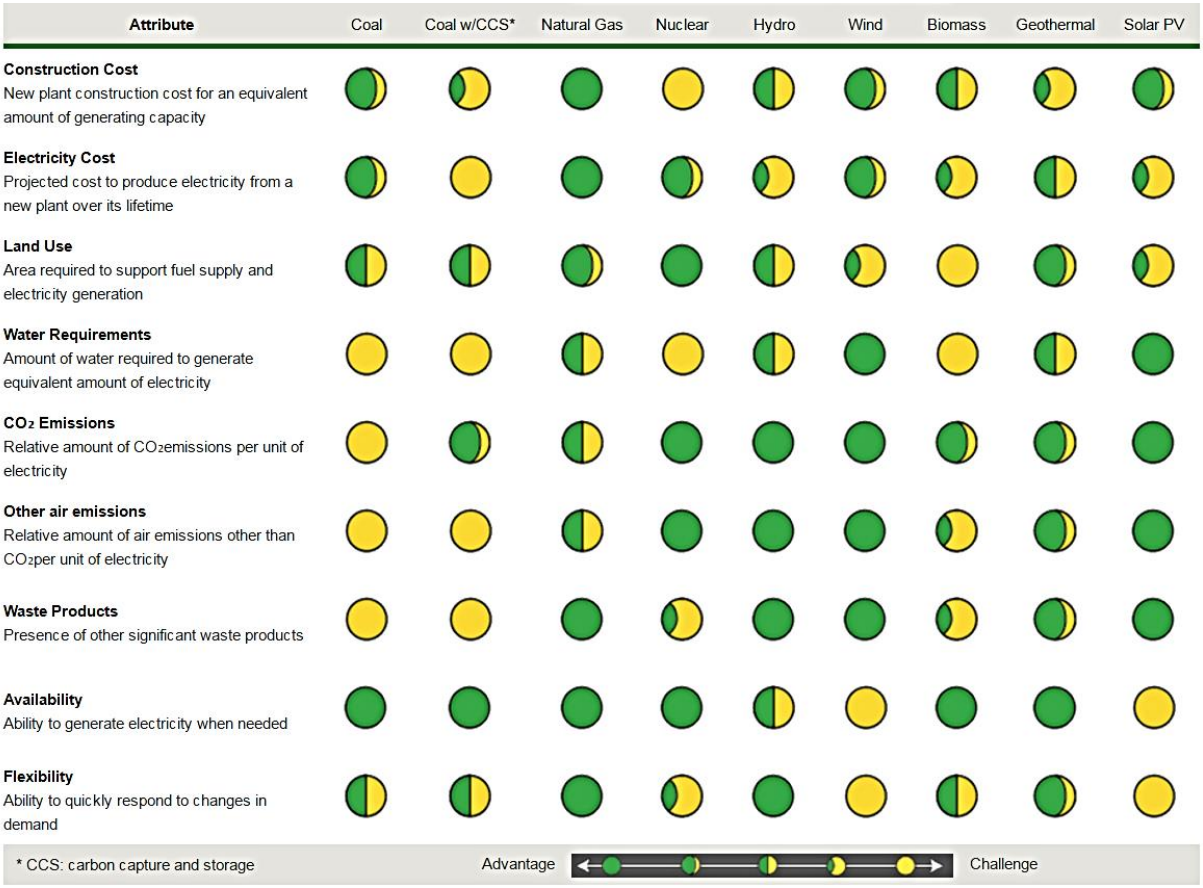



**Figure 2-1. Assessment of Relative Benefits and Impacts of Electricity Generation Technologies**

Source: Electric Power Research Institute, 2016

## 2.4 No Action Alternative

Efeler GPP Project, as an energy generation Project based on renewable resources, will provide public benefit by safeguarding the increasing energy demand of the country while reducing energy dependency. As with all energy development projects, the Project will bring benefits that are to be maximized and challenges that are to be managed properly, which would not occur if the Project is not realized. Potential economic, environmental and social consequences of opting for the No Project Alternative, where it is assumed that the Project will not be developed, would include following:

- To meet the energy demand of the country, alternative type(s) of energy development projects would be developed to supply the same amount of electricity annually. In case of a conventional thermal power plant of same energy yield using fossil fuels, additional mitigation measures would be required to be taken to manage environmental impacts in a sound and sustainable manner (land use, impacts on biodiversity, air emissions, water supply and use, impacts due fuel extraction/supply, waste/residue management, health and safety risks, etc.). If import fuel is used, no contribution would be provided to the limiting foreign energy dependency.
- National benefits due to payment of royalties to state could not be gained.
- In the case of No Project Alternative, the socioeconomic benefits expected due to increase in employment opportunities will not have been achieved as no area of employment for the locals and national professionals will be established.
- The socioeconomic benefits such as indirect national and local scale economic benefits and subsequent employment opportunities expected to be sourced from services/ materials procurement would also not be achieved. It should be noted that the Project will ensure that local businesses will be selected to the extent possible for procurement of services/ materials.

- Infrastructure development, emerging as another local scale indirect benefit that will be sourced through Project infrastructure development activities would not be achieved. Potential community development projects would also not be implemented.
- Project's adverse environmental and social impacts would not occur. However, Project's identified impacts will either be eliminated or scaled to a manageable level with mitigation measures and management practices, in line with international standards.
- The Project will be developed in compliance with EBRD Environmental and Social Policy (2014) and PRs. In this sense, it will be a Project that can form an example and benchmark for current and future businesses as well as environmental, social and health and safety authorities. Therefore, the Project does not only have benefits in terms of economy, employment and environment, but also in terms of EHS awareness in the local and in the national scale. In the case of No Project Alternative, this opportunity would not be realized.

In the absence of the Project, the identified potential environmental and social impacts that are to be managed properly throughout Project's life would not take place. However, above-mentioned benefits associated with the Project would also not be achieved. Considering that the Project's environmental and social impacts will be managed in line with international standards through implementation of an Environmental and Social Management System, the Project's identified environmental and social impacts are assessed to be manageable in a sustainable manner. Therefore, No Project Alternative is not evaluated as a viable alternative when the Project's potential benefits are considered.

# 3. Corporate Environmental and Social Management System

Gurmat Elektrik has adopted accredited management systems and is certified for the standards listed in Table 3-1 for its electric power generation activities. Certification of the management systems has been done by an accredited independent firm based on the audits conducted. To monitor and enhance implementation performance, audits are conducted and annual employee trainings are organized.

**Table 3-1. Certified Management Systems Applied by Gurmat Elektrik**

| Standard | Management System | Certificate Issue Date | Validity Date |
|---|---|---|---|
| ISO 9001:2008 | Quality Management System | October 22, 2018 | October 22, 2019 |
| ISO 14001:2004 | Environmental Management System | October 22, 2018 | October 22, 2019 |
| OHSAS 18001:2007 | Occupational Health and Safety Management System | October 2, 2017 | October 1, 2020 |

## 3.1 Policy

### 3.1.1 Environmental Policy

The Project Company has in place an Environmental Policy that seeks to minimize the impacts of its activities and to protect natural resources. The Policy states that, to continuously develop the established Environmental Management System and to avoid pollution, the Project Company will ensure compliance with related legislation and other applicable provisions, as well as provide continuous trainings to its personnel.

### 3.1.2 Occupational Health and Safety Policy

Gurmat Elektrik has a written Occupational Health and Safety Policy. Having adopted the “First Health and Safety” principle to ensure the health and safety of the employees and improve the working environment constantly, this Policy commits to:

- Avoidance of occupational health and safety risks by taking precautionary measures in advance;
- Ensuring continuous improvement of occupational, health and safety aspects;
- Compliance with the applicable occupational health and safety legislation and administrative arrangements and the codes of the institutions, of which Company is a member;
- Providing trainings to raise the awareness of the Project Company employees as well as the employees of Contractors regarding their individual occupational, health and safety responsibilities;
- Periodical review of the Occupational Health and Safety Policy to maintain its conformity to existing conditions;
- Exchanging the occupational health and safety experiences with the public and private sector institutions and the non-governmental organizations to ensure continuous development of the occupational health and safety notion.

## 3.2 Identification of Risks and Impacts

Project’s environmental and social impacts were identified by the national EIA studies and this ESIA study and presented in related section of this report. The Project E&S management practices, mainly conducted in the scope of the above mentioned management systems for quality, environment and OHS, will ensure full compliance with identified measures and related legislation/standards.

## 3.3 Management Programs

The main approach in ESMS implementation is ensuring consistency of all adopted E&S processes and procedures throughout the Project phases, with the required adaptation flexibility to ensure a management system that can cater to any transforming E&S issue related to the Project.

Within this scope, Gurmat Elektrik has in place a comprehensive list of plans, procedures, legal compliance lists, instruction and handbook documents, etc. The management plans and procures include but are not limited to; documents for implementation and monitoring of ISO 9001, ISO 14001 and OHSAS 18001, HR Procedure, OHS Procedure, Contractor Management Procedure, Emergency Action Plan, Internal Audit Procedure, Annual Training Plan, etc.

The Project Company also sets goals in a structured manner for quality management system, environmental management system and OHS management system.

All contractors are responsible of ensuring Gurmat Elektrik's standards are applied in activities they conduct. For management of contractors and to ensure that the firms in its supply chain are conducting their activities to Gurmat Elektrik's standards, following management programs are in place:

- Contractor Management Procedure
- Procedure for Informing Contractors
- Procurement Procedure
- Supplier Selection Form
- Authorized Suppliers List

## 3.4 Organizational Capacity

Gurmat Elektrik is fully responsible of ensuring environmental and social impacts of the Project are minimized and managed appropriately through implementation of its management systems, as well as ensuring all contractors are also adhering to its standards and management practices. The roles and responsibilities and required qualifications of the personnel working at Gurmat Elektrik are defined in written procedures. At the corporate level, an environmental engineer and a social responsibility projects officer, who are reporting to Assistant General Manager, have been assigned to coordinate Project's environmental and social aspects. At the site level, an environmental officer and an occupational health and safety officer, who are reporting to the Site Manager, have been assigned by Gurmat Elektrik.

A Health and Safety Committee has been established by Gurmat Elektrik. This Committee conducts monthly meetings under the leadership of the Site Manager with the attendance of related personnel including Maintenance Chief, Construction Chief, Occupational Health and Safety Experts of Gurmat Elektrik and Guris Construction (Contractor), Occupational Health and Safety Coordinator, Administrative Affairs/Human Resources Chief, Environment, Occupational Health and Safety Coordinator, Workplace Doctor, Technical Personnel (Electrical, Mechanical), and Main Employee Representative. In addition, weekly meetings are held with workers and engineers, regarding environmental and OHS issues.

## 3.5 Emergency Preparedness and Response

An Emergency Action Plan and related procedures regarding fires and various technical emergencies are in place. The Plan provides preventive measures and response strategies in case of accidents that may likely occur at a GPP of the Project's scale, as well as identifying responsibilities. See Section 4.7 for details.

## 3.6 Stakeholder Engagement

A Stakeholder Engagement Plan (SEP) is developed to manage the relations with all stakeholders of the Project. The Stakeholder Engagement Plan is designed to ensure the following:

- Identification of all stakeholders such as persons, groups or entities which are, or which consider themselves to be, affected by the Project or have a direct or indirect influence/impact on the Project.
- Defining activities for appropriate engagement with identified stakeholders during the life time of the Project, with an ultimate aim of establishing and maintaining constructive relationships, including public consultation and information disclosure strategies.

## 3.7 External Communications, Reporting and Grievance Mechanism

The ESIA Addendum, SEP, NTS and all relevant documentation will be disclosed in the website of the Project Company (http://www.mogan.com.tr/). Information will also be made available for affected communities through contextually appropriate mediums, such as the Project office, newspapers, public boards and neighborhood headmen's offices in the nearby settlements, throughout the lifetime of the Project. The key to maintaining good, constructive relations with Project Affected Peoples (PAPs) is ensuring Project affected communities are kept informed with regards to Project activities and follow up actions of any ongoing grievances in a regular and periodic schedule. Disclosure activities and strategy are detailed in the SEP and these activities and means of communicating with key stakeholders will be regularly reviewed and updated, and reflected accordingly in the next revisions of the SEP.

A grievance mechanism tailored for the local communities and the Project personnel, comprising of grievance procedure and associated grievance form and record of grievances is also developed. Grievances and details of responses will be recorded and reported internally on a regular basis. The grievance mechanism will be easily accessible for all stakeholders through stakeholder engagement activities detailed in the SEP.

## 3.8 Monitoring and Review

In case any non-compliance with Project standards or any measurement above limits provided by related legislation or standard is identified during monitoring of environmental, OHS and community health and safety performance, the non-compliance will be recorded and reported. Follow up activities will include investigation of the non-compliance immediately and in the next monitoring term to ensure E&S safety. Monitoring of performance of any recommended action proposed against non-compliance by E&S management personnel and if related, in consultation with the contractor HSE team or equivalent, will also be monitored and recorded in the following monitoring terms.

In addition to internal monitoring to be conducted for the Project, Lenders will also be monitoring the Project through their technical, E&S and legal consultants.

The SEP and the ESMS, including all of its management programs, will periodically be checked to reflect latest Project conditions and any changes to legislation and applicable standards.

# 4. Compliance with EBRD Performance Requirements

## 4.1 Air Emissions

### 4.1.1 Baseline

Of the 3 national EIA reports prepared for Efe-6, Efe-7 and Efe-8 GPPs, only the EIA Report of Efe-6 provides baseline air quality information. According to the information provided, there is only one air quality measurement station in Aydin province, located in the Central district. This station measures $PM^{10}$ and $SO_2$ parameters. According to results for the year 2014, average $PM_{10}$ was measured as 65 $mg/m^3$ and average $SO_2$ was measured as 7 $mg/m^3$. On the other hand, although Efe-7 and Efe-8 EIA reports do not provide any measurement results, it is stated in both reports that high $PM_{10}$ values are most likely associated with the fact that the measurement station is located adjacent to İzmir-Denizli highway and the relatively lower $S0_2$ measurements are most likely associated with the fact that the quality of the coal used in province is high.

### 4.1.2 Construction Phase

Emission calculation results provided in the national EIA reports for construction phase of Efe-6, Efe-7 and Efe-8 GPPs are provided below in Table 4-1. The Industrial Air Pollution Control Regulation (IAPCR) requires calculation of “contribution to air pollution” only when the limit values provided in it’s Annex 2, Table 2.1 are exceeded. Therefore, the national EIAs state that no modelling studies are conducted and required, since the calculated emission values are below the limits provided by the Regulation.

**Table 4-1. Construction Phase Air Emission Findings of Local EIAs**

| Emission Source | Emission | Efe-6 | Efe-7 | Efe-8 | IAPCR1 Limit |
|---|---|---|---|---|---|
| Construction equipment and vehicle emissions | Hydrocarbons | 1.25 | 0.022 | 0.022 | - |
| | Carbon monoxide | 0.42 | 0.09 | 0.09 | 50 |
| | Nitrous oxides | 1.56 | 0.07 | 0.07 | 4 |
| | Sulphur oxides | 0.28 | Not calculated | Not calculated | 6 |
| Topsoil stripping and excavation activities | Dust (Uncontrolled) | 0.99 | 0.62 (topsoil stripping) | 0.97 (topsoil stripping) | 1 |
| | | | 0.22 (excavation) | 0.45 (excavation) | 1 |
| | Dust (Controlled) | 0.5 | 0.32 (topsoil stripping) | 0.49 (topsoil stripping) | 1 |
| | | | 0.11 (excavation) | 0.22 (excavation) | 1 |

1 IAPCR, Annex 2, Table 2.1

### 4.1.3 Operation Phase

No impacts for operation phase emissions are identified or assessed by the Efe-6 EIA; whereas cumulative $H_2S$ emissions to be sourced from Gürmat-1, Gürmat-2 and Efeler GPPs are assessed through modelling by Efe-7 and Efe-8 EIAs. Results of the $H_2S$ modelling studies provided in the national EIAs for Efe-7 and Efe-8 are summarized below in Table 4-2. As can be seen from these results, the identified short term values are below the limit provided by IAPCR and therefore, both EIAs state that the GPPs will not have cumulative impacts in terms of $H_2S$ emissions.

**Table 4-2. Cumulative $H_2S$ Model Results Provided by Efe-7 and Efe-8 National EIAs**

| EIA | Cumulative Hourly Value | Short Term Value | IAPCR Limit (µg/m$^3$) |
|---|---|---|---|
| Efe-7 | 0.00001 | 0.000001 | 100 (hourly limit) |
| Efe-8 | 0.00001 | 0.000001 | 20 (short term limit) |

### 4.1.4 $H_2S$ Monitoring

A multitude of $H_2S$ detectors exist around the existing Gurmat Elektrik GPPs:

- 4 detectors at Gurmat-1 site,
- 4 detectors at Efe-1, Efe-3, Efe-4 sites,
- 15 detectors distributed in the area.

$H_2S$ monitoring is being conducted by an accredited environmental laboratory since February 2017 at 15 indicative points for existing GPPs (i.e. Gurmat-1, Gurmat-2 GPPs), which are also selected to represent conditions at vicinity settlements. As the Project GPPs are located adjacent to these GPPs, these points will also be indicative for the Project.

The monitoring study methodology and the results are summarized below:

- Passive sampling tubes are used on a monthly basis for monitoring and the results are compared with the short term limit value provided by IAPCR (i.e. 20 µg/m$^3$).
- According to the monitoring results covering February 2018 to May 2018, the measurements ranged between 0.01-0.30 µg/m$^3$, all of the measurements are significantly below the short term limit value of 20 µg/m$^3$.
- In all monitoring terms, the highest measured $H_2S$ concentration (0.30 µg/m$^3$) is only 1.5% of the limit value.

In addition, a separate monitoring study is also being conducted since 2009 at 8 sampling points that are indicative for Gurmat-1 GPP. A review of these results proved that, with the extreme measurement at 0.98 µg/m$^3$, all of the measured $H_2S$ concentrations at these points are also significantly below the limit value provided by IAPCR (i.e. highest measured concentration is only approximately 5% of the provided limit).

Considering these results, exceedance of the limit is not expected during joint operation of Gurmat-1, Gurmat-2 and Efeler GPP Project GPPs.

## 4.2 Greenhouse Gas Emissions

Potential greenhouse gas (GHG) emissions associated with exploration, construction and operation phases of the Project is assessed in this section.

### 4.2.1 Methodology and Scope of Assessment

Within the scope of Project GHG assessments, IPCC's Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) and Fifth Assessment Report (AR5) (IPCC, 2014) were used for detailed calculations, as recommended by EBRD.

According to the GHG Protocol developed by the World Resources Institute (WRI) and the World Business Council on Sustainable Development (WBCSD), GHG emissions are categorized into three different scopes, namely Scope 1, Scope 2 and Scope 3. Activities that generate direct and indirect emissions along a company's value chain, categorized into these three scopes, are presented in the figure given Figure 4-1. According to this figure and the Greenhouse Gas Protocol, the three scopes are defined as below:

- Scope 1 describes 'direct' greenhouse gas emissions from sources that are owned by or under the direct control of the company. The quantification of Scope 1 emissions is considered mandatory by the GHG Protocol. An example for the Project Scope 1 GHG emissions would be the GHG emissions sourced during energy generation from the geothermal fluid, as part of non-condensable gases (NCGs) that were normally stored in the geothermal reservoir.
- Scope 2 describes 'indirect' greenhouse gas emissions associated with the project that are a consequence of the activities of the company, but occur at sources owned or controlled by another company. Emissions associated with the generation of purchased electricity are included in Scope 2. The quantification of Scope 2 emissions is also considered mandatory by the GHG Protocol.
- Scope 3 describes wider greenhouse gas emissions that occur along the value chain. The quantification of Scope 3 emissions are considered optional by the GHG Protocol.

Scope 3 emissions consisting of the upstream emissions associated with the provision of materials used by the Project and the downstream emissions from the use of electricity generated by the Project are not included within the scope of this study.

GHGs include not only carbon dioxide emissions, but also the gases addressed in the Kyoto Protocol:

- Carbon dioxide ($CO_2$);
- Methane ($CH_4$);
- Nitrous oxide ($N_2O$);
- Sulphur hexafluoride ($SF_6$);
- Hydro fluorocarbons (HFC); and
- Per fluorocarbons (PFC).

Electricity generation utilizing intermediate to high temperature geothermal resources contribute to GHG emissions, due to natural occurrence of NCGs and therefore some GHGs in the geothermal fluid. GHG composition of NCGs in geothermal reservoirs consists in majority of $CO_2$, which constitutes about 95% of GHGs and methane ($CH_4$) which at the most can comprise about 1.5% in rare cases (World Energy Council, 2016). Therefore, these two GHGs are considered in the assessments for exploration phase drilling activities and operation phase generation activities.

Other GHGs considered in the assessment include emissions associated with fuel use during construction phase, and SF6, a significantly powerful GHG used in high voltage electrical equipment such as circuit breakers and switchgear.

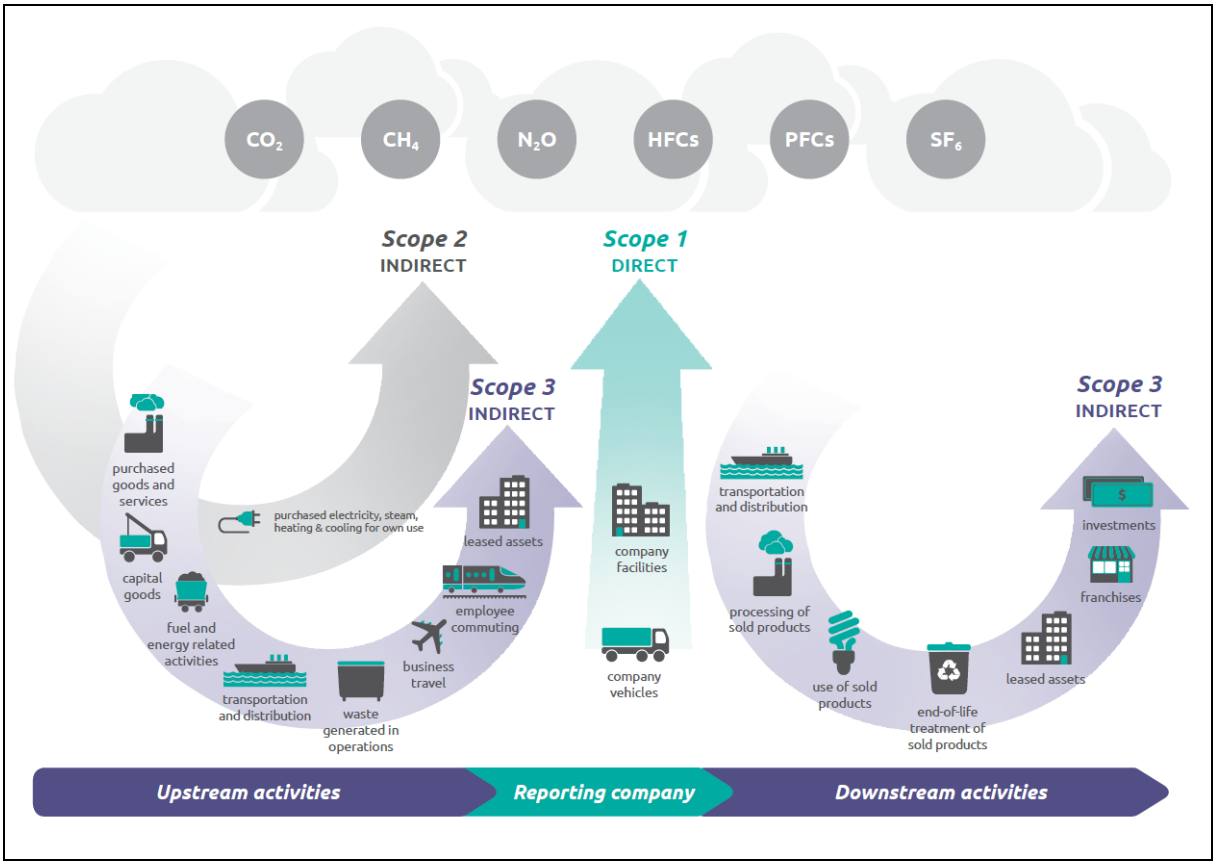



**Figure 4-1. GHG Sources**

*Source: Corporate Value Chain (Scope 3) Accounting and Reporting Standard, Greenhouse Gas Protocol*

It should be noted that HFC and PFCs are not emitted by any process associated with the Project; thus, are not considered any further within the assessment. It should also be noted that coal or other fossil fuels are not utilized for heating in existing or Project GPPs.

Non-$CO_2$ GHGs are calculated as "$CO_2$-equivalence" ($CO_2$-e) based on their contribution to the enhancement of the greenhouse effect. The $CO_2$-equivalence of a gas is calculated using an index called the Global Warming Potential (GWP). The GWPs for a variety of non-$CO_2$ GHGs are provided by IPCC Fifth Assessment Report (AR5) (IPCC, 2014). The GWPs of relevance to this assessment are presented below in Table 4-3.

**Table 4-3. Global Warming Potentials**

| Gas | Chemical Formula | IPCC 2014 Global Warming Potential |
|---|---|---|
| Carbon dioxide | $CO_2$ | 1 |
| Methane | $CH_4$ | 28 |
| Nitrous oxide | $N_2O$ | 265 |
| Sulfur hexafluoride | SF6 | 23,500 |

*Source: IPCC Fifth Assessment Report (AR5)(IPCC, 2014)*

Within the scope of this assessment, the NCG and GHG data provided by Gurmat was used. The NCG/ GHG data for Gurmat-1 and Efe-1 GPPs consist of actual measurements conducted at the plants, whereas the data for Efe-2, Efe-3 and Efe-4 is modelled based on actual measurements at Efe-1. In addition, continuous NCG monitoring is being conducted at wells indicative of these GPPs.

Gurmat states that the measurement results obtained at the wells verify the modelled results.

