HUMAN HEALTH IMPACT ASSESSMENT STUDY

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Study Processor:
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Comisia de înregistrare a elaboratorilor de studii de evaluare a impactului asupra sănătății

AVIZ DE ABILITARE
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a) obiective funcționale care se supun procedurii de evaluare a impactului asupra mediului conform prevederilor art. 9 alin. (1) și (2) din Legea nr. 292/2018 privind evaluarea impactului anumitor proiecte publice și private asupra mediului;
b) obiective funcționale care nu se supun procedurii de evaluare a impactului asupra mediului.

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1. Aim and objectives

The primary aim of this document is to assess the impact of planned activities on public health, focusing on determining factors that influence the well-being of nearby populations. Health Impact Assessment (HIA) serves as a practical tool for evaluating the potential health effects - both positive and negative - of various investment projects, providing critical insights for informed decision-making by stakeholders in the public and private sectors. Furthermore, in alignment with the Directive 2011/92/EU, as amended by Directive 2014/52/EU, and the Espoo Convention, this HIA considers the potential transboundary impacts, particularly on nearby Romanian communities. These legislative frameworks mandate the inclusion of cross-border effects in environmental impact assessments, ensuring that public health implications across borders are evaluated.

HIA combines a multidisciplinary approach of procedures, methods, and tools to analyze the possible outcomes of a project on health determinants. These determinants include age, genetics, income, housing conditions, lifestyle, physical activity, nutrition, social support, stress levels, environmental factors, and access to healthcare services. The goal is to identify how these factors are influenced by a given project and to propose strategies for enhancing positive effects while mitigating adverse ones. The determinants of health, such as air quality, noise levels, and access to clean water, are directly linked to environmental changes caused by the project. For example, emissions from the proposed facilities may influence local air quality, affecting respiratory health among vulnerable populations. This direct link underscores the importance of addressing environmental health factors in the HIA.

This assessment operates on a holistic understanding of health, defined as "a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity"[1]. Environmental health, as a key component of HIA, focuses on preventive measures to control environmental factors that may affect public health. It emphasizes a collaborative approach among experts from various sectors to identify, evaluate, and manage risks to health resulting from environmental impacts. Given the proximity of the project to the Romanian border, it is essential to account for potential effects on air quality and public health in Romanian communities. The data gathered from air quality monitoring stations and other relevant sources will contribute to a comprehensive understanding of the cross-border impact.

Health Impact Assessment facilitates the prediction of how specific investment activities or facilities may affect health determinants. For instance, high-traffic roads located within 100 meters of a community are known to degrade air quality, posing risks particularly to vulnerable groups such as children and individuals with pre-existing health conditions. By addressing such risks, HIA provides evidence-based recommendations for interventions that promote public health.

In summary, HIA supports decision-making by offering scientifically grounded insights to optimize health outcomes. It guides the development of health-promoting strategies while ensuring that potential negative impacts are effectively minimized. This comprehensive approach is instrumental in aligning project objectives with public health priorities, fostering

[1] World Health Organization (WHO), 1946

sustainable and community-centered development. In addition to public health and environmental considerations, key sectors involved in this HIA include waste management, air quality monitoring, and industrial operations. Collaboration among these sectors is vital to ensure that all aspects of the project's impact are thoroughly assessed and managed.

2. Glossary of terms

Waste-to-Energy Plant	Installation designed for the thermal treatment of non-recyclable hazardous and non-hazardous waste, where 30 MW of thermal energy is recovered from the fluid bad waste incineration process. WtE Plant Prahovo includes several buildings and facilities that together represent this technical - technological whole (waste storages, waste pretreatment facility, WtE boiler facility, flue gas cleaning system, wastewater treatment facility, facility for stabilization and solidification of thermally treated waste residues, administrative and other supporting units). WtE process plays a key role in reducing greenhouse gas emissions by utilizing waste as an energy source, replacing fossil fuels. In the Appendix to the EIS, term „Plant for energy utilization” is used as equivalent.
Non-Hazardous Waste Landfill	Installation designed for landfilling of stabilized and solidified waste residues from WtE Plant Prahovo, exclusively. Acceptance of waste for landfilling is predicated on demonstrating compliance with non-hazardous leaching criteria set for non-reactive waste class according to national and EU regulation. In the Appendix to the EIS, term „Landfill of non-hazardous waste” is used as equivalent.
The Subject Project	Refers to the both Waste-to-Energy Plant and Non-Hazardous Waste Landfill, located in the dedicated area of industrial chemical complex of Prahovo. The Subject Project aims to modernize waste management practices, reduce carbon emissions, and support sustainable energy production for constant need of Elixir Prahovo production processes.
Elixir Group	A Serbian business entity engaged in the production of phosphoric acid and mineral fertilizers, operating across several locations in Serbia, including two existing industrial chemical complexes - one in Prahovo, municipality of Negotin and the other in municipality of Šabac. As the mother company with over 2,000 employees across 13 member companies, the Elixir Group is the driving force supporting development and financing of the Subject Project.
Elixir Prahovo	A subsidiary of Elixir Group located in the dedicated area of industrial chemical complex in Prahovo, specializing in phosphoric acid and mineral fertilizer production, with constant need of thermal energy for its production processes.

Elixir Craft	A subsidiary of Elixir Group, specializing in providing range of industrial services for the Elixir Group subsidiaries operating in both industrial chemical complexes of Prahovo and Šabac. In accordance with the planned investments and operations development, the Elixir Craft has registered the Eco Energy branch, located in the dedicated area of industrial chemical complex in Prahovo.
Investor	Elixir Craft – Eco Energy branch is the Investor of the Subject Project as well as the future operator of both installations - the Waste-to-Energy Plant and the Non-Hazardous Waste Landfill.
Industrial Chemical Complex in Prahovo	The existing industrial chemical site located in Prahovo settlement, municipality of Negotin, developed over several decades since the period of the former Yugoslavia. After privatization in 2013. this site is owned by Elixir Group and its subsidiaries. Elixir Group subsidiaries operating within this site are Elixir Prahovo, owner of the existing installations specializing in the production of phosphoric acid and mineral fertilizers, and Elixir Craft, with its facilities and workshops specializing in providing of industrial services for Elixir Prahovo. Within this site is determined the suitable undeveloped land-plot dedicated for the construction of the Subject Project installations.
Seveso Complex	A classification for industrial sites that handle large quantities of hazardous substances, subject to strict safety regulations under the EU Seveso Directive.
Accident Scenarios	Scenarios of potential industrial accidents involving hazardous substances, such as chemical spills, explosions, or fires. These scenarios are used to develop preventive and emergency response measures to minimize harm to people and the environment.
Emission modelling	Process of simulating and predicting the environmental impact of emissions (air, water, soil, noise, etc.) from industrial activities. This involves using advanced modelling techniques to assess potential emissions from installations like the Subject Project, ensuring compliance with regulatory limits and minimizing environmental impact.
Prevention measures	Set of preventive actions and practices, in accordance with the best available techniques, implemented to prevent accident scenarios and environmental harm in compliance with national and EU regulations. These measures ensure safe storage, handling, and treatment of hazardous substances, as well as the installation of automatized detection systems, proper ventilation, operating procedures and emergency response protocols to mitigate any potential EHS risks (Environmental, Health, Safety).

Monitoring program	Systematic measuring and analyzing of environmental impact indicators and pollutant emissions as required by national laws and EU directives. The Investor is responsible for developing a monitoring plan that defines the frequency, types of pollutants, and methods for measuring the effectiveness of pollution prevention measures. Data from the monitoring program must be regularly submitted to the relevant authorities.

3. Documents used as the basis for the study

- Decision on the Scope and Content of the Environmental Impact Assessment Study, June 2024, Ministry of Environmental Protection, Republic of Serbia
- Environmental Impact Assessment Study - Elixir Prahovo, Ongoing revisions as of 2024, Technical Commission Review
- Study on the Impact of the Waste-to-Energy Plant and Non-Hazardous Waste Landfill on Air Quality in the Wider Area of the Chemical Industry Complex in Prahovo, April 2024, Faculty of Mechanical Engineering, University of Belgrade
- Study on the Impact of the Waste Pretreatment Filtration System and Activated Carbon Filters within the Waste-to-Energy Plant on Air Quality in the Wider Area of the Chemical Industry Complex in Prahovo, Faculty of Mechanical Engineering, University of Belgrade, July 2024
- Biodiversity study of the Industrial Complex Elixir Prahovo, 2024, Institute for Biological Research "Siniša Stanković"
- Analysis of Environmental Factors - Zone Designated for the Expansion of the Chemical Industry Complex in Prahovo, March 2023, Company for Copyright Protection and Engineering, Autorski Biro Belgrade
- Physico-Chemical Analysis of Soil Samples, December 2023, Institute for Prevention, Occupational Safety, Fire Protection, and Development LTD Novi Sad, Branch "27. January" Niš
- Physico-Chemical Analysis Report for Groundwater Samples, June 2022, Institute for Prevention, Occupational Safety, Fire Protection, and Development LTD Novi Sad, Branch "27. January" Niš
- Physico-Chemical Analysis of Wastewater and Surface Water Samples at the Production Site of the Elixir Prahovo Industrial Complex, July 2024, Institute for Prevention, Occupational Safety, Fire Protection, and Development LTD Novi Sad, Branch "27. January" Niš
- Air Quality Monitoring Report in the Vicinity of HIP Elixir Prahovo, June 2023, City Institute for Public Health, Belgrade
- Project Compliance Review with BAT Requirements, december 2023, Elixir Engineering
- Graphic Annex - Macro and Microlocation Overview - Integrated in Environmental Impact Assessment Study
- Graphic Annex - Waste-to-Energy Plant Details - Integrated in Environmental Impact Assessment Study
- Graphic Annex - Non-Hazardous Waste Landfill Details - Integrated in Environmental Impact Assessment Study

4. General and site-specific data

4.1. Waste-to-Energy Plant

The subject of this Conceptual Design Project is the construction of the "WASTE-TO-ENERGY PLANT" (hereinafter referred to as WtE). The project is undertaken by ELIXIR CRAFT doo, Eco Energy Prahovo branch. The WtE plant, with a total boiler capacity of 30 MW (steam production of 35 t/h), is designed based on the technology of the Austrian company "TBU Stubenvoll" GMBH, which has proven references with similar plants across Europe.

The project site is situated in Prahovo, Serbia, near the border with Romania. The area is part of the larger industrial complex Elixir Prahovo and lies in close proximity to the Danube River, an important transboudary waterway. Given its proximity to Romania, special attention will be paid to transboundary impacts, praticularly air and water quality, as required under the Espoo Convention. The region experiences a continental climate, characterized by hot summers and cold winters, with significant seasonal variations in temperature and precipitation. The project area features relatively flat terrain, with soil types primarily consisting of alluvial deposits.

The waste-to-energy process involves the thermal treatment of hazardous and non-hazardous liquid and solid waste (industrial, commercial, and municipal) in a stationary facility. The thermal energy produced will be used to generate steam, which will be supplied and utilized for the operations of existing industrial facilities at the Elixir Prahovo site.

The region has mixed rural and urban population, with the nearest major settlements being Negotin in Serbia and Dorbeta-Turnu Severin in Romania. The population density varies, with lower densities in rural areas and higher concentrations in urban centres. The site is currently designated for industrial use, primarily involving chemical production. Surrounding areas of the broader chemical industrial complex includes agricultural land, residental zones, and natural habitats along the Danube River. The Danube River serves as an important ecological corridor and a key transboundary waterway, necessitating strict monitoring of potential impacts on water quality.

The WtE plant is planned to be built on a site covering 5.8721 hectares, within boundaries defined by the conceptual engineering provider, measuring 217x270.7 meters. It will be located in Zone IV - the Energy and Environmental Island, in the southeastern section, with access via a planned road. The site layout and construction line are detailed in the situational plan. The entrance to the WtE complex is planned from the southern side of the plot, through a local road included in the updated urban development plan approved by the Municipality of Negotin. Vehicle access to the landfill will be provided from the western side of the complex.

The project site is located approximately 5 km form the nearest residential area in Prahovo and around 15 km from the Romanian border. Sensitive receptors include local communities, schools, hospitals, and natural reserves along the Danube River. The WtE plant will include production buildings, auxiliary facilities, traffic areas, operational spaces, and infrastructure necessary for the functioning of the industrial plant. The complex will be physically isolated with fencing and gated access points for pedestrians, motor vehicles, and cargo transport.

The total capacity of the WtE plant is designed to thermally process 100,000 tons of waste per year, operating for 8,000 hours annually. The site benefits from well-developed infrastructure, including access roads, railway connections, and proximity to the Danube River, faciliating transport and logistics. Utilities such as water, electricity, and waste management services are already established.

Traffic areas within the WtE plant are designed for circular movement and maneuvering of trucks. Internal traffic is circular, with a single entrance/exit on the southeastern side, connecting to the newly planned road in Zone IV - the Energy and Environmental Island. The newly planned roads in Zone IV are integrated into the internal infrastructure network, meeting the width requirements of current regulations in Serbia.

Baseline studies have identified key environmental factors, including air quality, water quality, soil conditions, and biodiversity. Current air quality measurements indicate moderate levels of pollutants, primarily from existing industrial sources. Preliminary results indicate moderate levels of PM10 and NO_x, primarily attributed to industrial emissions. Continuous monitoring is planned to track changes during project implementation. Potential natural hazards in the area include flooding due to the proximity to the Danube River and seismic activity, though the risk of significant earthquakes is considered low.

Given the proximity to Romania, transboundary impacts are a key consideration. The project has been notified under the Espoo Convention framework, and consultations with Romanian authorities are ongoing to address potential cross-border concerns and monitoring data sharing in case of an expressed preference. Consultations with Romanian authorities have highlighted the importance of mitigating potential air and water pollution to protect downstream communities.

The hydraulic installations of the WtE plant provide solutions for:

- Supplying the complex with: Sanitary water (connecting to the existing sanitary water supply system of the Elixir Prahovo industrial complex and distributing it to the end consumers of the WtE plant); Demineralized DEMI water, i.e., boiler water (connecting to the existing Central DEMI water plant of the Elixir Prahovo complex, delivery to DEMI water reception tanks, and distribution to the end consumers of the WtE plant); Process water for scrubbers, solidification, sludge tank cooling, chemical dosing, etc. (connecting to the existing Danube water supply system, primary treatment through sand filters, delivery to reception tanks, and distribution to the end consumers of the WtE plant); Firefighting water hydrant network and fire suppression (connecting to the existing Danube water supply system, delivery to firefighting water reservoirs, and distribution to the end consumers of the WtE plant).
- Collecting and treating wastewater: Sanitary-fecal wastewater (the sewer system collects sanitary-fecal wastewater and directs it to a treatment facility for mechanical and biological treatment. Treated wastewater is connected to the stormwater drainage system for conditionally clean water and then discharged into the internal network of the Elixir Prahovo industrial complex); Atmospheric clean water (stormwater drainage collects clean atmospheric water from building roofs and discharges it into the existing

central collector of the Elixir Prahovo industrial complex, which directs the wastewater to the existing inlet structure and discharges it into the Danube River); Atmospheric potentially oily wastewater (stormwater drainage collects oily wastewater from traffic areas, operational surfaces, and parking areas direct water to a coalescent separator for grease and oil treatment. After the separator, the treated water merges with the clean stormwater drainage system; Technological wastewater from the wastewater treatment plant of the boiler facility – technological drainage ; General technological wastewater (water from drains in Waste thermal treatment plant, water from boiler descaling, leachate from the non-hazardous waste landfill, etc.) – general technological drainage; Wastewater from firefighting – a system for collecting and discharging firefighting wastewater; Wastewater from washing sand filters used in process water preparation ; Wastewater from washing filters in the wastewater treatment plant.

In accordance with the above, the WtE plant is not connected to the public water supply or sewer system but rather to the internal network of the Elixir Prahovo industrial complex.

Summary of the Technological Process

The WASTE-TO-ENERGY PLANT (WtE) is designed for the thermal treatment of various non-recyclable waste types, including solid hazardous and non-hazardous waste, sludge, and liquid hazardous and non-hazardous waste. Within the WtE plant, the management of hazardous and non-hazardous waste will be conducted under the strict control of ELIXIR CRAFT doo, Eco Energy Prahovo branch, through the following activities:

- Incoming inspection, testing, and acceptance of hazardous and non-hazardous waste;
- Waste weighing and vehicle wheel washing;
- Unloading and temporary storage of solid waste materials;
- Transfer and temporary storage of liquid waste materials;
- Physical-mechanical pretreatment of solid waste (washing, shredding of hazardous and non-hazardous waste, separation, etc.);
- Transport and handling operations, as well as accompanying technological processes;
- Thermal waste treatment and production of thermal energy in the form of steam.

Auxiliary activities required for the operation of the plant include:

- Preparation of process water for the plant's operations;
- Distribution of auxiliary fluids (CNG, nitrogen, compressed air, ammonium water);
- Gas treatment (from pretreatment and storage, thermal waste treatment, and solidification processes) emitted by the plant;
- Treatment of residues from the thermal waste treatment process, including stabilization and solidification;
- Dispatch of solidified material to non-hazardous waste landfills and delivery of secondary raw materials (metal, plastic, etc.) to licensed operators for further processing;
- Collection and treatment of wastewater.

The starting point of the waste-to-energy process is incoming control, sampling, and testing of waste transported for thermal treatment.

Before accepting non-hazardous waste, the waste recipient must carry out the following verification procedures:

- Documentation accompanying the waste (e.g., Waste Transfer Document, delivery notes, weighbridge tickets, etc.);
- Waste testing report prepared in accordance with the list of parameters for testing waste for thermal treatment as specified in Annex 9 of the Rulebook on Waste Categories, Testing, and Classification[2];
- Hazardous waste characteristics, substances that must not be mixed, and safety measures to be implemented during waste handling.

Prior to the acceptance of hazardous waste at the facility, the waste recipient conducts the same acceptance procedure as for non-hazardous waste, with particular emphasis on:

- Verifying the documentation accompanying the hazardous waste (e.g., Hazardous Waste Movement Documents, delivery notes, weighbridge tickets, etc.), and if necessary, documentation required by regulations governing the transport of dangerous goods[3];
- Taking representative samples before unloading to verify compliance with the accompanying documentation;
- Allowing the competent authority to inspect and identify waste intended for thermal treatment.

After entry, vehicles first pass over a weighbridge located at the entrance to the complex, in visual contact with the security sector, which performs the weighing from its premises, while online detection of radioactivity is performed. After weighing, vehicles proceed through the vehicle wheel washing unit, positioned immediately after the weighbridge.

Within the facility, following the acceptance inspection and acceptance process, solid waste undergoes the following steps:

- Unloading and temporary storage of solid waste in designated areas.
- Physical-mechanical pretreatment of waste on one of the pretreatment lines to prepare the waste for thermal treatment in the boiler facility.
- Temporary storage of pretreated (mechanically processed and homogenized) waste in bunkers until dosing into the boiler facility.

The air from the material waste storage building in the bunkers and the sludge area will be directed by combustion air fans to the boiler plant to maintain negative pressure in the storage area and prevent the spread of unpleasant odors outside the building. When the boiler plant is not operational, the air from the storage facility in the bunkers is routed to the dedusting and ventilation system for pretreatment, which includes a bag filter and activated carbon columns, and is then discharged into the atmosphere through a chimney.

[2] "Official Gazette of the RS", nos. 56/2010, 93/2019, 39/2021, 65/2024, Available at Pravilnik o kategorijama, ispitivanju i klasifikaciji otpada (paragraf.rs)

[3] Law on the Transport of Dangerous Goods ("Official Gazette of the RS", nos. 104/2016, 83/2018, 95/2018 - other law and 10/2019 - other law), etc., Available at Zakon o transportu opasne robe (paragraf.rs)

When the boiler plant is not operational, nitrogen is automatically introduced into the sludge reception bunker to inertize the space. Ventilation of the sludge unloading area will be performed through louvers in case of boiler shutdown. The hazardous and non-hazardous waste pretreatment facility is connected to a closed ventilation and dedusting system, which includes a bag filter and activated carbon columns. Air purified to a quality that meets current regulations in this area is discharged through a chimney into the atmosphere after filtration.

