ESKİŞEHİR ALPU COAL-FIRED POWER PLANT HEALTH IMPACT ASSESSMENT REPORT

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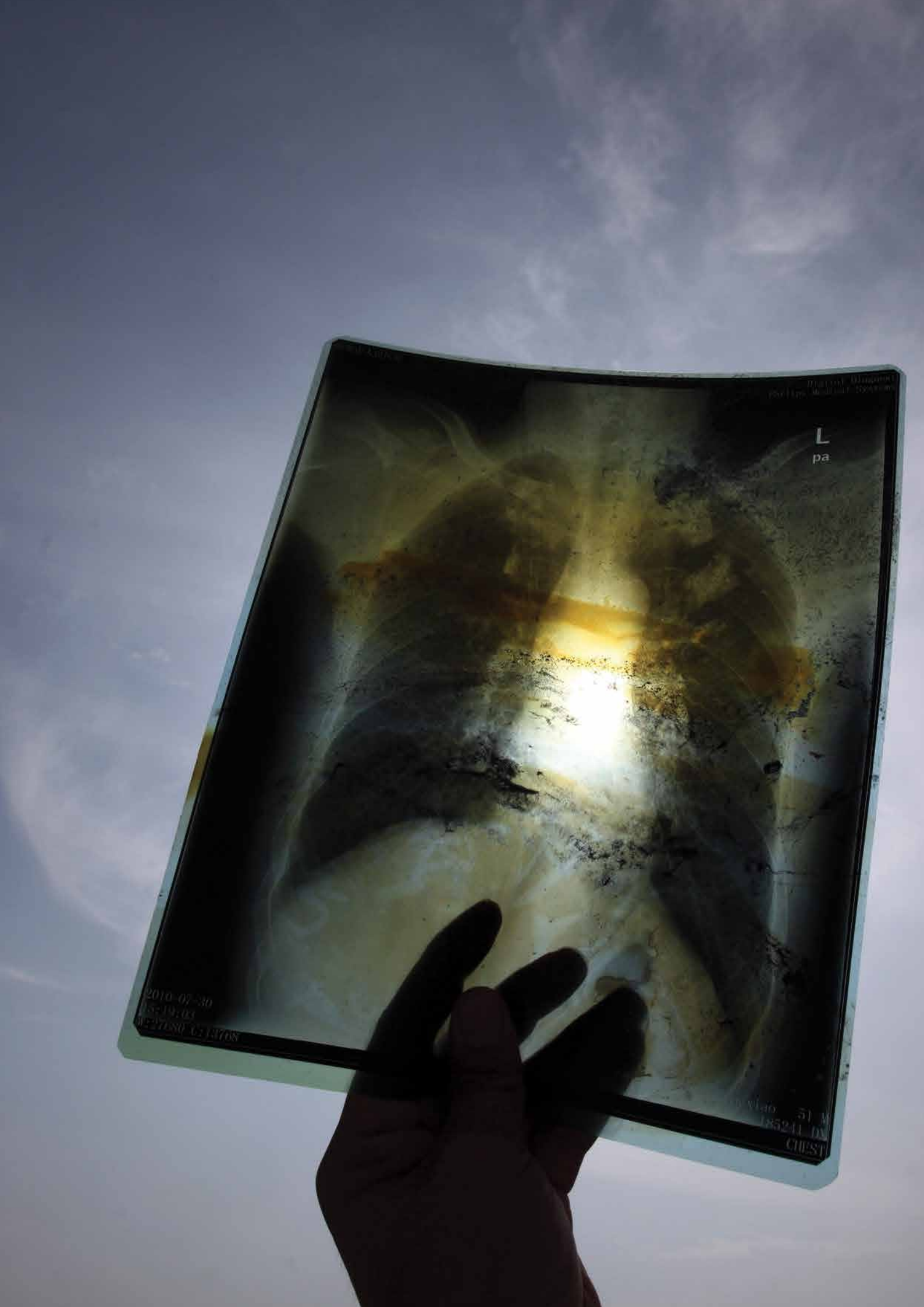
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About Right to Clean Air Platform:

Right to Clean Air Platform consists of 16 professional organizations and NGOs working on air pollution and health impacts in Turkey since 2015.

The aim of the Platform is to advocate for the right to live in an environment with clean air and to protect the public health from air pollution, especially resulting from the existing and the planned coal-fired power plants in Turkey.

Platform Constituents are:

• Association of Public Health Professionals (HASUDER) • CAN Europe • General Practitioner Association of Turkey • Greenpeace Mediterranean • Green Peace Law Association • Green Thought Association • Health and Environment Alliance (HEAL) • Physicians for Environment Association • TEMA Foundation (The Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats) • Turkish Medical Association (TTB) • Turkish Neurological Society • Turkish Respiratory Society (TÜSAD) • Turkish Society of Occupational Health Specialists (İMUD) • Yuva Association • WWF Turkey • 350.org

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Abbreviations

ABPRS / ADNK	Address-Based Population Registration System
EIA	Environmental Impact Assessment
FRS	Farmer Registration System
WHO	World Health Organization
EMR	Electromagnetic Radiation
EPA	Environmental Protection Agency
Ha	Hectare (10,000 m^2)
IARC	International Agency for Research on Cancer
OHS	Occupational Health and Safety
CPP	Coal-Fired Power Plants
POP	Persistent Organic Pollutants
PAH	Polycyclic Aromatic Hydrocarbons
PM	Particulate Matter
ppm	Parts per million
HIA	Health Impact Assessment
SSI / SGK	Social Security Institution
UCTEA	The Union of Chambers of Turkish Engineers and Architects
TMA	Turkish Medical Association
TSI / TÜİK	Turkish Statistical Institution

Foreword

This study is the **first health impact assessment in Turkey for a coal-fired power plant project.** Following China, Turkey ranks second in the world for the number of planned coal-fired power plant projects as of 2020.[1] Published by the Right to Clean Air Platform, this report will serve as an important exemplary document for the public and corporate sectors and NGOs alike in the evaluation of the health impacts of planned coal-fired power plants.

Why is health impact assessment needed?

Due to their negative impact on the climate and the integrity of ecosystems, coal-fired power plants are among the biggest causes of environmental health problems today. The existing legislation that specifies the approval process of coal-fired power plants in Turkey is unfortunately insufficient in assessing the health effects. Since environmental impact assessment reports do not evaluate the impact of the planned power plants on health, these risks are not taken into account during the approval and permit processes. Especially the fact that the health risks of flue gas emissions, which is the biggest source of pollution from the power plants, are not taken into account poses a severe risk on public health for at least 30 years during the operational period of the power plants.

Health Impact Assessment should enter legislation in Turkey

The process of Health Impact Assessment is currently absent in the permit processes and the legislation that controls these processes in Turkey. Fortunately, expertise and knowledge about Health Impact Assessment exists in Turkey, which can be used and further enhanced by combining the previous training and knowledge with the experienced perspective of this report.

This report, which is the first Health Impact Assessment report for a coal-fired power plant in Turkey, has been prepared by Turkish Medical Association as the main executive with the great contributions of Eskisehir Metropolitan Municipality, Tepebası Municipality, Çankaya Municipality, Alpu Municipality and very important scientific expertise of all chambers. We hope that the report will become an assessment tool supported by legislation, in order to protect the public and combat the climate crisis for a more livable Turkey with cleaner air in the future.

We hope that this report will aid in the formation of the necessary legal framework to combat climate change and provide access to clean air, water, and food by ensuring that the investments made in Turkey, which is the country with the **second highest number of planned coal-fired power plants as of 2020**, are made in a way that protects public health.

1 Boom and Bust (2020)

Executive Summary

The World Health Organization (WHO) placed air pollution and climate change on the top of the list of global health threats set for 2019. The burning of coal, a fossil fuel, has led to more than 0.3 degrees Celcius of the 1.1 ^{0}C Celcius temperature increase recorded in planetary temperatures since the late 1800s. In other words, coal is responsible for approximately 30 percent of the climate crisis.

One of the aspects of health problems caused by coal-fired power plants, which should be taken into account by decision-makers but is neglected,, is the cost of their health impacts. According to the Health and Environment Association's (HEAL) report, the use of coal for electricity generation in Turkey has health impacts that cost between €2.9 to €3.6 billion annually.[2]

Over the course of the COVID-19 pandemic that has had a global impact since 2019, we think we have learned a great lesson regarding the permission process of coal-fired power plants that health impacts should also be evaluated beside environmental impacts. Scientific studies indicate that people who are exposed to long-term air pollution are affected more by respiratory infections caused by viruses such as SARS-CoV-2, which is the cause of the COVID-19 pandemic, due to the health problems in their respiratory and cardiovascular systems.

There are currently 29 active coal-fired power plants in Turkey, and more than 40 at their project design stage. With the active ones spread all across Turkey, the planned power plants pose a growing threat to public health. Thus, the current course of events make the evaluation of planned coal-fired power plants in terms of public health even more urgent.

Prepared between May and December 2019, this report contains the health impact assessment of the Eskişehir Alpu Coal-Fired Power Plant (CPP).

Effects on Air Pollution:

- The health risks of the planned Eskişehir Alpu Coal-Fired Power Plants (CPP) will not only affect the province of Eskişehir, but also 24 other city, namely Ankara, Afyonkarahisar, Aksaray, Bartın, Bilecik, Bolu, Bursa, Çankırı, Çorum, Denizli, Düzce, Isparta, Karabük, Kastamonu, Kırıkkale, Kırşehir, Kocaeli, Konya, Kütahya, Sakarya, Uşak, Yozgat and Zonguldak.

2 HEAL; (2018) "Ödenmeyen Sağlık Faturası, Türkiye'de KömürlüTermik Santraller Bizi Nasıl Hasta Ediyor?"

- Over the course of 35 years, more than 11 million people will face adverse health effects due to the air pollution caused by the particulate matter ($PM_{2.5}$) arising from burning coal at Eskişehir Alpu CPP.

- It has been calculated that due to the air pollutants that will be released when Alpu CPP becomes operational, the plant will cause a total of approximately 3200 premature deaths over the course of 35 years, which is the minimum period the plant will be operational.

- Eskişehir Alpu CPP will cause public health costs of €146 million annually and €6.411 billion for 35 years, being the minimum operational period projected for the plant.

- It is predicted that the acids from the sulfur and nitrogen compounds from the stack as well as mercury that will be released will enter the food chain and pose public health risks such as such as acute and chronic poisoning, cancers, neurological problems and nutritional imbalance.

- In the period of December 2018-November 2019 at the Eskişehir Odunpazarı air quality monitoring station, particulate matter pollution (the annual average of PM_{10} level) was approximately 2.5 times the annual limit value recommended by the World Health Organization (WHO). In addition, the daily limit value determined by WHO for PM10 has been exceeded by 1 every 3 days.

Impact on Agriculture:

- Within the scope of the project, a total area of 575 football fields (419.9 hectares)[3] of agriculturally favorable topsoil will be eliminated directly by using them for non-agricultural purposes.

- 125,770 decares of soil with vegetable crops cultivated in the neighborhoods affected by the project, which has generated 135,472,000 Turkish Liras in 2019, will be adversely affected by the power plant.

- Toxic metals[4] found in coal ash such as arsenic, lead, mercury, cadmium, chromium and selenium have the risk to contaminate water and food.

- In the emission dispersion modeling prepared, it is expected that with the opening of Alpu CPP, mercury will reach the aquifers and Porsuk and Sakarya rivers and, through hunted fish and the streams used for irrigation in agricultural areas, enter the food chain not only in the region, but also the entirety of Turkey. Also, with the opening of Alpu CPP, agricultural production in the Alpu Plain will be damaged. It is predicted that mining activity will cause water problems in the plain due to the fact that Porsuk Stream feeds the Sakarya River, and the aquifers will be affected, all of which will adversely affect the existing agricultural activity.

3 1 hektar 10 dekara eşittir. 1 hektar 10.000 m2'dir. 1 dekar 1000 m2'dir.
4 Physicians for responsibility (2013)

Employment and Work Accidents:

- It is predicted that over the course of 35 years, which is the planned minimum operational period of the power plant, **17,852** work accidents will occur, 290 of which will result in death.

- The implementation of the project will result in the shift of economic activity in the Alpu Plain from agriculture to mining. According to calculations, **5.7 times more work accidents**, 10 times more deaths due to work accidents and 3.4 times more incapacity will occur throughout the activities regarding the project (i.e. construction, mining and operation of the power plant) compared to agricultural activities.

- According to the Environmental Impact Assesment (EIA) report,[5] the project will provide employment for 1500 people during the 62-month construction phase and for **3250 people** during the operational period which will last for its 35-year economic life. On the other hand, with the end of agricultural production in the region, it is predicted that a portion of the **25,000 people** registered in the farmer registration system will cease to work, and those farmers and agricultural workers who will be farmed will remain unemployed.

Other Effects:

- Within the project area, there are meerschaum (Turkish: lüle taşı) ore and meerschaum quarries that continue their production within the area boundaries of the Ash Regular Storage Facility. This means that the meerschaum quarries in question will cease to exist and the ores remaining in the field will be destroyed by the construction activity. Employment related to meerschaum, which is already facing important problems, will also be seriously damaged, and the production of meerschaum, which is a cultural value, will mostly cease.

- In the EIA report, the noise level arising from the operational area during daytime has been calculated as 65 dB, exceeding the Environmental Noise Assessment and Management Regulation[6] limits. Considering that the facility will operate uninterruptedly for 24 hours, it is predicted that continuous exposure to noise will cause problems such as anxiety, sleep disorders and stress disorder in people.

5 Environmental Impact Assessment will be abbreviated as EIA throughout the rest of the report.
6 "Çevresel Gürültünün Değerlendirilmesi ve Yönetimi Yönetmeliği" (2010)

The Possible Health Outcomes of the Eskişehir Alpu Coal-Fire Power Plant Project

	Significative	Health Outcomes	Affected Population	Influence	Level of Importance
EFFECTS DUE TO ENVIRONMENTAL POLLUTION	Air Pollution	Cancers	Population in the vicinity of the power plant, populations of crowded settlements such as Tepebaşı and Odunpazarı	Negative	Very Important
		Cardiovascular diseases	Population of Eskişehir and close settlements in other provinces	Negative	Very Important
		Stillbirths	Population near power plant	Negative	Important
		Chronic bronchitis	Population near the power plant, including crowded settlements such as Tepebaşı and Odunpazarı	Negative	Important
		Asthma attacks	Close vicinity of the power plant	Negative	Important
		Low birth weight	Population near power plant	Negative	Average
		Neurological problems	Population of Eskişehir and nearby settlements in other provinces	Negative	Average
	Contamination of drinking and utility water	Chronic toxicity	Eskişehir ve Sakarya, Porsuk nedeniyle geniş bir alan	Negative	Average
		Acute toxicity	Eskişehir and Sakarya, a large area due to Badger	Negative	Average
	Drinking and potable water shortage	Increased infectious diseases	Population near the power plant, including crowded settlements such as Tepebaşı and Odunpazarı	Negative	Average
	Noise	Stress	Close vicinity of the power plant	Negative	Average
		Sleep problems	Close vicinity of the power plant	Negative	Average
IMPACTS ON AGRICULTURAL LAND	Difficulty at access to healthy food due to high prices	Inadequate and unbalanced nutrition (obesity etc.)	Local people, especially the low-income population	Negative	Important
		Growth and development problems in children	Local people, especially the low-income population	Negative	Important
	Low-nutrient foods	Protein, vitamin mineral deficiency	Local people, especially the low-income population	Negative	Very Important
	Chemical effects in agricultural products	Chronic toxicity	Elderly population - may appear more quickly	Negative	Average
		Acute toxicity	Local people	Negative	Average
	Food safety from field to table	Cancers, neurologicaldiseases reproductive health problems, GIS problems	Local people, especially elderly population	Negative	Important
EFFECTS ON WORKER HEALTH	Working conditions	Disability (inability to work)	Power plant employees	Negative	Important
		Death because of work accident	Power plant employees	Negative	Important
		Occupational diseases	Power plant employees	Negative	Important
		Work accident injury	Power plant employees	Negative	Average
		Stress	Power plant employees	Negative	Average
	Noise	Hearing loss	Power plant employees	Negative	Important
		Stress	Power plant employees	Negative	Average
	Traffic accidents	Injury and deaths	Close vicinity of the power plant	Negative	Important
ECONOMIC EFFECTS	Employment	Having healthy living conditions	Power plant employees and their families	Positive	Important
		Access to health services	Power plant employees and their families	Positive	Important
		Post-retirement standard of living	Power plant employees and their families	Positive	Average
	Regular income	Having healthy living conditions	Power plant employees and their families	Positive	Important
	Unemployment	Having healthy living conditions	Those working in agriculture and their families (Farmers, seasonal agricultural workers) and those working in the production of agricultural products (food)	Negative	Very Important
		Negative impact on mental health	Those working in agriculture and their families (Farmers, seasonal agricultural workers) and those working in the production of agricultural products (food)	Negative	Very Important

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CHAPTER 1

CHAPTER 1

1. Introduction

1.1. Defining Health Impact Assessment

Health Impact Assessment (HIA) is an approach developed to examine the impacts of the planned projects on public health and to include the health aspect in the decision-making process of a plan, projects, and programs.

HIA emerged as a natural consequence of the environmental impact assessment (EIA) processes as well as a result of the development of the approach of social determinants of health. The World Health Organization Europe Office defined HIA in the text known as the Gothenburg Consensus in 1999. Accordingly, HIA is "a combination of procedures, methods, and tools that ensures the decision making regarding policy, program or project, in terms of their potential impacts on the health of a community and the extent of these impacts to the community".[7]

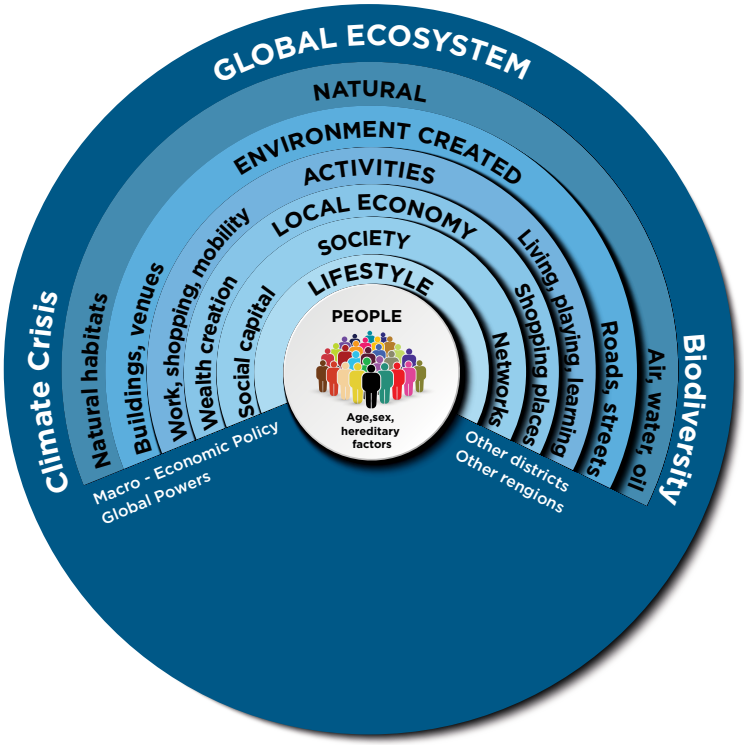
There have been many definitions of health impact assessment after the Gothenburg Consensus. According to the definition of the U.S. National Academy of Sciences, HIA "is a systematic process that uses a number of data sources and analytical methods and considers the views of the parties to determine the potential impacts of a designed policy, plan, program or project on the health of a community and the extent of these impacts within the community."[8]

HIA is an increasingly common practice. It has been conducted in many projects such as planning of urban spaces, transportation, airports, residential areas, power plants, industrial facilities, employment, etc. Each HIA is a separate case study and should consider all health-related aspects of the planned project or program. In terms of a methodological approach to health, there is a holistic approach that covers all social and environmental factors, which are considered to be the determinants of public health (Figure 1). HIA method, which has the contribution of many science branches, also has a multidisciplinary approach; while making use of epidemiology and toxicology sciences to reveal causal relationships, it also benefits from other areas such as demography, economics, sociology, etc. on the characteristics of the communities to be impacted.

7 WHO Europe (2005) Health Impact Assessment Toolkit for Cities, Document 1. Background documents: concept, processes, methods. Regional Office for Europe of the World Health Organization. WHO 2005

8 NAP (National Academy of Science) (2011) Improving health in the United States: The Role of Health Impact Assessment. National Research Council of the National Academies. National Academies Press, Washington. P:5

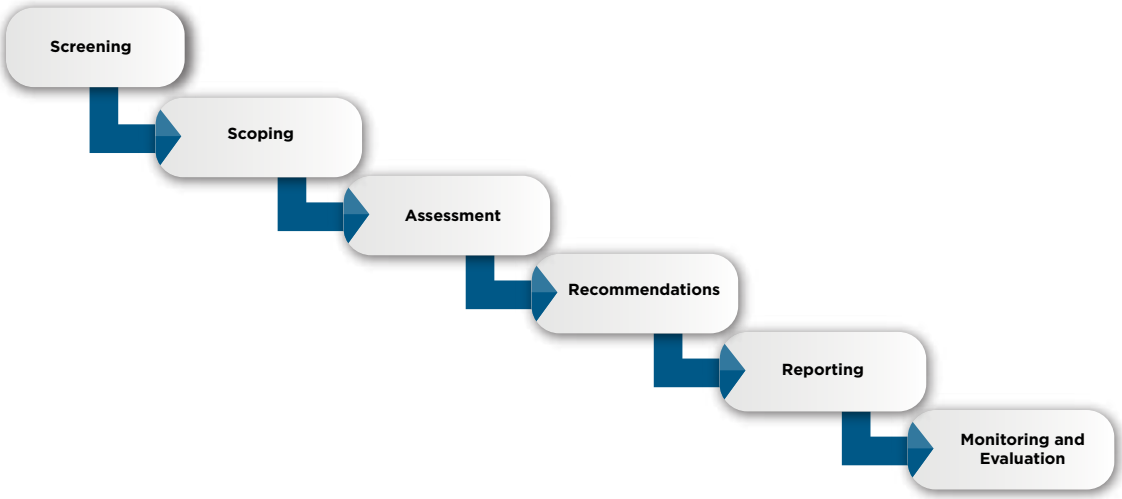
Figure 1. Determinants of Health



Source: H Barton & M Grant (2006). "A health map for the local human habitat"; The Journal for the Royal Society for the Promotion of Health

HIA is comprised of six steps: screening, scoping, assessment, recommendations, reporting, and monitoring & evaluation.

Figure 2 - Stages of Health Impact Assessment



HIAs have been conducted around the world for a long time. For instance, **Lithuania, Slovenia, Spain and Thailand** are implementing as a part of their legislation. In addition, reports were prepared in Turkey, the United States of America, Australia, and New Zealand via public sector, private sector and/or academia.

In Australia, Denmark, Lithuania, Ireland and the UK, there are examples of papers, training and evaluations aimed at expanding the HIA approach through public institutions.[9]

Turkey has the expertise and knowledge in the Health Impact Assessment. Three different Health Impact Assessment trainings have been carried out by the Turkish Medical Association so far. **But for the new projects in Turkey, there are no legal regulations or procedures that ensures health impact assessment during the permit process.**

1.2. Project Introduction

The Project is called "Alpu Coal-Fired Power Plant and Ash Landfill Facility with the Underground Mining in the Reserve Area to Provide Coal to this Power Plant" Project planned to be established and operated by Elektrik Üretim A.Ş. within the borders of Tepebaşı District of Eskişehir Province. Within the scope of the project, the following are planned to be established:

1) Reserve area (1,787 ha),
2) One coal-fired power plant (117 ha) within the boundaries of the energy generation area (893 ha),
3) One ash landfill facility (273 ha).

Alpu Coal-Fired Power Plant is planned as 2 units, each unit is designed with 550 MWe of electrical power, 561 MWm of mechanical power, and 1,247 Mwt of thermal power.

It is understood that the coal to be used as a raw material in the coal-fired power power plant will be extracted from Alpu-B Sector Reserve Area. The coal reserve is 450 m underground. The reserve area is 1,787 ha and 52% of the reserve is planned to be used. The apparent reserve amount of the coal to be produced in Alpu-B Sector Reserve Area is 568 Million Tons and the operable reserve amount is 296 Million tons. It is understood from the Environmental Impact Assessment report that approximately 7,854,000 tons (1,122 tons/h) of domestic coal (lignite) will be consumed annually as the main fuel in the power plant. The same report states that the sulfur (S) ratio in the coal to be fed to the boiler is 1.3%, and the ash content in the coal content will be approximately 27.5%. It states that the amount of coal that will be consumed for 35 years depending on the coal production in the plant will be approximately 274,890,000 tons and the annual amount of coal that will be needed in Alpu Coal-Fired power Power Plant will be 7,854,000 tons. The coal to be used as an ash content of 27.5% and the total amount of fly ash + boiler ash to be generated will be 2,163,000 tons/year (309 tons/h-2,163,000 m^3/year). Ash Landfill Facility will be stored in two lots within a total area of 273.14 hectares.[10]

9 HEAL; (2020); Sağlık Etki Değerlendirmesi Bilgi Notu
10 EN-ÇEV A.Ş., 2018

The study area is located within the boundaries of Eskişehir province, Tepebaşı district, Kozlubel, Beyazaltın, Kızılcaören, Ağapınar, and Gündüzler quarters. The field considered as an underground coal mine is approximately 30 km away from Eskişehir settlement and 40 km away from the location planned to be Coal-Fired power Power Plant and Ash Landfill area. The specified areas are located on the north side of Eskişehir-Alpu highway.

Figure 3. Representative photograph of Alpu Coal-Fired Power Plant (EIA Report)

Source: EN-ÇEV A.Ş. (2018). Alpu CPP and the Supplying Underground Mine and Ash Landfill Project Final EIA Report

1.3. Location of the Project

Eskişehir is located between 29-32 degrees east longitudes and 39-40 degrees north latitudes in the northwest of Central Anatolia Region. Eskişehir province is surrounded by natural borders such as Bozdağ and Sündiken Mountains on the north, Emirdağ on the south, the Central Asian Valley on the east, and Turkmen Mountain on the west, and its surface area is 13,653 km2. Eskişehir province is surrounded by Emirdağ and İhsaniye districts of Afyonkarahisar on the south; Yunak district of Konya on the southeast, Polatlı, Nallıhan and Beypazarı districts of Ankara on the east; Göynük district of Bolu on the northwest, Gölpazarı, Söğüt, Bozüyük districts of Bilecik, and Kütahya on the west.[11]

11 Eskişehir Provincial Culture and Tourism Directorate, 2019

Map 1. The Location of coal-fired power plant in Turkey

Source: Google Earth, 2019

Map 2. The Location of coal-fired power plant in Central Anatolian Region

Source: Google Earth, 2019

Map 3. The Location of coal-fired power plant in Eskisehir (City)

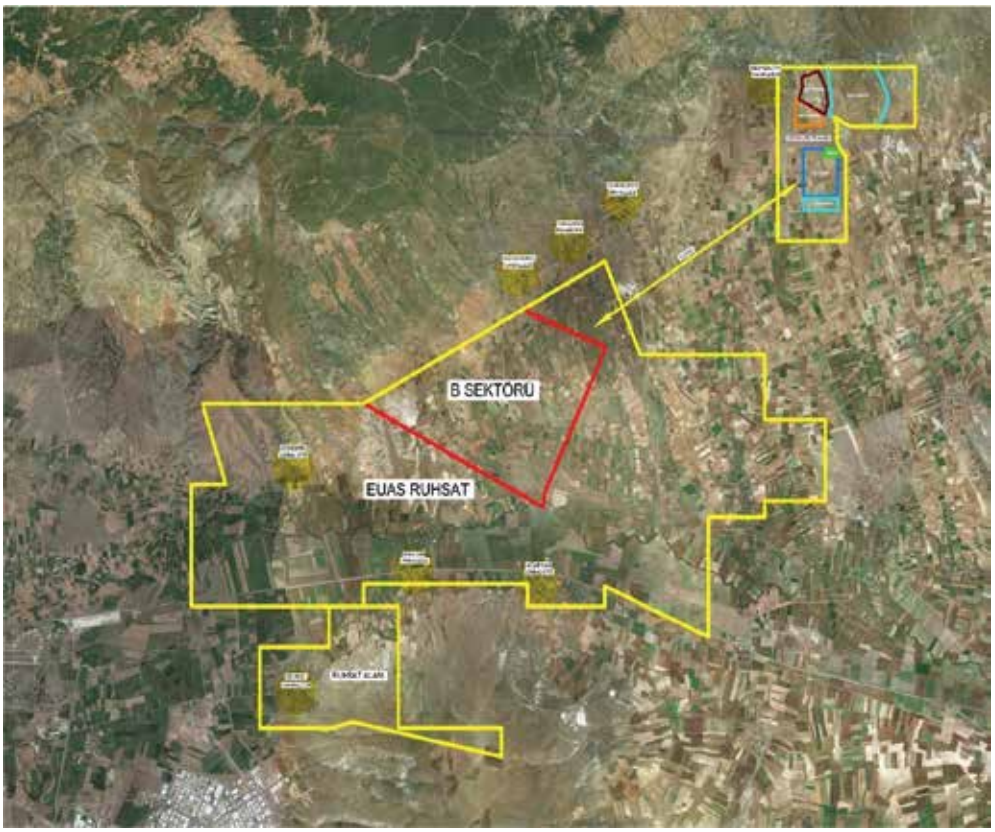
Source: Google Earth, 2019

The plant area is about 32 km air distance from Eskişehir Province and about 25 km air distance from Tepebaşı District. The settlements closest to the power plant area are Beyazaltın Quarter at approximately 1,940 m air distance, Kozlubel Quarter at approximately 3,350 m air distance, and Gündüzler Quarter at approximately 5,500 m air distance. The closest residence to the plant site is in the north-west direction of the nearest border point of the plant site and within the Beyazaltın Quarter at approximately 1,600 m air distance.[12]

The Reserve Area is located within the boundaries of Tepebaşı District and it is at approximately 18 km air distance to Eskişehir City Center, at approximately 11 km air distance to Tepebaşı District Center, and at approximately 17 km air distance to the Alpu District Center. Sector B has Gündüzler Town in the north-east direction and at approximately 3,200 m air distance, Yakakayı Quarter at approximately 2,000 m air distance, Kızılcaören Quarter at approximately 800 m air distance, Ahılar Quarter at approximately 3,000 m air distance, and Gökdere Quarter at approximately 2,750 m air distance. Porsuk Stream passes at an air distance of approximately 600 m in the south direction of the area.[13]

12 EN-ÇEV A.Ş. (2018).
13 EN-ÇEV A.Ş. (2018).

Map 4. Project Area Location



Source: EN-ÇEV A.Ş. (2018). Alpu CPP and the Supplying Underground Mine and Ash Landfill Project Final EIA Report

Map 5. Project Area Location

Source: Google Earth, 2019

CHAPTER 2

2. Methodology

A Health Impact Assessment (HIA) is generally conducted by following the steps below.[14]

Figure 4. Stages of Health Impact Assessment

Screening	The likelihood that a plan, project, or program will have a health impact is assessed. The time and other resources to carry out the HIA are assessed, and it is determined whether the HIA can provide information that is useful for the work of the parties and decision-making authorities.
Scoping	A plan is developed for HIA and the scope of the health impacts to be addressed is created. HIA team assesses the data sources, techniques to be used, and the options.
Assessment of Health Impacts	The current health status of the affected community is identified and potential impacts associated with the project are estimated. This covers a two-stage process. The first is to determine the current health status of the affected community, and secondly to estimate the potential impacts.
Recommendations	It is the suggestion of the options that can be applied for health promotion and the necessary measures to control the negative health impacts.
Reporting	Documentation and presentation of findings and recommendations for parties and decision-makers.
Evaluation and Monitoring	Monitoring may include monitoring the adopted variables, implementation recommendations of the HIA, and the level of health and health determinants. Evaluation can include the HIA process, its impact, or its consequences.

Source: Health Impact Assessment: A Guide for Practice. (2011)

14 R. Bhatia; 2011; "Health Impact Assessment: A Guide for Practice"; Human Impact Partners

The Eskişehir Alpu CPP HIA study was conducted between May and December 2019, a detailed schedule is provided below. Throughout the study, three meetings were held with the HIA Team in the Eskişehir-Bilecik Chamber of Medicine, and close communication was provided through e-group and digital communication platforms.

Table 1. Alpu CPP HIA Work Schedule

Activity	2019							
	May	June	July	August	September	October	November	December
Screening	X							
HIA meeting organization		X	X					
Scoping workshop with HIA team			X					
Literature screening and compilation		X	X	X	X	X	X	
Evaluation - Current status analysis				X	X	X		
Site visit and interviews							X	
Assessment workshop with HIA Team			X				X	
Assessment workshop with HIA Team							X	
Recommendation development								X
Reporting			X	X	X	X	X	X

The stages of Alpu CPP health impact assessmen study are as follows:

2.1. Screening

The screening stage, which is the first stage of the HIA process, includes a series of studies conducted to decide whether or not the HIA will be performed. The main criteria addressed during the screening are impact on the decision, resources, health outcomes, differential impacts, and the value of its contribution.

The screening stage was carried out by Greenpeace Akdeniz Office and Turkish Medical Association in May 2019.

There are reports of both local and national institutions and organizations in the EIA process of Alpu CPP. These reports are:

- Coal-FiredPower Plant Danger in Eskişehir" Greenpeace, April 2018[15]
- Haluk Direskeneli. "Eskişehir Alpu Coal Beds and 1080 MWe New Coal-Fired Power Plant"[16]
- UCTEA Chamber of Geology Engineers "Eskişehir Alpu Coal-Fired Power Plant Project Final EIA Report Assessment Report"[17]
- Right to Clean Air Platform "Expert Opinion: Black Clouds on Eskişehir" September 2018[18]
- HEAL Declaration "Assessment of Eskişehir Province Tepebaşı District Alpu Coal-Fired Power Plant Project Final EIA Report in Terms of Health"[19]
- Expert reports:
    - o Eskişehir 1st Administrative Court Expert Report, File No: 2017 / 897 E.
    - o Eskişehir 2nd Administrative Court Expert Report, File No: 2018 / 121 E.
    - o Eskişehir 1st Administrative Court Expert Report, File No: 2018 / 203 E.
    - o Report of Eskişehir Metropolitan Municipality 1st Legal Advisory Submitted to the 2nd Administrative Court, File No: 2018 / 191 E.

An HIA Team, consisting mainly of people in Eskişehir, who has been working for Alpu CPP and carrying out an environmental struggle, has been formed (ANNEX-1).

The following questionnaire was used in the screening stage of CPP HIA:

15 http://www.greenpeace.org/turkey/Global/turkey/report/2018/Eskisehir'de-Santral-Tehlikesi.pdf
16 https://www.academia.edu/34788822/Eski%C5%9Fehir_Alpu_K%C3%B6m%C3%BCr_Yataklar%C4%B1_ve_1080_MWe_Yeni_Termik_Santral
17 http://www.jmo.org.tr/resimler/ekler/7769a15ed575901_ek.pdf
18 https://www.temizhavahakki.com/uzman-gorusu-eskisehirde-kara-bulutlar-eylul-2018/
19 https://www.env-health.org/IMG/pdf/-44.pdf

The Alpu CPP Project:

- is expected to have direct or indirect impacts on the physical, mental, and social health of the people living in the region.
- is expected to have an impact on the social determinants of health. The most important among these is the change in employment areas fields (from agricultural production to the mining sector).
- is expected to have negative impacts on the environment, especially air, soil, and water pollution.

The screening tool (Table 3), which is used by the Canadian Institute of Public Health and provides guidance regarding the necessity of HIA (Table 2) and systematical reviews of health determinants, was applied during the screening stage.[20]

Table 2. Alpu Coal-Fired Power Plant Health Impact Assessment: SCREENING

Result: Tendency to carry out HIA	In light of the available information:	Result: Tendency to move away from HIA
Yes	In case the HIA is carried out, does it have the potential to affect decision-makers?	No
Yes	Is there a minimum resource for the HIA to be realized?	No
Partially Yes	Is there sufficient information to assess health impacts?	No
Yes	Are potential impacts (+ or -) important enough to continue the analysis?	No
High	What is the likelihood that the health impacts of this project will be more pronounced for disadvantaged groups?	**Low**
High	Positive health impacts Negative health impacts	Low

20 Institut National de Santé Publique Québec.

Table 3. Possible impacts of the Alpu CPP project on the determinants of health (screening stage)

Determinants of Health	Yes Negative Impact	Yes Positive Impact	No Impact	More information needed	Affected population	Comments
Lifestyle and behavior						
Nutrition	X				Population of Eskişehir	With the destruction and pollution of agricultural fields, it is likely that problems will arise in accessing cheap and reliable food.
Physical activity Tobacco use Alcohol use Other			X X X X			The project is not expected to have an impact on living behaviors.
Environment						
Air Water Soil Noise Odor Waste Landscaping	X X X X X			X X	Settlements near the project, current and future population in Eskişehir province and surrounding cities	It is likely that the emissions of the coal-fired power plant will generate air pollution, water pollution, soil pollution, and noise in the nearby settlements. Especially air and water pollution may affect the provinces other than Eskişehir. There is not enough information about odor and landscaping.
Environment						
Green areas Connection Safe environment Road networks	 X X		 X X		Settlements near the project	With the establishment of the project, green areas will disappear in a certain area. No impact is anticipated in terms of its connection with other provinces.

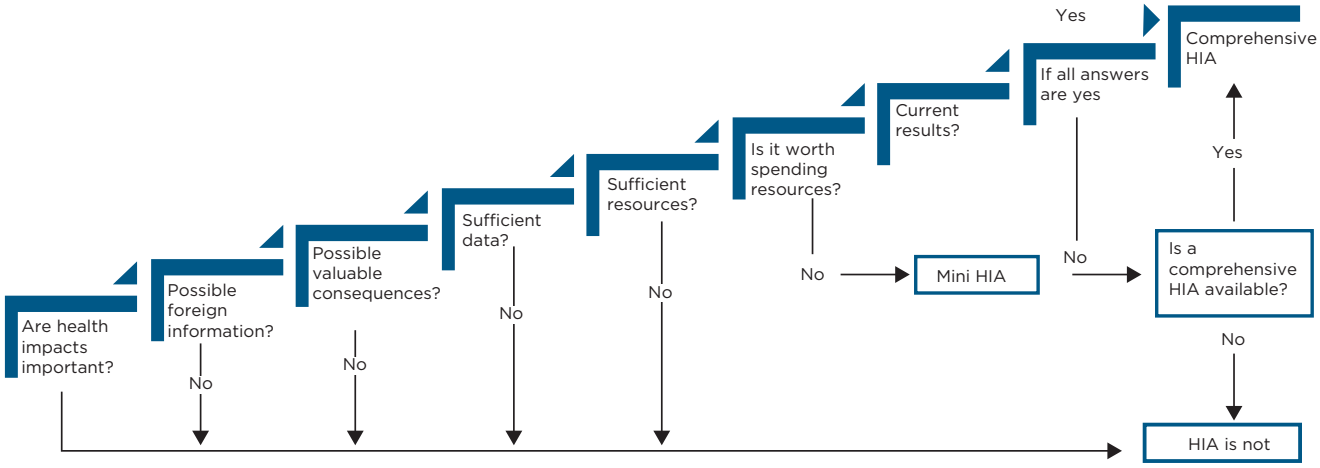
Determinants of Health	Yes Negative Impact	Yes Positive Impact	No Impact	More information needed	Affected population	Comments
Social determinants						
Social ties/ support Self-esteem Acculturation Sense of security Discrimination			X X X X			
Child development						
Family Ties Work-Life Balance Support services			X X X			
Economic development						
Employment opportunities Working Conditions The spread of welfare	X	X X		X	Population of Eskişehir province	The project will create employment for a certain number of people. Working conditions will have very dangerous occupational conditions. On the other hand, the population covered by social security will increase, but it is not known whether this situation is equivalent to the spread of welfare.
Food safety						
Access to healthy and nutritious food options Food	X X				The population of Eskişehir and the other provinces where food is sold	Food contamination is likely due to soil pollution.

Determinants of Health	Yes Negative Impact	Yes Positive Impact	No Impact	More information needed	Affected population	Comments
Transportation						
Goods and people transportation Effective transportation Road safety		 X	X X		Nearby settlements	It is possible that road safety will be negatively affected as a result of the increased traffic in the region with the implementation of the project.
Education						
Access to education Skill development			 X X			
Housing						
Accessibility Healthy/safe housing Other			 X X			
Access to public services						
Health care services Social services Recreation/ community services		X	 X X		People working on the project	They will be covered by health insurance.

As a result of the studies carried out during the screening stage, it was decided to conduct the Alpu CPP HIA study as a comprehensive HIA (Table 3). The comprehensive HIA includes new data collection and literature review in four or five different fields. It can also include interviews with many key people, focus groups, and research. Models should be built to predict various aspects of the design of health. The whole study can take two or three years and covers various people from different organizations. It is suggested that the HIA of controversial large infrastructure projects should be comprehensive.[21]

21 Kemm, 2012:9-10

Figure 5. SED decision stages in Alpu CPP project



Source: Institut National de Santé Publique Québec

2.2. Scoping Works

Scoping started in June 2019. Within this context, the literature review on the health impacts of coal-fired power plants, as well as the reports of the HIA studies conducted for coal-fired power plants were screened.