### 4.2.2 GHG Emissions from GPPs

As stated above, GHGs normally contained in the reservoir are emitted during energy generation activities. According to the World Energy Council (2016), the global average for operational GPP GHG emissions for the year 2001 was estimated as 122 g $CO_2$/kWh. However, high temperature reservoirs hosted in carbonate rocks lead to increased and sometimes excessive GHG emissions due to higher occurrence of $CO_2$ in these reservoirs. These reservoirs are not common but they occur especially in southwest Turkey. Therefore, extreme GHG emission values ranging between 900 to 1,300 g $CO_2$/kWh have been reported by power plants located in South West Turkey, utilizing the reservoirs of Menderes and Gediz grabens (ESMAP, 2016).

The Germencik field, the resource to be utilized by the Project, is located in the northern Menderes Graben along and south of the Menderes Massif. Therefore, the field reflects the high $CO_2$ conditions expected in the reservoirs located in the high carbonate rocks of Menderes graben. According to “the Numerical Reservoir Simulation of Germencik Geothermal Resource” prepared by Veizades & Associates Inc. (Veizades), Geologica Geothermal Group, Inc. (Geologica) and Leidos Inc. (Leidos), Germencik Geothermal Field is producing from Paleozoic-aged Menderes metamorphic rocks, and is a liquid-dominated mid-enthalpy geothermal system with a relatively high concentration of $CO_2$ in the reservoir fluid (Veizades & Geologica & Leidos, 2017).

It should be noted that GHG emission rates sourced from geothermal generation are not only affected by resource chemistry, including the resource temperature and rock type unique to the associated reservoir, but also the utilized GPP technology (dry steam, flash, binary). As stated in Chapter 2 of this report, NCGs can be retained in a closed loop system in binary systems, and then reinjected back into the reservoir with spent fluids, resulting in practically zero emissions. However, if the reservoir contains high NCG values, a closed loop is not applicable. This is due to the fact that as the steam passes through the vaporizer, it condenses and the high amount of NCGs are vented out of the vaporizer to prevent pressure build-up (ESMAP, 2016). Since the Germencik Geothermal Resource, the resource to be utilized by the Project, has a significantly high NCG content, reinjection of the NCGs will not be possible.

### 4.2.3 Baseline Emissions

The baseline emissions represent the pre-project emissions, usually zero where the project is a green-field development or the facility pre-investment annual emissions where the project comprises upgrading or refurbishment. The NCG data provided by Gurmat Elektrik for Gurmat-1 and Gurmat-2 GPPs (i.e. Efe-1, Efe-2, Efe-3 and Efe-4 GPP units) was used for this assessment. As the Project is a capacity extension project of the Gurmat-2, and since Gurmat-1, Gurmat-2 and the Project are all using the same reservoir, provided information is representative of the reservoir NCG content. It should also be noted that Efe-6 is in operation since August 2017. However, operation data for this GPP is included in baseline assessments since according to the provided data covering August 2017 to December 2017, the GHG measurement trend is not stabilized yet, as expected during the start-up. It should also be noted that due to equipment error and major overhaul, Gurmat-1 data covering July, August, September and October 2018 is missing. For the purposes of this assessment, the NCG content for these 4 months is assumed to be equal to the previous month (June 2016).

As described in Chapter 1, Efe-2 became operational in 2014, and the remaining Gurmat-2 GPPs became operational in 2015. As seen below in Figure 4-2, the first measurements indicate an initial NCG kg/kWh rate of 0.90 for the reservoir. Overall, as additional GPPs using the reservoir became operational, the NCG content kept decreasing as expected. This decrease corresponds to an approximate 0.4 kg/kWh over the course of 3 years for Gurmat-2 GPPs and approximately0.15 kg/kWh over the course of 2 years.

NCGs sourced from electricity generation of Gurmat 1 and Gurmat-2 GPPs consist of the GHGs ($CO_2$ and $CH_4$) and additionally the remaining NCGs ($H_2S$ and $N_2$). For calculation of Non-$CO_2$ GHGs, i.e. only $CH_4$ for this case, Global Warming Potential (GWP) values for 100-year time horizon provided by IPCC’s Fifth Assessment Report (AR5) *(IPCC, 2014*) were used.

GHG emissions change in time for the Gurmat-1 and Gurmat-2 (Efe 1-4) GPPs is provided in Figure 4-3. As can be seen, emissions are in a general decreasing trend, measured at around 0.75 tonnes $CO_2$-e /MWh in 2015 and decreased to around 0.4 tonnes $CO_2$-e /MWh in December 2017.

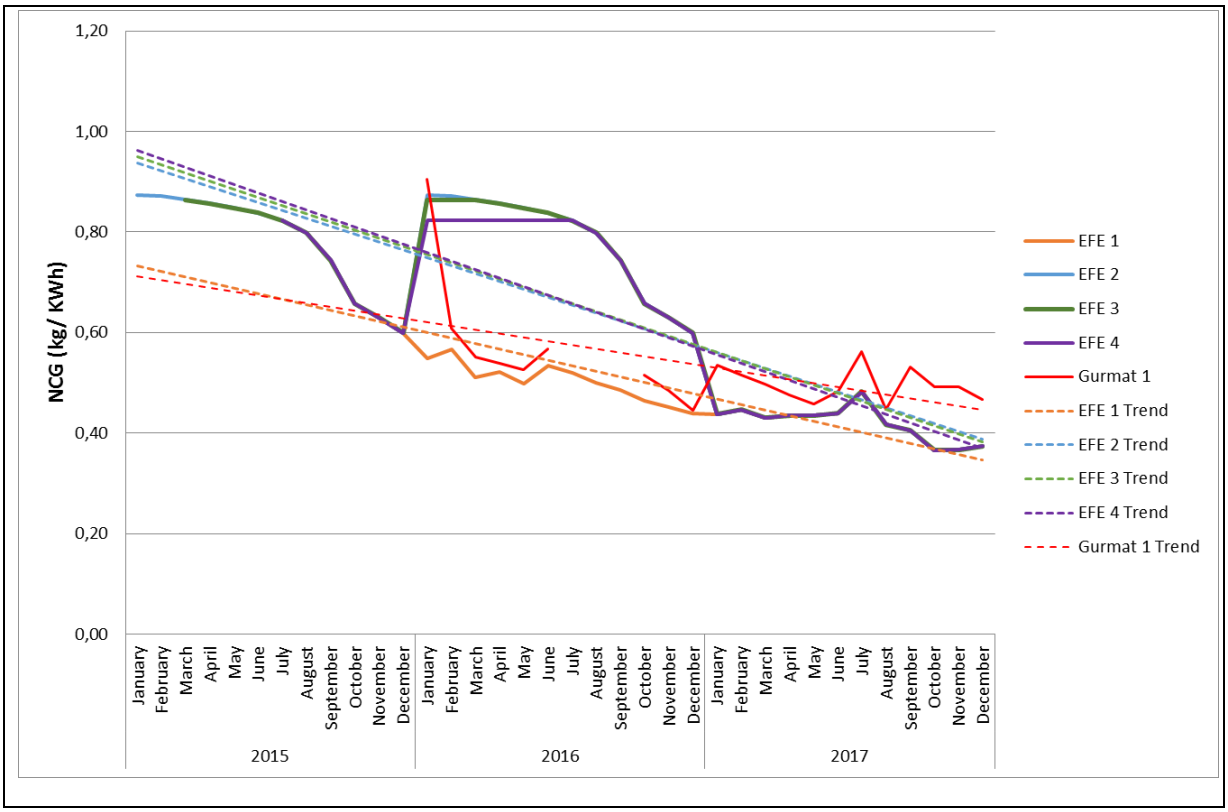



**Figure 4-2. NCG Emissions per kWh Energy Generated at Gurmat 1 and Gurmat-2 GPPs**

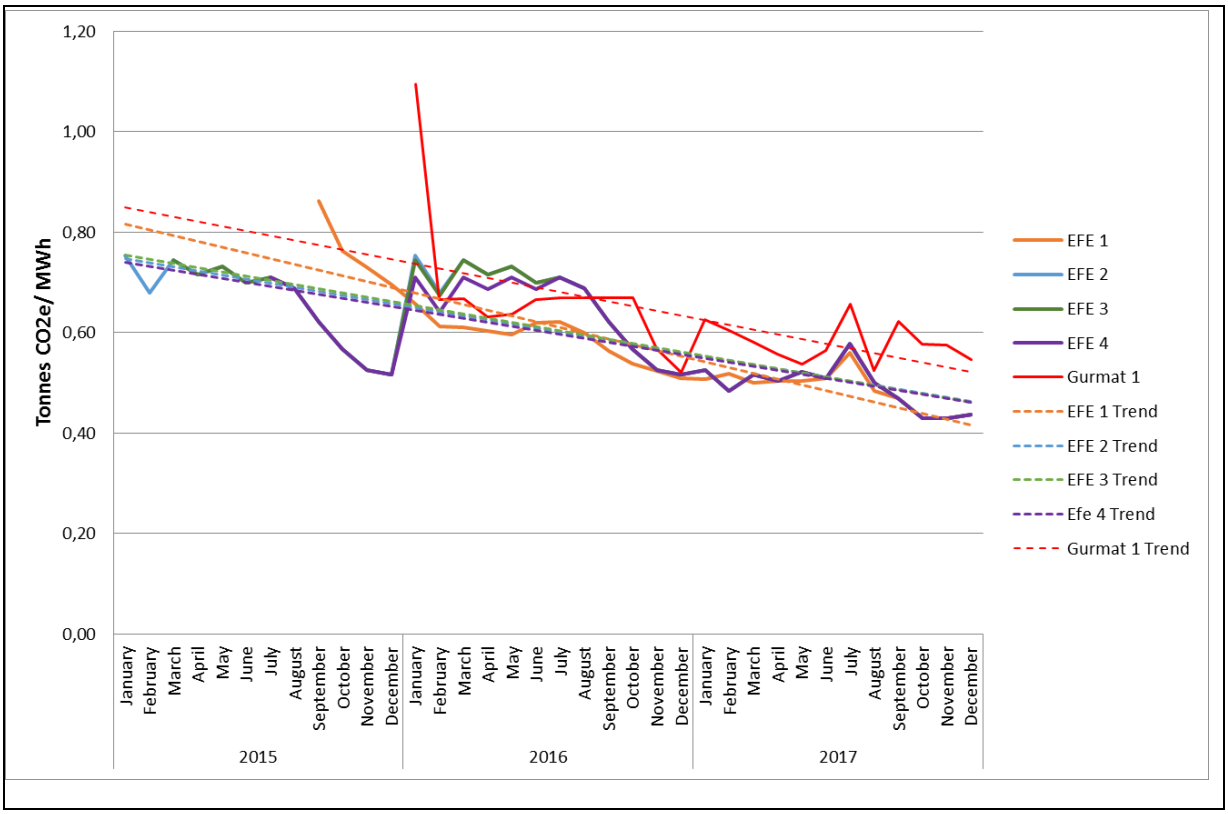



**Figure 4-3. GHG Emissions per MWh Energy Generated at Gurmat 1 and Gurmat-2 GPPs**

With the data covering January 2015 to December 2017 for Efe-1, Efe-2, Efe-3 and Efe-4 GPPs and data covering January 2016 to December 2017 for Gurmat-1 GPP; total generation output, total GHG emissions and therefore, baseline GHG emissions per MWh of energy generated are calculated and results are provided in Table 4-4. The average baseline emission value is estimated to be 0.61 tonnes $CO_2e$/ MWh for Gurmat-2 GPPs and 0.65 tonnes $CO_2e$/ MWh for Gurmat-1 GPP.

**Table 4-4. GHG Emissions Assessment for Gurmat-1 and Gurmat-2 GPPs**

| GPP | Total Output* (MWh) | Total GHG Emissions* (tonnes $CO_2e$) | Baseline GHG Emissions** (tonnes $CO_2e$/ MWh) |
|---|---|---|---|
| **Gurmat-1** | **754,987** | **494,067** | **0.65** |
| Efe-1 | 966,587 | 608,816 | 0.63 |
| Efe-2 | 665,290 | 403,029 | 0.61 |
| Efe-3 | 618,427 | 369,505 | 0.60 |
| Efe-4 | 547,560 | 315,327 | 0.58 |
| **Gurmat-2Average Baseline Emissions** | | | **0.61** |

**The timeframe covered for Total Output and Total GHG Emissions vary based on the data provided for each GPP.*
***Efe-1 values are measured, Efe-2, Efe-3, Efe-4 are modelled based on Efe-1 values. For Efe-2, Efe-3 and Efe-4, model results are verified by well measurements.*

In addition, $CO_2$ and $CH_4$ ratios in the total GHG emissions were also calculated using the data provided by Gurmat Elektrik and it was identified that for the Gurmat-2 GPPS, the GHG content of the geothermal fluid consists 99.38% of $CO_2$ and 0.62% of $CH_4$.

## 4.2.4 Project GHG Assessment

### 4.2.4.1 Exploration Phase

During the exploration phase, covering a total 14 months (9, 11 and 14 months for months EFE 6, EFE 7 and EFE 8 GPP units), GHG emissions sources consisted of diesel fuel used by service vehicles, rental trucks and generators of drill rigs, as well as geothermal fluid related emissions sourced from drilled test wells. Emissions from diesel fuel use are provided in Table 4-5 and data required for emissions related to venting of NCGs at test wells are provided in Table 4-6.

**Table 4-5. Exploration Phase Combustion Related GHG Emissions**

| Source | Fuel Use (kL/month) | Emission Factor* (kg/TJ fuel)* | | | Monthly Emissions (tonnes $CO_2e$/ month) | Exploration Phase Total Emissions (tonnes $CO_2e$) |
|---|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ | | |
| Service vehicles and rental trucks | 0.3 | 74,100 | 3.9 | 3.9 | 0.82 | 11.5 |
| Drill rig generators | 47 | 74,100 | 3.0 | 0.6 | 126.21 | 1767 |
| Total | | | | | 127.02 | 1778.5 |

**Source: IPCC, 2006*

**Table 4-6. Test Well Data**

| Total Geothermal Fluid Flow Rate (tonnes/h) | NCG Percentage of Geothermal Fluid (Mass Percentage) | GHG Percentage of Geothermal Fluid* (Mass Percentage) | GHG Stream (tonnes/h) | Total Test Duration (h) |
|---|---|---|---|---|
| 5295 | 1.51 | 0.99 | 52.4 | 1944 |

* Includes $CO_2$ and $CH_4$

Information on NCG (including $CO_2$ and $CH_4$) emitted during exploration phase is presented in Table 4-7.

**Table 4-7. NCG Information (for Exploration Phase)**

| Molecular Weight of One Mole NCG | Mol per Hour | Mol Percentage | | tonnes /h | |
|---|---|---|---|---|---|
| | | $CO_2e$ | $CH_4$ | $CO_2$ | $CH_4$ |
| 43.85* | 1,195,450 | 0.9896 | 0.0024 | 52.05 | 0.046 |

** Molecular Weight of $CO_2$ =44 gr/mol, Molecular Weight of $CH_4$ =16 gr/mol*

As a result;

- The GHG emission equivalent for the exploration phase of the Project from combustion related emissions is calculated as 1778.5 tonnes $CO_2e$.
- The GHG emission equivalent for the exploration phase of the Project from NCGs (i.e. test well emissions) is calculated as 53.34 tonnes $CO_2e$/h, corresponding to 103,689 tonnes $CO_2e$ for the entire exploration phase.
- With the 1,778.5 tonnes $CO_2e$ from combustion and 103,689 tonnes $CO_2e$ from test well venting, the total exploration phase emissions are calculated as 105,467 tonnes $CO_2e$.

#### 4.2.4.2 Construction Phase

The construction phases of Efeler GPPs are coinciding with each other, with Efe-6 already in operation and construction of Efe-7 ongoing. In total, the construction phase of the Project (starting with construction of Efe-6 and ending with construction of Efe-8) is estimated to last 40 months. Construction activities will require use of various heavy construction equipment and vehicles. The large diesel powered equipment will generate combustion gases including $CO_2$ and $N_2O$. In addition, the use of vehicles will also generate $CO_2$ and $N_2O$ emissions as they travel to and from, as well as on, the construction sites.

Total emissions generated due to use of heavy construction equipment and vehicles and use of generators during construction phase are summarized in Table 4-8

**Table 4-8. Construction Phase Combustion Related GHG Emissions**

| Source | Estimated Total Fuel Use (kL/month) | Emission Factor* (kg/TJ fuel) | | | Monthly Emissions (tonnes $CO_2$-e) | Construction PhaseTotal Emissions (tonnes $CO_2$-e) |
|---|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ | | |
| Heavy equipment and vehicles | 10 | 74,100 | 3.9 | 3.9 | 27.18 | 1,087.2 |
| Generators | 0.2 | 74,100 | 3.0 | 0.6 | 0.54 | 21.6 |
| TOTAL | | | | | 27.71 | 1,109 |

**Source: IPCC, 2006*

In addition, according to the information provided by Gurmat Elektrik, during the construction phase of Efe-6, 148.4 MWh electricity was purchased from the grid for various purposes, including heating (i.e. coal or other types of fossil fuels were not used for heating). Assuming Efe-7 and Efe-8 will use the same amount of electricity, the total purchased electricity will correspond to an approximate 445.2 MWh. Considering the 0.486 t $CO_2$/MWh $CO_2$ grid emission factor in Turkey provided by EBRD, emissions from purchased electricity corresponds to 216 tonnes $CO_2e$ for the entire 40 months construction phase (i.e. 64.9 $CO_2e$/annum).

As a result, The GHG emission equivalent for the construction phase of the Project from combustion related emissions and purchased electricity is estimated to be 1,325 tonnes $CO_2e$ for the 40 months construction phase (397.5 tonnes $CO_2e$/annum).

#### 4.2.4.3 Operation Phase

Efe-6, Efe-7 and Efe-8 GPPs will collectively contribute an installed capacity of 97.6 MWe and the GHG percentage of geothermal fluid is estimated as 0.99%. Information on Operation phase geothermal fluid flow and GHG stream is provided in Table 4-9.

**Table 4-9. Operation Phase Geothermal Fluid Flow and GHG Information**

| GPP | Total Geothermal Fluid Flow Rate (tonnes/h) | GHG Stream (tonnes/h) |
|---|---|---|
| Efe-6 | 1,295 | 12.82 |
| Efe-7 | 1,500 | 14.85 |
| Efe-8 | 2,500 | 24.75 |
| Total | 5,295 | 52.42 |

Information on GHGs emissions during operation phase are presented in Table 4-10, Table 4-11 and Table 4-12 for Efe-6, Efe-7 and Efe-8 GPPs. For the calculations, molecular weight of $CO_2$ was taken as 44 gr/mol and molecular weight of $CH_4$ was taken as 16 gr/mol, based on Efe-7 GPP and Efe-8 GPP National EIA Reports, whereas the Capacity factor was taken as 92% based on EMRA's Council Decision No: 4709-2, dated October 21, 2013.

**Table 4-10. NCG Information for Operation Phase of Efe-6 GPP**

| Molecular Weight of One Mole NCG | Mol per Hour | Mol Percentage | | Hourly GHG Emissions (tonnes/h) | | Annual GHG Emissions** (tonnes/annum) | | Annual GHG Emissions** (tonnes $CO_2e$/annum) | Annual GHG Emissions** (tones $CO_2e$/mWh |
|---|---|---|---|---|---|---|---|---|---|
| | | $CO_2$-e | $CH_4$ | $CO_2$ | $CH_4$ | $CO_2$ | $CH_4$ | | |
| 43.85* | 292,372 | 0.9896 | 0.0024 | 11.71 | 0.0103 | 101,567 | 2,508 | 104,075 | 0.58 |

**Table 4-11. NCG Information for Operation Phase of Efe-7 GPP**

| Molecular Weight of One Mole NCG | Mol per Hour | Mol Percentage | | Hourly GHG Emissions (tonnes/h) | | Annual GHG Emissions** (tonnes/annum) | | Annual GHG Emissions** (tonnes $CO_2e$/annum) | Annual GHG Emissions** (tones $CO_2e$/mWh |
|---|---|---|---|---|---|---|---|---|---|
| | | $CO_2$-e | $CH_4$ | $CO_2$ | $CH_4$ | $CO_2$ | $CH_4$ | | |
| 43.85* | 338,655 | 0.9896 | 0.0024 | 13.57 | 0.0119 | 117,645 | 2,905 | 120,550 | 0.60 |

**Table 4-12. NCG Information for Operation Phase of Efe-8 GPP**

| Molecular Weight of One Mole NCG | Mol per Hour | Mol Percentage | | Hourly GHG Emissions (tonnes/h) | | Annual GHG Emissions** (tonnes/annum) | | Annual GHG Emissions** (tonnes $CO_2e$/annum) | Annual GHG Emissions** (tones $CO_2e$/mWh |
|---|---|---|---|---|---|---|---|---|---|
| | | $CO_2$-e | $CH_4$ | $CO_2$ | $CH_4$ | $CO_2$ | $CH_4$ | | |
| 43.85* | 564,424 | 0.9896 | 0.0024 | 22.61 | 0.0199 | 196,076 | 4,841 | 200,918 | 0.50 |

Therefore, the GHG emission equivalent for the operation phase of the Project (Efe-6, Efe-7 and Efe-8 GPPs) from NCGs is calculated as 425,544 tonnes $CO_2$-e/year (for reservoir related emissions).

As seen in Figure 4-2 and Figure 4-3, the NCG and GHG content of the geothermal fluid is actually decreasing as the generation continues. This decrease will go on for some time and the NCG content will be stabilized in the future. The decrease in NCG content is directly related to the amount of emissions, which results in the reduction in NCG concentration of the reservoir waters, as the reinjected fluid's NCG content is smaller compared to the reservoir waters. Therefore, actual average annual emissions are expected to be less than the estimations provided here.

In addition, a list of the high voltage equipment that use $SF_6$ and their capacities are provided in Table 4-13. IPCC suggests that about 1% of $SF_6$ contained in the equipment is lost. Therefore considering the total SF6 capacity of 19.676 kg and the approximately 0.197 kg of $SF_6$ lost each year, 4.703 tonnes $CO_2$e/annum GHG emissions will be sourced from $SF_6$.

**Table 4-13. $SF_6$ Data for Equipment**

| Equipment | $SF_6$ capacity of Single Equipment (kg) | Number of Equipment | | | Total $SF_6$ capacity (kg) |
|---|---|---|---|---|---|
| | | Efe-6 | Efe-7 | Efe-8 | |
| 154 kV Circuit Breaker | 9.5 | 1 | 0 | 1 | 18 |
| 31.5 kV Circuit Breaker | 0.338 | 0 | 2 | 0 | 0.676 |
| **Total** | | | | | 19.676 |

Therefore, considering the 425,544 tonnes $CO_2$-e/annum operation phase GHG emissions sourced from the reservoir NCG content, and 4.703 tonnes $CO_2$e/annum emissions sourced from $SF_6$ containing equipment, the total operation phase emissions of the Project is calculated as 425,549 tonnes $CO_2$e/year.

#### 4.2.4.4 GHG Emissions Assessment Summary

##### 4.2.4.4.1 GHG Emissions Summary for Gurmat-2 GPPs (Predicted Emissions Comparison with Calculated Actual Emissions)

With an annual operating time of 8,672 hour (*WS Atkins International Ltd., 2014)* for each GPP Project, the total annual GHG emissions projected to be sourced from Gurmat-2 GPPs (Efe-1, Efe-2, Efe-3 and Efe-4) are provided below in Table 4-14, together with most recent estimations based on the data provided by Gurmat. It should be noted that, the actual emissions estimated within the scope of this study are based on measurement data for Efe-1, and modelled data for Efe-2, Efe-3 and Efe-4 (modelled based on Efe-1 measurement data). On the other hand, periodic measurements are conducted at wells. Gurmat stated that the well measurements verify the modelled results.

As can be seen, estimations based on the actual emissions data of Efe-1 and modelled data of Efe-2, Efe-3 and Efe-4 provided by Gurmat indicate that the GHG content of the reservoir is decreasing in time, as expected, due to decrease in NCG content of the reservoir caused by continuous emissions to atmosphere as the GPPs operate. The predicted total for Efe-1, Efe-2, Efe-3 and Efe-4 GPPs was 893,673 $tCO_2e$/ annum, which corresponds to 0.84 $tCO_2e$/ MWh (WS Atkins International Ltd., 2014); whereas the actual emissions occurred as 642,831 $tCO_2e$/ annum or 0.61 $tCO_2e$/ MWh.