The project includes one thermal waste treatment line, W-C11, with a capacity of 100,000 t/year. The thermal treatment line consists of a fluidized bed incineration chamber, followed by boiler heating surfaces in three passes of flue gases, which then pass through an evaporator and economizer. Upon exiting the heat exchange section, the flue gases enter the gas cleaning section. The flue gases are purified through operations of dedusting, absorption, adsorption, and catalytic reactions.

Dry cleaning of emitted gases is performed via bag filters and adsorption on activated carbon, while wet cleaning is conducted in two-stage scrubbers. Water from the scrubbers is treated in a water treatment plant. Calcium hydroxide is added to the bottom of the second scrubber, and oxygen (air) is injected to regulate pH and oxidation.

Reduction of nitrogen compounds in the emitted gases is achieved through primary methods of staged combustion, which involve combustion in a low-oxygen zone followed by combustion in a high-oxygen zone, minimizing the formation of NOx during the combustion process. The equipment also includes secondary methods for reducing nitrogen oxides via a selective catalytic reduction (SCR) unit, which represents the final step in the flue gas treatment process. Purified gases are emitted through the chimney into the atmosphere.

The thermal treatment chamber consists of a fluidization section, a lower zone, and an upper zone. In the fluidization section, the gas velocity is approximately 1.4 m/s (average value), and the temperature must be maintained between 650-800°C. This temperature is achieved by supplying the required amount of oxygen (air). The gas in the upper zone of the column has a temperature between 850-950°C. The gas retention time in the upper zone at a minimum temperature of 850°C is more than 2 seconds. If, for any reason, the temperature drops below 850°C, natural gas burners are automatically activated to maintain the temperature at the set value.

The boiler is equipped with two burners, each with a nominal power of 2x12 MW, for initial ignition with natural gas. The burners are used only for boiler startup and shutdown or if the furnace temperature drops below 850°C. During regular operation, the burners are used solely for introducing secondary combustion air.

During the regular operation of the fluidized bed boiler plant, the following solid (unburned) residues may be generated:

- Bottom ash: Coarse fraction of unburned material collected at the bottom of the boiler beneath the furnace.
- Boiler ash: Collected between the second and third pass of flue gases through the boiler.
- Cyclone ash: Fraction of fly ash from the boiler separated from emitted gases as they pass through two cyclone separators (T > 400°C).

- Economizer ash: Fine fraction of fly ash separated as flue gases pass through the economizer.
- Filter ash: Fine fraction of fly ash separated as flue gases pass through the bag filter system.
- Activated carbon with fine particle fractions from flue gas.
- Sludge from wastewater treatment from the wet cleaning of flue gases.
- Solid residue from centrifuges (gypsum).

To standardize the characteristics of the solid residues from the boiler plant and render them suitable for disposal in a non-hazardous waste landfill, the project owner has decided to treat this waste using stabilization (preventing leaching) and solidification (hardening) processes as part of the energy-from-waste (WtE) facility. The stabilization and solidification process, planned within the W-C12 Stabilization and Solidification unit, will include the following operations:

- Cooling and metal separation of bottom ash (coarse fraction of unburned material):
- The coarse fraction of unburned material, separated from metals, will be mixed with other residue fractions from the boiler plant and solidified. The separated metallic waste (secondary raw material) will be temporarily stored until handed over to authorized operators for further processing.
- Temporary storage and curing (stabilization) of boiler plant residues: In addition to serving as storage units, the boxes also facilitate the stabilization process of solid residues, lasting 7–14 days. The stabilization process ensures the completion of any residual reactions within the material, resulting in solidified waste with minimal leaching potential.
- Dosing and mixing of boiler plant residues with cement and water (solidification): Waste material is transferred from the boxes using cranes to the feed hopper of the screw conveyor with a weighing system. According to the specified ratio, the waste is dosed together with other reactants into a stationary mixer-reactor, where the final solidification process occurs.
- Transport of solidified material to the non-hazardous waste landfill for permanent disposal: Upon completion of the mixing process, the resulting solidified material is discharged directly from the bottom of the mixer-reactor into a tipper truck and transported to the non-hazardous waste landfill, planned to be constructed adjacent to the WtE facility.

To minimize dust emissions, the stored material will be regularly sprayed, and the W-C12 Stabilization and Solidification unit will be connected to a closed ventilation and dust collection system that includes a bag filter. For the regular operation of the WtE plant, the following auxiliary process fluids must be provided:

- Demineralized (DEMI) water for boiler operation,
- Process water (for scrubbers, solidification, cooling the sludge tank, dosing chemicals, etc.),
- Compressed air,
- Nitrogen, and
- Natural gas.

Piping bridges will distribute technological and energy fluids, including DEMI water, steam, CNG, compressed air, nitrogen, and liquid waste.

4.2. Non-hazardous waste landfill

The landfill for non-hazardous waste is designated for disposing of waste generated during the waste-to-energy process. This waste is classified as hazardous or non-hazardous and includes various types of ash and metals. Before being disposed of in the landfill, all waste classified as hazardous undergoes appropriate treatment (solidification and stabilization) to convert it into inert hazardous waste suitable for deposition in non-hazardous waste landfills. This process ensures that non-reactive hazardous waste can be safely deposited in such landfills.

The average expected production of solidified waste is 1.08 m^3/h, while the maximum simultaneous logistical load is 3.08 m^3/h. Considering the annual operating time of 8,300 hours, the average yearly production of solidified waste for storage amounts to 8,964 m^3, with a maximum production of 25,564 m^3 annually.

For the establishment of the non-hazardous waste landfill, an irregularly shaped area of approximately 8.5 hectares is available. This area has dimensions of approximately 330 meters in length and 280 meters in width, with a triangular reduction in the northwest corner. The conceptual design outlines a phased construction of the landfill in two primary stages (Phase I and Phase II). Phase I is further divided into Phases I-A and I-B. This project defines the spatial parameters of the non-hazardous waste landfill within the IHP Elixir premises in Prahovo, on the land selected and allocated by the Investor for this purpose. Additionally, it includes the design and selection of all auxiliary facilities and elements required to ensure continuous, uninterrupted, and safe operation of the landfill.

The space allocation is organized so that trucks carrying waste enter the landfill area from the southeast side, with transport proceeding along the southern side. Initial waste deposition begins from this side, with the dumping front moving northward.

The available space is divided into two landfill formation phases:

- Phase I-A: A net area of 1.82 hectares,
- Phase I-B: A net area of 1.84 hectares, and
- Phase II: An additional 2.77 hectares,

resulting in a total net area of 6.43 hectares for waste deposition. Since the landfill will store solidified and stabilized waste, the available space will be utilized in multiple layers. Each layer (or tier) will be 3 meters high. Once the space of a specific phase is filled to this height, the deposition process will shift inward by 3 meters on all sides, forming a new tier of 3 meters in height.

The landfill will feature a closed water circulation system. This system ensures that all collected water is either used for sprinkling the landfill or sent to the water treatment facility, meeting environmental protection requirements. Two separate systems for water collection are planned:

- A system for collecting leachate, which will transport water to the wastewater basin within the waste-to-energy facility, and

- A system for collecting atmospheric runoff from the landfill slopes, which will be collected and used for sprinkling the slopes, enabling water recirculation.

Both basins for collecting water from the landfill - one for atmospheric runoff and one for leachate - along with the pumps, are housed within a single structure.

On the eastern and western sides, collection pipelines will be installed for the drainage of leachate and its transport to a temporary leachate collection basin.

Around the landfill, at the base of the embankment, a channel will be constructed to collect atmospheric runoff from the slopes of the landfill, directing this water into a collection basin for atmospheric water.

The initial embankment is designed to provide an initial accumulation space for waste storage. Since the waste will be in a dry state, the height of the initial peripheral embankment will be 1.0 m, at an elevation of 49.00 masl. The embankment crest width on all four sides will be 5.5 m, with slopes at a ratio of V:H - 1:2.

To prevent air pollution and the dispersion of fine-grained materials from the landfill, regular wetting of the landfill surface with water is planned. Water for wetting will be sourced from the atmospheric water basin and transported to the landfill using equipment installed in the pump chamber/basin for atmospheric water collection.

In the southern part of the landfill, just west of the pump stations, a standard facility for truck washing with pressurized water will be installed.

5. Project description

This section outlines the key components and operational details of the planned project, including the Waste-to-Energy (WtE) plant and Non-Hazardous Waste Landfill (NHWL). The project aims to provide an environmentally sustainable solution for waste management while generating energy and minimizing the environmental impact of waste disposal.

The WtE plant is designated to process municipal solid waste (MSW) and certain types of industrial waste to recover energy in the form of heat. The plant's capacity is expected to be maximally 100000 tons of waste per year.

The incineration process will utilize advanced combustion technology to ensure high efficiency and low emissions. The plant will be equipped with a modern flue gas cleaning system (In compliance with Directive 2010/75/EU on industrial emissions, the plant will adhere to strict emission limits and reporting protocols), including:

- Bag filters to remove fine particulate matter.
- Scrubbers to reduce sulfur dioxide (SO2) and other acid gases.
- Selective catalytic reduction (SCR) to control nitrogen oxides (NOx).
- Activated carbon injection to capture heavy metals and dioxins.

The NHWL is intended to receive residues from the WtE plant (e.g., bottom ash, fly ash) and other non-recyclable, non-hazardous industrial waste. The landfill will be constructed in compliance with EU regulations and will include (The design will follow the requirements of the Landfill Directive 1999/31/EC, ensuring long-term environmental protection).

The primary aim of this project is to establish a sustainable waste-to-energy (WtE) solution that addresses pressing environmental and energy challenges while supporting the local economy. Key objectives include:

- Reducing landfill dependency: By diverting waste from traditional landfills to energy recovery,
- Generating renewable energy: The thermal treatment of waste will produce renewable energy, directly contributing to local energy needs and enhancing energy self-sufficiency.
- Minimizing environmental impact: Advanced pollution control technologies will ensure that emissions are strictly regulated, mitigating harmful environmental effects.
- Supporting circular economy goals: The project will recover valuable materials and energy from waste.

The WtE project is designed to deliver significant environmental and social advantages, fostering both ecological sustainability and community well-being. These benefits include:

- Air quality improvement: By controlling emissions using advanced technologies, the project will reduce the release of harmful pollutants compared to uncontrolled waste burning.

- Job creation: The project will generate employment opportunities during both construction and operational phases.
- Energy security: The energy produced will contribute to the local grid, enhancing energy availability and reliability
- Cross-border cooperation: Given the project's proximity to Romania, cooperation with Romanian authorities will ensure that potential transboundary impacts are managed effectively. While the project presents substantial benefits, certain challenges are anticipated. Proactive mitigation measures will be implemented to address these challenges effectively:
- Emission control: Continuous monitoring and adaptive management to ensure compliance with emission limits. In addition, emission data will be shared with relevant authorities to enhance transparency and regulatory oversight in a cross-border context in case of such request within Espoo Convention framework.
- Waste acceptance criteria: Strict protocols for the types of waste accepted to prevent hazardous waste forms entering the process.
- Community engagement: Ongoing consultations with local communities and stakeholders to address concerns and ensure transparency.

By addressing these objectives, benefits, and challenges holistically, the WtE project will serve as a cornerstone of sustainable development in the region, aligning with both local and international priorities for environmental stewardship and resource management.

5.1. Introduction

Elixir Group is a Serbian business system specializing in the production of phosphoric acid and complex mineral fertilizers. The Group operates across four locations in Serbia, including two existing industrial chemical sites, one in Prahovo, municipality of Negotin and the other in municipality of Šabac, with over 2,000 employees across 13 member companies.

In pursuit of more responsible and sustainable development of its production facilities, Elixir Group has initiated the investment cycle focusing on implementing circular economy concept, recourse efficiency and decarbonization of production value chain in both industrial chemical sites.

Planned investments in industrial chemical site in Prahovo, municipality of Negotin, aims to modernize production of Elixir Prahovo, member company engaged in phosphoric acid and mineral fertilizer production, maximize resource efficiency and accelerate the transition to alternative and renewable energy sources.

Therefore, Elixir Group via its subsidiary **Elixir Craft - Eco Energy branch, as the Investor**, envisions investment in the project of a Waste-to-Energy Plant construction on cadastral parcels 1420/1, 1420/4, 1491/1, 1541/1, 1541/2, 1552, 5824/1, 6513/1, 6513/2 on the cadastral map of Prahovo, municipality of Negotin, and phased construction of a Non-Hazardous Waste Landfill within the industrial chemical complex in Prahovo on cadastral parcels number 2300/1, 1491/1 and 1541/1 Prahovo, municipality of Negotin (hereinafter: the Subject Project).

Through the Subject Project, Elixir Group aims to decarbonize its energy sources and substitute using of fossil-based fuels for production of heating energy needed for phosphoric acid production of Elixir Prahovo, contributing to global efforts to combat climate change and protection of the environment.

The Subject Project includes the construction of two technologically connected installations:

- Waste-to-Energy Plant and
- Non-Hazardous Waste Landfill.

Both above mentioned installations of the Subject Project will be located within the area of industrial chemical complex in Prahovo, municipality of Negotin, where also are located the existing production installations of Elixir Prahovo which are constant heating energy consumers.

Waste-to-Energy Plant is based on bubbling fluidized bed technology for waste incineration with a combustion chamber of a 30 MW thermal power. The purpose of the Subject Project would be to thermally treat non-recyclable hazardous and non-hazardous waste with energy recuperation higher than 0,7 according to R1 calculation applicable for such installations. The energy would be utilized for production of Low-Pressure Steam (LPS). LPS is currently utilized in the phosphoric acid concentration within Elixir Prahovo production process. The investment would thereby phase out current LPS based on fossil fuels. Consequently, such investment reduces greenhouse gas emissions in the full scope of material lifecycle.

Non-Hazardous Waste Landfill is designed for disposal of stabilized and solidified thermal treatment waste residues from WtE Plant, exclusively. It includes use of advanced non-filtrable membrane which prevent leachate from contaminating soil and underground water, as well as systems for leachate drainage, collection and processing in a wastewater treatment facility of the Waste-to-Energy Plant, complying with best available techniques and strict environmental regulations. Acceptance for landfilling is predicated on demonstrating compliance with non-hazardous leaching criteria set for non-reactive waste class according to national and EU regulation.

The Subject Project would be aligned with EU Waste Directive favorizing incineration of non-recyclable material over landfilling. Moreover, such investments are intended to improve the national waste management efforts, while supporting the overall goal of decarbonation, addressed as one of the key principles for sustainable and low-carbon development in the Green Agenda for Western Balkans.

5.2. Project description

The technology necessary for safe and effective thermal treatment of waste is well established. Only in EU there are nearly 500 Waste-to-Energy (WtE) plants in operation across 23 European countries (according to CEWEP: Confederation of European Waste-to-Energy plants), yielding large industrial experience in the field. The selected partner with proven field track record in engineering design is Austrian company "TBU Stubenvoll" GMBH[4]. The proposed design encapsulates experience accumulated in the field with state-of-the-art technical solutions.

Upstream of the boiler the process incorporates liquid waste loading to the working buffer storage tanks, solid waste shredding, shredded solid waste mixture homogenization, nitrogen blanketed shredding of multiphase hazardous waste and sludge loading to a buffer tank.

[4] TBU Stubenvoll GmbH References List: ABRG DRO (AT), ABRG WSO (AT), ABRG WSO new (AT), AVN 1,2 (AT), AVN 3 (AT), Kralupy (CZ), Malta (M), Monthey (CH), Moscow (RU), RVL Lenzing (AT), Villas (AT), Villas II (AT). For more details, you can visit their official website: TBU

Prepared waste is fed to the boiler using dossing screw or special pumps connected to supercritical nozzles for atomization. Waste combustion is performed in sub-stoichiometric and stoichiometric zone of the boiler. The lower zone with the sand bed is characterized by sub-stoichiometrically condition, which is the basic requirement for controlling the process while mixing combustion air and recirculation gas. In the upper boiler zone, gases coming from the bottom boiler zone are mixed with the upper secondary air. The nozzles are arranged to create a vortex movement of the gas. Flue gases enter this zone sub-stoichiometrically and react with secondary air in the turbulent flow zone. At the end of this reaction, the flue gases have an excess of oxygen and a temperature between 850°C and 950°C. The retention time after the secondary air level injection is minimum 2 seconds or even longer. Consequently, three most important parameters for molecule decomposing are met, turbulence, temperature and retention time.

Most sophisticated part of the Waste-to-Energy Plant is the flue gas cleaning system (flue gas treatment). In the first step a cyclone battery removes large particles. Downstream, activated carbon filter adsorbs dioxins, Hg and heavy metals from the stream before being separated in the 6-chamber bag filter. The gases are then directed to a 2-step scrubbing process where chlorides, fluorides, heavy metals, and SO_x are removed. Finally, before emitting the flue gas on a stack, the gas is treated in a selective catalytic $DeNO_x$ process, where NO_x is in reaction with ammonia water converted to nitrogen (N_2) and water (H_2O).

Wastewater generated on the Waste-to-Energy Plant includes the stream contaminated in the flue gas scrubbing process which is treated via three complementary neutralization steps (pH value and additives varied) and always followed by sedimentation process. In the final stage of neutralization, a flocculant agent is also added for easier contaminant separation. In case the treated wastewater does not meet the set quality control standards it is directed to column with sand filter followed by column with activated carbon, before ones again sent to the first neutralization step of the purification process.

Combustion process residues, bottom ash, cyclone ash, filter ash and scrubbing process residues are intended to be treated before disposal on Non-Hazardous Waste Landfill. Firstly, ferrous, and non-ferrous metals will be separated from bottom ash as non-hazardous metals for recycling. Subsequently, non-recyclable material would be combined with other residues stream before all residues will be stabilized and solidified. Water should be added to the mixture to promote completion of chemical reactions. After a minimal stabilization time of 10 days, the mixture should be reacted with cement and additives to solidify contaminants in a concreate crystal structure. Solidified structure would be disposed on a specially designed Non-Hazardous Waste Landfill with a protective textile membrane on top of high-density polyethylene membrane with a filterability of 10^{-7} (GRI Test method GM 13[5]). Material to be positioned on the membranes is selected to control the water filterability and rate of flow to the non-filtrable membrane, which prevents leachate (contaminated water) to reach the soil and underground water. The leachate would be drained and directed for processing in the wastewater treatment facility. The processing strategy is intended to control the quality of leachate to meet the non-hazardous waste requirements, while collection and drainage does not allow release of the leachate to the environment.

[5] Test Methods, or European standard EN 134934

Adopted technical solutions have been developed fully in compliance with the applicable laws and by-laws of Republic of Serbia as well as Commission implementing decision (EU) 2019/2010 of 12th November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration (notified under document C(2019) 7987), Commission Implementing Decision (EU) 2018/1147 of August 10th 2018 establishing best available techniques (BAT) conclusions for waste treatment, under Directive 2010/75/EU of the European Parliament and of the Council (notified under document C(2018) 5070), Commission reference document on Best Available Techniques on Emissions from Storage (July 2006) and Directive (EU) 2018/850 of the European Parliament and of the Council of May 30th 2018 amending Directive 1999/31/EC on the landfill of waste.