On 25-26th July 2019, a meeting was heald with professional associations and non-governmental organisations in Eskişehir (the meeting schedule is provided in Annex-1). After the meeting, the HIA team was formed.

On the first day of the two-day study, a scoping workshop was held with the HIA team. At the end of this study, the frame shown in Figure 4 was determined.

On the second day of this study, the area where the coal-fired power plant is planned to be established, and the coal reserve area were observed. Meanwhile, short meetings were held with some local leaders of the villages (Annex-3).

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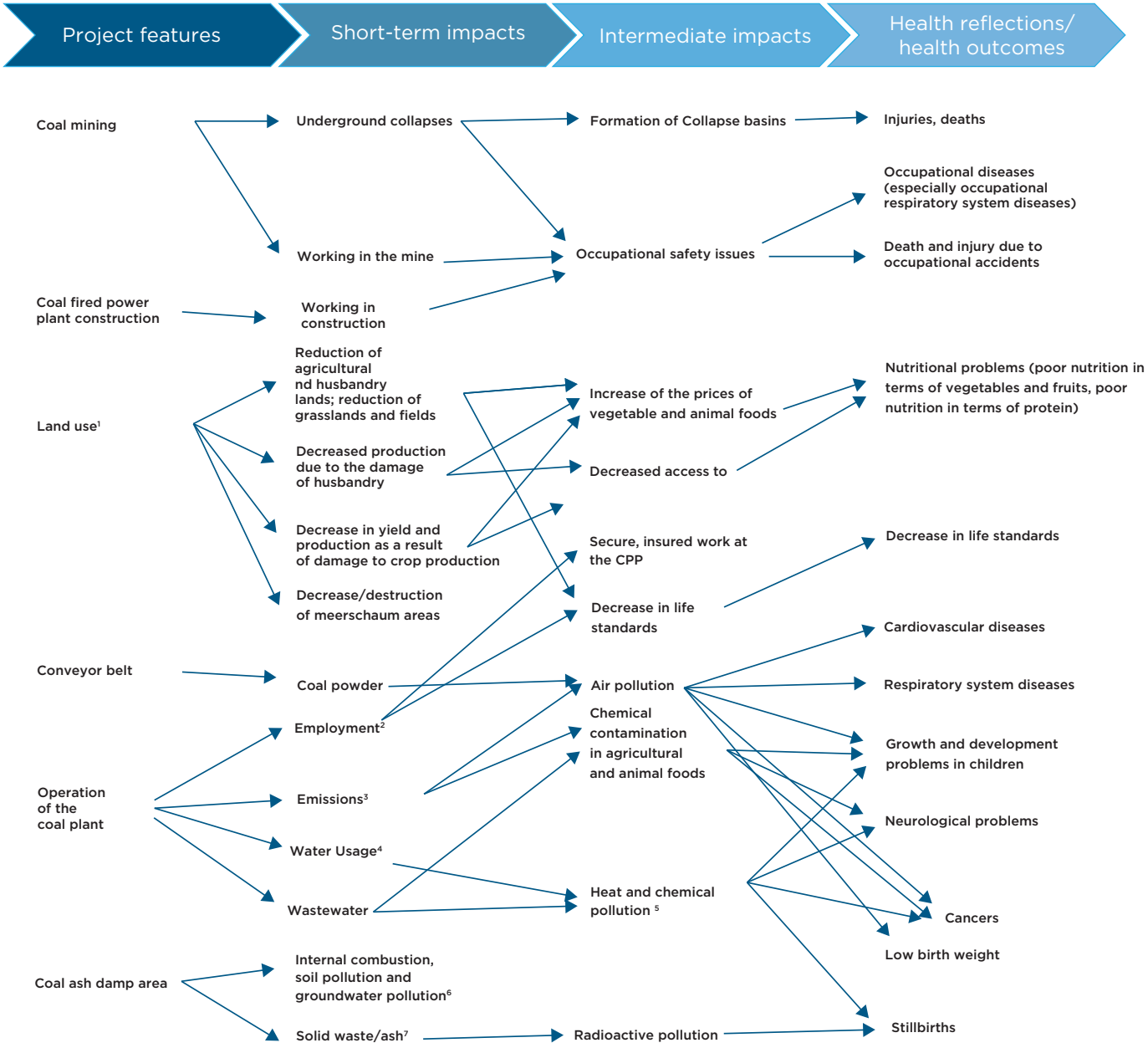
Figure 6. Eskişehir Alpu Coal-Fired Power Plant Health Impact Assessment Scope Chart



1 Total 892 Ha area with the power plant area (117 Ha), ash landfill area (273 Ha), and mining area.
2 greenhouse gases SOX, NOX, CO, CO2, HF, HCl, dust emission = PM particulate matter, heavy metals (mercury, lead, arsenic, cadmium, nickel, chrome)
3 Cooling water: Extracting a significant amount of water back from nature and giving it back to nature with higher temperatures and chemicals
4 It is planned to employ 1500 people in construction and 1000 people in the operation phase. Some of them will be locals, some of them will be from outside (through worker migration)
5 Fe, Zn, Cu, Pb, etc. contained in fly ash. Heavy metals can reach groundwater and drinking water sources through rainwater.
6 Approximately 220 thousand tons of ash will be produced annually. Coal in the Alpu region has a high ash rate of 27.5%. During the 35-year operation of the power plant, a total of 275 million tons of coal will be consumed.
7 Approximately 220 thousand tons of ash will be produced annually. Coal in the Alpu region has a high ash rate of 27.5%. During the 35-year operation of the power plant, a total of 275 million tons of coal will be consumed.

2.3. Assessment

The assessment was carried out under two headings: the first one is the current profile of the region obtained in the context of CPP. In the second stage, the anticipated impacts were analyzed.

Possible health effects arising in the scoping chart during the evaluation of health impacts were divided into 4 groups and evaluated. These are:

1. Environmental and public health problems that will arise from the operation of the power plant and waste landfill
2. Health impacts that will result from the use of agricultural lands
3. Occupational health and safety issues that will arise due to mining, construction of the power plant and the operation of the power plant
4. The impacts of the economic changes of the project on health

While determining the health impacts of the project, the direction of the possible change (increased or decreased), the size of the change (how big), and the distribution of the impact in the subgroups of the society are examined.[22] In this study, a matrix proposed by Winkler et al. (2010), which has a similar approach, was used. A) Size, B) intensity, C) duration, D) the magnitude of health impacts, E) probability of the potential impacts which are the components of this matrix, were used to perform the evaluation.

A- Size of the impact: The size of the community that is likely to be affected.

Level	Score	Definition
Low	**0**	Rare individual cases
Average	**1**	Local: small and limited Few households are affected
High	**2**	Project area: average but localized Small settlement level
Very high	**3**	Extends beyond the project area Regional level

22 Kemm, 2015

B- Intensity of the impact: Determines the severity of the impact

Level	Score	Definition
Low	**0**	People barely notice the impact.
Average	**1**	The affected can easily adapt to health impacts and maintain the pre-impact level of health.
High	**2**	The affected can adapt to health impacts with some difficulties and maintain their pre-impact level of health only with support.
Very high	**3**	The affected cannot adapt to health impacts or maintain the pre-impact level of health.

C- Duration of the impact

Level	Score	Definition
Low	**0**	<1 month
Average	**1**	Short-Term (1-12 months) Low frequency
High	**2**	Medium Term (1-4 months) Medium or intermittent frequency
Very high	**3**	Long-term/irreversible (>4 years) Permanent

D- Magnitude of health impacts The level of health impacts likely to result from the project.

Level	Score	Definition
Low	**0**	Health impacts cannot be determined.
Average	**1**	Health impacts resulting in minor injuries or diseases that do not require hospitalization
High	**2**	Health impacts resulting in moderate injury or illness requiring hospitalization
Very high	**3**	Health effects resulting in loss of life, serious injuries that require hospitalization or chronic illness

E- Probability of the impact

Stage	Description
<40%	Impossible - low probability
40-70%	There is a possibility
70-90%	Probable - strong possibility
>90%	Exact

Health impacts assessed according to the tables above were scored for each predicted impact using a four-stage risk assessment matrix shown below.

Figure 7. Four-stage risk assessment matrix proposed for the HIA

1ST STAGE → Results

2ND STAGE → Severity of impact

IMPACT LEVEL (score)	Results: A Size	Results: B Intensity	Results: C Duration	Results: D Health impacts	SEVERITY OF IMPACT A+B+C+D	Probability: Impossible (<40%)	Probability: Probable (40-70%)	Probability: Possible (70-90%)	Probability: Certain (90-100%)	3RD STAGE
Low (0)	Rare individual cases	People barely notice the impact.	<1 month	Health impacts cannot be determined.	**Low (0-3)**	Low	Low	Low	Average	4TH STAGE
Average (1)	Local: small and limited Few house holds are affected	The affected can easily adapt to health impacts and maintain the pre-impact level of health.	Short-term (1-12 months) Low frequency	Health impacts resulting in minor injuries or diseases that do not require hospitalization	**Average (4-6)**	Low	Average	Average	High	
High (2)	Project area: average but localized Village level	The affected can adapt to health impacts with some difficulties and maintain their pre-impact level of health only with support.	Medium-term (1-4 years) Medium or intermittent frequency	Health impacts resulting in moderate injury or illness requiring hospitalization	**High (7-9)**	Average	High	High	Very High	
Very high (3)	Extends beyond the project area Regional level	The affected cannot adapt to health impacts or maintain the pre-impact level of health.	Long-term/ irreversible (>4 years) Fixed frequency	Health effects resulting in loss of life, serious injuries that require hospitalization or chronic illness	**Very High (10-12)**	High	Very High	Very High	Very High	

Source: Winkler MS et. al. (2010)

2.4. Data and data sources

During the preparation of the report, most of the data belonging to the project region (Eskişehir) was obtained from public statistics of institutions such as TUIK, Eskişehir Metropolitan Municipality, SSI, and the Ministry of Environment and Urbanization. Accessing the statistics regarding the health profile of the region was not possible, and to make up for this, the data of the East Marmara Region, which is the İBBS 1st level region was used.

In order to understand the thoughts of the people living in the region regarding the Alpu CPP project, meetings were held in two villages.

2.5. Analysis

The AirQ+ software was used to estimate the health impacts of the current $PM_{2.5}$ level in Eskişehir. The software is developed by the World Health Organization European Regional Office to calculate the health burden and impacts of air pollution.[23] The AirQ+ software estimates the expected number of deaths when the $PM_{2.5}$ values in outdoor air exceed 10 μg/m^3, in other words, "the number of deaths that can be prevented by the elimination of air pollution".

Analyzes were carried out using CALPUFF in the estimation of the regional dispersion of air pollutants expected to spread from the plant chimney.

The population and cities that will be affected by the planned coal-fired power plant are categorized in 5 degrees of impact. The geographical boundaries of the mentioned 5 degrees (sites) were determined on the basis of the modeling of the dispersion of the $PM_{2.5}$ pollutant that the plant will emit if it is constructed, as shown in Greenpeace's 2018 report titled "Coal-fired Power Plant Hazard in Eskişehir".[24] According to the model, the settlements where the borders coincide with the dispersion of $PM_{2.5}$ are determined on Google Earth. Population information in settlements within each grade (field) was obtained from the Turkish Statistical Institute database. The count of the population which will face health risks due to the power plant has been calculated by adding the number of people living in the settlements within the relevant degree.

In the methodology section, the economic costs of different health impacts are evaluated using the EEA (European Environment Agency) Report "Air Pollution Costs from European Industrial Plants 2008-2012- An Updated Evaluation" methodology. All costs are adapted using the ratio of per capita GDP between the EU and Turkey. Based on the OECD recommendations for fatalities, 0.9 flexibility was used for adaptation, the flexibility of economic cost relative to income for other health effects was kept in line with a prudent approach.

23 World Health Organization (WHO) AirQ example of calculations, (October 2018)

24 L Myllyvirta; Greenpeace Akdeniz; (2019); "Eskişehir'de Termik Santral Tehlikesi: Planlanan Alpu Termik Santralinin Hava Kalitesi ve Sağlık Üzerindeki Etkileri

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CHAPTER 3

3. Coal-Fired Power Plants

3.1. What are Coal-Fired Power Plants (CPP)?

Coal power plants (or coal-fired power plants) are power generation facilities that transfer heat power to electricity by use-ing coal as fuel. Water is heated and evaporated using the solid, liquid, or gaseous fuels, and the mechanical energy obtained from steam is converted into electrical energy in generators. Basically, chemical energy is converted into mechanical energy and mechanical energy into electrical energy.

3.2. State of Coal-Fired Power Plants in the World

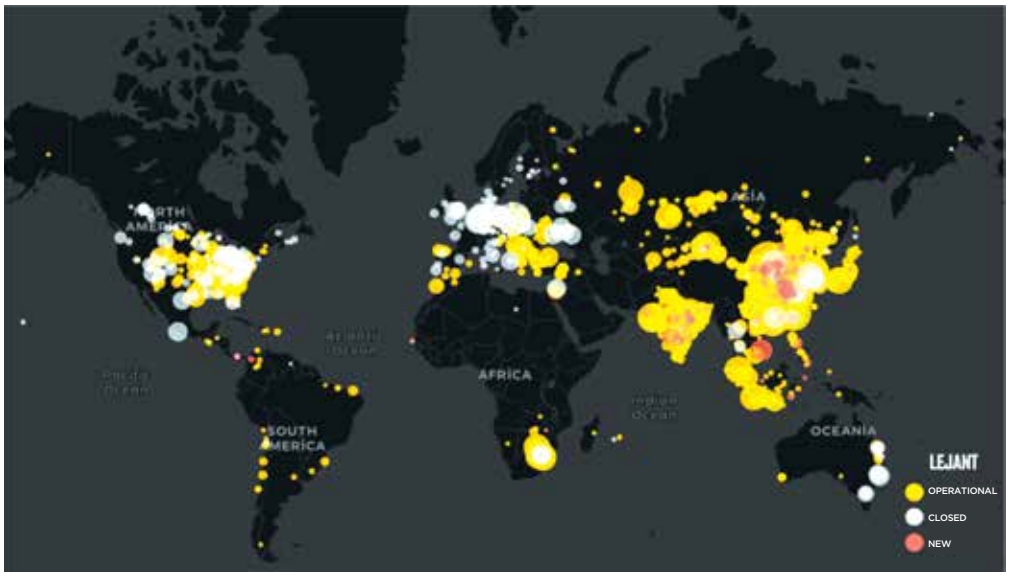
It is imperative to meet the demand for cheap, reliable, and sustainable clean energy for economic and social development. While meeting the energy need, the whole world must first develop a common clean energy policy and develop steps to reduce energy consumption. The intensive use of coal and other fossil fuels in electricity generation around the world is a trigger for the climate crisis.

The structure of the energy sector has started to take shape with environmental factors, and the energy policies of the countries have started to change with the fact of the climate crisis. Despite the energy sector changing due to the climate crisis, coal plants are a major source of greenhouse gas emissions, which can increase significantly globally, according to the analysis of the World Resources Institute (WRI).[25]

According to the "World Energy Outlook 2019" report by the International Energy Agency, global coal use has risen again in 2018, following a decline in recent years. The determinations include the fact that this increase originates mainly from China, India, Indonesia, and certain other countries in Southeast Asia.[26] The continuing growth of electricity demand in Asia and the fact that coal is the biggest source of electricity generated shows that coal still maintains its importance in the energy sector. Although certain regulations have been implemented to phase-out coal-fired power plants under the Paris Agreement signed due to the climate crisis, coal continues to maintain its position in the energy sector. Within the scope of coal use, the following countries show the entire coal capacity operated in the world, and China and India contain more than 50% of the entire list.[27]

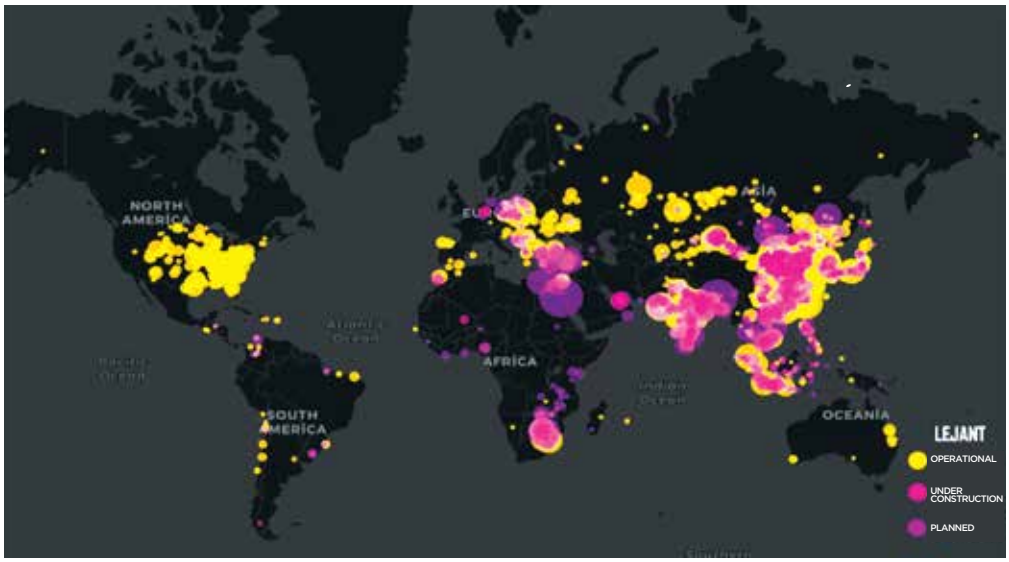
25 WRI., Global Coal Rsik Assesment
26 International Energy Agency (IEA), World Energy Outlook 2019
27 “How plans for new coal are changing around the world?”, (2019)

Map 6. Worldwide Distribution of the Operational, Closed and New Coal-Fired Power Plants



Source: carbonbrief.org/mapped-worlds-coal-fired-power-plants

Map 7. Worldwide Distribution of the Operational, Under Construction and Planned Coal-Fired Power Plants



Source: carbonbrief.org/mapped-worlds-coal-fired-power-plants

China alone has about half (49%) of the global coal fleet, with 987.4 GW. It is followed by the USA with 13% and India with 11%.

While this is the case in energy generation from coal, it was stated in the Paris Climate Change Agreement signed in 2015 that countries emphasize that the global transition to clean energy is indispensable in energy policies and that coal-fired power plants should be phased-out.

Map 8. The coal phase-out map of Europe

Source: https://beyond-coal.eu/solving-the-coal-puzzle/

In this direction, the phasing-out coal plans announced by countries are as follows:[28]

- The UK became the first country in the world to announce its policies regarding phasing-out its coal operations with the announcement made before the Paris Climate Summit in 2015. The country has pledged to gradually abandon coal by making a promise to close all operational coal-fired power plants by 2025.
- France has announced to phase-out coal operations by 2022. Policy development is expected.
- The Netherlands is among the countries that announced that they phase-out coal operations by the end of 2029. In May 2018, the government of the Netherlands announced that as of January 1, 2030, electricity generation with coal will be declared illegal.
- Finland has committed to ending coal-based electricity generation by 2029. A draft law was proposed by the Finnish government in October 2018 to prohibit coal use for electricity generation after 1 May 2029 to abandon coal.
- Italy is among the countries that announced that it will abandon coal by 2025. At the 2019 UN Climate Action Summit, Italian Prime Minister Conte confirmed this date.

28 Based on the information from the activities of Europe Beyond Coal.

- Belgium is the first European country to close down its coal-fired power plants and abandon coal use in energy generation. The last coal-fired power plant was closed down in April 2016.
- Denmark announced that it will abandon coal by 2030.
- Hungary is among the countries that announced that it will abandon coal by 2030.
- Austria decided to abandon coal until 2020.
- Portugal is among the countries that announced that it will abandon coal by 2023.
- Sweden is among the countries that decided to abandon coal and announced that the last power plant will be closed down by 2022.
- Romania is among the countries where even discussions about abandoning coal have not started yet.
- The Western Balkans have not yet started a discussion about coal-fired power plants.
- Turkey has not yet discussed abandoning coal and officially announced that coal-fired power plant capacity will be increased to up to 30 GW by 2023.
- Greece has announced that it will abandon coal by 2028.
- India has set a clear official roadmap in the 2018 National Electric Power Plan to realize and exceed the goal of obtaining 40% of its installed power from non-fossil fuel sources by 2030. This plan envisions that the share of the electricity system, 67% of which is fossil fuels, in total installed power will be reduced to 43% by 2027.[29]

Research by Carbon Tracker shows that it is economically beneficial to close down the coal-fired power plants in line with the Paris Agreement.

The findings of the research reveal that[30]

- 42% of the installed power of the global coal-fired power plants is not profitable (due to high fuel costs). We can see that this number may increase to 72% in 2040 because the current carbon pricing and air pollution regulations increase the costs, while the coastal wind and solar energy prices continue to decrease, and all future regulations will further reduce the coal energy profit margin.[31]
- Furthermore, research has found that keeping 35% of coal-fired power plants in operation is more costly than installing new renewable power plants and pointed out that by 2030, the establishment of new renewable power plants will be cheaper than operating 96% of the existing coal-fired power plants today.
- As a final finding, it has been determined that China could save 389 billion USD by closing down the coal-fired power plants in line with the Paris Climate Agreement instead of maintaining its current plans; the European Union can save 89 billion US dollars, ABAD 78 billion US dollars, and Russia 20 billion US dollars.

29 İklim Haber, "Hindistan, Paris iklim hedeflerini gerçekleştirerek küresel iklim lideri oluyor"
30 Dunyada ilk defa yapilan bir calismaya gore komurlu termik santrallerin yüzde 42si zarar ediyor
31 Yusuf. (2018, Kasım 30). Dünyada ilk defa yapılan bir çalışmaya göre kömürlü termik santrallerin yüzde 42'si zarar ediyor. Eylül 4, 2019 tarihinde 350Türkiye

3.3. Coal-Fired Power Plants in Turkey

There is are operating coal-fired power plants registered in Turkey. Additionally, there are 32 coal-fired power plant projects planned to be built. 36.3% of the energy in Turkey is provided by coal-fired power plants.[32]

After India has halved its capacity; Turkey ranks the second at the list of countries with mostly planned coal-fired power plant capacity with 31.7 GW after China in 2019. This was an unimaginable prospect until just a few years ago, when China and India dominated the world in terms of the new coal-fired power plant capacity under development.[33]

The Table below shows that although the number of coal-fired power plants is the highest in Çanakkale province, the coal-fired power plant with the highest power (capacity) is Zonguldak Zetes Coal-Fired Power Plant. Considering the operation times, CO_2 emission, and the surrounding population of these power plants, it is evident that they constitute a serious problem in terms of environmental pollution and ecological balance.

Even though they have infrastructures to prevent environmental pollution such as dust filters and desulphurization units, it is a matter of debate how reliable these facilities are because their current operating performances are not shared with the public. The privatization process of state-owned power plants, which has been going on since the 1980s, is also considered as a source of concern in terms of environmental pollution.[34]

32 TEİAŞ, Ocak 2020

33 https://endcoal.org/wp-content/uploads/2020/04/BoomAndBust_2020_t3.pdf

34 Sağlık ve Çevre Birliği (HEAL), 2015. ÖDENMEYEN SAĞLIK FATURASI: Türkiye'de Kömürlü Termik Santraller Bizi Nasıl Hasta Ediyor?

Table 5. Coal-fired power plants in operation in Turkey

NAME OF COAL-FIRED POWER PLANT	PROVINCE	DISTRICT	CAPACITY (MWe)
Tufanbeyli Coal-Fired Power Plant	Adana	Tufanbeyli	450
İsken Sugözü Coal-Fired Power Plant	Adana	Yumurtalık	1210
Çayırhan Coal-Fired Power Plant	Ankara	Nallıhan	620
Bolu-Goynük Coal-Fired Power Plant	Bolu	Göynük	270
Orhaneli Coal-Fired Power Plant	Bursa	Orhaneli	210
Cenal Coal-Fired Power Plant	Çanakkale	Biga, Karabiga	1320
Bekirli Coal-Fired Power Plant	Çanakkale	Biga	1200
İçdaş Biga Coal-Fired Power Plant	Çanakkale	Biga	405
Çan-2 Coal-Fired Power Plant	Çanakkale	Çan	330
Çan (18 Mart) Coal-Fired Power Plant	Çanakkale	Çan	320
Atlas İskenderun Coal-Fired Power Plant	Hatay	İskenderun	1200
İzdemir Coal-Fired Power Plant	İzmir	Aliağa	350
Afşin Elbistan A Coal-Fired Power Plant	Kahramanmaraş	Afşin-Elbistan	1745
Afşin Elbistan B Coal-Fired Power Plant	Kahramanmaraş	Afşin-Elbistan	1830
Çolakoğlu 2 Coal-Fired Power Plant	Kocaeli	Gebze	190
Çelikler Seyitömer Coal-Fired Power Plant	Kütahya	Tavşanlı	600
Tunçbilek Coal-Fired Power Plant	Kütahya	Tavşanlı	365
Soma Kolin Coal-Fired Power Plant	Manisa	Soma	510
Soma B Coal-Fired Power Plant	Manisa	Soma	990
Yatağan Coal-Fired Power Plant	Muğla	Yatağan	630
Kemerköy Coal-Fired Power Plant	Muğla	Milas	630
Yeniköy Coal-Fired Power Plant	Muğla	Milas	420
Kangal Coal-Fired Power Plant	Sivas	Kangal	536.66
Silopi (Ciner) Coal-Fired Power Plant	Şırnak	Silopi	405
Aksa Göynük Coal-Fired Power Plant	Yalova	Çiftlikköy	142.5
Çatalağzı Coal-Fired Power Plant (ÇATES)	Zonguldak	Çatalağzı	315
ZETES 1 Coal-Fired Power Plant	Zonguldak	Çatalağzı	160
ZETES 2 Coal-Fired Power Plant	Zonguldak	Çatalağzı	1230
ZETES 3 Coal-Fired Power Plant	Zonguldak	Çatalağzı	2790

Source: Global Coal Plant Tracker

3.4. Risks of Coal-Fired Power Plants in Terms of Their Impacts on Ecosystem

The fuel used in Coal-fired power plants is very important in the environmental impact of the facility. Fuels with high carbon emission such as coal and lignite are known to destroy the ecological structure and threaten natural life. Since natural gas is an imported fuel in Turkey, coal and lignite are used as fuel in Coal-fired power plants to reduce costs.[35] This shows how the Coal-fired power plants play a major role in global warming and climate crisis, i.e. the world's most important environmental problem.

Coal-fired power plants produce a large amount of waste that must be disposed of for the environment and human health. These wastes are as follows:

- Industrial-grade solid wastes such as ash, slag, gypsum, treatment sludges from treatment units, scrap materials, solid wastes generated during maintenance of the units
- Domestic solid wastes such as packaging wastes, organic wastes
- Industrial liquid wastes such as cooling water, process wastewater, hazardous chemicals, and waste oils during maintenance of the units
- Domestic liquid wastes
- Gas waste such as SO_X, NO_X, CO, CO_2, hydrogen fluoride (HF), hydrochloric acid (HCl), dust emission.[36]

The other major problem created by these wastes in addition to CO_2 emissions is air pollution. SO_x, NO_x, CO, CO_2, HF, HCl gases released as a result of internal combustion in coal-fired power plants threaten both the environment and human health. Particularly, particulate matters can cause or increase the incidences of lung diseases and heart attacks, affect the central nervous system and reproductive system, and cause cancer. These impacts can cause premature death. They may increase preterm birth cases. Sulfur oxides (SOx) and nitrogen oxides (NOx) can aggravate asthma and decrease lung function. Furthermore, thy can also aggravate lung diseases by causing respiratory symptoms and increasing susceptibility to respiratory infection. [37]

These gases, which have serious effects on human health, also pose a threat to the ecosystem. Particulate matters that cause air pollution affect not only humans but also animals and plants. They can change growth times, especially in plants. This affects ecosystem balance as well as economic balance in agricultural cities.

35, 36, 37 O. Aytaç, (2018); "Kömür Yakan Santrallerin Çalışma Prensibi ve Çevresel Etkileri", "TMMOB Makina Mühendisleri Odası

Sulfur oxides (SOx) increase the acidification of soil and surface waters. In addition to the damage to vegetation, it causes losses in local species in marine and terrestrial systems. Especially along with the climate crisis, key species of the geographies are disappearing. In this sense, air pollution caused by coal-fired power plants triggers this problem. Nitrogen oxides (NOx) also increase the acidification of soil and water, causing the soil structure and vegetation to change.[38] This also leads to crises such as the loss of special products or reduced productivity, especially in agricultural cities.

Coal-fired power plants draw a considerable amount of water from nature for cooling function. This affects marine ecosystems. Furthermore, the liquid waste discharged after the cooling function can change the microclimate of the environment and cause permanent damage to the aquatic ecosystem when it is not treated sufficiently or not discharged at the appropriate temperature.

All these environmental impacts will not only destroy the environment. Damage of natural elements such as water and soil that keep the cities alive will have serious adverse effects on the economy, health, and endurance of the cities.

3.5. Case study:

General examination of the impact of the Coal-fired power plant selected from the examples abroad on the area in which it was established in terms of urban planning expertise.

The Polnoc Coal-Fired Power Plant, planned by the private company Polenergia in 2011 in the Pomerania region of Northern Poland, was expected to be the biggest new coal-fired power plant of Europe with a capacity of 1600 MW, burning 3.7 million tons of coal, and to contribute 8 million tons of carbon emissions to the irreversible climate change.

Pomerania Region is the region located on the southern Baltic coast, covering the west of Poland and the east of Germany. Although it is a virgin area in terms of industrial investments, the people live by livestock, forestry, and fishing in this area where the dominant sector is agriculture. Grain, potato farming and sugar beet production are common.

Towards the end of the 19th century, tourism activities started to increase along the coastline.

In this region, which has many values in the context of cultural heritage, especially Malbork Castle, which is on the UNESCO Cultural Heritage list, is close to the area where the power plant is planned.

38 Aytaç, 2018

The researches made by experts from the EP Platform has scientifically revealed that the outer surface of this castle, which enables heritage tourism will become eroded due to certain pollutants that it will be produced if the power plant is built.

In this context, although the importance of socio-cultural heritages on an international scale is not denied, it is safe to say that this project will affect the past along with the local people and economy in the future.

It is also envisaged that the power plant will seriously affect groundwater resources, the ecosystem of the Vistula River, where water will be drawn for cooling, and air quality.

Considering the above-mentioned characteristics of the region, the negative impact that the Polnoc Coal-Fired Power Plant will cause to live here is visible.

For this reason, the STOP EP (Stop Polnoc Coal-Fired Power Plant) platform, which is formed by local people and non-governmental organizations working at the local and national level, took action, and when the long-range, systematic campaign of the Platform was supported by the international non-governmental organizations, the campaign achieved success, and with the lawsuit filed against the last permission Polnoc needed to obtain, the project was dismissed by the state court.[39]

The project, which was planned to complete all the permission processes and proceed to the construction phase in 2016, had not fully received any of its permits by the end of 2015. The EIA had been returned by the court twice, and there were no financiers left interested in the project. When the construction permit application, which was previously returned to the owner for improvement in 2012, was returned by the court for a second time in December 2016, Polenergia returned to the beginning of the process that started in 2011 without even one permit, and the project was canceled in 2016.

39 Gündüzyeli, E. (2016, 12 15). Polnoc coal-fired power plant project canceled: How was a UNESCO heritage saved? on 09 17, 2019, Northern Forests Defense: https://kuzeyormanlari.org/2016/12/18/polnoc-termik-santral-projesi-iptal-bir-unesco-mirasi-nasil-kurtarildi/

3.6. Effects of a Coal-Fired Power Plant on the Life, Resources and Planning of Cities in the Climate Crisis Period

Coal-fired power plants are projects that are claimed to provide significant benefits to the economy, employment, and energy needs of the cities. Coal burning is responsible for 0.3 of the 1-degree increase in average global temperatures compared to the pre-industry levels.[40] This makes coal alone the biggest source of global temperature increase and the biggest responsible for climate change. However, as stated in the previous titles, this way of generating energy, from which many cities in the world have withdrawn their investments, directly and indirectly, damages nature, ecosystems, and cities. The biggest threats are climate crisis, air pollution, pollution of water resources, and extinction of living species. People in settlements that are constantly under the impact of coal-fired power plants are threatened by permanent or even lethal diseases due to the gases released. On the other hand, coal and other fossil fuels harm both living species and all the elements that provide life. Soil, water, and ecosystems are also threatened. Emissions of high-income countries are at the forefront as the cause of the climate crisis and climate deterioration. According to the International Energy Agency (IEA), to prevent the disastrous effects of climate change, including drought, floods and significant life losses of global warming, the global warming should be kept below 2 degrees compared to before the Industrial Revolution, and all coal-fired power plants should be closed down in the coming years.

Burning coal are the biggest are the biggest source of human-caused carbon emissions, and one-third of the carbon dioxide emissions in the world is due to the use of coal.[40] 40% of the electricity need in the world is obtained from coal-fired power plants. In addition, the world has a clean energy source that can meet technically 6 times the energy demand. Considering the fact that coal is one of the most dangerous fuels that cause climate change, coal-fired power plants that will be or planned to be built, or the ones that are not closed down, will increase the speed of the climate crisis that is already apparent in every aspect of life and a new disaster will be added to the disasters experienced in the world every day. It is also important that coal-fired power plants cause mercury pollution, which pollutes soil and water resources, causes acid rains and the smoke released in these rains will pose the threat of destroying the entire ecosystem. coal-fired power plants cause drought, coal mining causes erosion, mining destroys the vegetation on the surface of the mining area, and underground mining causes underground gaps that can collapse, which are all triggering factors of climate change. In addition to these factors, coal-fired power plants cause a decrease in agricultural potential in the region, leading to losses in storage capacity in current reserves.

40 International Energy Agency, Global Energy and CO2 Situation Report 2019 - https://www.iea.org/reports/global-energy-CO2-status-report-2019/emissions

CHAPTER 4

CHAPTER 4

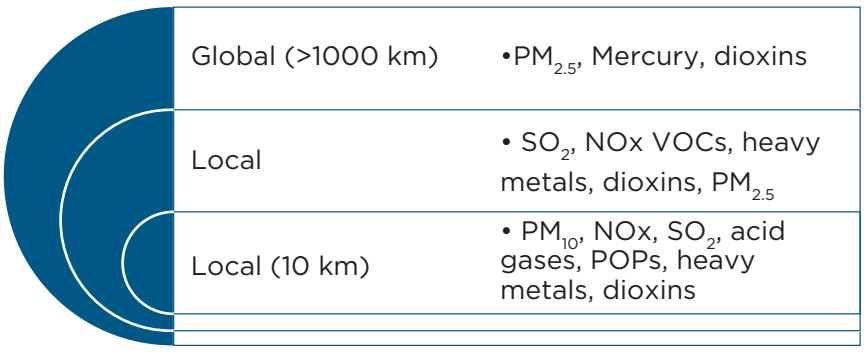
4. Impacts Of Coal-Fired Power Plants On Public Health

Coal-fired power plants are among the industrial facilities that pollute the environment we live in the most. Two main activities stand out in the impacts of CPP on health: health problems caused by underground mining and pollutants emitted during the operation of the power plant. Furthermore, during the construction of the power plant, problems arising from construction should also be considered. On the other hand, the effects of CO2 emitted by CPP on the climate also pose serious health problems.

4.1. Health Problems Caused by Burning Coal

Air pollutants released from the chimney of the plant as a result of the burning of coal do not only affect the people living around the coal fired power plant; but also the ones living in other cities by moving far away, and even people in neighboring countries by moving across the border. Fine particulate matter ($PM_{2,5}$) released from coal-fired power plants, mercury, and dioxins can spread thousands of kilometers and spread all over the world. It has been shown that nitrogen oxides originating from power plants in South Africa reached Australia by crossing the Indian Ocean. This makes coal-fired power plants not just a problem in the country, but a global threat.[41]

Figure 8. Distribution of air pollutants

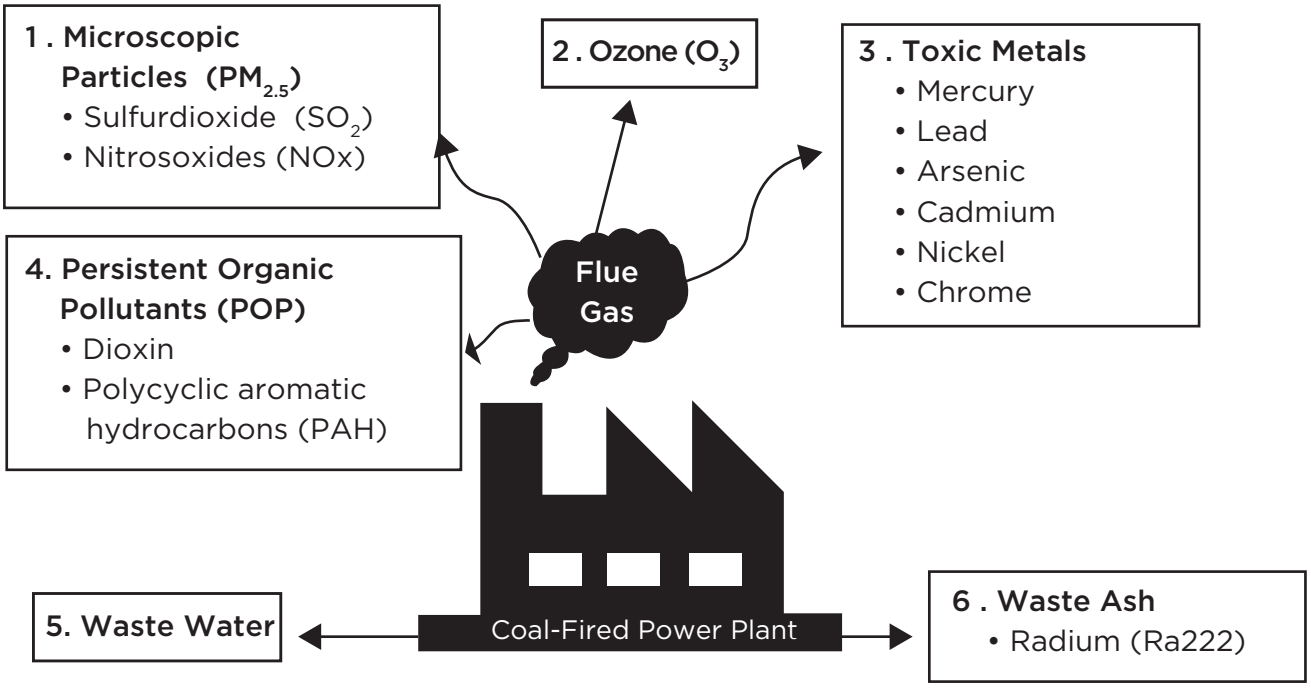


Source: The Unpaid Health Bill: How Coal-Fired Power Plants in Turkey Are Causing Diseases

41 Health and Environment Alliance (2015) Ödenmeyen Sağlık Faturası: Türkiye'de Kömürlü Termik Santraller Bizi Nasıl Hasta Ediyor?

The contribution of coal-fired power plants to environmental pollution is summarized in Figure 9. As can be understood from the figure, harmful substances, and flue gas in particular, are emitted from the wastewater and waste ashes of the coal-fired power plants. These substances pollute the air, water, and soil. Therefore, harmful substances spread from the coal-fired power plants to the environment affect not only humans but also all living beings and plants in nature. In addition to their direct impacts on human health, they also cause indirect impacts by polluting vegetable and animal products, and water resources.

Figure 9. Harmful substances released from coal-fired power plants



Health problems resulting from coal-fired power plant emissions are summarized in Table 7. Accordingly, all systems and organs in the human body are damaged by the toxic effects of harmful substances, which are caused by burning coal.[42]

Gases and smoke emitted from the flue gas of CPP are an important source of air pollution. There is sufficient scientific evidence about the impacts of air pollution on human health. In the Global Disease Burden study conducted by the World Health Organization in 2010, air pollution is among the most important risk factors for chronic diseases.[43] There are many studies on the relationship between air pollution and respiratory system and cardiovascular system diseases. Oxidative stress caused by air pollutants causes inflammation and cytotoxicity.[44]

42 TMA EIA assessment report

43 Lim S.S. et. al. (2012) A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis

44 Burt E., Orris P. and Buchanan S. (2013) Scientific Evidence of Health Effects from Coal Use in Energy Generation, University of Illinois at Chicago School of Public Health, Access:21.04.2016 https://noharm.org/sites/default/files/lib/downloads/climate/Coal_Literature_Review_2.pdf

Table 5. Health Problems Caused by Coal-Fired Power Plant Emissions

Affected organs and systems	Impact
Lungs	Inflammation
	Oxidative stress
	Rapid progression and exacerbation in COPD
	Increased respiratory symptoms
	Affected pulmonary reflexes
	Decrease in lung function
	Increased risk of lung cancer
Heart	Disruption in the autonomic function of the heart
	Oxidative stress
	Dysrhythmic sensitivity increase
	Cardiac repolarization disorder
	Increased myocardial ischemia
Blood	Flow change
	Increased coagulability
	Displacement of particles
	Peripheral thrombosis
	Decreased oxygen saturation
Veins	Vascular occlusion, a rapid progression in plaques and destabilization
	Endothelial dysfunction
	Vasoconstriction and hypertension
Brain	Increased cerebrovascular ischemia
	Attention deficit hyperactivity disorder
Other	Low birth weight
	Premature birth
	Skin, bladder cancer
	Diabetes

Source: Turkish Medical Association (Türk Tabipleri Birliği - TTB) Eskişehir Alpu Coal-Fired Power Plant Environmental Impact Assessment report, 2018

The International Agency for Research on Cancer (IARC) operating under the World Health Organization classified outdoor air pollution in Group 1 (definitive carcinogen) factors that cause cancer in humans in 2013.[45] Following a detailed review of the current scientific literature, the world's leading experts, who came together within the framework of the IARC Monograph Program, concluded that there is sufficient evidence that outdoor air pollution causes lung cancer. The particulate matter (PM), an important component of outdoor air pollution, was also evaluated, and it was also classified under Group 1 as a cancer-causing factor in humans.