**Table 4-14. Total Predicted and Current Annual Reservoir Related GHG Emissions for Gurmat-2 GPPs (Efe-1, Efe-2, Efe-3 and Efe-4)**

| | Generation (MWh / annum) | GHG Emissions** ($tCO_2e$ / hr) | GHG Emissions ($tCO_2e$ /annum) | GHG Emissions ($tCO_2e$ / MWh) |
|---|---|---|---|---|
| Predicted/ Efe-1* | NA | 42.62 | 369,600 | NA |
| Predicted/ Efe-2* | NA | 20.98 | 177,581 | NA |
| Predicted/ Efe-3* | NA | 19.98 | 173,250 | NA |
| Predicted/ Efe-4* | NA | 19.98 | 173,242 | NA |
| **Predicted/ Total*** | **1,069,307** | **103.06** | **893,673** | **0.84** |
| Efe-1 (average for August 2015 - December 2017) (based on measurements) | 399,967 | 28,76 | 251,924 | 0.63 |
| Efe-2 (average for January 2015 - December 2017) (modelled based on Efe-1 measurements, verified by well measurements) | 221,763 | 15,34 | 134,343 | 0.61 |
| Efe-3 (average for March 2015 - December 2017) (modelled based on Efe-1 measurements, verified by well measurements) | 218,268 | 14,89 | 130,413 | 0.60 |
| Efe-4 (average for July 2015 - December 2017) (modelled based on Efe-1 measurements, verified by well measurements) | 219,024 | 14,40 | 126,130 | 0.58 |
| **Actual/ Total** | 1,059,023 | **73.38** | **642,831** | **0.61** |

** Source: Gurmat-2 Geothermal Power Plant EIA Addendum (WS Atkins International Ltd., 2014),*
*** Annual operating hours are assumed to be 8,672 in the actual case.*

#### 4.2.4.4.2 GHG Emissions Summary for the Capacity Expansion Project

A summary of GHG emissions from Efe-6, Efe-7 and Efe-8 GPPs is presented in Table 4-15

**Table 4-15. Summary of GHG Emissions from Efe-6, Efe-7 and EFe-8**

| Project Phase | Duration | Total Emissions (tonnes CO2-e) |
|---|---|---|
| Exploration Phase/ (Combustion) | 14 months | 1,778.5 |
| Exploration Phase/ (NCGs from test wells) | 1944 hours | 103,689 |
| Exploration Phase/ Total | 14 months | 105,467 |
| Construction Phase/ (Combustion) | 40 months | 1,109 |
| Construction Phase/ (Purchased Electricity) | 40 months | 216 |
| Construction Phase/ Total | 40 months | 1,325 |
| Operation Phase (NCGs) | per annum | 425,544 |
| Operation Phase (SF6) | per annum | 4.703 |
| Operation Phase Total | per annum | 425,549 |

#### 4.2.4.4.3 GHG Emissions Summary for Gurmat 2 and the Capacity Expansion Project GPPs

Considering an annual operating time of 8,672 for each GPP Project, the total annual GHG emissions to be sourced from Gurmat-1 GPP,Gurmat-2 GPPs (Efe-1, Efe-2, Efe-3 and Efe-4) and the capacity extension project (Efe-6, Efe-7 and Efe-8) during operation phase are provided below in Table 4-16.

**Table 4-16. Total Reservoir Related GHG Emissions Estimation for Gurmat-2 and Capacity Extension Project GPPs (Efe-6, Efe-7 and Efe-8)**

| GPP | Generation (MWh / annum) | GHG Emissions ($tCO_2e$ / hr) | GHG Emissions** ($tCO_2e$ /annum) | GHG Emissions ($tCO_2e$ / MWh) |
|---|---|---|---|---|
| Baseline Emissions Gurmat-1 | 377,493 | 28,20 | 247,034 | 0,65 |
| Baseline Emissions Gurmat-2 (Efe-1, Efe-2, Efe-3, Efe-4) | 1,059,023 | 73.38 | 642,831 | 0.61 |
| Capacity Extension/ Efe-6 | 180,800* | 12.00 | 104,075 | 0.58 |
| Capacity Extension/ Efe-7 | 200,000* | 13.90 | 120,550 | 0.60 |
| Capacity Extension/ Efe-8 | 400,000* | 23.17 | 200,918 | 0.50 |
| **Capacity Extension Total (Efe-6, Efe-7, Efe-8)** | **780,800** | **49.07** | **425,544** | **0.55** |
| **Gurmat 2 and Capacity Extension Total** | **1,839,823** | **122.45** | **1,068,375** | **0.59** |
| **Gurmat-1, Gurmat-2 and Capacity Extension Total** | **2,217,316** | **150.65** | **1,315,409** | **0.62** |

** Source: Efe-6 GPP National EIA Report, August 2016; Efe-7 GPP National EIA Report, April 2017; Efe-8 GPP National EIA Report, April 2017.*
***Excluding SF6 emissions, since SF6 emissions correspond to 0.001% of reservoir related emissions.*

As of November 2014, the EBRD's Environmental and Social Policy (ESP) requires any Project with anticipated GHG emissions of more than 25,000 tonnes $CO_2e$/year to report its emissions annually. Therefore, with GHG emissions estimated at 425,544 tonnes $CO_2e$/annum and total GHG emissions together with Gurmat-2 GPP estimated at 1,315,409 tonnes $CO_2e$/annum, annual reporting to the Bank is required.

### Comparison of Actual Emissions and Predicted Emissions for Efe-6 GPP

As stated prior, Efe-6 GPP is in operation since August 2017 and Guris provided NCG data for this GPP covering August 2017 to December 2017. Although emissions trend of this GPP is not stabilized within the provided data timeframe, as expected during start-up, the actual emissions from this GPP is compared to the emissions predicted within the scope of this GHGs assessment.

As can be seen from the trendline provided in Figure 4-4, where NCG Emissions per kWh Energy Generated at Efe-6 GPP is presented, the average NCG emissions are around 0.49 kg/kWh. On the other hand, when the trendline for the GHG emissions per MWh energy generated given in Figure 4-5 is observed, it is identified that the average GHG emissions from this GPP are around 0.57 tonnes $CO_2$e/MWh (the actual average is 0.569 tonnes $CO_2$e/MWh according to calculations made). As can be seen in Table 4-16, the predicted GHG emissions for Efe-6 is 0.58 tonnes $CO_2$e/MWh, meaning that the actual emissions trend is already below the predicted values. As stated, a decreasing trend for emissions of each GPP is expected as the reservoir NCG contect decreases due to emissions. See Section 4.2.5 below for assessments on reservoir $CO_2$ evolution over time.

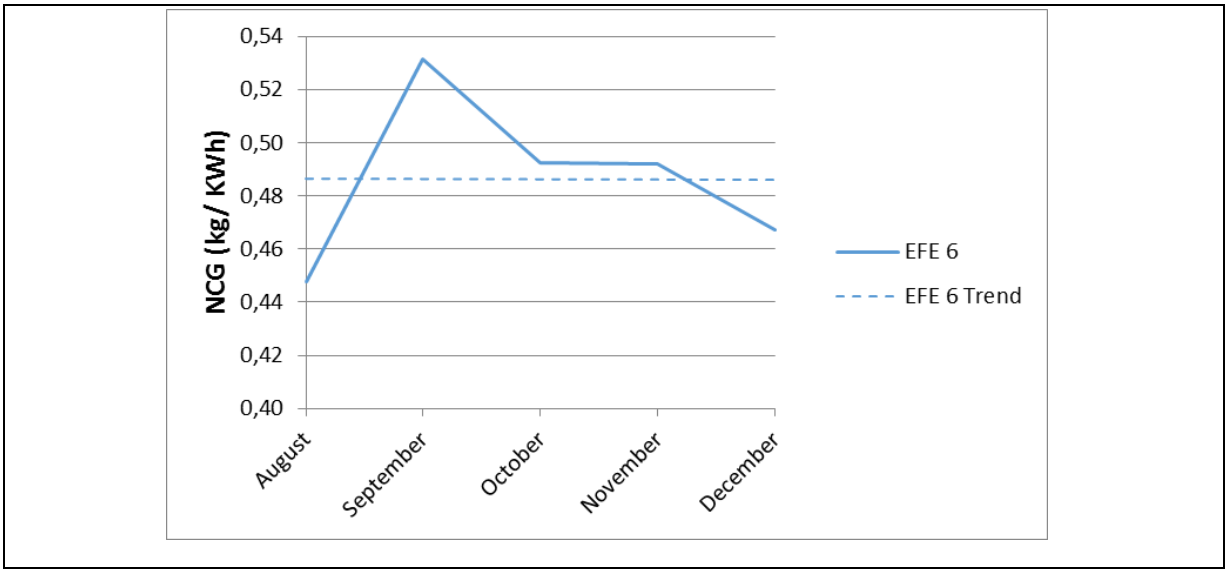



**Figure 4-4. NCG Emissions per kWh Energy Generated at Efe-6 GPP**

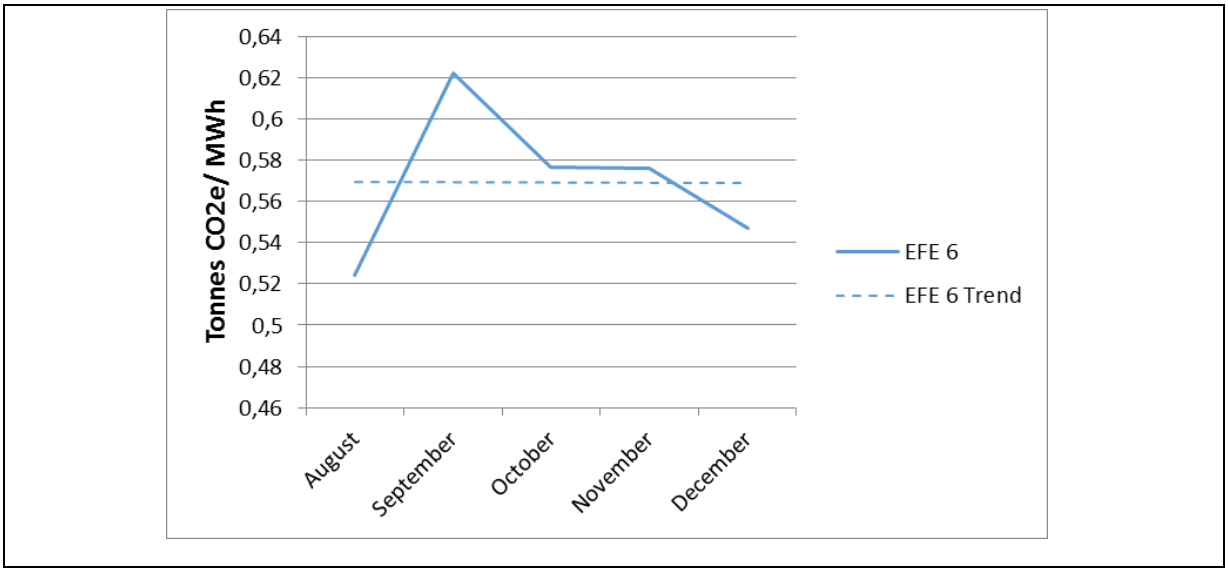



**Figure 4-5. GHG Emissions per MWh Energy Generated at Efe-6 GPP**

### 4.2.5 Numerical Reservoir Simulation and $CO_2$ Evolution over Time

Numerical Reservoir Simulation of Germencik Geothermal Resource Study (May 2017) was conducted by Veizade, Geologica and Leidos to investigate the potential for expansion of power generating capacity at Germencik Geothermal License. The work method for developing the numerical reservoir simulation study consisted of:

- Conceptual model of Germencik Geothermal Resource
- Data evaluation and analysis of Germencik Geothermal Field
- Numerical modelling grid
- Natural state model
- History match
- Forecasting

Starting with the end of January 2017, the model was run for 19.75 years (i.e. until 2035 year-end).The modelling was conducted for 4 different production and injection scenarios, variants being the production and injection well configurations and timing of production/reinjection for the Gurmat-2 and the Project GPPs. Of these scenarios, only Scenario D considers operation of all Project GPPs (Efe-6, Efe-7 and Efe-8); which reflects the actual case.

The initial $CO_2$ concentration and evolution over time diverges per well and reservoir. The $CO_2$ time evolution trend due to power plant operation in Germencik geothermal field has been reported previously under PLUTO framework (EBRD, 2016). The NCG data of Gurmat-1 (47.4 MWe dual flash plant) from the Germencik area has been analyzed. Since 2009, the plant has been in service in the area, with the consequent extraction of NCGs from the geothermal resources and the re-injection of condensate free of NCGs. The time evolution of NCG concentration at GPP inlet over six years of operation have been correlated (effects of power plant re-start as well as of the production tests of neighboring plants have been considered as outliers) and the more realistic fitting based on scientific literature suggest a long-term carbon emission factor of 0.53 $tCO_2$/MWh (or 530 g/kWh) for this plant in absence of any additional carbon abatement measures.

The Numerical Reservoir Simulation of Germencik Geothermal Resource Study (May 2017) also includes forecast for $CO_2$ evolution with time. Results for Scenario D are provided in Table 4-17.

**Table 4-17. Forecasted $CO_2$ Mass Fraction Values for Gurmat-1, Gurmat-2 and Capacity Extension Project Production Wells**

| | Gurmat-1 | Gurmat-2 | | | | Capacity Extension Project | | |
|---|---|---|---|---|---|---|---|---|
| | | Efe-1 | Efe-2 | Efe-3 | Efe-4 | Efe-6 | Efe-7 | Efe-8 |
| January 2017 | 0.016 | 0.015 | 0.020 | 0.021 | 0.021 | na | na | na |
| December 2025 | 0.005 | 0.007 | 0.007 | 0.016 | 0.012 | 0.009 | 0.011 | 0.012 |
| December 2035 | 0.003 | 0.004 | 0.005 | 0.008 | 0.009 | 0.005 | 0.006 | 0.007 |

*Source: The Numerical Reservoir Simulation of Germencik Geothermal Resource (Veizades & Geologica & Leidos, 2017)*

As can be seen in Table 4-17, modelling results and the assessment concluded that the $CO_2$ mass fraction of the produced fluid declines significantly over time. This decrease is attributed to the depletion of $CO_2$ in the reinjected water, as well as influx of water without $CO_2$ from the lateral boundaries (*Veizades & Geologica & Leidos, 2017).*

The $CO_2$ grid emission factor in Turkey is estimated as 0.486 t $CO_2$/MWh for the year 2018 and presents a fluctuating increase to 0.5 t $CO_2$/MWh in 2022 (*EBRD, 2015*). As detailed throughout this assessment, in the long run, the $CO_2$ emissions will be approaching the $CO_2$ grid emission factor in Turkey.

### 4.2.6 Current and Planned Monitoring

As stated, online/ continuous NCG measurements are conducted at Efe-1 GPP site and the results of Efe-1 measurements are used to model Efe-2, Efe-3 and Efe-4 GPPs' emissions. The model results are than verified by measurements conducted at wells that are indicative of the GPPs.

The Project GPPs (i.e. Efe-6, Efe-7 and Efe-8) on the other hand all have/ will have their own online/ continuous NCG measurement equipment at the GPPs and continuous monitoring will be conducted:

- Online/ continuous monitoring system is installed and currently operated at Efe-6.
- Online/ continuous monitoring system installed at Efe-7; and will be online once the plant is operational.
- Continuous online monitoring system is included in the design of Efe-8; this will be installed in due course.

In addition, throughout the Project lifetime, Gurmat will continue conducting NCG measurements at wells that are indicative of each Gurmat GPP, which will provide additional NCG data.

## 4.3 Water Resources

There are various issues associated with construction and operation activities of GPPs that may have potential impacts on water availability and surface water/groundwater quality. Potential impacts associated with the Project and existing or proposed measures and management practices for prevention/mitigation of these impacts are summarized in this section.

Water use requirements and wastewater management methods are presented in Table 4-1. For Efe-7 and Efe-8, utility water and water to be used by personnel will be provided by Aydin Metropolitan Municipality, within the scope of an agreement, whereas for Efe-6 utility water and water to be used by personnel is provided from the municipal water supply network. On the other hand, drinking water will be provided by procurement for all GPPs.

**Table 4-18. Water Use and Wastewater Management during Construction and Operation Phases**

| Water Use | Efe-6 GPP | Efe-7 GPP | Efe-8 GPP |
|---|---|---|---|
| **Construction Phase** | | | |
| Water Use | | | |
| Domestic purposes (drinking and utility) | 10.15 $m^3$/day | 45.25 $m^3$/day | 72.40 $m^3$/day |
| Dust suppression | 5.00 $m^3$/day | Not indicated | Not indicated |
| Total | 15.15 $m^3$/day | 45.25 $m^3$/day | 72.40 $m^3$/day |
| Wastewater | | | |
| Domestic Wastewater Generation | 10.15 $m^3$/day | 45.25 $m^3$/day | 72.40 $m^3$/day |
| Wastewater Management Method | Existing WWTP located at the Gurmat-1 site (10 $m^3$/day capacity) | Collection in impermeable cesspools and transport to Aydin Metropolitan Municipality WWTP by sewage trucks | Collection in impermeable cesspools and transport to Aydin Metropolitan Municipality WWTP by sewage trucks |
| **Operation Phase** | | | |
| Water Use | | | |
| Water Use for Domestic Purposes (drinking and utility) | 8.12 $m^3$/day | Not provided (Can be calculated as 1.45 $m^3$/day)* | Not provided (Can be calculated as 2.17 $m^3$/day)** |
| Wastewater | | | |
| Domestic Wastewater Generation | 8.12 $m^3$/day | 1.45 $m^3$/day*** | 2.17 $m^3$/day*** |
| Wastewater Management Method | Existing WWTP located at the Gurmat-1 site (10 $m^3$/day capacity) | Construction of a 5 $m^3$/day capacity WWTP. | Construction of a 6 $m^3$/day capacity WWTP |

** Calculated for 8 personnel, based on same consumption amount assumption (181 liter/person/day) used for construction phase by the EIA.*
*** For 12 personnel based on same consumption amount assumption (181 liter/person/day) used for construction phase by the EIA.*
**** Value not provided by the EIAs. It is assumed that entire domestic water requirement will turn into wastewater.*
*Source: Efe-6 GPP National EIA Report, August 2016; Efe-7 GPP National EIA Report, April 2017; Efe-8 GPP National EIA Report, April 2017.*

Potential impacts on water quantity/quality that may be sourced from the Project's construction and operation activities are summarized below, together with design and management related measures:

- Utility water and potable water will be supplied by purchasing and no groundwater or surface water resource will be used during construction and operation phases. Therefore, there will be no on-site impact on water availability.
- The Projects utilize air cooling condenser systems. Therefore, operation phase water requirement is kept to a minimum, consisting mainly of domestic water requirement for personnel.
- The production and reinjection wells drilled/to be drilled utilize leak proof well casings and blowout prevention equipment, which will prevent interaction of geothermal water and shallow groundwater.
- Following the completion of drilling, some test studies are conducted for determination of physical and chemical characteristics of the geothermal waters that will be utilized for energy generation. If found to be suitable, the collected geothermal waters are moved to the geothermal fluid storage ponds that are already in place as shared ponds (Efe-6 using the existing Gurmat-1 geothermal fluid storage pond, Efe-7 using the existing Efe-2 geothermal fluid storage pond and Efe-8 using the existing Efe-1 geothermal fluid storage pond). The geothermal fluids collected in these ponds are later reinjected back in to the reservoir. In case this option is not possible, the geothermal fluids collected in the mud pools (i.e. not the geothermal fluid ponds but the impermeable ponds located in well sites) will only be discharged to receiving environments once related tests are conducted by licensed laboratories and compliance with discharge limits set by Water Pollution Control Regulation is ensured. Required treatment will be implemented prior to discharge in case the test results indicate that the tested parameters are not in compliance with the Regulation.
- The Project will utilize deep, high temperature groundwater for energy generation and will reinject the spent fluids back into the reservoir. The wells have/will have leak-proof well casings in order to ensure no interaction of deep and shallow groundwater resources occur.
- In case of rare emergencies, existing geothermal fluid storage ponds of Gurmat-1 and Gurmat 2 GPPs will be utilized. Efe-6 is jointly using the existing 12,500 $m^3$ capacity geothermal fluid storage pond of Gurmat-1 GPP, in addition to a newly constructed 7,500 $m^3$ emergency pond. Efe-7 will use the existing Efe-2 geothermal fluid storage pond and Efe-8 will use the existing Efe-1 geothermal fluid storage pond. In addition, all generation activities will be halted in case of any emergency situation where the existing storage capacities are likely to be surpassed. The fluids stored in these ponds will later be reinjected back into the reservoir.
- During the construction phase of Efe-6, domestic wastewater was collected in septic tanks and transported off-site as required and currently, the existing, permitted WWTP of Gurmat-1 is being used. Efe-7 and Efe-8 on the other hand will use impermeable cesspools for collection of domestic wastewater during both construction and operation phases. The wastewater collected in these cesspools will be transported to Aydin Metropolitan Municipality WWTP by sewage trucks, within the scope of related agreements.
- According to the national EIA report for Efe-6, there are no natural river drainage patterns in the vicinity since groundwater and surface water is controlled by drainage and irrigation channels. Pipeline routes for all Project GPPs were designed to ensure these channels are not impacted by the Project activities.

### 4.3.1 Groundwater Monitoring

In the vicinity of Gurmat Elektrik GPPs, groundwater monitoring studies are being conducted at 2 sampling points; one located 1.1 km east of Efe-1, 3, 4, 8 GPPs' site, adjacent to southern border of Fig Investigation Site Directorate of Ministry of Food, Agriculture and Husbandry and one in 1.1 km west of Efe-1, 3, 4, 8 site (i.e. 1.3 km northeast of Efe-2, 7 GPPs' site. Monitoring has been conducted for 5 terms to date, in March 2012, November 2015, April 2016, November 2016 and May, 2017.

During the May 2017 term, only total phosphorus, $NO_2$ and $NO_3$ of the measured parameters presented Class 4 water quality (lowest quality of the 4 ranges provided by Regulation on Control of Water Pollution). These results are in line with the fact that heavy agricultural activities are being conducted in the area.

## 4.4 Biodiversity

In line with Efeler Capacity Extension Project ESIA Addendum studies, flora and fauna composition of the Project Area, and potential impacts of the Project on biodiversity features are assessed in this section according to the provisions of the EBRD PR 6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources.

Flora and fauna site surveys for Efe-6, Efe-7 and Efe-8 GPPs were conducted within the scope of the national EIA studies in September of 2016, which provide the baseline data for the ESIA Report and the Addendum studies. This ESIA Addendum provides further analyses on biodiversity features, with updates on previously identified species, especially those that have been recorded from literature as opposed to direct on-site observations. Based on these updated species composition at the Project Area, assessments made within the scope of the ESIA Report have also been updated to reflect results of a more thorough analysis conducted in line with EBRD PR 6.

### 4.4.1 Methodology and Project Standards

Efeler Capacity Extension Project ESIA studies have been conducted in accordance with the Turkish legislation, as well as international environmental and social standards and guidelines, the European Union (EU) legislation, and all conventions and protocols applicable to the Project. The Addendum biodiversity studies have been conducted in line with the provisions of EBRD PR 6, in data analyses and related assessments.

#### 4.4.1.1 Guidelines on National Threat Statuses of Flora and Fauna

***Protected Areas***

There are three important sources in the Turkish biodiversity literature that provide guidance on determining a site's status as a whole, especially when it is not a conservation area officially designated and protected by law, but is significant to be considered as a protected area. In "122 Important Plant Areas of Turkey", Ozhatay et al. (2008) define important plant areas (IPAs) from different regions of Turkey, based on internationally recognized criteria and locally collected data. Each IPA is explained in terms of its general characteristics, detailed flora species' composition, threats it faces and related conservation efforts if there are any.

Important Bird Areas (IBA) of Turkey have also been studied since 1990, through successive projects, which today are conducted by WWF-Turkey. An inventory that defines 97 IBAs, also in accordance with international selection criteria that had previously been developed by BirdLife International (Magnin & Yarar, 1997), was published in 1997 and is updated on regular basis as conservation studies continue across the country.

Doğa Derneği, partner of BirdLife International in Turkey, which has been working towards sustaining biodiversity since 2002 all across the country, through a number of projects covering a wide array of ecosystems, habitats, species, protected areas, as well as local communities and educational programs, initiated a comprehensive study on Key Biodiversity Areas (KBAs) in Turkey analyzing a total of 472 sites from different regions. An inventory was published in 2006, which defines each site in terms of its outstanding characteristics and provides a detailed list of species and their global and regional threat statuses (Eken et al., 2006).

***Flora***

Plant specimens collected during field surveys were identified using the "Flora of Turkey and East Aegean Islands" (Davis, 1965-1988), while Turkish names of the identified species were compiled using the "Turkish Plant Names" by Prof. Dr. Turhan Baytop (Baytop, 1994). Threat statuses for flora species identified within the biodiversity study area were evaluated according to the categories and criteria presented in the reference book of Red Data Book of Turkish Plants (Ekim et al., 2000), which was prepared in accordance with the IUCN Red List criteria of 1994. The threat categories provided in this reference book were re-evaluated considering the population of endemic species within the site and also IUCN 2001 criteria.

***Fauna***

Unlike the Red Data Book of Turkish Plants (Ekim, et al. 2000) that provides a list for national threat statuses of flora species, on which a consensus have been reached among the scientific community in Turkey, there are no widely accepted threat lists established for fauna species. The available references are mostly utilized to provide some form of evaluation, but they do not provide adequate information to make thorough assessments when it comes to make detailed assessments on critical and higher priority habitats and species.

#### 4.4.1.2 International Standards and Guidelines

***EBRD Performance Requirement 6***

EBRD Performance Requirement (PR) 6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources covers areas of biodiversity conservation, ecological functions of ecosystems, sustainable management of living resources, as well as the livelihood of indigenous people and affected communities whose access to or use of biodiversity or living natural resources may be affected by project activities. Accordingly, the objectives of PR6 are outlined as the following (EBRD, 2014: 44):

- To protect and conserve biodiversity using a precautionary approach;
- To adopt the mitigation hierarchy approach, with the aim of achieving no net loss of biodiversity, and where appropriate, a net gain of biodiversity; and
- To promote good international practice (GIP) in the sustainable management and use of living natural resources.

EBRD PR6 requires that for conservation of biodiversity, if the assessments conducted within the scope of ESIA studies, potential impacts that the Project might have on biodiversity features are managed through mitigation strategies following a mitigation hierarchy and good international practice (GIP). It should also be identified whether the Project would have adverse effects on what might be evaluated as “priority biodiversity features” including threatened habitats, vulnerable species, other significant biodiversity features identified by various stakeholders, as well as ecological structure and functions needed to maintain the integrity of priority biodiversity features. The most sensitive of these biodiversity features are assessed according to the concept of “critical habitat”, which requires that habitat and species-specific action plans are prepared, as appropriate (EBRD, 2014).

***The EU Birds Directive (2009/147/EC)***

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (this is the codified version of Directive 79/409/EEC as amended). This Directive ensures far-reaching protection for all of Europe's wild birds, identifying 194 species and sub-species among them as particularly threatened and in need of special conservation measures.