5.3. Location selection & current state of the environment

There are very limited thermal treatment capacities for non-hazardous and hazardous waste treatment in Serbia, affecting business development sustainability. Alternative way of handing produced industrial waste is export to treatment facilities in the neighboring and EU countries. It is clear that such practices increase the emissions induced via transport, create long administrative process with elevated costs. Consequently, increasing the capacities of treatment would improve the waste management practices, elevate the economic effect of business activities and reduce energy dependency on third parties. Successful implementation of such a project requires an industrial zone with established production practices and constant consumption of energy recovered. Due to these factors and most importantly constant energy need of Elixir Prahovo production process, Investor considers the location within the area of existing industrial complex in Prahovo as suitable for the Subject Project implementation.

Produced energy would reduce the need for LPS production using fossil-based fuels, on aggregate project implementation would have a positive effect on the overall greenhouse gas emissions (Product Life Cycle Analysis). Water utilization as a resource would not change on the location, as the amount of produced steam would not change. Moreover, any water treatment results in a wastewater release to the original water source and/or recipient, Danube River.

Emissions in air have been considered within the process of location selection; emission synergies are carefully analyzed while flue gases characterized for such facilities do not impose a cumulative large influence. Current state of the environment has been assessed before any modelling has been conducted, all measurement has been done by accredited bodies.

The study considered the biodiversity representative for the larger area, including neighboring Bulgaria and Romania, potentially affected by the project. It has been concluded that the eradication of the Mesian forest of gray pedunculate and the drainage of the floodplain of ponds and wetlands in the 1930s, and the construction of HPP "Đerdap II" permanently destroyed natural potential vegetation, and with it the accompanying fauna. The area is dominated by anthropogenic communities. Current vegetation, flora and fauna are of secondary origin and are of no protection interests. Study also found that negative effects on the fish fauna are mainly due to the impact of the HPP dams "Đerdap I and II", which prevent migration upstream and downstream, affect the flow regime and cause large oscillations in the water level, above, between and in the part of the flow below the dams. These significant changes caused changes in the ichthyofauna of the Danube. Migratory fish species such as sterlet and barbel, which favor the faster flow, have migrated to the upstream part of the Danube, while species such as bream showed intensive growth in the newly formed reservoirs.

The project is located in neighbourhood of Romania, on the left bank of the Danube River, 4 km from the nearest settlement, namely Izvoarele in Mehedinți County and the municipality of Calafat in Dolj County. From a biodiversity perspective, the transboundary area of the Danube River is home to a number of protected natural areas, namely: ROSPA0011 Blahnița, ROSPA0074 Maglavit, ROSPA0046 Gruia-Gârla Mare. In terms of the status of water bodies in the mentioned area, the Danube River has water quality classified as "good status."

5.4. Emission modelling

Influence on the environment has been studied cumulatively taking into account impact specific for the existing industrial activities within the existing industrial chemical complex in Prahovo, particularly air emissions, wastewater emissions, soil contamination, noise, etc. State-of-art rigorous modelling approach took theoretical maximal allowed emissions from the considered technical solutions. Dominant influence of Waste-to-Energy Plant would be reflected in air and wastewater emissions. Other induced influence is minimized to marginal due to either nature of the project and/or selected technical solutions. On the other hand, Non-Hazardous Waste Landfill is considered as a potential source of dust emissions. Leachate and contaminated soil induced effects are not possible in regular operations of neither Waste-to-Energy Plant nor Non-Hazardous Waste Landfill.

5.4.1. Waste acceptance for thermal treatment

The Subject Project documentation defines that waste containing more than 1% of halogen organic substances expressed as chlorine cannot be treated in the Subject Waste-to-Energy Plant. It is strictly forbidden to receive waste that is explosive, flammable, infectious, radioactive, waste materials containing or contaminated with polychlorinated biphenyls (PCBs) and/or polybrominated triphenyls (PCTs) and/or polybrominated biphenyls (PBB), waste containing cyanides, isocyanates, thiocyanates, asbestos, peroxides, biocides, cytostatic, electronic waste. Additional restrictions on admission to the subject Waste-to-Energy Plant are waste substances in the form of aerosols, as well as organometallic compounds (spent metal-based catalysts, or organometallic wood preservatives) and aluminized paints. Moreover, the subject WtE installation will not accept infectious, explosive, flammable and waste which releases toxic gases in reaction with water. Waste pre-acceptance and acceptance procedure define in which way is the documentation, characterization with assurance and control performed within the process of waste reception. After reception the waste would be prepared for the thermal process, to prevent emissions and odors a significant number of measures are foreseen, i.e., special design is made. After reception gates are closed, while the air from the separation is succeed with a vacuum system and directed to the combustion process. Similarly, in special preparation lines, liquid and sludge lines, nitrogen is used for blanketing. In case the boiler is not in operation, the vacuum system from the storage and waste shredding allows for gases to be directed to the filtering system consisting of a waste pretreatment filter system and activated carbon filter.

5.4.2. Air emissions

Atmospheric dispersion models of pollutants are used to determine the concentration of pollutants in flue gas during the removal of the smoke plume from the source of emissions, and to estimate their ground concentrations. The dispersion model represents the mathematical expression of the influence of atmospheric processes on pollutants in the atmosphere. Atmospheric conditions (which include wind speed and direction, air temperature and mixing height) are simulated using dispersion models, and pollutant concentrations are estimated as they move away from the emitter. The software package AERMOD was used, i.e., a model based on the Gaussian distribution and recommended by the EPA[6]. AERMOD includes a wide range of capabilities for modeling the impact of pollutants on air pollution. The mentioned model provides the possibility of modeling several pollution sources, including point, line, surface and volume sources. The model contains algorithms for the analysis of aerodynamic flow in the vicinity of and around buildings. Modelling strategy considered all existing stack and surface emissions within the existing industrial chemical complex in Prahovo, as a current state of air pollutant emissions in the area. Additionally, a cumulative approach is considered where it is envisioned that with the Subject Project execution there would be 3 additional emitters:

- Emitter of the Waste-to Energy boiler - after the flue gas cleaning system which includes bag filters, activated carbon filters, scrubbers and SCR filter (selective catalytic $DeNO_x$ reduction)
- Emitter of the waste pretreatment filter stacks - after the bag filter and activated carbon filter
- Emitter of the stabilization and solidification of the thermal treatment residues - after the bag filters

Moreover, Non-Hazardous Waste Landfill is also taken into account as a potential surface emitter in the model.

Study included an impact zone of 50 km x 50 km, i.e., an area of 2500 km^2 expressed in the form of Cartesian coordinate system with variable receptor distance (Multi-Tier Grid). Thereby, the model was set to assess the potential local as well as cross-border impact.

In order to define local prevailing meteorological parameters, hourly meteorological data for a specific location and for a period of five consecutive calendar years (2017 - 2021) were procured from Lakes Environmental Consultants from Canada. This dataset consists of information on the surface and upper atmosphere layers, which are required to run the dispersion model.

Emission of pollutants already characteristic for the industrial chemical complex in Prahovo would be negligible affected by the Subject Project implementation (Waste-To-Energy Plant & Non-Hazardous Waste Landfill), namely influence of the existing Elixir Prahovo and Phosphea emitters are dominating point source emissions. On the other hand, surface sources found in phosphor-gypsum storage area are dominating the emissions of dust (total particulate matter). It was found that in the case of some components (SO_2, PM10 and HF), there is a possibility of episodic high concentrations in the case of extremely unfavorable (from the point of view of dispersion) meteorological conditions. However, the number of hours/days with these

[6] U.S. Environmental Protection Agency

concentrations is extremely small, i.e., there is low statistical probability of this happening. It has been established that the cause of these potential episodic elevated concentrations is the existing SO_2 and HF emitters within the Elixir Prahovo, i.e., phospho-gypsum landfills in the case of PM10, both for the current and future situation. Therefore, these episodic emissions are not a potential consequence of the operation of the future Waste-to-Energy Plant and Non-Hazardous Waste Landfill. Moreso, potential zones with exceedances of the limit values of these components occur on uninhabited areas in the immediate vicinity of the property limit of the existing chemical industry complex in Prahovo. Pollutants components that are currently not emitted and that would be emitted only from the emitters of the Waste-to-Energy Plant (Hg and PCDD/F), the modelling results indicate that the concentrations would be far below the regulated limit values. Additionally, the results show that the emissions would be practically negligible from the aspect of PM10 and TVOC (indicator of odor emissions) in cases of Waste-to Energy boiler in or out of operations.

Comprehensively concluded, the modelling results indicate that that already active emission sources are dominating the air quality, while the added emissions related to Subject Project execution would be almost negligible. The impact of the Subject Project installations would be marginal with limited synergistic effect. The potential influence on the larger area air quality is marginal, meaning that there is no potential influence in neighboring area of Romania and Bulgaria.

5.4.3. Wastewater emissions

Considered technical solutions do not allow for underground water contamination under normal operating circumstances. On the other hand, it is envisioned that there are 3 wastewater sources to be treated and discharged to the existing receiving collector of the industrial chemical complex in Prahovo, as a single collection point before being released to the final recipient, Danube River.

- The first wastewater source to be discharged to the receiving collector would be sanitary wastewater (separate sewage system collects waste sanitary-foul wastewater) threated mechanically and biologically. This stream is similar in quality with a regular municipal sewage water; thus, its cleaning is considered to be standard with limited threats for the receiving water body.
- The second wastewater source to be discharged to the receiving collector would be a stream of potentially oiled wastewater originated from roads, manipulative surfaces and parking lots. This source would be drained and directed for processed on oil/grease "bypass" separators before being discharged to the receiving collector.
- The third and potentially most contaminated wastewater source would be the stream originating from process wastewater treatment, which includes water from the drainage of the waste storage and boiler area, leachate from the Non-Hazardous Waste Landfill, wastewater from fire extinguishing, wastewater from process water preparation process and finally wastewater produced during Waste-to-Energy flue gas scrubbing (wet cleaning) process.

All these streams (abovementioned as the third wastewater source) would be treated on the wastewater treatment process with three stages of neutralization, sedimentation and flocculation, before being released to the existing central receiving collector and finally to Danube River.

The release of the atmospheric clean water (separate rainwater sewerage for the collection of clean atmospheric water from the roofs of buildings) would naturally be a non-contaminated source directly released to the central receiving collector.

Wastewater release to the existing central receiving collector and to the Danube River have been assessed cumulatively considering the currently measured emissions which are connected to existing industrial complex operation. Before attempting any modelling, the current values of contaminant concentration in Danube River upstream and downstream of the release point have been determined. For newly expected pollutant sources, concentration limits given by BAT conclusions, Commission implementing decision (EU) 2019/2010 of 12th November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration (notified under document C (2019) 7987)[7] have been taken as an overestimate of expected negative contribution of the Subject Project execution.

Release models consider the current flow of industrial complex wastewater release of 141.8 l/s, flow of wastewater from the oil separators 233 l/s, flow from fecal wastewater treatment 4 l/s and flow from the process wastewater treatment of 5 l/s, The model took into account the average flow rate of the Danube (at the Prahovo site) of 4,9 ·103 m^3/s. Model implies that the outflow of wastewater disperses through the Danube River course in the form of a developed plume and in accordance with the hydrodynamic parameters of the Danube River[8], taking into account transverse and vertical turbulent diffusion of pollutants in the river flow.

By comparing the results of the Danube River pollution modeling due to the discharge of collective wastewater from the Elixir Prahovo complex and the addition of the future Subject Project complex, it can be observed that no parameters exceed the concentration limit values of the tested parameters[9]. Moreover, it should be borne in mind that based on the results of the "zero state" of the Danube River water quality, it can be stated that in the tested water in its current state there is no to negligable load of any of the polluting substances characteristic for expected wastewater release which will be discharged from the future Subject Project complex. Bearing in mind the above, as well as the fact that all pollutants in wastewater from the Subject Project installations will be below the Emission Limit Value (ELV) prescribed by the conclusions on the best available technologies and BREF documents from 2019[7], it can be stated that after putting the Subject Project into operation, there would be no cumulatively higher values of the concentration of polluting substances in the collective wastewater discharged into the Danube River. Flow modeling additionally shows that concentrations already 100 m downstream from the wastewater outlet are negligible. At 100 m downstream from the outlet is the relatively highest load (in relation to the limit value) of chemical Oxygen Demand (COD), which is 22 times less than defined by the Regulation on limit values of polluting substances in surface and underground waters and sediment and deadlines for reaching them[10]. On the other hand, among the parameters not regulated by the Regulation,

[7] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)
[8] J. Rutherford Handbook on mixing in rivers, Water & soil miscellaneous publication, No. 26/1981, Wellington
[9] Environmental Impact Assessment study issued by Elixir Engineering, 2024 and physico-chemical testing results of waste and surface water executed in 2024 by Institute for Prevention, Occupational Safety, Fire Protection and Development DOO Novi Sad, branch "27. January" Niš
[10] Official Gazette of RS, No. 50/2012, Available at Uredba o graničnim vrednostima zagađujućih materija u površinskim i podzemnim vodama (paragraf.rs)

the highest relative load (in relation to the limit value) is Tl, which is 1667 times less than the concentration prescribed by the conclusions on the best available technologies and BREF documents from 2019[11].The project holder will follow in a similar manner during operation the regulation[12] for Danube River.

Additionally, modeling the effects of pollutant emission into the air from the Subject Project even under the most unfavorable weather conditions, and in the case of accidental situations with the most damaging scenarios of air pollutants release, didn't indicate any impact on the quality of Danube.

Determined concentrations 100 m and 200 m downstream of the treated wastewater discharge point are negligable in concentration and to a large level barrely if at all detectable. The study results conclusively showed that there would not be any violation of emission limits outlined for such installations and, more importantly, deterioration of Danube water quality as a consequence of the Subject Project execution.

5.4.4. Solid Waste Management

As above described all solid residues formed during the process are treated to incapsulate contaminants in the crystal structure of concreate after stabilization. This allows for management of waste in a sustainable manner on a Non-Hazardous Waste Landfill, which would be equipped with a non-permeable HDPE foil, thus the leachate would be drained and sent for treatment in the wastewater processing.

Acceptance of waste on the Non-Hazardous Waste Landfill is predicated on demonstrating compliance with non-hazardous leaching criteria set for non-reactive waste class according to national and EU regulation[13] which set the criteria for the solidified waste characterization to be accepted for landfilling. Consequently, the operating procedure specifies the need of taking samples of material after the stabilization and solidification process. In case of demonstrating compliance to the criteria the material would be accepted to be landfilled on the Non-Hazardous Waste Landfill. If case the material analysis would not demonstrate compliance to the criteria, it would be reverted to other operators for hazardous waste landfill and/or underground storage.

The management strategy prevents direct exposure of soil to solid waste, moreover the underground water sources are protected. The Non-Hazardous Waste Landfill operation itself would be monitored constantly via quality control piezometers. More precisely, soil and water quality will be monitored with preset frequency.

5.5. Accident scenarios

Detailed assessment of the consequences and risks at the Subject Project complex, defining the safety system, prevention and response measures in emergency situations, will be carried out through the development of Documents for operators of Seveso plants according to the

[11] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)
[12] Regulation on Setting Pollutant Load Limits for Industrial and Urban Wastewater Discharge into Natural Recipients, NTPA-001/2002, of February 28, 2002.
[13] NEN 7345 Leaching Characteristics of Soil and Stony Building and Waste Materials - Leaching Tests - Determination of the Leaching of Inorganic Components from Building and Monolithic Waste Materials with the Diffusion Test or an equivalent test

provisions of the Law on Environmental Protection[14]. Pursuant to the provisions of the Seveso Directive on the control of major accident hazards involving dangerous substances, i.e., article 58 of the Law on Environmental Protection and the Rulebook on the list of hazardous substances and their quantities and criteria for determining the type of documents prepared by the operator of the Seveso plant or complex, taking into account the maximum possible quantities of hazardous substances that may be present at any time within the Subject Project complex, as in Table 1 - List of dangerous substances and limit values thereof (ordinal number 11, 33 and 40), as well as in Table 2 – List of dangerous substances category and limit values thereof (Section "H" - HEALTH HAZARD, Section "P" – PHYSICAL HAZARDS, Section "E1" and "E2" HAZARD for the AQUATIC ENVIRONMENT), the status of the Subject Project was determined.

It was noted that the Subject Project represents a "higher order" Seveso complex and therefore it is the obligation of the Investor, in terms of accident risk management obligations, to prepare a Safety Report and an Accident Protection Plan and obtain the consent of the competent authority bearing the obligation of notification of new Seveso complex on the location. Considering that these documents as well as the project documentation will envisage all necessary measures in order to prevent and minimize the consequences of the accident, we believe that the only impacts that can be significant for the environment (accident situations) due to the operation of the Subject Project will be limited by these documents. It is the obligation of the Investor to prepare both the Final Fire Protection Design and the Fire Protection Plan in accordance with the Law on Fire Protection[15] and to obtain the consent of the competent Ministry of the Interior, Republic of Serbia.

5.5.1. Waste-to-Energy Plant accident scenarios

12 scenarios have been analysed as potential Waste-to-Energy Plant accident (please be refered to chapter 7 of Environmental Impact Assessment study issued by Elixir Engineering, 2024 for details and corresponding maps of exposure), classified in accoldance to level of potential consequences:

- level II (level of the complex – consequences of the accident limited to the entire complex - there are no consequences outside the boundaries of the complex)
- level III (the level of the municipality or city – the consequences of the accident are extended to the municipality or the entire city)
- level IV (regional level – the consequences have spread to the territory of several municipalities or cities) and
- level V (international level – the consequences have spread beyond the boundaries of the Republic of Serbia).

These occurances consider liquid waste spilage, dust discharge, gas leakage, gas formation followed with toxic contaminate spread or fire initiation with toxic gas formation. Accident effects were modelled using appropriate mathematical models and the ALOHA[R] software

[14] "Official Gazette of the RS", nos. 135/2004, 36/2009, 36/2009 - other law, 72/2009 - other law, 43/2011 - CC, 14/2016, 76/2018 and 95/2018 - other law , available at Zakon o zaštiti životne sredine (paragraf.rs)

[15] "Official Gazette of the RS", Nos. 111/2009, 20/2015, 87/2018 and 87/2018 – other laws, Available at Zakon o zaštiti od požara (paragraf.rs)

program[16], designed for professionals dealing with chemical accident issues to ensure quality assessment of vulnerable zones in case of chemical accidents and to enable quick responses to minimize consequences. The program, developed by US EPA ALOHA^R, successfully models three types of risks: toxic gas dispersion, fires, and explosions. For gas dispersion modelling (release of toxic substances), ALOHA^R uses the Gaussian dispersion model. According to this model, wind and atmospheric turbulence are forces that move the released gas molecules through the air, and turbulent mixing and lateral wind allow the cloud to spread in multiple directions. At the moment of hazardous gas release, the concentration of the pollutant is very high, but as it moves away from the accident site, the concentration decreases. ALOHA^R models three levels of hazard for toxic gas dispersion.

The most important events are accidents classified as level II and level III. There are no accidental scenarios classified as level IV or level V.

Accident clasified as level II, with consequences limited to the boundaries of the Subject Project complex, is accidental leak at the liquid waste transfer point, uncontrolled discharge of dust (total particulate matter) from flue gas bag filter, forced flue gas discharge to the stack without cleaning in the scrubber system and accidental situations in the stabilization and solidification facility.

Accidental leak at the liquid waste transfer station involving a tank truck fire for about 30 minutes, leading to BLEVE[17] effect is considered to be the worst case scenario accident. This would potentially include contained within a range of up to 57 m, some of the accompanying effects, such as shock waves and fragments from the potential tank truck explosion, could extend beyond the Waste-to-Energy Plant's area. However, toxic concentrations for CO, NO_x, SO_2, and soot remain below hazardous levels in the vicinity of the Waste-to-Energy Plant, classifying this accident scenario as Level II, meaning the consequences are limited to the boundaries of the Subject Project complex, with no impact beyond its boundaries.