Recent death statistics published by the Turkish Statistical Institute (TSI) show that circulatory system diseases rank #1 in the causes of deaths in our country with 40.1%, followed by benign and malignant tumors with 19.9% and respiratory system diseases with 11%. Among the deaths due to cancer, the most common types of cancers are trachea/bronchial/lung cancers (31.1%), namely respiratory system cancers.[46] All of these diseases are directly related to air pollution.

Using the opportunities offered by scientific developments, the number of deaths or burdens of disease directly caused by the burning of coal in the world or in any region can be calculated. The file titled “Energy and Health” of Lancet, which is one of the reputable medical journals in the world, reports that 210,000 deaths, 2 million serious diseases, and 151 million mild diseases per year occur for each TWh electricity generated by burning coal all over the world.[47] A similar calculation was made by HEAL (Health and Environment Alliance) in 2015 using emission data included in the latest statement of Turkey under the Convention on Long-Range Transboundary Air Pollution (CLRTAP) and the study titled "Global Burden of Disease" by World Health Organization. Accordingly, the health cost of using coal in Turkey is at least 2876 premature deaths, approximately 3823 new cases of chronic bronchitis in adults, 4,311 hospital admissions, and 637,643 lost working days annually. The economic cost of the impacts of coal on health is estimated to be between 2.9 and 3.6 billion Euros per year.[48]

Among the fuel types, lignite is the one that gives the most health outcomes. When equal amounts of lignite and hard coal are burnt, lignite usually causes less air pollution. However, since lignite has a lower energy content than hard coal, it will be necessary to burn approximately three times more lignite coal to generate the same amount of electricity. Therefore, compared to a coal-fired power plant with the same electrical power output, a lignite power plant will generally release a higher amount of harmful pollutant emissions. Turkey's domestic lignite has low calorific value and relatively high amounts of ash, moisture, and sulfur content. Therefore, air pollution caused by burning this lignite is also high.

45 WHO International Agency for Research on Cancer (IARC) (2013) Outdoor air pollution a leading environmental cause of cancer deaths. Access: March 20, 2018 http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf
46 Turkish Statistical Institute (TÜİK) (2017) Cause of Death Statistics, 2016, Date Accessed 20 March 2018
47 Markandya A. and Wilkinson P. (2007) Energy and Health 2: Electricity generation and health, The Lancet 370(9591):979-990
48 Health and Environment Alliance (2015)

Table 8 shows how many deaths, serious and mild diseases occur per terawatt hour (TWh) of electricity generation by primary energy source. The data show the mean. 95% confidence intervals are provided in parentheses. Serious diseases include hospital admissions for respiratory and cerebrovascular causes, congestive heart failure, and chronic bronchitis. Mild diseases include restricted activity days in asthmatic patients, cases where bronchodilators are used, cough and lower respiratory tract symptoms, and chronic cough episodes.[49]

Table 8. Health Impacts of Electricity Generation by the Primary Energy Sources in Europe (Deaths/Cases per TWh)

Fuel type	Impacts related to air pollution		
	Deaths	Serious diseases	Mild diseases
Lignite	32,6 (8,2-130)	298 (74,6-1193)	17676 (4419-70704)
Coal	24,5 (6,1-98,0)	225 (56,2-899)	13288 (3322-53150)
Natural Gas	2,8 (0,70-11,2)	30 (7,48-120)	703 (176-2813)
Fuel	18,4 (4,6-73,6)	161 (40,4-645,6)	9551 (2388-38204)
Biomass	4,63 (1,16-18,5)	43 (10,8-172,6)	2276 (569-9104)

Source: Energy and Health 2: Electricity generation and health, The Lancet, (2007)

A cohort (monitoring) study conducted on people living in Italy nearby a CPP operating between 1990 and 2014 shows that CPP plays a role in both hospitalization and premature deaths. According to the results of this study, while there is an increase in deaths caused by the respiratory and cardiovascular system diseases, the risk of death in lung, trachea, and bronchial tumors also increases. The increase in both hospitalizations and mortality have been shown for nervous system diseases.[50]

49 Minichilli, F., Gorini, F., Bustaffa, E., Cori, L., & Bianchi, F. (2019). Mortality and hospitalization associated to emissions of a coal-fired power plant: A population-based cohort study. Science of The Total Environment, 694, 133757.

50 Health and Environment Alliance (2015)

4.2. COVID-19 and Air Pollution

Shortly after this report was completed, the COVID-19 pandemic, which is the largest one in the world in the last 100 years, has broken out. As of now, it is still effective on a global scale. The disease first emerged with reports of pneumonia cases of an unknown etiology in Wuhan, Hubei Province, China on December 31, and these were subsequently detected to be caused by a virus from the coronavirus family. The disease was first diagnosed outside of China on January 13, 2020, and it was confirmed that it was transmitted from person to person toward the end of January. On March 11, WHO declared the disease a pandemic (worldwide epidemic). In the ongoing pandemic, 11,301,850 cases and 531,806 deaths have been confirmed worldwide as of July 6, 2020 according to the data of the World Health Organization.[51]

The most common symptoms of COVID-19 are reported as high fever, cough, shortness of breath and difficulty in breathing. In addition to individual factors, all kinds of environmental factors that decrease respiratory quality directly affect the impact of COVID-19 and increase the morbidity and mortality of the disease. In this context, air pollution has become an important factor in evaluating COVID-19 due to its systemic effects on the respiratory tract.

As part of the fight against the pandemic in Turkey, 30 major provinces and Zonguldak province, which has a very high rate of lung diseases, were closed to vehicle access with the Interior Ministry's mandate dated April 3, 2020.[52] In addition to the fact that Zonguldak province has four coal-fired power plants in operation and one in the planning phase, it is understood that the city was added to the lockdown list due to the importance of coal mining as a field of employment.

In fact, the reality of the high-risk job opportunities that coal-fired power plants provide to the people of the region for employment is to work in extremely unhealthy conditions at the expense of the health of their lungs.

Over the course of the research related to the pandemic, scientific studies that investigate the aggravation of health risks posed by COVID-19 due to worldwide air pollution and air pollutants, especially $PM_{2.5}$, are being published one after the other. In the information note published by the Center for Research on Energy and Clean Air, CREA, the situation is clearly summarized as follows:[53]

51 Dünya Sağlık Örgütü COVID19 veri tablosu
52 The mandate on April 3, 2020
53 Centre for Research on Energy and Clean Air, CREA

- High levels of air pollution affect the body's natural defense against airborne viruses and increase the likelihood of people being infected by viral diseases. It is estimated that this is also true for COVID-19. This indicates that exposure to air pollution is effective in the spread of the disease.

- Air pollution is a risk factor that affects severe chronic diseases and conditions that increase the severity and mortality of COVID-19, such as chronic respiratory diseases, cardiovascular diseases, hypertension, diabetes, stroke and cancer. Patients undergoing cancer treatment are in a higher risk group due to the suppression of their immune systems.

- The concentration of particulate matter in the atmosphere is associated with an increased rate of spread of viruses and other pollutants. The particulate matter acts as a carrier to which viruses can attach or adhere. [54]

Scientific studies on the pandemic as of the beginning of June 2020 have obtained various findings indicating that air pollution increases health problems and mortality risks associated with COVID-19. One of these studies is the research done by the Harvard School of Public Health by investigating COVID-19 cases that resulted in death from 3000 different settlements in the USA. The research revealed that only 1µg / m^3 increase in PM2.5, the most dangerous pollutant in the air, is associated with a 15% increase in the mortality rate of COVID-19.[553]

Another study was conducted on the samples obtained from the industrial and urban areas of Bergamo, one of the most affected settlements in Italy. In the study carried out at the University of Bologna, genetic material specific to COVID-19 was detected in these samples.[56] The findings were also confirmed by an independent laboratory.

On the other hand, industrial activities that have stopped globally due to the COVID-19 pandemic gave us insight into whether another world is possible: The levels of air pollutants decreased when production stopped, and the ozone layer depletion also partially decreased. At this point, the question of whether we really need so much production or goods and the idea that this production and consumption craze all over the world has less weight in daily life than people thought it did are among the emerging discussion topic with the COVID-19 pandemic. In a nutshell, COVID-19 has shown that the world is likely to become a livable place with all the creatures and ecosystem on it. In other words, the COVID-19 pandemic showed us that reversibility in terms of the environmental damage inflicted by humans is still possible.

54 Setti et al, 2020
55 Wu et al. 2020
56 Setti et al. 2020

4.3. Critical Pollutants Occurring During the Combustion of Coal

4.3.1. Particulate Matter (PM)

The particulate matter (PM) contained in the dust formed as a result of burning coal is very dangerous for human health. In air quality monitoring, these microscopic particles are measured as PM_{10} and $PM_{2,5}$. The particles with diameters smaller than 10 micrometers are called PM_{10}, and those with diameters smaller than 2.5 micrometers are called $PM_{2.5}$. Considering that the diameter of a hair strand is 70 micrometers and the diameter of a sand grain is 50 micrometers, you can understand how small these particles are.

20% of health problems attributed to exposure to $PM_{2.5}$ in Turkey are caused by coal-fired power plants.[57] The United States (US) Environmental Protection Agency (EPA) published a large-scale report on the health effects of $PM_{2.5}$ exposure in 2009 and reported that children exposed to $PM_{2.5}$ experienced respiratory symptoms, asthma and had decreased lung function.[58] The report also reports that each 10 $\mu g/m^3$ increase in $PM_{2.5}$ causes a decrease in FEV1, a measure of respiratory function, up to 1-3.4% in children with asthma. The report also emphasized that exposure to $PM_{2.5}$ increased emergency and hospital admissions due to infections and respiratory diseases such as chronic obstructive pulmonary disease (COPD). The relationship between $PM_{2.5}$ exposure and lung cancer is one of the highlights of the report. Furthermore, various studies have shown that even short-term exposure to $PM_{2.5}$ causes death by triggering a heart attack, stroke, and heart arrhythmias.[59,60,61] Long-term exposure to PM increases the risk of developing many cardiovascular diseases such as hypertension and atherosclerosis.[62]

There are no regulations on $PM_{2.5}$ in the Regulations of the Assessment and Management of Air Quality in Turkey. $PM_{2.5}$, whose strong causality with cancer is now indisputable, is not measured at many stations, and even if it is measured, it is not possible to take measures because limit values are not determined.

57 Health and Environment Alliance (2015)
58 United States Environmental Protection Agency (USEPA); 2009; Integrated Science Assessment for Particulate Matter
59 A. Peters; 2000; "Air pollution and incidence of cardiac arrhythmia"; Epidemiology
60 A. Peters; 2001; "Increased particulate air pollution and the triggering of myocardial infarction"; Circulation
61 B. Z. Simkhovich, M. T. Kleinman, R.A. Kloner; 2009; "Particulate air pollution and coronary heart disease"; Current Opinion in Cardiology
62 R. D. Brook; 2007; "Is air pollution a cause of cardiovascular disease? Updated review and controversies"; Reviews on Environmental Health

4.3.2. Sulfur dioxide (SO_2)

SO_2 exposure increases the incidence and severity of respiratory symptoms in people living around the coal-fired power plant, especially children with asthma. SO_2 inhalation by sensitive individuals causes inflammation and hypersensitivity of the airways, provokes bronchitis, and reduces lung function. Epidemiological studies have revealed a significant relationship between SO_2 concentration in the air and hospital admissions due to asthma and other respiratory symptoms.[63]

Desulphurization units (Flue Gas Desulfurization-FSD), built to prevent SO_2 emission from coal-fired power plants to the environment, have decreased SO_2 concentrations in the air in many countries over the last few decades. FSD units can hold 95% of the sulfur released by burning coal. Desulphurization units only hold the sulfur. Other environmentally damaging factors are not affected by this system. This unit converts SO_2 in the flue gas into solid substances by passing it through a solution of basic substances. Although some of these sulfuric compounds can be used in the chemistry or fertilizer industry, there is still a significant solid waste problem.[64]

4.3.3. Nitrogen oxides (NOx)

One of the undesirable products that are released to the environment by burning coal in coal-fired power plants is Nitrogen oxides (NOx). NOxs react with chemicals in the atmosphere, causing ozone, nitrogen oxide (NO_2), and nitrogen dioxide (NO_2) generation. Ozone and NO_2 are important pollutants. NO_2 exposure increases the development of wheezing and cough in children with asthma. It also increases susceptibility to viral and bacterial infections and causes airway inflammation at high concentrations (1-2 ppm). At low concentrations (3-50 ppb), it decreases lung function in people with asthma.[65]

63 United States Environmental Protection Agency (USEPA) (2008a) Integrated Science Assessment for Sulfur Oxides - Health Criteria, EPA/600/R-08/047F

64 Türk Tabipleri Birliği (TTB), Yatağan'da Hava Kirliliğinin Değerlendirilmesi Raporu, TTB Raporları, (2000)

65 United States Environmental Protection Agency (USEPA), (2008) Integrated Science Assessment for Oxides of Nitrogen-Health Criteria

4.3.4. Heavy metals

As a result of the burning of coal, many heavy metals, mainly mercury, spread to the environment. Coal is responsible for 21% of mercury emissions worldwide.[66] A thesis study conducted in the environmental engineering department of the Middle East Technical University in 2015 determined that the primary source of atmospheric mercury emissions was coal burning. The study revealed that as a result of burning coal in coal-fired power plants, 10,551 kg of mercury is released annually and 9285 kg (88%) of this is released into the air.[67]

Mercury released from coal-fired power plants into the air is stored with precipitation and is converted into organic form methyl mercury by certain bacteria after entering the water cycle. As methyl mercury increases in the food chain, it accumulates in the structure of living beings (bioaccumulation) and reaches the highest concentrations in long-lived fish species. The exposure of humans to methyl mercury with neurotoxic nature often occurs through the consumption of fish contaminated with mercury.[68]

Organic mercury taken with food has toxic effects on the nervous system and seriously affects brain development. This damage is neurologically irreversible and mostly occurs due to exposure to mercury in the early fetal period. A relationship between mercury exposure in pregnancy and low birth weight, neurodevelopmental retardation, retardation in vision, memory, and language development was determined.[69] [70] [71] Cognitive development in children can be negatively affected with intense exposure to mercury, and irreversible damage can occur in the vital organs of the fetus. Therefore, large amounts of mercury emissions from coal-fired power plants are an important problem for human health.

In a study conducted in the Afşin-Elbistan coal-fired power plants region, copper, chromium, cadmium, and nickel levels were determined to be at high concentrations over long distances in line with the direction of the wind. On the other hand, although it does not exceed the limits, lead and zinc are mostly observed in areas close to the power plant.[72]

66 United Nations Environment Programme (UNEP), Global Mercury Assessment 2018: Sources, Emissions, Releases and Environmental Transport, UNEP Chemicals Branch, Switzerland.

67 D. Civancik, U. Yetis; 2015; "Substance flow analysis of mercury in Turkey for policy decision support"; Environmental Science and Pollution Research

68 Sağlık ve Çevre Birliği (HEAL), 2015. ÖDENMEYEN SAĞLIK FATURASI: Türkiye'de Kömürlü Termik Santraller Bizi Nasıl Hasta Ediyor?

69 K.R. Mahaffey, R.P. Clickner,C.C. Bodurow; 2004; "Blood organic mercury and dietary mercury intake: National Health and Nutrition Examination Survey 1999 and 2000"; Environ Health Perspect

70 S. Diez; 2009; "Prenatal and early childhood exposure to mercury and methylmercury in Spain, a high-fish-consumer country"; Archives Environmental Toxicology

71 H.S. Lam; 2013; "Long term neurocognitive impact of low dose prenatal methylmercury exposure in Hong Kong"; Environment International

72 A. Çayır, M. Belivermiş, Ö. Kılıç, M. Coşkun; 2012; "Heavy metal and radionuclide levels in soil around Afsin-Elbistan coal-fired power plants"; Turkey. Environmental Earth Sciences

4.3.5. Persistent organic pollutants (POPs)

Persistent organic pollutants, as the name implies, can remain in nature for decades. Dioxins are the most dangerous of POPs and emerge as an unwanted by-product during the burning of coal. Very low amounts of dioxins are released from the coal-fired power plants, but dioxins can cause significant damage even at very low concentrations.[73] The International Agency for Research on Cancer classified a type of dioxin (2,3,7,8-tetrachlorodibenzo- para-dioxin) in Group 1, which is a definite carcinogen for humans.[74] Furthermore, dioxins have toxic effects on both the nervous system and the reproductive system.[75] Another POP group that is released by burning coal is polycyclic aromatic hydrocarbons (PAHs). There are more than 100 PAH compounds in nature. There are studies conducted with only a few of them. PAHs are thought to be carcinogenic to humans.[76] Animal experiments have shown that PAHs are compounds with tumor initiator, enhancer, and promoter properties.[77] [78]

4.3.6. Ashes

One of the important environmental problems related to the coal-fired power plants is the ashes that result from burning tons of coal. Waste ash is important not only in terms of waste disposal but also for Radon gas (Ra_{222}), which accumulates in the area where ash is stored. Even if these ashes are covered with soil, Ra222 passing through the pores of the soil mixes with the air. Ra222 can turn into Polonium (Po210) and active lead (Pb210) within a period of 3-8 days. Therefore, ashes spread radioactivity to the environment.[79]

Coal ashes mix with the surface and groundwater from the areas where they are stored. Analyzes on samples taken from water sources close to areas where coal ash is stored have revealed that heavy metals such as lead, mercury, cadmium, chromium, and selenium, and especially arsenic, show a high accumulation. The heavy metals contained in coal ash are mixed with the soil and water due to the fact that the wastewater resulting from the wetting of the ashes is not properly disposed of, and can pollute the water sources supplying drinking/utility water. Thus, they cause cancer and neurological damage in humans, contaminate, and poison the fish in the rivers.[80] A study by the US EPA revealed that the risk of cancer due to arsenic exposure in drinking water is 1/50 in those living near the places where coal ash is stored. This figure exceeds the EPA's target to reduce cancer risk to 1/100,000 by 2000 times.[81]

73 Sağlık ve Çevre Birliği (HEAL), 2015. ÖDENMEYEN SAĞLIK FATURASI: Türkiye'de Kömürlü Termik Santraller Bizi Nasıl Hasta Ediyor?
74 WHO International Agency for Research on Cancer (IARC) IARC Monographs on the Evaluation of Carcinogens Risks to Humans, (1997)
75 World Health Organisation (WHO), (2010), Preventing Disease Through Healthy Environments
76 United States Environmental Protection Agency (USEPA) (2009), Integrated Science Assessment for Particulate
77 E. Alver,A. Demirci; M. Özcimder; 2012; "Polisiklik Aromatik Hidrokarbonlar ve Sağlığa Etkileri"; Mehmet Akif Ersoy Üniversitesi Fen Bilimleri Enstitüsü Dergisi
78 Physicians for responsibility (2013) Coal Ash Toxics: Damaging to Human Health
79 Türk Tabipleri Birliği - Yatağan'da Hava Kirliliğinin Değerlendirilmesi Raporu (2000)
80 Physicians for responsibility (2013) Coal Ash Toxics: Damaging to Human Health
81 USEPA (2010) Coal Threats to Human Health – Fact Sheet Series

With the storage of ashes around the CPP and/or the spread of ashes to the environment, both the toxic effects of the heavy metals contained and the pH caused by the ash damage the viability of the soil. The disappearance of microorganisms that live in a symbiotic relationship with plants also makes it difficult for plants to feed. [82]

4.4. Health-Related Consequences of Coal Mining

There are various exposures in coal mining, especially coal dust, asbestos, radon, etc. often leading to certain health consequences. These health risks include tuberculosis and other infections in addition to lung diseases such as pneumoconiosis, chronic bronchitis, and obstructive pulmonary diseases, asthma, and lung cancer. Occupational dermatological diseases, eye diseases, and infections such[83] as tetanus are also observed in coal miners. According to a study, the frequency of pneumoconiosis in coal miners is[84] between 13-14%.[85]

Besides the effects of occupational exposure to combustion products in the CPP on the respiratory system, the cytogenetic damage effect is also mentioned. According to these results found in power plant workers who do not smoke or consume alcohol, a number of disorders occur at the chromosomal level in lymphocytes in the blood, which are associated with ashes and gas emissions of burning coal rather than any specific substance.[86]

Coal mining activity is in a very dangerous class. In our country, the deficiencies in occupational safety practices and inadequate inspections result in serious injuries, disabilities, and deaths in miners. Union of Chambers of Turkish Engineers and Architects (UCTEA) stated that mining of coal and lignite rank first in occupational accidents in Turkey and second in occupational deaths.[87] Another study shows that Turkey has the world's worst coal mining safety record. Considering the miner deaths per one million tons of coal produced between 2007-2012, Turkey ranks second in the world following China, the biggest coal producer in the world.[88] The Soma disaster, which took place in May 2014 and cost the lives of 301 workers, has been recorded among the accidents with the highest number of deaths in the history of mining.

82 M. Karagöktaş, (2012). Afşin-Elbistan Termik Santrali'nin Çevreye Olan Olası Etkisinin Belirlenmesi. Master Tezi. Kahramanmaraş
83 Coal Workers' Lung Diseases, 10. Respiratory System, Encyclopedia of Occupational Health and Safety, Jeanne Mager Stellman, (2011)
84 Türkiye`de İşyerlerinde İş Sağlığı ve Güvenliği Koşullarının İyileştirilmesi Projesi, KOBİ'ler için İş Sağlığı ve Güvenliği Yönetim Rehberi: Risk Değerlendirmesi, İSG Performans İzleme ve Sağlık Tehlikeleri, MADEN SEKTÖRÜ: Kömür
85 General aspect of pneumoconiosis in Turkey, Indian journal of occupational and environmental medicine, (2007)
86 Cytogenetic damage in workers from a coal-fired power plant, Mutation Research/Genetic Toxicology and Environmental Mutagenesis, (2007)
87 TMMOB. Makine Mühendisleri Odası (2014). İşçi Sağlığı ve İş Güvenliği, Rapor
88 Kömür Madeni İşletmelerinde Verimlilik ve İş Güvenliği. Değerlendirme Notu. Türkiye Ekonomi Politikaları Araştırma Vakfı – TEPAV, (2014)

4.5. Climate Change and Health

CPPs are the leading industrial facilities contributing to climate change due to the significant emission of greenhouse gases. Turkey's National Greenhouse Emission Inventory shows that electricity generation is responsible for 27% of total greenhouse gas emissions.[89]

Considering the effects of climate change on health from a broad perspective, it is evident that the increase in temperature will cause serious problems far beyond the problems and stress. Globally increasing temperatures will change the ecological balance in the world, and accordingly, previous tropical/subtropical regions will expand. This means the spread of disease agents or disease-bearing organisms living in these regions.

One of the less voiced consequences of climate change is its impact on food quality. The increase in CO_2 levels in the atmosphere causes the vegetation products to become poor in terms of the nutrients such as proteins, vitamins, and minerals, which are accepted as essential in terms of nutritional value. In an experimental study on rice, which provides 25% of total calories worldwide, a decrease in protein, iron, zinc, and B vitamins (B1, B2, B5, and B9) was detected with the increase in CO_2 levels.[90]

89 Temiz Hava Hakkı Platformu (2019), Kara Rapor

90 C. Zhu, K. Kobayashi, I. Loladze, J. Zhu, Q. Jiang, ...(2018). "Carbon dioxide (CO2) levels this century will alter the protein, micronutrients, and vitamin content of rice grains with potential health consequences for the poorest rice-dependent countries"

CHAPTER 5

CHAPTER 5

5. Impact Analysis

5.1. Characteristics Of The Region and The Population

5.1.1. General Features of the Region

Eskişehir has an important position in the country's transportation system. It is an important stop on the roads connecting Istanbul to Central Anatolia and Ankara to South Marmara and Western Anatolia. The main highway connection of Eskişehir is the İstanbul-Eskişehir-Ankara state road. This road, which extends from Adapazarı, goes south and passes through Bilecik, turns east from Bozüyük and enters the province of Eskişehir. This road, which runs in the northwest-southeast direction, is the backbone of city transportation. Eskişehir is one of the most important junctions of the railway system of the country. It is connected to Ankara and the entirety of Anatolia. Distances between the central stations are as follows: Eskişehir-Ankara 264 km. Eskişehir-Haydarpaşa 375 km. Eskişehir-Afyon 162 km. The length of State Railways in the province is 215 km. It is the key point of express and postal trains in all directions.

In terms of socio-economic development, Eskişehir is one of the most important cities in Turkey and has come to the forefront with its economy. The fact that it is at the crossroads of railways and highways, the developments in agriculture and industry and the richness of underground resources have made Eskişehir an important center in terms of economy, industry, and trade. The rapid growth of the city population compared to the rural population, the availability of trained labor force, its proximity to the markets, the suitability of energy and raw material resources, the necessary infrastructure investments for the industry have led to the gradual development of the regional industry. According to Eskişehir Chamber of Industry 2015 data, 60% of Eskişehir's economy is composed of services, 30% of the industry, and 10% of agriculture.

5.1.2.Physical-Ecological Structure

Eskişehir takes its geographical character from the Central Anatolia Region. A harsh continental climate prevails in Eskişehir. There is a temperature difference between day and night. The most important mineral deposits in the province are Boron-Borax, Perlite, Magnesite, Chromium, Thorium, Torite (Crystal), and Meerschaum, which is one of the important symbols of Eskişehir.

5.1.2.1. Topography

The highest mountain of Eskişehir is Türkmendağı Hill with 1825 meters. Eskişehir province is surrounded by natural borders such as Bozdağ and Sündiken Mountains on the north, Emirdağ on the south, the Central Asian Valley on the east, and Turkmen Mountain on the west. Approximately 22% of the province is composed of mountains, and the share of the plains in the landforms is 26%.[91] Located in the northwest corner of Central Anatolia, the topographic structure of the Eskişehir province is the plains in the Sakarya and Porsuk basins and the mountains surrounding them. Basin plains are surrounded by the Bozdağ-Sündiken Mountain Range on the north and the Türkmen Mountain, Yazılıkaya Plateau, and Emirdağ, located on the east edge of the Inner Western Anatolian threshold on the west and south. The valleys have generally deepened as a result of prolonged erosion due to external factors. In the province where the hill ridges are flat and round apart from the young formations, closed basins are not very common. Bozdağ and Sündiken Mountains, the inner mountain ranges of Anatolia, are located in the north of the province, in the west-east direction, and their extensions go in the east to the Sakarya River, which forms the provincial border.[92]

Considering the topography of the region, the project area is located in the north-east of the province, between Gündüzler and Beyazaltın districts, on the partly flat skirts of Bozdağ-Sündiken mountain range surrounding the province.[93]

5.1.2.2. Geology

Eskişehir Fault zone passes through Eskişehir province and approximately 50% of the province is located in the 2nd degree, 30% in the 3rd degree, and 20% in the 4th-degree earthquake zone. Eskişehir fault line is 22 km away from the project area.[94] Units surfacing in and around Eskişehir-Alpu coalfield are composed of the pre-Miocene basement and Miocene-Pliocene cover rock communities, according to reports on the "Geology and Reserve Drilling" studies conducted by MTA. Sediments containing coal are located under the Upper Miocene-Lower Pliocene deposits. This indicates that coal formation is seen between 200-250 meters.[95]

5.1.2.3. Climate

A harsh continental climate prevails in Eskişehir. There is a temperature difference between day and night. A small part of Seyitgazi, one of the districts of Eskişehir, is under the influence of the Aegean region, the whole of Sarıcakaya District and some parts of the Centre and Mihalıççık districts are under the influence of the Black Sea region. However, Eskişehir generally takes its geographical character from the Central Anatolia Region.[96.]

91 Eskişehir Provincial Culture and Tourism Directorate, 2019
92 Governorship of Eskişehir, 2016
93 EN-ÇEV A.Ş. (2018). Alpu Termik Santrali ve Bu Santrale Kömür Sağlayacak Olan Rezerv Alanındaki Yeraltı Maden İşletmesi ile Kül Düzenli Depolama Tesisi Projesi Nihai ÇED Raporu
94 EN-ÇEV A.Ş. (2018). Alpu Termik Santrali ve Bu Santrale Kömür Sağlayacak Olan Rezerv Alanındaki Yeraltı Maden İşletmesi ile Kül Düzenli Depolama Tesisi Projesi Nihai ÇED Raporu
95 EN-ÇEV A.Ş. (2018). Alpu Termik Santrali ve Bu Santrale Kömür Sağlayacak Olan Rezerv Alanındaki Yeraltı Maden İşletmesi ile Kül Düzenli Depolama Tesisi Projesi Nihai ÇED Raporu
96 Eskişehir Provincial Directorate of Environment and Urbanization, 2011

5.1.2.4. Meteorology

The meteorological features of the province are provided as follows in the "Eskişehir in Statistics" report published by Eskişehir Metropolitan Municipality.

Table 7 - Monthly Temperatures in 2017 (°C)

	January	February	March	April	May	June	July	August	September	October	November	December
Maximum	10,2	18,7	21,4	26,5	31,6	35,4	39,8	35,1	36,4	25,2	18,3	16,0
Mean	-2,0	1,9	7,6	9,6	14,4	19,1	23,1	22,0	19,6	10,8	5,5	3,9
Minimum	-11,3	-15,3	-4,2	-2,7	1,9	7,4	10,6	10,0	4,4	-0,7	-5,8	-6,6

Source: Meteorology Regional Directorate

Table 8. Monthly Temperatures in 2015-2017 (°C)

		January	February	March	April	May	June	July	August	September	October	November	December
2017	Maximum	10,2	18,7	21,4	26,5	31,6	35,4	39,8	35,1	36,4	25,2	18,3	16,0
	Minimum	-11,3	-15,3	-4,2	-2,7	1,9	7,4	10,6	10,0	4,4	-0,7	-5,8	-6,6
2016	Maximum	17	21,8	23,5	28,6	29,9	35,3	38,5	36,5	33,7	28,1	20,4	12,7
	Minimum	-17,6	-8,5	-6,7	-1,9	2,8	4,8	10,4	9,6	2,3	-2,4	-9,3	-13,5
2015	Maximum	12,9	18,1	21	27,7	31,8	29,1	36,9	33,4	35,3	26,4	20,6	11,6
	Minimum	-13,1	-6,7	-3,6	-2,4	6,6	9,6	12,6	13,6	13	3,8	0	-6,2

Source: Meteorology Regional Directorate

Considering the features related to precipitation, it is understood that spring rains in Eskişehir come from west and southwest and fall in a downpour.

Table 9. Monthly Rainfall in 2017 (mm)

January	February	March	April	May	June	July	August	September	October	November	December
33,0	9,2	16,0	62,2	51,2	44,8	0,0	5,4	2,6	45,0	27,4	36,6

Source: Meteorology Regional Directorate

Foggy days intensify between October and February in Eskişehir. Fog on days when the spread of air pollutants caused by coal is high creates results in more air pollution. Smog, a word produced from the words smoke and fog, has historically been described as London-type air pollution.

Table 10. Distribution of foggy days by months in Eskişehir in the last three years (2014-2016)

Years	2014	2015	2016	Mean of 2014-2016
January	4	7	3	4,7
February	3	0	3	2,0
March	0	2	0	0,7
April	0	1	0	0,3
May	1	0	0	0,3
June	1	0	0	0,3
July	0	0	0	0,0
August	0	0	0	0,0
September	1	2	0	1,0
October	5	10	1	5,3
November	5	8	0	4,3
December	5	9	0	4,7

5.1.2.5. Wind direction:

The wind in the east-west direction in the region in the winter months turns to the northwest-northeast direction in the spring months. Towards the end of the spring season, winds blowing from the southwest, west, and northwest prevail.[97]

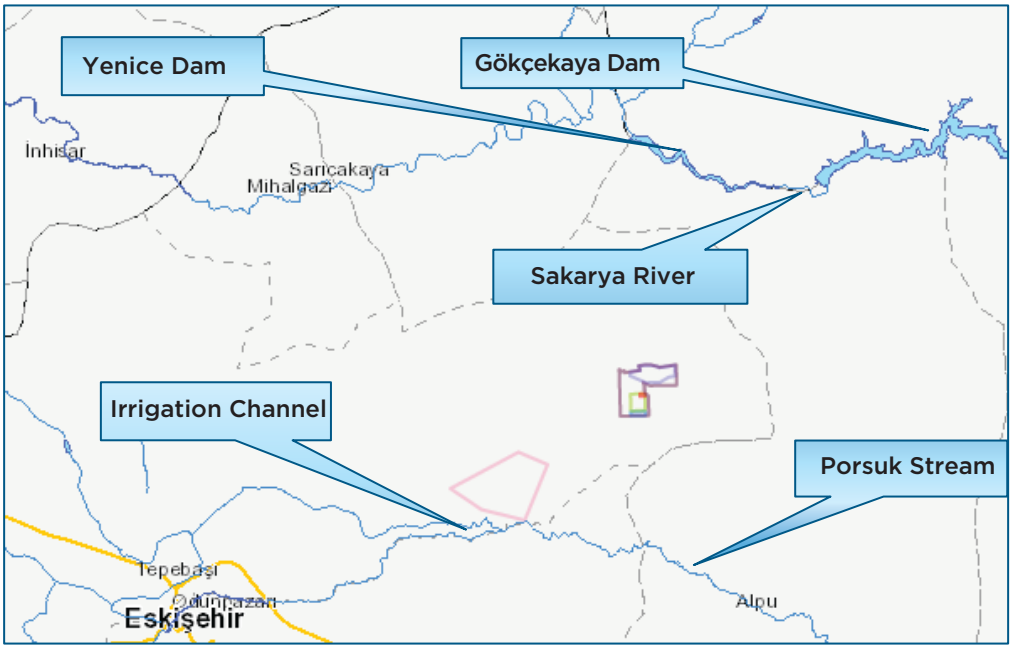
97 O. Özden, T. Dögeroglu, S. Kara; 2008; "Assessment of ambient air quality in Eskişehir, Turkey"; Environ Int.

5.1.2.6. Hydrology

Eskişehir has an advanced river network, which is studied in two sections as temporary and permanent streams. Floods, which play the main role in shaping the topography, are called temporary streams. These streams are present in times of precipitation and snowmelt, and at other times they are completely dry. Apart from these temporary stream movements, there are also permanent (flowing) streams. Sakarya River, one of the most important rivers of Turkey is in Eskişehir. Sakarya River meets Porsuk Stream, which is one of the important surface water resources of Eskişehir in the southeast.

The importance of dam and pond construction is increasing to provide drinking and potable water throughout the region. The dams and ponds in the region are generally built for irrigation purposes, and they also have the objectives to meet the drinking water needs of the surrounding village groups.

Map 9. Surface Water in the Project Area and Its Surroundings (EN-ÇEV A.Ş., 2018)



Source: EN-ÇEV A.S. ; Final EIA Report of Alpu Coal-Fired Power Plant and Underground Mining Plant in the Reserve Area to Provide Coal to This Power Plant and Ash Landfill Facility Project

According to the "Final EIA Report of Alpu Coal-Fired Power Plant and Underground Mining Plant in the Reserve Area to Provide Coal to This Power Plant and Ash Landfill Facility Project" prepared by the Project owner Elektrik Üretim A.Ş., Gündüzler Dam, which is in the project phase, is located in the west direction of the power plant area and about 6 km air distance from to the power plant area.

Yenice Dam, which is at about 15 km air distance, and Gökçekaya Hydroelectric Power Plant at about 21 km air distance are located which is in the northeastern direction of the power plant area. Anonymous dry streams pass through and around the power plant area, Porsuk Stream, which flows continuously and is at about 10 km air distance, passes from the south direction of the area, and Sakarya River, which is at about 15 km air distance, passes from the north direction.

5.1.2.7.Flora

The Central Anatolian steppes, the North Anatolian and Western Anatolian forests constitute the vegetation of Eskişehir. On the southern slopes of the Sündiken Mountains overlooking the Porsuk Valley, oak thickets are observed after 1000 meters, followed by dwarf oaks. If the Sakarya Valley direction of the Sündiken Mountains, where the black pines are visible after 1300 meters, Türkmenbaba, Eşekli Türkmen Hill and the Bozdağ are observed, it will ve seen that they are covered with larch (especially between Tandırlar Dağküplü Villages). Here, among the larch, red pines are also seen. There are scotch pine trees up to Taştepe and Mihalıççık. High oaks are seen among the pine forests around Yapıldak. There are no forests on the plateaus in the south of Eskişehir and Çifteler Plain, but there are characteristic steppe plants. The flora of the Sarisu Porsuk Valley is composed of floc, sagebrush, and thyme. The vegetation on the edges of Porsuk and Keskin Streams consists of willows, poplars, elms, and groves. 26.3% of Eskişehir, which is located in the characteristic vegetation of the Central Anatolia Region, is covered with forests.

78% of the forests of Eskişehir are larch, 9% are scotch pine and 6% are red pine. The rest is swamp forests, all of which are oak.

There are 8 soil groups identified in Eskişehir province. Accordingly, 44.8% is brown soil, 26.36% is brown forest soil, and 12.70% is brown forest soils without limestone.[98]

Aquatic flora was also investigated around the project area. Three of the species determined according to the Final EIA Report of Alpu Coal-Fired Power Plant and Underground Mining Plant in the Reserve Area to Provide Coal to This Power Plant and Ash Landfill Facility Project are included in the LC (Least Concern) class as per the IUCN categories. There are no species according to the Bern Convention. As a result of the studies, no endemic aquatic flora species have been identified in the project area and its vicinity.

98 Eskişehir İl Çevre ve Şehircilik Müdürlüğü, 2011

5.1.2.8. Fauna

The terrestrial fauna of Eskişehir province can be classified as mammals and birds. The habitat of mammals is forests and they continue their lives in remote areas partially covered with reed and steppe vegetation.
The terrestrial fauna of Eskişehir province can be classified as mammals and birds. The habitat of mammals is forests and they continue their lives in remote areas partially covered with reed and steppe vegetation.
The mammals in this habitat can be classified as follows.

- Deer (Moose): They are in the game preserve in Mihalıççık, Çatacık, Sarıcakaya forests, and based on the observations, their number is estimated to be around 450.
- Bear (Ursus aretos): Their number is very low. They are about to become extinct.
- Rabbit (lepus europeus): Their number is quite high. It is possible to come across them in rural areas and forests. Stoat, Weasel, and Martes species are common.
  Mammals such as squirrels and hedgehogs are rare. The habitat of mammals such as wolf, jackal, and boar are forests and they are common. Their number is quite high.

Eskişehir fauna is especially rich in terms of bird species. Balıkdam Wetland (Sivrihisar), Doğancı Pond (Alpu), Emineken Pond (Çifteler) and Yörükkırka Pond (Center) are important places for bird watching because they are the stops of migratory birds. Balıkdam hosts approximately 140 bird species during the migration period.

The fauna area is Çatacık Forests (1350m) which is important for mammals. One of the two Red Deer Breeding Stations in Turkey is located in this region. Çatacık Wildlife Protection Area, which is completely closed to hunting draws attention with its mammals such as red deer, bear, pig, wolf, rabbit, squirrel, wild sheep, and birds such as partridge, hawk, red eagle, eagle, and falcon. There is no national park within the provincial borders.[99]

Within the scope of the study on the Detection of Large Mammals and Determination of Population Ecologies in Eskişehir Province Using Camera Trap Method prepared by Forrest Engineer Emre Özay as TR Bartın University, Institute of Science, Forest Engineering Department Master's Thesis, it was determined that endangered lynx lives in the region. Furthermore, within the scope of this study, it was also determined that otters live in the region and that lutra lutra species of an otter living in Turkey are determined to be nearly endangered by The International Union for Conservation of Nature.

Due to the close proximity of the project area to surface water sources, the aquatic fauna was investigated in the Final EIA Report of Alpu Coal-Fired Power Plant and Underground Mining Plant in the Reserve Area to Provide Coal to This Power Plant and Ash Landfill Facility Project. According to this report, 5 fish species belonging to 2 families were identified in Porsuk Stream and Gökçekaya Dam, and 4 amphibian species belonging to 3 families were identified in the project area and its vicinity. None of these species are on the list of endangered species of international institutions that monitor the status of living species for ecological continuity, such as the IUCN or the Bern Convention. No endemic species were identified in the area.