***The EU Habitats Directive (1992/43/EC)***

The main aim of this Directive is to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. While the Directive makes a contribution to the general objective of sustainable development; it ensures the conservation of a wide range of rare, threatened or endemic species, including around 450 animals and 500 plants. Some 200 rare and characteristic habitat types are also targeted for conservation in their own right.

***IUCN Red List of Threatened Species***

The International Union for Conservation of Nature (IUCN) Species Programme, together with the IUCN Species Survival Commission (SSC) has been providing assessments on conservation statuses of a whole range of taxa, including species, subspecies, varieties and even subpopulations of certain species around the globe, in order to draw attention to especially those that are threatened with extinction. Using the IUCN Red List Categories and Criteria, the IUCN Red List of Threatened Species provides information on species’ taxonomy, conservation status and distribution, which have been evaluated globally. The main purpose of the system that the IUCN puts forth is to “catalogue and highlight those plants and animals that are facing a higher risk of global extinction (ie. those listed as Critically Endangered, Endangered and Vulnerable)”.

## 4.4.2 Baseline Data Update

### 4.4.2.1 Protected Areas and Designated Sites

The International Union for Conservation of Nature (IUCN, 2017; IUCN, 2008) proposes the following definition for a protected area, which today is widely used around the globe, and accepted as the most appropriate and valid definition by EBRD to be recognized to comply with provisions of PR 6:

> *"A protected area is a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values."*

Protected areas constitute an integral part of biodiversity conservation efforts, as well as ecosystem services provided by ecological functions they convey. In Turkey, Ministry of Forestry and Water Affairs (MoFWA) is the main official body responsible for development and implementation of national biodiversity conservation policies, action plans, designation of conservation areas, and many other related tasks conducted by its central and local within the Ministry's organizational structure.

The Project Area does not overlap with any national, regional and/or global designated sites protected under the above-listed categories of Protected Area System in Turkey.

The nearest designated area is Bati Mentese Mountains Key Biodiversity Area, located at a distance of about 13 km to the southeast of the Project Area (see Figure 4-6). The other protected areas and designated sites, which are located within a 25-km radius of the Project Area are further provided in Table 4-19.

**Table 4-19. Protected Areas and Designated Sites**

| Type | Category | Name | Distance from the Closest Power Plant | Direction with respect to the Project Area |
|---|---|---|---|---|
| Designated site | Key Biodiversity Area | Batı Menteşe Mountains | 13 km | SE |
| Designated site | Key Biodiversity Area | Dilek Yarımadası | 22 km | SW |
| Designated sites | Key Biodiversity Area | Küçük Menderes Delta | 23 km | NW |
| Designated site | Key Biodiversity Area | Mahal Hills | 23 km | NW |
| Legally protected area | Nature Park | Meryemana | 25 km | NW |


**Figure 4-6. Map of Nationally Protected and Internationally Recognized Areas**

#### 4.4.2.2 Flora and Fauna Species

Flora and fauna lists from the national EIA Reports have been reviewed within the scope the ESIA Addendum studies, in line with the provisions of the EBRD PR6, and international guidelines and standards. Accordingly, the following list of flora and fauna species presented in Table 4-20, which consists of priority biodiversity features, has been extracted from the species lists prepared during the national EIA studies.

**Table 4-20. Priority Biodiversity Features**

| Species | English Name | IUCN | Red Data Book of Turkish Plants | Endemism | EU Habitats Directive/ | EU Birds Directive |
|---|---|---|---|---|---|---|
| *Quercus frainetto* | Hungarian Oak | LC | LC | Endemic | - | - |
| *Quercus aucheri* | | NT | VU | Endemic | - | - |
| *Testudo graeca* | Spur-thighed Tortoise | VU | - | - | Annex II /IV | - |
| *Streptopelia turtur* | Eurasian Turtle Dove | VU | - | - | - | Annex II |
| *Falco peregrinus* | Peregrine Falcon | LC | - | - | - | Annex I |
| *Buteo rufinus* | Long-legged Buzzard | LC | - | - | - | Annex I |
| *Aquila chrysaetos* | Golden Eagle | LC | - | - | - | Annex I |
| *Lanius collurio* | Red-backed Shrike | LC | - | - | - | Annex-I |
| *Lanius minor* | Lesser Grey Shrike | LC | - | - | - | Annex I |
| *Emberiza hortulana* | Ortolan Bunting | LC | - | - | - | Annex I |

Species listed in Table 4-21 are those that have been assessed as “priority biodiversity features” based on their IUCN threat categories, or the EU protection statuses according to the Habitats and Birds directives. These species are “presumed present” at the Project Area, given that except for the two species; *Testudo graeca* and *Buteo rufinus*, the EIA studies report these flora and fauna species based on literature data.

### 4.4.3 Biodiversity Assessment Update

EBRD PR 6 Guidance Note defines the following broad categories for identification of priority biodiversity features, which are “species or issues that do not meet merit critical habitat status, but remain of concern from a conservation perspective”. Table 4-21 summarizes the most up-to-date assessments made regarding priority biodiversity features that are “presumed present” at the Project Area.

**Table 4-21. Priority Biodiversity Features as per EBRD PR 6**

| Priority Biodiversity Feature | Presumed Present Project Biodiversity Feature |
|---|---|
| Threatened habitats | There are no habitats that overlap with the Project site that are under pressure by national, regional or international assessments.<br>No natural and priority habitats identified under the EU Habitats Directive Annex I. |
| Vulnerable Species | There are two endemic oak species that were identified during the national EIA studies. Presence of these species was not identified/ reported in the Project area and these species were not observed during the site studies.<br>There is also one reptile; *Testudo gracea*, and one bird; *Streptopelia turtur*, species that are listed as VU according to the IUCN Red List. Although assessed as a VU species due to its global population status, *Testudo graeca* is quite widespread in all of Turkey. The regional population status does not call for any species-specific measure. *Streptopelia turtur,* on the other hand, is presumed to be present in the area from literature records. The species is known to occur in all of Turkey. However, Project Area and its vicinity, where |

| Priority Biodiversity Feature | Presumed Present Project Biodiversity Feature |
|---|---|
| | there are high levels of anthropogenic impacts, are not expected to be inhabited by the species' populations. |
| Significant biodiversity features identified by a broad set of stakeholders or governments | There are no protected areas or designated sites within the vicinity of the Project Area, which would be impacted by Project-related activities. |
| Ecological structure and functions needed to maintain the viability of priority biodiversity features | There are no identified structures or functions in the area that are vital to priority biodiversity features |

According to EBRD PR 6, among the priority biodiversity features, critical habitats (CH) are the most sensitive biodiversity features, which are identified to hold the highest tier of irreplaceable and vulnerable features and comprise one of the following according to EBRD PR 6:

(i) Highly threatened and/or unique ecosystems

(ii) : Critically Endangered (CR) and/or Endangered (EN) species (As listed in the IUCN Red List)

(iii) : Endemic and/or restricted-range species

(iv) : Migratory and/or congregatory species

(v) : Key evolutionary processes

(vi) : Ecological functions

In order to determine statuses of species identified during the national EIA studies, besides the IUCN Red List of Threatened Species utilized to determine endangered and critically endangered species, other criteria were also used in the Critical Habitat Assessment, wherever applicable. In determining "highly threatened and unique ecosystems", habitats listed under Annex I to Habitats Directive, as well as IUCN Red List assignments for ecosystems were used as the main criteria. Since international, even European biodiversity assessments do not always cover Turkish habitats and species, conclusions on the current statuses of biodiversity components were drawn based on expert judgment. Potential critical habitat trigger biodiversity features for the Project are summarized in Table 4-22.

**Table 4-22. Potential Critical Habitat Trigger Biodiversity Features**

| Critical Habitat as per EBRD PR 6 | Potential Critical Habitat Trigger Biodiversity Feature |
|---|---|
| (i) Highly threatened or unique ecosystems | No such habitat or ecosystem |
| (ii) Habitats of significant importance to endangered or critically endangered species | No CR or EN species |
| (iii) Habitats of significant importance to endemic or geographically restricted species | *Quercus frainetto* and *Quercus aicheri* are two endemic oak species that have been reported to exist in the region, within the scope of the national EIA studies. Presence of these species was not identified/ reported in the Project area and these species were not observed during the site studies. Therefore, based on all available data, *Quercus frainetto* and *Quercus aicheri* do not trigger critical habitat at the Project Area. |
| (iv) Habitats supporting globally significant (concentrations of) migratory or congregatory species | No migratory or congregatory species |
| (v) Areas associated with key evolutionary processes | No such habitat or a species population |
| (vi) Ecological functions that are vital to maintaining the viability of biodiversity features described (as critical habitat feature) | No identified ecological functions that are vital to potential critical habitat trigger biodiversity feature |

## 4.5 Noise

No baseline noise measurements or information is provided within the scope of national EIA studies for Efe-6, Efe-7 and Efe-8 GPPs. However, within the scope of ESAP monitoring for Gurmat-2 GPP, a monitoring study was conducted. Results of this monitoring study are provided in Table 4-23 and the monitoring locations map is provided in Figure 4-7. As can be seen in Table 4-23, none of the monitoring results exceed the noise limit values applicable to the Project.

An additional noise monitoring study was conducted in 2016, with results pending.

No baseline noise measurements or information is provided within the scope of national EIA studies for Efe-6, Efe-7 and Efe-8 GPPs. However, within the scope of ESAP monitoring for Gurmat-2 GPP, 2 monitoring studies were conducted. The first monitoring, conducted in 2015, covered a total of 6 locations and the results are provided in Table 4-23; whereas the second monitoring, conducted in 2016, covered 12 locations and the results are provided in Table 4-24. As can be seen, none of the monitoring results exceed the noise limit values applicable to the Project. The monitoring locations covered by both monitoring studies are provided in Figure 4-7.

**Table 4-23. ESAP Monitoring Results for Gurmat-2 GPP**

| | Noise Level (dBA) | | IFC Guideline Values (for residential; institutional and education places) | |
|---|---|---|---|---|
| | 07:00-22:00 | 22:00-7:00 | 07:00-22:00 | 22:00-7:00 |
| N1 | 50.2 | 42.3 | 55 dBA | 45 dBA |
| N2 | 47.3 | 38.4 | | |
| N3 | 51.2 | 40.6 | | |
| N4 | 53.6 | 39.8 | | |
| N5 | 52.3 | 39.7 | | |
| N6 | 49.1 | 38.9 | | |

*Source: Annual Environmental and Social Report – Reporting Period: 2015 (17.10.2016, Gurmat Elektrik Uretim A.S.)*

**Table 4-24. 2017 Noise Monitoring Results for Gurmat-1, Gurmat-2 and Efe-6 GPPs**

| Plant | Location of Measurement | Noise Measurement Leq Value (dBA) 10:00-16:00 |
|---|---|---|
| Gurmat-1 | Closest settlement measurement point | 45,02 |
| | Kızılcagedik Köyü Mosque measurement point | 48,97 |
| | OBOG Well measurement point | 44,25 |
| Gurmat-2 (Efe-1, Efe-3, Efe-4) | Closest settlement measurement point | 43,37 |
| | Off-site Rear Land Measurement Point | 48,47 |
| | Farm Front Measuring Point | 47,71 |

| Plant | Location of Measurement | Noise Measurement Leq |
|---|---|---|
| Gurmat-2 (Efe-2) | Settlement next to Tariş fig factory measurement point | 47,35 |
| | Closest settlement measurement point | 50,17 |
| | Germencik Anadolu School measurement point | 47,35 |
| Efeler GPP Capacity Extension Project (Efe-6) | Off-site Rear Land Measurement Point | 46,81 |
| | Closest settlement measurement point | 44,34 |
| | OB-86 Well measurement point | 50,29 |

On the other hand, the national EIAs include assessments for construction phase noise to be sourced from construction activities, in terms of compliance with Turkish Regulation on Assessment and Management of Environmental Noise (RAMEN). During the construction phase, noise impact will be sourced from construction vehicles and equipment. Assessment results provided by the national EIAs, which did not factor in baseline noise levels, are summarized below:

- For Efe 6, the construction phase limit of 70 dBA is ensured at only 10 m from the construction area. Considering that the closest settlements to Efe-6, namely Kizilcagedik and Alagullu, are located at more than approximately 1,200 m to the construction site, it can be assessed that noise impact for this GPP did not constituted an issue for communities in terms of applicable limits.
- For Efe-7, the construction phase limit of 70 dBA is ensured at approximately 125 m from the construction site. The closest residential areas are located at approximately 1700 m to the construction site(with settlements centers located more than 3 km away). Therefore, noise impact is not expected at any of the nearby settlements.
- For Efe-8, the construction phase limit of 70 dBA is also ensured at approximately 125 m from the construction site. The closest point of the residential area, namely Germencik, to this GPP location is approximately 400 m away. ). Therefore, nearby communities are not expected to experience any noise impact due to construction activities.

During the operation phase, wellhead equipment and generators are expected to be the main noise generating sources. As equipment will all be housed in close spaces, the Project operation activities are not expected to have any noise impact on local communities.

Considering the above assessments, a noise related grievance from local communities is not expected. In case of any grievance, it will be evaluated in line with the Grievance Mechanism; the grievance will be recorded, assessed and responded to in a timely and appropriate manner. It should be noted that no blasting activity will be conducted within the scope of Project activities. Therefore no vibration impact is expected, except for a negligible impact that may occur in the immediate vicinity of drill sites.

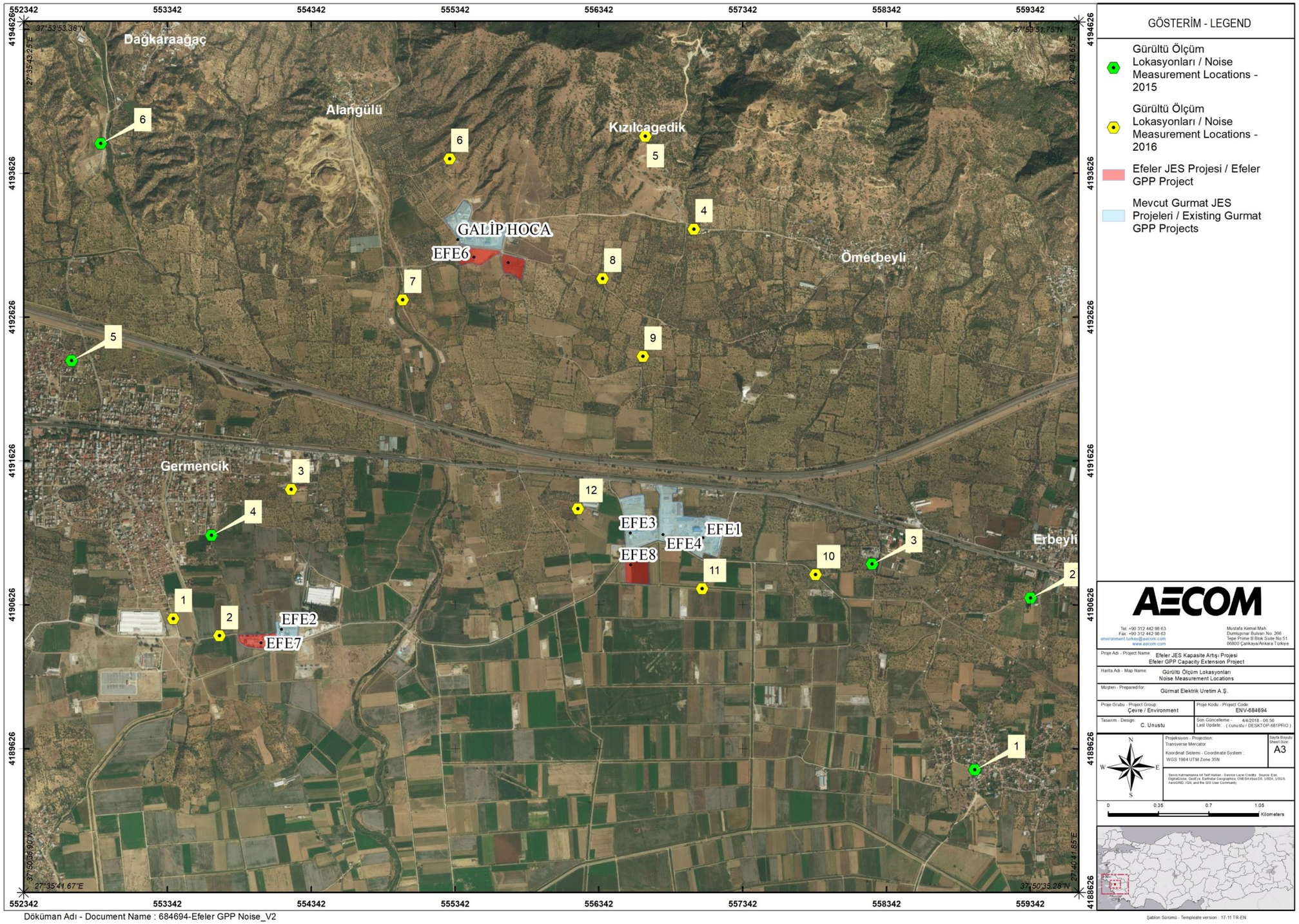



**Figure 4-7. Noise Monitoring Locations**

## 4.6 Waste Management

Good waste management practices follow the waste hierarchy as given in Figure 4-8, which responds to financial, environmental, social and management considerations.

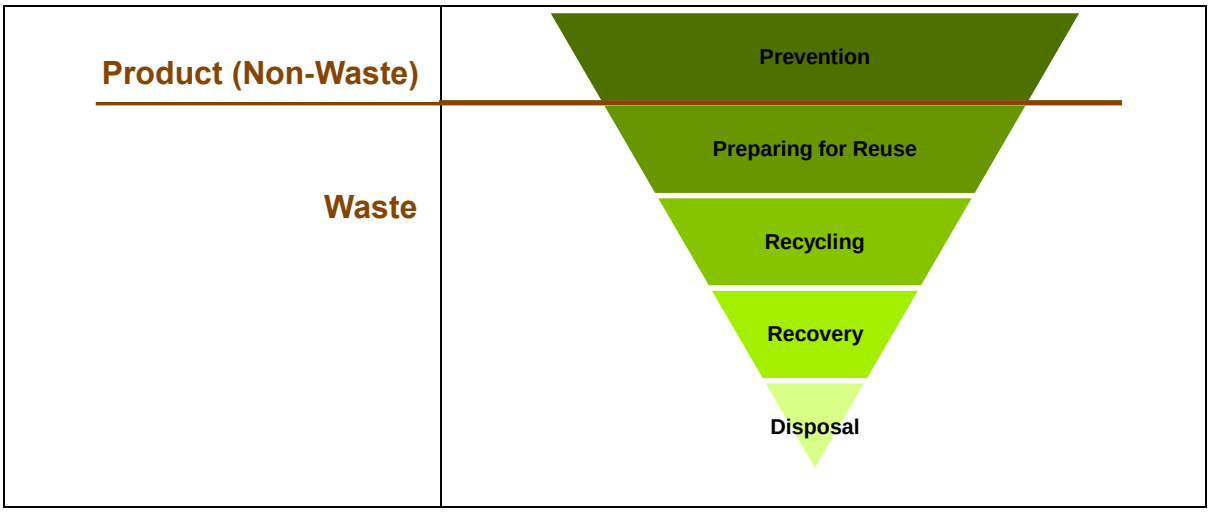



**Figure 4-8. Waste Management Hierarchy**

*Source: Modified from European Commission website, https://ec.europa.eu)*

For the management of wastes, the Project will also adopt this hierarchical waste management approach. Within this framework, the priority of the Project will be to maximize conservation of resources to avoid generation of wastes or minimize waste generation at the source where avoidance is not possible. Training for the construction phase personnel will be especially important for raising awareness in terms of waste generation and effective implementation of the Waste Management Plan. Where waste generation cannot be avoided, any generated waste will be evaluated for reuse, recycling, recovery and segregated accordingly, depending on the waste type. Where an onsite reuse option is not applicable (such as reuse of suitable excavated materials in fill operations), waste will be transported by licensed firms for further reuse, recycling and recovery options, also based on the waste type. Only in case no alternative is left, the ultimate option will be sending the waste to final disposal for landfilling.

Potential types of waste anticipated to be generated in the scope of Efeler GPP Project are listed below:

- Excavated materials (during construction phase only): The estimated excavation amounts for the Project GPPs are; 15,000 $m^3$ for Efe-6, 5.686 $m^3$ for Efe-7, 10,070 $m^3$ for Efe-8. Any access excavated material that cannot be used on-site for filling and landscaping activities will be sent by licensed firms to excavation waste disposal areas designated by related municipalities.
- Municipal solid waste (including packaging wastes): See Table 4-25 below for details.
- Medical waste: This special hazardous waste will be collected separately and sent by licensed transport vehicles to the medical waste disposal facility that has an agreement with Germencik Municipality,
- Waste vegetable oil: Waste vegetable oils will be collected in leak-proof containers, stored in temporary waste storage areas and sent to licensed recovery firms. It should be noted that the catering firms contracted/ to be contracted will be responsible of management of waste vegetable oils, in line with Project standards.
- Waste oil: Waste oil will be collected in leak proof containers, stored in temporary waste storage areas and sent for recovery by licensed firms.

- Waste battery and accumulators, electronic waste: Waste batteries and accumulators will be stored in temporary waste storage areas and sent to licensed disposal firms. It should be noted that maintenance of vehicles is being conducted and will be conducted in authorized facilities located outside the Project areas. Therefore this type of waste amount is expected to be minimal. Electronic waste on the other hand, will first be evaluated for reuse prior to transport by licensed firms.
- Waste tires: Waste tires will be stored in temporary waste storage areas and sent to licensed disposal firms.
- Other hazardous waste: To be stored in temporary waste storage areas and sent to licensed disposal firms.

**Table 4-25. Construction Phase Municipal Solid Waste**

| GPP | Waste Amount (kg/day) | | Management Practice |
|---|---|---|---|
| | Construction Phase | Operation Phase | |
| Efe-6 | 54 (6.48 kg consisting of packaging waste) | 43.2 (5.18 kg consisting of packaging waste) | Segregated collection on-site<br>Transport and disposal of non-recyclable domestic waste by Aydın Metropolitan Municipality<br>Transport of recyclable waste by licensed firms. |
| Efe-7 | 290 (34.8 kg consisting of packaging waste)1 | 9.282 (1.11 kg consisting of packaging waste) | |
| Efe-8 | 464 (55.68 kg consisting of packaging waste) | 13.92 (1.67 kg consisting of packaging waste) | |

*Source: Efe-6 GPP National EIA Report, August 2016; Efe-7 GPP National EIA Report, April 2017; Efe-8 GPP National EIA Report, April 2017*
*Packaging waste amount not provided by the EIA. The amount stated here is calculated by using the assumption provided by the EIA for Efe-6, which states that 12% of the generated domestic waste is packaging waste.*
*Municipal solid waste amount not provided by the EIA. The amount stated here is calculated based on the EIA's assumption that each person generates 1.6 kg of waste per day and a total of 8 people will be employed.*

According to the waste declaration forms provided by the Project Company, following hazardous wastes are being generated by the currently operational GPPs (i.e. Gurmat-1, Gurmat-2 and Efe-6), and therefore are anticipated to be generated by Efe-7 and Efe-8 GPPs as well:

- Packaging contaminated by contact with hazardous waste
- Fluorescent lamps and other mercury containing waste
- Laboratory chemicals consisting of or has in its contents hazardous materials, including laboratory chemical mixtures
- Oil filters
- Absorbents, filters, PPEs contaminated with hazardous waste
- Used wax (paraffin) and other oils
- Other hydraulic oils
- Metallic packaging with hazardous porous solid structures (e.g. asbestos), including empty, pressurized containers
- Scrap electrical and electronic materials

### 4.6.1 Drilling Mud

For production and reinjection wells drilled/to be drilled within the scope of the Project, ponds covered with impermeable geomembrane layers are utilized in drilling locations to collect drilling mud. The drilling mud collected in these ponds is analyzed by licensed laboratories for identification of their storage classes. Depending on analysis results (i.e. drilling mud identified as non-hazardous waste or hazardous waste) the collected drilling mud is either left on site or removed in accordance with related legislation. In addition, the minor amounts of excavation materials sourced during drilling activities are also stored in these ponds. Under no circumstances, the drilling mud is discharged to receiving environments and the mud ponds are fenced off with related cautionary signs in place.

A drilling mud analysis report is in place for the mud pit located adjacent to OB49B production well of Efe-7 GPP. The analysis is based on comparison of measured parameters with the limits provided by the Regulation on Sanitary Landfilling of Wastes. This Regulation provides 3 separate limits for multiple parameters. If all analyzed parameter concentrations are below the first limits, the analyzed waste is categorized as suitable for storage/disposal in inert waste storage areas; if any of the analyzed parameter's concentration is between the first-and the second limits, the analyzed waste is categorized as suitable for disposal in a non-hazardous waste storage area; and if any analyzed parameter's concentration is above the second or the third limit, the analyzed waste is categorized as suitable for disposal in a hazardous waste storage area. For the analyzed drilling mud, none of the parameter concentrations are above the respective first limits provided by the Regulation. Therefore the drilling mud collected in this pond is suitable for disposal in an inert waste storage area. The results also mean that the drilling mud can be left on site instead, after proper solidification processes and rehabilitation applications (e.g. covering with topsoil and vegetation).

## 4.7 Labor and Working Conditions and Occupational Health and Safety

Turkey is party to a multitude of ILO conventions, including but not limited to conventions on equal treatment of employees, gender equality, child labor, forced labor, OHS, right of association and minimum wage. Accordingly, the current Turkish Labor Law is in compliance with international labor standards and EBRD PR2 requirements; including aspects such as child labor, forced labor, non-discrimination and equal opportunity and right to join workers' organizations. Subsequently, and also due the fact that the Guris-2 GPP and the Project are conducting its activities in line with EBRD Environmental and Social Policy (2014), Gurmat Elektrik is committed to full compliance with these national legislation and international standards in terms of labor management.