Accident clasified as level III, with the the highest reach which extends the boundaries of the Subject Project, is linked to accidents involving ammonia water, as the furthest range for toxic concentrations is 680 m. Effects of subsequent ignition are within the boundaries of the complex, and the subsequent ignition effects remain within 11 m from the spill site.

By implementing protective measures in accordance with technical standards across construction, electrical, technological, and mechanical engineering, along with adhering strictly to relevant regulations and operational guidelines, the risk of accidents (such as fires, explosions, and spills) is minimized. Regular technical inspections and proper WtE installation maintenance also help prevent such accidents. In case of an accident, local emergency interventions will be conducted following established instructions and standards. For larger-scale accidents, the remediation process will be coordinated in collaboration with competent institutions to ensure proper management and resolution.

Special attention has been given to the effects of hazardous substance emissions in accident situations at the Waste-to-Energy Plant on the Danube River. For modelling pollution on the river flow, a mathematical model for a continuous pollution source was applied, based on the FATE[18] software development. In the case of ammonia vapours, the fractions of ammonia,

[16] Areal Locations of Hazardous Atmospheres
[17] Boiling Liquid Expanding Vapor Explosion
[18] Faculty of Civil Engineering, Podgorica, https://www.ucg.ac.me.objava_130961

HCl, SO_2 and NO_x dissolving in the river surface were calculated based on the deposition velocity, whose value in this case is taken as 0.01 m/s[19] – the effect of "acid rain". On the other hand, In the case of total particulate matter (PM), the portion of PM reaching the Danube River was calculated based on the deposition fraction flux from the turbulent diffusion equation, based on the calculated deposition velocity of the mean PM particle diameter.

The modelling results shown that the pollutant levels (PM and recalculated values of NH_3, HCl, HF, SO_2 i NO_x) are far below the acceptable values, meaning that accident situations at the Waste-to-Energy Plant would not lead to pollution of the Danube River even in the worst case scenario.

The Subject Project is clasified as a "higher order" Seveso complex and therefore it is the obligation of the Investor, in terms of accident risk management obligations, to prepare a Safety Report and an Accident Protection Plan and obtain the consent of the competent authority (Ministry of Environmental Protection, Republic of Serbia).

5.5.2. Non-Hazardous Waste Landfill accident scenarios

Two scenarios have been analysed as potential Non-Hazardous Waste Landfill accident, migration of contaminants and leakage of contaminated leachate causing groundwater contamination both in case of cracking of HDPE foil. After analysing the possible consequences due to these accidents, the occurances are assessed as low in likelihoud and of low significance in magnitude.

Molecular diffusion of two saturated layers occurs, in conditions where there is no flow, so that the transport of the contaminant occurs due to flux from the higher concentration zone to the lower concentration zone, it can be concluded that it takes more than 100 years for the concentrations at a distance of 5 m to be 0.5 % of the initial value. By increasing the distance, as well as the time, this value becomes negligibly small. In the presented case, it is clearly evident that diffusion is not a rapid process and is the prevailing mechanism of transport of contaminants in conditions of poorly permeable to watertight formations.

The scenario of leakage of contaminated water, leachate, from the landfill into the aquifer, causing contamination of groundwater, and consequently their drainage into the Danube watercourse, represents the most unfavorable possible accident scenario of the movement of contaminated groundwater, which has reached the groundwater level and is still transported by advective transport. The obtained results for a period of ½, 1 and 2 years and a distance of up to 500 m, refer to the hydrodynamic dispersion of the inert tracer (chloride) without retardation, shown that after 1 year the pollutions would reach a point 125 m from the location of release and 500 m after 2 years.

Metals are characterized by large sorption in the soil, the effect is dependent on the pH of the soil, thereby multiple scenarios are considered. In case of pH 4,9 the value would be almost 500 times lower than the initial one at 20 m after 2 years. In case of pH 6,8 the retardation is larger, thereby the pollution transfer is even less a concern.

The study results conclusively indicate that there is sufficient time to react in case of accidents involving leakage of contaminated leachate in case of cracking of HDPE foil

[19] S. Hanna et al., Handbook on Atmospheric Diffusion, Oak Ridge, 1982.

of the Non-Hazardous Waste Landfill, imposing limiting risks for the environment considering the introduced protective measures.

5.6. Prevention measures

All foreseen environmental harm and accident prevention measures have been developed fully in compliance with applicable laws and by-laws of Republic of Serbia as well as the following:

- Commission implementing decision (EU) 2019/2010 of 12th November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration (notified under document C (2019) 7987);[20]
- Commission Implementing Decision (EU) 2018/1147 of August 10th, 2018, establishing best available techniques (BAT) conclusions for waste treatment, under Directive 2010/75/EU of the European Parliament and of the Council (notified under document C (2018) 5070);[21]
- Commission reference document on Best Available Techniques on Emissions from Storage (July 2006);[22]
- Directive (EU) 2018/850 of the European Parliament and of the Council of May 30th, 2018, amending Directive 1999/31/EC on the landfill of waste;[23]
- Law No. 59/2016 of 11 April 2016 on the control of major accident hazards involving dangerous substances [24].

Moreover, all national legislation strongly corresponding EU regulatory framework has also been considered and the developed technical, operation and organizational strategies are fully compliant with the requirements. The Subject Project is considered as a high-order Seveso complex, thereby preparation of the Safety Report and an Accident Protection Plan is mandatory including obtaining approval from the competent authority (Ministry of Environmental Protection, Republic of Serbia).

Finally, operating procedures are subject to the Waste Framework Directive[25] and corresponding Serbian Law on Waste Management[26] and Law on Integrated Prevention and Control of the Environmental Pollution[27].

In order to familiarize employees with preventive fire protection measures as well as with the use of fire extinguishing agents, training and testing of employees should be conducted. It is the obligation of the Investor (as the future Operator) to develop a Training Program of Employees for Fire Protection according to the Law on Fire Protection[28], and in accordance

[20] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)
[21] Implementing decision - 2018/1147 - EN - EUR-Lex (europa.eu)
[22] Waste Incineration | EU-BRITE (europa.eu)
[23] Landfill Directive - Directive (EU) 2018/850 | Circular Cities and Regions Initiative (europa.eu)
[24] ''Official Gazette of Romania'' No. 290
[25] The Waste Framework Directive 2008/98/EC of the EU Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives and its amendments (2018)
[26] "Official Gazette of the RS", no. 36/2009, 88/2010, 14/2016, 95/2018 - other law and 35/2023, *Available at* Zakon o upravljanju otpadom (paragraf.rs)
[27] "Official Gazette of the RS", No. 135/2004, 25/2015 and 109/2021, *Available at* Zakon o integrisanom sprečavanju i kontroli zagađivanja životne sredine (paragraf.rs)
[28] "Official Gazette of the RS", no. 111/2009, 20/2015, 87/2018 and 87/2018 - other laws, *Available at* Zakon o zaštiti od požara (paragraf.rs)

with the Rulebook on the minimum content of the general part of the training program for workers in the field of fire protection[29] and to obtain the approval of the relevant authority. For each planned civil unit within the Waste-to-Energy Plant, the basic requirements from the aspect of fire protection are defined in accordance with the applicable regulations in this area. System design allows for early detection, alarming and response of the operation personnel.

The Subject Project foresees its own fire station with trained personnel, in addition to which in case of need it is possible to hire two more fire brigades equipped to react: Elixir Prahovo and Negotin municipality fire brigades. In case of unwanted events remediation procedures exist, setting monitoring measures and or special handling of residual contaminated waste (e.g., fire extinguishing wate, contaminated soil, etc.).

Both regulatory framework and technical operating requirements set a need for constant availability of responsible expert personal. Among the staff, expert chemists would be needed with responsibilities linked to pre-acceptance and acceptance procedures of waste, waste testing, stabilized and solidified waste compliance testing with landfilling criteria requirements. Complementary, an expert for waste regulatory framework would be necessary, while verification of full compliance of the regulatory framework is mandatory within the scope of work, it would also be necessary to execute a sophisticated reporting schedule. Responsibility for the full operation of the Subject Project in terms of environmental protection must be given to the Environmental Health and Safety expert, as an EHS Manager. Naturally, the operation of the Waste-to-Energy installation must be guided by an expert in that field, as a Technical Manager. Responsibility and scope delegation would be determined by the operating procedures which include but are not limited to, equipment operating procedures, start and shutdown procedures, maintenance procedures, waste pre-acceptance and acceptance procedure, waste movement reporting procedure (including waste recycling preparation, waste thermal treatment and waste disposal), equipment calibration and certification procedures, R1 calculation procedure, safety report development procedure, accident protection plan development procedure, fire protection system maintenance and testing procedure, environment state monitoring plan report development procedure, emergency situation reaction procedure, eco-management and audit scheme verification procedure.

Prevention measures are taken within design to avoid hazard circumstances and/or to prevent magnitude in case of an event. Thereby, material storage would be segregated maximally allowable by process unit co-dependency, installation of significance concentration detectors for H_2, CH_4, CO, H_2S and NH_3 are envisioned on locations outlined as potentially hazardous zones. Complete Subject Project complex would be equipped with signalization of gas detection. Moreover, design measures are taken for the regular operations of the Subject Project installations to avoid incomplete waste treatment, unpleasant odours, or uncontrolled emissions.

Furthermore, it is foreseen that the waste incineration boiler will be equipped with two auxiliary burner which must be activated automatically when the process gas temperature drops below 850°C. Air ventilation system is designed with large capacity to prevent harmful gas accumulation in an event of hazardous scenario unravelling. Waste storage system would be kept under vacuum with automatic direction of the gas to the combustion burners. At the same

[29] "Official Gazette of the SRS", no. 40/1990 Available at Pravilnik o minimumu sadržine opšteg dela Programa obuke radnika iz oblasti zaštite od požara

time, the vacuum would be directed to the filter system with activated carbon in case the boiler is not in operation. Moreover, the liquid waste, sludge and hazardous waste preparation would be nitrogen blanketed to prevent any release of gas to the environment.

Most of these practices are well defined within Commission implementing decision (EU) 2019/2010 of 12th November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration (notified under document C(2019) 7987)[30], Commission Implementing Decision (EU) 2018/1147 of August 10th 2018 establishing best available techniques (BAT) conclusions for waste treatment, under Directive 2010/75/EU of the European Parliament and of the Council (notified under document C(2018) 5070)[31] and Commission reference document on Best Available Techniques on Emissions from Storage (July 2006)[32]. The best practices set by these documents are as well the basis for procedure development, emission monitoring and reporting requirements of the Waste-to-Energy Plant. In order to minimize the Subject Project influence on the surrounding environment, the designers as well based the above-described technical solutions on BAT described in the EU reference documents.

5.7. Monitoring program

In accordance with the Law on Environmental Protection[33], and according to Article 72, the Investor (as the future Operator) is obliged to monitor emission indicators, i.e. indicators of the impact of its activities on the environment and indicators of the effectiveness of applied measures for preventing the occurrence or reducing the level of pollution. The Investor is obliged to develop a monitoring plan, which will define the dynamics of monitoring and the type of pollutants to be measured. The Investor shall submit the data on the performed monitoring to the competent authorities within the legally prescribed deadline. An environmental impact monitoring program already exists at the location of the industrial chemical complex in Prahovo, and monitoring reports are regularly submitted to the competent authorities. The report results are also integrated as a so-called “zero state” as a part of environment impact assessment of the project.

In terms of Waste-to Energy Plant, the technical and technological conditions of measurement, emission limit values and their monitoring are defined by the Regulation on technical and technological conditions for the design, construction, equipping and operation of installations and types of waste for thermal waste treatment, emission limit values and their monitoring[34], as well as Conclusions on best available techniques for waste incineration (Commission implementing decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration (notified under document C(2019) 7987)[35].

The content and method of monitoring the operation of the Non-Hazardous Waste Landfill, as well as subsequent maintenance after the closure of the landfill are defined by the Regulation

[30] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)
[31] Implementing decision - 2018/1147 - EN - EUR-Lex (europa.eu)
[32] Waste Incineration | EU-BRITE (europa.eu)
[33] "Official Gazette of the RS", nos. 135/04, 36/09, 36/09 - other law, 72/09 - other law, 43/11 - decision of the CC and 14/16, Available at Zakon o zaštiti životne sredine (paragraf.rs)
[34] "Official Gazette of the RS", No. 103/2023, Available at about:blank (ekologija.gov.rs)
[35] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)

on the disposal of waste at landfills[36] and Directive (EU) 2018/850 of the European Parliament and of the Council of May 30th, 2018, amending Directive 1999/31/EC on the landfill of waste[37].

5.8. Monitoring of the Waste-to-Energy Plant operation

5.8.1. Monitoring of pollutant emissions into the air

The EIS study and monitoring of air quality aims to control and determine the degree of air pollution, as well as to determine the trend of pollution to act in a timely manner to reduce the emission of harmful substances to a level that will not significantly affect the quality of the environment. The results of measurements of pollutant concentrations are compared with the prescribed emission limit values (ELVs), and based on the performed analyses, the conditions and trends are determined to take appropriate air protection measures. Air monitoring activities may be performed by professional organizations accredited as a testing laboratory, which meets the prescribed requirements and has the permission of the ministry responsible for environmental protection to perform air monitoring and/or emission measurement.

By implementing the Subject Project from point stationary sources of pollutants into the air, where monitoring of emissions into the air should be established, the following are:

- Emitter of the Waste-to Energy boiler: dust (total particulate matter), heavy metals, (Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V), Cd + Tl, HCl, HF, SO_2, NOx, CO, NH_3, TVOC, PCDD/F, dioxins as PCBs and Hg).
- Emitter of the waste pretreatment filter stacks: dust (total particulate matter), TVOC, i.e. organic matter, expressed as total carbon and unpleasant odours.
- Emitter of the stabilization and solidification of the thermal treatment residues: dust (total particulate matter).

Measurements of pollutant emission into the air from the Waste-to-Energy boiler stack shall be carried out in accordance with Annexes 2 and 3. Regulation on technical and technological conditions for the design, construction, equipping and operation of plants and types of waste for thermal treatment, emission limit values and their monitoring[38] and the Conclusions on best available techniques for waste incineration (Commission Implementing Decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration)[39]:

1) Continuous measurement of nitrogen oxides (NO_x), ammonia (NH_3), carbon monoxide (CO), dust (total particulate matter), total organic carbon (TVOC), hydrogen chloride (HCl), hydrogen fluoride (HF), sulphur dioxide (SO_2).
   Note: For waste thermal treatment plants with a proven low and stable mercury content as is the case of the Subject Project installation, continuous monitoring of emissions can be replaced by long-term sampling (there is no EN standard for long-term mercury sampling) or periodic measurements with a minimum frequency once every six months. In the second case, EN 13211 is relevant.

[36] "Official Gazette of the RS", No. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)
[37] Directive - 2018/850 - EN - EUR-Lex (europa.eu)
[38] "Official Gazette of the RS", No. 103/2023, Available at about:blank (ekologija.gov.rs)
[39] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)

2) Continuous measurement of the following process parameters: temperature at the inner wall of the combustion chamber or at another representative point of the combustion chamber and/or additional combustion chamber, in accordance with the permit of the competent authority, as well as the volume fraction of oxygen, flue gas flow, pressure, temperature and water vapor content in the waste gases.
   The gas retention time as well as the minimum temperature and oxygen content of the process gases shall be adequately checked, at least once, when the thermal treatment plant is put into operation and under the most unfavourable operating conditions expected.
3) Individual measurement of the heavy metals' concentration and metalloids (As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Sb, Tl, V), dioxins and furans at least twice a year, whereby these measurements in the first year of operation are performed at least four times a year with an interval of three months, as well as benzo[a] pyrene once a year.

Limit values for emissions of pollutants into the air from thermal waste treatment plants are prescribed in Appendix 2. of Regulation on technical and technological conditions for the design, construction, equipping and operation of plants and types of waste for thermal treatment, emission limit values and their monitoring[40] and the Conclusions on best available techniques for waste incineration (Commission Implementing Decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration)[41] as shown in Table 1 and 2. Emission limit values are prescribed for dry waste gas, under normal conditions: T=273.15 K and P=101.3 kPa. The standard values are with an oxygen content of 11 %, except in cases of incineration of mineral waste oil, in accordance with the regulation governing the management of waste oils, when the standard value is 3 % of the oxygen content. Regulation on technical and technological conditions for the design, construction, equipping and operation of plants and types of waste for thermal treatment, emission limit values and their monitoring[42].

Table 1. Emission limit values of pollutant emissions into the air from waste thermal treatment plant.

Pollutant	Unit	ELV according to RS regulation[43]	BAT-AELs in accordance with BREF WI[44]		Test method according to BAT-AELs according
			BAT-AEL for new plants	Averaging period	

[40] "Official Gazette of the RS", No. 103/2023, Available at about:blank (ekologija.gov.rs)
[41] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)
[42] "Official Gazette of the RS", No. 103/2023, Available at about:blank (ekologija.gov.rs)
[43] Regulation on technical and technological conditions for the design, construction, equipping and operation of plants and types of waste for waste thermal treatment, emission limit values and their monitoring ("Official Gazette of the RS", No. 103/2023), *Available at* about:blank (ekologija.gov.rs)
[44] Conclusions on best available techniques for waste incineration (Commission Implementing Decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration) Available at Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)

					to BREF WI*
Dust (Total Particulate matter)	mg/Nm³	10	< 2–5	Mean daily	General Standard and EN 13284-2
Cd+TI	mg/Nm³	0.05	0.005-0.02	During the sampling period	EN 14385
Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V	mg/Nm³	0.5	0.01-0.3	During the sampling period	EN 14385
HCl	mg/Nm³	10	< 2–6	Mean daily	General EN Standards
HF	mg/Nm³	1	< 1	Mean daily or mean during the sampling period	General EN Standards
SO_2	mg/Nm³	50	5-30	Mean daily	General EN Standards
NOx	mg/Nm³	200	50-120	Mean daily	General EN Standards
CO	mg/Nm³	50	10-50	Mean daily	General EN Standards
NH_3	mg/Nm³	-	2-10	Mean daily	General EN Standards
TVOC	mg/Nm³	10	< 3–10	Mean daily	General EN Standards
PCDD/F	ng I-TEQ/Nm³	0.1	< 0.01-0.04	Mean value during the sampling period	EN 1948-1, EN 1948-2, EN 1948-3
			< 0.01-0.06	Long sampling period	
PCDD/F + dioxin- like PCBs	ng WHO-TEQ/Nm³	-	< 0.01-0.06	Mean value during the sampling period.	EN 1948-1, EN 1948-2, EN 1948-4

			< 0.01-0.08	Long sampling period	
Hg	µg/Nm^3	50	< 5–20	Mean daily or mean value during the sampling period	General EN standards and EN 14884
			1-10	Long sampling period	

Table 2. Mean half-hour limit values (in accordance with the Regulation on technical and technological conditions for the design, construction, equipping and operation of plants and types of waste for thermal treatment, emission limit values and their monitoring[45]) for the following pollutants.

Pollutant	(100% of measured values) A	(97% of measured values) B
Dust (Total Particulate matter)	30 mg/normal m^3	10 mg/normal m^3
Gaseous or vapour organic matter, expressed as total organic carbon (TOC)	20 mg/normal m^3	10 mg/normal m^3
Hydrogen chloride (HCL)	60 mg/normal m^3	10 mg/normal m^3
Hydrogen fluoride (HF)	4 mg/normal m^3	2 mg/normal m^3
Sulphur dioxide (SO_2)	200 mg/normal m^3	50 mg/normal m^3
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as nitrogen dioxide for incineration plants whose nominal capacity exceeds six tonnes per hour or for new plants	400 mg/normal m^3	200 mg/normal m^3

Table 3. Mean half-hour limit values (in accordance with the Regulation on technical and technological conditions for the design, construction, equipping and operation of plants and types of waste for thermal treatment, emission limit values and their monitoring[46]) for the following heavy metals during sampling for a minimum of 30 min. and a maximum of 8 h.