99 Forestry and Water Affairs Eskişehir Branch Directorate, 2012

5.1.2.9. Terrain characteristics

21.8% of Eskişehir Province land is mountainous, 6% is highlands, 25.8% is lowlands and 51.8% is undulating terrain. Eskişehir Province, which has an agricultural area of 582.505 hectares (43%), has 325,851 hectares of pasture (24%), 331,263 hectares (24%) of forest and shrubland, 125,581 hectares (9%) of land unsuitable for agriculture.[100]

5.1.3. Characteristics of the Population to be Affected

Eskişehir is a Western province with a population of 871,187 according to the 2018 Address-Based Population Registration System.[101] When we look at the population pyramid showing the age and gender distribution of Eskişehir (Figure 7), the first thing that we see is the high population of both women and men between the ages of 20-24, which is due to the university students in the province. 18.1% of the population is under the age of 15 (children), 52.8% is between the ages of 15 and 49 (there are 226,196 females in this group), 18.0% is between the ages of 50 and 64, and 11.1% is 65 and older. It is observed that fertility in the province has been on a similar level for the last 15 years.

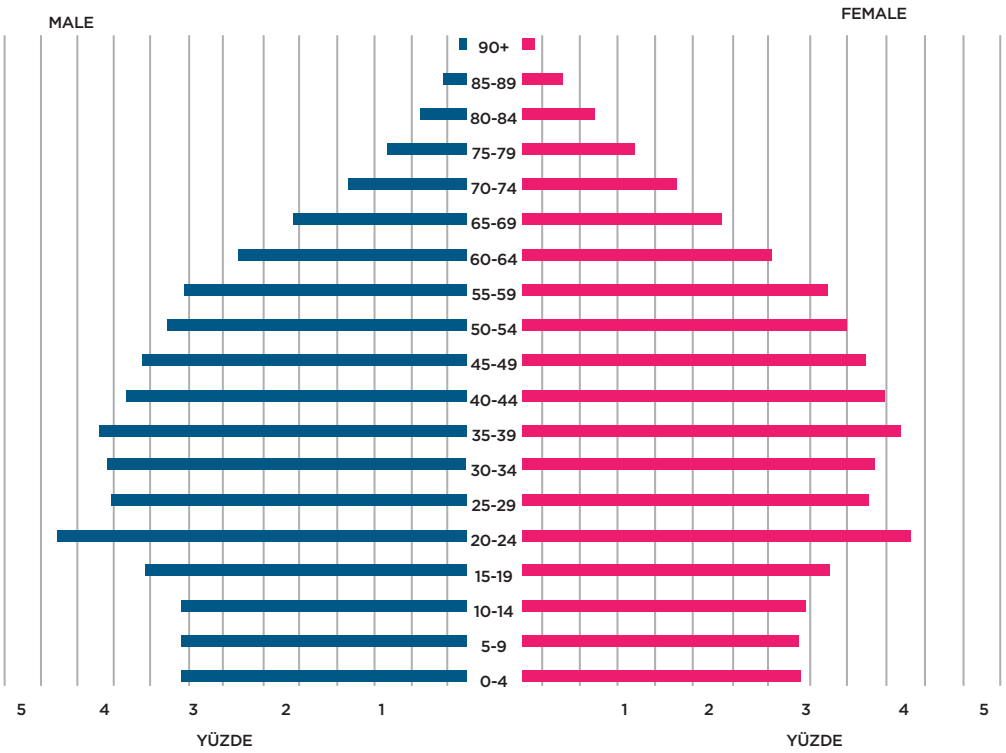
The educational status distribution of the province is 26% primary school graduates, 14% secondary school graduates, 35% high school graduates, 22% college or faculty graduates, 2% college graduates. While the net migration rate of Eskişehir was 6.41 in 2010, this rate dropped to 3.51 in 2018.[102]

The area where the power plant in the report will be constructed is under the jurisdiction of Tepebaşı district and it is on the border of Alpu district. A part of Tepebaşı district is the city center of Eskişehir and is called "Adalar". The entire cities and surrounding provinces will be affected by the power plant to be built, and Alpu and Tepebaşı, Odunpazarı districts are the districts that will be primarily affected. 2018 population of Tepebaşı district is 359.303 people. While 49% of the population of Eskişehir Tepebaşı district was male in 2010, this ratio increased to 50% in 2018 and this has continued in the following years. 34% of the district's population is young, 50% is middle-aged, and 16% is elderly. The population of Alpu district is 11,242 people. 51% of the population is male and 49% is female.[103]

The settlements within the borders of the coal-fired power plant are Gündüzler, Kozlubel, Danışmend, Kızılcaören, Yakakayı, Taycılar and Beyazaltın quarters of Tepebaşı district, Osmaniye, Bahçecik, Karakamış, Söğütcük and Çukurhisar quarters of Alpu district, and Karahüyük quarter of Odunpazarı district. The total population of these settlements in the project area is 4.648 people.[104]

100 Eskişehir Provincial Directorate of Agriculture and Forestry, 2019
101 ADNK-TÜİK, 2018
102 Turkish Statistical Institute (TÜİK), 2018
103 Turkish Statistical Institute (TÜİK), 2018
104 Turkish Statistical Institute (TÜİK), 2018

Figure 10. Population pyramid of Eskişehir in 2018



Source: Compiled from 2018 data from TÜİK ADNK

Odunpazarı is the most populous district of Eskişehir and constitutes almost half of the province's total population (46.4%). Tepebaşı district is in the second most populous with a rate of 41.2%. It is evident that both districts are high in terms of population density. It is known that the main livelihood in the districts with low population density, including Alpu district, is agriculture and has wide agricultural areas.

Map 10. Project Area and the Location of Surrounding Districts

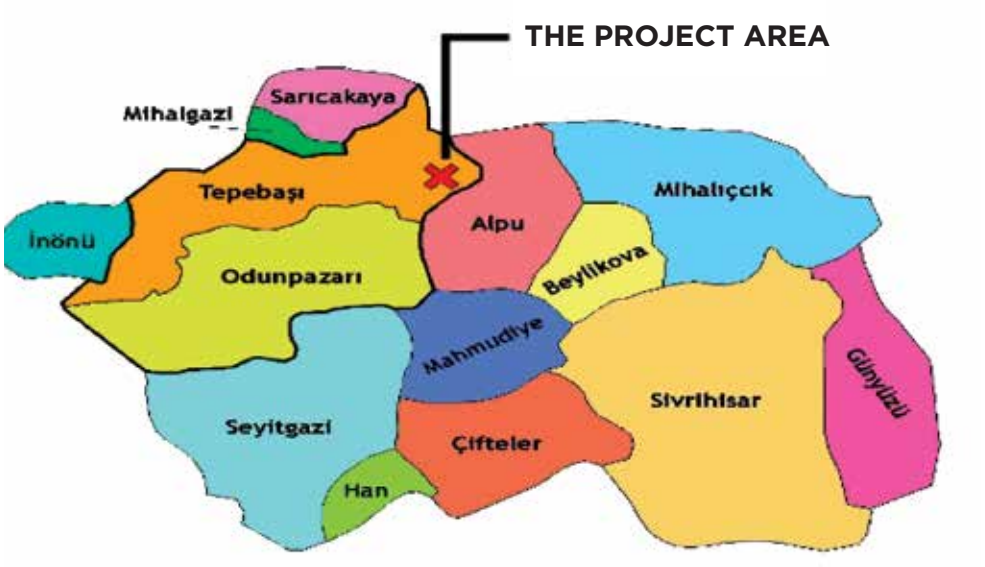


Table 11. Population, area and density of districts in Eskişehir province[105]

	Population of Districts		Area of districts	
	Number	Percent	Surface Area	person per km²
Odunpazarı	404267	46,4	1120	361,0
Tepebaşı	359303	41,2	1403	256,1
Sivrihisar	20746	2,4	2748	7,5
Çifteler	15098	1,7	858	17,6
Seyitgazi	13405	1,5	1578	8,5
Alpu	11242	1,3	1028	10,9
Mihalıççık	8526	1,0	1809	4,7
Mahmudiye	7998	0,9	659	12,1
Beylikova	6953	0,8	715	9,7
İnönü	6797	0,8	345	19,7
Günyüzü	6127	0,7	828	7,4
Sarıcakaya	5080	0,6	382	13,3
Mihalgazi	3373	0,4	109	30,9
Han	2272	0,3	378	6,0
Total	871187	100,0	13960	62,4

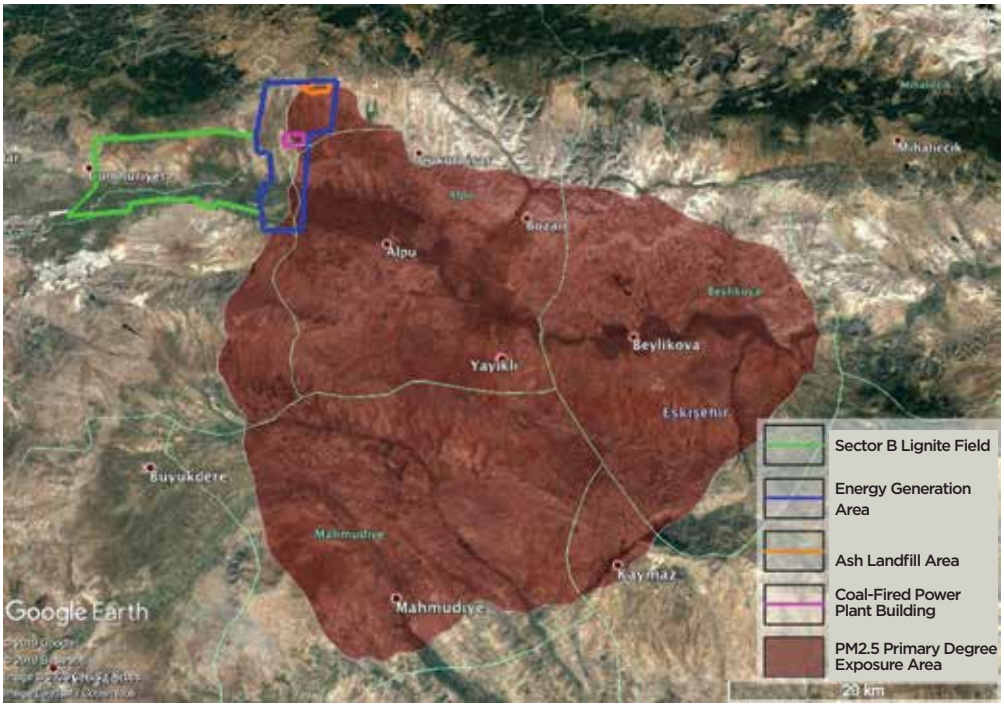
%87,6

Source: TÜİK, ADNK 2018

The population and cities that will be affected by the planned coal-fired power plant have been split into 5 impact levels. The geographical boundaries of the five impact levels have been designated based on the model in Greenpeace's 2018 report titled "Coal-Fired Power Plant Danger in Eskişehir", which shows the dispersion of the PM2.5 pollutant the plant will emit if it is constructed. The settlements within the borders of the PM2.5 dispersion model have been marked on Google Earth. Population information regarding the settlements within each impact level has been obtained from Turkish Statistical Institution database. The total population who will experience health effects due to the power plant at a given impact level has been calculated by adding the number of people living in the settlements within the impact level/area.

105 Kaynak: TÜİK, ADNK 2018, Harita Genel Müdürlüğü (https://www.harita.gov.tr/il-ve-ilce-yuzolcumleri
106 Eskişehir'de Santral Tehlikesi; (2018)

Map 11: The Populations That Will Be Primarily Affected by The Coal-Fired Power Plant



Source: Google Earth, 2020

The populations that will be primarily affected by the coal-fired power plant are the settlements within the boundaries of the power plant and the regions determined according to the PM2.5 annual dispersion rate analysis as a result of regional winds. The settlements which have populations that will be primarily affected are located in Alpu, Beylikova, Mahmudiye, Odunpazarı, and Tepebaşı districts and consist of 49 quarters. These are:

- Osmaniye, Karakamış, Bahçecik, Gökçeoğlu, Fevziye, Aktepe, Sarıkavak, Işıkören, Esence, Hamamkoy, Yayıklı/Koşmat, Güroluk, Mamure/Güneli, Çardakbaşı, Yeşildon, Bozan, Fevzipaşa quarters in Alpu district,

- İkipınar, Halilbağı, Parsıbey, Beylikova, Emircik, İmikler, Doğray, Yalınlı, Yeniyurt, Aşağıığdeağacı, Süleymaniye, Akgüney /Rahmiye, Sultaniye quarters in Beylikova district,

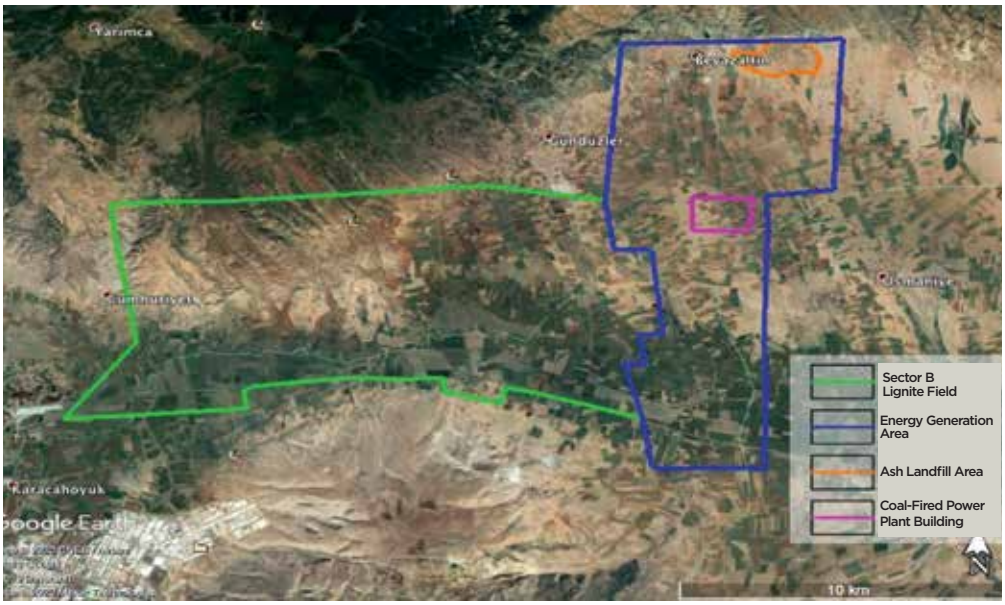
- Topkaya, Fahriye, Akyurt, Tokathan, Yeşilyurt, Hamidiye, Şerefiye, Mesudiye, Doğanca, Mahmudiye/Işıklar, Balçıkhisar and Kaymaz villages in Mahmudiye district,

- Karaçay, Harmandalı, Karahüyük, Ağapınar quarters in Odunpazarı district

- Beyazaltin, Gökdere and Ahılar quarters in Tepebaşı district.

The population to be primarily affected is 13,593 people.

Map 12: The map showing the population that will be primarily affected in case Eskişehir Coal-Fired Power Plant is built, Google Earth, 2020[107]



Source: Google Earth, 2020

The distribution of the total population to be primarily affected by the coal-fired power plant planned to be constructed in Eskişehir by districts in Eskişehir is provided in the table below, and the highest populations are in Alpu and Mahmudiye with populations of 5626 people and 3189 people, respectively. The population within the primary exposure area contains 17 quarters in Alpu district, 13 quarters in Beylikova, 12 quarters in Mahmudiye, 4 quarters in Odunpazarı, and 3 quarters in Tepebaşı.

Table 13. Total population living in districts of Eskişehir within the primary area of impact

Year	Province	District	Population
2018	Eskişehir	Alpu	5626
2018	Eskişehir	Beylikova	3111
2018	Eskişehir	Mahmudiye	3189
2018	Eskişehir	Odunpazarı	1120
2018	Eskişehir	Tepebaşı	547
		Total	**13593**

Source: Turkish Statistical Institute (TÜİK), 2018

107 $PM_{2.5}$ Based on the population within the primary area of impact.
L Myllyvirta; Greenpeace Akdeniz; 2019; "Eskişehir'de Termik Santral Tehlikesi: Planlanan Alpu Termik Santralinin Hava Kalitesi ve Sağlık Üzerindeki Etkileri

Table 13. Population of Settlements within the Primary Area of Impact of the Power Plant

Year	Province	District	Quarter Name	Quarter Population
2018	Eskişehir	Alpu	Osmaniye	853
2018	Eskişehir	Alpu	Karakamış	365
2018	Eskişehir	Alpu	Bahçecik	313
2018	Eskişehir	Alpu	Gökçeoğlu	79
2018	Eskişehir	Alpu	Fevziye	143
2018	Eskişehir	Alpu	Aktepe	62
2018	Eskişehir	Alpu	Sarıkavak	138
2018	Eskişehir	Alpu	Işıkören	55
2018	Eskişehir	Alpu	Esence	64
2018	Eskişehir	Alpu	Hamamkoy	206
2018	Eskişehir	Alpu	Yayıklı/Koşmat	146
2018	Eskişehir	Alpu	Güroluk	39
2018	Eskişehir	Alpu	Mamure /Güneli	124
2018	Eskişehir	Alpu	Çardakbaşı	36
2018	Eskişehir	Alpu	Yeşildon	49
2018	Eskişehir	Alpu	Bozan	1469
2018	Eskişehir	Alpu	Fevzipaşa	1485
2018	Eskişehir	Beylikova	İkipınar	173
2018	Eskişehir	Beylikova	Halilbağı	183
2018	Eskişehir	Beylikova	Parsıbey	267
2018	Eskişehir	Beylikova	Beylikova	1046
2018	Eskişehir	Beylikova	Emircik	226
2018	Eskişehir	Beylikova	Imikler	83
2018	Eskişehir	Beylikova	Doğray	218
2018	Eskişehir	Beylikova	Yalınlı	125
2018	Eskişehir	Beylikova	Yeniyurt	344
2018	Eskişehir	Beylikova	Aşağığdeağacı	107
2018	Eskişehir	Beylikova	Süleymaniye	116
2018	Eskişehir	Beylikova	Akgüney /Rahmiye	118
2018	Eskişehir	Beylikova	Sultaniye	105
2018	Eskişehir	Mahmudiye	Topkaya	163
2018	Eskişehir	Mahmudiye	Fahriye	73
2018	Eskişehir	Mahmudiye	Akyurt	66
2018	Eskişehir	Mahmudiye	Tokathan	123
2018	Eskişehir	Mahmudiye	Yeşilyurt	205
2018	Eskişehir	Mahmudiye	Hamidiye	252
2018	Eskişehir	Mahmudiye	Şerefiye	89
2018	Eskişehir	Mahmudiye	Mesudiye	298
2018	Eskişehir	Mahmudiye	Doganca	180
2018	Eskişehir	Mahmudiye	Mahmudiye/Işıklar	1394
2018	Eskişehir	Mahmudiye	Balçıkhisar	191
2018	Eskişehir	Mahmudiye	Kaymaz	155
2018	Eskişehir	Odunpazarı	Karaçay	99
2018	Eskişehir	Odunpazarı	Harmandalı	101
2018	Eskişehir	Odunpazarı	Karahüyük	261
2018	Eskişehir	Odunpazarı	Ağapınar	659
2018	Eskişehir	Tepebaşı	Beyazaltin	347
2018	Eskişehir	Tepebaşı	Gökdere	142
2018	Eskişehir	Tepebaşı	Ahılar	58
		Total		**13593**

Source: Turkish Statistical Institute (TÜİK), 2018

Table 14. Number of quarters that house people living in Eskişehir, within the primary area of impact

Province	District	Number of Quarters
Eskişehir	Alpu	17
Eskişehir	Beylikova	13
Eskişehir	Mahmudiye	12
Eskişehir	Odunpazarı	4
Eskişehir	Tepebaşı	3

Source: Turkish Statistical Institute (TÜİK), 2018

The settlements in the secondary exposure area are those within the regions designated according to the annual PM2.5 dispersion rate analysis due to regional winds. The provinces that will be affected due to these winds are Eskişehir, Ankara, Afyonkarahisar and Bolu. **According to PM2.5 analyses, the total population within the secondary exposure area is 61,113 people.** As seen in Table 15, 37,959 of this population live in Eskişehir, 21,204 in Ankara, 1715 in Afyonkarahisar and 235 in Bolu.

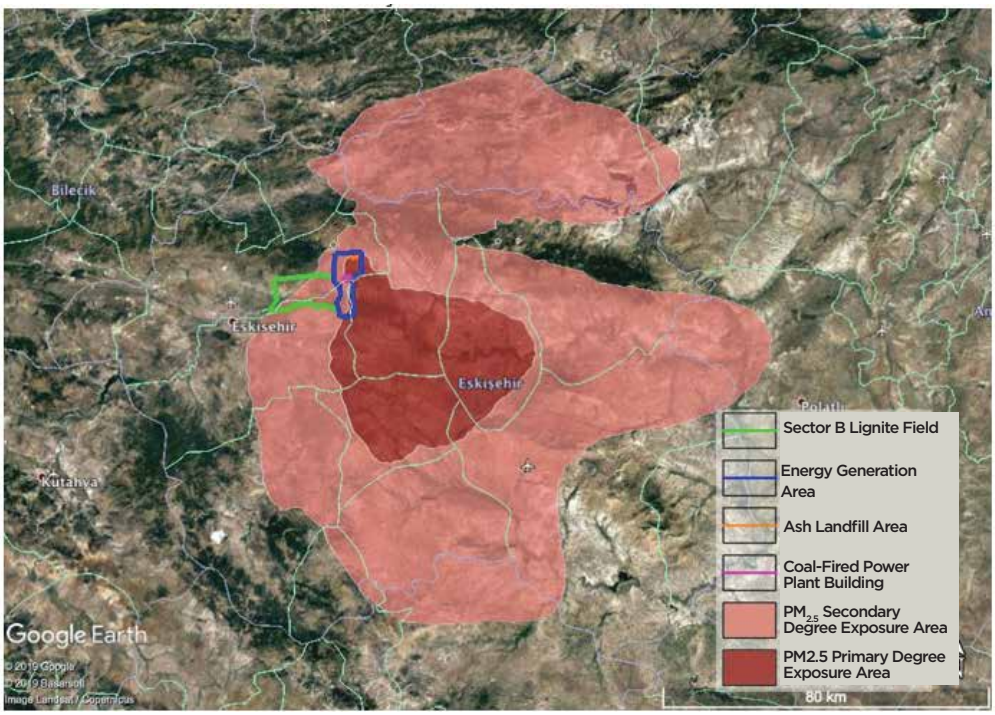
Table 15. Distribution of the population within the secondary exposure area by province according to the PM2.5 analyses

Year	Province	Population
2018	Afyonkarahisar	1715
2018	Ankara	21204
2018	Bolu	235
2018	Eskişehir	37959
	Total	**61113**

Source: Turkish Statistical Institute (TÜİK), 2018

The population living within the borders of Eskişehir province in the area of secondary exposure from the planned coal-fired power plant in Eskişehir is 37,959 people.

Map 13: Area of the Power Plant and the Primary Exposure Area



Source: Google Earth, 2020

Among the Eskişehir districts, Alpu, Beylikova, Mahmudiye, Odunpazarı and Tepebaşı districts are within the secondary exposure area.

Table 16. Total population and quarters in districts of Eskişehir within the secondary exposure area

Year	Province	District	Population	Quarter Number
2018	Eskişehir	Alpu	3321	15
2018	Eskişehir	Beylikova	1087	6
2018	Eskişehir	Çifteler	6460	22
2018	Eskişehir	Han	202	2
2018	Eskişehir	Mahmudiye	2115	4
2018	Eskişehir	Mihalıççık	4654	22
2018	Eskişehir	Odunpazarı	4294	15
2018	Eskişehir	Seyitgazi	5801	20
2018	Eskişehir	Sivrihisar	5308	35
2018	Eskişehir	Tepebaşı	4717	6
	Total		**37959**	**147**

Source: Turkish Statistical Institute (TÜİK), 2018

As seen in Table 16, Çifteler district has the highest population with 6460 people, followed by Seyitgazi with 5801 people and Sivrihisar with 5308 people. This population lives in 35 quarters in Sivrihisar district, 22 in Mihalıççık and Çifteler districts, 20 in Seyitgazi district, and 15 in Alpu and Odunpazarı districts. Following these districts, the population in the affected area lives in 6 quarters in Beylikova and Tepebaşı districts, 4 in Mahmudiye and 2 in Han district.

Table 17: Total population and quarters in districts of Ankara within the secondary exposure area

Year	Province	District	Population	Quarter Number
2018	Ankara	Nallıhan	17544	57
2018	Ankara	Polatlı	3660	7
	Total		21204	64

Source: Turkish Statistical Institute (TÜİK), 2018

The population living within the borders of Ankara province in the area of secondary exposure from the planned coal-fired power plant in Eskişehir is 21,204 people.

Among the districts of Ankara, Nallıhan and Polatlı districts remain within the secondary exposure area. 57 of the quarters in Nallıhan district are in the affected area with a total population of 17,544 people. In Polatlı district, 7 quarters are within the secondary exposure area with a total population of 3660 people.

The population living within the borders of Afyonkarahisar province in the area of secondary exposure from the planned coal-fired power plant in Eskişehir is 1715 people.

Table 18: Total population and quarters in districts of Afyonkarahisar within the secondary exposure area

Year	Province	District	Population	Quarter Number
2018	Afyonkarahisar	Bayat	50	57
2018	Afyonkarahisar	Emirdağ	1665	7
	Total		1715	64

Source: Turkish Statistical Institute (TÜİK), 2018

In Afyonkarahisar province, it was determined that Bayat and Emirdağ districts remained within the secondary exposure area. Among these districts, 1665 people living in Emirdağ district live within this exposure area, and the number of quarters hosting this population is 19. The study reveals that a village settlement of 50 people in Bayat district also live within this area of exposure.

The population living within the borders of Bolu province in the area of secondary exposure from the planned coal-fired power plant in Eskişehir is 235 people.

Table 19: Total population and quarters in districts of Bolu within the secondary exposure area

Year	Province	District	Population	Quarter Number
2018	Bolu	Göynük	235	1
	Total		235	1

Source: Turkish Statistical Institute (TÜİK), 2018

Among the districts of Bolu, Göynük is the one district located within the secondary exposure area. The affected population is 235 people and these people live in 1 quarter in Göynük district.

The settlements in the tertiary exposure area are those within the regions designated according to the annual $PM_{2.5}$ dispersion rate analysis due to regional winds. The provinces that will be affected due to these winds are Eskişehir, Ankara, Afyonkarahisar and Bolu.

According to the $PM_{2.5}$ analysis, the total population in the tertiary exposure area is 204,961 people. As can be seen from the table (see. Table 23) 198,284 of this population live in Eskişehir, 3784 live in Ankara, 2387 live in Afyonkarahisar and 506 live in Bolu.

Table 20. Distribution of the population within the tertiary exposure area by province according to the $PM_{2.5}$ analyses

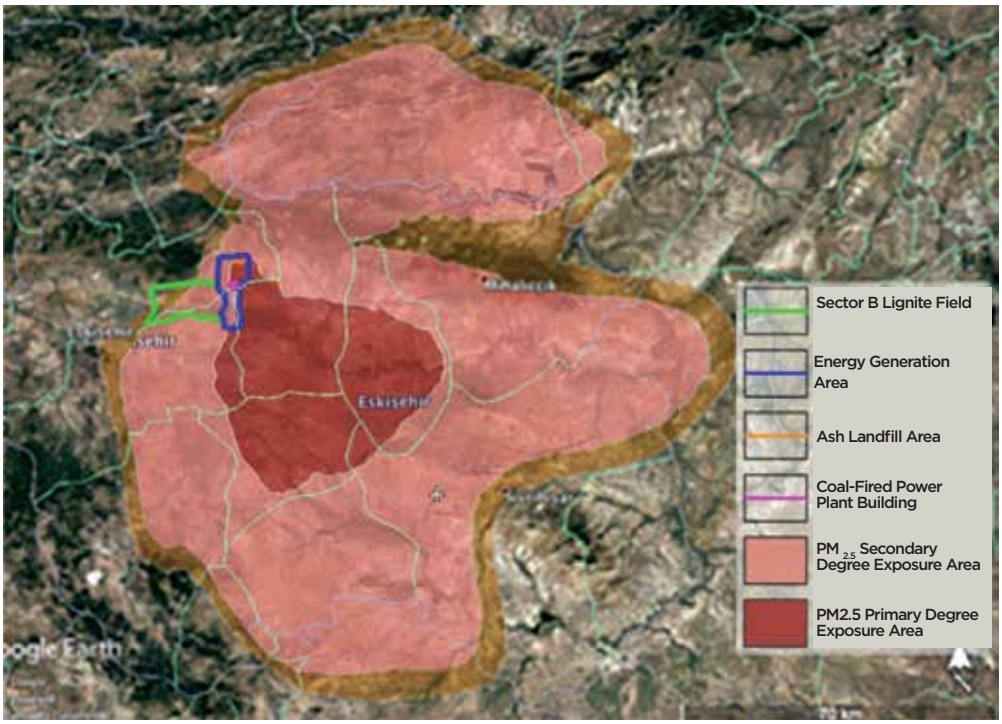
Year	Province	Population
2018	Ankara	3784
2018	Afyonkarahisar	2387
2018	Bolu	506
2018	Eskişehir	198.284
	Total	204.961

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Eskişehir that will be tertiarily affected by the planned coal-fired power plant in Eskişehir is shown in the table below (See Tables 25-26). With 183,252 people, the highest population is in the Odunpazarı district, followed by Seyitgazi with 7520 people and Mihalıççık with 2277 people. This population lives in 18 quarters in Mihalıççık district and 17 quarters in Odunpazarı district.

The population in question lives in 12 quarters in Sivrihisar district, 4 in Han and Tepebaşı districts, 3 in Seyitgazi and Sarıcakaya districts, and 1 in Alpu district.

Map 14. Map of the population that will be tertiarily affected if the Eskişehir Coal-Fired Power Plant is built



Source: Google Earth,2020

Table 21. Total population and quarters in districts of Eskişehir within the tertiary exposure area

Year	Province	District	Population	Quarter Number
2018	Eskişehir	Alpu	158	1
2018	Eskişehir	Han	1142	4
2018	Eskişehir	Mihalıççık	2277	18
2018	Eskişehir	Odunpazarı	183252	17
2018	Eskişehir	Sarıcakaya	1083	3
2018	Eskişehir	Seyitgazi	2018	3
2018	Eskişehir	Sivrihisar	7520	12
2018	Eskişehir	Tepebaşı	834	4
	Total		198284	62

Source: Turkish Statistical Institute (TÜİK), 2018.

The population living within the borders of Ankara province in the area of tertiary exposure from the planned coal-fired power plant in Eskişehir is 3784 people.

Table 22 Total population and quarters in districts of Ankara within the tertiary exposure area

Year	Province	District	Population	Quarter Number
2018	Ankara	Beypazarı	864	5
2018	Ankara	Nallıhan	755	9
2018	Ankara	Polatlı	2165	7
	Total		3784	21

Source: Turkish Statistical Institute (TÜİK), 2018

Among the districts of Ankara, Nallıhan, Polatlı and Beypazarı districts remain within the tertiary exposure area. 7 of the quarters in Polatlı district are in the affected area with a total population of 2165 people. In Nallıhan district, 7 quarters are within the tertiary exposure area with a total population of 755 people. In Beypazarı district, 5 quarters are within the tertiary exposure area with a total population of 864 people.

The population living within the borders of Afyonkarahisar province in the area of tertiary exposure from the planned coal-fired power plant in Eskişehir is 2387 people.

Table 23. Total population and quarters in districts of Afyonkarahisar within the tertiary exposure area

Year	Province	District	Population	Quarter Number
2018	Afyonkararhisar	Bayat	546	1
2018	Afyonkararhisar	Emirdağ	2341	9
	Total		2387	10

Source: Turkish Statistical Institute (TÜİK), 2018

Table 24. Total population and quarters in districts of Bolu within the tertiary exposure area

Year	Province	District	Population	Quarter Number
2018	Bolu	Göynük	348	4
2018	Bolu	Mudurnu	158	2
	Total		506	6

Source: Turkish Statistical Institute (TÜİK), 2018

In Afyonkarahisar province, it was determined that Bayat and Emirdağ districts remained within the tertiary exposure area. Among these districts, 2341 people living in Emirdağ district live within this exposure area, and the number of quarters hosting this population is 9. The study reveals that a village settlement of 46 people in Bayat district also live within this area of exposure.

The population living within the borders of Bolu province in the area of tertiary exposure from the planned coal-fired power plant in Eskişehir is 235 people.

In Bolu province, it was determined that Göynük and Mudurnu districts remained within the tertiary exposure area. Among these districts, 348 people living in Göynük district live within this exposure area, and the number of quarters hosting this population is 4. The study reveals that a village settlement of 158 people in Mudurnu district also live within this area of exposure.

Settlements in the quaternary exposure areas are the regions determined by $PM_{2.5}$ annual dispersion rate analysis as a result of regional winds. The provinces to be affected due to these winds are Eskişehir, Ankara, Afyonkarahisar, Bilecik, Bolu, Düzce, Konya, Kütahya, Sakarya, and Zonguldak'tır.

The settlements in the quaternary exposure area are those within the regions designated according to the annual $PM_{2.5}$ dispersion rate analysis due to regional winds. The provinces that will be affected due to these winds are Eskişehir, Ankara, Afyonkarahisar, Bilecik, Bolu, Düzce, Konya, Kütahya, Sakarya and Zonguldak. **According to $PM_{2.5}$ analyses, the total population within the secondary exposure area is 5,248,598 people.** As seen in the table, 4,014,955 of this population lives in Ankara, 612,511 in Eskişehir, 301,190 in Düzce, 157,919 in Afyonkarahisar, 121,191 in Bolu, 87,478 in Kütahya, 26,549 in Konya, 23,749 in Bilecik, 2873 in Bilecik, and 183 people in Sakarya.

Table 25. Total Population Within the Quaternary Exposure Area

Year	Province	Population
2018	Afyonkarahisar	157919
2018	Ankara	4014955
2018	Bilecik	23749
2018	Bolu	121191
2018	Düzce	301190
2018	Eskişehir	612511
2018	Konya	26549
2018	Kütahya	87478
2018	Sakarya	183
2018	Zonguldak	2873
	Total	**204.961**

Source: Turkish Statistical Institute (TÜİK), 2018

The population living within the borders of Ankara province in the area of quaternary exposure from the planned coal-fired power plant in Eskişehir is 4,014,955 people.

Table 26. Total population and quarters in districts of Ankara within the quaternary exposure area

Year	Province	District	Population	Number of Quarters
2018	Ankara	Altındağ	150149	10
2018	Ankara	Ayaş	15540	33
2018	Ankara	Beypazarı	47410	73
2018	Ankara	Çamlıdere	18107	9
2018	Ankara	Çankaya	914417	116
2018	Ankara	Etimesgut	570727	36
2018	Ankara	Gölbaşı	91441	25
2018	Ankara	Güdül	10074	31
2018	Ankara	Haymana	18007	38
2018	Ankara	Kahramankazan	51535	34
2018	Ankara	Keçiören	526371	24
2018	Ankara	Mamak	301919	23
2018	Ankara	Polatlı	116788	81
2018	Ankara	Sincan	518890	59
2018	Ankara	Yenimahalle	663580	57
	Total		4014955	649

Source: Turkish Statistical Institute (TÜİK), 2018

914,417 people live in Çankaya district, one of the central districts of Ankara, and 116 quarters are within the quaternary exposure area. Çankaya is followed by Yenimahalle district with 663,580 people, and 57 quarters are within the quaternary exposure area.

570,727 people of the population living in Etimesgut district live in 36 quarters and are in this affected area. 526,371 people live in the quaternary exposure area in 24 quarters of Keçiören. 518,890 people of Sincan district live in 59 quarters within the quaternary exposure area according to the PM2.5 analysis. 301,919 people living in Mamak district (23 quarters), 150,149 people living in Altındağ district (10 quarters), 116,788 people living in Polatlı district (81 quarters), 91,441 people living in Gölbaşı district (25 quarters), are within the quaternary exposure area.

34 of the quarters in Kahramankazan district are in the affected area and the population count is 51535 people. 73 of the quarters in the Beypazarı district are in the affected area and the population count is 47,410 people. 18,107 people in Çamlıdere district (9 quarters), 18,007 people in Haymana district (38 quarters), 15,540 people in Ayaş district (33 quarters), and 10,074 people in Güdül district (31 quarters) live in the quaternary exposure area.

The population living within the borders of Eskişehir province in the area of secondary exposure from the planned coal-fired power plant in Eskişehir is 612,511 people.

Table 27. Total population and quarters in districts of Eskişehir within the quaternary exposure area

Year	Province	District	Population	Number of Quarters
2018	Eskişehir	Günyüzü	6127	22
2018	Eskişehir	Han	964	10
2018	Eskişehir	İnönü	6797	16
2018	Eskişehir	Mihalgazi	3373	9
2018	Eskişehir	Odunpazarı	219088	53
2018	Eskişehir	Sarıcakaya	2777	7
2018	Eskişehir	Seyitgazi	10093	28
2018	Eskişehir	Sivrihisar	8435	33
2018	Eskişehir	Tepebaşı	354857	81
	Total		**612511**	**259**

Source: Turkish Statistical Institute (TÜİK), 2018

Among the districts of Eskişehir, Tepebaşı, Odunpazarı, Seyitgazi, Sivrihisar, İnönü, Günyüzü, Mihalgazi, Sarıcakaya and Han districts are within the quaternary exposure area.

The distribution of the total population in the districts of Eskişehir that will be quaternarily affected by the planned coal-fired power plant in Eskişehir is shown in the table below (See Table 27). With 354,857 people, the highest population is in the Tepebaşı district, followed by Odunpazarı with 219,088 people and 53 quarters, and Seyitgazi with 10,093 people and 28 quarters. This population lives in 18 quarters in Mihalıççık district and 17 quarters in Odunpazarı district. The population in question lives in 12 quarters in Sivrihisar district, 4 in Han and Tepebaşı districts, 3 in Seyitgazi and Sarıcakaya districts, and 1 in Alpu district.

Among the other districts within this area, a population of 8435 people live in 33 quarters in Sivrihisar district, and 6797 people live in 16 quarters in İnönü district. According to the PM2.5 analysis, a population of 6127 people live in 22 quarters in Günyüzü district, 3373 people in 9 quarters in Mihalgazi district, a population of 2777 people in Sarıcakaya district in 7 quarters and a population of 964 people in Han district in 10 quarters.

The population living within the borders of Düzce province in the area of quaternary exposure from the planned coal-fired power plant in Eskişehir is 301,190 people.

Table 28. Total population and quarters in districts of Düzce within the quaternary exposure area

Year	Province	District	Population	Number of Quarters
2018	Düzce	Akçakoca	4413	13
2018	Düzce	Çilimli	18665	23
2018	Düzce	Gölyaka	2123	5
2018	Düzce	Gümüşova	755	1
2018	Düzce	Kaynaşlı	20414	27
2018	Düzce	Merkez	240629	165
2018	Düzce	Yığılca	14191	39
	Total		**301190**	**273**

Source: Turkish Statistical Institute (TÜİK), 2018

Among the districts of Düzce, Merkez, Yığılca, Kaynaşlı, Çilimli, Akçakoca, Gölyaka and Gümüşova districts are within the quaternary exposure area. The distribution of the total population that will be affected by the coal-fired power plant planned to be built in Eskişehir according to the districts in Düzce is shown in the table above (See Table 28), and the highest population is in Merkez district with 165 quarters and 240,629 people within the quaternary exposure area. It is followed by Kaynaşlı with 20,414 people and 27 quarters and Çilimli district with 18,665 people and 23 quarters. A population of 14,191 people live in 39 quarters in Yığılca district, and 4413 people live in 13 quarters in Akçakoca district. Finally, according to PM2.5 analysis, a population of 2123 people live in 5 quarters in Gölyaka district and a population of 755 people live in 1 quarter in Gümüşova district.

Table 29. Total population and quarters in districts of Afyonkarahisar within the quaternary exposure area

Year	Province	District	Population	Number of Quarters
2018	Afyonkarahisar	Bayat	7693	15
2018	Afyonkarahisar	Bolvadin	7796	13
2018	Afyonkarahisar	Çobanlar	14508	16
2018	Afyonkarahisar	Emirdağ	35055	81
2018	Afyonkarahisar	İhsaniye	28526	50
2018	Afyonkarahisar	İscehisar	24420	23
2018	Afyonkarahisar	Merkez	25915	24
2018	Afyonkarahisar	Sinanpaşa	13089	28
2018	Afyonkarahisar	Sultandağ	917	2
	Total		**157919**	**252**

Source: Turkish Statistical Institute (TÜİK), 2018

The population living within the borders of Afyonkarahisar province in the area of quaternary exposure from the planned coal-fired power plant in Eskişehir is 157,919 people.

Among the districts of Afyonkarahisar, Emirdağ, İhsaniye, Merkez, İscehisar, Çobanlar, Sinanpaşa, Bolvadin, Bayat and Sultandağ districts are within the quaternary exposure area.