Gurmat Elektrik has in place a Human Resources Procedure, which aims to increase effectiveness and efficiency in all matters of human resources and define the implementation principles for general human resources management; including ensuring the labor force is trained sufficiently to protect them from accidents/incidents, increasing the motivation of workers, identification, planning, implementation and evaluation of training requirements, etc.

For all Company activities, ensuring employees' health and safety is a priority at Gurmat Elektrik. Within this scope and in addition to the HR Procedure described above, a Health and Safety Policy is in place. In line with its policy statements, Gurmat Elektrik aims to;

- Take precautions to prevent accidents/incidents from occurring;
- Constantly improving the OHS conditions and ensuring related trainings are in place for both its own personnel and the contractors' personnel.

To ensure the highest standards of OHS, the Project Company holds a certificate for OHSAS 18001:2007 Occupational Health and Safety Management System, applicable to its energy generation facilities. Within this scope, and in addition to the Human Resources Procedure described above, multiple other procedures, manuals, hand books, instruction documents, etc. are in place. These documents include, but are not limited to; a Health and Safety Procedure, Procedure for Identification and Evaluation of Large Industrial Accidents, Contractor Management Procedure, a Reward/Punishment System for OHS, Trainings Procedure, Emergency Procedure, multiple instruction documents for first aid, emergencies and fires. As the Contractor Management Procedure suggests, all contractors are also responsible for implementation of the Project Company's labor management practices.

For implementation of these procedures and ensuring compliance with both national standards and international standards, personnel with necessary skills and background are employed both at corporate and site level. Main personnel responsible for labor management practices include the OHS expert and the Human Resources Chief, whereas other main personnel with overseeing and implementations responsibilities to a narrower extent include the Operations Director, Procurement Chief, Administration and Security Chief, etc. The OHS standards and related legislation are followed by using compliance charts.

In addition, the Project Company is committed to sharing OHS statistics/information with public, private sector institutions and NGOs to further improve the OHS conditions through cooperation.

According to the Annual Environmental and Social Report for Gurmat-2 GPPs– Reporting Period: 2015, two separate consultant companies are contracted to monitor health and safety procedures, including providing trainings. No accidents with injuries or fatalities occurred during this reporting term.

### 4.7.1 Human Resources (HR) Policy and Management

Apart from Human Resources Procedure (see above), Company has no written HR Policy and Management System. Generally, the Project Company manages labor and social activities on site with unwritten procedures; however, a designated Human Resources Chief is in place and all related activities are reported to the General Manager.

Due to the absence of a written HR Policy, the following topics are not covered:

- Trade union recognition
- Collective bargaining
- Training, development and career management
- Equal opportunity for women and disabled people

It was also noted that the Project Company has not established a standard on Code of Ethics.

***Labor statistics***

During the construction phase of the Project, work hours will consist of 8 hr/day shifts in 26 days/month for 12 months/year. On the other hand, generation will constantly continue during the operation phase. Therefore a system of three 8 hour shifts will be implemented throughout the entire year. Personnel requirement for the Project, based on the national EIAs for the GPPs is summarized in Table 4-27

**Table 4-26. Personnel Requirement for the Project**

| GPP | Construction Phase | Operation Phase |
|---|---|---|
| Efe-6 (construction completed) | 50 | 40 |
| Efe-7 | 250 | 8 |
| Efe-8 | 400 | 12 |

*Source: Efe-6 GPP National EIA Report, August 2016; Efe-7 GPP National EIA Report, April, 2017; Efe-8 GPP National EIA Report, April, 2017*

Operation phase personnel data provided by Gürmat Elektrik is presented in Table 4-27 for the currently operational GPPs.

**Table 4-27. Operation Phase Labor Statistics for Gurmat-2 and the Project GPPs**

| | Gurmat-1 GPP | Gurmat-2 (Efe-1,2,3,4) | The Project* (Efe-6) |
|---|---|---|---|
| Number of direct employees | 47 | 173 | 58 |
| Number of contracted workers | 47 | 173 | 58 |
| Number of non-employee workers | 0 | 0 | 132 |
| Ratio of women workers (direct and contractor total) | %2.1 | %1.7 | %8.6 |

** Efe-7 construction phase is ongoing and Efe-8 construction phase projected to be initiated in February, 2018.*

The total number of permanent personnel employed by the Project Company is 278, consisting of 269 men and 9 women. Out of the 9 women, 5 are white collar employees (engineers and HR staff) and 4 are unskilled. The average age of the employees ranges between 25-29. The number of employees who have been working in the Project Company for more than 10 years is 8 and the main reason for leaving the job is retirement.

Out of 278 employees, 133 employees (48 percent) are hired from local communities.

The Project Company employs interns who attend apprenticeship schools and industrial vocational schools. In 2017, 80% of interns were hired from Aydin Province and 20% were hired from Ankara Province.

There are a total of 6 disabled employees and no prisoner or ex-prisoners are working at the Project Company.

### 4.7.2 Worker's Accommodation

Accommodation conditions are directly related to well-being of personnel in terms of diseases and general morale. These impacts may result from incompliance with related standards. Within the scope of the Project, Gurmat Elektrik's main goal has been and will be to maximize the number of personnel employed from the local to ensure the maximum employment related beneficial social impacts are achieved. For this purpose, Gurmat Elektrik provides/will provide transport services for its local employees. This way, requirement for on-site accommodation is minimized, leading to subsequent decrease in related impacts such as increase in prevalence of communicable diseases in the workforce.

For the external workforce, accommodation in line with IFC and EBRD's Workers' accommodation: processes and standards, 2009 is provided/will be provided either on-site, in the nearby GPP sites of the Project Company or in the vicinity settlements. Photographs showing examples of provided accommodation are shown in Figure 4-9. In addition, the Turkish Regulation on Water Intended for Human Consumption is also followed. Within this scope, bottled potable water is procured from the market and water for personnel use is procured from Aydın Municipality.

**Figure 4-9. Existing Workers Accommodation**

### 4.7.3 Child & Forced Labor

The minimum hiring age is 18 for both men and women and no persons under 18 years of age are employed by the Project Company, which was verified by a review of the employment records. The Project Company usually hires workers who complete their military services.

In line with the national Law, forced labor is also not an issue, and the workers are present at the site voluntarily.

### 4.7.4 Employee Rights and Equal Opportunity

The employees' rights are governed by "Labor Law No. 4857; OG Date/Number: 10.06.2003/25134". The Project Company management and the line managers pay attention not to be subject to legal or administrative charges. It was reported that there has been no administrative, civil or criminal actions against the Project Company and the management of the Project Company in the past. Ministry of Labor and Social Security inspectors regularly monitor the employment standards. The Project Company has not been cited or penalized for non-compliance related to employment standards in the past.

There is no Labor Union recognized by the Project Company; however; according to the interviews conducted with the employees, the Project Company is not blocking the right to association or collective bargaining and current worker rights are sufficient for employees.

The Project Company has 3 workers' representatives who are authorized to represent workers in activities such as participating in occupational health and safety related activities, monitoring these activities, requesting measures and making propositions to their line management. Company holds yearly elections and workers have the right to select their own representatives from the workers.

### 4.7.5 Wages

The wage policies of the Project Company are communicated to the workers. Worker wages are paid by bank transfers monthly and payments have never been delayed. Minimum wage is always ensured and minimum increase in salary is based on country-wide inflation percentage (i.e. adapted based on inflation to ensure no loss of purchase power).

Review of the wage records verified that all gains, overtimes, deductions (medical, compensation, retirement, social security, income tax, etc.) are calculated within the wage system. The records are kept by HR department. Overtimes are not above 270 hours (i.e. the upper limit set by the national Labor Law).

### 4.7.6 Grievance Mechanism for Workers

A grievance mechanism for employees is in place and the grievances can be conveyed by using the grievance and suggestion boxes situated in the facilities or by verbal application through Worker Representatives.

When a formal grievance is submitted, the grievance process is followed by the relevant department managers and representatives and the departments take the necessary actions. Additionally, in monthly meetings, the Administrative Committee reviews the unresolved grievances. Verbal grievances, on the other hand, can be communicated to each grievance holders' department manager or the Environment and Security Coordinator. Anonymous applications are not covered in grievance mechanism.

It should be noted that records and samples of the grievances were not obtained during the site visit.

### 4.7.7 Emergency Prevention and Response

There is an Emergency Action Plan in place for Gurmat-2, covering Efe-1, Efe-2, Efe-3 and Efe-4 GPPs. The Plan defines emergencies (i.e. fire, earthquake, sabotage and pentane gas related emergencies and lists actions for prevention of risks, response measures during emergencies and what will be done following any such emergency. In addition, responsibilities are also listed, including responsibilities of emergency teams and general responsibilities for workers. Other sections of the plan consist of emergency drills, trainings and communications. This plan is required to be updated to cover Efeler GPP Project units.

Emergency prevention and response trainings and first aid trainings are provided. In addition, a fire drill was conducted on March 31, 2015 on the basis of a scenario prepared by a consultant company specializing in fire management. These trainings and drills will be repeated periodically and as required.

## 4.8 Community Health and Safety

Potential community health and safety issues associated with GPP developments are described in this section. As reported by the Company, the requests and suggestions of the public are taken into account. Accordingly, the Company implements necessary actions for appropriate requests/suggestions from local communities.

It was identified that the majority of the issues raised by local communities is related to odor impact of $H_2S$ emissions (see Section 4.1.4 and Section 4.8.1 for details on $H_2S$ impacts and monitoring results). Regarding the issue, an interview was conducted with the District Directorate of Health, and it was stated by the related authority that there is no evidence on relation of public health and Geothermal Power Plants in the region. The Directorate also stated that there are no endemic diseases present within the region and studies indicate that there is no particular disease that is experienced by local people in recent years.

### 4.8.1 $H_2S$ Emissions

Compared to conventional fossil fuel plants, GPPs have significantly lower emissions. However, dissolved NCGs within geothermal fluids are of concern, especially $H_2S$, due to the fact that it is a malodorous, toxic gas, which poses health and safety problems in case appropriate monitoring and management practices are not in place.

$H_2S$ in gas form is heavier than air and therefore, it can accumulate in areas that are topographically lower than their surroundings. In order to ensure that potential health and safety risks are managed appropriately, $H_2S$ sensors are installed in the general area, representative of GPPs and also of conditions in the vicinity settlements. According to the $H_2S$ monitoring results, no exceedance of the limits provided by IAPCR (i.e. short term limit of 20 $\mu g/m^3$) occurred to date. In all monitoring terms, the highest measured concentration is only about 5% of the provided limit. Details of $H_2S$ monitoring are provided in Section 4.1.4.

### 4.8.2 Infrastructure and Equipment Related Risks

Infrastructure and equipment related hazards to community health and safety may be caused due to contact with hot surfaces such as active wells and pipelines and risks associated with equipment failures and abandoned wells.

To date no pipeline failures or similar emergencies occurred. As stated, collection systems are designed to ensure the geothermal fluid is collected and diverted to emergency ponds during any rare case of equipment or pipeline failure. To minimize risks to communities, following measures are in place:

- Shortest routes are selected for pipeline network to minimize potential hazards.
- Insulated pipes are used, which avoid thermal loss and therefore hazards associated with contact with hot surfaces.
- Due to chemical characteristics of geothermal fluids, especially due to the fact that Germencik reservoir rocks have high carbonate content, carbonate and sulphate accumulate and create a crust on inner walls of pipes. This phenomenon results in limited flow rate and may eventually lead to leakages or more serious pipeline failures. Therefore, chemical dosing (inhibitor injection) is conducted at each well head to prevent crust formation. This way, risk of failure and associated community health and safety risks are minimized and as the pipelines are closed systems; these chemicals do not interact with the environment.

### 4.8.3 Security Personnel

Within the scope of Efeler GPPs (including Efe-6, which is in operation as of August 2017), a total of 30 security personnel are employed, in addition to 8 personnel employed for Gurmat-1. These personnel are employed mainly from the local, which ensures no conflicts in terms of regional sensitivities occur.

### 4.8.4 Induced Seismicity

Utilization of geothermal resources may induce seismicity since drilling works for establishment of production and reinjection wells during construction phase and especially production and reinjection activities conducted during the operation phase may alter the stress patterns of the area rock formations (Geothermal Energy Association, 2009; US Department of Energy; 2012). However, multiple studies identified that these seismic events are of small magnitudes and are rarely felt by communities in almost all of the cases (Majer et al., 2007; from US Department of Energy; 2012).

Geothermal Energy Association (2009) states that the micro-earthquakes that may be induced by GPP activities contribute to increased seismic activity, generally in the close vicinity of reinjection wells. However, these micro-earthquakes have magnitudes of 1 to 3 on Richter scale, which are too low to be felt by communities. Similarly, Bromley (2012) states that no induced seismicity was reported in majority of the conventional GPPs and the reported ones are small or micro scale earthquakes. Even with the case being so, there have been some grievances of communities and therefore, some protocols and GIIPs were developed to address the issue. It should be noted that the areas where such grievances were reported are considerably larger geothermal fields with high number of operational GPPs. Another issue is that geothermal fields are located in seismically active zones, where high seismic activity normally occurs. Therefore, some seismic events recorded in these areas may have been natural events and not induced by GPPs.

Regarding the Project GPPs and other Gurmat Elektrik GPPs in the area, no such grievance was relayed.

### 4.8.5 Natural Hazards

According to the Earthquake Zones Map of Aydin province, the entire province is located in a 1st degree earthquake zone. Therefore, the main natural hazard risks are associated with earthquakes. Detailed geological and geotechnical surveys and earthquake risk assessments are provided in the scope of the GPPs' Geological and Geotechnical Survey Reports (presented as annexes to EIA Reports). Measures regarding occupational and community health and safety risks associated with earthquakes are design measures, which are laid out in detail by related national legislation. The Project GPPs are in full compliance with provisions of national legislation regarding constructions on 1st degree earthquake zones.

Surface and groundwater is completely controlled by drainage systems and irrigation channels in the Project area vicinity and therefore flooding is not a risk. Necessary drainage systems are knotholes designed and are/will be in place.

Landslides and rockfalls are of no concern due to flat topography and avalanches and extreme weather conditions are of no concern due to vicinity meteorological conditions.

## 4.9 Land Acquisition, Involuntary Resettlement and Economic Displacement

Title deed information for the Project is provided in Section 1.4. Land acquisition process is now complete and all required land was acquired on willingness basis, where agreements were reached with land owners in terms of a mutually agreed price. Therefore no expropriation occurred. As the acquired lands were all agricultural areas, physical displacement was also not required.

According to the interview held with a land owner during the site visit, all owners who sold their lands are satisfied with the compensations. The same owner stated that he sold 6 decares of his land to the Project Company (for an Efe-6 well location) and could buy 13 decares of land in the same region with the provided cash compensation. Similarly, another owner sold 25 decares of his land and he could buy 54 decares of land within the region.

The land purchased for Efe-6 was partially used for fig production and with the remaining section not used for any purpose. Fig trees were relocated before the construction of the plant. The land required for Efe-7 and Efe-8 are agricultural lands and the Project Company allowed (for Efe-7, which is currently under construction) and will allow (for Efe-8, which will begin construction in first half of 2018) owners to use the land until initiation of land preparation activities

## 4.10 Cultural Heritage

According to the national EIA Reports, the Project GPP areas do not correspond to any cultural heritage sites or natural protection sites. In case any cultural heritage is encountered during land preparation and construction phase, related Museum Directorate or Regional Board Directorate for Conservation of Cultural and Natural Assets will be informed as per national legislation.

## 4.11 Information Disclosure and Stakeholder Engagement

The Project will have in place a Stakeholder Engagement Plan (SEP), identifying primary stakeholders and pertinent engagement methods for each stakeholder, including information disclosure, regular meetings, grievance mechanism, networking and cooperation activities, etc.

### 4.11.1 Stakeholder Engagement in the scope of National EIA Process

In line with the requirements of the Turkish EIA Regulation, Public Participation Meetings were held in locations that are easily accessible for communities identified to be potentially affected by the Project. More than 10 days in advance of the meeting dates, advertisements were published in local and national newspapers to inform the public about the meeting dates and locations in accordance with the provisions of Turkish EIA Regulation.

Additionally, announcements were posted at the meeting venues and offices of the neighborhood headmen for the same purpose. The main questions and concerns raised by the participants during the meetings and meeting details are summarized below in Table 4-28.

**Table 4-28. Public Participation Meetings for Efe-6, Efe7 and Efe-8 GPPs**

| Project | Meeting Location | Meeting Date | Estimated Number of Participants | Main Concerns/Questions/Issues Raised by Participants |
|---|---|---|---|---|
| Efe-6 GPP | Omerbeyli neighborhood (Wedding Hall) | February 25, 2016 | More than 25 participants from the public (estimated based on meeting photographs) | • Details of the operation process to be conducted at the power plant;<br>• Air pollution caused by geothermal power plants operating in the region;<br>• Impacts of air pollutants emitted from these plants on agricultural lands;<br>• Disturbances due to steam emitted from the stacks of the power plants. |
| Efe-7 and Efe-8 GPPs (joint meeting) | Germencik Municipality Conference Hall | December 23, 2016 | | |

Source: Efe-6 GPP National EIA Report, August 2016; Efe-7 GPP National EIA Report, April 2017; Efe-8 GPP National EIA Report, April 2017

### 4.11.2 Stakeholder Engagement in the scope of Gurmat-2 ESAP

A stakeholder Engagement Plan is in place for Gurmat-2 (Efe-1, Efe-2, Efe-3 and Efe-4). Within this scope, a public participation meeting was held on October 31, 2014. To inform the communities and potentially interested parties of the meeting, invitiation letters were sent to administrative bodies, advertisements were posted at local public spaces and announcements were published in local and regional newspapers 1 week prior to meeting. During the meeting, information regarding Gurmat-2, its potential environmental and social impacts, applicable national legislation and international standards were provided to the public. The key concerns raised by the public included following:

- Maximization of local employment
- Request for further information regarding land acquisition procedure

A grievance mechanism is also in place for Gurmat-2. Within this scope, the Project Company appropriately addresses all relayed grievances in a timely manner. The contractors are also responsible of receiving and addressing any grievances in line with the Project Company's standards. Contractor grievance response performance is monitored by the Project Company.

According to the grievance records provided by the Project Company, multiple grievances were received regarding economic damage to crops and properties. The Project Company has completely compensated all of the related damages.

Within the Annual Environmental and Social Monitoring Report for reporting term 2015, the Project Company reported that no grievances were received from public or civil society organizations.

### 4.11.3 Community Development

The Project Company is committed to keeping good community relations not only through addressing community grievances but also through planned corporate social responsibility (CSR) activities. Within the scope the Project, following CSR and community development activities were conducted:

- Sapling distribution and plantation campaign
- Construction of a vocational school specializing in agriculture and other educational CSR activities including, provision of scholarships (including scholarships for 16 school girls who are living in the immediate vicinity), improvement of existing schools, landscaping and provision of computers and equipment to vicinity schools
- Reforestation activities carried out around the plants
- Construction and improvement of public spaces such as wedding halls, mosques, graveyards
- Construction of village headmen offices
- Infrastructure improvement such as road construction
- Provision of required machinery and equipment to Germencik Municipality, as well as construction of various facilities for this municipality
- Other CSR activities such as accepting visits from various universities and conducting Ramadan feasts

# 5. Cumulative Environmental and Social Impact Assessment

## 5.1 Assessment Methodology and Data Sources

The Cumulative Environmental and Social Impact Assessment study conducted for Efeler GPP Project follows the methodologies specified by relevant international guidelines. Being one of the most recent and comprehensive documents, the Good Practice Handbook on the Cumulative Impact Assessment and Management (IFC, August 2013) is the main reference for the methodology to be applied in the scope of Efeler GPP Project, while the following additional key references will also be resorted:

- Cumulative Effects Assessment and Management Guidance published by International Association for Impact Assessment (IAIA) (Canter L., and William R., 2009; http://www.iaia.org/);
- European Commission's (EC) Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions (May, 1999);
- Cumulative Effects Assessment Practitioners Guide prepared by the Cumulative Effects Assessment Working Group (Hegmann, G. C. Cockling, R. Creasey, S. Dupuis, Kennedy, L. Kingsley, W. Rodd, H. Spaling and D. Stalker; February and AXYS Environmental Consulting Ltd. for the Canadian Environmental Assessment Agency (1999).

IFC defines cumulative impacts as "those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred as "developments") when added to other existing, planned, and/or reasonably anticipated future ones. Multiple and successive environmental and social impacts from existing developments, combined with the potential incremental impacts resulting from proposed and/or anticipated future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development (IFC, August 2013) (see Figure 5-1).

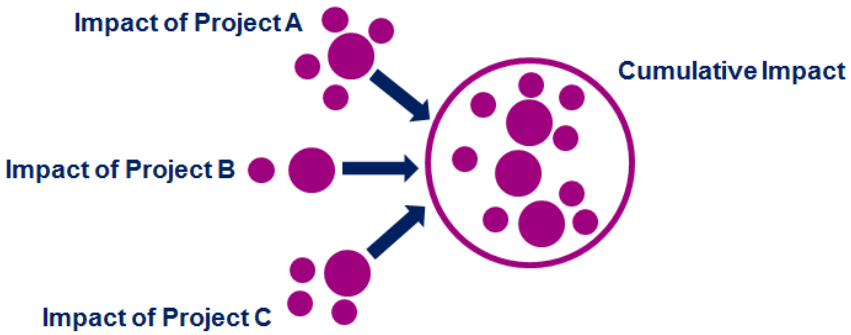



**Figure 5-1. Illustration of Cumulative Impacts**

The need for Cumulative Impact Assessment (CIA) emerges in circumstances where a series of developments, which may or may not be of the same type, is occurring, or being planned within an area where they would impact the same VESCs, which are defined as the environmental and social attributes that are considered to be important in assessing risks. The CIA process to be implemented in case of such circumstances is defined by IFC (August 2013) as (i) analyzing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social drivers on the chosen VESCs over time, and (ii) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible.

In light of the evolving global practice, IFC proposes a six-step approach for conducting Project-initiated CIA studies (IFC, August 2013). This approach, which will be adopted in the CIA study to be conducted as a part of Efeler GPP Project, is illustrated in Figure 5-2.

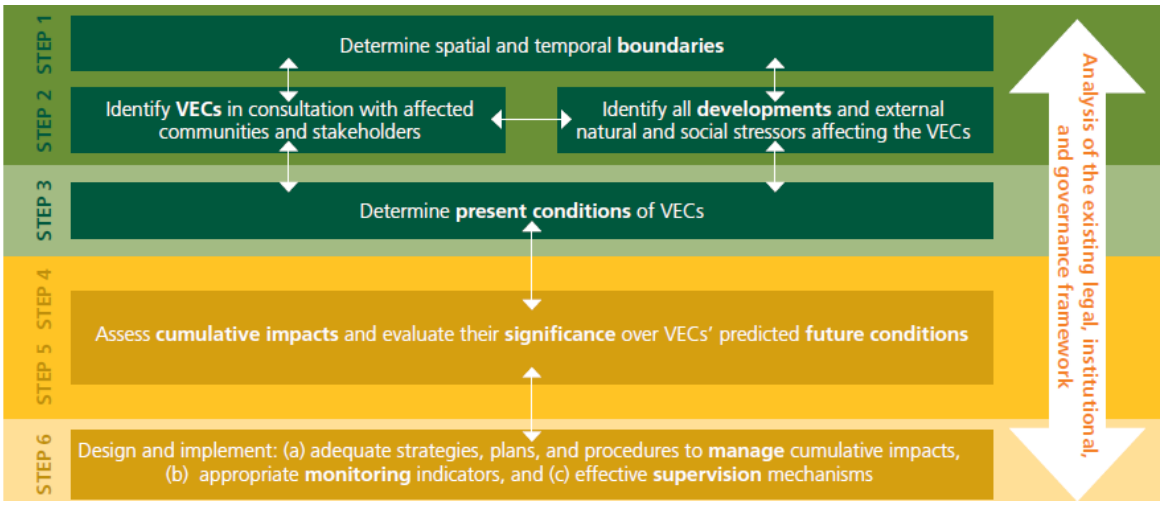



**Figure 5-2. Six-step CIA Approach**

(Source: IFC, August 2013)

There are a number of limitations to the assessment of the cumulative impacts of the Project with other projects over a wide area and over a long period of time. Most of these limitations would apply to many projects of similar scale and duration. The main limitations are:

- The available information on future projects is variable and in many cases very limited. Therefore, their physical characteristics are uncertain or subject to change. The timing of many future projects is also uncertain and subject to change. Additionally, any planning documentation regarding these projects can be confidential.
- Some of the other projects have not been subject to environmental and social impact assessments (or the assessments are not accessible) as yet and the effects of these possible developments have therefore not been documented.
- There are a number of unknowns associated with the baseline conditions in the CIA study area.
- Cumulative impacts will be influenced by policies and developments outside of the study area.

Given the limitations described above, this CIA has been prepared to establish at a very broad level the types of effects that could occur as a result of the Project in addition to other projects.

## 5.2 Cumulative Impact Assessment Study

The following section presents the implementation of the step-wise methodology and results of the CIA study for the Project. Steps to be followed are listed below:

- Step 1: Scoping Phase I – VESCs, Spatial and Temporal Boundaries
- Step 2: Scoping Phase II – Other Activities and Environmental Drivers
- Step 3: Establish Information on Baseline Status of VESCs
- Step 4: Assess Cumulative Impacts on VESCs
- Step 5: Assess Significance of Predicted Cumulative Impacts
- Step 6: Management of Cumulative Impacts

### 5.2.1 Step 1: Scoping Phase I – VESCs, Spatial and Temporal Boundaries

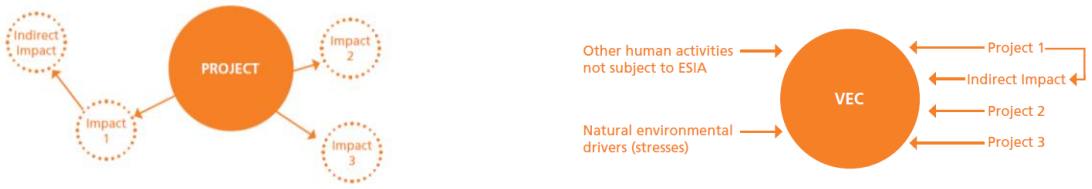
In the first step of the CIA study, initially VESCs will be identified in consideration of the previous environmental and social assessments done. Afterwards, time frame (spatial boundaries) for the analysis will be determined and geographical scope (spatial boundaries) of the assessment will be established as the CIA Study Area. Details of the Step 1 assessments are provided in the following sections.