Pollutant	(Sampling for min of 30 minutes)	(Sampling for max of 8 hours)
Cadmium and its compounds, measured as cadmium (Cd)	total 0.05 mg/normal m^3	total 0.1 mg/normal m^{3*})
Thallium and its compounds, expressed as thallium (Tl)		
Mercury and its compounds, expressed as mercury (Hg)	0,05 mg/normal m^3	0.1 mg/normal m^{3*})
Antimony and its compounds, expressed as antimony (Sb)	total 0.5 mg/normal m^3	total 1 mg/normal m^{3*})
Arsenic and its compounds, expressed as arsenic (As)		
Lead and its compounds, expressed as lead (Pb)		
Chromium and its compounds, expressed as chromium (Cr)		

45 "Official Gazette of the RS", No. 103/2023, Available at about:blank (ekologija.gov.rs)
46 Ibid.

Cobalt and its compounds, expressed as cobalt (Co)		
Copper and its compounds, expressed as copper (Cu)		
Manganese and its compounds, expressed as manganese (Mn)		
Nickel and its compounds, expressed as nickel (Ni)		
Vanadium and its compounds, expressed as vanadium (V)		

Table 4**.** shows the mean emission values for dioxins and furans over a sampling period of at least 6 h and at most 8 h. The emission limit values apply to the total concentrations of dioxins and furans, calculated based on factors of equivalent toxicity.

Table 4. Mean emission values for dioxins and furans over a sampling period of at least 6 h and at most 8 h

Dioxins and furans	0.1 ng/Nm^3

The emission limit values for carbon monoxide (CO) must not be exceeded regarding gases from the combustion process:

a) 50 mg/normal m^3 determined as a daily average.

b) 100 mg/normal m^3 determined as a half-hour value.

(c) 150 mg/normal m3 as the mean ten-minute value.

An emission limit value for carbon monoxide (CO) may be applied to waste incineration installations using fluidised bed combustion process, provided that the permit clearly states an emission limit value for carbon monoxide (CO), which is a maximum of 100 mg/normal m^3, determined as the mean hourly value. Air emission limit values for gaseous or vapour organic substances, expressed as total organic carbon (TOC) of 20 mg/Nm^3 (100 % of measured values) and 10 mg/Nm^3 (97 % of measured values), for mean half-hourly LV and carbon monoxide (CO) referred to in point 5 for mean half-hourly LV (100 mg/Nm^3) must not be exceeded.

During the regular operation of the pretreatment (mechanical treatment) of waste to be thermally treated at the Waste-to-Energy boiler, as well as during the unloading of waste, dust (total particulate matter), unpleasant odours and TVOC may be emitted (only when the organic compounds in question have been identified as relevant in the waste gas stream). To dedust and remove unpleasant odours, the air from the area where the unloading and pretreatment of non-hazardous and hazardous waste intended for energy generation is carried out will be conducted by means of a fan with a capacity of 24,000 m^3/h through a system of suction hoods and pipelines to the filter unit (Waste Pretreatment Bag Filter System and Activated Carbon Filter). The filter unit consists of a bag filter with pulsed shaking by compressed air, an activated carbon filter and an emitter.

All sources of dust (total particulate matter) emission into the air from the stabilisation and solidification process are equipped with bag filters on which total particulate matter is separated (ash mixture and thickened sediment storage bunker in which the stabilisation process takes place; mechanical treatment of slag or separation of ferrous metals using magnetic separators and non-ferrous metals using eddy current separators; mixer reactor in which the process of mixing cement, ash and water or the solidificates takes place; cement storage silo; cement weighing scale and ash weighing scale). The dedusting system consists of exhaust shutters and hoods, pipelines, bag filter unit with accompanying equipment, centrifugal fan (capacity Q=25,000 m^3/h, P=37 kW) and emitter (stack).

Limit values of emissions into the air for these two emitters are prescribed by the Regulation on Limit Values of Emissions of Pollutants into the Air from Stationary Pollution Sources, except for combustion plants[47]. In accordance with the Regulation on measurements of pollutant emissions into the air from stationary sources of pollution[48] and the Regulation on limit values for the emission of pollutants into the air from stationary sources of pollution, except for combustion plants[49] - Annex 1, Part VII WASTE TREATMENT PLANTS and OTHER MATERIALS, with the EXCEPTION OF THERMAL TREATMENT and BAT conclusions for waste treatment plants (Commission Implementing Decision (EU) 2018/1147 of 10 August 2018 establishing best available techniques (BAT) conclusions for waste treatment, under Directive 2010/75/EU of the European Parliament and of the Council (notified under document C(2018) 5070) [50] (Text with EEA relevance.) it is necessary to:

- On the emitter of the Waste Pretreatment Bag Filter System and Activated Carbon Filters, measure the concentrations of dust (total particulate matter), TVOC or organic matter, expressed as total carbon.
- Measure the concentrations of dust (total particulate matter) on the emitter of the stabilization and solidification process.

At the specified point emission sources, periodically measure emissions twice during the calendar year, in accordance with legal regulations. One periodic measurement is performed in the first six calendar months, and the other periodic measurement in the second six ones. Table 5 shows the limit values for the emission of pollutants into the air from the Emitter of the Waste Pretreatment Bag Filter System and Activated Carbon Filter, as well as Filter system of the stabilization and solidification process.

[47] "Official Gazette of the RS", No. 111/2015 and 83/2021, Available at Uredba o graničnim vrednostima emisija zagađujućih materija u vazduh (paragraf.rs)
[48] "Official Gazette of the RS", no. 5/16 and 10/24, Available at Uredba o merenjima emisija zagađujućih materija u vazduh (paragraf.rs)
[49] "Official Gazette of the RS", No. 111/2015 and 83/2021, Available at Uredba o graničnim vrednostima emisija zagađujućih materija u vazduh (paragraf.rs)
[50] Implementing decision - 2018/1147 - EN - EUR-Lex (europa.eu)

Table 5. Limit values for the emission of pollutants into the air.

Emitter		Pollutants	ELV with RS regulations[51]	BAT WT[52]	Test method according to BAT-AELs in accordance with BREF WT[4]
Emitter of the Waste Pretreatment Filter System and Activated Carbon Filters	Stack after bag filter and activated carbon filter (H=21.5 m)	Dust (Total Particulate matter)	10 mg/Nm^3	2-5 mg/Nm^3	EN 13284-1
		TVOC	20 mg/Nm^3	10-30* mg/Nm^3	EN 12619
Emitter of the stabilization and solidification process Filter system	Stack after bag filter (H=21.5 m)	Dust (Total Particulate matter)	10 mg/Nm^3	2-5 mg/Nm^3	EN 13284-1

The impact on air quality in the subject area will be based on the monitoring of ambient air quality. Currently, in accordance with the adopted environmental monitoring plan and program, the operator Elixir Prahovo performs monitoring of ambient air quality in the vicinity of the subject location through an authorized accredited laboratory of the City Institute for Public Health Belgrade.

Air quality monitoring is carried out once a year for 15 days at the measuring point 1: Dragiša Brebulović-Žmiga, 11 Vuka Karadžića Street, Prahovo (N 44°17'40.6", E 22°35'9.5 "), which is about 2.5 km northwest of the location of the Waste-to-Energy Plant and Non-Hazardous Waste Landfill. The tests include monitoring of the following parameters:

- Mass concentrations of suspended particles PM10 and PM2,5.
- Total content of metals (As, Cd, Pb, Ni, Cr) in fraction of suspended particles PM10.
- Hydrogen fluoride (HF) mass concentration.
- Total content of phosphorus (P) in fraction of suspended particles PM10.

The analysis of the pollutants concentration in the air results, in the impact zone in relation to the maximum permissible concentration, was conducted in accordance with the Regulation on monitoring conditions and air quality requirements[53]. Based on the results of the Report on the conducted public consultations in the implementation of the projects for the construction of the Waste-to-Energy Plant in Prahovo, a strategic and systematic approach to future long-term interactions between investors and the local community regarding the operation of the Waste-to-Energy Plant has been defined through consultations with citizens. In addition to the

[51] "Official Gazette of the RS", No. 111/2015 and 83/2021, Available at Uredba o graničnim vrednostima emisija zagađujućih materija u vazduh (paragraf.rs)
[52] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)
[53] "Off. Gazette of RS" no.75/10, 11/10 and 63/13, Available at Uredba o uslovima za monitoring i zahtevima kvaliteta vazduha

conducted consultation, the need to donate an automatic measuring station to the municipality of Negotin was recognized. The automatic measuring station would be part of the network of the Environmental Protection Agency, at whose initiative an adequate location would be defined and relevant parameters for measurement would be determined. In accordance with the above, in the Environmental Protection Agency, a meeting was held in mid-April 2024, attended by the President of the Municipality of Negotin and representatives of the Elixir Foundation. On May 13th 2024, the Head of the Monitoring Group of the Environmental Protection Agency, the representative of Urbanism of the Negotin Municipality and the representative of the Elixir Foundation visited 6 potential locations in Negotin, after which the representative of the Agency selected the location of the preschool institution “Pčelica” (in the city centre). Representatives of the local authorities and the civil association ‘Negotinci in Action’ were also introduced to all the above.

5.8.2. Wastewater quality monitoring

In accordance with the Law on Waters[54], and the Rulebook on the manner and conditions for measuring and testing the quality of wastewater and their impact to the recipient and the content of the report on the performed measurements[55], Appendix 1 - technical conditions for the implementation of monitoring, it is the obligation of the water treatment facility owner, in this case the Investor, to monitor wastewater before and after their treatment through a legal entity authorized for wastewater testing or independently if the conditions are met.

Sampling of treated and/or untreated wastewater will be done by taking a composite or instantaneous sample depending on the dynamics of wastewater discharge. The basic parameters of the wastewater to be tested are flow (minimum, maximum and mean daily), air temperature, water temperature, barometric pressure, colour, odour, visible substances, sediment matter (after 2h), pH value, biochemical oxygen demand (BOD5), chemical oxygen demand (COD), oxygen content, dry residue, annealed residue, annealing loss, suspended matter and electrical conductivity.

In addition to the above basic parameters, testing of certain groups or categories of pollutants prescribed for technological and other wastewater that is directly discharged into the recipient will be performed (in accordance with the Regulation on Emission Limit Values for Pollutant into Water and Deadlines for Their Reach[56] as well as parameters related to emissions from wastewater treatment from the flue gas treatment process generated in the waste incineration installation (in accordance with the Regulation on technical and technological conditions for the design, construction, equipment and operation of plants and types of waste for thermal treatment, emission limit values and their monitoring[57]).

In accordance with the characteristics of wastewater generated and discharged into the recipient, it is the obligation of the Investor to perform regular monitoring of wastewater quality:

[54] "Official Gazette of the RS", no. 30/2010, 93/2012, 101/2016, 95/2018 and 95/2018 - other law, Available at Zakon o vodama (paragraf.rs)
[55] "Official Gazette of the RS", no. 18/2024, Avilabile at Pravilnik o načinu i uslovima za merenje količine i ispitivanje kvaliteta otpadnih voda
[56] "Official Gazette of the RS", No. 67/2011, 48/2012 and 1/2016, Available at Uredba o graničnim vrednostima zagađujućih materija u vode
[57] "Official Gazette of the RS", No. 103/2023, Available at about:blank (ekologija.gov.rs)

- After treatment at the wastewater treatment facility: total suspended solids (TSS), total organic carbon (TOC), metals and metalloids (As, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Tl, Zn, Mo), ammonium-nitrogen (NH4-N), sulphates (SO4-2) and PCDD/ F, chlorides.
- before and after treatment on the grease and oil "by-pass" separator: temperature, pH value, biochemical oxygen demand (BOD5), chemical oxygen demand (COD), hydrocarbon index.

To facilitate manipulation and response in the event that the water quality does not correspond to the required quality after treatment for discharge into the recipient, wastewater chamber (numbered as chamber 2) is divided into four identical parts (sub-chambers 2a, 2b, 2c, 2d). The volume of each part, i.e. each sub chamber, is 80 m^3, which is enough for each sub-chamber to accept wastewater for a period of 8 hours. After that, the wastewater from the sub-chamber in question is sampled and the quality parameters are evaluated. In this way, it is possible for each batch of 80 m^3 to be analysed before discharge. By dividing chamber two into smaller segments, a semi-batch method of wastewater treatment management is enabled, to have time to perform complete physic-chemical analyses. The maximum duration of the analysis is 8 hours, and then the water can be discharged in an appropriate manner, depending on the analysis results. In case that the waters do not have a satisfactory quality for discharge into the final recipient, water would be transported to the wastewater treatment facility by filtration (sand filter column and activated carbon column). After these filters, the water is once again sent for re-treatment to the wastewater treatment facility from the WtE boiler facility.

Limit Values for Emissions of Pollutants in Wastewater from the Waste Gas Treatment Process Generated in the Incineration Plant and Co-Incineration of Waste, Regulation on technical and technological conditions for the design, construction, equipping and operation of plants and types of waste for thermal treatment, emission limit values and their monitoring[58]. Emission limit values shall be applied at the point where the wastewater generated in the waste gas treatment process, containing the pollutants referred to in Annexes 2 and 3 of the said Regulation is discharged, i.e., at the point where the cleaned process water from the receiving basin is discharged into the collector of wastewater from the Waste-to-Energy Plant. In addition to Serbian national legislation, to define the monitoring of wastewater from the Subject Project, the Conclusions on best available techniques for waste incineration (Commission implementing decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration (notified under document C(2019) 7987)) were also used[59].

Regulation on technical and technological conditions for the design, construction, equipping and operation of plants and types of waste for waste thermal treatment, emission limit values and their monitoring[60], the following measurements are performed at the wastewater discharge point:

1) continuous measurement of the parameters referred to in the aforementioned Annex 4 of the Regulation.
2) individual daily measurement of total suspended solids.

58 "Official Gazette of the RS", No. 103/2023, Available at about:blank (ekologija.gov.rs)
59 Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)
60 "Official Gazette of the RS", No. 103/2023, Available at about:blank (ekologija.gov.rs)

3) monthly measurement also on a representative sample of discharged waters for 24 hours, i.e., pollutants in connection with Annex 4 of the Regulation.
4) measurements of dioxins and furans every six months (in the first year of operation, it would be measured at least four times a year with an interval of three months).

Table 6. Emission limit values for pollutants at discharging of wastewater from the waste gas treatment system of the thermal treatment plant.

Parameter name	Process		Unit	BAT-AELs BREF WI[61]	ELV in accordance with the regulations of RS[62]	Test method according to BAT-AELs in accordance with BREF WI[5]	Minimum monitoring requirement
Total suspended solids (TSS)	FGC Treatment of bottom ash		mg/l	10-30	30 (in 95% measured values) 45 (in 100% measured values)	EN 872	Once a day (2) Once a month (1)
Total organic carbon (TOC)	FGC Treatment of bottom ash			15 – 40	-	EN 1484	Once a month Once a month (1)
Metals and metalloids	As	FGC		0.01-0.05	0.15	Different EN standards (e.g. EN ISO 11885, EN ISO 15586 or EN ISO 17294-2)	Once per month
	Cd	FGC		0.005-0.03	0.05		Once per month
	Cr	FGC		0.01-0.1	0.5		Once per month
	Cu	FGC		0.03-0.15	0.5		Once per month
	Mo	FGC		--	-		
	Hg	FGC		0.001-0.01	0.03	Different EN standards (e.g. EN ISO 12846 or EN ISO 17852)	Once per month
	Ni	FGC		0.03-0.15	0.5	Different EN standards (e.g. EN ISO 11885, EN ISO 15586 or EN ISO 17294-2)	Once per month
	Pb	FGC Treatment of bottom ash		0.02-0.06	0.2 -		Once per month
	Sb	FGC		0.02-0.9	-		Once per month
	Tl	FGC		0.005-0.03	0.05		Once per month
	Zn	FGC		0.01-0.5	1.5		Once per month

[61] Commission implementing decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration (notified under document C(2019) 7987), Available at Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)

[62] Regulation on technical and technological conditions for the design, construction, equipping and operation of plants and types of waste for waste thermal treatment, emission limit values and their monitoring "Official Gazette of the RS", No. 103/2023, Available at about:blank (ekologija.gov.rs)

PCDD/F	FGC	ng I-TEQ/l	0.01-0.05	0.3	No EN standard	Once every 6 months

(1) Monitoring may also be performed once every 6 months if it is proven that emissions are relatively stable.
(2) Daily 24-hour flow-proportional sampling may be replaced by daily measurements.

In accordance with the characteristics of the wastewater that is generated and discharged into the recipient, it is the responsibility of the Investor to carry out regular monitoring of the quality of wastewater after treatment at the wastewater treatment facility: total suspended matter (TSS), total organic carbon (TOC), metals and metalloids and (As, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Tl, Zn, Mo) and PCDD/ F.

During the regular operation of the Subject Project, atmospheric (potentially polluted) wastewater will be generated. For the purpose of treating oily atmospheric water from manipulative surfaces, roads and parking lots, two "by pass" separators of petroleum products are planned, made and tested according to SRPS EN 858, rated size NS10/100 (flow through the separator 10 l/s while the max flow is 100 l/s) and rated size NS15/150 (flow through the separator 15 l/s while the max flow is 150 l/s). The efficiency of separating light petroleum products - light liquids in the separator outlet water is up to 5 mg/l. So cleaned oily sewer is connected to the conditionally clean rainwater sewer and conducted to the drainage existing central receiving collector for the entire industrial chemical complex in Prahovo, and through it is discharged into the Danube River.

Wastewater quality control will include regular analyses of samples of potentially polluted atmospheric wastewater, before and after their treatment on the separator of petroleum products. Wastewater quality testing will be carried out 4 times a year in accordance with Article 99 Law on Waters[63] and in accordance with the Rulebook on the method and conditions for measuring the amounts and examination of the quality of wastewater and its impact on the recipient and the content of the report on the measurements performed[64] the Regulation on Limit Values of Pollutant Emissions into Water and Deadlines for Reaching Them[65].

When sampling, preparing samples, storing, and storing them, handling samples, as well as during field testing and analysis of wastewater samples, reference methods as required by standard SRPS ISO/IEC 17025 will be applied. The quality of wastewater discharged into the recipient (Danube River) must correspond to the values prescribed by the Rulebook on the method and conditions for measuring the amounts and examination of the quality of wastewater and its impact on the recipient and the content of the report on the measurements performed[66] and the Regulation on Limit Values of Pollutant Emissions into Water and Deadlines for Reaching Them[67], Appendix 2, 19. Emission limit values for wastewater; II Other

[63] "Official Gazette of the RS", no. 30/2010, 93/2012, 101/2016, 95/2018 and 95/2018 - other law, Available at Zakon o vodama (paragraf.rs)
[64] "Official Gazette of the RS", no. 18/2024, Avilabile at Pravilnik o načinu i uslovima za merenje i ispitivanje kvaliteta otpadnih voda
[65] "Official Gazette of the RS", No. 67/2011, 48/2012 and 1/2016, Available at Uredba o graničnim vrednostima zagađujućih materija u vode
[66] "Official Gazette of the RS", no. 18/2024, Avilabile at Pravilnik o načinu i uslovima za merenje i ispitivanje kvaliteta otpadnih voda
[67] "Official Gazette of the RS", No. 67/2011, 48/2012 and 1/2016, Available at Uredba o graničnim vrednostima zagađujućih materija u vode

wastewater; Section 4. Limit values for the emission of wastewater containing mineral oils. Table 7 provides emission limit values at the point of discharge into surface waters.

In accordance with the characteristics of the generated wastewater and discharge of them into the recipient, it is the responsibility of the Investor to perform regular monitoring of the quality of wastewater before and after treatment at the grease and oil separator: temperature, pH value, biochemical oxygen demand (BOD5), chemical oxygen demand (COD), hydrocarbon index.