The distribution of the total population in the districts of Afyonkarahisar that will be quaternarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 29), and the highest population is in Emirdağ district with 81 quarters and 35,055 people within the quaternary exposure area. It is followed by İhsaniye with 28.526 people and 50 quarters, and Merkez district with 25.915 people and 24 quarters. A population of 24,420 people live in 23 quarters in İscehisar district, which is one of the other districts within this affected area, and 14,508 people live in 16 quarters in Çobanlar district. Finally, according to PM2.5 analysis, a population of 13,089 people live in 28 quarters in Sinanpaşa district, a population of 7796 people in 13 quarters in Bolvadin district, a population of 7693 people in 15 quarters in Bayat district and a population of 917 people in Sultandağ district in 2 quarters.

The population living within the borders of Bolu province in the area of quaternary exposure from the planned coal-fired power plant in Eskişehir is 121,191 people

Among the districts of Bolu, Göynük, Kıbrıscık, Merkez, Mudurnu and Seben remain within the quaternary exposure area.

Table 30. Total population and quarters in districts of Bolu within the quaternary exposure area

Year	Province	District	Population	Number of Quarters
2018	Bolu	Göynük	7287	37
2018	Bolu	Kıbrıscık	3112	24
2018	Bolu	Merkez	91161	58
2018	Bolu	Mudurnu	14693	71
2018	Bolu	Seben	4938	29
	Total		121191	219

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Bolu that will be quaternarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 30), and the highest population is in Merkez district with 58 quarters and 91,161 people within the quaternary exposure area. The following districts are Mudurnu with 14,693 people and 71 quarters, and Göynük district with 7287 people and 37 quarters. Finally, according to the $PM_{2.5}$ analysis, a population of 4938 people live in 29 quarters in Seben district and a population of 3112 people live in 24 quarters in Kıbrıscık district that remain within this area.

The population living within the borders of Kütahya province in the area of quaternary exposure from the planned coal-fired power plant in Eskişehir is 87,478 people.

Table 31. Total population and quarters in districts of Kütahya within the quaternary exposure area

Year	Province	District	Population	Number of Quarters
2018	Kütahya	Merkez	87478	70
	Total		87478	70

Source: Turkish Statistical Institute (TÜİK), 2018

Among the districts of Kütahya, only Merkez remains within the quaternary exposure area. This district has 87.478 people within the exposure area in 70 quarters.

The population living within the borders of Konya province in the area of quaternary exposure from the planned coal-fired power plant in Eskişehir is 26,549 people.

Table 32. Total population and quarters in districts of Konya within the quaternary exposure area

Year	Province	District	Population	Quarter of Number
2018	Konya	Çeltik	10071	14
2018	Konya	Yunak	16478	25
	Total		265549	39

Source: Turkish Statistical Institute (TÜİK), 2018

Among the districts of Konya, only Çeltik and Yunak are within the quaternary exposure area. The distribution of the total population in Konya that will be affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 32), and the highest population is in Yunak district with 25 quarters and 16,478 people within the quaternary exposure area. It is followed by Çeltik district with 10,071 people and 14 quarters.

The population living within the borders of Bilecik province in the area of quaternary exposure from the planned coal-fired power plant in Eskişehir is 23,749 people.

Table 33. Total population and quarters in districts of Bilecik within the quaternary exposure area

Year	Province	District	Population	Quarter of Number
2018	Bilecik	Bozhüyük	1124	7
2018	Bilecik	İnhisar	2031	12
2018	Bilecik	Merkez	1202	3
2018	Bilecik	Söğüt	18683	25
2018	Bilecik	Yenipaşa	709	9
	Total		23749	56

Source: Turkish Statistical Institute (TÜİK), 2018

Among the districts of Bilecik, Bozhüyük, İnhisar, Merkez, Söğüt and Yenipaşa districts are within the quaternary exposure zone.

The distribution of the total population in the districts of Bilecik that will be quaternarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 33), and the highest population is in Söğüt district with 25 quarters and 18,683 people within the quaternary exposure area. It is followed by İnhisar district with 2031 people and 12 quarters, Bozhüyük district with 1124 people and 7 quarters. Finally, 1202 people living in Merkez district and 709 people living in Yenipaşa district remain within the quaternary exposure area. The population living in the quaternary exposure area is located in 3 quarters in Merkez district and 9 quarters in Yenipaşa district.

The population living in the quaternary exposure area of the coal-fired power plant planned to be built in Eskişehir and staying within the provincial borders of Zonguldak is 2873 people. Within the districts of Zonguldak, only Alaplı district is within the quaternary exposure area.

Table 34. Total population and quarters in districts of Zonguldak within the quaternary exposure area

Year	Province	District	Population	Quarter of Number
2018	Zonguldak	Alaplı	2873	7
	Total		2873	7

Source: Turkish Statistical Institute (TÜİK), 2018

Detailed tables showing the names and populations of the quarters and villages in the districts of Zonguldak, which are within the quaternary exposure area, are included in Annex 17. The total population that will be quaternarily affected by the coal-fired power plant planned to be built in Eskişehir in Zonguldak province live in Alaplı district. The population of this district within the exposure area is 2873 people, and the number of quarters within the exposure area is 7. The population living in the quaternary exposure area of the coal-fired power plant planned to be built in Eskişehir and staying within the provincial borders of Sakarya is 183 people.

Table 35. Total population and quarters in districts of Sakarya within the quaternary exposure area

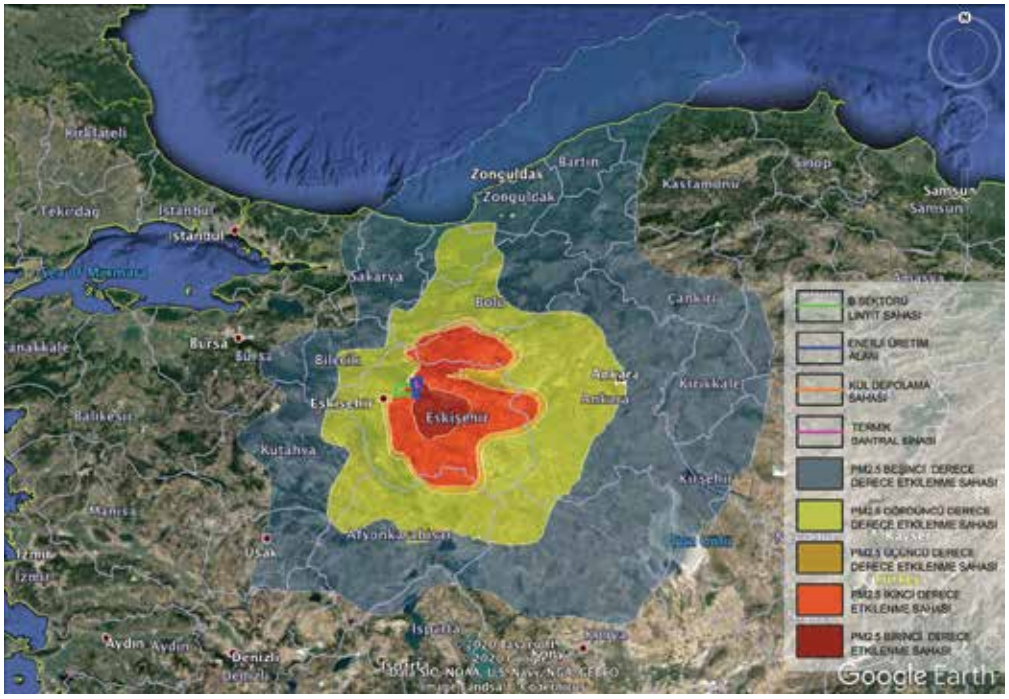
Year	Province	District	Population	Quarter of Number
2018	Sakarya	Taraklı	183	1
	Total		183	1

Source: Turkish Statistical Institute (TÜİK), 2018

Detailed tables showing the names and populations of the quarters and villages in the districts of Sakarya, which are within the quaternary exposure area, are included in Annex 18. The total population that will be quaternarily affected by the coal-fired power plant planned to be built in Eskişehir in Sakarya province live in Taraklı district. The population of this district within the exposure area is 183 people, and the number of quarters within the exposure area is 1.

Settlements in the quinary (fifth-degree) exposure areas are the regions determined by PM2.5 annual dispersion rate analysis as a result of regional winds. The provinces to be affected due to these winds are Ankara, Afyonkarahisar, Aksaray, Bartın, Bilecik, Bolu, Bursa, Çankırı, Çorum, Denizli, Düzce, Isparta, Karabük, Kastamonu, Kırıkkale, Kırşehir, Kocaeli, Konya, Kütahya, Sakarya, Uşak, Yozgat ve Zonguldak.

Map 15. Map showing the population that will be quinarily affected if Eskişehir Coal-Fired Power Plant is built.



Source: Google Earth

The population living in the quinary exposure area of the coal-fired power plant planned to be built in Eskişehir and staying within the provincial borders of Ankara is 1,354,176 people.

Table 36. Population distribution by province in the quinary impact areas according to the $PM_{2.5}$ analysis

	Year	Province	Population
1	2018	Ankara	1354176
2	2018	Afyonkarahisar	419551
3	2018	Aksaray	7853
4	2018	Bartın	100768
5	2018	Bilecik	175515
6	2018	Bolu	186022
7	2018	Bursa	277014
8	2018	Çankırı	141960
9	2018	Çorum	23103
10	2018	Denizli	21000
11	2018	Düzce	48675
12	2018	Isparta	8978
13	2018	Karabük	248363
14	2018	Kastamonu	95536
15	2018	Kırıkkale	273674
16	2018	Kırşehir	53721
17	2018	Kocaeli	32719
18	2018	Konya	279052
19	2018	Kütahya	344433
20	2018	Sakarya	999493
21	2018	Uşak	268590
22	2018	Yozgat	2108
23	2018	Zonguldak	378036
		Total	**5.740.340**

Source: Turkish Statistical Institute (TÜİK), 2018

Table 37. Total population and quarters in districts of Ankara within the quinary exposure area

Year	Province	District	Population	Quarter of Number
2018	Ankara	Akyurt	36123	26
2018	Ankara	Altındağ	242027	17
2018	Ankara	Bala	30280	55
2018	Ankara	Çamlıdere	9825	48
2018	Ankara	Çankaya	6007	8
2018	Ankara	Çubuk	90764	84
2018	Ankara	Elmadağ	45557	30
2018	Ankara	Evren	3097	13
2018	Ankara	Gölbaşı	44218	31
2018	Ankara	Haymana	16878	40
2018	Ankara	Kahramankazan	1917	14
2018	Ankara	Keçiören	396509	27
2018	Ankara	Kalecik	13234	57
2018	Ankara	Mamak	388288	44
2018	Ankara	Şereflikoçhisar	29452	64
	Total		**1354176**	**558**

Source: Turkish Statistical Institute (TÜİK), 2018

Among the districts of Ankara, Akyurt, Altındağ, Bala, Çamlıdere, Çankaya, Çubuk, Elmadağ, Evren, Gölbaşı, Haymana, Kahramankazan, Keçiören, Kalecik, Mamak and Şereflikoçhisar are within the quinary exposure area (See Table 37). Within these districts, there are 558 quarters in total.

396,509 people live in Keçiören district, one of the central districts of Ankara, and 27 quarters are within the quinary exposure area. Mamak district follows it with 388,288 people, and 44 quarters are within the quinary exposure area. 242,027 of the population living in Altındağ district live in 17 quarters and remain within the quinary exposure area according to the $PM_{2.5}$ analysis.

The population living within the borders of Afyonkarahisar province in the quinary exposure area from the planned coal-fired power plant in Eskişehir is 419,551 people.

Among the districts of Afyonkarahisar, Bolvadin, İscehisar, Merkez, Sinanpaşa, Sultandağ, Sandıklı, Hocalar, Kızılören and Dinar are within the quinary exposure area.

Table 38. Total population and quarters in districts of Afyonkarahisar within the quinary exposure area

Year	Province	District	Population	Quarter of Number
2018	Afyonkarahisar	Bolvadin	37396	64
2018	Afyonkarahisar	İscehisar	664	1
2018	Afyonkarahisar	Merkez	265036	109
2018	Afyonkarahisar	Sinanpaşa	23798	46
2018	Afyonkarahisar	Sultandağ	14663	28
2018	Afyonkarahisar	Sandıklı	56104	72
2018	Afyonkarahisar	Hocalar	9728	18
2018	Afyonkarahisar	Kızılören	2283	6
2018	Afyonkarahisar	Dinar	9879	18
	Total		**419551**	**362**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Afyonkarahisar that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 38), and the highest population is in Merkez district with 109 quarters and 265,036 people within the quinary exposure area. It is followed by Sandıklı district with 56,104 people and 72 quarters. Within the area, a population of 37,396 people live in 64 quarters in Bolvadin district, and 23,798 people in 46 quarters in Sinanpaşa district. According to PM2.5 analysis, a population of 14,663 people live in 28 quarters in Sultandağ district, 9879 people live in 18 quarters in Dinar district, and a population of 9,728 people in 18 quarters in Hocalar district.

The population living within the borders of Aksaray province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 7853 people. Among the districts of Aksaray, only Sarıyahşi remains within the quinary exposure area. This district has 7853 people within the exposure area in 7 quarters.

Table 39. Total population and quarters in districts of Aksaray within the quinary exposure area

Year	Province	District	Population	Quarter of Number
2018	Aksaray	Sarıyahşi	7853	75
	Total		**7853**	**7**

Source: Turkish Statistical Institute (TÜİK), 2018

The population living within the borders of Bartın province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 100,768 people. Among the districts of Bartın, Merkez, Ulus, Amasra and Kurucaşile districts remain within the quinary exposure area.

Table 40. Total population and quarters in districts of Bartın within the quinary exposure area

Year	Province	District	Population	Quarter of Number
2018	Bartın	Merkez	83896	28
2018	Bartın	Ulus	8740	13
2018	Bartın	Amasra	5963	5
2018	Bartın	Kurucaşile	2169	4
	Total		100768	50

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Bartın that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 40), and the highest population is in Merkez district with 28 quarters and 83,896 people within the quinary exposure area. It is followed by Ulus district with 8740 people and 13 quarters, Amasra district with 5963 people and 5 quarters, and Kurucaşile district with 2169 people and 4 quarters.

The population living within the borders of Bilecik province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 175,515 people.

Table 41, Total population and quarters in districts of Bilecik within the quinary exposure area

Year	Province	District	Population	Quarter of Number
2018	Bilecik	Bozhüyük	74212	51
2018	Bilecik	Gölpazarı	10496	53
2018	Bilecik	Merkez	78059	62
2018	Bilecik	Pazaryeri	10265	30
2018	Bilecik	Söğüt	236	1
2018	Bilecik	Yenipazar	2247	18
	Total		175515	215

Source: Turkish Statistical Institute (TÜİK), 2018

Among the districts of Bilecik, Bozhüyük, Gölpazarı, Merkez, Pazaryeri, Söğüt and Yenipazar districts remain within the quinary exposure area.

The distribution of the total population in the districts of Bolu that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 41), and the highest population is in Merkez district with 78,059 people and 62 quarters within the quinary exposure area. It is followed by Bozhüyük district with 74,212 people and 51 quarters and Gölpazarı district with 10,496 people and 53 quarters. A population of 10,265 people live in 30 quarters in Pazaryeri district, and 2247 people in 18 quarters in Yenipazar district. Finally, according to the $PM_{2.5}$ analysis, a population of 236 people live in 1 quarter in Söğüt district within the quinary exposure area.

The population living within the borders of Bolu province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 186,022 people.

Table 42. Total population and quarters in districts of Bolu within the quinary exposure area

Year	Province	District	Population	Quarter of Number
2018	Bolu	Dörtdivan	6423	32
2018	Bolu	Gerede	32341	100
2018	Bolu	Mengen	13840	65
2018	Bolu	Merkez	125462	100
2018	Bolu	Kıbrıscık	815	1
2018	Bolu	Seben	179	2
2018	Bolu	Yeniçağa	6962	19
	Total		**186022**	**319**

Source: Turkish Statistical Institute (TÜİK), 2018

Among the districts of Bolu, Dörtdivan, Gerede, Mengen, Merkez, Kıbrıscık, Seben ve Yeniçağa districts remain within the quinary exposure area.

Eskişehir'de yapılması planlanan kömürlü termik santralden beşinci derece The distribution of the total population in the districts of Bolu that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 42), and the highest population is in Merkez district with 125,462 people and 100 quarters within the quinary exposure area. It is followed by Gerede district with 32,341 people and 100 quarters, and Mengen district with 13,840 people and 65 quarters. Within this area, a population of 6423 people live in 32 quarters in Dörtdivan district, and 6962 people live in 19 quarters in Yeniçağa district. Finally, according to the $PM_{2.5}$ analysis, a population of 815 people live in 1 quarter in Kıbrıscık district and 179 people live in 2 quarters in Seben district within the quinary exposure area.

The population living within the borders of Bursa province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 277,014 people.

Table 43. Total population and quarters in districts of Bursa within the quinary exposure area

Year	Province	District	Population	Quarter of Number
2018	Bursa	İnegöl	273931	116
2018	Bursa	Yenişehir	3083	12
	Total		277014	128

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Bursa that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 43), and the highest population is in İnegöl district with 273,931 people and 116 quarters within the quinary exposure area. It is followed by Yenişehir district with 3083 people and 12 quarters.

The population living within the borders of Çankırı province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 141,960 people.

Table 44. Total population and quarters in districts of Çankırı within the quinary exposure area

Year	Province	District	Population	Quarter of Number
2018	Çankırı	Atkarıncalar	1358	5
2018	Çankırı	Çerkeş	17191	64
2018	Çankırı	Eldivan	6105	22
2018	Çankırı	Kızılırmak	6921	29
2018	Çankırı	Korgun	1799	8
2018	Çankırı	Kurşunlu	735	5
2018	Çankırı	Orta	10554	33
2018	Çankırı	Merkez	96570	59
2018	Çankırı	Yapraklı	727	5
	Total		141960	230

Source: Turkish Statistical Institute (TÜİK), 2018

Among the districts of Çankırı, Atkarıncalar, Çerkeş, Eldivan, Kızılırmak, Korgun, Kurşunlu, Orta, Merkez and Yapraklı districts remain within the quinary exposure area.

The distribution of the total population in the districts of Çankırı that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 44), and the highest population is in Merkez district with 59 quarters and 96,570 people within the quinary exposure area. It is followed by Çerkeş with 17,191 people and 64 quarters, and Orta district with 10,554 people and 33 quarters. Within this area, a population of 6105 people live in 22 quarters in Eldivan district, and 1799 people live in 8 quarters in Korgun district. 1358 people live in 5 quarters in Atkarıncalar district, and 6921 people live in 29 quarters in Kızılırmak district.

Finally, according to PM2.5 analysis, a population of 735 people live in 5 quarters in Kurşunlu district and a population of 727 people live in 5 quarters in Yapraklı district within the quinary exposure area.

The population living within the borders of Çorum province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 23,103 people.

Among the districts of Çorum, Bayat, Sungurlu and Uğurludağ districts remain within the quinary exposure area.

Table 45. Total population and quarters in districts of Çorum within the quinary exposure area

Province	District	Population	Quarter of Number
Çorum	Bayat	1365	6
Çorum	Sungurlu	21632	31
Çorum	Uğurludağ	106	2
	Total	**23103**	**39**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Çorum that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 45), and the highest population is in Sungurlu district with 31 quarters and 21,632 people within the quinary exposure area. It is followed by Bayat district with 1365 people and 6 quarters, and Uğurludağ district with 106 people and 2 quarters.

The population living within the borders of Denizli province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 21,000 people.

Among the districts of Denizli, Çivril and Bekilli districts remain within the quinary exposure area.

Table 46. Total population and quarters in districts of Denizli within the quinary exposure area

Province	District	Population	Quarter of Number
Denizli	Çivril	20296	20
Denizli	Bekili	704	4
	Total	**21000**	**24**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Denizli that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 46), and the highest population is in Çivril district with 20 quarters and 20,296 people within the quinary exposure area. It is followed by Bekilli district with 704 people and 4 quarters.

The population living within the borders of Düzce province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 48,675 people.

Among the districts of Düzce, Cumayeri, Çilimli, Akçakoca, Gölyaka and Gümüşova districts remain within the quinary exposure area

Table 47. Total population and quarters in districts of Düzce within the quinary exposure area

Province	District	Population	Quarter of Number
Düzce	Akçakoca	4226	14
Düzce	Cumayeri	14312	26
Düzce	Çilimli	1057	3
Düzce	Gölyaka	12948	21
Düzce	Gümüşova	16132	24
	Total	**48675**	**88**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Düzce that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 47), and the highest population is in Gümüşova district with 24 quarters and 16,132 people within the quinary exposure area. It is followed by Cumayeri district with 14,312 people and 26 quarters, and Gölyaka district with 12,948 people and 24 quarters. Within the quinary exposure area, a population of 4226 people live in 14 quarters in Akçakoca district, and 1057 people in 3 quarters in Çilimli district.

The population living within the borders of Isparta province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 8978 people.

Among the districts of Isparta, Yalvaç, Senirkent and Uluborlu districts remain within the quinary exposure area.

Table 48. Total population and quarters in districts of Isparta within the quinary exposure area

Province	District	Population	Quarter of Number
Isparta	Yalvaç	7853	20
Isparta	Senirkent	704	4
Isparta	Uluborlu	421	2
	Total	**8978**	**26**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Isparta that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 48), and the highest population is in Yalvaç district with 20 quarters and 7853 people within the quinary exposure area. It is followed by Senirkent district with 704 people and 4 quarters, and Uluborlu district with 421 people and 2 quarters.

The population living within the borders of Karabük province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 248,363 people.

Among the districts of Karabük, Eflani, Eskipazar, Merkez, Ovacık, Safranbolu and Yenice districts remain within the quinary exposure area.

Table 49. Total population and quarters in districts of Karabük within the quinary exposure area

Province	District	Population	Quarter of Number
Karabük	Eflani	7666	56
Karabük	Eskipazar	11984	57
Karabük	Merkez	137653	66
Karabük	Ovacık	2850	39
Karabük	Safranbolu	68527	81
Karabük	Yenice	19683	51
	Total	**248363**	**350**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Karabük that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 49), and the highest population is in Merkez district with 66 quarters and 1,137,653 people within the quinary exposure area. It is followed by Safranbolu district with 68,527 people and 81 quarters, and Eskipazar district with 11,984 people and 57 quarters. Within the quinary exposure area, a population of 19,683 people live in 51 quarters in Yenice district, 7666 people in 56 quarters in Eflani district, and 2850 people in 39 quarters in Ovacık district.

The population living within the borders of Kastamonu province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 248,363 people.

Among the districts of Kastamonu, Araç, Cide, Doğanyurt, Pınarbaşı and Şenpazar districts remain within the quinary exposure area.

Table 50. Total population and quarters in districts of Kastamonu within the quinary exposure area

Province	District	Population	Quarter of Number
Kastamonu	Araç	1713	12
Kastamonu	Cide	74212	97
Kastamonu	Doğanyurt	10496	24
Kastamonu	Pınarbaşı	4894	28
Kastamonu	Şenpazar	4221	30
	Total	**95536**	**191**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Karabük that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 50), and the highest population is in Cide district with 97 quarters and 74,212 people within the quinary exposure area. It is followed by Doğanyurt district with 10,496 people and 24 quarters, and Pınarbaşı district with 4894 people and 28 quarters. Within the quinary exposure area, a population of 4221 people live in 30 quarters in Şenpazar district, and 1713 people in 12 quarters in Araç district.

The population living within the borders of Kırıkkale province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 273,674 people.

Among the districts of Kırıkkale, Bahşılı, Ballışeyh, Çelebi, Delice, Karakeçili, Keskin, Merkez and Yahşiyan districts remain within the quinary exposure area.

Table 51. Total population and quarters in districts of Kırıkkale within the quinary exposure area

Province	District	Population	Quarter of Number
Kırıkkale	Bahşılı	7167	10
Kırıkkale	Ballışeyh	5723	32
Kırıkkale	Çelebi	2291	17
Kırıkkale	Delice	8573	53
Kırıkkale	Karakeçili	3294	10
Kırıkkale	Keskin	17376	61
Kırıkkale	Merkez	198507	40
Kırıkkale	Yahşiyan	30743	17
	Total	**273674**	**240**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Kırıkkale that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 51), and the highest population is in Merkez district with 40 quarters and 198,507 people within the quinary exposure area. It is followed by Yahşiyan district with 30,743 people and 17 quarters, and Keskin district with 17,376 people and 61 quarters. Within the quinary exposure area, a population of 8573 people live in 53 quarters in Delice district, 7167 people in 10 quarters in Bahşılı district, 5723 people in 53 quarters in Ballışeyh district, 3294 people in 10 quarters in Karakeçili district, and 2291 people in 17 quarters in Çelebi district.

The population living within the borders of Kırşehir province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 53,721 people.

Among the districts of Kırşehir, Akçakent, Akpınar, Çiçekdağ, Kaman and Merkez districts remain within the quinary exposure area.

Table 52. Total population and quarters in districts of Kırşehir within the quinary exposure area

Province	District	Population	Quarter of Number
Kırşehir	Akçakent	3707	23
Kırşehir	Akpınar	7179	32
Kırşehir	Çiçekdağ	2454	14
Kırşehir	Kaman	35514	65
Kırşehir	Merkez	4867	26
	Total	**53721**	**160**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Kırşehir that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 52), and the highest population is in Kaman district with 65 quarters and 35,514 people within the quinary exposure area. It is followed by Akpınar district with 7179 people and 32 quarters, and Merkez district with 4867 people and 26 quarters. Within the area, a population of 3707 people live in 23 quarters in Akçakent district, and 2454 people in 14 quarters in Çiçekdağ district.

The population living within the borders of Kocaeli province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 32,719 people.

Eskişehir'de yapılması planlanan kömürlü termik santralden beşinci derece etkilenme sahası içerisinde yaşayan ve Kocaeli il sınırları içerisinde kalan nüfus TOTAL 32.719 kişidir. Among the districts of Kocaeli, İzmit, Kandıra and Kartepe districts remain within the quinary exposure area.

Table 53. Total population and quarters in districts of Kocaeli within the quinary exposure area

Province	District	Population	Quarter of Number
Kocaeli	İzmit	6577	23
Kocaeli	Kandıra	16310	37
Kocaeli	Kartepe	9832	4
	Total	**32719**	**64**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Kocaeli that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 53), and the highest population is in Kandıra district with 37 quarters and 16,310 people within the quinary exposure area. It is followed by Kartepe district with 9832 people and 4 quarters, and İzmit district with 6577 people and 23 quarters.

Table 54. Total population and quarters in districts of Konya within the quinary exposure area

Province	District	Population	Quarter of Number
Konya	Akşehir	33333	21
Konya	Altınekin	14351	20
Konya	Cihanbeyli	51748	47
Konya	Ilgın	50643	51
Konya	Kadınhanı	32144	53
Konya	Kulu	50825	46
Konya	Selçuklu	3478	15
Konya	Sarayönü	27026	26
Konya	Tuzlukçu	6529	15
Konya	Yunak	8975	19

Source: Turkish Statistical Institute (TÜİK), 2018

The population living within the borders of Konya province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 279,052 people.

Among the districts of Konya, Akşehir, Altınekin, Cihanbeyli, Ilgın, Kadınhanı, Kulu, Selçuklu, Sarayönü, Tuzlukçu and Yunak districts remain within the quinary exposure area.

The distribution of the total population in the districts of Konya that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 54), and the highest population is in Cihanbeyli district with 47 quarters and 51,748 people within the quinary exposure area. It is followed by Kulu district with 50,825 people and 4 quarters, and Ilgın district with 50,643 people and 51 quarters.

Within the quinary exposure area, a population of 33,333 people live in 21 quarters in Akşehir district, 32,144 people in 53 quarters in Kadınhanı district, 27,026 people in 26 quarters in Sarayönü district, 14,351 people in 20 quarters in Altınekin district, 8975 people in 19 quarters in Yunak district, 6529 people in 15 quarters in Tuzlukçu district, and 3478 people in 15 quarters in Selçuklu district.

The population living within the borders of Kütahya province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 344,433 people.

Among the districts of Kütahya, Gediz, Merkez, Emet, Hisarcık, Tavşanlı, Domaniç, Çavdarhisar and Aslanpala districts remain within the quinary exposure area.

Table 55. Total population and quarters in districts of Kütahya within the quinary exposure area

Province	District	Population	Quarter of Number
Kütahya	Gediz	7392	25
Kütahya	Merkez	183234	109
Kütahya	Emet	19333	40
Kütahya	Hisarcık	11537	29
Kütahya	Tavşanlı	96076	98
Kütahya	Domaniç	11288	27
Kütahya	Çavdarhisar	6327	27
Kütahya	Aslanpala	9246	35
	Total	**344433**	**390**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Kütahya that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 55), and the highest population is in Merkez district with 183,234 people and 109 quarters with the highest population in the fifth degree impact area. It is followed by Tavşanlı district with 96,076 people and 98 quarters, and Emet district with 19,333 people and 40 quarters.

Table 56. Total population and quarters in districts of Sakarya within the quinary exposure area

Province	District	Population	Quarter of Number
Sakarya	Adapazarı	276385	84
Sakarya	Serdivan	147500	24
Sakarya	Akyazı	90362	73
Sakarya	Erenler	89128	33
Sakarya	Hendek	85570	91
Sakarya	Karasu	64790	40
Sakarya	Geyve	47499	64
Sakarya	Arifiye	45375	24
Sakarya	Sapanca	87790	29
Sakarya	Pamukova	2228	4
Sakarya	Ferizli	27347	24
Sakarya	Kaynarca	24138	45
Sakarya	Kocaali	22938	36
Sakarya	Söğütlü	14086	23
Sakarya	Karapürçek	12982	15
Sakarya	Taraklı	6750	21
	Total	**1044868**	**630**

Source: Turkish Statistical Institute (TÜİK), 2018

Within the quinary exposure area, a population of 11,537 people live in 29 quarters in Hisarcık district, 11,288 people in 27 quarters in Domaniç district, 9246 people in 35 quarters in Aslanpala district, 7392 people in 25 quarters in Gediz district, and 6327 people in 27 quarters in Çavdarhisar district.

The population living within the borders of Sakarya province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 1,044,868 people.

Among the districts of Sakarya, Adapazarı, Serdivan, Akyazı, Erenler, Hendek, Karasu, Geyve, Arifiye, Sapanca, Pamukova, Ferizli, Kaynarca, Kocaali, Söğütlü, Karapürçek and Taraklı districts remain within the quinary exposure area.

The distribution of the total population in the districts of Kütahya that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 56), and the highest population is in Adapazarı district with 84 quarters and 276,385 people within the quinary exposure area. It is followed by Serdivan district with 147,500 people and 24 quarters, Akyazı district with 90,362 people and 73 quarters, and Erenler district with 89,128 people and 33 quarters.

Within the quinary exposure area, a population of 87,790 people live in 29 quarters in Sapanca district, 85,570 people in 91 quarters in Hendek district, 64,790 people in 40 quarters in Karasu district, 47,499 people in 64 quarters in Geyve district, 45,375 people in 24 quarters in Arifiye district, 27,347 people in 24 quarters in Ferizli district, 24,138 people in 45 quarters in Kaynarca district, 22,938 people in 36 quarters in Kocaali district, 14086 people in 23 quarters in Söğütlü,district, 12,982 people in 15 quarters in Karapürçek district, 6750 people in 21 quarters in Taraklı district, and 2228 people in 4 quarters in Pamukova district.

The population living within the borders of Uşak province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 268,590 people in 160 quarters.

Among the districts of Uşak, Merkez, Banaz, Karahallı, Sivaslı ve Ulubey districts remain within the quinary exposure area.

Table 57. Total population and quarters in districts of Uşak within the quinary exposure area

Province	District	Population	Quarter of Number
Uşak	Merkez	194481	44
Uşak	Banaz	35691	55
Uşak	Karahallı	11990	21
Uşak	Sivaslı	20603	30
Uşak	Ulubey	5825	10
	Total	**268590**	**160**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Uşak that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 38), and the highest population is in Merkez district with 44 quarters and 194,481 people within the quinary exposure area. It is followed by Banaz district with 35,691 people and 55 quarters, Sivaslı district with 20,603 people and 30 quarters, and Ulubey district with 5825 people and 10 districts.

The population living within the borders of Yozgat province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 2108 people in 13 quarters. Among the districts of Yozgat, only Yerköy remains within the quinary exposure area.

Table 58. Total population and quarters in districts of Yozgat within the quinary exposure area

Province	District	Population	Quarter of Number
Yozgat	Yerköy	2108	13
	Total	**2108**	**13**

Source: Turkish Statistical Institute (TÜİK), 2018

The distribution of the total population in the districts of Yozgat that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 58), and Yerköy district with 13 quarters and 2108 people remains within the quinary exposure area.

The population living within the borders of Zonguldak province in the area of quinary exposure from the planned coal-fired power plant in Eskişehir is 378,036 people in 189 quarters.

Among the districts of Zonguldak, Alaplı, Ereğli, Merkez, Çaycuma, Devrek and Gökçebey districts remain within the quinary exposure area.

Table 59. Total population and quarters in districts of Zonguldak within the quinary exposure area

Province	District	Population	Quarter of Number
Zonguldak	Alaplı	42106	55
Zonguldak	Ereğli	132189	44
Zonguldak	Merkez	114108	38
Zonguldak	Çaycuma	44374	32
Zonguldak	Devrek	33924	10
Zonguldak	Gökçebey	11335	10
	Total	**378036**	**189**

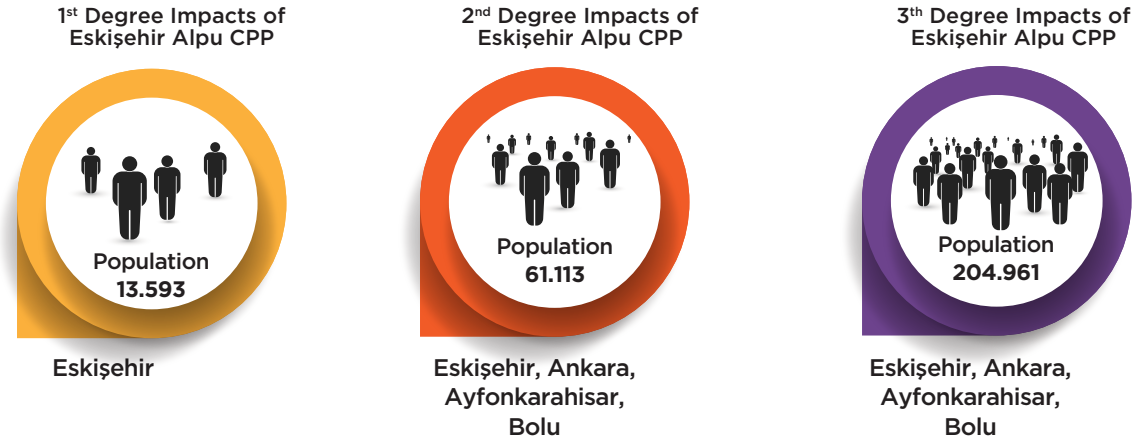
Source: Turkish Statistical Institute (TÜİK), 2018

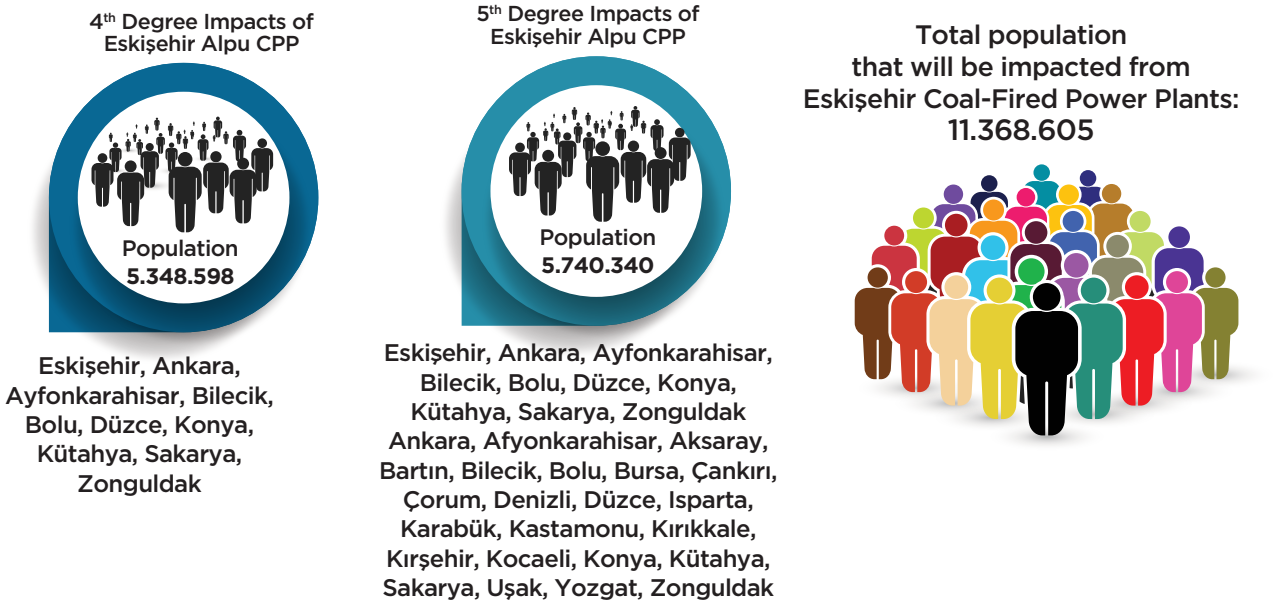
The distribution of the total population in the districts of Zonguldak that will be quinarily affected by the coal-fired power plant planned to be built in Eskişehir can be seen in the table above (See Table 59), and the highest population is in Ereğli district with 44 quarters and 132,189 people within the quinary exposure area. It is followed by Merkez district with 114,108 people and 38 quarters, Çaycuma district with 44,374 people and 32 quarters, and Alaplı district with 42,106 people and 55 quarters.

Within this exposure area, a population of 33,924 people live in 10 quarters in Devrek district, and 11,335 people in 10 quarters live in Gökçebey district.

In summary:

Table 60. Distribution of the population within all exposure areas by province according to the $PM_{2.5}$ analyses





According to the analysis of the annual $PM_{2.5}$ dispersion rate due to regional winds from the coal-fired power plant that is planned to be built in Eskişehir, the total number of provinces that will be affected is 24, and the total number of people that will be affected is **11.368.605,** as seen in the table above.

Eskişehir, which is the building site of the coal-fired power plant, is in the primary exposure area, with a population of 13,593 people that will be primarily affected.

The provinces that will be secondarily and tertiarily affected are Eskişehir, Ankara, Afyonkarahisar and Bolu. The total population that will be secondarily affected is 61.113 people, and those who will be tertiarily affected are 204.961 people.

The quaternary exposure area of the Eskişehir Coal-Fired Power Plant extends more than the third, including provinces in the Central Anatolia, Black Sea, and Marmara regions. These provinces are **Eskişehir, Ankara, Afyonkarahisar, Bilecik, Bolu, Düzce, Konya, Kütahya, Sakarya and Zonguldak.**

According to the analysis of the annual PM2.5 dispersion rate due to regional winds, the total population that will be quinarily affected in the Central Anatolia, Black Sea, Mediterranean, and Marmara regions is 5,740,340 people. **The provinces that will be affected are Ankara, Afyonkarahisar, Aksaray, Bartın, Bilecik, Bolu, Bursa, Çankırı, Çorum, Denizli, Düzce, Isparta, Karabük, Kastamonu, Kırıkkale, Kırşehir, Kocaeli, Konya, Kütahya, Sakarya, Uşak, Yozgat and Zonguldak.**

The last population count in Eskişehir was 871,187 in 2018. Although the population growth rate in the province is higher than the average in Turkey, only the two most densely populated districts (Odunpazarı and Tepebaşı) had an increase in population whereas all other districts had a decrease in population (See Table 61).

Table 61. Population Growth Rate in the Districts of Eskişehir Province

Districts	2008	2018	2008-2018 NAH (%)	Yıllık NAH (%)
Odunpazarı	342.515	404.267	**18,0%**	**1,6%**
Tepebaşı	271.732	359.303	**32,2%**	**2,9%**
Sivrihisar	24.877	20.746	-16,6%	-1,5%
Çifteler	17.219	13.405	-22,1%	-2,0%
Seyitgazi	16.840	15.098	-10,3%	-0,9%
Alpu	13.884	11.242	-19,0%	-1,7%
Mihalıççık	11.158	8.526	-23,6%	-2,1%
Mahmudiye	9.202	7.998	-13,1%	-1,2%
Beylikova	7.678	6.127	-20,2%	-1,8%
İnönü	7.547	6.797	-9,9%	-0,9%
Günyüzü	7.136	6.953	-2,6%	-0,2%
Sarıcakaya	5.511	5.080	-7,8%	-0,7%
Mihalgazi	3.952	3.373	-14,7%	-1,3%
Han	2.488	2.272	-8,7%	-0,8%

Kaynak: TÜİK ve ADNK veri tabanından hesaplanmıştır.

5.1.3.1 Migration Features

Main crop production activities in Eskişehir that require the most seasonal mobile agricultural work are hoeing and pulse harvesting in May-June, and onion and sugar beet harvests in September-November.