***Valued Environmental and Social Components (VESCs)***

The good CIA practice suggests that the CIA studies are conducted with a focus on the environmentally or socially important natural resources, ecosystems or human values, which are in this report referred to as Valued Environmental and Social Components (VESCs) and may include the following:

- Physical features (e.g. habitats, wildlife populations),
- Social conditions (e.g. health, economics), or
- Cultural aspects (e.g. archaeological sites).

This approach entails the CIA studies to be looked at "from the VESCs point of view", instead of a Project-centered perspective as this is the case in the environmental and social impact assessment (ESIA) studies and allows assessment of combined (i.e. cumulative) impacts of various projects/activities on each VESC. The Project-centered perspective of the ESIA and the VEC-centered perspective of CIA processes are comparatively illustrated in Figure 5-3.




ESIA Perspective (Project-centered) CIA Perspective (VEC/VESC-Centered Perspective)

**Figure 5-3. ESIA (Project-centered) vs. CIA (VESC-centered) Perspectives**

In line with the good CIA perspectives as explained above, the CIA study for Efeler GPP Project will focus on the impacts on the selected VESCs that are to be affected by the Project activities. In other words, any VESC that would be affected by other projects/activates, but not the Efeler GPP, will not be assessed in the scope of the CIA. This approach is illustrated in Figure 5-4.

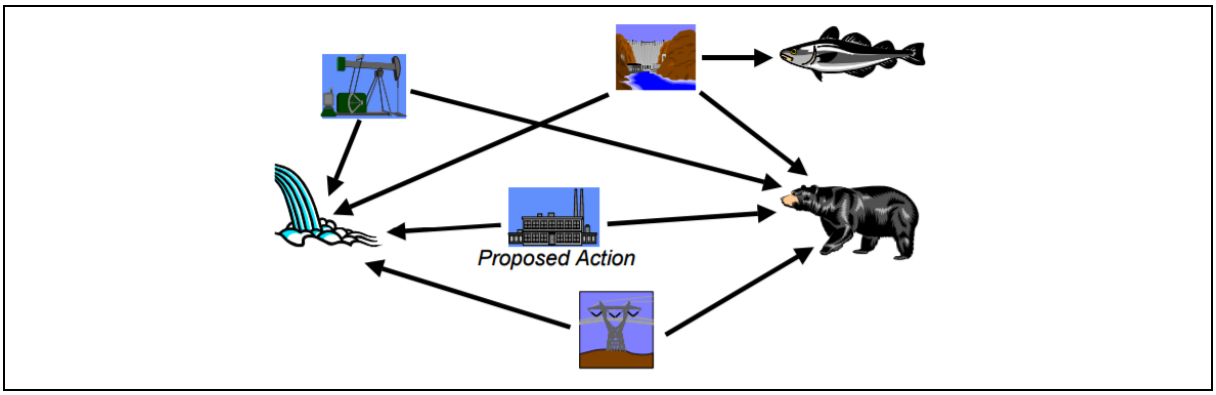



**Figure 5-4. Focusing on Impacts on VECs**

*Source: Effects Assessment Working Group for the Canadian Environmental Assessment Agency, 1999*

In line with the findings of the baseline and impact assessment studies conducted for the Efeler GPP Project, VESCs to be considered in the CIA have been selected as presented in Table 5-1.

**Table 5-1. Selected VESCs for the Efeler GPP CIA Study**

| Environmental/ Social Subject | Valued Environmental/Social Components |
|---|---|
| Land use | Agricultural lands |
| Biodiversity and living resources | Habitats |
| | Priority biodiversity features |
| Air emissions | Air quality in local settlements |
| Noise | Background noise levels at local settlements |
| Visual environment | Visual amenity of local communities (visual receptors) |
| Social and economic environment | Socio-economic conditions of local communities |
| Induced Seismicity | Rock stress patterns |

***Spatial and Temporal Boundaries***

Cumulative impacts can occur (a) when there is “spatial crowding” as a result of overlapping impacts from various actions on the same VESCs in a limited area (e.g. increased noise levels in a community from industrial developments, existing roads, and a new highway; or landscape fragmentation caused by the installation of several transmission lines in the same area) or (b) when there is “temporal crowding” as impacts on a VESC from different actions occur in a shorter period of time than the VESC needs to recover (e.g. impaired health of a fish’s downstream migration when subjected to several cascading hydropower plants) (IFC, August 2013).

The entire Germencik and İncirliova districts were selected as the study area, since multiple GPPs are located in the vicinity as well as additional energy generation Projects that may have potential impacts on the same VESCs. Identified CIA Study Area is shown on the map provided in Figure 5-5.

Electricity Generation License duration for other geothermal projects existing and planned in the region is generally 49 years. The generation license for Efe-6 and Efe-7 on the other hand states more than 16 years of generation time frame. Efe-8 currently does not have a generation license. Accordingly, temporal boundary of the CIA study has been determined as the Project life of the Efeler GPP, which will start with the beginning of land preparation activities and be limited with the duration of the applicable Electricity Generation Licenses (assuming no license extension at the end of license duration). It should be noted that construction of GPP projects and the thermal power plant projects are typically completed in relatively short periods when compared to operation duration; thus, the temporal crowding of the impacts resulting in cumulative impacts would occur during the operation phases of the contributing projects, if there is any. Hence, the operational phase of the Efeler GPP will be the main focus of this CIA study.

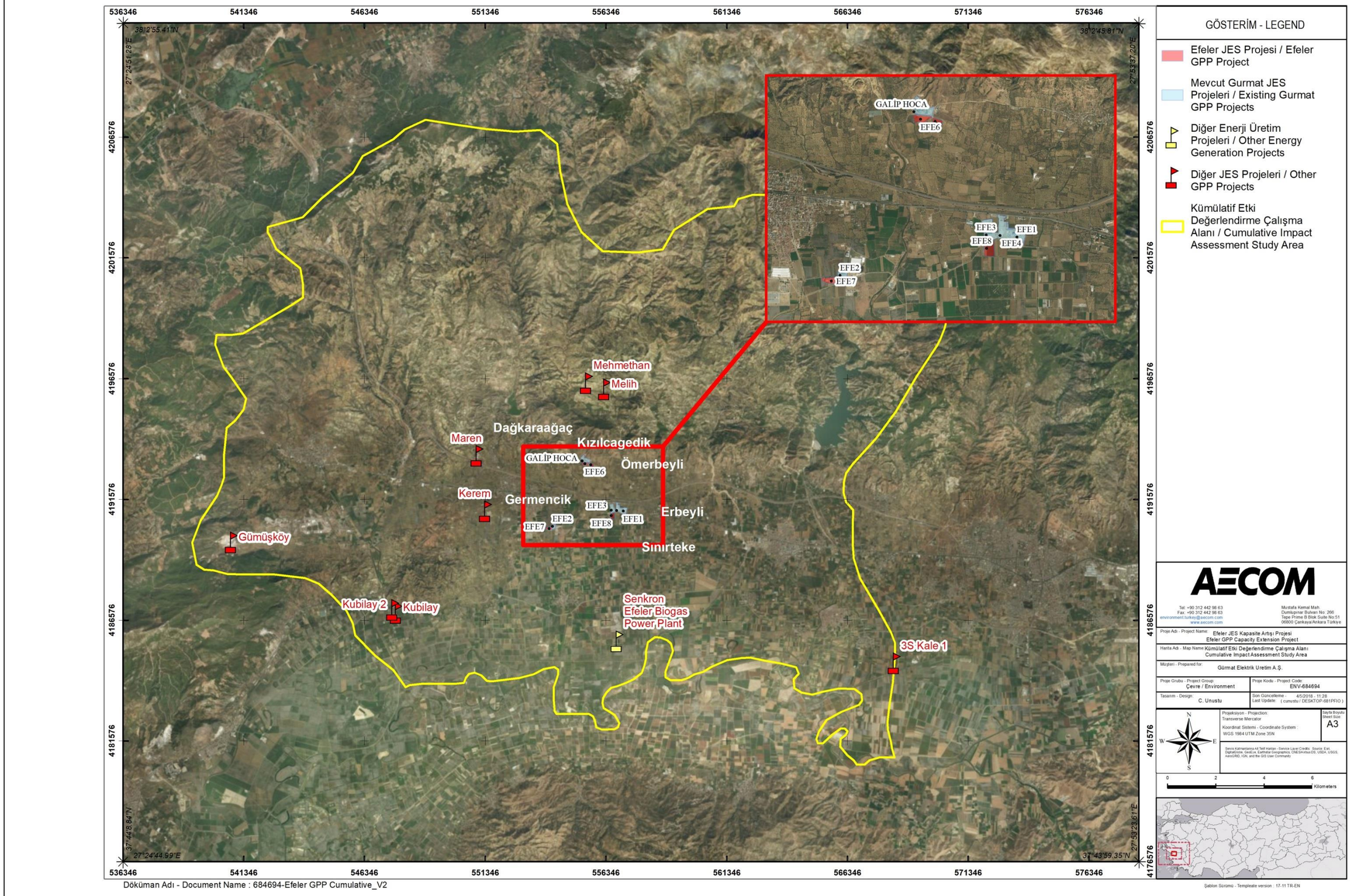



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**Figure 5-5. CIA Study Area and Projects Included in the CIA**

### 5.2.2 Step 2: Scoping Phase II – Other Activities and Environmental Drivers

Once the CIA Study Area and the spatial and temporal boundaries of the assessment are determined, other past, existing and foreseeable activities/developments and environmental drivers within these boundaries that would affect the condition of the selected VESCs have been identified on the basis of a review of public database of Electricity Generation Licenses issued by the EMRA for GPP projects.

***Other Activities***

Efeler GPP is the "Project under Assessment" in this CIA study. In identifying other contributing projects within the CIA Study Area, focus is given on energy generation projects, as only GPP projects and thermal power plant projects were identified in the study area (based on EMRA licenses) and that these types of projects would have common types of impacts that would affect the same VESCs, especially in terms of emission related impacts. Reasonable efforts have been made to determine and include both the existing (currently operational) and future projects in the CIA. With regard to selection of future projects, "Cumulative Effects Assessment Practitioners Guide" prepared for the Canadian Environmental Assessment Agency's (Hegmann et al., AXYS Environmental Consulting Ltd. February 1999) three future action categories have been considered; certain, reasonably foreseeable and/or hypothetical. Description of each category and their descriptors are depicted in Figure 5-6.

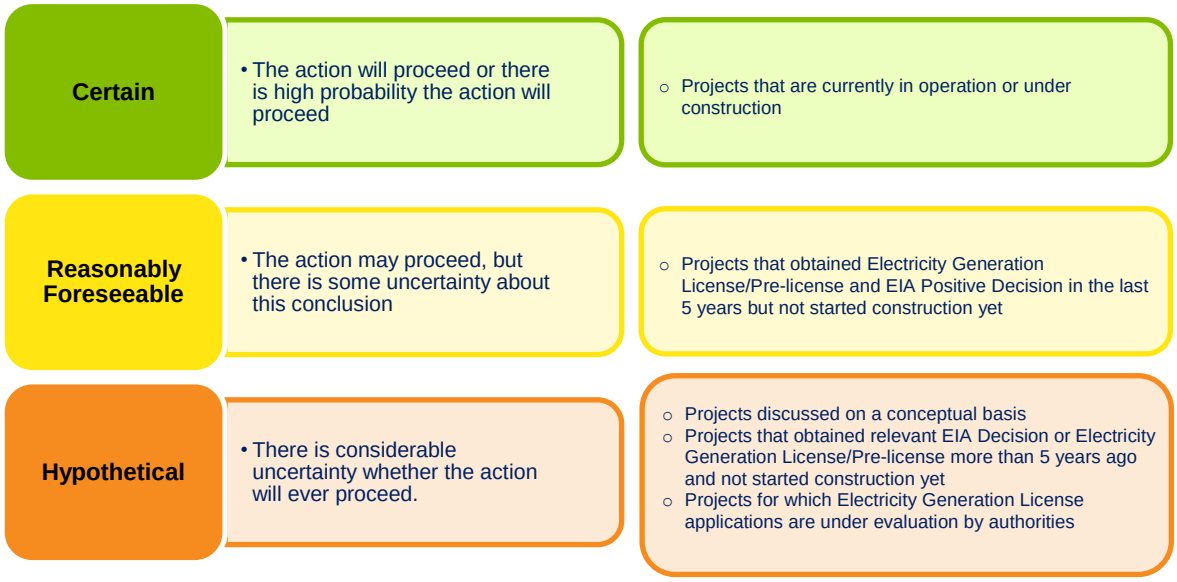


**Figure 5-6. Categorization of Future Projects**

(*Source: Adapted from Hegmann et al., AXYS Environmental Consulting Ltd. February 1999*)

The Guide further recommends inclusion of at least the certain scenario and at best the most likely future scenario, or in other words, "reasonably foreseeable projects" that could have a significant cumulative effect with the Project under assessment, in this case Efeler GPP. Accordingly, the future projects included in this CIA study involved both the certain and reasonably foreseeable projects identified within the CIA Area.

In light of this information, existing, reasonably foreseeable and hypothetical projects that have been identified and included in the CIA together with Efeler GPP are presented in Figure 5-7, whereas information on other projects (i.e. Projects not sponsored by Gurmat Elektrik) are provided in Table 5-2. Map given above in Figure 5-5 demonstrates the CIA Study Area and the projects to be included in the assessment (only Projects with public information on locations).

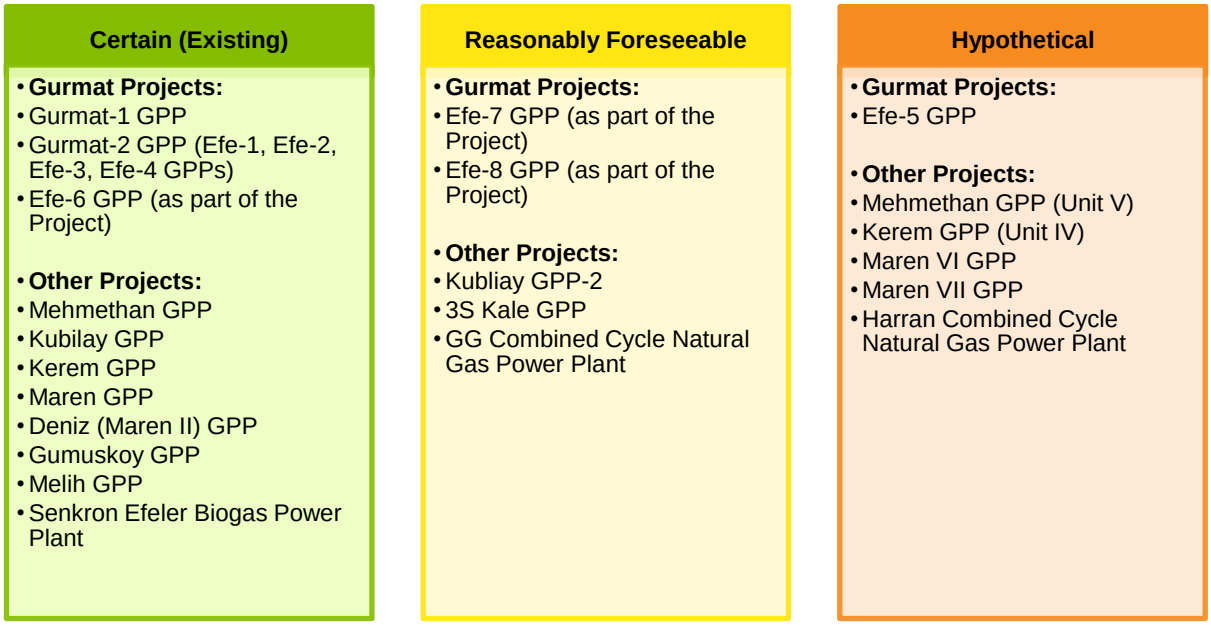


**Figure 5-7. Projects to be included in the CIA Study**

**Table 5-2. Other Projects Identified for CIA**

| Project | District | Installed Capacity (MW) | Electricity Generation License Information | | | Status | Category |
|---|---|---|---|---|---|---|---|
| | | | Type | Start | End | | |
| Mehmethan GPP | Germencik | 24.8 | Generation | 21.10.2016 | 11.03.2039 | Generation License in force | Existing |
| Kubilay GPP | Germencik | 24 | Generation | 13.10.2016 | 05.03.2043 | Generation License in force | Existing |
| Kerem GPP | Germencik | 24 | Generation | 09.10.2014 | 09.10.2063 | Generation License in force | Existing |
| Maren GPP | Germencik | 44 | Generation | 30.07.2009 | 11.03.2039 | Generation License in force | Existing |
| Deniz (Maren II) GPP | Germencik | 24 | Generation | 09.05.2012 | 11.03.2039 | Generation License in force | Existing |
| Gumuskoy GPP | Germencik | 13.2 | Generation | 24.02.2011 | 09.02.2040 | Generation License in force | Existing |
| Melih GPP | Germencik | 33 | Generation | 07.12.2017 | 11.03.2039 | Generation License in force | Existing |
| Senkron Efeler BPP | İncirliova | 3.6 in operation, 1.9 under construction | Generation | 03.10.2012 | 03.10.2027 | Generation License in force (capacity extension under construction) | Existing |
| Kubilay GPP-2 | Germencik | 24 | Prelicense | 22.03.2018 | 22.09.2020 | EIA Positive Decision obtained | Reasonably Foreseeable |
| 3S Kale GPP-1 | İncirliova | 25 | Prelicense | 20.07.2017 | 20.01.2020 | EIA Positive Decision obtained | Reasonably Foreseeable |
| GG CCGT PP | Germencik | 440 | Generation | 01.11.2011 | 01.11.2060 | EIA Positive Decision obtained/ Generation License ended | Reasonably Foreseeable |
| Harran CCGT PP | Germencik | 135 | Generation | 27.12.2012 | 27.12.2061 | EIA Positive Decision unknown/ Generation License | Hypothetical |

| Project | District | Installed Capacity (MW) | Electricity Generation License Information | | | Status | Category |
|---|---|---|---|---|---|---|---|
| | | | Type | Start | End | | |
| | | | | | | ended | |
| Mehmethan GPP (Unit V) | Germencik | 24 | Generation | Denied | | Generation License denied | Hypothetical |
| Kerem GPP (Unit IV) | Germencik | 24 | Generation | Denied | | Generation License denied | Hypothetical |
| Maren VI | Germencik | 24 | Generation | Denied | | Generation License denied | Hypothetical |
| Maren VII | Germencik | 24 | Generation | Denied | | Generation License denied | Hypothetical |

*Source: EMRA License Database, March 2017 (http://www.epdk.org.tr/)*

#### *Environmental Drivers*

Environmental drivers refer to natural drivers and other stressors, such as fires, droughts, floods, predator interactions, human migration, new settlements, etc. that may exert an influence on the VESCs. For example, the fire regime in forested areas is a major driver that shapes social, ecological and economic systems (IFC, August 2013).

Based on the existing knowledge of the ecology and/or natural dynamics of the selected VESCs, no major environmental driver that may contribute to cumulative impacts has been identified for this CIA study.

### 5.2.3 Step 3: Establish Information on Baseline Status of VESCs

Information on the baseline status of the VESCs will be mainly based on the information gathered for each environmental and social subject in scope of the ESIA Addendum study and the national EIAs. Thus, relevant information on the baseline status for VESCs are presented in the related chapters of this Report.

### 5.2.4 Assess Cumulative Impacts on VESCs

The potential cumulative environmental and social impacts have been assessed only for operation phases of the projects, since construction phase impacts are relatively insignificant and temporary, compared to impacts caused during the long operation phase of power plants, which, for GPPs (majority of the identified projects) may last as long as 50 years with proper maintenance in place. Some of the impacts identified by this CIA stem from construction activities (e.g. impacts on land use, visual impacts etc.), and persist during the operation phase. Any such impact is also included in the operation phase impacts identified in this study.

Assessment of potential cumulative impacts of the Project together with other projects identified in the CIA Study Area on the selected VESCs has been based on a qualitative approach, as technical information on other projects readily available through public information sources is limited.

Potential environmental and social issues identified within the scope of the Project national EIAs and this ESIA Addendum have been screened in consideration of identified existing and reasonably foreseeable future projects to determine potential cumulative impacts. In addition, the findings of the Commission Report prepared by the commission authorized by Efeler Municipality to identify potential environmental and social risks geothermal power plants were also considered during identification of potential cumulative impacts. The impacts identified by the said Commission Report, which are assessed to be of cumulative importance, include the following:

- $H_2S$ emissions in terms of health and safety, including toxicity and odor,
- Vapor visual impacts,
- Potential discharge of geothermal fluids to receiving environments leading to chemical and thermal pollution and especially impacts to agricultural production as a result (this impact not included in this CIA study as Gurmat Elektrik reinjects the entirety of spent geothermal fluids),
- Induced seismicity

The key environmental and social issues where project(s) in combination with the Project have the potential to result in cumulative impacts are summarized in Table 5-1.

### 5.2.5 Assess Significance of Predicted Cumulative Impacts

The potential cumulative impacts of Efeler GPP Project together with other energy generation projects identified in the CIA Study Area are summarized in Table 5-4. As can be seen, cumulative impact of GHG emissions from GPPs in the vicinity is assessed to be moderate, due to high $CO_2$ content of the reservoir. In addition, beneficial economic impacts due to opportunities for services sector and employment and beneficial community development impact were also assessed to have moderate significance.

### 5.2.6 Management of Cumulative Impacts

For the management of cumulative impacts, it is important to underline that the responsibility of the management/mitigation of the cumulative impacts resulting from the actions of multiple stakeholders involves a collective responsibility which requires individual actions to eliminate or minimize the contribution of each action/development. Therefore, managing the potential cumulative impacts is not solely the responsibility of Gurmat Elektrik. Within this regard, other project owners, related local and national level authorities, NGOs, associations and research institutions should also be involved.

For the long run, it is important to ensure that cumulative environmental and social impacts of GPPs and other projects operating within a geographical context are assessed in a well-structured, technically and scientifically correct manner through engagement with key stakeholders. As a result of such a study, regional action plans could be developed to clearly define roles and responsibilities of each party involved.

Considering the scale of such a study, participation by a multitude of stakeholders would be required and ideally the responsibility for conducting a detailed CIA would lie with relevant governmental authorities. Gurmat Elektrik will participate and contribute to such a study.