Bearing in mind that all wastewater, which meets the prescribed ELV, from the subject Waste-to-Energy Plant will be collectively released into the existing central receiving collector, which is discharged into the natural recipient – the Danube River, it is the obligation of the Investor to perform regular quarterly monitoring of the surface water quality of the Danube River upstream and downstream of the inflow of wastewater from the central receiving collector of clean water, after the implementation of the Subject Project.

Table 7. Emission limit values at the point of discharge into surface waters (I).

Parameter name	Unit	Limit value(I)	Testing method
Temperature	°C	30	EPA Method 150.1:1982
pH		6.5-9	EPA Method 170.1:1974
Biochemical Oxygen Demand (BOD_5)	mgO_2/l	40	EN 1899
Chemical Oxygen Demand (COD)	mgO_2/l	150	EPA Method 410.1:1978
Hydrocarbon index	mg/l	10	EN ISO 9377-2

(I) The values refer to a two-hour sample.

The final recipient of the treated wastewater is the River Danube; therefore, 2 sampling points are subject to the monitoring program on the Danube, the sampling positions being before and after the collector point wastewater discharge. The monitoring program foresees testing the quality of the natural recipient in accordance with Serbian and international regulation with an almost equivalent scope as outlined in Romanian "Regulation on Setting Pollutant Load Limits for Industrial and Urban Wastewater Discharge into Natural Recipients, NTPA-001/2002, of February 28, 2002.". The list of pollutant load limits for Natural Recepient, Danube is given in Table 8. For parameters set in Serbian legislation, serbian parameters and limit values are addopted, for the supplemented parameters non-existing in Serbian legislation and set in corresponding Romanian legislation, Romanian limit values are addopted.

Table 8: Pollutant Load Limits for Industrial and Urban Wastewater Discharge into Natural Recepients

Parameter	Regulation	Unit	Limit Value
General			
pH		-	6,5 - 8,5

Temperature	**Water Law[68], Regulation on limit values of pollutants in surface and groundwater and sediment and deadlines for their achievement[69] ,Annex 1, Tables 1 and 3. Regulation on limit values of priority and priority hazardous substances polluting surface waters and deadlines for their achievement[70], Annex 1, Table 1. For determining quality classes, the criteria prescribed by the Regulation[71] were used.**	°C	35
Suspended matter		mg/l	25
Oxygen Regime			
Dissolved Oxygen		mg O2/l	7
Oxygen Saturation			
epilimnion (stratified water)		%	70-90
hypolimnion (stratified water)		%	70-50
non-stratified water		%	50-70
BOD (bichromate method)		mg O2/l	5
COD (permanganate method)		mg O2/l	10
Total Organic Carbon (TOC)		mg/l	5
Nutritients			
Total Nitrogen		mg N/l	2
Nitrates		mg N/l	3
Nitrites		mg N/l	0.03
Amonium ion		mg N/l	0,3
Non-ionized ammonia		mg l/ NH3	0,025
Total Phosphorus		mg P/l	0,2
Ortophosphates		mg P/l	0,1
Salinity			
Chlorides		mg/l	100
Total residual chlorine		mg/l HOCl	0,005
Sulfates		mg/l	100
Total mineralization		mg/l	1000
Electrical condutivity		mS/cm	1000
Metals			
Arsenic		µg/l	10
Boron		µg/l	1000
Copper		µg/l	5 (T = 10) 22 (T = 50) 40 (T = 100) 112 (T = 300)

68 "Official Gazette of the RS" nos. 30/2018 and 64/2019, Appendix 2, Available at Uredba o graničnim vrednostima zagađujućih materija u zemljištu (paragraf.rs)
69 "Official Gazette RS" no. 50/2012 Available at Uredba o graničnim vrednostima zagađujućih materija u površinskim i podzemnim vodama (paragraf.rs)
70 "Official Gazette of the RS", no. 24/2014, Available at Uredba o graničnim vrednostima prioritetnih i prioritetnih hazardnih supstanci (paragraf.rs)
71 Official Gazette RS" no. 50/2012 Available at Uredba o graničnim vrednostima zagađujućih materija u površinskim i podzemnim vodama (paragraf.rs)

Zinc		µg/l	300 (T = 10) 700 (T = 50) 1000 (T = 100) 2000 (T = 500)
Chromium (Total)		µg/l	50
Iron (Total)		µg/l	500
Cadmium and its compounds depending on water hardness		µg/l	<0,45 (class 1) 0,45 (class 2) 0,6 (class 3) 0,9 (class 4) 1,5 (class 5)
Manganese (total)		µg/l	100
Organic substances			
Phenolic compoundsa (as C2H5OH)		µg/l	1
Petroleum hydrocarbons		mg/dm3	20
Surface-active substances (as lauryl sulfate)		µg/l	200
AOH (adsorbed organic halogen)		µg/l	50
Microbiological parameters			
Fecal coliforms		cfu/100 ml	1000
Total coliforms		cfu/100 ml	10000
Red enterococci		cfu/100 ml	400
Number of aerobic heterotrophs (Kohl method)		cfu/100 ml	10000
Substances extractable with organic solvents	**Regulation on Setting Pollutant Load Limits for Industrial and Urban Wastewater Discharge into Natural Recipients, NTPA-001/2002, of February 28, 2002.**	mg/dm3	20
Petroleum derivates		mg/dm3	5
Filtered residue at 105 °C		mg/dm3	0,1
Sulfur and Hydrogen Sulfide		mg/dm3	0,5
Sulfties		mg/dm3	1
Total Cyanides (CN)		mg/dm3	0,1
Fluorides		mg/dm3	2000
Aluminium		mg/dm3	300,6
Calcium		mg/dm3	0,2
Lead		mg/dm3	0,2
Hexavalent Chromium		mg/dm3	5
Nickel		mg/dm3	0,5
Mercury		mg/dm3	0,1
Silver		mg/dm3	0,1
Molybdenum		mg/dm3	0,1

Selenium		mg/dm3	1
Magnesium		mg/dm3	1

Monitoring requirements for underground water, treated sewage water, soil quality, noise and waste handling are not described in detailed in this brief summary. All the procedures with corresponding pollutant limits have been developed in accordance with Serbian legislative framework and are subject to special permitting system as a part of the IPPC permit authorization process.

5.8.3. Monitoring of Non-Hazardous Waste Landfill operations

The content and method of monitoring the operation of the Non-Hazardous Waste Landfill, as well as subsequent maintenance after the closure of the landfill are defined by the Regulation on the disposal of waste at landfills[72], Appendix 6 - Monitoring the operation of the landfill.

The monitoring of the landfill operation will be conducted during the active and passive phase of the landfill and will include the following:

1) monitoring of meteorological parameters (daily).
2) monitoring of surface waters (volume and composition measurement upstream and downstream of the landfill quarterly).
3) monitoring of leachate (volume – monthly, composition – quarterly).
4) monitoring of gas emissions (there will be no emissions of landfill gas and unpleasant odours).
5) monitoring of groundwater (water table every six months, composition – must be determined based on the flow).
6) monitoring of the amount of rainwater (daily).
7) monitoring of the landfill body stability (every year).
8) monitoring of protective layers (continuously).
9) monitoring of pedological and geological characteristics (yearly).

The monitoring will be conducted by sampling and measurement in the manner defined in Appendix 6. – Monitoring the operation of the landfill, the Regulation on disposal of waste on landfills[73].

In the first six months of the landfill operation every 15 days, measurement, and testing (shortened chemical and bacteriological analyses) of groundwater will be performed, and after this period the frequencies of measurement during exploration determined. If the results of the testing of the taken samples show that it has deviated from the limit values in accordance with the law governing water, it is considered that an accidental situation of the protective layers of the landfill has occurred. In this case, additional hydrogeological facilities shall be made considering the hydrogeological conditions of the environment. All processed data are displayed by control charts with established control rules of limit values for each groundwater measuring point.

[72] "Official Gazette of the RS", No. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)
[73] Ibid.

Due to critical nature of the activity and with a purpose of accident prevention/control a plan has been proposed to determine the soil quality in the subject area during exploration:

- In order to determine the characteristics of the drilled soil, sampling should be performed for laboratory testing of the granulometric composition of approximately 5 samples per well, which would include all changes in relation to the heterogeneity of the lithological column, as well as the material immediately below the ground up to 1 m, the area above the aquifer zone, and specifically the capillary rise zone and the aquifer zone.
- Based on the drilled core of the well, soil sampling for physical and chemical soil analysis should be performed on the characteristic changes of the terrain. From each exploration well, take 1 sample in the over aquifer zone above the capillary zone, 1 sample in the capillary rise zone, 1 sample in the groundwater fluctuation zone, as well as 1 sample in the zone one meter below the aquifer level) – approximately 4 samples per well, in accordance with SRPS ISO 18400-101:2019, SRPS ISO 18400-104:2019, SRPS ISO 18400-203:2020.
- Installation of a piezometer structure made of solid threaded PVC pipes with a diameter of Ø 90 mm in accordance with (SRPS EN ISO 1452-1 and SRPS EN ISO 1452-5 as well as standards EPA/540/S-95/500).
- During the first year of groundwater quality monitoring, it is proposed that monitoring be conducted on a quarterly basis in all observation piezometers simultaneously, with daily groundwater level measurements. After the annual review of the status, it is proposed to switch to 6-month quality monitoring, if there is no deterioration in the quality of groundwater, i.e., that all tested parameters are in accordance with the applicable legislation.

The establishment of an adequate monitoring system will ensure:

- consideration of the direction of groundwater flow towards the Danube River (and or to underground water directly connected to River Danube) under different conditions of the relationship between the groundwater regime, the precipitation regime, and the surface water regime, by forming potentiometer maps,
- encompassing the complete convection image of the aquifer formed in the terraced deposits of the "City Terrace" as well as the aquifer formed in the Pliocene deposits, in order to determine the hydraulic dependence of the roof and floor aquifer,
- hydraulic connection between the surface waters of the Danube and the intergranular aquifer formed within the "City Terrace",
- defining hydrogeological parameters for each facility – piezometer, by evaluating them,
- monitoring the potential movement of the pollutant in order to alert early and applying preventive and remediation measures to improve the quality of groundwater drained into the Danube.

The concept of establishing monitoring to alert early by establishing three zones of representative piezometers:

A- zone - background piezometers in relation to the position of industrial chemical complex in Prahovo and Danube reflecting the neutral composition of groundwater – were, in addition to the existing piezometers two additional should be placed.

Leachate monitoring zone in the landfill zone with two piezometers, both reaching the depth above the HDPE film.

B – zone – placed downstream in the direction of the underground flow towards the Danube in the immediate zone in relation to the position of a potential source of pollution – Non-Hazardous Waste Landfill. Based on the calculated values of advective transport, this zone should be set to a distance of 125 m in relation to the landfill, namely three piezometers.

C – zone – is set downstream in the direction of the underground flow, as a downstream control zone. Based on the calculated values of the advective transport, the control piezometers should be placed at a distance of 250 m and 500 m in relation to the landfill in the direction of the flow. In this zone, it is necessary to place three piezometers at a distance of 250 m from the landfill. In addition, two more piezometers must be installed at a distance of 500 m.

With the aforementioned concept, it is necessary to include the layers that represent the Perched aquifer as well as the lower intergranular aquifer formed in Pliocene deposits. Figure 1 provides a conceptual model of the proposed zoning system for monitoring the subject area.

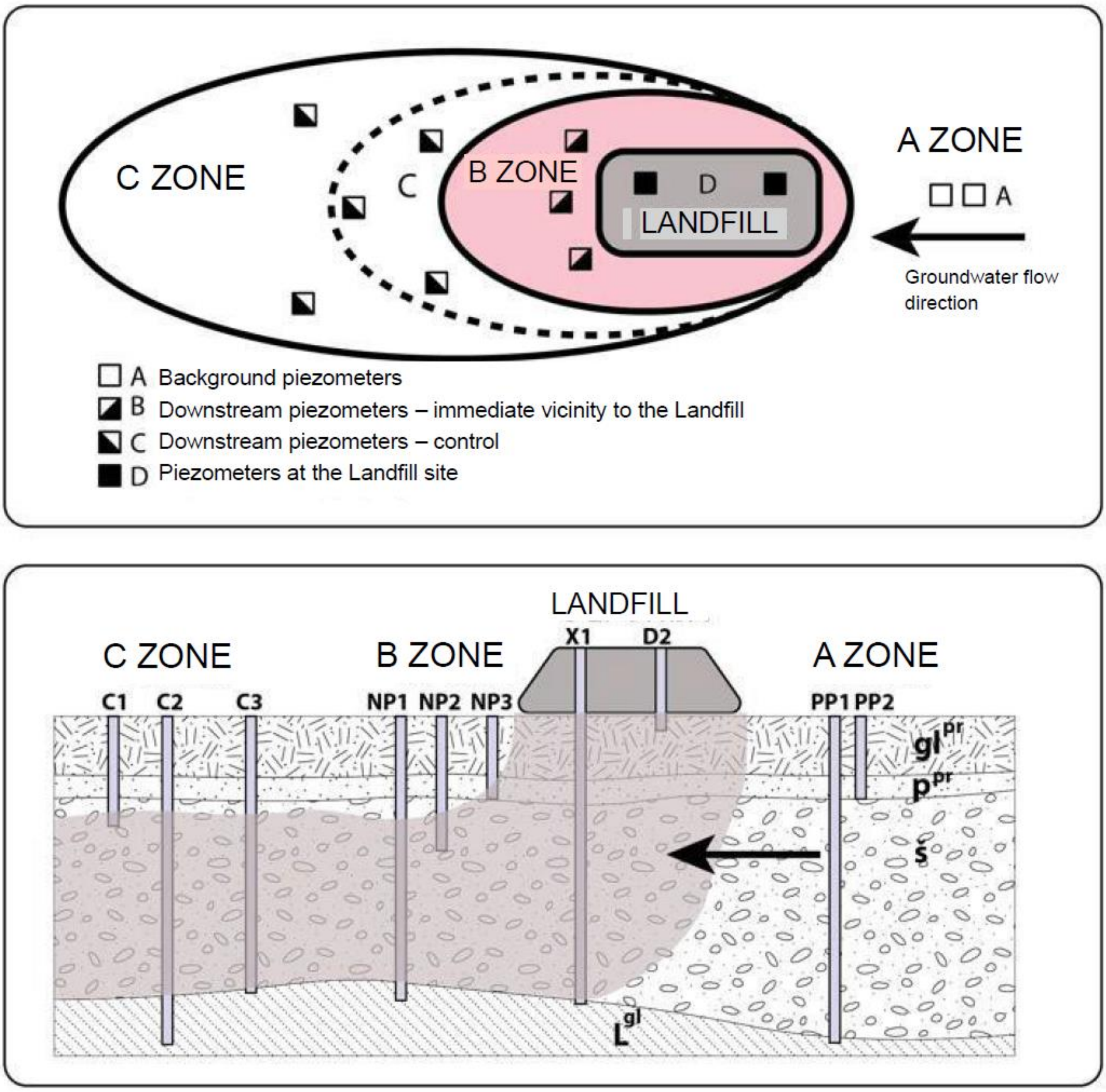

Figure 1. Conceptual model of the proposed zoning system for monitoring the subject area.

5.8.4. Monitoring of waste quantities

Pursuant to the Law on Waste Management[74], the Investor is obliged to constantly monitor and record the quantities and types of waste that are taken over and disposed of at the Non-Hazardous Waste Landfill, in accordance with the operating procedures of the Subject Project (pre-acceptance, acceptance, operation guidance of the Waste-to-Energy Plant and the Non-Hazardous Waste Landfill).

Waste monitoring is achieved by the following activities:

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[74] "Official Gazette of the RS", no. 36/09, 88/2010, 14/2016, 95/2018 – other law and 35/2023, Available at Zakon o upravljanju otpadom (paragraf.rs)

- Implementation of the Work Plan and the permit of the competent authority for the disposal of waste at the Non-Hazardous Waste Landfill.
- At the entrance to the Non-Hazardous Waste Landfill, the installed scale shall measure the mass of the waste transport vehicle and measure the waste received by the landfill.
- The acceptance of waste into a Non-Hazardous Waste Landfill is conducted according to the following procedures:
  - examination of waste for disposal.
  - compliance check.
  - on-site check.
- By obtaining the Waste Characterization Report.

Examination of waste for disposal shall be conducted for each type of waste, in accordance with a special regulation prescribed by Regulation on disposal of waste on landfills[75] and sampling in accordance with the prescribed standards. The data obtained by examination of waste for disposal at the landfill, in particular relate to:

1) a description of the previous waste treatment or a statement that the waste can be disposed of without prior treatment,
2) composition of waste and leachate,
3) the class of landfill to which the waste is disposed,
4) proof that the waste is not the waste referred to in Article 9 of this regulation,
5) specific requirements and measures to be taken when disposing of, if necessary, in accordance with Article 13 of Regulation on disposal of waste on landfills[76] ("Official Gazette of the RS", no. 92/2010),
6) certain key parameters for checking compliance, as well as its dynamics.

For waste regularly produced in the same procedure and in the same plant, the examination produces data which particularly refer to:

- variability in the composition of individual types of waste,
- limits of variability of significant properties.

For waste that is regularly produced in the same process but in different plants, examination provides data related to waste from each plant based on a certain number of measurements performed.

Examination of waste intended for disposal shall be conducted by authorized professional waste examination organizations in accordance with the Law on Waste Management[77]. The data obtained from examination of waste are an integral part of the waste examination report for disposal, in accordance with a special regulation prescribed by Regulation on disposal of waste on landfills[78].

[75] "Official Gazette of the RS", No. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)
[76] "Official Gazette of the RS", no. 92/2010, Available at "Official Gazette of the RS", No. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)
[77] "Official Gazette of the RS", no. 36/09, 88/2010, 14/2016, 95/2018 – other law and 35/2023, Available at Zakon o upravljanju otpadom (paragraf.rs)
[78] "Official Gazette of the RS", No. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)

Special examining: For waste regularly produced in the same process and in the same plant, for which there are data specified in Article 16, par. 2 and 3 of the Regulation on the disposal of waste at landfills[79], if the measurement results show small deviations from the limit values of the disposal parameters, perform examination at the first delivery, and then periodic compliance verification in accordance with the Regulation.

For waste that is not regularly produced in the same process and in the same plant, as well as for waste whose characteristics are variable, examination of waste for disposal is performed for each batch of waste and no compliance check is performed for it.

Compliance check is a periodic check of waste that is regularly submitted for disposal in order to determine whether the parameters of that waste correspond to the parameters obtained by examination of the waste for disposal and whether they meet the limit values of the parameters for disposal of waste. The parameters for the compliance check and the dynamics of the implementation of the compliance check are contained in the report referred to in Article 16, paragraph 6 of the Regulation on disposal of waste on landfills[80]. The compliance check is performed only for those parameters that were determined as critical during the examination of waste for disposal. When checking compliance, the same examinations that were used in examination of waste for disposal will be applied. The compliance check is conducted at least once a year, and the landfill operator makes sure that it is conducted according to the scope and dynamics in accordance with the regulation.