Approximately 10 thousand seasonal agricultural workers come from neighboring provinces, Eastern and Southeastern provinces for vegetable production, sugar beet hoe and harvest, cherry harvest and pulses harvest from April to November.[108]

5.1.3.2. Fertility Level

The Total Fertility Rate, which was 1.40 in Eskişehir in 2009, increased slightly over the years and reached 1.49 in 2018.[109] In 2018, there are 43.1 births per 1000 15-49 women (General fertility rate is calculated as 43.1 per thousand).

In 2018, 9743 deliveries occurred throughout the province, more than 90% of the deliveries were in the districts of Alpu, Tepebaşı and Odunpazarı, the districts which will be affected by the Alpu CPP.[110]

Table 62. Number of births by districts in Eskişehir (2018)

Districts	Number of Live Births (2018)	Percent
Odunpazarı	4645	47,7
Tepebaşı	4134	42,4
Alpu	122	1,3
Beylikova	49	0,5
Çifteler	156	1,6
Günyüzü	43	0,4
Han	14	0,1
İnönü	61	0,6
Mahmudiye	82	0,8
Mihalgazi	26	0,3
Mihalıççık	69	0,7
Sarıcakaya	51	0,5
Seyitgazi	117	1,2
Sivrihisar	174	1,8
Province Total	4989	100,0

%91,4

Source: Turkish Statistical Institute (TÜİK), 2018

108 Eskişehir ilinde bitkisel üretimde çalışan çocuklar. Kalkınma Atölyesi. 2014.
109 TÜİK, 2018
110 TÜİK, 2018

5.1.4. Socioeconomic Status

In recent years, Eskişehir has become one of the leading provinces that showed significant improvement in social, economic, and cultural fields with the rapid change of the university, industry, and trade structure. According to a survey conducted by the Ministry of Development in 2013, Eskişehir ranks 7th in terms of socio-economic development level.

In addition, Tepebaşı Municipality, where the project will be carried out, ranked 8th according to the survey carried out in all districts within the metropolitan municipality and 186 districts with the highest populations under the coordination of Dr. Murat Şeker from Istanbul University Faculty of Economics in 2017. Tepebaşı Municipality ranked 8th in the "Very High Human Development" group, which is called the "Green Zone", which includes 30 districts, according to the ranking based on 65 criteria that include objective indicators such as education, health, social life, governance, transparency, environment, transportation, and infrastructure.

The economy of the region where the project area is located is based on agriculture and animal husbandry. The products grown most are corn, tomato, pepper, eggplant, sugar beet, asparagus, wheat, barley, chickpeas, and watermelon. All of these products meet the needs of the various provinces of Turkey. Cattle and ovine breeding are also among the livelihoods of the region.

5.1.4.1. Economical Situation

According to TSI Income and Living Conditions Survey Regional results, in 2018, the average per capita income in the region including Eskişehir (TR-41: Bursa, Eskişehir, Bilecik) is higher than the 8.5% average of Turkey with 26 262 TL.[111]

According to TSI 2017 data, GDP in Eskişehir is above the average of Turkey. GDP is USD 10,602 in Turkey, while it is USD 11,139 in Eskişehir.

According to TSI, the poverty rate was calculated as 10.3% in 2018, while it was 9.2% in 2017 in the TR-41 region. This rate is lower than Turkey's average of 13.9% in 2018 and 13.5% in 2017.[112] When the regional average is calculated over 10.3%, it can be estimated that in 2018, 89,732 of the population of Eskişehir (ABPRS, 2018) was poor.

As can be seen in Table 55, the TR-41 region is in a more positive situation compared to the rest of the country in terms of economic inequality.

Table 63. Economic inequalities in the region including Eskişehir

	Gini coefficient [113]			P80/P20 oranı		
	2016	2017	2018	2016	2017	2018
Turkey	0,404	0,405	0,408	7,7	7,5	7,8
TR41 (Bursa, Eskişehir, Bilecik)	0,341	0,347	0,337	5,3	5,5	5,2

Source: Turkish Statistical Institute (TÜİK)Newsletter, Income and Living Conditions Survey, Regional Results

111 Eşdeğer hane halkı kullanılabilir fert gelirine göre sıralı yüzde 20'lik gruplar itibariyle yıllık eşdeğer hane halkı kullanılabilir fert gelirinin dağılımı, (2017, 2018)

112 http://www.tuik.gov.tr/HbGetir.do?id=30756&tb_id=6

113 Ginie coefficient is used to measure the inequality level in a country and is used to understand whether the GDP is equally distributed. Coefficient ranks among 0 and 1 and the higher the value, the higher the inequal income distribution.

5.1.4.2. Economic Activity Areas of The Working Population/Working Life

Eskişehir is a region with both industrial production and agricultural production. While the services sector ranks first in the provincial economy with 54%, this is followed by the industry sector with 39% and the agriculture sector with 7%. After the industrialization movement that started in the 1970s in Eskişehir, a large number of industrial establishments became operational. As of 2017, the number of industrial establishments registered in Eskişehir Chamber of Industry (ESO) was 730, and the number of employees in these enterprises was 64,300. [114]

While the largest number of companies under industrial production is machinery and equipment with 13.4%, food production with 12.9% and metal products with 11.3% are in the second place. In terms of the number of employees, the highest number of employees are in the food industry and constitute 13.7% of employment in the province. [115]

According to the SSI records of Eskişehir province in 2017, there are 261.429 insured persons, 67.6% (176.841) of them work for someone else (4-1a), 10.0% (26.148) of them are self-employed and agricultural workers (4-1b) and 15.7% (41.081) are public employees (4-1c).[116] The unemployment rate is 8.5% in the province and remains below the average of Turkey.[117]

In Eskişehir province, the self-employed group within the scope of Law No. 5510, 4 / 1b are provided in the table below. Considering that a significant part of Eskişehir is an agricultural area, it is notable that the number of people under the "Persons Doing Agricultural Activity Law No. 2926 "registered in SSI is very low (6.891 people) (Table 56). The reason for this is thought to be that most of the workers in the agricultural sector are unregistered in Turkey. In the calculation made by using SSI's Household Labor Force Statistics, unregistered employment in the agricultural sector in Turkey in 2018 is reported to be 82.71%.[118] On the other hand, the number of farmers registered in the Farmer Registration System (FRS) in Eskişehir Province Agricultural Investment Guide in 2016 is 24,724. It is known that all farmers have an FRS certificate, but not all those with an FRS certificate are farmers.[119]

Tablo 64. Number of self-employed people in Eskişehir (2017)

	Number of Employees
Self-employed Law No. 1479	17.548
Agricultural workers Law 2926	6.891
Voluntary insured	1501
Mukhtars	210
Total	26.148
4-1c	41.081

Source: SGK Statistics 2017 (calculated from Table 1.7)

114 Bilim, Sanayi Teknoloji Bakanlığı, 81 İli Sanayi Durum Raporu (E-K)
115 Bilim, Sanayi Teknoloji Bakanlığı, 81 İli Sanayi Durum Raporu (E-K)
116 SGK İstatistikleri 2017. Tablo 1.7'den hesaplanmıştır.
117 İskur, 2018
118 SGK Web sayfası: http://www.sgk.gov.tr/wps/portal/sgk/tr/calisan/kayitdisi_istihdam/kayitdisi_istihdam_oranlari/kayitdisi_istihdam_orani
119 T.C. Gıda Tarım Hayvancılık Bakanlığı. Eskişehir İli Tarımsal Yatırım Rehberi.

Table 65. Number of people registered to the farmer registration system and average size of enterprises in Eskişehir (2016)

District	Number of Farmers	Average Area (da)	Degree of Impact
Sivrihisar	5.590	159,17	2nd
Seyitgazi	2.553	128,89	2nd
Çifteler	2.418	184,04	2nd
Tepebaşı	2.114	111,09	1st
Alpu	1.908	168,49	1st
Odunpazarı	1.729	166,90	1st
Günyüzü	1.598	92,66	4th
Mihalıççık	1.561	112,23	2nd
Mahmudiye	1.555	216,86	1st
Beylikova	1.386	143,89	1st
İnönü	871	90,29	4th
Han	598	67,60	2nd
Sarıcakaya	567	23,13	4th
Mihalgazi	276	7,73	2nd
Total	24.724	Province Average= 141,68	

Source: Ministry of Food, Agriculture and Livestock, Eskişehir Province Agricultural Investment Guide

When the establishments operating under the scope of Law No. 5510 4-1 in Eskişehir, retail trade ranks the first as in the rest of Turkey, followed by building construction.[120]

There are 151 workplaces that operate in mining in Eskişehir. It is provided in Table 57 that 3 of the establishments engaged in mining activities are coal and lignite mines and the overwhelming majority are others.

Table 66. Number of mining establishments and employees in Eskişehir

Activity code	Activity Groups (*)	Number of workplaces	Number of the insured
05	Coal and Lignite Extraction	3	705
07	Metal Ore Mining	18	990
08	Other Mining and Stone Quarries	122	2460
09	Mining Support Services	8	62

Source: SGK 2017

120 SGK, 2017

5.1.5. Agricultural Production

Almost half of the surface area of Eskişehir province consists of 582.505 hectares of cultivated land.[121] 20.3% of these agricultural lands are Class I 31.4% are Class II and 92.7% are class I+II+III+IV lands.[122] The agricultural land in Tepebaşı, where the project is located, is 54,635 Ha and 45,446 Ha in Alpu district. [123]

Alpu Plain is the largest of the 3 big lowlands in Eskişehir and has been taken under protection with the decision of the Council of Ministers no. 2016/9620.[124] Eskişehir is one of the most important agricultural centers in Turkey and has a significant share in cereal production. Production information in Tepebaşı and Alpu districts, which are expected to be affected by the coal-fired power plant, is provided in Table 58.

Table 67. The most produced crops in the districts of Alpu and Tepebaşı

	Planted area (hectares)		Amount produced (ton)	
	Alpu	Tepebaşı	Alpu	Tepebaşı
Sugar beet	30.202	11.371	185.161	67.695
Corn (Silage)	10.100	8.200	57.640	40.500
Corn	38.110	18.547	37.142	18.902
Wheat, Except Durum Wheat	115.620	14.1971	32.152	39.069
Barley (Other)	93.419	96.484	25.389	25.653
Clover	7.600	8.400	13.680	42.000

Source: Turkish Statistical Institute (TÜİK), 2018

Production yield per area of some crops produced in Eskişehir province (kg/hectare) is higher than the average of Turkey. These are corn (starch) is 2.44 times, and sage provides 85% more yield, sorghum (green) and clover (green) 32%, clover seed 18%, lavender, and sainfoin (green) 15% and vetch (green) 10%.[125]

Livestock data in Eskişehir are provided in Table 59. Calculations that are not included in the table but made using the data show the importance of husbandry in Alpu and Tepebaşı districts of Eskişehir. 46.6% of the domestic bovine milk is produced in Alpu. In addition, 21.4% of bovine (culture hybrid) milk, 22.0% of angora goat milk, and 27.9% of angora production are produced in Alpu. 21.4% of domestic bovine milk and 28.9% of culture hybrid cattle milk are produced in Tepebaşı district. Beekeeping and silkworm production in Tepebaşı constitutes approximately a quarter of the province's production. On the other hand, sheep milk (merinos) produced in Eskişehir amount of 15.2% of Turkey, while the merinos fleeces constitute 20.2%.

121 İstatistiklerle Eskişehir 2014. S.278
122 İstatistiklerle Eskişehir 2014. S.279
123 İstatistiklerle Eskişehir 2014. S.280
124 Resmi Gazete. https://www.resmigazete.gov.tr/eskiler/2017/01/20170121M1-1.pdf
125 TÜİK (2018), Bitkisel Üretim veri tabanından hesaplanmıştır.

Table 68. Animal production data in Eskişehir (TSI, 2018)

Animal products	Amount produced (Ton)
Bovine Milk (Culture) (Excluding Water Buffalo Milk)	38.363
Bovine Milk (Culture Hybrid) (Excluding Water Buffalo Milk)	49.964
Bovine Milk (Domestic) (Excluding Water Buffalo Milk)	4.699
Water Buffalo Milk (Domestic)	252
Sheep Milk, Merinos, Unprocessed	9.774
Sheep Milk, Domestic and Others, Unprocessed)	6.614
Goat Milk (Angora), Unprocessed	95
Goat Milk (Hair Goat And Others), Unprocessed	2.305
Fleece (Merinos), Livestock	1.666
Fleece (Domestic and Others), Livestock	450
Angora, Livestock	21
Goat Hair, Livestock	48
Bees (Beehive), (Old Type) and Number of Hives	450
Bees (Beehive), (New Type) and Number of Hives	20.103
Silkworm (Except Breeding Silkworm) and Box	130
Natural Honey	130

Table 69. Vegetable product cultivated areas in the quarters that will be affected by the project and income based on 2019 prices

District	Quarter	Cultivation area (da [1.000 m2])	TL value
Alpu	Bahçecik	16716	18.869.542
Alpu	Çukurhisar	5800	1.678.610
Alpu	Karakamış	6160	3.016.739
Alpu	Osmaniye	25800	14.383.608
Alpu	Söğütcük	11371	2.987.201
Tepebaşı	Beyazaltın	15694	11.268.373
Tepebaşı	Danışmend	2814	874.850
Tepebaşı	Gündüzler	20956	13.195.160
Tepebaşı	Kızılcaören	6548	3.808.058
Tepebaşı	Kozlubel	5106	2.463.023
Tepebaşı	Taycılar	56	12.642.036
Tepebaşı	Yakakayı	8749	50.285.780
Total		**125.770**	**135.472.980**

Source: Data provided by the Tepebaşı Municipality of Eskişehir was used in Tables 68 and 69.

5.1.6. Health Profile in The Region

Life expectancy at birth in Eskişehir is 78.0 in total for 2015-2017, similar to the average in Turkey. This number is 80.8 for women and 75.2 for men.[126]

The crude mortality rate of 6.7 per thousand in 2018 is below 10.1 per thousand, which is the average of Turkey. The main cause of deaths is circulatory diseases and cancer as in Turkey (Table 61). Circulatory system diseases have a lower share than Turkey, but the rate of deaths due to cancer is higher. 23.2% of total deaths occurred due to "benign and malignant tumors". The cancer-specific death rate, i.e. the likelihood of death due to cancer in 100,000 people, is 101.3 in Turkey while it is 152,3 in Eskişehir (calculated from TSI 2018).

Tablo 70. Distribution of causes of death in Eskişehir (2018)

Causes of Death	Turkey		Eskişehir	
	Number	%	Number	%
Circulatory system diseases	161 920	38,4	1 907	33,4
Benign and malignant tumors	83 163	19,7	1 327	23,2
Respiratory system diseases	52 568	12,5	657	11,5
Nervous system and sensory organs diseases	20 766	4,9	372	6,5
Diseases related to endocrine (internal gland), nutrition and metabolism	20 074	4,8	436	7,6
External injury causes and poisoning	18 462	4,4	274	4,8
Other	64 211	15,2	745	13,0
Total	421 164	100,0	5 718	100,0

(Calculated from the Turkish Statistical Institute data about causes of death)

Infant mortality rate, which is the best indicator of community health, not only mortality level, is below the average of Turkey in Eskişehir; while it was 6.7 per thousand in 2018 in Eskişehir, it was reported to be 9.3 per thousand in Turkey. [127]

The perinatal mortality rate includes deaths before birth (death in the womb), during delivery and within a week after birth. The perinatal mortality rate is associated with environmental pollution as well as causes such as the age of the mother, diseases such as rubella during pregnancy. While the perinatal mortality rate is 11.0 per thousand births in Turkey, it is 9,3 per thousand birth in the eastern Marmara Region which includes Eskişehir.

126 TÜİK, 2017
127 TÜİK İl Göstergeleri. Dinamik sorgulama.

One of the important indicators of women's health, maternal mortality rate, is higher than the average in Turkey with 19.9 per hundred thousand live births (14.6 per hundred thousand in Turkey).[128] However, this may be related to the fact that more maternal deaths are reported in the province.

Health data related to common diseases and health problems in Eskişehir could not be accessed. Considering the situation in Turkey in terms of diseases associated with coal-fired power plants, asthma has a prevalence of 4.5%, and COPD 5.3% according to the Chronic Disease Reports of the Ministry of Health.[129] In the Eastern Marmara Region, where Eskişehir is located, the total prevalence of COPD and asthma is 8.4% for men and 6.4% for women. In the National Burden of Disease study conducted in 2000, the prevalence of pf COPD was reported to be 10.2% and asthma 3.8%.

As acknowledged by WHO, outdoor air pollution is an important factor for cancer. Turkey's Health Report published by Public Health Specialist Association (HASUDER are) in 2014 reported that the incidence of breast cancer, which is the most common type of cancer in women, was 39 per 100,000, and the incidence of lung cancer, which is the most common type of cancer in men, was 8 per 100,000. In the 2015 Cancer Statistics report of the Ministry of Health, the incidence of lung-bronchial cancer in women was 9.0 per 100,000, and breast cancer was 43.8 per 100,000; and the incidence of lung-bronchial cancer in men was 52.5 per 100,000.

According to the results of the TNSA, 10.1 of 1000 live births in the Eastern Marmara Region, and according to 2018 results, 13.9 are born with low birth weight, that is, less than 2500 grams.[130] [131]

In 2017, 6,545 occupational accidents and 14 deaths occurred in Eskişehir. Although the incidence of occupational accidents in Eskişehir is higher than Turkey (2.5%) with 3.7%, the likelihood of death due to occupational accidents per one hundred thousand employees is less (7.9 per hundred thousand in Eskişehir, 11.3 per hundred thousand in Turkey). This may be related to the lower fatality rate of occupational accidents in the province or to the greater reporting of occupational accidents.

In Table 62, occupational health indicators in four sectors were calculated using the SSI statistics. There is a subgroup of "electric power generation" that fully complies with the project activity under the group (35-Electricity, the gas stream, and ventilation system production and distribution) that covers the operation of the CPP. However, since the data of the subgroups were not presented for all variables, the rates were calculated for the entire category 35. However, since this category does not only cover energy production, but also less dangerous jobs such as its distribution, trade, etc., if it has been possible to calculate the subgroups separately, the occupational accident and occupational disease estimations in this group would have been higher. In summary, it should be noted that the estimation under this heading is more optimistic.

128 TÜSEB. https://www.tuseb.gov.tr/enstitu/tacese/anne-l-mleri
129 Sağlık Bakanlığı "Türkiye Kronik Hastalıklar ve Risk Faktörleri Sıklığı Çalışması" Sağlık Bakanlığı Yayın No:909 (2013)
130 TNSA 2013
131 TNSA 2018

Table 71. Occupational health indicators in construction, coal mining, energy and agriculture sectors (2013-2017)

	41-Building construc-tion	05-Coal and Lignite Extraction	35-Sieve, gas, steam and ventilation fog production and distribution	01-Crop and animal production and hunting activities
Occupational disease*	41	254	3	2
Occupational accident*	97.970	45.486	8.850	8.663
Deaths due to occupational accidents*	1.374	439	95	81
Permanent incapacity*	2.758	492	125	152
Total number of employees*	6.027.639	204.948	498.370	524.696
Occupational accident incidence (in 100 workers)**	1,63 percent	22,19 percent	1,78 percent	1,65 percent
The death rate due to occupational accidents (in 100,000 workers)*	22,79 in one hundred thousand	214,20 in one hundred thousand	19,06 in one hundred thousand	15,44 in one hundred thousand

* total number for five years ** Annual average of five years

Source: SSI Statistics

5.1.7. Sensitive Population Groups

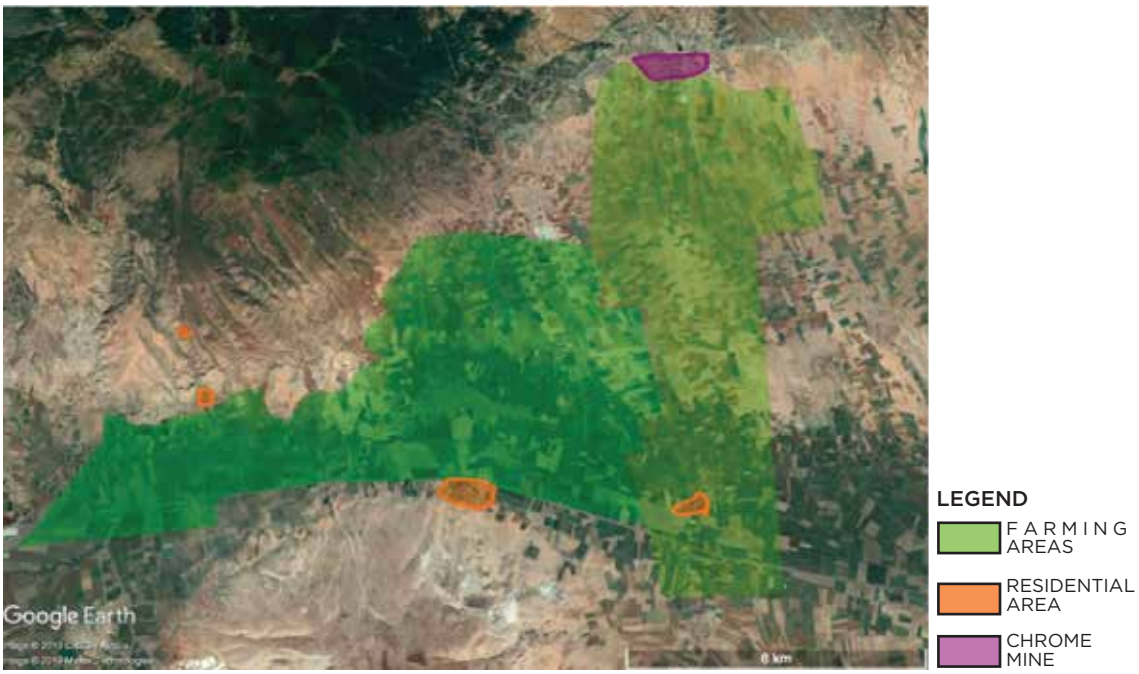
Air pollution caused by coal-fired power plants is a more important health threat for some groups in the community than the general population. These groups are children under the age of five (especially babies under one-year-old), elderly population over 65 years and pregnant women, as well as people with diseases such as cardiovascular disease, asthma, chronic lung disease.

5.1.8. The Current State of The Environment

5.1.8.1. Functions of The Project Area According to The Current Situation

The area where Eskişehir Alpu Coal Fired Power Plant is planned to be built is in "Forest Areas", "Agricultural Nature Protection Areas" and "Pasture Areas" in the current "Eskişehir Province 1/100.000 scale Environmental Plan". In addition, chrome ore and settlements were found in the on-site observations.

Map 16. Current Status of the Project Area and Project Functional Distribution



Prepared on Google Earth based on the EIA report prepared by EN-ÇEV and the current land specifications

47% of the energy generation area planned to be established on Eskişehir Alpu CPP 892.9 Ha is an agricultural area and 9.7% is pasture (Table 72).

Table 72. Land Qualifications of the Area for the Alpu coal-fired power plant

The nature of the land	Area* (Ha [10.000 m²])	Percent**
Total agricultural land	419,9	%47,0
Absolute agricultural land	358,3	%40,1
Special production lands	42,0	%4,7
Dry marginal agricultural lands	10,7	%1,2
Pastureland	86,8	%9,7
Forrest land	235,0	%26,3
Non-agricultural land	160,3	%17,9
Energy generation land	892,9	%100,0

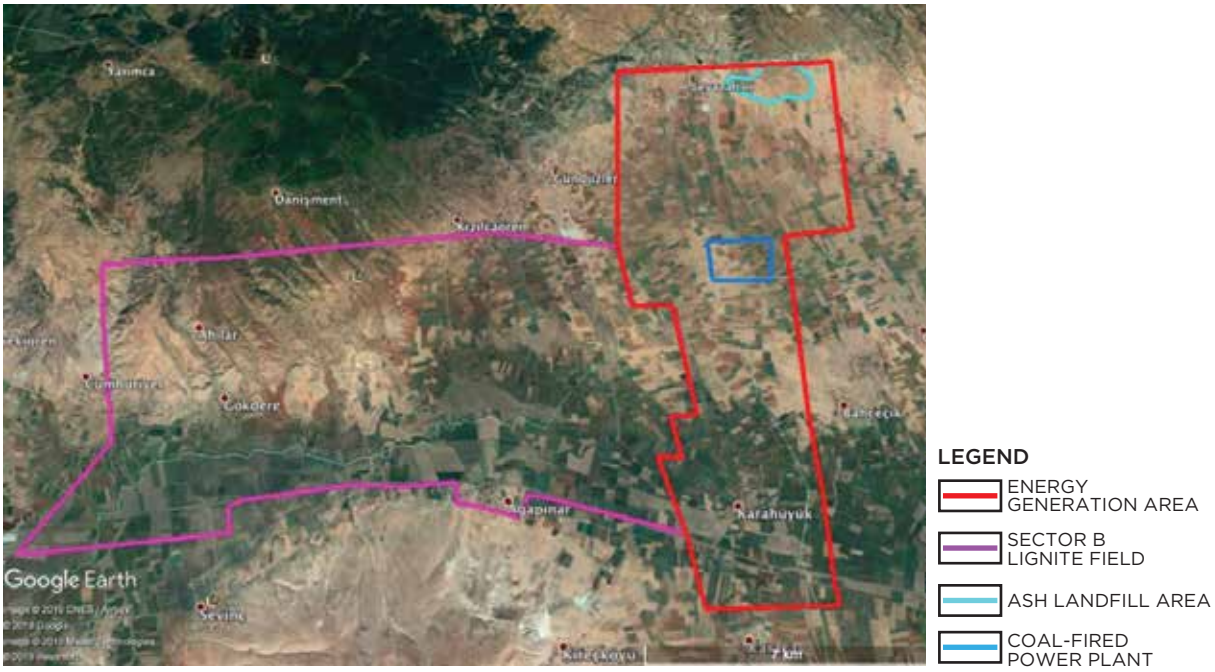
**The percentages were calculated by the authors.

Source: HIA Report (pg. 162)

Only the energy generation area has been provided in the EIA Report, and since no ash landfill area and mining area have been provided, information on the land quality of the area to be directly affected by the entire project has not been obtained.

The EIA Report assumes that it will affect the agriculture on the surface of the mining site. However, it can be predicted that agriculture will be adversely affected in the entire Alpu Plain due to drought since the aquifers in the plain will be affected.

Map 17. Current Functional Distribution of the Project Area



5.1.8.2. Air Quality in Eskişehir

The most important sources of outdoor air pollution are solid fuels such as coal, lignite, biomass, industrial emissions, and transportation.

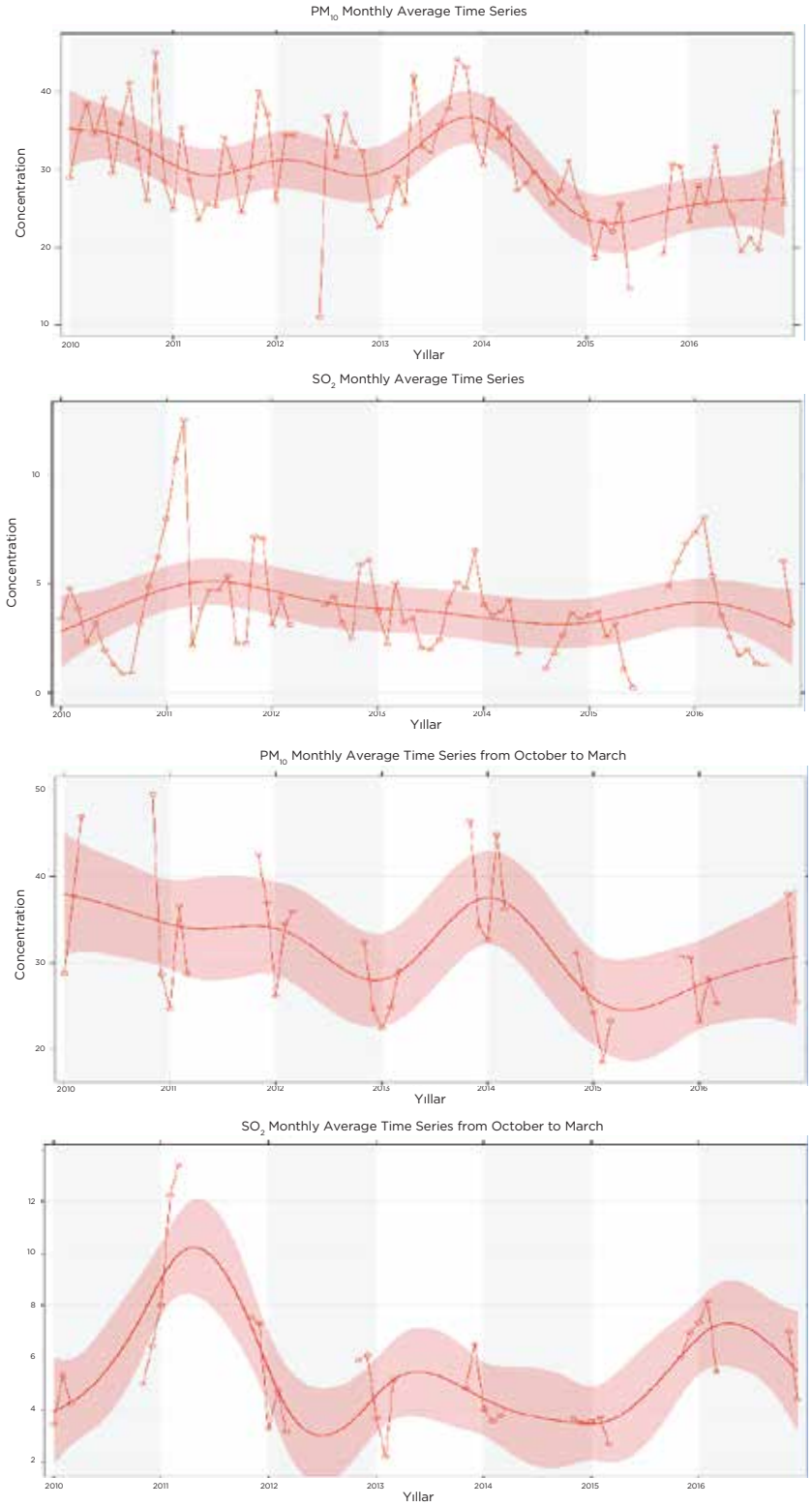
Throughout Eskişehir, 75% natural gas and 25% solid fuels are used for heating purposes in residences. The use of natural gas is only available in Odunpazarı, Tepebaşı and Seyitgazi districts. Fuel consumption rates of the three districts using natural gas between 2011-2016 are provided in the figures below. While it is mostly used for heating purposes in Odunpazarı and Tepebaşı districts, natural gas subscribers in the Seyitgazi district, which started to use natural gas in 2014, are mostly industrial facilities. While the use of natural gas in 2011 was 84% in both Odunpazarı and Tepebaşı districts, in 2016, it increased to 91% in Tepebaşı and decreased to 74% in Odunpazarı.[133]

In terms of air emissions from the industry; there are two organized industrial zones (OIZ), 16 small industrial sites, two technoparks, and three technology development zones in Eskişehir, and there are 792 establishments registered in the Chamber of Industry. 6% of the industrial enterprises are large-scale, 17% are medium-scale, 41% are small-scale and 36% are micro-scale.[134]

133 Eskişehir İli Hava Kalitesi Analiz Raporu (2010-2016). T.C. Çevre ve Şehircilik Bakanlığı, Kuzey İç Anadolu Temiz Hava Merkezi Müdürlüğü. S:43.
134 İstatistiklerle Eskişehir-2017. S:411

In Eskişehir province, the only station monitored by the Ministry of Environment and Urbanization is Odunpazarı station, but very little data of this station is available on the Ministry's website. In the report titled Air Quality in Eskişehir, PM_{10}, and SO_2 levels between 2010 and 2016 are shown in detail. In the report, it is stated that the highest median value in the SO_2 parameter was observed in December and PM_{10} value was observed in November, while SO_2 value was predominantly high in winter.[135]

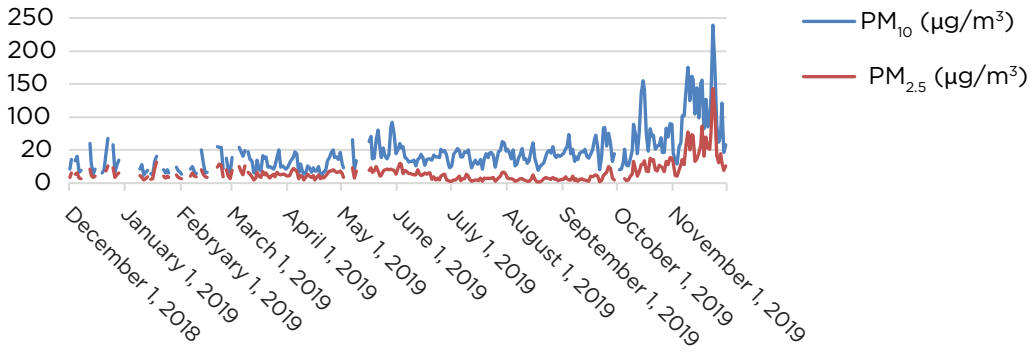
Figure 11. The trend of air PM_{10} and SO_2 parameters in Eskişehir between 2010-2016



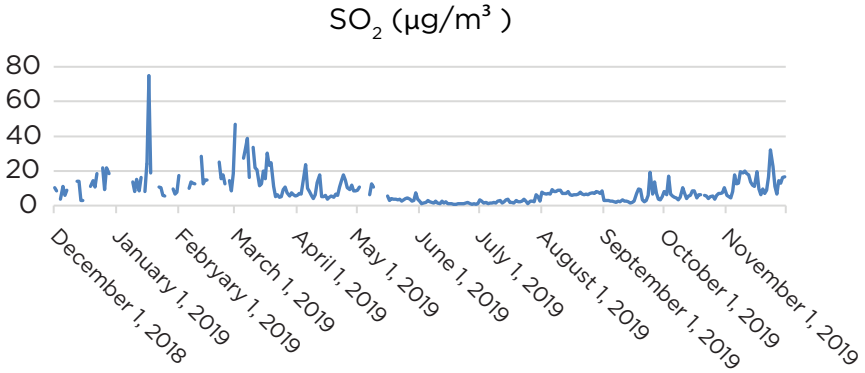
135 Eskişehir İli Hava Kalitesi Analiz Raporu (2010-2016). T.C. Çevre ve Şehircilik Bakanlığı, Kuzey İç Anadolu Temiz Hava Merkezi Müdürlüğü. S:59

In this report, 51% of PM10 level in outdoor air in Eskişehir originates from industry, 22% from heating, and 27% from transportation. For the SO2 level, it is stated that the contribution of the industry is 50%, heating 25%, and transportation 25%.[136] The air pollution parameters of 2017 show that the PM10 level increases up to 100 µg/m³, and in general, both PM10 and SO2 values are higher in the winter months.[137] The parameters measured (24 hours) at the Eskişehir-Odunpazarı station in the last year on the air monitoring website of the Ministry of Environment and Urbanization are provided in the graphics below (Figure 12, 13, 14).

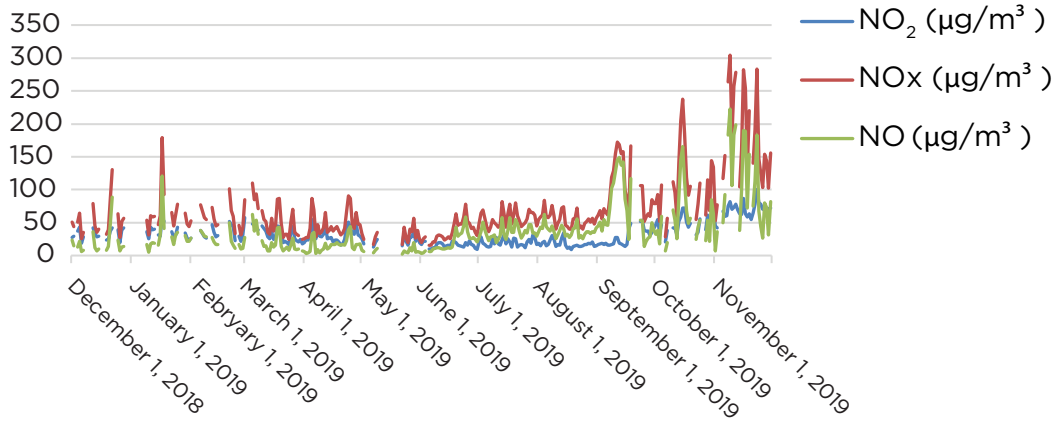
Figurel 12. PM_{10} and $PM_{2.5}$ data measured at Eskişehir Odunpazarı air quality monitoring station (December 1, 2018 - November 30, 2019)



Figurel 13. SO_2 data measured at Eskişehir Odunpazarı air quality monitoring station (December 1, 2018 - November 30, 2019)



Figurel 14. NOx data measured at Eskişehir Odunpazarı air quality monitoring station (December 1, 2018 - November 30, 2019)



Source: Data from the Directorate of North Central Anatolia Clean Air Center of the Turkish Ministry of Environment and Urbanization has been used for Figures 12-14.

136 Eskişehir İli Hava Kalitesi Analiz Raporu (2010-2016). T.C. Çevre ve Şehircilik Bakanlığı, Kuzey İç Anadolu Temiz Hava Merkezi Müdürlüğü. S:80

137 İstatistiklerle Eskişehir-2017. Eskişehir Büyükşehir Belediyesi web sayfası.

According to WHO recommendations, the limit that should not be exceeded for PM_{10} is 20 µg/m³ per year and 24-hour average is 50 µg/m³. For $PM_{2.5}$, the annual average is 10 µg/m³, and the 24-hour average is 25 µg/m³ (the limit values of WHO for air pollutants are provided in Annex-5).

Accordingly, the PM_{10} level in Eskişehir Odunpazarı air monitoring station has exceeded 50 µg/m³'in 92 of the 309 days (29.8%) measured while the annual average level of PM_{10} was 47.2 µg/m³. For $PM_{2.5}$, the annual average was calculated as 16.1 µg/m³, and it was found to be high in 47 of the 309 days (15.2%) measured. $PM_{2.5}$ is one of the most dangerous air pollutants on human health. The fact that there is no limit on $PM_{2.5}$ in the air quality regulation also ignores the danger that may arise in public health.

The daily average limits for SO_2 and NO_2 have not been exceeded in the past year, and their annual average levels are 8.5 µg/m³ for SO_2, 550.5 µg/m³ for CO, 32.0 µg/m³ for NO^2, 69.9 µg/m³ for NOx.

The WHO European Office program called AirQ+ allows the calculation of the number of deaths attributed to air pollution using the average levels of $PM2_{.5}$ in an area.

$PM_{2.5}$ measurements were performed at Odunpazarı Station on 317 days (88%) of 2019.[138]

Annual mean of measured $PM_{2.5}$ values:	: 17,02 µg/m³
Eskişehir population over 30 years old (TSI, 2019)	: 583,706 people
Number of deaths (excluding external causes) in the population over 30 years old (TSI, 2019)	: 5434 deaths
Death rate in the population over 30 years old (excluding deaths due to external causes)	: 930.9 per 100,000

The results indicate that the number of deaths due to all causes is 225 (95% CI: 148-296) per year. In other words, the existing air pollution of Eskişehir causes the death of 225 people every year for all reasons.

Emissions of air pollutants predicted in the project

If the plant operates for 35 years, which is the planned period, a total of 274,890.00 tons of coal will be burned.[139] The table below shows the flue gas emission values calculated in the EIA Report.

138 www.havaizleme.gov.tr
139 ÇED Raporu.