**Table 5-3. Potential Cumulative Environmental and Social Impacts**

| Key Issues | Potential Cumulative Environmental and Social Impacts |
|---|---|
| Air emissions (NCGs) | • The main NCG emission of concern other than GHGs is $H_2S$, which is a toxic gas and which may also affect local communities due to its malodorous character. As indicated by monitoring studies for Gurmat-1 and Gurmat-2 GPPs, which use the same reservoir with the Project, the Project's contribution to cumulative $H_2S$ emissions is expected to be very small. Nonetheless, cumulative $H_2S$ emissions, specifically in terms of impacts on local communities due to odor, shall be investigated by a detailed cumulative impact study to be conducted by related authorities and associations, since existence of abatement techniques and potentially affective factor such as wind patterns are unknown. Additional organizational measures/limits may be proposed as a result of any such detailed study. |
| Air emissions (GHGs) | • Considering the fact that area reservoirs have high GHG content, the cumulative GHG emission impact is expected to have moderate significance. A detailed, regional cumulative study to be conducted by related authorities is required in this regard. However, it should also be noted that the contribution of the Project to GHG emissions will decrease in time, as described in the related section of this report where GHG assessments are provided. |
| Terrestrial flora/fauna | • Cumulative impacts of the existing and foreseeable projects can be listed as; fragmentation of habitats into higher number of patches, which limit individual species' ranges in a given area, cumulative result of multiple infrastructure, synergistic effect of multiple GPPs in a given area, as well as increased mortality risk due to various project activities, including increased traffic in the area.<br>• Although projects may be carried out by different developers, they do have cumulative impacts on landscape and biology, some of which must be assessed together. Neither the legislation nor the private initiatives in Turkey support such an approach. Therefore, it is not possible to make an assessment of cumulative impacts on biodiversity features, without adequate data from other existing and foreseeable projects in the area. International best practices also suggest that when a number of projects are planned in an area like this, it is more effective for different project owners to come to an agreement on a single cumulative impact assessment, which could also be supervised by related authorities. This would usually mean assessment of a joint impact on the same natural element, for example the same reptile population in the area, whose territory, distribution, and population status would be identified to assess impacts of various developments. |
| Land use and agricultural land | • There will be some change in the land use characteristics in the area that will start with construction activities and persist during operation phase. The permanent land use characteristic change is especially important in terms of loss of agricultural land. However, the ETLs and pipelines of the projects only use easement rights instead of acquisition of the entire land parcels where these components' routes passes from and therefore, agricultural activities can continue around the small footprint corridors of these components. Consequently, cumulative impact on arable land is mainly limited to plant footprint areas.<br>• The Project GPPs will reinject the spent fluids directly back in to the reservoir (i.e. no discharge to receiving environments) by utilizing reinjection wells that are designed to ensure no interaction with soil or shallow groundwater environments occur. Therefore, the Project will have no impact on agricultural land, in terms of decrease in productivity due to geothermal fluid discharges. |
| Visual impacts | • Cumulative visual impacts of binary GPPs would result from the presence of facility structures and increased traffic load. Detailed site planning, facility design, materials selection are measures that can be applied specifically by each facility; and revegetation programs and adjustment to transmission line routing are measures that can be applied following a detailed cumulative assessment which can be conducted by related authorities or associations.<br>• As the Project GPPs will use binary systems, their contribution to vapor in the local atmosphere will be minimal. Therefore there will be no cumulative impact of the Project GPPs in terms of visual impacts of vapor, which, in lack of proper stakeholder engagement and awareness raising activities, may be perceived as harmful gasses by local communities. |
| Induced seismicity | • Induced seismicity is an issue of importance at geothermal sites where there are a large number of operational GPPs with very high generation capacities (i.e. the Geysers geothermal field in California, US, where more than 20 GPPs with a collective approximate installed capacity of 1.5 GW are operated, as opposed to the approximate 0.5 GW total installed capacity identified by this CIA, using the Germencik reservoir). Even in this case, majority of the seismic activity cannot be sensed by local communities due to very small magnitudes of 1-3.Therefore, a cumulative impact study is not of importance for the determined CIA area (cumulative impact of identified existing/future GPPs negligible).<br>• If required by related authorities or in case multiple new plants are planned in the future years and/or specific grievances are received the issue should be reevaluated. |

| Key Issues | Potential Cumulative Environmental and Social Impacts |
|---|---|
| Economy (services sector and employment) | • Cumulative economic impacts of geothermal power plants in the region will be positive in terms of providing employment opportunities for the local work force and stimulating local markets that deliver services (transportation, housing, catering, etc.) and commercial dynamics (i.e. sales of goods, food, fuel, construction materials, equipment, etc.).<br>• It is anticipated that competitive markets will result in improved level of services, while new businesses will also be developed based on particular demands of geothermal projects. $CO_2$ end-use applications such as greenhouse applications, enhanced oil recovery, dry ice production, beverage applications, anti-fire applications are potential industries to develop. However, cooperation of geothermal power plants in the region with regional development agencies for guiding new businesses and increasing the quality of labor force through joint training activities is very important in terms of enhancing and maximizing this positive impact. |
| Quality of life (community investments, emissions) | • The impact of GPPs in the region is positive on quality of life in general, mainly in terms of community investment programs that aim to improve current conditions of facilities such as schools, healthcare organizations, community centers, mosques, etc.<br>• Cumulative adverse impacts in the form of general nuisance and concerns can be observed in time, if mitigation measures (especially for emissions to air) are not-taken by all plants contributing and also if the mitigations are not well-communicated with local communities. |

**Table 5-4. Interaction of Projects with VESCs**

| Projects | | VESCs | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Settlements (Air Quality Impacts related to $H_2S$ – Incl. odor) | | | | | | | Global Scale/ Ecosystem Components (GHG Emissions) | Biodiversity | Land Use (Agricultural Land Availability) | Settlements (Visual Impacts/ GPP Facilities) | | | | | | | Settlements (Visual Impacts/ Vapor Plume) | Settlements (Induced Seismicity) | Local Communities and Regional Economy (services sector and employment) | Local Communities (Quality of Life) |
| | | Dagkaraagac | Alangulu | Kizilcagedik | Omerbeyli | Germencik | Sinirteke | Erbeyli | | | | Dagkaraagac | Alangulu | Kizilcagedik | Omerbeyli | Germencik | Sinirteke | Erbeyli | | | | |
| Project Under Assessment | Efe-6 | √ | √ | √ | √ | | | | √ | √ | √ | √ | √ | √ | √ | | | | | √ | √ | √ |
| | Efe-7 | | | | | √ | | | √ | √ | √ | | | | | √ | | | | √ | √ | √ |
| | Efe-8 | | | | √ | √ | √ | √ | √ | √ | √ | | | | | | √ | √ | | √ | √ | √ |
| Existing Projects | Gurmat-1 | √ | √ | √ | √ | | | | √ | √ | √ | √ | √ | √ | √ | | | | | √ | √ | √ |
| | Efe-1 | | | | √ | √ | √ | √ | √ | √ | √ | | | | | | √ | √ | | √ | √ | √ |
| | Efe-2 | | | | | | | | √ | √ | √ | | | | | √ | | | | √ | √ | √ |
| | Efe-3 | | | | √ | √ | √ | √ | √ | √ | √ | | | | | | √ | √ | | √ | √ | √ |
| | Efe-4 | | | | √ | √ | √ | √ | √ | √ | √ | | | | | | | | | √ | √ | √ |
| | Mehmethan GPP | √ | √ | √ | | | | | √ | √ | | | | | | | | | | √ | √ | √ |
| | Kubilay GPP | | | | | | | | √ | √ | √ | | | | | | | | | √ | √ | √ |
| | Kerem GPP | | | | | √ | | | √ | √ | √ | | | | | √ | | | | √ | √ | √ |
| | Maren GPP | √ | | | | √ | | | √ | √ | √ | √ | | | | | | | | √ | √ | √ |
| | Gumuskoy GPP | | | | | | | | √ | √ | | | | | | | | | | √ | √ | √ |
| | Melih GPP | √ | √ | √ | √ | | | | √ | √ | | | | | | | | | | √ | √ | √ |
| | Senkron Efeler BPP | | | | | | | | | √ | √ | | | | | | | | | √ | √ | √ |
| Reasonably Foreseeable Projects | Kubilay GPP-2 | | | | | | | | √ | √ | √ | | | | | | | | | √ | √ | √ |
| | 3S Kale GPP-1 | | | | | | | | √ | √ | √ | | | | | | | | | √ | √ | √ |
| Cumulative Impact Potential | | Yes (Minor due to very low $H_2S$ measurements recorded during monitoring) | | | | | | | Yes (Moderate due to high reservoir GHG content) | Yes (Minor, due to high industrial and agricultural activity in the area, the natural flora and fauna composition has already been degraded to a great extent that no major further impacts are expected. ) | Yes (Minor, since the impact is limited to power plant and well footprints, which are relatively small compared to other energy generation technologies, and the very limited width of easement corridor for pipelines) | Yes (Negligible, due to the fact that although some GPPs are visible from the same settlements, the distances are far enough) | | | | | | | No (As the Project GPPs will use binary and closed loop systems that reinject the condensed fluids back into the reservoir / no flash systems) | No (Although all identified GPP Projects can hypothetically contribute to induced seismicity, research indicates that this is an issue only for large reservoirs utilized by large number of GPPs - compared to Germencik reservoir-). | Yes (Moderate, since a multitude of energy generation projects, especially GPPs, are already operating and others are being planned, which would all contribute to local economy and employment opportunities for skilled and unskilled personnel from the region. | Yes (Moderate for Gurmat Elektrik GPPs since the Project Company conducts and will continue to conduct various community development activities and programs.<br><br>Unknown for other GPPs and other power plants. |

# 6. Permits, Licenses and Approvals

Existing status of major permits, licenses and approvals that are necessary for Project activities are provided in Table 6-1.

**Table 6-1. Status of Permits, Licenses and Approvals**

| Column heading | Related Authority | Efe-6 GPP | Efe-7 GPP | Efe-8 GPP |
|---|---|---|---|---|
| Geothermal Resource Operation License | Aydin Provincial Special Administration | 01.04.2004 | 01.04.2004 | 01.04.2004 |
| Permit for Non-agricultural Use of Agricultural Lands | Aydin Governorate, Provincial Directorate of Food, Agriculture and Livestock | 06.10.2016 | 29.06.2012 | 15.02.2018 |
| Building (Construction) Permit | Municipality/Governorate | 12.06.2017 | 23.08.2017 | Prior to construction phase |
| Waste Water Treatment Plant (WWTP) Approval | Aydin Provincial Directorate of Environment and Urbanization | Obtained on 15 March, 2017 (for the joint WWP with Gurmat-1 WPP) | Obtained on 25.12.2017. | Will use the WWTP of Efe-1, Efe-3 and Efe-4. Approval to be obtained if an additional WWTP is planned. |
| Environmental Permit for the WWTP Discharge | Aydin Provincial Directorate of Environment and Urbanization | 15.03.2017 (Efe-6 will use the WWTP of Gurmat-1) | Planned to be obtained during operation phase | Will use the WWTP of Efe-1, Efe-3 and Efe-4. Permit to be obtained if an additional WWTP is planned. |
| ETL Connection and System Use Agreement | TEIAS/ ADM Electricity (distribution company) | 12.07.2017<br>03.08.2017 | 15.02.2018 | To be obtained following the construction phase |
| Waste Disposal Agreements | Related municipalities/ licensed firms | Tenders received as required (no annual agreements are made) | | |
| Waste Management Plan | Aydin Provincial Directorate of Environment and Urbanization | XDuring operation phase | XDuring operation phase | Xduring operation phase |

# 7. Status of Environmental and Social Action Plan (ESAP) Implementation of Gurmat-2 GPPs

An ESAP was prepared by WS Atkins International Ltd in 2014, within the scope of ESIA Disclosure Package for Gurmat-2, which was disclosed on 23 September 2014. Preparation of an annual report covering environmental and social issues and ESAP implementation progress is a requirement of this ESAP. In this context, the first Annual Environmental and Social Report for the Lenders was submitted on 17 October 2017. The report was mainly prepared by Gurmat Elektrik, with 3rd parties involved in monitoring activities; including OHS monitoring, $H_2S$ monitoring, noise monitoring and groundwater monitoring. An ESAP implementation status (addressed by the Project Company) is also provided together with this report.

Implementation status assessment of the ESAP based on this ESIA Addendum findings is provided in Table 7-1 below, together with the Project Company's own reporting remarks included in the Project Company's ESAP status assessment provided in the 17 October 2017 dated annual report.

**Table 7-1. Environmental and Social Action Plan (ESAP) for Gurmat-2 Project (Efe-1, Efe-2, Efe-3 and Efe-4 GPPs)**

| No. | Action | Environmental Risk, Liability/ Benefit | Legislative Requirement/ EBRD/Good practice | Investment Needs/ Resources Costs | Timetable Action to be Completed | Target and Evaluation Criteria For Successful Implementation | Remarks in Annual Reporting to Lenders | Status of Compliance based on ESIA Addendum Findings |
|---|---|---|---|---|---|---|---|---|
| 1 | Environmental, Health & Safety and Social (EHSS) Management System:<br>Establish and implement an EHSS management system (ESMS) and associated operating procedures for project operations based on the requirements of ISO 14001 and OHSAS 18001. In particular, the ESMS shall include:<br>-EHSS Management Plan, incorporating key operational procedures on Hazardous Materials Management, Solid & Liquid Waste Management, Emergency Response, and Community Grievance Redress<br>-EHSS training of staff and contractors.<br>-The Company will establish a grievance mechanism for stakeholders including staff and third parties. | Clear responsibilities and enforcement abilities. | PS 1/PR 1 | Own resources plus external support if required | Prior to commissioning of EFE 1. | EHSS Management procedures implemented and evidence of formalized routine monitoring of EHSS issued by management.<br>Clear rules are agreed and confirmed by involved parties.<br>Formal certification in 2015 | Gürmat has satisfied all of the requirements for environmental, health, safety and social aspects of EHSS management systems in this period.<br>Please find the attached certificates for ISO 14001, ISO 9001 and OHSAS 18001 for the period.<br>Waste Management Procedure has been published in September 2015.<br>Trainings in terms of EHSS have been conducted by our Company's consultants.<br>Possible grievance of third parties and staff are strictly monitored and reported as defined in the stakeholders' engagement plan. | Grievances are received and responded to in a timely manner. However, the grievance mechanism is relaying on cultural patterns instead of the existing mechanism and this method is not allowing for documentation of the entire grievance process.<br>Contractor and supply chain management procedures in place and implemented.<br>Emergency Action Plan and related procedures in place.<br>Annual Training Program and other training related management programs/procedures in place. |
| 2 | EHSS Monitoring:<br>Gürmat shall:<br>-Establish and implement routine monitoring procedures covering $H_2S$ (hydrogen sulphide), noise, grievance redress, OHS statistics and waste management.<br>-Provide information to the Lenders on any serious accidents and incidents. | Report to Lenders on project implementation. | Lenders requirement | | Annual report to the Lenders. | Report to Lenders | Routine monitoring procedures are being held and reported to the lenders within the scope of Annual Environmental and Social Monitoring Report.<br>Noise measurements have been done for 2016. The report is expected to be published by the external consultant.<br>Waste management procedure has been published and there has been no nonconformities found during the report period. All licenses, permits have been provided. Site visits and audits have been done.<br>Routine medical checks and occupational safety inspections are held and reported to the company by independent consultants.<br>No serious accidents or incidents during the reporting period. | Compliant |
| 2 | EHSS Capacity:<br>-Appoint an experienced person responsible for management of EHSS matters during operations. | Need to have on site EHS manager to deal with EHS issues, grievance requirements and ensure best practice implemented | PS/PR 1, Turkish regulations | One full time employee | Prior to operations commencing | EHSS Officer appointed in the Gürmat 2 GPP. | Confirm OHS Officer present already for construction<br>Completed | Compliant |
| 3 | Occupational Health & Safety (OHS)<br>Gürmat shall:<br>-Develop/implement Risk Assessments (RAs) and Safe Operating Procedures (SOPs)<br>-Monitor OHS performance on an ongoing basis and report output (KPIs such as Lost Time Incidents) to Lenders on an annual basis | Need to ensure compliance with international and national OHS standards | Turkish legislation, PS 2/PR 2 | GÜRMAT 2 GPP and consultant support | Start of construction and revision for operation | Develop and implement RAs and SOPs and update periodically as required.<br>Part of the annual report to the Lenders. | Use of internal and/or external specialists.<br>Consideration should be given to emission of $H_2S$.<br>Occupational Health & Safety implementation is performed by our consultants. Internal environmental, HS audits, drills have been performed during the reporting period.<br>In all these internal audits, it was seen that all the requirements for the standards were satisfied where there were no unconformities. | Risk Assessments (RAs) in place.<br>Safe Operating Procedures in place (named only as procedure).<br>OHS audits and inspections are being conducted.<br>KPI based monitoring ongoing. Internal reporting ongoing, covering accidents with lost work days, number of days lost, material/ equipment damage, etc. |
| 4 | Labour & Working Conditions:<br>Gürmat shall:<br>-Modify HR policies as necessary in accordance with PS/PR 2 requirements and communicate to employees.<br>-Establish a health and safety committee<br>-Develop and implement a worker grievance mechanism, including all direct employees, | To ensure compliance with Turkish regulations and GIIP. | Turkish legislation, PS 2/PR2 and GIIP | GÜRMAT 2 GPP | Prior to the operational phase | HR policies (endorsed by senior management) and Procedures prepared and terms of appointment provided. | Use of internal resources and external HR advisors.<br>HR Policies are modified<br>Health and Safety Committee has been established and necessary trainings had been given<br>Grievance mechanism has been developed and strictly implemented which includes all direct employees, contractors and subcontractors. | The HR procedure in place is not in line with EBRD PR2 requirements (i.e. prevention of child labour, forced labour, tolerance of workers associations, retrenchment principles and encouragement of non-discrimination).<br>The grievance mechanism is relaying on cultural patterns instead of the existing mechanism and this method is not allowing for documentation of the entire |

| No. | Action | Environmental Risk, Liability/ Benefit | Legislative Requirement/ EBRD/Good practice | Investment Needs/ Resources Costs | Timetable Action to be Completed | Target and Evaluation Criteria For Successful Implementation | Remarks in Annual Reporting to Lenders | Status of Compliance based on ESIA Addendum Findings |
|---|---|---|---|---|---|---|---|---|
| | contractors and sub-contractors | | | | | | | grievance process. |
| 5 | Greenhouse Gas (GHG) Emissions:<br>-Gürmat shall provide a detailed breakdown of GHG emissions to Lenders on an annual basis, including an update on the success of any supplemental measures taken to reduce emissions.<br>-Data will include details of emission per kWh and per MWh as well as total carbon emissions. | GIIP | Lender requirement. | Own resources | Annually in December. | Part of the annual report to the Lenders. | The report should also comment upon the progress and success of any $CO_2$ collection adopted at the Gürmat and the Gürmat 2 GPP facilities.<br>Completed | Ongoing item |
| 6 | Within 3 years of operations;<br>-Undertake a review of whether GHG emission can be reduced from the plant, and<br>-Prepare a report to be presented to Lenders on options available. | The report will review if it is possible to further reduce GHG emissions | Lender requirements | Own resources plus external support if required | 2017 | Report Lenders | Will be provided in 2018 (for the year 2017) | Ongoing item |
| 7 | Within three years of commissioning EFE 1 and 4 (Phase I) undertake an EHSS audit that will include:<br>-Review and verify carbon emissions<br>-Review and verify noise impacts (including monitoring)<br>-Review and verify hydrogen sulphide emissions<br>-Review grievance procedure as well as land allocation and use<br>-Review implementation of SEP and SIC<br>-The Report will include recommendations, which will be discussed and agreed with the Lenders and the Company and implemented by the Company to ensure compliance with the ESAP and Loan agreement conditions. | The commissioning report will review how the plant has been developed, and whether the ESAP and EIA requirements have been met. | Lender Requirement | External advisor | Within three years of commissioning EFE 1 and 4. | Report to Lenders on status of compliance and recommendations | Will be provided in 2018. | Ongoing item |
| 8 | -ESIA disclosure package to be disclosed locally and on web site throughout the life of the Project.<br>-Implement the requirements of the Lenders ESIA disclosure package and National legislation.<br>-Provide an update on the implementation of the SEP and Social Impact Assessment (SIC) | The Lender ESIA disclosure document contains information on the project design and implementation as well as compliance. This will be used to benchmark the plants EHSS performance | Lender requirement | Internal | ongoing | Report available on line | The Lenders ESIA disclosure document may be updated only on the basis of consent of all Lenders<br>Completed | ESIA Disclosure Package disclosed in the Company website<br>A public participation meeting was held on October 31, 2014.<br>Other stakeholder engagement activities included visits by university students and primary level education students. |

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# Appendix A Updated Fauna and Flora Tables

Explanations of CITES,The EU Habitats and Birds Directives

Flora/fauna survey results given in the local EIA Reports are reviewed and updated taking into account the EU Habitats Directive, the EU Birds Directives and CITES, distribution of the species and the most updated literature data. The notes related to the species, if there are, are given with asterix (*) under the updated species tables.

CITES ( the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. As CITES entered in force on 1 July 1975 CITES, Turkey joined as a party in 1996.

The species covered by CITES are listed in three Appendices, according to the degree of protection they need.

Appendix I: species that are the most endangered among CITES-listed animals and plants. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial (i.e. for scientific research). In these exceptional cases, trade may take place provided it is authorized by the granting of relevant permits.

Appendix II: lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. It also includes so-called "look-alike species", i.e. species whose specimens in trade look like those of species listed for conservation reasons. International trade in specimens of Appendix-II species may be authorized by the granting of an export permit or re-export certificate. No import permit is necessary for these species under CITES (although a permit is needed in some countries that have taken stricter measures than CITES requires). Permits or certificates should only be granted if the relevant authorities are satisfied that certain conditions are met, above all that trade will not be detrimental to the survival of the species in the wild.

Appendix III: lists species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation. International trade in specimens of species listed in this Appendix is allowed only on presentation of the appropriate permits or certificates.

The EU Habitats Directive ensures the conservation of a wide range of rare, threatened or endemic animal and plant species. Over 1,000 animal and plant species, as well as 200 habitat types, listed in the Directive's annexes are protected in various ways:

Annex II species (about 900): core areas of their habitat are designated as sites of Community importance (SCIs) and included in the Natura 2000 network. These sites must be managed in accordance with the ecological needs of the species.

Annex IV species (over 400, including many annex II species): a strict protection regime must be applied across their entire natural range within the EU, both within and outside Natura 2000 sites.

Annex V species (over 90): Member States must ensure that their exploitation and taking in the wild is compatible with maintaining them in a favourable conservation status.

The EU Birds Directive aims to protect all of the 500 wild bird species naturally occurring in the European Union. The 500 wild bird species naturally occurring in the European Union are protected in various ways:

Annex 1: 194 species and sub-species are particularly threatened. Member States must designate Special Protection Areas (SPAs) for their survival and all migratory bird species.

Annex 2: 82 bird species can be hunted. However, the hunting periods are limited and hunting is forbidden when birds are at their most vulnerable: during their return migration to nesting areas, reproduction and the raising of their chicks.

Annex 3: overall, activities that directly threaten birds, such as their deliberate killing, capture or trade, or the destruction of their nests, are banned. With certain restrictions, Member States can allow some of these activities for 26 species listed here.

Annex 4: the directive provides for the sustainable management of hunting but Member States must outlaw all forms of non-selective and large scale killing of birds, especially the methods listed in this annex.

Annex 5: the directive promotes research to underpin the protection, management and use of all species of birds covered by the Directive, which are listed in this annex.

Abbreviations

| | |
|---|---|
| An. | Annex |
| App. | Appendix |
| Eur-Sib | European-Siberian |
| G | Migrant species that arrive in Turkey to breed |
| L | Literature |
| Med. | Mediterranean |
| O | Observation |
| Spp. | Species |
| Subsp. | Subspecies |
| Var. | Variety |
| Y | Native, resident species |

Updated Flora and Fauna Species Tables

**Table 8-1. Updated Flora Table for Efe-6 Local EIA Report**

| Family | Scientific Name of the Species | Turkish Name of the Species | English Name of the Species | Phytogeographic Region | Bern | IUCN | EU Habitats Directive | CITES | Identification Method |
|---|---|---|---|---|---|---|---|---|---|
| ASPLENIACEAE | Asplenium trichomanes | Baldırıkara | - | - | - | NE | - | - | L |
| HYPOLEPIDACEAE | Pteridium aquilinum | Eğrelti | - | - | - | NE | - | - | L |
| PAPAVERACEAE | Papaver minus | Gelincik | - | East Med | - | NE | - | - | L |
| POLYGONACEAE | Rumex tuberosus L. | - | - | - | - | NE | - | - | L |
| | Polygonum bellardii ALL. | Potuk | - | - | - | NE | - | - | L |
| CUPRESSACEAE | Juniperus oxycedrus | Ardıç | - | - | - | NE | - | - | L |
| | Juniperus foetidissima | Kokar Ardıç | - | - | - | NE | - | - | L |
| | Juniperus excelsa M. BIEB. subsp. excelsa | Boz ardıç | - | - | - | NE | - | - | L |
| APIACEAE | Eryngium creticum | Göz Dikeni | - | East Med. | - | NE | - | - | L |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LAM. | | | | | | | | |
| MALVACECEAE | Althaea hirsuta L. | Gülhatmi | - | - | - | NE | - | - | L |
| | Malva sylvestris | Ebe gümeci | Garden Mallow | - | - | NE | - | - | L |
| CISTACEAE | Fumana procumbens | Yer güneşotu | - | - | - | NE | - | - | L |
| | Cistus laurifolius L. | Davşan otu | - | Med. | - | NE | - | - | L |
| CARYOPHYLLACEAE | Silene macrodanta BOISS | Deve nakılı | Largetooth Catchfly | - | - | NE | - | - | L |
| | Silene compacta | Yapışkan otu | - | - | - | NE | - | - | L |
| LAMIACEAE | Lamium moschatum MILLER var. rhodium | Ballıbaba | - | East Med. | - | NE | - | - | L |
| | Phlomis pungens WILLD. var. hirta VELEN. | Çalba | - | - | - | NE | - | - | L |
| LILIACEAE | Allium hirtovaginum CAND. | - | - | East Med. | - | NE | - | - | L |
| | Ornithogalum armeniacum | Ak yıldız | - | East Med. | - | NE | - | - | L |
| GERANIACEAE | Geranium robertianum L. | Dağ ıtırı | - | - | - | NE | - | - | L |
| FAGACEAE | Castanea sativa MILLER | Kestane | Sweet Chestnut | Eur-Sib | - | NE | - | - | L |
| | Quercus frainetto TEN. | Macar meşesi | Hungarian Oak | Eur-Sib | - | NE | - | - | L |
| | Quercus cerris | Saçlı meşe | Turkey Oak | Med. | - | NE | - | - | L |
| | Quercus pubescens WILLD. | Tüylü meşe | Downy Oak | - | - | NE | - | - | L |
| | Quercus infectoria OLIVIER subsp. boissieri (REUTER) | Mazı meşesi | - | - | - | NE | - | - | L |
| PINACEAE | Pinus brutia TEN. var. brutia | Kızılçam | Turkish Pine | - | - | NE | - | - | L |
| | Pinus nigra J. F. ARNOLD | Karaçam | European Black Pine | - | - | NE | - | - | L |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | subsp. nigra var. caramanica | | | | | | | | |
| | Pinus sylvestris L. var. hamata STEVEN | Sarıçam | Scots Pine | - | - | NE | - | - | L |
| POACEAE | Aegilops triuncialis L. subsp. triuncialis L. | Üç kılçık | - | - | - | NE | - | - | L |
| | Poa angustifolia L. | Dar salkımotu | - | - | - | NE | - | - | L |
| | Triticum sp. | Yabani buğday | Wheat | - | - | NE | - | - | L |
| | Avena sp. | Yabani yulaf | Oat | - | - | NE | - | - | L |
| | Hordeum pusillum | Yabani arpa | Little Barley | - | - | LC | - | - | L |
| ASTERACEAE | Anthemis auriculata BOISS. | Papatya | | East Med. | - | NE | - | - | L |
| BRASSICACEAE | Eruca sativa MILLER | Roka | | - | - | NE | - | - | L |
| | Alyssum minus (L.) ROTHM. var. minus (L.) | - | - | - | - | NE | - | - | L |
| | Capsella bursa-pastoris | Çoban çantası | - | - | - | NE | - | - | L |
| FABACEAE | Astragalus hamosus L. | Deli Çöven | Hooked milkvetch | - | - | NE | - | - | L |
| | Genista anatolica BOISS. | Kandaş dikeni | - | East Med. | - | NE | - | - | L |
| MYRTACEAE | Eucalyptus sp. | Okaliptus | - | - | - | NE | - | - | L |
| BORAGINACEAE | Heliotropium dolosum DE | Siğil otu | - | - | - | NE | - | - | L |
| | Myosotis cadmaea BOISS. | Honaz boncuğu | - | East Med. | - | NE | - | - | L |
| ZYGOPHYLLACEAE | Peganum harmala L. | Üzerlik | Harmal | - | - | NE | - | - | L |
| RANUNCULACEAE | Ranunculus arvensis | Düğün çiçeği | Corn-buttercup | - | - | NE | - | - | L |
| ROSACEAE | Potentilla recta L. | Su parmakotu | Sulphur Cinquefoil | - | - | NE | - | - | L |
| | Pyrus communis L. subsp. | Bey armudu | - | - | - | NE | - | - | L |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | communis L. | | | | | | | | |
| | Rubus caesius L. | Büküzümü | Dewberry | - | - | NE | - | - | L |
| OLEACEAE | Olea europaea L. var. europaea L. | Zeytin | - | Med. | - | NE | - | - | L |
| | Phillyrea latifolia L. | Akçakesme | - | Med. | - | NE | - | - | L |
| TYPHACEAE | Typha latifolia | Sazlık kamışı | Broadleaf Latifolia | - | - | LC | - | - | L |
| CORNACEAE | Cornus mas L. | Sarı çiçekli kızılcık | European Cornel | Eur-Sib | - | NE | - | - | L |
| | Cornus sanguinea L. | Kırmızı meyvalı kızılcık | Common Dogwood | - | - | NE | - | - | L |
| SALICACEAE | Salix caprea L. | Keçi söğüdü | Goat Willow | Eur-Sib | - | NE | - | - | L |
| | Salix alba L. | Ak söğüt | White Willow | Eur-Sib | - | LC | - | - | L |
| ERICACEAE | Arbutus andrachne L | Sandal ağacı | Eastern Strawberry -tree | - | - | NE | - | - | L |
| TAMARICAEAE | Tamarix smyrnensis BUNGE | Ilgın | Smyrna tamarisk | - | - | NE | - | - | L |

Since no field survey was conducted within the scope of the local EIA, the identification method is based on literature.