On-the-spot checks: The on-the-spot check consists of a visual inspection of each batch of waste before and after unloading, as well as a check of the accompanying documentation in accordance with Regulation:

- Waste is accepted at the landfill if it has been determined on the spot that it is identical to the waste for which the testing or compliance check was performed, as well as the description in the waste testing report.
- Criteria for accepting or not accepting waste at the landfill are limit values of waste disposal parameters defined by the Rulebook on Waste Categories, Examination and Classification[81], Appendix 8, point two. Disposal of non-reactive hazardous waste at the Non-Hazardous Waste Landfill in cassettes not used for the disposal of biodegradable waste:

Parameter	Concentration limit value in granular waste
Total Organic Carbon (TOC)	5%
pH	Minimum 6
Acid neutralizing capacity (ANC)	Must be assessed
	Concentration limit value in leachate in mg/ kg dm* (L/S= 10 l/kg) **
Antimony, Sb	0.7
Arsenic, As	2

[79] Ibid.
[80] Ibid.
[81] "Official Gazette of the RS", No. 56/2010, 93/2019, 39/2021 and 65/2024, Available at Pravilnik o kategorijama, ispitivanju i klasifikaciji otpada (paragraf.rs)

Copper, Cu	50
Barium, Ba	100
Mercury, Hg	0.2
Cadmium, Cd	1
Molybdenum, Mo	10
Nickel, Ni	10
Lead, Pb	10
Selenium, Se	0.5
Chromium Total, Cr	10
Zinc, Zn	50
Evaporation residue at 105°C	60000
Soluble Organic Carbon (DOC)	800
Sulphates (SO_4^{2-})	20000
Fluorides (F^-)	150
Chlorides (Cl^-)	15000
Parameter	**Concentration limit value in leachate in mg/m²kg dm (monolithic waste) *** **
Antimony, Sb	0.3
Arsenic, As	1.3
Copper, Cu	45
Barium, Ba	45
Mercury, Hg	0.1
Cadmium, Cd)	0.2
Molybdenum, Mo	7
Nickel, Ni	6
Lead, Pb	6
Selenium, Se	0.4
Chromium Total, Cr	5
Zinc, Zn	30
Soluble Organic Carbon (DOC)	Must be assessed
Sulphates (SO_4^{2-})	10000
Fluorides (F-)	60
Chlorides (Cl-)	10000
Parameter	**Additional concentration values in monolithic waste**
pH	Must be assessed
Acid neutralizing capacity (ANC)	Must be assessed
Electrical conductivity, mS/cm at 20°C/m²	Must be assessed

- *and non-reactive hazardous waste is hazardous waste whose leaching behaviour does not deteriorate over a long period of time, under the conditions present at the landfill or a possible accident: in the waste itself, due to the influence of external factors (temperature, air or the like), the influence of other waste including waste disposal products: landfill gas and leachate).*
- ** dm – dry mass*

- *** Refers to granular or fractured monolithic waste. Leaching tests are performed according to the following standards:*
- *EN 12457-2:2002 Characterization of waste-Leaching – Compliance test for leaching of granular waste materials and sludges – Part 2: One stage batch test at a liquid to a solid ratio of 10l/kg for materials with particle size below 4mm (without or with size reduction),*
- *EN 12457-4:2002 Characterization of waste-Leaching – Compliance test for leaching of granular waste materials and sludges – Part 4: One stage batch test at a liquid to a solid ratio of 10l/kg for materials with particle size below 10mm (without or with size reduction).*
- ****Leaching tests for the monolithic waste in question will be performed according to the NEN 7345 Leaching Characteristics of Soil and Stony Building and Waste Materials – Leaching Tests – Determination of the Leaching of Inorganic Components from Building and Monolithic Waste Materials with the Diffusion Test. The concentration limit values are given in relation to the 64-day test, but it is possible to use a shorter test in the first four steps, where the concentration limit values are a quarter of the concentration values for individual parameters given in the table.*
- *In addition to the parameters given in the table, it is possible to examine other parameters that can be found in waste such as pollutants, which are significant from the aspect of risk assessment.*

- Reporting (announcement) to the competent ministry on the movement of hazardous waste in electronic form; Submitting data from the document on the movement of hazardous waste to the Environmental Protection Agency, electronically, by entering data from the document on the movement of hazardous waste into the Agency's information system through the portal www.sepa.gov.rs.
- Completely certified and signed Document on the movement of waste in accordance with the Rulebook on the form of the document on the movement of hazardous waste, the form of prior notification, the manner of its delivery and the instructions for their completion[82], as a recipient /donor of hazardous waste, must also submit it to the postal address of the Ministry and the Agency, in accordance with the law governing waste management.
- By regularly completing the Document on the movement of waste as a recipient /donor of hazardous waste in accordance with the Rulebook on the form of the document on the movement of waste and the instructions for its completion[83].
- Pursuant to Article 75 of the Law on Waste Management[84] and the Rulebook on the form of daily records and annual report on waste with instructions for its completion[85] The Investor, as the future operator at the landfill, is obliged to keep daily records of the collected and disposed quantities of waste, i.e., to submit to the Agency a regular

[82] "Official Gazette of the RS", no. 17/2017, Available at Pravilnik o obrascu Dokumenta o kretanju opasnog otpada
[83] Ibid.
[84] "Official Gazette of the RS", no. 36/09, 88/2010, 14/2016, 95/2018 – other law and 35/2023, Available at Zakon o upravljanju otpadom (paragraf.rs)
[85] "Official Gazette of the RS", nos. 7/2020 and 79/2021), Available at Pravilnik o obrasacu dnevne evidencije i godišnjeg izveštaja

annual report on the types and quantities of disposed waste on the Non-Hazardous Waste Landfill and the results of monitoring, as follows:

- Form DEO 2 - Daily waste records of the Landfill Operator,
- Form GIO 2 - Annual Waste Report of the Landfill Operator.
  The report shall contain data on all necessary costs during the operation of the Landfill.

Report forms shall be submitted to the Agency as follows:

- in electronic form by entering data into the information system of the National Register of Pollution Sources at the address of the Environmental Protection Agency:
  http://www.sepa.gov.rs/index.php?menu=20170&id=20004&action=showAll

5.9. Most Important Implications

Waste-to-Energy is a well-established technic for thermal treatment of waste, deemed as necessary within EU waste management hierarchy for waste which cannot be recycled. Industrial field has captivated considerable experience in technical, operational, and legislative domain.

Thereby, Elixir Group via its subsidiary Elixir Craft - Eco Energy branch, as the Investor, utilizes state-of-the art knowledge to present a project proposal for a Waste-to-Energy Plant based on bubbling fluidized bed technology for waste incineration with a combustion chamber of a 30 MW thermal power. Technical design is in full compliance with Commission implementing decision (EU) 2019/2010 of 12th November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration (notified under document C(2019) 7987)[86], Commission Implementing Decision (EU) 2018/1147 of August 10th 2018 establishing best available techniques (BAT) conclusions for waste treatment, under Directive 2010/75/EU of the European Parliament and of the Council (notified under document C(2018) 5070)[87], Commission reference document on Best Available Techniques on Emissions from Storage (July 2006) and Directive (EU) 2018/850 of the European Parliament and of the Council of May 30th 2018 amending Directive 1999/31/EC on the landfill of waste[88].

Adopted solutions minimize the risk of environment degradation possibility. Moreover, investment is planned for the industrial area with constant energy take-off need, with limited influence on the inhabited area. Cumulative impact assessment study indicated that there are limited synergic pollutants with the existing operation within the industrial chemical complex in Prahovo. The impact of execution of the Subject Project would be limited, with marginal to no impact on the surrounding, including the cross-border areas of Romania and Bulgaria.

The Subject Project should limit overall need of the Elixir Prahovo for fossil-based fuel due to the intended production of low-pressure steam from heating energy recovered in thermal treatment process of non-recyclable hazardous and non-hazardous waste. Goals of the Subject Project are in full alignment with environmental, decarbonation and energy

[86] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)
[87] Implementing decision - 2018/1147 - EN - EUR-Lex (europa.eu)
[88] Directive - 2018/850 - EN - EUR-Lex (europa.eu)

independence goals of EU Green Deal, Green Agenda for Western Balkans with a positive effect on the Serbian national waste management market.

6. Regions Affected by Project

The municipality of Negotin, on whose territory the chemical industry in Prahovo is located, has an area of 1,090 km^2. The municipality includes 39 settlements.

The municipality of Negotin has extremely unfavorable demographic trends, which are reflected in the occurrence of a negative population growth, a high rate of emigration and the average age of the population compared to the rest of the Republic of Serbia. According to the 2022 census, there were 28,261 inhabitants in 12,386 households in the municipality of Negotin, while according to the 2011 census, there were 37,056 inhabitants in 13,906 households in the municipality of Negotin. According to the 2022 census, there were 14,647 inhabitants in 6,147 households in the city of Negotin, 799 inhabitants in 332 households in Prahovo, and 735 inhabitants in 308 households in Radujevac.

Of the total population in the municipality of Negotin, 13,689 were men and 14,572 were women, of which 393 were men and 406 were women in the settlement of Prahovo. The average age of the population of the municipality of Negotin was 50.36; men 48.83 and women 51.80 years. The average age in Prahovo is 50.68 years, and the Radujevac settlement is 56.33 and both settlements have a predominantly adult population.

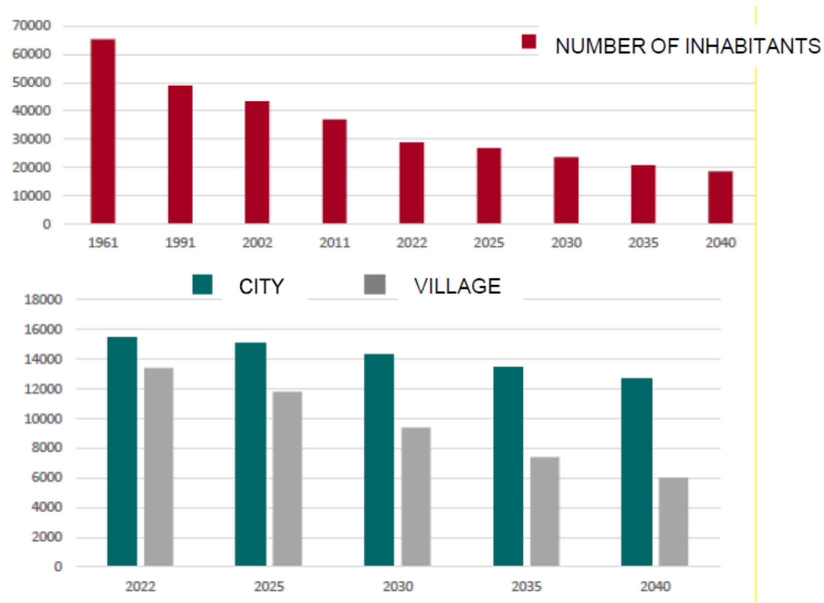


Figure 2. Demographic trend of Negotin municipality

A large number of inhabitants from the municipality of Negotin live abroad (12,427 people or 25% of the total population according to Census 2011). However, returnees from abroad do not represent significant demographic potential due to their unfavorable age structure and generational weakening of the returnee wave.

Below is an overview of the population according to migratory characteristics, by municipalities and cities.

Table 9. Population according to migratory characteristics, by municipalities and cities

Region Area *City – Municipality*	Total	Inhabiting in the same settlement since birth	Settler population					
			Total	from the territory of RS, namely:				
				Total	from another settlement of same municipality	from another municipality in same area	from another area	Unknown municipality of immigration
Bor region	**101100**	**56578**	**44522**	**35367**	**14768**	**4496**	**15636**	**467**
Bor	*40845*	*24406*	*16439*	*13881*	*3957*	*1068*	*8663*	*193*
Kladovo	17435	9325	8110	6142	3698	859	1508	77
Majdanpek	14559	8657	5902	4898	2307	631	1912	48
Negotin	28261	14190	14071	10446	4806	1938	3553	149

According to the national affiliation, Serbs (80.88%), Vlachs (6.24%), Roma (1.14%) and other national minorities live on the territory of the municipality of Negotin.

Table 10. shows the composition of the population by age groups and sex in the municipality of Negotin and the settlement of Prahovo according to the results of the 2022 census of the Statistical Office of the Republic of Serbia (RZS).

Table 10. Population by age groups and sex.

Age of population	**2022**					
	Municipality of Negotin			**Settlement Prahovo**		
	f	**m**	**Total**	**f**	**m**	**Total**
Up to 9 years	870	900	1.770	24	28	52
10-14 years	523	508	1.031	15	10	25
15-19 years	554	557	1.111	12	14	26
20-64 years	7.303	7.533	14.836	194	219	413
od 65 years	5.322	4.191	9.513	161	122	283
Total population	14.572	13.689	28.261	406	393	799

Table 11. shows an overview of the population by economic activity and gender in the municipality of Negotin according to the results of the 2022 census of the Republic Institute of Statistics (RZS).

Table 11. Economic activity of the Negotin municipality population Transboundary status.

Economic activity	2022		
	Negotin		
	f	m	Total
Employed	3,464	4,622	8,086
Unempoyed	614	747	1,361

The populousness of the site

There are no residential buildings in the immediate vicinity of the site intended for the construction of the Waste to Energy Plant and the Landfill for non-hazardous waste. The settlement of Prahovo, located at a distance of about 2 km in the direction of the west, the village of Radujevac is located at a distance of about 4 km in the east-southeast direction of the project in question, the settlement of Samarinovac, at a distance of about 5 km in the southwest direction, the settlement of Srbovo, at a distance of about 6 km in the south direction, the settlement of Dušanovac, at a distance of about 7 km in the northwest direction, and the settlement of Negotin, at a distance of about 10 km in the southwest direction. Along the border of the expansion of the chemical industry complex in Prahovo , at a distance of about 1,300 m from the future Eco Energy complex in the west direction, there is a workers' settlement (a smaller group of residential buildings).

The assessment of the health status of the population in subject area

In 2023, the Institute of Public Health "Timok" Zaječar57 conducted an "Analysis of the health state of the population of the Bor district in the period from 2018 to 2022", which also included the subject area of Negotin. The results of the analysis for the municipality of Negotin are presented below in the Study.

The classic indicators of the health status of the population are disease indicators. In Serbia, officially registered morbidity (morbidity of the population) consists of data on the number and type of diseases, the basic demographic characteristics of a person, the length of treatment, the type of therapy and the outcome, but only for the part of the population that seeks help in a health institution (any level of health care) for the provision of services. Outpatient morbidity and inpatient morbidity and mortality are monitored separately.

Outpatient Morbidity

The analysis of outpatient morbidity was performed on the basis of data taken from:

- General Medicine Services;
- Health care services for preschool children;
- Health care services for school children and youth;
- Women's Health Care Services;
- Services for the protection and treatment of oral diseases.

General Medicine Service of the Municipality of Negotin

From 18955 (2018) to 16868 (2022) diseases, conditions and injuries were registered in the general medicine service in the municipality of Negotin in the period from 2018 to 2022, so the morbidity rate in 2022 was 692.7‰.

The most common group of diseases in this period are "Special Purpose Codes (U04, U07) with the diagnosis "Emergency Use of U07 (Covid 19-U07.1, U07.2)" (37.7% in 2022). The morbidity rate in 2022 is 261.5 per 1,000 population over the age of 19. In second place in frequency are "Diseases of the respiratory system". Among them, "Acute inflammation of the pharynx and tonsils" dominates, accounting for, on average, 6.9% of all diagnoses in a five-year period. The third place belongs to the group "Diseases of the musculoskeletal system and connective tissue". The proportion of this group of diseases in total morbidity ranged from

15.7% in 2018 to 7.6% in 2022. The morbidity rate for this group of diseases in the last year of follow-up is 52.3‰. "Other back diseases" is the most common diagnosis of this group of diseases with an average prevalence of 7.6% in the analysed five-year period. "Diseases of the circulatory system" account for about 10.5% of total morbidity and are ranked fourth in frequency (the morbidity rate in 2022 is 48.3‰). The leading diagnosis in this group is “High blood pressure”. "Diseases of the Reproductive and Urinary System" occupy the fifth place (9.6% on average) in the structure of morbidity registered in the general medicine service in the municipality of Negotin in the study period.

So, in 2018-2022 period, in the territory of the municipality of Negotin, the leading five diagnoses were: emergency use of U07(Covid 19-U07.1, U07.2), acute inflammation of the pharynx and tonsils (6.9% on average), inflammation of the bladder (4.9% on average), increased blood pressure (7% on average) and other symptoms, signs and abnormal clinical and laboratory findings (3.5%).

Health Care Service for Preschool Children of the Municipality of Negotin

The number of identified diseases, conditions and injuries in the health care service for preschool children in the municipality of Negotin in a five-year period ranged from 7614 diseases in 2018 to 5325 in 2022. The rate of illness in 2022 is 4354/1000 children of preschool age.

The first is "Diseases of the respiratory system". The respiratory disease rate was 2254.3/1000 in 2022 for children aged 0-6 years. This group of diseases accounts for 51.8% of total morbidity in 2022. The following is the group "Symptoms, signs and pathological clinical and laboratory findings" with 14.9% in 2018.-18.0% in 2022 of the morbidity of this service (rate-785.8‰ in 2022). In third place with a share of 6.4% on average in the five-year period are "Skin and subcutaneous tissue diseases" (morbidity rate in 2022 – 282.9‰). In the fourth place in the structure of morbidity are "Diseases of the ear and mastoid extension" with a share of 5.8% in 2022 (rate -253.5‰ in 2022). In the fifth place in the structure of morbidity are "Diseases of the digestive system", which account for 4.5-6.1% of all recorded diagnoses in this service (rate -197.9‰ in 2022).

The five most common diagnoses: acute upper respiratory tract infections, fever of unknown origin, other nasal and sinus diseases, acute pharyngitis and tonsillitis, and other symptoms, signs, and abnormal clinical and laboratory findings. The first five diagnoses in the health care service for preschool children in the territory of the municipality of Negotin in 2022 accounted for 59% of the total morbidity.

Health Care Service for School Children and Youth of the Municipality of Negotin

The number of identified diseases, conditions and injuries in the health care service of school children in the municipality of Negotin in the period 2018-2022 ranged from 10861 (2018) to 5994 (2022). The rate of total illness in 2022 is 2429.7/1000 children.

The most common are "Diseases of the respiratory system" (rate – 1267.9‰ in 2022) with the most common diagnosis "Acute upper respiratory tract infections". Second and third place are "Symptoms, signs and pathological and clinical laboratory findings" (rate – 348.2‰ in 2022) and "Diseases of the digestive system" (rate -185.2‰ in 2022). In fourth place are "Diseases of the ear and mastoid continuation" with a disease rate of 107.8/1000 in 2022. "Skin and subcutaneous tissue diseases" (5.9% on average) with a disease rate of -106.6‰ in 2022 are ranked fifth in frequency among school-age children.

In the health care service for school-age children in the territory of the municipality of Negotin in 2022, the first five leading diagnoses accounted for 56.6% of registered morbidity. The diagnosis of acute upper respiratory tract infection comes first. Other diseases of the nose and sinuses of the nose, acute inflammation of the pharynx and tonsils, fever of unknown origin and other symptoms, signs and abnormal clinical and laboratory findings follow.

Women's Health Care Service of the Municipality of Negotin

In the health care service for women in the territory of the municipality of Negotin in a five-year period, the number of registered diseases, injuries and conditions ranged from 3216 (2018) to 1611 (2022). The morbidity rate in 2022, is 122.2 per 1,000 women over the age of 15.

"Diseases of the reproductive and urinary system" are most commonly present in the women's health care service (an average of 74.5%). The rate of illness in 2022 was 103.3/1000. The second group by frequency includes "Pregnancy, childbirth and midwives" with 9.3% on average of the share in total morbidity (rate in 2022 - 7.2‰). In relation to these groups of diseases, the prevalence of "Tumors" is 3.2% and "Glandular diseases with internal secretion, nutrition and metabolism" 2.8% in 2022.

In the territory of the municipality of Negotin, visits to women's health care services in 2022 were most often realised under diagnoses: other inflammation of the female pelvic organs (25.5%), breast diseases (15.5%), inflammation of the bladder (14.5%), menstrual disorders (9%) and menopause-climacteric diseases (7.6%). The first five diagnoses account for more than two thirds (71.8%) of registered diseases and conditions in the women's health care service.