Table 73. The emission values and chimney design parameters of the planned power plant[140]

Flue Gas Emissions	ALPU TES
SO_2	319,77 kg/sa
NO_2	319,77 kg/sa
CO	319,77 kg/sa
PM_{10}	47,97 kg/sa
HCl	159,89 kg/sa
HF	23,98 kg/sa
Chimney height	110 m (234.17 m Effective Height)
Flue gas outlet temperature	304,15 K
The inner diameter of the chimney	8 m
Coal furnace portal input-1	3.2548E-07 gr/sn
Coal stock field	4.2548E-07 gr/sn
Ash landfill area PM_{10}	2.1548E-07 gr/sn

Source: Appencies 3.6 Air Quality Model of EIA Report of the Project

The estimated levels determined in the calculations made by assuming that the planned power plant will operate with 80% capacity in the report titled "Coal-Fired Power Plant Danger in Eskişehir" prepared by Greenpeace are provided in Table 65 below. [141]

Table 74. Estimated air pollutant emissions in coal-fired power plants

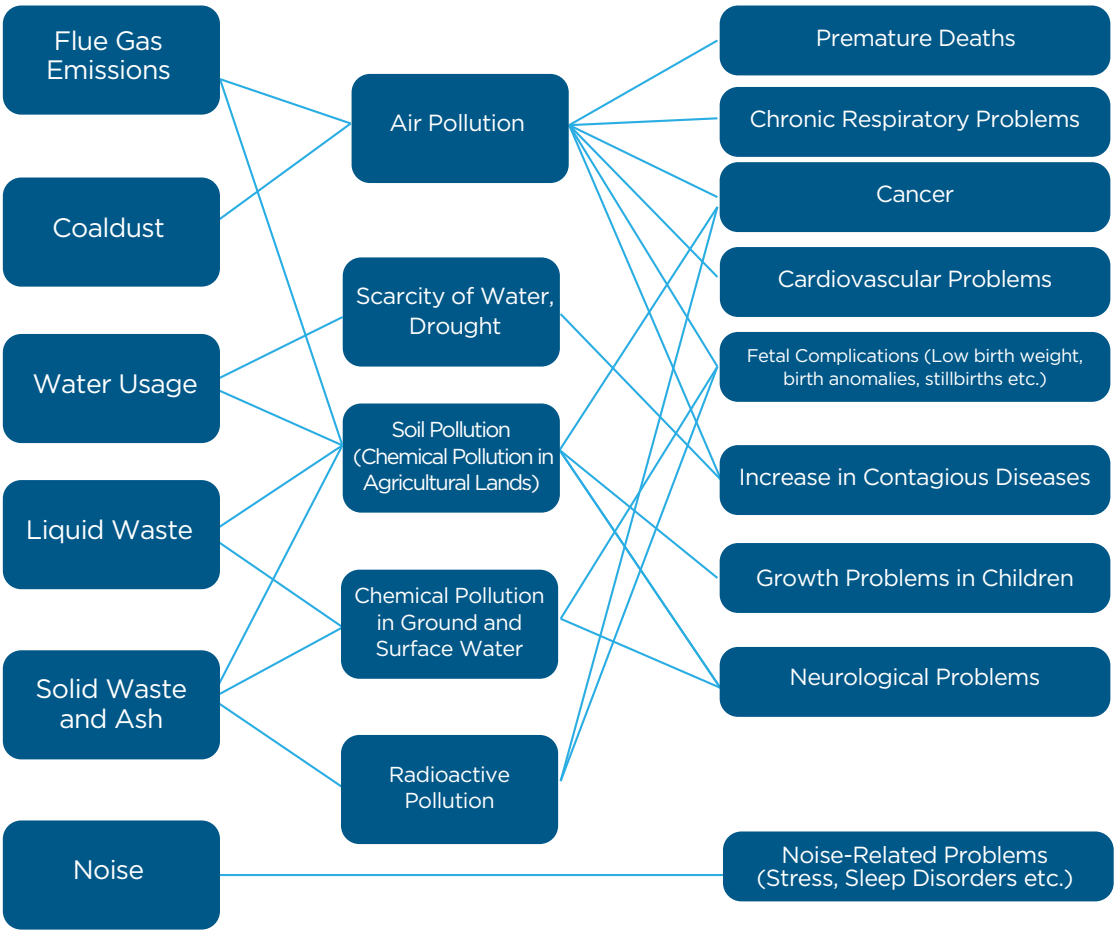
Unites	Flue gas concentrations (kg/hour) Annual emission (t)			
	SO_2	NO	NO_2	Toz
Alpu	5031	4780	252	503

Source: Greenpeace Türkiye, Eskişehir'de Termik Santral Tehlikesi

140 Ek-3.6 Hava Kalitesi Modelleme Raporu s:23
141 Greenpeace Türkiye, Eskişehir'de Termik Santral Tehlikesi (2018)

5.2. Evaluation of The Health Impacts of the Project

5.2.1. Environmental Health Problems to be Caused by The Project



The health hazards of the CPP are summarized in Table 25. Similarly, with the implementation of the Alpu CPP project, dangers such as various air pollutants released from the plant chimney, solid and liquid wastes, thermal pollution, noise, vibration, explosion, radioactivity, etc. will occur.

Table 75. Health impacts of coal fired power plants

Health Impacts	Construction	Conveyor band	Power generation
Air emissions			
Dust	X	X	X
SO_2		X	X
Nitrogen oxides		X	X
Toxic substances and heavy metals			X
CO_2		X	X
Greenhouse gases (CO_2, CFC)		X	X
Steam			X
Steam		X	X
Ozon, HC, VOC		X	X
Liquid and solid wastes			
Surface water	X		
Chemicals		X	X
Fondness			X
Solid wastes	X		
Conditions that cause discomfort and distress			
Vibration	X		
Water use			X
Conveyor			X
Land use			X
Noise	X		X
Energy transmission lines (land use)		X	
Energy transmission lines (EMR waves)			X
Using public services	X	X	X
Explosion		**X**	**X**
Radioactivity			**X**

Source: Health Impact Assessment Guideline for Power Plant Project. Health Impact Assessment Division, Department of Health, Ministry of Public Health. 2016

5.2.1.1. Air Emissions

The most important impact of the CPPs is undoubtedly the air emissions emitted to the atmosphere from the power plant chimney. In the coal-fired power plants, where energy is generated, the pollutants that will result from the burning of coal will cause a significant amount of air pollution and these substances will be transported to kilometers away. In addition, coal dust released from the conveyor belt will affect the closer distances. The pollution of the agricultural products is also possible by the air pollution that results from each combustion and the collapse of the coal dust to the agricultural lands. Exposure of ovine and bovine animals in the affected areas to chemical contamination through both feed and water will lead to chemical pollution, especially in dairy products.

PM, SO_2 and NO_2 emissions of the planned Alpu CPP will be added to the current air pollutant level in Eskişehir and will have a cumulative effect. Eskişehir province is mentioned as one of the provinces to have "clean" as air quality in many reports. The last report of the Right to Clean Air Platform stated that there was not enough measurement in Eskişehir between 2016-2018.[142] The havaizleme.gov.tr webpage of the Ministry of Environment has started to publish air measurements. As provided in Figure 8, the annual average of PM_{10} and $PM_{2.5}$ levels between December 1, 2018, and November 30, 2019, is above the WHO limits and the air quality in Eskişehir is not as good as presumed. The air pollution in Eskişehir, which has been examined in the previous section (5.1.8.2), is estimated to cause early death of 335 people every year.

In a study conducted in Eskişehir reported that the applications to the emergency services due to lower respiratory tract infections, COPD and cor pulmonale have increased with the increase of daily SO_2 level.[143] Another study found that the probability of having a myocardial infarction (heart attack) increased on days when SO_2 and PM levels were high. The same study shows that the risky groups have an increased risk, especially in the cold seasons due to the fact that 10 $\mu g/m^3$ increase in SO_2 is 1.74 times (95% CI: 1.05–2.87) higher in people above 65 in the cold season.[144]

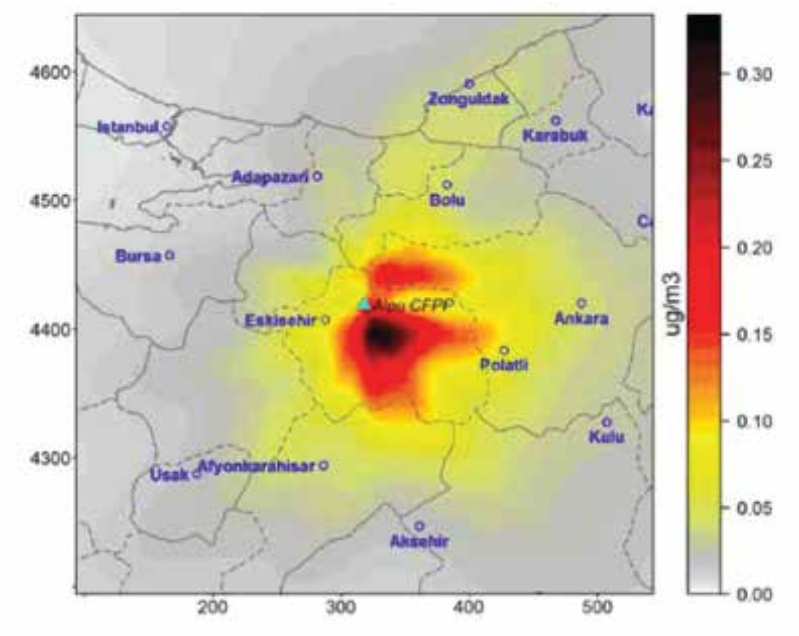
It is estimated that emissions from flue gas will affect $PM_{2.5}$ pollution levels not only around the coal-fired power plant but will also reach up to Bolu in the north-west, Eskişehir in the west and Akşehir in the south, as shown in Figure 12 and Figure 13.

142 Hava Kirliliği ve Sağlık Etkileri, 2019. THH

143 Temiz Hava Hakkı (2018). Eskişehir'de Kara Bulutlar: Alpu Termik Santrali, Hava Kirliliği ve Olası Sağlık Etkileri. Temiz Hava Hakkı Platformu, Eylül 2018.

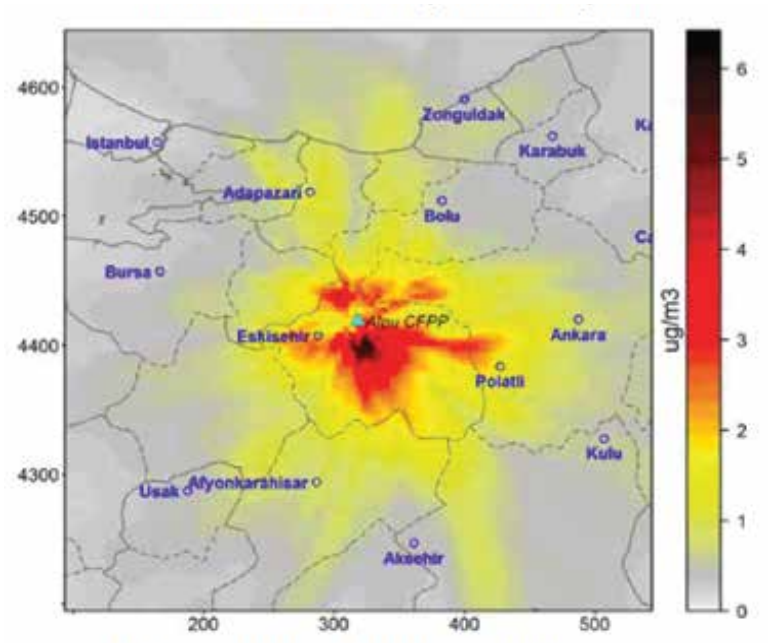
144 Günay O. Yavuz CI. (2009)

Figure 15. Estimated annual average $PM_{2.5}$ concentration (µg/m³) attributable to the Alpu CPP emissions



Kaynak: L Myllyvirta; Greenpeace Akdeniz, (2019); "Eskişehir'de Termik Santral Tehlikesi: Planlanan Alpu Termik Santralinin Hava Kalitesi ve Sağlık Üzerindeki Etkileri

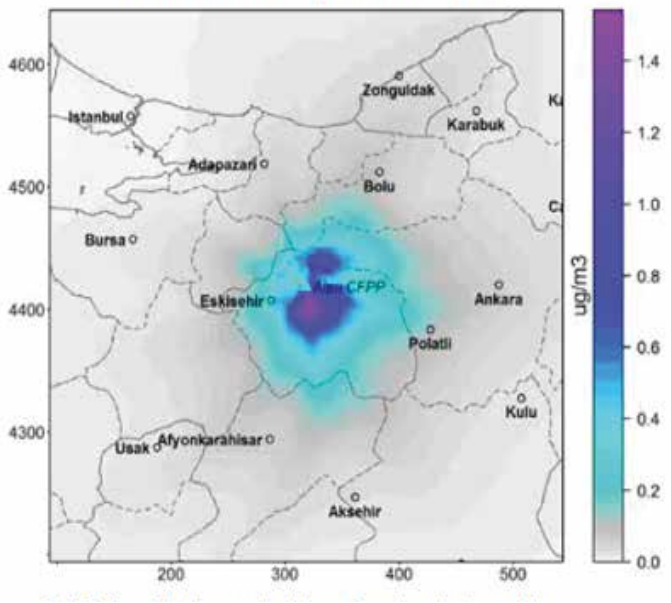
Figure 16. Estimated 24-hour maximum $PM_{2.5}$ concentration (µg/m³) attributable to the Eskişehir Alpu CPP emissions



Source: L Myllyvirta; Greenpeace Akdeniz, (2019); "Eskişehir'de Termik Santral Tehlikesi: Planlanan Alpu Termik Santralinin Hava Kalitesi ve Sağlık Üzerindeki Etkileri

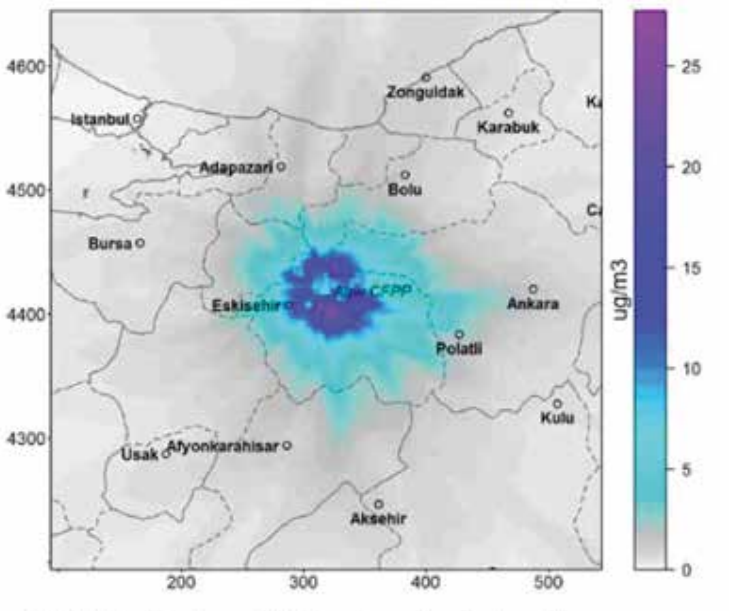
24-hour maximum NO_2 concentrations exceeding 20 µg/m³ in the most affected locations (Figure 15) indicate that one of the biggest impacts in the surrounding regions, especially in Alpu and throughout Eskişehir, will be experienced at the monthly estimated NO_2 level (Figure 19).

Figure 17. Estimated annual average NO_2 concentration (µg/m^3) attributable to the Eskişehir Alpu CPP emissions



Source: L Myllyvirta; Greenpeace Akdeniz, (2019); "Eskişehir'de Termik Santral Tehlikesi: Planlanan Alpu Termik Santralinin Hava Kalitesi ve Sağlık Üzerindeki Etkileri

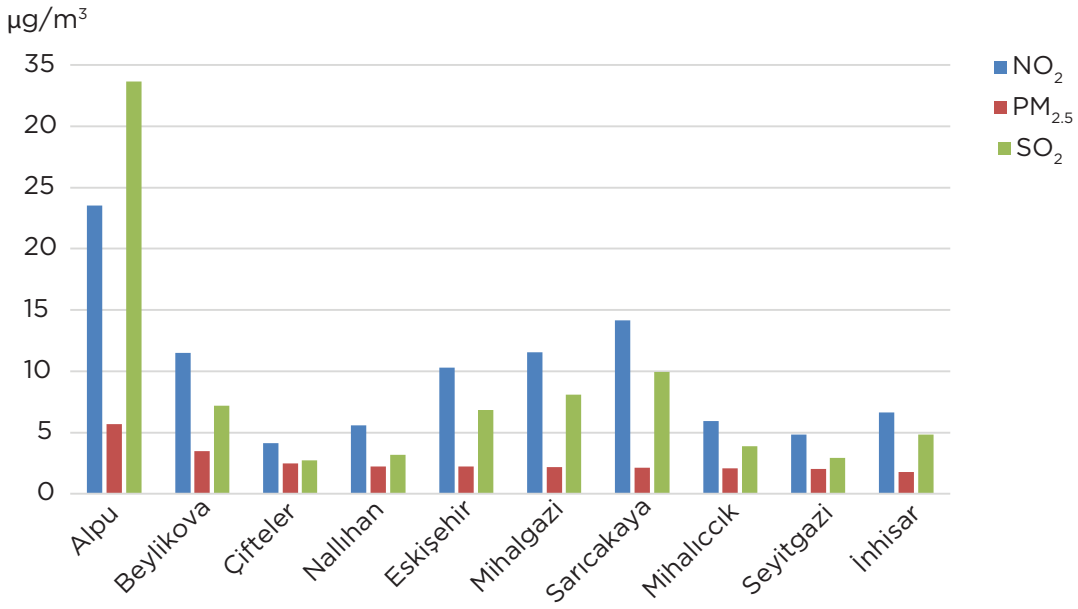
Figure 18. Estimated maximum 24-hour NO_2 concentration (µg/m^3) attributable to the Eskişehir Alpu CPP emissions



Source: L Myllyvirta; Greenpeace Akdeniz, (2019); "Eskişehir'de Termik Santral Tehlikesi: Planlanan Alpu Termik Santralinin Hava Kalitesi ve Sağlık Üzerindeki Etkileri

As shown below, the emissions of the planned Alpu CPP will mostly affect the pollution levels in the cities and towns around the plant. The highest estimated daily NO_2 and SO_2 levels are in the Alpu, Eskişehir center (Tepebaşı and Odunpazarı), Sarıcakaya, Beylikova, and Mihalgazi regions (Figure 16).

Figure 19. Settlements that will be affected the most



Source: L Myllyvirta; Greenpeace Akdeniz, (2019); "Eskişehir'de Termik Santral Tehlikesi: Planlanan Alpu Termik Santralinin Hava Kalitesi ve Sağlık Üzerindeki Etkileri

5.2.1.2. Premature Deaths

In the report titled "Coal-Fired Power Plant Danger in Eskişehir"[145] by Greenpeace, the premature death forecast caused by the air emissions that will occur as a result of the project's implementation has been calculated to be 73 per year in line with current population assumptions. It is estimated that 54 of these 73 predicted deaths will occur due to $PM_{2.5}$ exposure and 19 due to NO_2 exposure (Table 76). Considering population growth and aging, the number of premature deaths in 2030 will increase to 69 and 26 for $PM_{2.5}$ and NO_2, respectively. Acid rain and fly ash spray risks are also serious problems for areas within 50 km of the Alpu power plant.

Table 76. Current and predicted premature death and other health impacts due to emissions of the coal-fired power plant of the study, based on annual cases

	Result:	Current	95% GA	2030	95% GA
$PM_{2.5}$, premature death	Lung cancer	4	(2-5)	6	(4-9)
	Other cardiovascular diseases	13	(8-17)	16	(10-22)
	Ischemic heart disease	19	(11-27)	25	(15-36)
	Stroke	13	(6-20)	15	(7-24)
	Other respiratory diseases	2	(1-5)	3	(2-7)
	Chronic obstructive pulmonary disease	3	(2-4)	4	(3-6)
	PM2.5 Total	54	(30-78)	69	(41-104)
NO_2, premature death	All causes	19	(8-28)	26	(10-38)
Premature deaths	**Total**	**73**	**(38-106)**	**95**	**(51-142)**

Source: L Myllyvirta; Greenpeace Akdeniz, (2019); "Eskişehir'de Termik Santral Tehlikesi: Planlanan Alpu Termik Santralinin Hava Kalitesi ve Sağlık Üzerindeki Etkileri

145 L Myllyvirta; Greenpeace Akdeniz, (2019); "Eskişehir'de Termik Santral Tehlikesi: Planlanan Alpu Termik Santralinin Hava Kalitesi ve Sağlık Üzerindeki Etkileri

5.2.1.3. Impacts on Pregnancy and Reproduction

There are many studies showing that air pollution exposure during pregnancy results in complications such as low birth weight, preterm birth, stillbirth.[146] There is sufficient evidence showing the relationship between particulate matter exposure and deaths due to postpartum respiratory problems. In a meta-analysis study, preterm deliveries increased by 1.23 times with an increase of 10 μg/m^3 in PM_{10}, and 1.14 times with an increase of 10 μg/m^3 in $PM_{2.5}$.[147] Another meta-analysis study reports that every 10 μg/m^3 increase in $PM_{2.5}$ results in a 1.05 times increase in low birth weight and 1.02 times increase in preterm births. In babies born at 20 km distance of the coal-fired power plant, low birth[148] weight is reported as 1.12 times, preterm birth 1.10 times, and very early birth 1.23 times.[149]

The population projection made for Eskişehir until 2050 is provided in detail in Annex-3. Accordingly, assuming that the rough birth rates in 2018 in Alpu, Tepebaşı and Odunpazarı districts will be at the same level, the number of births that will occur for 30 years between 2020 and 2050 is estimated. According to this, 1906 live births will take place in Alpu, 188.200 in Tepebaşı and 176.036 in Odunpazarı. In total 374.910 live births are expected in Eskişehir province. Considering that the coal-fired power plant will operate for at least 35 years, these numbers of births will be even more. The biological mechanisms suggested by molecular epidemiology studies on birth weight, premature birth, and IUGR support the relationship between air pollution and birth results. When it is considered in terms of pollutants, it shows that particulate matter is important for infant deaths and PAHs are important for IUGR.[150]

Although the mechanisms are not fully illuminated, the impacts of outdoor air pollution during pregnancy also vary with chronic diseases of the mother. Chronic diabetes, preeclampsia, and asthma in the mother affect the relationship between air pollution and preterm delivery.[151]

Considering the demographic structure of the population, it is noteworthy that the number of both women and men are more in proportion in the age group of 20-24, which is related to the fact that Eskişehir is a college city. When the population pyramid of the province is examined, it is seen that the population under the age of 25 composes the one third (33.2%) of the population. Another impact of the fact that this population, which constitutes one-third of the population, will be exposed to pollution due to CPP in the early period of their lives will be on the reproductive system.

146 Li et al 2017
147 Lamichhane et al. 2015
148 Li et al 2017
149 Amster and Levy 2019
150 Ambient air pollution and pregnancy outcomes: a review of the literature. Environmental health perspectives (2005)
151 Ambient air pollution and adverse birth outcomes: differences by maternal comorbidities. Environmental research

5.2.2. Health Costs Due to Air Pollution Generated by the Power Plant

The CPP that is planned to be built in Eskişehir will result in an increase in public health spending and place a significant burden on the budget. Health problems caused by air pollution from the plant will cost €146 million per year. If the plant is built, the resulting public health expenditure caused by it over the course of its 35-year economic lifespan as specified in the EIA report will be €6.411 billion.

Table 77. Alpu Coal-Fired Power Plant Project Planned in Eskişehir health costs projected by annual incidents from emissions

	Annual (million euros)			Cumulative for 35 years (million euros)		
Impact	**Average**	**Lowest**	**Highest**	**Average**	**Lowest**	**Highest**
Long-term death, all causes, $PM_{2.5}$	97.1	63.3	128.7	4260.1	2777.6	5646.8
Cardiovascular hospitalization, $PM_{2.5}$	0.0	0.0	0.0	0.4	0.1	0.7
Hospitalization for respiratory problems, $PM_{2.5}$	0.0	0.0	0.0	0.4	0.0	0.9
Days of limited activity, $PM_{2.5}$	7.1	6.3	8.0	261.9	234.6	294.5
Workday loss, $PM_{2.5}$	0.6	0.5	0.7	23.7	20.1	27.2
Low birth weight, $PM_{2.5}$	3.4	1.1	5.9	126.5	39.2	219.6
Postneonatal ölüm, PM_{10}	0.7	0.4	1.2	26.6	13.5	46.0
Bronchitis in children, PM_{10}	0.1	0.0	0.2	3.4	-0.9	7.7
Asthma symptoms in children with asthma, PM_{10}	0.1	0.0	0.1	2.1	0.5	3.8
Incidence of chronic bronchitis in adults, PM_{10}	1.1	0.4	1.7	39.4	14.0	61.6
Bronchitis symptom in children with asthma, NO_2	0.0	0.0	0.0	0.0	0.0	0.0
Hospitalization for respiratory problems, NO_2	0.0	0.0	0.0	0.5	0.3	0.7
Long-term death, all causes, NO_2	35.9	20.4	51.5	1666.8	950.4	2395.8
Total	**146.1**	**92.5**	**198.2**	**6411.7**	**4049.3**	**8705.3**

The calculation method is explained in Section 2.5.

5.2.2.1. Liquid and Solid Wastes

Alpu CPP, which is planned to work for 7000 hours a year, will consume 7.8 million tons of lignite coal annually. Considering that the lignite to be used has an ash content of 27.5%, according to this calculation, 309 tons of fly ash and under boiler ash per hour and 2.1 million tons per year will emerge. Considering the limestone to be thrown into the system for sulfur removal, the total annual solid waste amount will reach 2.8 million tons.[152]

The EIA report contains ash elemental analysis of coal samples taken from the reserve (p:4). Accordingly, it contains mostly SiO2 (silicon dioxide), Al2O3 (aluminum oxide), and FeO3 (iron oxide).

Coal ash contains toxic metals such as arsenic, lead, mercury, cadmium, chromium, and selenium.[153] Even though it is stated that precautions will be taken, these substances will contaminate water and food. At this point, it will be useful to remember the impacts that occurred after the cyanide pool of Kütahya Eti-Maden facility collapsed and spread to an agricultural area. These substances, each of which is dangerous for the human body, are more likely to cause chronic intoxication rather than acute intoxication.

5.2.2.2. Noise

The noise that will occur in the most unfavorable conditions during the operation of the power plant is calculated to be 120 dB and 113 dB for ash landfill areas.[154] Although the conveyor belt is planned to be installed away from settlements, it should be noted that the total 7 km long conveyor belt will be an important source of the noise. The EIA Report states that the noise level in the nearest settlements will be below 35 dB except for the village of Beyazaltın. The Environmental Noise Assessment and Management Regulation of the Ministry of Environment[155] has determined 40 dB in the city and 35 dB in rural areas for bedrooms in terms of indoor noise levels. The regulation sets a limit value of 55dB in the city and 40dB in rural areas for living rooms. The EIA Report states that the noise level arising from the operating area during the day will be calculated to be 65 dB, and this value is higher than the Regulation.

Noise is defined as disturbing sounds. In addition to the loudness of noise, the continuity of the noise is also an important factor in the effect of noise on people. Considering that the facility will operate uninterruptedly for 24 hours, the consequences of continuous exposure to noise are predicted to be problems such as anxiety, sleep disorders, and stress disorder.

152 Eskişehir 1. İdare Mahkemesi Başkanlığı Bilirkişi Raporu. 28 Aralık 2018.
153 Physicians for responsibility (2013)
154 ÇED Raporu, s.368.
155 "Çevresel Gürültünün Değerlendirilmesi ve Yönetimi Yönetmeliği" RG Sayı ve Tarihi: 27601 ve 04.06.2010

Table 78. Assessment of the impacts that can be caused due to the operation of the power plant

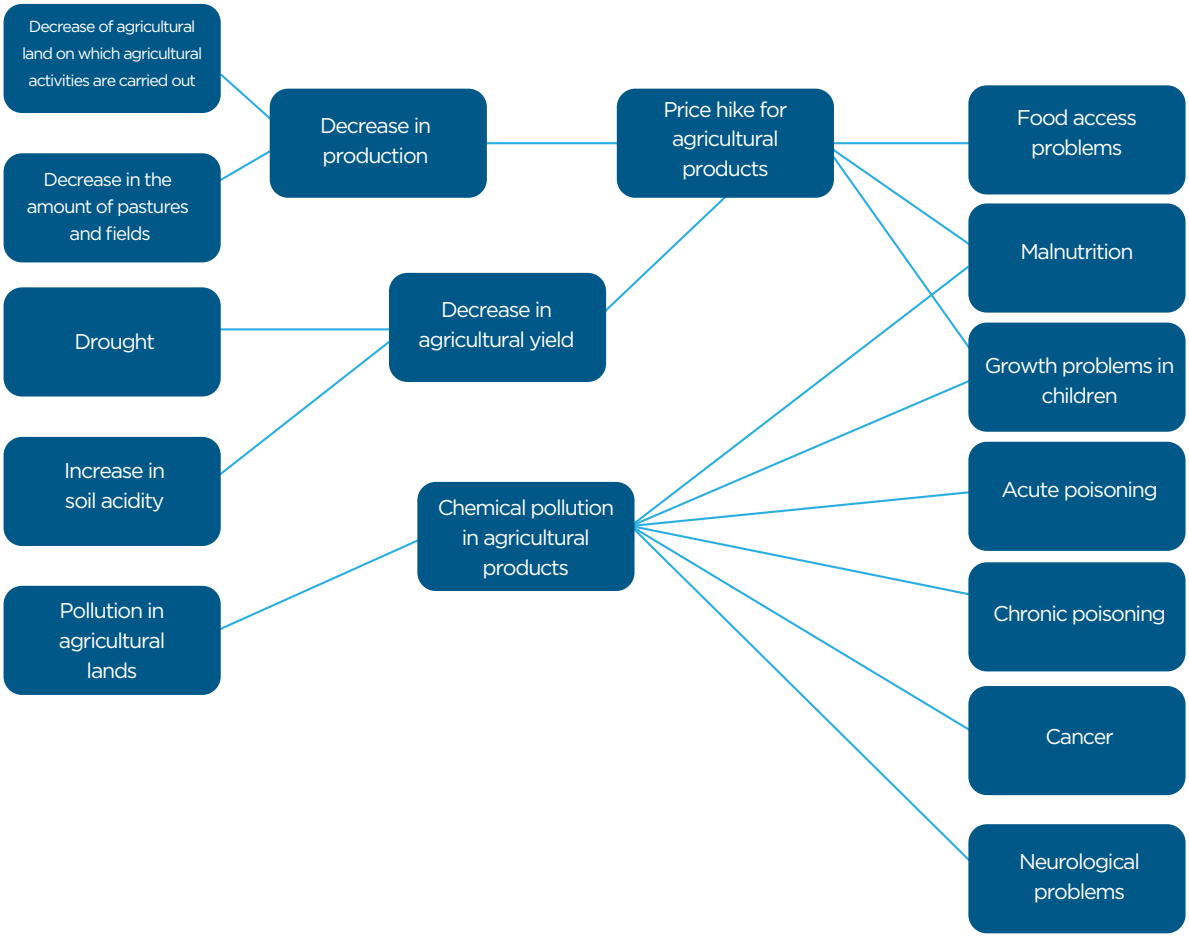
		Impact					
Determinant	Possible impact	Affected population	Intensity[156]	Dura-tion	Magnitude of health impacts	Proba-bility	Severity level
Air pollution	Chronic bronchitis	Population around thepower plant (2)	2	3	1	40-70%	High
	Asthma attacks	Population around thepower plant (2)	2	1	2	40-70%	High
	Cardiovascular diseases	Population around the power plant, including crowded settlements such as Tepebaşı and Odunpazarı (3)	1	3	3	40-70%	Very High
	Neurological problems	Population around the power plant, including crowded settlements such as Tepebaşı and Odunpazarı (3)	1	3	2	<40%	Average
	Cancers	Population around the power plant, including crowded settlements such as Tepebaşı and Odunpazarı (3)	3	3	3	40-70%	Very High
	Low birth weight	Close vicinity of the power plant	1	1	1	40-70%	Average
	Stillbirths	Close vicinity of the power plant	3	3	3	<40%	High
Pollution of drinking and utility water	Chronic toxicity	Population around the power plant, including crowded settlements such as Tepebaşı and Odunpazarı (3)	0	2	1	40-70%	Average
	Acute toxicity	Population around the power plant, including crowded settlements such as Tepebaşı and Odunpazarı (3)	3	0	3	<40%	Average
Drinking and potable water shortage	Increased contagious diseases	Population around the power plant, including crowded settlements such as Tepebaşı and Odunpazarı (3)	1	3	1	70-90%	High
Noise	Stres	Close vicinity of the power plant	1	1	1	40-70%	Average

Table 79. Summary of the impacts that can be caused due to the operation of the power plant

Determinant	Health outcomes	Severity level
Air pollution	Chronic bronchitis	High
	Asthma attacks	High
	Cardiovascular diseases	Very high
	Neurological problems	Average
	Cancers	Very high
	Low birth weight	Average
	Stillbirths	High
Pollution of drinking and utility water	Chronic toxicity	Average
	Acute toxicity	Average
Drinking and potable water problems	Increased infectious diseases	High
Noise	Stress	Average
	Sleep disorders	Average

156 Not: Etki şiddeti 0 - 3 arasında artan şekilde ifade edilmiştir. Detaylar için Yöntem başlığındaki değerlendirme bölümüne (2.3.) bakınız

5.2.3.Health impacts that arise due to the effects on agricultural lands



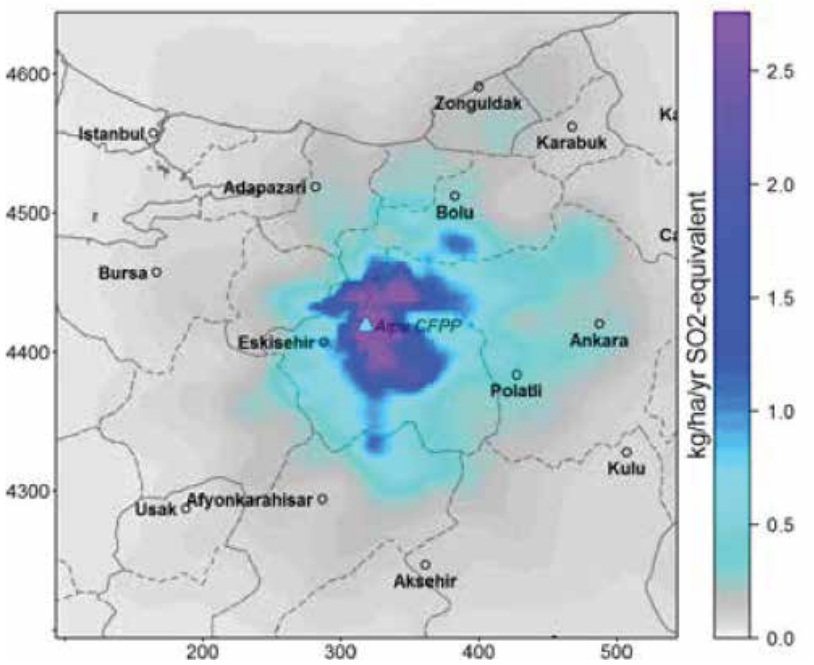
As the direct effects of the project on agricultural lands, the following are expected;

- reduction of agricultural lands through direct land use,
- pollution of agricultural land with toxic substances, especially mercury,
- agricultural lands affected by acid,
- insufficient agricultural irrigation due to the aquifers being affected.

Pollution emissions of the coal plant cause the accumulation of toxic heavy metals and fly ash, as well as acid rains. As seen in the figures below, it is predicted that the most concentrated acid and fly ash accumulation will take place in the regions around the power plant, especially in the north of Alpu, and the most affected areas will be exposed to 2.5 kg SO2 equivalent and 0.3 kg fly ash per hectare each year.[157]

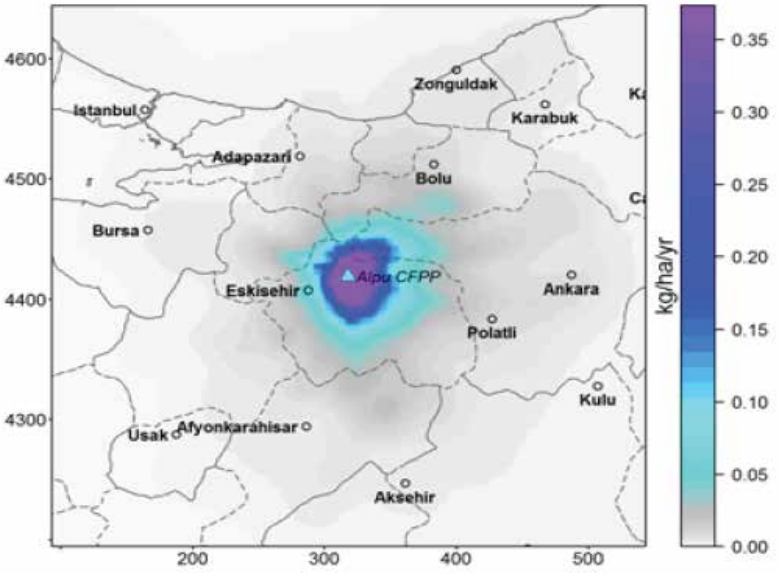
157 Coal-Fired Power Plant Danger in Eskişehir (2018)

Figure 20. Estimated acid accumulation (SO_2 equivalent) from Alpu coal-fired power plants (kg/ha/year).



Source: Greenpeace Türkiye (2018), Eskişehir'de Termik Santral Tehlikesi

Figure 21. Estimated fly ash accumulation from Alpu CPP (kg/ha/year).



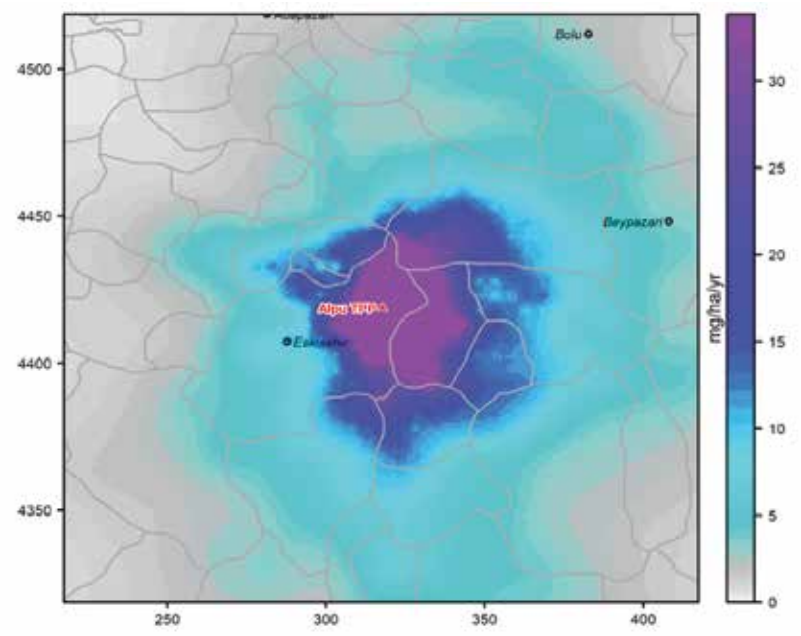
Source: Greenpeace Türkiye (2018), Eskişehir'de Termik Santral Tehlikesi

Pollutants emitted from the chimneys of coal-fired power plants to the atmosphere are transported to long distances by air currents. Ashes coming out of the chimney and carrying heavy metals can be detected up to 30 km away from the power plant. The sulfuric compounds coming out of the flue gas are collected in the form of acid on the leaves in humid environments, descend to the plant roots, reducing nitrogen, causing bacteria to die and increasing the acidity of the soil. [158]

158 KARACA, A., TÜRKMEN, C., ARCAK, S., HAKTANIR, K., TOPÇUOĞLU, B., & YILDIZ, H. (2009). Determination of the effects of Çayırhan coal-fired power plant emissions on the scopes of some heavy metal and sulfur of local soils. Ankara University Journal of Environmental Sciences, 1(1).

It is possible that the mercury from Alpu CPP will affect the aquifers and hence reach the Porsuk stream and Sakarya river, spreading to the soil will affect a wide area. It is believed that heavy metals will enter the food chain as a result of eating fish that are caught from streams contaminated with heavy metals and in addition to using these streams for irrigation in agricultural areas. It should be noted that these agricultural products will not only be consumed in the region, but they will be distributed to all of Turkey.

Figure 22. Estimated annual mercury accumulation (mg/m^3) from Alpu CPP



Source: Greenpeace Türkiye (2018), Eskişehir'de Termik Santral Tehlikesi

Another effect to be considered is the fact that it creates impoverishment in foods as an indirect effect that may arise due to greenhouse gas emissions. It has been reported that in atmospheric conditions with higher carbon dioxide levels, the content of nutrients becomes poor and protein, zinc, iron, B1, B2, B5, and B9 levels decrease. [159]

159 Zhu, C., Kobayashi, K., Loladze, I., Zhu, J., Jiang, Q., Xu, X., ... & Fukagawa, N. K. (2018). Carbon dioxide (CO2) levels this century will alter the protein, micronutrients, and vitamin content of rice grains with potential health consequences for the poorest rice-dependent countries. Science advances, 4(5), eaaq1012.