None of the flora species given in the table are listed in the Red Data Book of Turkish Plants.

**Table 8-2. Updated Flora Table for Efe-7 and Efe-8 Local EIA Reports***

| Family | Scientific Name of the Species | Turkish Name of the Species | English Name of the Species | Phytogeographic Region | Bern | IUCN | EU Habitats Directive | CITES | Identification Method |
|---|---|---|---|---|---|---|---|---|---|
| ARACEAE | Dracunculus vulgaris | Yılanbıçağı | Dragon Lilly | Med. | - | LC | - | - | L |
| | Biarum tenuifolium | - | - | Med. | - | NE | - | - | L |
| VITACEAE | Vitis vinifera | Asma | Wild Grape | - | - | LC | - | - | L, O |
| UMBELLIFERAE | Ammi visnaga | Diş otu | Toothpick Plant | Med. | - | NE | - | - | L |
| | Thapsia garganica | Delikörek | - | Med. | - | NE | - | - | L |
| BORAGINACEAE | Alkanna tinctoria ssp.tinctoria | Havacıvaotu | - | - | - | NE | - | - | L |
| | Buglossoides arvensis | Tarla Taşkeseni | Field Gromwell | - | - | NE | - | - | L |
| BRASSICACEAE | Raphanus raphanistrum | Turp otu | Wild Radish | - | - | NE | - | - | L, O |

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|---|---|---|---|---|---|---|---|---|---|
| CARYOPHYLLACEAE | Silene colorata | Salkım çiçeği | - | - | - | NE | - | - | L |
| CISTACEAE | Cistus salviifolius | Kartlı | Sage-leaved Rock-rose | - | - | NE | - | - | L, O |
| COMPOSITAE | Anthemis auriculata | Akbaba Çiçeği | - | Med. | - | NE | - | - | L |
| | Notobasis syriaca | Yavan Kenger | - | Med. | - | NE | - | - | L |
| | Anthemis pseudocotula | - | False Stinking Chamomile | - | - | NE | - | - | L |
| | Leontodon tuberosus | Yumrulu Aslandişi | - | Med. | - | NE | - | - | L |
| SALICACEAE | Salix alba | Ak Söğüt | White Willow | Eur-Sib. | - | LC | - | - | L, O |
| FAGACEAE | Quercus aucheri | Boz pırnal | - | Med. | - | LR/nt | - | - | L, O |
| GERANIACEAE | Geranium purpureum | Ebedön | - | - | - | NE | - | - | L |
| | Erodium ciconium | Kocakarı iğnesi | - | - | - | NE | | - | L, O |
| GRAMINEAE | Bromus hordeaceus ssp.hordeaceus | Başakotu | - | - | - | NE | - | - | L |
| | Bromus rigidus | Sert brom | - | - | - | NE | - | - | L |
| | Lolium rigidum var.rigidum | Sert çim | - | - | - | NE | - | - | L |
| GUTTIFERAE | Hypericum empetrifolium | Sarı püren | - | Med | - | | | - | L |
| LABIATAE | Lamium moschatum var.moschatum | Linlinotu | Dead-nettle | Med | - | NE | - | - | L, O |
| | Marrubium peregrinum | Yabani derme | Horehound | - | | NE | - | - | L, O |
| | Salvia virgata | Yılancık | Southern Meadow Sage | İran-Turan | | NE | - | - | L |
| | Mentha suaveolens | Kaba nane | Round-leaved Mint | Med | - | LC | - | - | L |
| | Satureja thymbra | Kaya kekiği | Thyme-leaved Savory | Med | | NE | - | - | L |
| LAURACEAE | Laurus nobilis | Defne | Bay Laurel | Med | | NE | | - | L, O |
| CONVOLVULACEAE | Convolvulus arvensis | Tarla sarmaşığı | Field Bindweed | - | | NE | - | - | L |
| LEGUMINOSAE | Ononis pubescens | Havlı örsele | - | Med | - | NE | - | - | L |
| | Trifolium spumosum | Yonca | Subterranean Clover | - | - | NE | - | - | L |
| | Trigonella | Hülbe | - | Med | - | NE | - | - | L |

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|---|---|---|---|---|---|---|---|---|---|
| | gladiata | | | | | | | | |
| | Medicago granadensis | Sıtri | - | Med | - | NE | - | - | L |
| | Anthyllis hermanniae | Akıllı geven | Yellow-kidney Vetch | Med | - | NE | - | - | L |
| | Hippocrepis ciliata | Zarif gevrecik | Many-flowered Horseshoe Vetch | Med | | | - | - | L |
| | Onobrychis aequidentata | Dişlek korunga | - | Med | - | NE | - | - | L |
| LILIACEAE | Ornithogalum nutans | Tükrükotu | Drooping Star of Bethlehem | - | - | NE | - | - | L |
| | Asphodelus aestivus | Çiriş otu | Summer Asphodel | Med | | LC | - | - | L |
| | Linum strictum var.strictum | Tok keten | - | - | - | NE | - | - | |
| MORACEAE | Ficus carica | İncir | Fig | - | - | LC | - | - | L, O |
| | Morus alba | Ak dut | White Mulberry | - | - | NE | - | - | L, O |
| PAPAVERACEAE | Fumaria densiflora | Ergendöşeği | - | - | - | NE | - | - | L, O |
| | Papaver rhoeas | Gelincik | Common Poppy | - | - | NE | - | - | L |
| POLYGONACEAE | Rumex bucephalophorus | Çipir | Horned Dock | Med | - | NE | - | - | L |
| PINACEAE | Pinus brutia | Kızılçam | Calabrian Pine | Med | - | LC | - | - | L |
| RANUNCULACEAE | Delphinium staphisagria | Kokar ot | - | Med | - | NE | - | - | L, O |
| | Ranunculus muricatus | Kutsaldefne | Rough-fruited Buttercup | Med | - | NE | - | - | L, O |
| UMBELLIFERAE | Torilis leptophylla | İnce dercikotu | Bristlefruit Hedgeparsley | - | - | NE | - | - | L |
| | Smyrnium rotundifolium | Yabani Kereviz | - | Med | - | NE | - | - | L, O |
| | Hippomarathrum cristatum | Tarhana otu | - | Med | - | NE | - | - | L |

*None of the flora species given in the table are listed in the Red Data Book of Turkish Plants.

*Although there are separate ESIA reports for Efe-7 and Efe-8, the flora tables are the same in both of the GPPs.

**Table 8-3. Updated Amphibian Species Table of Efe-6 Local EIA Report**

| Family | Scientific Name of the species | Turkish Name of the species | English Name of the species | Bern | IUCN | Identification Method | EU Habitats Directive | CITES |
|---|---|---|---|---|---|---|---|---|
| SALAMANDRIDAE | Triturus vulgaris | Pürtüklü | Smooth Newt | App | LC | L | -* | - |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (=Lissotriton vulgaris) | semender | | III | | | | |
| BUFONIDAE | Bufo viridis (=Bufotes viridis) | Gece kurbağası | Green Toad | App II | LC | L | Annex IV | - |
| | Bufo bufo | Kara kurbağası | Common Toad | App III | LC | L | - | - |
| RANIDAE | Rana(=Pelophylax) ridibundus | Ova kurbağası | Eurasian Marsh Frog | App III | LC | L | Annex V | - |

*Although the subspecies Triturus vulgaris ampelensis is listed in both Annex II and Annex IV of the EU Habitats Directive, Triturus vulgaris is not included as a species in the annexes of the Directive.

Since no field survey was conducted within the scope of the local EIA, the identification method is based on literature.

**Table 8-4. Updated Amphibian Species Table of Efe-7 and Efe-8 Local EIA Reports***

| Family | Scientific Name of the species | Turkish Name of the species | English Name of the species | Bern | IUCN | Identification Method | EU Habitats Directive | CITES |
|---|---|---|---|---|---|---|---|---|
| PELOBATIDAE | Pelobates syriacus | Toprak Kurbağası | Eastern Spadefoot | App III | LC | L | Annex IV | - |
| HYLIDAE | Hyla arborea arborea | Yaprak kurbağası | European Tree Frog | App II | LC | L | Annex IV | - |
| BUFONIDAE | Bufo bufo | Kara kurbağası | Common Toad | App III | LC | L | - | - |
| | Bufo (=Bufotes) viridis | Gece kurbağası | Green Toad | App II | LC | L | Annex IV | - |

*Although there are separate ESIA reports for Efe-7 and Efe-8, the tables of amphibian species are the same in both of the GPPs.

**Table 8-5. Updated Reptilian Species Table of Efe-6 Local EIA Report**

| Family | Scientific Name of the species | Turkish Name of the species | English Name of the species | Bern | IUCN | Identification Method | EU Habitats Directive | CITES |
|---|---|---|---|---|---|---|---|---|
| TESTUDINIDAE | Testudo graeca | Tosbağa | Spur-thighed Tortoise | App II | VU | L | Annex II and IV | - |
| LACERTIDAE | Lacerta (=Darevskia) saxicola | Kaya Kertenkelesi | Rock Lizard | - | LC | L | - | - |
| | Lacerta trilineata | İri Yeşilkertenkele | Balkan Green Lizard | App II | LC | L | Annex IV | - |
| TYPHLOPIDAE | Typhlops (=Xerotyphlops) vermicularis | Kör Yılan | Eurasian Blind Snake | App III | LC | L | - | - |
| COLUBRIDAE | Coluber (=Dolicophis) jugularis | Karayılan | Large Whip Snake | App III | LC | L | Annex IV | - |
| | Eirenis modestus | Uysal Yılan | Ring-headed Dwarf Snake | App II | LC | L | - | - |

**Note: Since no field survey was conducted within the scope of the local EIA, the identification method is based on literature. Table 8-6. Updated Reptilian Species Table of Efe-7 and Efe-8 Local EIA Reports***

| Family | Scientific Name of the species | Turkish Name of the species | English Name of the species | Bern | IUCN | Identification Method | EU Habitats Directive | CITES |
|---|---|---|---|---|---|---|---|---|
| TESTUDINIDAE | Testudo graeca | Tosbağa | Spur-thighed Tortoise | App II | VU | L | Annex II and IV | - |
| GEKKONID | Hemidactylus turcicus | Geniş parmaklı | Turkish Gecko | App | LC | L | - | - |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| AE | | Keler | | III | | | | |
| AGAMIDAE | Laudaki (=Stellagama) stellio | Dikenli Keler | Starred Agama | App II | - | L | - | - |
| SCINCIDAE | Ablepharus kitaibelii | İnce Kertenkele | Juniper Skink | App II | LC | L | Annex IV | - |
| | Mabuya (Trachylepis) aurata | Tıknaz Kertenkele | Levant Skink | App III | LC | L | - | - |
| ANGUINIDAE | Ophisaurus (=Pseudopus) apodus thracius | Oluklu Kertenkele | European Glass Lizard | App II | - | L | Annex IV | - |
| BOIDAE | Eryx jaculus | Mahmuzlu Yılan | Sand Boa | App III | - | L | Annex IV | - |
| TYPLOPIDAE | Typhlops (=Xerotyphlops) vermicularis | Kör yılan | Eurasian Blind Snake | App III | - | L, O | - | - |
| COLUBRIDAE | Eirenis modestus | Uysal yılan | Ring-headed Dwarf Snake | App III | LC | L | - | - |
| | Elaphe quatuorlineata saoromates | Sarı yılan | Four-lined Snake | App II | NT | L | Annex II and IV | - |
| | Coluber caspius (=Delicophis schmidti) | Hazer Yılanı | Red-bellied Racer | App III | LC | L | Annex IV | - |

*Although there are separate ESIA reports for Efe-7 and Efe-8, the tables of reptilian species are the same in both of the GPPs.

**Table 8-7. Updated Bird Species Table of Efe-6 Local EIA Report**

| Family | Scientific Name of the species | Turkish Name of the species | English Name of the species | Red Data Book | Bern | Status | IUCN | Identification Method | EU Birds Directive | CITES |
|---|---|---|---|---|---|---|---|---|---|---|
| COLUMBIDAE | Columba livia | Kaya Güvercini | Rock Dove | A.5 | App III | Y | LC | L | Ann II | - |
| ALAUDIDAE | Streptopelia decaocto | Kumru | Eurasian Collared-dove | A.5 | App III | Y | LC | L | Ann II | - |
| HIRUNDINIDAE | Alauda arvensis | Tarla kuşu | Eurasian Skylark | A.4 | App III | Y | LC | L | Ann II | - |
| MUSCICAPIDAE | Hirundo rustica | Kır kırlangıcı | Barn Swallow | A.5 | App II | G | LC | L | - | - |
| TURDIDAE | Muscicapa striata | Benekli sinekkapan | Spotted Flycatcher | A.3 | App II | G | LC | L | - | - |
| | Turdus merula | Karatavuk | Blackbird | A.3 | App III | Y | LC | L | Ann II | - |
| | Saxicola ruberta | Çayır taşkuşu | Whinchat | A.3 | App II | Y | LC | L | - | - |
| SITTIDAE | Sitta krueperi | Anadolu Sıvacısı | Krueper's nuthatch | A.2 | App II | Y | LC | L | Ann I | - |
| CORVIDAE | Pica pica | Saksağan | Eurasian Jay | A.5 | - | Y | LC | L | Ann II | - |
| | Corvus frugilegus | Ekin kargası | Rook | A.5 | - | Y | LC | L | Ann II | - |
| | Garrulus glandarius | Alakarga | Magpie | A.3.1 | - | Y | LC | L | Ann I and II | - |
| PASSERIDAE | Passer domesticus | Ev serçesi | House Sparrow | A.5 | - | Y | LC | L | - | - |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRINGILLIDAE | Fringilla montifringilla | Dağispinozu | Brambling | A.3 | App III | Y | LC | L | - | - |
| | Fringilla coelebs | İspinoz | Common Chaffinch | A.4 | App III | Y | LC | L | -* | - |
| | Carduelis carduelis | Saka | Goldfinch | A.3.1 | App II | Y | LC | L | - | - |
| UPUPIDAE | Upupa epops | İbibik | Hoopoe | A.2 | App II | G | LC | L | - | - |
| PICIDAE | Dendrocopos syriacus | Alaca ağaçkakan | Syrian Woodpecker | A.2 | App II | Y | LC | L | Ann I | - |
| PHASIANIDAE | Alectoris chukar | Kınalı keklik | Chukar Partridge | A.2 | App III | Y | LC | L | Ann II | - |
| | Coturnix coturnix | Bıldırcın | Common Quail | A.3 | App III | Y | LC | L | Ann II | - |
| RECURVIROSTRIDAE | Himantopus himantopus | Uzunbacak | Lack-winged Stilt | A.3 | App II | Y | LC | L | Ann I | - |
| RALLIDAE | Fulica atra | Sakarmeke | Eurasian Coot | A.5 | App III | Y | LC | L | Ann II and III | - |

*Although the subspecies Fringilla coelebs ombrisa is listed in Annex I of the EU Habitats Directive, Fringilla coelebs is not included as a species in the annexes of the Directive.

**Table 8-8. Updated Bird Species Table of Efe-7 and Efe-8 Local EIA Reports****

| Family | Scientific Name of the species | Turkish Name of the species | English Name of the species | Red Data Book | Bern | Status | IUCN | Identification Method | EU Birds Directive | CITES |
|---|---|---|---|---|---|---|---|---|---|---|
| SYLVIDAE | Sylvia hortensis | Ak gözlü Ötleğen | Orphean Warbler | A.2 | App II | G | LC | L | - | - |
| ALAUDIDAE | Alauda arvensis | Tarlakuşu | Eurasian Sky Lark | A.4 | App III | Y | LC | L | Ann II | - |
| | Melanocorypha leucoptera | Akkanatlı Tarlakuşu | White-winged Lark | A.1.2 | App II | G | LC | L | - | - |
| HIRUNDINIDAE | Hirundo rustica | Kır kırlangıcı | Barn Swallow | A.5 | App II | G | LC | L | - | - |
| | Delichon urbicum | Ev kırlangıcı | Northern House Martin | A.3 | App II | G | LC | L | - | - |
| PHASIANIDAE | Alectoris graeca*** | Kaya kekliği | Rock Partridge | A.1.2 | App III | Y | NT | L | Ann I and II | |
| | Coturnix coturnix | Bıldırcın | Common Quail | A.3 | App III | Y | LC | L | Ann II | - |
| TURDIDAE | Erithacus rubecula | Kızılgerdan | European Robin | A.3 | AppII | Y | LC | L | - | - |
| | Luscinia megarhynchos | Bülbül | Common Nightingale | A.2 | App II | G | LC | L | - | - |
| | Turdus pilaris | Tarla ardıcı | Fieldfare | B.2 | App III | K | LC | L | Ann II | - |
| | Turdus merula | Karatavuk | Eurasian Blackbird | A.3 | App III | Y | LC | L | Ann II | - |
| COLUMBIDAE | Columba palumbus | Tahtalı | Common Wood-Pigeon | A.4 | - | Y | LC | L | Ann II and III | - |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Streptopelia turtur | Üveyik | Eurasian Turtle Dove | A.3.1 | App III | G | VU | L | Ann II | - |
| CHARADRIIDAE | Scolopax rusticola | Çulluk | Eurasian Woodcock | B.3 | App III | K | LC | L | Ann II and III | - |
| FALCONIDAE | Falco tinnunculus | Kerkenez | Common Kestrel | A.2 | App II | Y | LC | L | - | App II |
| | Falco peregrinus | Gökdoğan | Peregrine Falcon | A.1.2 | App II | Y | LC | L | Ann I | App II |
| ACCIPITRIDAE | Accipiter nisus | Atmaca | Eurasian Sparrowhawk | A.3 | App III | Y | LC | L | -** | App II |
| | Buteo buteo | Şahin | Common Buzzard | A.3 | App II | Y | LC | L, O | - | App II |
| | Buteo rufinus | Kızıl Şahin | Long-legged Buzzard | A.3 | App II | Y | LC | L, O | Ann I | App II |
| | Aquila chrysaetos | Kaya Kartalı | Golden Eagle | A.1.2 | App II | Y | LC | L | Ann I | App II |
| STRIGIDAE | Asio otus | Kulaklı Orman Baykuşu | Long-eared Owl | A.2 | App II | Y | LC | L | - | App II |
| | Strix aluco | Alaca Baykuş | Tawny Owl | A.2 | App II | Y | LC | L | - | App II |
| LANIIDAE | Lanius collurio | Kızılsırtlı çekirgekuşu | Red backed Shrike | A.3 | App II | G | LC | L | Ann I | - |
| | Lanius minor | Karaalın çekirgekuşu | Lesser Gray Shrike | A.3 | App II | G | LC | L | Ann I | - |
| | Lanius senator | Kızılbaşlı çekirgekuşu | Woodchat Shrike | A.2 | App II | Y | LC | L | - | - |
| CORVIDAE | Corvus monedula | Küçük karga | Eurasian Jackdaw | A.5 | - | Y | LC | L | Ann II | - |
| | Corvus frugilegus | Ekin Kargası | Rook | A.5 | - | Y | LC | L | Ann II | - |
| | Corvus corone | Leş Kargası | Carrion Crow | A.5 | - | Y | LC | L | Ann II | - |
| | Pica pica | Saksağan | Eurasian Magpie | A.5 | - | Y | LC | L | Ann II | - |
| EMBERIZIDAE | Emberiza hortulana | Tarla kirazkuşu | Ortolan Bunting | A.3 | App III | G | LC | L | Ann I | - |
| | Emberiza melanocephala | Karabaşlı kirazkuşu | Black headed Bunting | A.4 | App II | G | LC | L | - | - |
| FRINGILLIDAE | Fringilla coelebs | İspinoz | Chaffinch | A.4 | App III | Y | LC | L | -** | - |
| | Carduelis chloris | Florya | European Greenfinch | A.3 | App II | Y | LC | L | - | - |
| | Carduelis carduelis | Saka | European Goldfinch | A.3.1 | App II | Y | LC | O, L | - | - |
| STURNIDAE | Sturnus vulgaris | Sığırcık | European Starling | A.5 | - | Y | LC | L | Ann II | - |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| PASSERIDAE | Passer domesticus | Ev serçesi | House Sparrow | A.5 | App III | Y | LC | O, L | - | - |
| PARIDAE | Parus major | Büyük baştankara | Great Tit | A.3.1 | App II | Y | LC | L | - | - |

*Although the subspecies Accipiter nisus granti is listed in Annex I of the EU Habitats Directive, the species Accipiter nisus is not included as a species in the annexes of the Directive.

**Although the subspecies Fringilla coelebs ombrisa is listed in Annex I of the EU Habitats Directive, the species Fringilla coelebs is not included as a species in the annexes of the Directive.

***The distribution of the species Alectoris greaca does not cover Turkey and therefore the Project Area.

****Although there are separate ESIA reports for Efe-7 and Efe-8, the tables of bird species are the same in both of the GPPs.

**Table 8-9. Updated Mammal Species Table of Efe-6 Local EIA Report**

| Family | Scientific Name of the species | Turkish Name of the species | English Name of the Species | Bern | IUCN | Identification Method | EU Habitats Directive | CITES |
|---|---|---|---|---|---|---|---|---|
| MURIDAE | Mus musculus* | Ev faresi | House Mouse | App III | LC | L | - | - |
| | Mus domesticus* | Ev faresi | House Mouse | App III | LC | L | - | |
| | Apodemus mystacinus | Kaya faresi | Eastern Broad-toothed Field Mouse | App III | LC | L | - | |
| MUSTELIDAE | Mustela nivalis | Gelincik | Least Weasel | App III | LC | L | - | - |
| | Martes foinea | Kaya sansarı | Beech Marten | App III | LC | L | - | - |
| HYSTRICIDAE | Hystrix cristata** | Oklu Kirpi | Crested Porcupine | App II | LC | L | Annex IV | - |
| LEPORIDAE | Lepus europaeus | Yaban tavşanı | European Hare | App III | LC | L | - | - |
| TALPIDAE | Talpa europaea | Köstebek | European Mole | - | LC | L | - | - |
| CANIDAE | Vulpes vulpes | Kızıl tilki | Red Fox | - | LC | L | - | - |
| SUIDAE | Sus scrofa scrofa | Yaban domuzu | Wild Boar | App III | LC | L | - | - |

*Mus musculus and Mus domesticus are the same species.

**The distribution of the species Hystrix cristata doesn't overlap with Turkey and therefore Project Area

Since no field survey was conducted within the scope of the local EIA, the identification method is based on literature.

**Table 8-10. Updated Mammal Species Table of Efe-7 and Efe-8 Local EIA Reports***

| Family | Scientific Name of the species | Turkish Name of the species | English Name of the Species | Bern | IUCN | Identification Method | EU Habitats Directive | CITES |
|---|---|---|---|---|---|---|---|---|
| ERINACEIDAE | Erinaceus concolor | Kirpi | European Hedgehog | - | LC | L | - | - |
| SORICIDAE | Crocidura leucodon | Sivriburunlu fare | Bicoloured Shrew | App III | LC | L | - | - |
| TALPIDAE | Talpa levantis | Kör köstebek | Levantine Mole | - | LC | L | - | - |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SPALACIDAE | Spalax leucodon | Kör fare | Lesser Mole Rat | - | DD | L | - | - |
| MUSTELIDAE | Mustela nivalis | Gelincik | Least Weasel | App III | LC | L | - | - |
| CRICETIDAE | Cricetulus migratorius | Cüce avurtlak | Grey Dwarf Hamster | - | LC | L | - | - |
| LEPORIDAE | Lepus europaeus | Yaban tavşanı | European Hare | App III | LC | L | - | - |
| CANIDAE | Vulpes vulpes | Kızıl tilki | Red Fox | - | LC | L | - | - |

*Although there are separate ESIA reports for Efe-7 and Efe-8, the tables of mammal species are the same in both of the GPPs.