Table 80. Assessment of possible outcomes upon the impact on agricultural lands

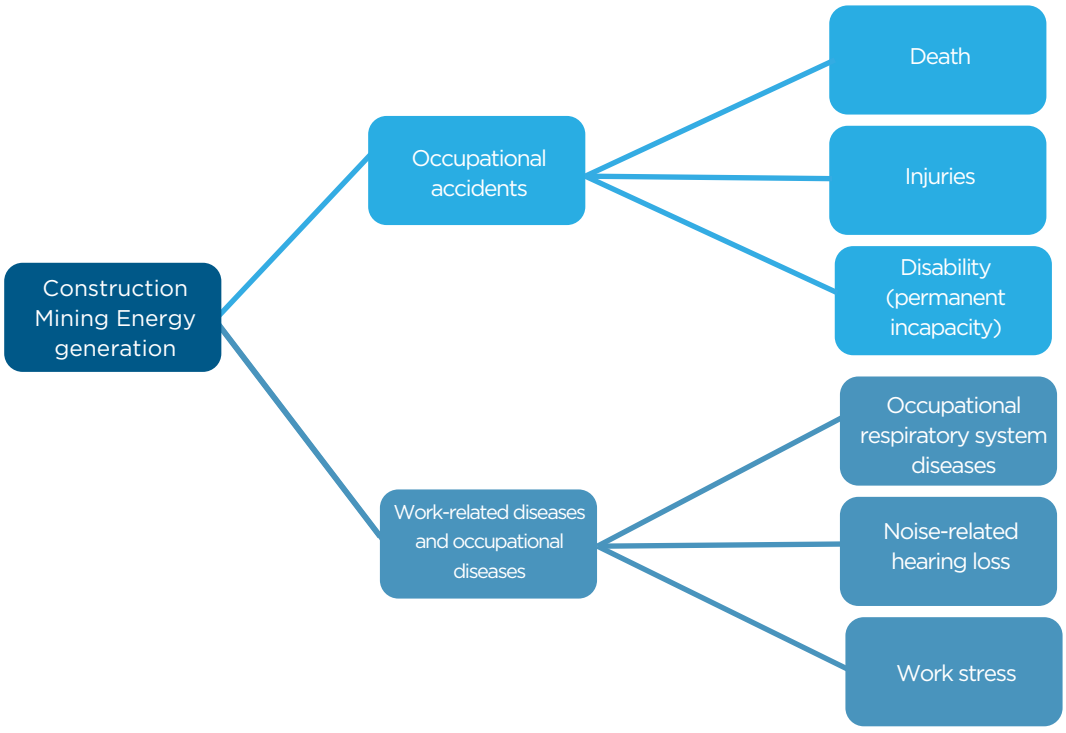
Determinants	Possible health impact	Affected population	Intensity[160]	Dura-tion	Magnitude of health impacts	Probability	Severity level
Difficult access to healthy food due to the expensive food	Inadequate and unbalanced nutrition (obesity, vitamin and mineral deficiencies, etc.)	Local people especially the poor, low incomes (3)	1	3	1	70-90%	High
	Growth and development problems in children	Local people (3)	1	3	2	70-90%	High
Low-nutrient foods	Protein, vitamin mineral deficiency	Local people (3)	2	3	2	>90%	Very high
Chemical exposure in agricultural products	Chronic toxicity	Local people elderly population - it may manifest faster (3)	1	2	1	70-90%	High
	Acute toxicity	Local people	2	0	2	>40%	Average
Food safety from field to table	Cancers, neurological diseases, reproductive health problems, digestive system problems	Local people Especially the elderly population	0	3	3	40-70%	High

160 Note: The intensity of impact has been expressed in an increasing range of 0 - 3. For detailed information about scoring, see Section 2.3 - Evaluation under Chapter 2 - Methodology.

Table 81. Summary of the effects that may arise from the impact of agricultural land

Determinants	Health outcomes	Affected population	Impact direction	Severity level
Difficult access to healthy food due to the expensive food	Inadequate and unbalanced nutrition (obesity, vitamin and mineral deficiencies, etc.)	The poor, low income	Negative	High
	Growth and development problems in children	Children below the age of five	Negative	High
Low-nutrient foods	Protein, vitamin-mineral deficiency		Negative	Very high
Chemical exposure in agricultural products	Chronic toxicity	Elderly population - it may manifest faster	Negative	High
	Acute toxicity		Negative	Average
Food safety from field to table	Cancers, neurological diseases, reproductive health problems, digestive system problems	Especially the elderly population	Negative	High

5.2.4. Effects of the power plant on occupational health



For the Alpu (Tepebaşı) CPP Project, which is planned to be built, occupational health and safety (OHS) services and the risk of possible occupational accidents and occupational diseases should be examined under three headings: coal mining, construction, and operation of the power plant.

During both the construction and operation phases, the Alpu CPP and the mines, which are planned to provide coal reserves for this power plant, and the ash landfill areas are included in the VERY HAZARDOUS class according to the relevant communiqué of the Ministry of Labor and Social Security. [161]

For the facility, which is planned to be built and put into operation in three main sections (1-Reserve Area, 2-Coal-Fired Power Plant, 3-Ash landfill area), the occurrence of serious occupational accidents in the short and long term (death and permanent disability) and occupational diseases (mainly respiratory and skin diseases) is estimated.

According to the EIA report, the planned duration of the Coal-Fired Power Plant from the project to the production process is 62 months. The period determined for the operation of the power plant and landfill area activities is planned to be approximately 30 years.

Again, in the EIA report, the total number of personnel to work underground and aboveground for the reserve area is 2200 people (3 shifts total), 1500 people for the coal-fired power plant construction (2 shifts total), 1000 people for power plant operation (3 shifts total), and 30 people for ash landfill areas construction (2 shifts total), 20 people for landfill area operation (3 shifts total), and 4750 people in total.

A total of 1530 people is planned to work for about 62 months for the construction area, 1020 people for the operation for about 30 years, and 2202 people for the Reserve area (both production and construction).

Based on SSI statistics, it is possible to predict the number of deaths related to occupational accidents for this facility. The estimated number is more difficult to predict since occupational diseases and associated deaths have a long pathogenesis period of 20 years on average.

Based on the figures above, it has been calculated that during the construction of the power plant, mining and operation of the power plant which is 35 years, 17,852 occupational accidents will occur and 290 of them will result in death (Table 79). As a result of the establishment of Alpu CPP, there will also be 96 occupational diseases and 189 permanent incapacities. In the same table, it is evident that if the total number of people to work in the construction, mining, and operation in the power plant continues agricultural activity, the estimated number of occupational accidents will be 3150, 29 deaths due to occupational accidents, one occupational disease, and 55 permanent incapacity cases.

161 Communiqué on Hazard Classes of the Ministry of Labor.

Table 82. Alpu CPP construction and mining activity costs to occupational health

	Duration of the operation	Number of workers	Number of occupational accidents	Expected Number of deaths due to occupational accidents	Occupational diseases	Permanent incapacity
Construction	5,2 years (62 months)	1530	128	128	0,1	4
Mining	35 years	2200	17089	17089	95	185
Operation	35 years	1020	634	634	0,5	0
Project total	40,2 years	4750	17852	17852	96	189
Agriculture	40,2 years	4750	3150	3150	1	55
Alpu CPP/ Agricultural activity ratio			5,7	5,7	96,0	3,4

The calculations made were based on the EIA report and SGK data.

As mentioned in the previous chapter, according to the EIA report, the noise that will occur in the most unfavorable conditions during the operation of the power plant is calculated to be 120 dB and 113 dB for ash landfill areas.[162] According to the legislation of the Ministry of Labor,[163] being exposed to 85 dB noise continuously in working environments equals the risk of hearing loss due to noise.

Table 83. Evaluation of the impacts that may occur because of mining and power plant construction[64]

		Impact					
Determinants	Possible health impact	Affected population	Intensity	Duration	Magnitude of health impacts[154]	Probability	Risk Estimate
Working Conditions	Injuries due to occupational accidents	**Workers (1)**	2	1	2	40-70%	Average
	Deaths due to occupational accidents	**Workers (1)**	3	3	3	<40%	High
	Occupational diseases	**Workers (1)**	3	3	3	<40%	High
	Disability (incapacity to work)	**Workers (1)**	3	3	3	<40%	High
	Stress	**Workers (1)**	1	1	0	70-90%	Low
Noise	Hearing loss	**Workers (1)**	2	3	1	70-90%	High
	Stress	**Workers (1)**	1	1	0	70-90%	Low
Traffic accidents	Injuries and deaths	**Vicinity of the power plant (2)**	2	1	2	40-70%	High

162 Kaynak: EN-ÇEV A.S. ; 2018, "Alpu Termik Santrali ve Bu Santrale Kömür Saglayacak Olan Rezerv Alanındaki Yeraltı Maden Isletmesi ile Kül Düzenli Depolama Tesisi Projesi Nihai ÇED Raporu"; sayfa 368

163 "Çalışanların Gürültü ile İlgili Risklerden Korunmalarına Dair Yönetmelik" RG Sayı - Tarih: 28721 - 28.07.2013

164 Not: Etki şiddeti 0 - 3 arasında artan şekilde ifade edilmiştir. Detaylar için Yöntem başlığındaki değerlendirme bölümüne (2.3.) bakınız

Table 84. Impacts on occupational health and safety

Determinants	Health outcomes	Impact direction	Severity level
Working Conditions	Injuries due to occupational accidents	Negative	Average
	Deaths due to occupational accidents	Negative	High
	Occupational diseases	Negative	High
	Disability (incapacity to work)	Negative	High
	Stress	Negative	Low
Noise	Hearing loss	Negative	High
	Stress	Negative	Low
Traffic accidents	Injuries and deaths	Negative	High

5.2.5 Impacts on employment and income

Income, employment, social security, etc. economic indicators are among the most important macro determinants of public health. Therefore, the economic situation created by the power plant has the potential to affect the health of the population of the region, especially in the long term.

In the construction activity of the power plant, 1530 people will be employed for 62 months (5.2 years). During the 35 years in which the power plant will operate, a total of 3220 people will be employed. As mentioned in the previous "5.1.4. Socio-economic Status" chapter, according to the records in the province, there are 6891 people engaged in agricultural activities within the scope of Law No. 2926. Considering that unregistered employment in agriculture is more than 70% in Turkey, it is safe to assume that this number is quite below the actual number of people employed in agriculture. Approximately 10 thousand seasonal agricultural workers should be added to this number.

Agriculture will be damaged in Eskişehir due to the Alpu CPP project and a section that provides a livelihood from agriculture will be unemployed due to reasons such as a decrease in the product yield and the products contaminated with chemical substances not finding a place in the market as well as the land use due to the project.

Another consequence of the decrease in agricultural activity in the Alpu Plain is predicted to be in the food industry in the province. Production of food products takes second place with a rate of 12.9% in industrial production in Eskişehir. Considering the sectoral distribution of the Eskişehir industry, it is known that it is in the 2nd place in terms of the number of companies and in the first place in terms of the number of employees.[165] Employees in food manufacturing in Eskişehir make up 13.7% of the employment in the province (Section 5.1.4.2.). In SSI statistics "manufacture of food products" activity is higher in Eskişehir than the average of Turkey. It is thought that the higher food production activities Eskişehir province is related to the processing of products obtained from agriculture and animal husbandry in the province; it is not possible to make this distinction from SSI statistics. It can be predicted that the decreased agriculture and animal husbandry in the province will also decrease activities such as processing, sale of vegetable and animal products, etc. in the region.

In summary, with the implementation of the project, 3220 people will be employed in the project, while some of the farmers, whose number is around seven thousand, will be unemployed.

With the realization of the project, it is possible to predict the change in the income of employment based on SSI statistics. It is known that the average daily earning of a 4a (SSI insured employees) employee under law no 5510 in 2017 is 71.81 Turkish Liras in the construction sector, 194.54 Turkish Liras in the mining sector, and 133.34 Turkish Liras in the "generation and distribution of electricity, gas, steam and air systems" sector, and 85.44 Turkish Liras in the vegetable and animal production sector.[166] It is understood that the transition from agricultural work to construction work will not cause an improvement in the economic situation of the employees. It was not possible to compare the income of the workers in the mines and power plants with the income obtained from agriculture due to the lack of data. However, the direct or indirect effect of the use of agricultural lands in the province will result in the dispossession of the farmers in the region.

165 Eskişehir ili 2017 Yılı Yatırım Destek ve Tanıtım Stratejisi. S.
166 SGK, İşyeri ve sigortalılara ait istatistikler, 2017.

Table 85. Evaluation of the impacts of the economic changes of the project on health

Determinant	Possible impact and direction of impact	Affected population	Intensity	Duration	Magnitude of health impacts	Probability	Risk Estimate
Employment	Effect on living conditions (+)	Power plant workers and their families (1)	3	3	2	%70-90	Very high
	Access to healthcare services	Power plant workers and their families (1)	3	3	2	%70-90	High
	Post-retirement life standards	Power plant workers and their families (1)	2	3	1	%70-90	Average
Regular income	Having healthy living conditions	Power plant workers and their families (1)	3	3	1	%70-90	High
Unem-ployment	Effect on living conditions (-)	Agricultural workers and their families (Farmers and seasonal agricultural workers) People working in the field of agricultural (food) production(3)	3	3	2	>%90	Very High
	Effects on mental health (-)	Agricultural workers and their families (Farmers and seasonal agricultural workers) People working in the field of agricultural (food) production(3)	3	3	2	>%90	Very High

Table 86: The impacts of the economic changes on health

Determinant	Health outcomes	Affected population	Impact direction	Severity level
Employment	Having healthy living conditions	Power plant workers and their families	Positive	High
	Access to healthcare services	Power plant workers and their families	Positive	High
	Post-retirement life standards	Power plant workers and their families	Positive	High
Regular income	Effect on living conditions	Power plant workers and their families	Positive	High
Unemployment	Effect on living conditions	Agricultural workers and their families (Farmers and seasonal agricultural workers) People working in the field of agricultural (food) production	Negative	Very High
	Effects on mental health	Agricultural workers and their families (Farmers and seasonal agricultural workers) People working in the field of agricultural (food) production	Negative	Very High

5.2.6. Evaluation in terms of natural disaster risk

In the comprehensive report prepared by UCTEA and Chamber of Geological Engineers, “Nature Related Risks and Resulting Problems” are gathered under three headings in the evaluation made on the Final EIA Report of Eskişehir Alpu Coal-Fired Power Plant Project. These are:

• Active Fault and Earthquake,
• Flood
• Landslide

- Active Fault and Earthquake

In the final EIA report presented, only seismicity and landslide type risks were partially examined and their relationship with the impact of the project was not be revealed, and there is no analysis on the flooding on the Porsuk River and its important branches. It is not understood to what extent the project will be affected by nature risks. Since the risks in question cannot be established with the impact area of the project, it is not possible to predict what kind of measures should be taken.

Indeed, there are active faults in this region. No detailed examination has been made on this. The fact that Eskişehir Fault is 22 km away does not mean that the effect of an earthquake on this fault will be less. First of all, the impacts of such an earthquake underground in both the Coal-Fired Power Plant area and the B-Sector have not been investigated. It will be useful to take the magnitude of the earthquake that is likely to affect Eskişehir as at least M = 6.4 in projects and designs.

The assessment of earthquake is based on small-scale maps. "Deterministic and Probabilistic Earthquake Modeling" is required on the field. Again, it should be associated with the Turkey Earthquake Hazard Map that was reviewed last month, and interpretations should be carried out according to this final state.

- Flood

There is no evaluation of the flood. The information presented in the Final EIA Report pages 241-242 is insufficient and it is thought that the flood analysis should be modeled by considering possible disasters at least every 50 or 100 years.

- Landslide

The assessment of landslide is based on small-scale maps. In this regard, it is necessary to conduct detailed studies especially in the northern parts of the area where the Coal-Fired Power Plant will be built.

5.2.7. Hydrological Effects

In order to understand the environmental impact of the coal-fired power plant planned to be built in Eskişehir, it is necessary to know the underground and surface water system of Eskişehir in particular. Water is one of the main components of structural and vital formation in Eskişehir. Every scientific approach to Eskişehir in terms of water shows that the province has an integrated water system.

Most of the settlement grounds in Eskişehir consist of sand, silt, and clay mixtures up to the first 10 meters. In a few regions, it was observed that the ground consisted of clayey sand and gravel. This type of ground formation carries risks in terms of construction and earthquake on this ground. Especially in terms of Eskişehir Plain, the layers that can be considered as solid in Eskişehir can only be found at a depth of 20-50 meters. It is obvious that the ashes coming out of the coal-fired power plant can be stored in existing meerschaum quarries and will be mixed with groundwater. It is understood that there is groundwater flow in Eskişehir province from the peripheries to the center and the water tank in the plain is fed with this flow. The following determination has been reached with other studies: As we move away from the Porsuk Stream, the underground well water becomes fresher. In other words, there is a trade between Porsuk and groundwater in the plain. The harmful chemical ratio (such as nitrogen derivatives, heavy metals, etc.) in Porsuk Stream can increase with the pollution of the environment. This causes contamination of groundwater and hot thermal water through the water system. The fact that Eskişehir has a water system is an important tip for keeping our water resources clean and for their careful use.

Considering the groundwater (such as deep water, groundwater) and surface waters such as Sakarya, Porsuk, and their branches, Eskişehir is an example of a fully composite container in terms of water. In the meantime, we should also note that new sources coming with precipitation as snow and rain directly feed this compound container system. Any negativity that forms or created at a point related to water is exposed in another aspect of the water system. Geological and hydrological researches confirm that if there is pollution in any source that creates the system, it will be reflected in the other water assets. Harmful chemical contamination at any point in the water system will be rapidly reflected in the other water assets.
When coal ash comes into contact with water, toxic components can pass from ash to water. It has been observed in the world examples that coal ash transfers toxic substances for living life to surface waterways such as rivers, streams, and wetlands, groundwater sources that supply drinking water, or aquifers.

Conceptual and numerical models are not established in terms of hydrogeology. The relationship of the project with groundwater and groundwater is unknown. Existing water uses and water user studies in the region have not been conducted. Therefore, impact assessment to water users is not included in the report.

Groundwater observation wells drilled in the region, the aquifer status of the region and the water condition used for irrigation have not been defined characteristically, and the amount of water to be used in the coal-fired power plant facility and its effect on the groundwater situation in the region have not been determined and shown on the map.

Since the licensed and unlicensed water wells, Porsuk stream, and the aquifers in the region have not been examined in the EIA report, it is not correct to compare and interpret the underground water source status of the region and the water expenditure potential of the facility. The groundwater usage status, groundwater flow direction, water quality and amount of water to be used in the facility are not clearly stated. Except for the static water level of the surrounding water wells, the aquifer and well artesian conditions are not mentioned and hydrogeological evaluation is not made.

No studies on acid mine drainage have been conducted in the region.

The return of the water used in the cooling system in the CPP to nature after reaching high temperature is called thermal pollution. It raises the temperature of the water in the environment in which it is discharged and threatens the biological viability of the water as a result of reducing the dissolved oxygen in the water. Therefore, thermal pollution is an important danger for the ecosystem.

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CHAPTER 6

CHAPTER 6

6. Conclusion

The primary impact of Alpu CPP is the emissions of substances such as PM, SO_2, NO_2, fly ash, and mercury from the power plant into the air. These emissions will directly impact human health through inhalation, and indirectly impact human health by entering the soil, water, and subsequently into the food chain. Not only will this spread affect the vicinity of the power plant, but it will also spread beyond the province of Eskisehir to the provinces of Ankara, Afyonkarahisar, Aksaray, Bartın, Bilecik, Bolu, Bursa, Çankırı, Çorum, Denizli, Düzce, Isparta, Karabük, Kastamonu, Kırıkkale, Kırşehir, Kocaeli, Konya, Kütahya, Sakarya, Uşak, Yozgat and Zonguldak and affect the health of **more than 11 million people in 24 provinces over 35 years.** The International Agency for Research on Cancer (IARC) included outdoor air pollution in **Group 1 (a definitive carcinogen)** among the causes of cancer in humans in 2013.

It is estimated that the air is already polluted in Eskişehir province, and thescientific calculations suggest that 195 people die prematurely due to airpollution in Eskişehir. It is calculated that, with the additional pollution during the operations of the planned Alpu CPP, at least 300 people will die prematurely due to air pollution. Considering the 35-year lifespan of the power plant's operation, **the number of premature deaths will reach 10,000 according to relatively optimistic predictions.** In addition, due to air pollution, increases are expected in cases of chronic lung diseases, acute asthma attacks, cardiovascular diseases, and especially neurological problems and cancers due to mercury. It should also be noted that air pollution has negative consequences on pregnancy, causing low birth weight and stillbirths. It should also be taken into consideration that the pollution that will spread from the chimneys of the Alpu CPP will spread not only to Eskisehir but also to the surrounding provinces.

The construction of the power plant and its operation for the next 35 years will aggravate **worker health issues** in the region, and many deaths, occupational diseases and injuries will occur due to occupational accidents with the transition from agricultural production to energy generation.

Another important impact area of Alpu CPP will be on Alpu Plain when the agriculture and related food sectors are replaced by the mining and energy sector. This change will **reduce agricultural food production** in the plain, which is an activity of great economic significance for the entire province. This is expected to lead to a decrease in employment and income, which are the most important social determinants of health. Alpu district is the region where Meerschaum, which is a mineral unique to Eskisehir, is extracted. The coal mines to be opened for the power plant have the possibility of damaging the Meerschaum resources, and this will have a negative impact on both the economy of the province and touristic activities.

The realization of the Alpu CPP project will have significant impacts on agriculture in the Alpu Plain. These impacts include the destruction of some agricultural areas, acidification of the soil, degradation of the product quality, and damage to food safety. These effects will also reduce economic access to food, as products will become expensive and cause nutritional problems among the low-income population.

The main reasons for the project appear to be job creation and economic development. According to the EIA report, the project will provide employment to 1500 people during the 62-month construction period of the power plant, and to **3250 people** over the 35-year economic lifespan of the power plant's operational period. However, upon the realization of the project and the consequent disruption of the local agricultural activities, **a portion of the 25,000 workers registered in the farmer registration system will cease their activities** and a number of households and people whose number we cannot estimate will lose their jobs and income due to the decrease in food production and agriculture.

The subject should not be considered only as an underground energy source: it should also be noted that the resulting hydrological pollution can poison all people, freshwater, salt water and drinking water sources, aquifers, irrigation water, surrounding streams, and agricultural products. Therefore, it is of utmost importance to remember that water is the most important component for living beings. Furthermore, it is seen that these adverse effects will affect the Sakarya River and, in turn, impact the **agricultural areas in the Sakarya Plain.**

Coal-fired power plants are considered to be the most polluting among energy generation methods. Due to the climate crisis, which is becoming more prominent every day, many countries have started to abandon coal-fired power plants during their pursuit to reduce greenhouse gas production.

In addition to all of these important considerations, according to the research made with data from August 2018, **the purchase guarantee (2 billion Turkish Liras per year) that will be made for the electricity produced by the Eskişehir/Alpu CPP can instead be used for the following services and investments:**

- The salary of 1,143,275 four-person, single-income families at the starvation line can be paid for one month.
- The current net minimum monthly salary can be increased from 1,603.12 TL to 1,845.22 TL.
- The one-year salary of 43,000 of the 430,000 teachers awaiting public employment in public schools can be paid. During the 15-year purchase guarantee expected to be provided to the power plant, all teachers awaiting employment can be appointed within 10 years.
- 11 700-bed hospitals can be built.
- A solar power plant with an installed capacity of 563.69 MW per year can be built.
- With the 15-year purchase guarantee expected to be provided to the power plant, Turkey's current installed solar power could be increased by a factor of 2.15.

In summary, according to this study that is conducted for the Eskisehir Alpu Coal-Fired Power Plant, which is Turkey's first Health Impact Assessment Report for a coal-fired power plant:

- The planned coal-fired power plant will have serious consequences for the health of the people.
- These consequences are not restricted to Eskişehir; in other words, it is likely that they will spread across multiple regions.
- With the transition from agriculture to mining, agriculture in the region will grind to a halt.
- Problems regarding access to food will arise; thus, the region will be adversely affected, especially in terms of nutrition.
- The claimed socioeconomic contribution will be limited to the people working at the power plant, as this contribution is in the forms of regular income and social security. Formal and informal employment in agriculture will be threatened.

After the conducted Health Impact Assessment, the following are recommended:

The impact of coal-fired power plants is not only limited to the region it is built in: it also has region-wide, country-wide, and global effects. This impact creates negative consequences for the ecosystem, the living beings that are part of the ecosystem, and therefore human health. Furthermore, other aspects impacting human health, such as agricultural production, should also be taken into account. During the permit process of coal-fired power plants, a wide perspective that also includes social and health-based considerations for all living beings should be used, instead of just the EIA procedures.

In light of the existing data, analyses, and evaluations, it will be the most appropriate approach to cancel the Alpu CPP project and meet the energy needs using **clean energy methods.**

Since the absence of $PM_{2.5}$ regulations prevents the monitoring of adverse effects of important air pollutants such as coal-fired power plants, there should be **national legislation regarding $PM_{2.5}$,** and limit values should be determined. The limit values determined by the WHO should be taken as a basis in determining the air emission limits in national legislation.

The entire scope of Health Impact Assessment should be included in legislation, HIA should be conducted by a committee of experts, and the regulatory measures should be reinforced by strict supervision and deterrent sanctions.

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8. Annexes

ANNEX-1: JULY 25-26, 2019 - ESKİŞEHİR ALPU COAL-FIRED POWER PLANT HIA GUIDANCE TEAM MEETING ATTENDEES LIST

	NAME	ORGANIZATION	OCCUPANCY
1	Nilay Etiler	TMA Public Health Department	Public Health Specialist
2	Ayşe Yıkıcı	Freelance	Urban Planner
3	Onur Akgül	Greenpeace	Public administration
4	Levent Özbunar	UCTEA Chamber of Agricultural Engineers	Agricultural Engineer
5	Ahmet Kapanoğlu	Eskişehir City Council	General Secretary
6	Hidayet Açar	Tepebaşı Municipality	Physician
7	Sinem Şaylan	Eskişehir M. Municipality	Environmental engineer
8	Derya Balcı	Odunpazarı Municipality	Urban Planner
9	Melih Karasözen	TEMA Eskişehir	Mechanical engineer
10	Kübra Ayçiçek	TEMA Headquarters	Environmental engineer
11	Yiğit Önen	Odunpazarı Municipality	Geophysical engineer
12	Hasan Sofuoğlu	Tepebaşı Municipality	Veterinary
13	M Sadık Yurtman	Eskişehir Environmental Association	Mechanical engineer
14	Barış Adıgüzel	Eskişehir Environmental Association	Construction engineer

ANNEX-2. HIA Meeting
ESKİŞEHİR ALPU COAL-FIRED PLANT HEALTH IMPACT ASSESSMENT MEETING - 1 -

Date : July 25-26, 2019
Location : Eskişehir Bilecik Chamber of Physicians (EBTO), Eskişehir
Attendees : Alpu Coal-FiredPower Plant (CPP) Health Impact Assessment (HIA) team

Purpose of the meeting

In this two-day program, it was aimed at the Alpu CPP HIA report team to get acquainted with each other, to synchronize their knowledge about the HIA method, to get informed about the planned CPP project, to plan the HIA study and to examine the CPP area.

Schedule

The schedule, where the first day is planned as key presentations and workshop, and the second day as a field visit, is as follows:

1st DAY	WORKING TOGETHER	
09:00-09:30	Discussion	
09:00-10:15	Briefing on Health Impact Assessment (HIA) Method	Nilay Etiler TMA
10:15-10:30	What is the purpose of the HIA study for Alpu CPP?	Onur Akgül Greenpeace
10:30-10:45	Break	
10:45-12:00	Briefing on Alpu CPP project	Eskişehir ZMO
12:00 – 13:00	Lunch	
13:00 – 13:45	Expectations from the workshop, working method, etc.	Nilay Etiler
13:45-14:00	Break	
14:00- 16:15	Workshop	HIA Team
16:15-16:30	Break	
16:30-17:00	Summarizing/sharing the results	HIA Team
2nd DAY	SITE VISIT	
08:45	Meeting (Göksu Bridge)	HIA Team
09:00	Departure to the project site	
10:00-13:00	Examination of the planned Alpu CPP area	HIA Team
13:00-14:00 PM	Return to the city	
14:00–15:30 PM	Lunch and evaluation of the site visit	HIA Team

ANNEX 3: SITE OBSERVATIONS IN ALPU CPP AREA

Interviews (November 12, 2019, Tuesday)

Personal Interview

Agricultural engineer, male, in his 40s. Eskişehir Chamber of Agricultural Engineers.

The water quality of the Porsuk Stream is 3rd grade, it is not suitable for agricultural irrigation.

Alpu CPP will 100% affect irrigation. They have to dry the groundwater in order to extract the mine. 6 thousand hectares of irrigation of 16 thousand hectares are met from the well. As irrigation is made through a soil channel, water loss will be even more.

Secondly; they say that the cooling water will be discharged to the nearest stream, it is not named, but this will Porsuk Stream with a probability of 80%. The cooling water will destroy the biological vitality of Porsuk Stream. Porsuk Stream is one of the branches that feed the Sakarya River.

Third, the exposed ash will fly and settle on the leaves of the plants. This will affect photosynthesis. When we expressed this situation, they said that they would set the ash with water when we said there was not enough water, they said that they would use chemicals, but it is not clear which chemical substance they will use. If a chemical substance is used, chemical pollution will occur this time.

The power plant is located at the 45th km of Alpu Plain, which is 92.5 km in total. Agricultural production efficiency will decrease and 50% of Alpu Plain will be damaged.

Corn (silage) production has increased in recent years. When agricultural production decreases, so will the animal production. There is no beekeeping in the Alpu plain, beekeeping is in other parts of Eskişehir.

They said cooling water would come from the Gökçekaya dam, but we think that they will use Porsuk Stream because bringing the water from the dam costly and difficult since it is far away.

Research is being carried out for the new coal-fired power plant in Sevinç quarter

“Without water, there is no agriculture”

Group (Gündüzler District)

1. Manufacturer, 60s, male.
2. Retired teacher, 60s, male.
3. Agricultural Engineer, 30s, male.
4. Manufacturer (ex-TIR driver), 60s, male. (defends the CPP)
5. Producer, 50s, male, joined later, the biggest producer in the village.

General observations:

We sat at the coffee shop located in the village square. There were 5 people we met continuously at the table we were sitting at, but one person followed us from a very close place, they did not interfere. All but one person - including those interfered from the side tables - did not want the CPP.

[Participant No. 1] We see the Alpu Plain as the Karacabey of the future. It will be a big loss if the CPP is built. Corn was planted instead of barley and wheat, as it brought more income.

[when I asked, "Did you attend the EIA Information Meeting?"]

They did not participate in the EIA Information Meeting.

The President came here, said, "it will not be built," but they are still trying to build it. If we cannot trust the word of the President, who will we trust?

Kütahya is full of people with cancer, with widows whose spouses have died due to cancer.

There will be no one to work in the coal-fired power plant from here, they will come from the outside. They say that we would get high salaries, that this place will be like Paris. As if Zonguldak is also like Paris!

The plain is completely irrigated with groundwater. The village's irrigation cooperative has 37 water wells, and drinking water will disappear.

Here, 2000 tons of corn is obtained from an acre and 1200 tons of corn in Seyitgazi.

Provincial Directorate of Environment, took them to Çan CPP to show it as an example. One day, they keep us in Çanakkale saying that the CPP was being prepared. We went, it was clean.

[Participant No. 1] I wanted to go, got registered but they did not take me.

There is a CPP in Mihalıççık but it is closed. Since they want a coal-fired power plant, why do not they operate it?

Gökçekaya dam was sold to an individual, only one of the 3 turbines is working.

[Participant No. 3] We could use solar energy, wind, and biogas through husbandry.

"The soil will collapse due to the mine."

“Sakarya River is born from Çifteler. "

"They are thinking about Eskişehir, Zonguldak, and Çan because all of them do not vote for power."

[Participant No. 4]

“If the CPP is closed, there is no problem. We cannot perform irrigated farming anymore; the water is extracted from 200 meters. Already irrigated farming will end. We buy electricity from Bulgaria, let's generate our own electricity.” He defends nuclear power plants, says only a few people died in the explosion in Chernobyl. [When I asked where he got this information, he says that he was a TIR driver and he saw.] "There is a thorium mine here, it is very precious, more precious than uranium." “They operate the chimney of the power plant, or not, I do not care."

[Participant No. 5]

If one has 25 decares of land than that person will have no economic problems. It will impact both agriculture and those who live here. I also saw the CPP in Çan, I do not want it. This is Turkey's 2nd largest plain.

Group (Beyazaltın Village)

1. Manufacturer, mukhtar. 50-55 years old, male
2. Manufacturer, lived in Germany, 50-55 years old, male
3. Producer, 60s, male
4. Producer, 60s, male

General observations:

When we went to meet with women in the village, we could not find any women around, but a group of men, including the mukhtar, were sitting in the school garden. 4 people actively participated in the interview, but 2 people watched from behind and did not comment at all. They support in general.

[Participant No. 1] If they are going to build a new generation power plant, then it's okay. Many meetings were held; the village does not oppose it.

[Participant no. 2] Yield is low where the plant will be built.

[Participant 3] Public health and environmental issues are important. We cannot answer technical questions. We have to have electricity, I have to plant my field. Do we need electricity? Yes, we do. Then I have no technical knowledge of how to do it.

I went to Çan, it is called a new generation CPP, SO_2 can be blocked. They can block with a filter system. I am not in a position to analyze the information, I do not know.

We need electricity for irrigation, I do not know if the information is being camouflaged about the damage the CPP will cause to the environment

(4) There are people who die from cancer in this village, and the CPP is said to cause cancer. So then the CPP does not cause cancer, but they do get cancer even without it [Meanwhile, participant 1 approves]

People will eat bread, some will die

(2) I have been living near a CPP in Germany for years. Nothing happened at all.

The place where it will be built is worthless.

And if the substances from the CPP chimney will be carried away, I do not know anything about it.

(1 and 4) Meerschaum quarries are far away. Who says that the meerschaum will end, is lying.

(3) I asked about Elbistan to the manager, he said that the technology of Elbistan was old and the new CPP would be built using the new technology.

I saw vegetables, fruit trees, leeks, etc. in Çan. What I want is building the CPP, but I want to breathe fresh air and plant my fields. Energy is a must.

We need electricity, we irrigate for 24 hours.

[Will the establishment of the power plant meet your electricity needs?]

The electricity to be generated is for the country. We will install solar panels next year, as the village cooperative.

They will extract coal from 450 m underground, but they will put the ash where they remove it, they will fill the gaps, just like a weasel. They told us this.

We do not want a political view (means political discourse), a party.

[What do you mean, please explain a little more]

We do not want anyone telling us what AKP did.

(3) other villages do not want it, if the power plant was on their land, they would want it.

Whatever we say, the state will build it.

There is a greenhouse project, they will give hot water.

(1) They give a lot of money in return for a decare, it is above its value. Here, the peasants whose fields are expropriated will buy fertile land from another part of the plain.

[It is often mentioned about the aridity of the land where the CPP will be built in the village.]

[It is said that the power plant will affect the entire plain, the fumes coming from the power plant will collapse on the agricultural fields in the plain]

(2) We would not know about that.

ANNEX-3. POPULATION PROJECTION WITH THE ARITHMETIC INCREASE METHOD

The following formulas are used in the arithmetic increase method.

$$k_a = \frac{N_s - N_i}{t_s - t_i}$$

$$N_g = N_s \times k_a (t_g - t_s)$$

k_a	Arithmetic Increase Coefficient
N_g	Future Population
N_s	Latest Population Census
N_i	First Population Census
t_g	Future Population Year
t_s	Last Population Census Year
t_i	First Population Census Year

When calculating the arithmetic increase coefficient, the population values above were used. In this context, primarily the arithmetic increase coefficients were calculated (Annex Table-1). Future population values calculated according to the increase coefficients are provided in Annex Table 2.

Annex Table-1. Arithmetic Increase Coefficients

Municipality Name	2007	2015	2015-2007	Mean	Highest	Lowest
Odunpazarı	339,240 people	383,523people	5535	5535	5535	5535
Tepebaşı	255,917 people	333,553 people	9705	9705	9705	9705
Alpu	13,870 people	11,526 people	-293	-293	-293	-293
Beylikova	7,450 people	6,091 people	-170	-170	-170	-170
Çifteler	16,936 people	15,232people	-213	-213	-213	-213
Günyüzü	8,135 people	5,970 people	-271	-271	-271	-271
Han	2,526people	1,959 people	-71	-71	-71	-71
İnönü	7,583 people	6,822 people	-95	-95	-95	-95
Mahmudiye	9,144 people	7,987 people	-145	-145	-145	-145
Mihalgazi	3,476 people	4,507 people	129	129	129	129
Mihalıççık	11,618 people	8,850 people	-346	-346	-346	-346
Sarıcakaya	5,924 people	5,678 people	-31	-31	-31	-31
Seyitgazi	17,624 people	13,753 peoplee	-484	-484	-484	-484
Sivrihisar	25,406 people	21,265 people	-518	-518	-518	-518
Total	724,849 people	826,716 people	-92	-92	0	-518

ANNEX TABLE 2. POPULATION PROJECTION BY DISTRICTS IN ESKIŞEHIR (2015-2050)

Years	Odun pazarı	Tepebaşı	Alpu	Beylikova	Çifteler	Günyüzü	Han	İnönü	Mahmudiye	Mihalgazi	Mihalıççık	Sarıcakaya	Seyitgazi	Sivrihisar	Total
2015	383523	333553	11526	6091	15232	5970	1959	6822	7987	4507	8850	5678	13753	21265	826716
2016	389058	343258	11233	5921	15019	5699	1888	6727	7842	4636	8504	5647	13269	20747	839448
2017	394593	352963	10940	5751	14806	5428	1817	6632	7697	4765	8158	5616	12785	20229	852180
2018	400128	362668	10647	5581	14593	5157	1746	6537	7552	4894	7812	5585	12301	19711	864912
2019	405663	372373	10354	5411	14380	4886	1675	6442	7407	5023	7466	5554	11817	19193	877644
2020	411198	382078	10061	5241	14167	4615	1604	6347	7262	5152	7120	5523	11333	18675	890376
2021	416733	391783	9768	5071	13954	4344	1533	6252	7117	5281	6774	5492	10849	18157	903108
2022	422268	401488	9475	4901	13741	4073	1462	6157	6972	5410	6428	5461	10365	17639	915840
2023	427803	411193	9182	4731	13528	3802	1391	6062	6827	5539	6082	5430	9881	17121	928572
2024	433338	420898	8889	4561	13315	3531	1320	5967	6682	5668	5736	5399	9397	16603	941304
2025	438873	430603	8596	4391	13102	3260	1249	5872	6537	5797	5390	5368	8913	16085	954036
2026	444408	440308	8303	4221	12889	2989	1178	5777	6392	5926	5044	5337	8429	15567	966768
2027	449943	450013	8010	4051	12676	2718	1107	5682	6247	6055	4698	5306	7945	15049	979500
2028	455478	459718	7717	3881	12463	2447	1036	5587	6102	6184	4352	5275	7461	14531	992232
2029	461013	469423	7424	3711	12250	2176	965	5492	5957	6313	4006	5244	6977	14013	1004964
2030	466548	479128	7131	3541	12037	1905	894	5397	5812	6442	3660	5213	6493	13495	1017696
2031	472083	488833	6838	3371	11824	1634	823	5302	5667	6571	3314	5182	6009	12977	1030428
2032	477618	498538	6545	3201	11611	1363	752	5207	5522	6700	2968	5151	5525	12459	1043160
2033	483153	508243	6252	3031	11398	1092	681	5112	5377	6829	2622	5120	5041	11941	1055892
2034	488688	517948	5959	2861	11185	821	610	5017	5232	6958	2276	5089	4557	11423	1068624
2035	494223	527653	5666	2691	10972	550	539	4922	5087	7087	1930	5058	4073	10905	1081356
2036	499758	537358	5373	2521	10759	279	468	4827	4942	7216	1584	5027	3589	10387	1094088
2037	505293	547063	5080	2351	10546	8	397	4732	4797	7345	1238	4996	3105	9869	1106820
2038	510828	556768	4787	2181	10333	-263	326	4637	4652	7474	892	4965	2621	9351	1119552
2039	516363	566473	4494	2011	10120	-534	255	4542	4507	7603	546	4934	2137	8833	1132284
2040	521898	576178	4201	1841	9907	-805	184	4447	4362	7732	200	4903	1653	8315	1145016
2041	527433	585883	3908	1671	9694	-1076	113	4352	4217	7861	-146	4872	1169	7797	1157748
2042	532968	595588	3615	1501	9481	-1347	42	4257	4072	7990	-492	4841	685	7279	1170480
2043	538503	605293	3322	1331	9268	-1618	-29	4162	3927	8119	-838	4810	201	6761	1183212
2044	544038	614998	3029	1161	9055	-1889	-100	4067	3782	8248	-1184	4779	-283	6243	1195944
2045	549573	624703	2736	991	8842	-2160	-171	3972	3637	8377	-1530	4748	-767	5725	1208676
2046	555108	634408	2443	821	8629	-2431	-242	3877	3492	8506	-1876	4717	-1251	5207	1221408
2047	560643	644113	2150	651	8416	-2702	-313	3782	3347	8635	-2222	4686	-1735	4689	1234140
2048	566178	653818	1857	481	8203	-2973	-384	3687	3202	8764	-2568	4655	-2219	4171	1246872
2049	571713	663523	1564	311	7990	-3244	-455	3592	3057	8893	-2914	4624	-2703	3653	1259604
2050	577248	673228	1271	141	7777	-3515	-526	3497	2912	9022	-3260	4593	-3187	3135	1272336

ANNEX-5: AIR QUALITY LIMIT VALUES RECOMMENDED BY WORLD HEALTH ORGANIZATION

Pollutant	Measurement time	Guideline Value
Ozon	8-hour average	10 µg/m^3
NO_2	Annual average	40 µg/m^3
	1-hour average	200 µg/m^3
SO2	24-hour average	20 µg/m^3
	10-minute average	500 µg/m^3
$PM_{2.5}$	Annual average	10 µg/m^3
	24-hour average	25 µg/m^3
PM_{10}	Annual average	20 µg/m^3
	24-hour average	50 µg/m^3

9. Index of Tables, Figures, and Maps

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