Service for the Protection and Treatment of Oral Diseases of the Municipality of Negotin

In the area of the municipality of Negotin, in the period from 2018 to 2022, an average of 4120.6 diseases were registered in the dental service. The morbidity rate in 2022 was 92.4/1000 inhabitants. The most common diseases registered in this service are: other diseases of the teeth and supporting structures (an average of 54.1%), dental caries (an average of 30.2%) and other diseases of the oral cavity, salivary glands and jaws.

Hospital Morbidity

During 2022, the population of the municipality of Negotin achieved 5434 episodes of hospital treatment at the Negotin General Hospital. The hospitalisation rate is 192.28‰.

The leading position in the structure of hospital morbidity of hospitalised residents is held by "Diseases of the urinary and genital system", accounting for 14.65% of all inpatients in 2022. Due to these diseases, there were a total of 796 episodes of hospital treatment, so the hospitalisation rate for this group of diseases is the highest at 28.17‰. The second most common cause of hospitalisation is "Diseases of the respiratory system". In 2022, 695 hospitalisations were recorded, which is 12.79% of all hospitalised patients, and 24.59 per 1,000 population. In third place is the group "Factors that affect the state of health and contact with the health service" with 659 hospitalized (12.13%) and a rate of 23.32‰. This is followed by the group "Diseases of the circulatory system" in the fourth place with 545 hospitalisations

(10.03%) and a rate of 19.28/1000 inhabitants. The fifth place in the structure of the cause of hospitalization of hospitalized residents is occupied by "Injuries, poisoning and consequences of external factors" (395 or 7.27% of hospital morbidity) with a hospitalization rate of 13.98‰. "Tumors" ranks sixth in the structure of hospital morbidity with 334 hospitalizations, with a share of 6.15% and a hospitalisation rate of 11.82/1000 inhabitants. These groups of diseases make up 63.01% of hospital-treated residents in the Negotin General Hospital.

In relation to individual diagnoses, the most common causes of inpatient treatment of residents were: extracorporeal dialysis; pneumonia caused by the virus, unmarked; acute respiratory insufficiency; urinary tract infection of unmarked localisation; narrowing of the bladder, unmarked; anemia in other chronic diseases classified elsewhere; spastic (spasmodic) unilateral paralysis; hereditary factor VIII deficiency; malignant prostate tumor and pneumonia, unmarked.

The total number of fatal outcomes of stationary treated residents in the municipality of Negotin in 2022 is 265 (3,315 in total), which gives a general hospital flight rate of 7.99%.

Population mortality

During the observed five-year period, the largest share of mortality in the population of the municipality of Negotin is in the group "Diseases of the circulatory system", with a share ranging from 44.6% (2021) to 56% (2018). "Tumors" are at the second place of the cause of death, with slightly less than 15% of total deaths. During 2020 and 2022, the "COVID-19 Diseases" group ranked third in frequency, and in 2021 it ranked second. The following are diseases with a small share in total mortality, with a different ranking of shares by years of the observed period. For the determination of the zero state at the site envisaged for the construction of the Eco Energy complex, the report **"Analysis of the Environmental Factors"** by the company for copyright protection and engineering, „Autorski biro Beograd“ (eng. Authors' Bureau Belgrade).

6.1. Transboundary regions

The location where the Eco Energy complex is planned to be built is at a distance of about 750 m from the Romanian border. On the other side of the Danube, on the Romanian side, there is undeveloped land. Two neighboring counties in Romania are in close proximity to the project area, Dolj and Mehedinți Counties. The nearest Romanian settlements are:

- Izvoarele, located at a distance of about 4 km, north of the location in question. According to the census, 951 inhabitants live in the settlement.
- Gruia is a settlement in Romania, the seat of the municipality of Gruia. It is located in the Mehedinți County, in South-West Region (Oltenia) at a distance of about 7 km, east of the Eco Energy complex. According to the census, there were 1,890 inhabitants in the settlement.

Both settlements are in the municipality of Gruia, in Mehedinți County. A bit further south is Dolj County, with the municipality of Calafat, located on the Danube.

Demographic trends: number of inhabitants in rural and urban areas and total number of inhabitants in two neighboring counties (Dolj and Mehedinți) for the period 2013-2023

As shown in Figure 3, the number of inhabitants in Dolj County has dramatically decreased in urban areas during the last ten years, and not as dramatically in rural areas, but a decerease was noticed. The number of inhabitants during the last two years has remained constant, about 300,000 people in both rural and urban areas. The total number of inhabitants in this county is 599,567.

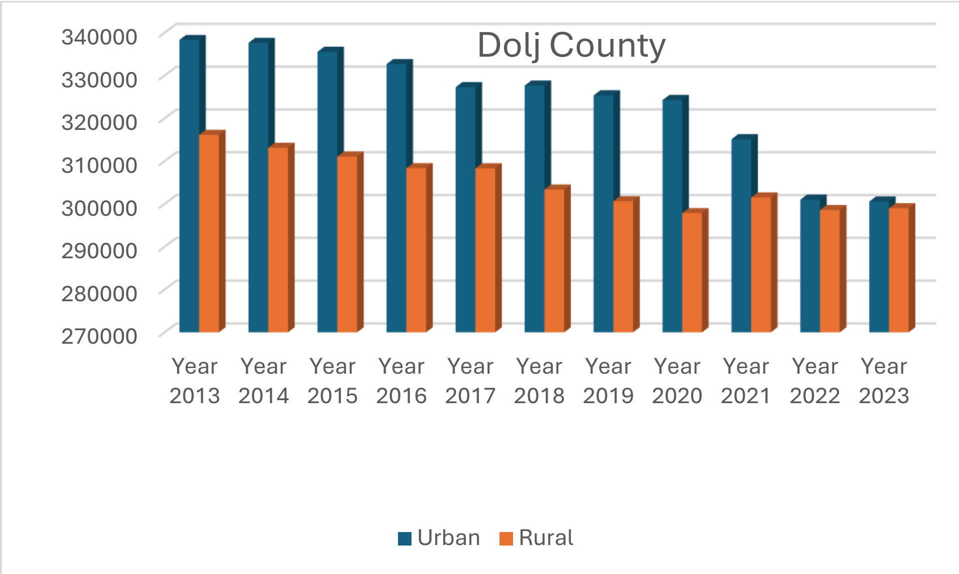


Figure 3. Number of people in rural and urban areas in Dolj County from 2013-2023.

In Figure 4, the number of inhabitants in Mehedinți County is shown, and the trend is not the same, as there is constancy in both the rural and urban areas. More people live in rural areas, about 125,000, and about 105,000 inhabitants in urban areas of Mehedinți County. The total number of inhabitants in this county is 231,407.

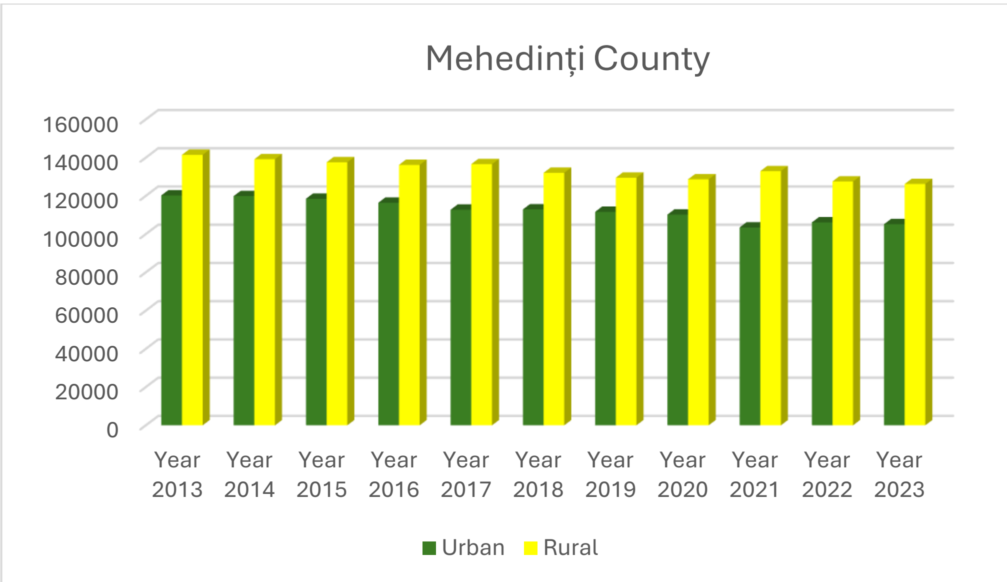


Figure 4. Number of people in rural and urban areas in Mehedinți County from 2013-2023.

These changes do not significantly affect the total number of inhabitants shown in Figure 5. It is fairly constant, with an imperceptible decline. The total number of inhabitants is 231,407 in Mehedinți County and 599,567 in the neighboring Dolj County.

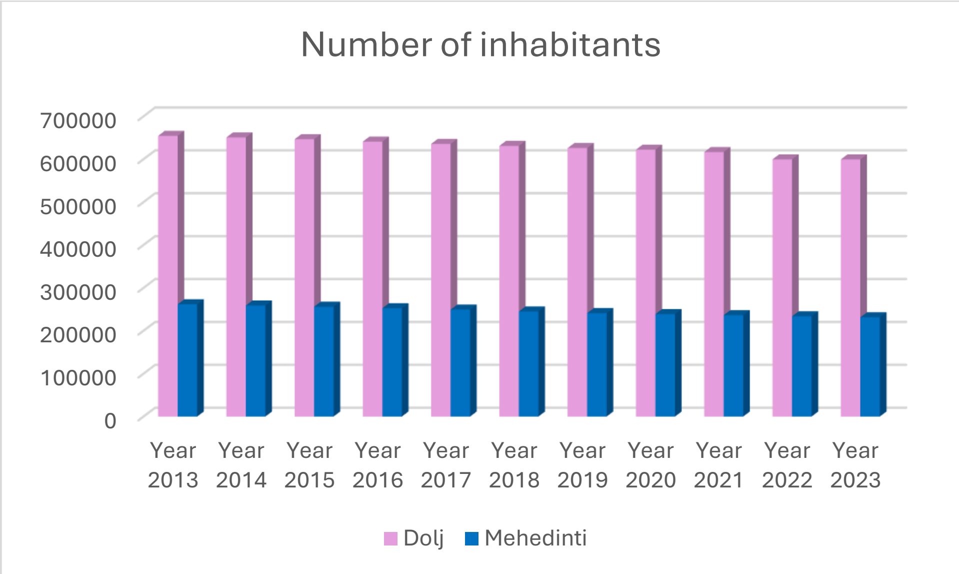


Figure 5. The total number of people in Mehedinți and Dolj Counties from 2013-2023.

Table 12 shows the composition of the population by age groups and gender, in Dolj and Mehedinți Counties and the settlements of these two regions according to public data from 2023. Of the total population in Dolj County, 289,270 are men and 310,297 are women, while in Mehedinți County there are 118,190 women and 113,217 men. The number of inhabitants by age is given in Table 12.

Table 12. Population by age groups and gender in Dolj and Mehedinți Counties in the year 2023.

Ages and age groups	2023			2023		
	Counties Dolj			Counties Mehendinti		
	female	male	total	female	male	total
0-4 years old	14343	15308	29651	4514	4785	9299
5-9 years old	15490	16341	31831	5466	5697	11163
10-14 years old	15656	16737	32393	6055	6316	12371
15-19 years old	15866	16514	32380	6277	6710	12987
20-24 years old	15320	15861	31181	5254	5806	11060
25-29 years old	14819	15416	30235	4783	5625	10408
30-34 years old	17469	18251	35720	5899	6653	12552
35-39 years old	18862	19589	38451	6424	6927	13351
40-44 years old	21262	21838	43100	7854	8059	15913
45-49 years old	22688	23518	46206	9155	9534	18689
50-54 years old	24539	24511	49050	10595	10746	21341
55-59 years old	19065	18120	37185	7699	7786	15485
60-64 years old	20347	17847	38194	8412	7852	16264
65-69 years old	22374	17910	40284	9328	7691	17019
70-74 years old	19631	13792	33423	8018	5838	13856
75-79 years old	13606	8503	22109	5336	3509	8845
80-84 years old	10380	5446	15826	3861	2129	5990
85 years old and older	8580	3768	12348	3260	1554	4814
Total	310297	289270	599567	118190	113217	231407

<u>Analyzing Migration and natural population growth by counties and localities</u>

It can be observed from Tables 13 and 14, that the departure of people from their places of residence and permanent emigrants is much greater than the number of permanent immigrants for the observed counties and municipalities of interest. Another negative demographic characteristic is the high rate of negative natural population growth in the two observed communities (Dolj and Mehedinți).

Table 13. The total number of people who departed Mehedinți and Dolj Counties, and Calafat and Gruia municipalities from 2013-2023.

	Departures with residence by counties and localities				Permanent emigrants by counties and localities of departure			
	County Dolj	Municipality Calafat	County Mehedinti	Municipality Gruia	County Dolj	Municipality Calafat	County Mehedinti	Municipality Gruia
Year 2013	6644	385	4907	44	277	5	111	3
Year 2014	5202	310	3769	38	260	11	92	1
Year 2015	5183	302	4088	25	303	4	103	1
Year 2016	7534	344	5740	35	526	15	168	3
Year 2017	4884	267	3569	24	468	13	148	1
Year 2018	5089	281	3404	27	515	21	180	1
Year 2019	5215	218	3585	28	519	15	213	1
Year 2020	11366	336	9734	28	410	12	144	1
Year 2021	4190	185	2978	25	674	27	275	2
Year 2022	4563	198	2938	19	914	24	310	1
Year 2023	4823	190	3128	26	770	32	339	1

Table 14. The total number of people who immigrated to Mehedinți and Dolj Counties from 2013-2023.

	Permanent imigrates by counties										
	Year 2013	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019	Year 2020	Year 2021	Year 2022	Year 2023
Dolj	93	135	140	159	206	195	217	102	269	316	271
Mehedinti	32	42	54	77	76	74	90	47	87	100	103

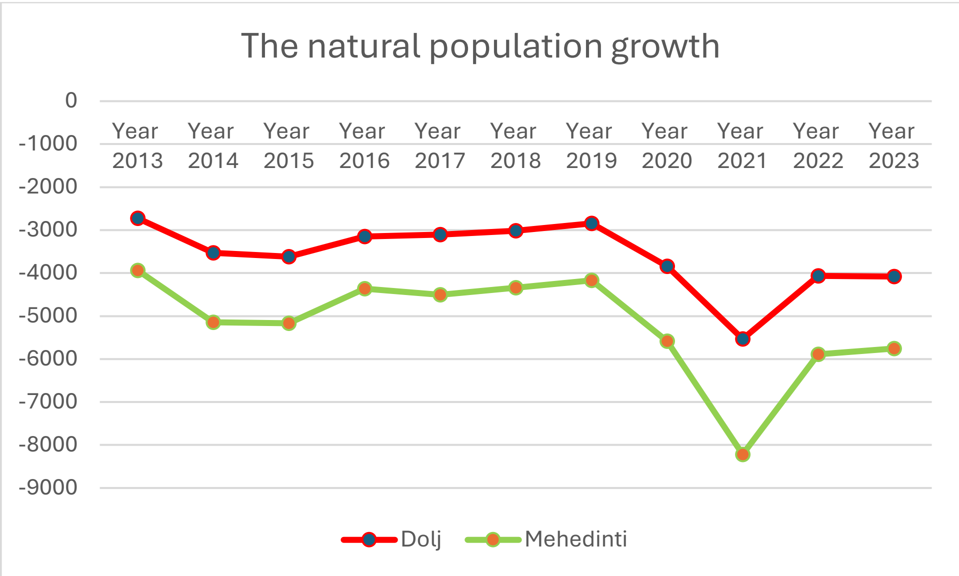
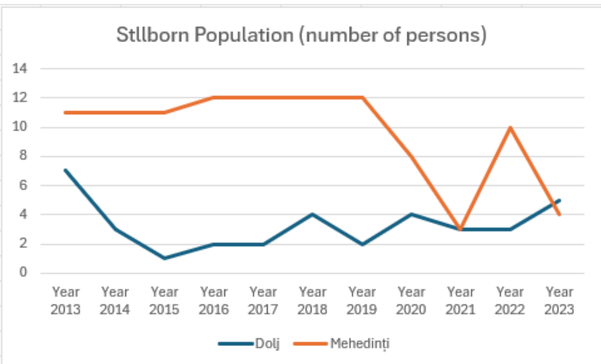


Figure 6. The trend of natural population growth in the counties over the past ten years.

After analyzing natural population growth, it is important to also consider the data on live births and stillbirths, which provide additional insights into the demographic and health aspects of the population.

Live births represent the number of children born alive, which is a key indicator of fertility and the health status of pregnant women. On the other hand, stillbirths are an important indicator of the quality of prenatal and perinatal care. High rates of stillbirths may indicate problems within the healthcare system.



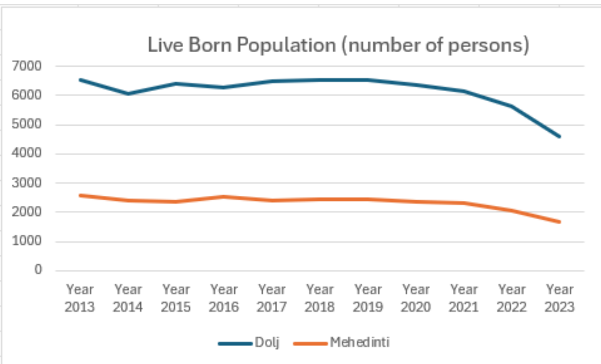


Figure 7. Stllborn and live born population from the time period 2013-2023 by counties (dolj and Mehedinți*).*

Residence establishments

Residence establishments by localities are shown in Table 15. You can notice a decrease in the number of establishments over the past 10 years in both municipalities neighboring the project area.

Table 15. Residence establishments *by localities from 2013-2023.*

	Residence establishments localities										
	Year 2013	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019	Year 2020	Year 2021	Year 2022	Year 2023
Municipality Calafat	133	100	83	80	75	71	63	77	44	78	88
Gruia	89	15	23	21	17	16	25	46	21	15	13

Educational institutions by levels of education in counties Dolj and Mehedinti

According to data from the past year, in **Mehedinți County** there are 7 preschools, 73 primary and lower secondary (including special education), 20 high schools, and 2 post-secondary schools (including special education). The total number of educational institutions is **102**. According to data for the year 2023, in **Dolj County** there are 34 preschools, 126 primary and lower secondary schools (including special education), 45 high schools, 2 vocational schools, 10 post-secondary schools (including special education), and 2 undergraduate universities. The total number of educational institutions in Dolj County is **219**.

Built-up areas and green spaces in the observed region for the period of the last ten years

There is no growth in built-up areas in the observed region for the period of the last ten years. Dolj County has 12,006 hectares of built-up area, while the municipality of Calafat has 1,055 hectares. Only a slight loss of built-up area is recorded for Mehedinți County, from 4,253 to 4,586 hectares during the last 10 years. Additionally, there is no change in the green areas of the observed region in the same period of time. For Dolj County, green spaces are 1,258 hectares and for the municipality of Calafat 52 hectares. Unlike built-up areas, green spaces have shown growth inthe observed period in Mehedinți County, from 214 to 690 hectares.

Infrastructures: drinking water and termal energy distribution and total length of the sewage pipes

The total length of the simple network for drinking water distribution in Dolj and Mehedinți Counties is 2,858.5 and 1,320.7 kilometers, respectively, and for the simple sewage network is 1,351 kilometers in Dolj County and 557.3 kilometers in Mehedinți Counies. The minicipalities Gruia and Calafat have 9.4 and 93.5 kilometers of drinking water network, respectively, and 65.7 kilometers of simple sewage network. The capacity of drinking water production facilities in Dolj and Mehedinți Counies are 466,540 and 106,520 cubic meters per day, respectively. Meanwhile, the capacity of drinking water production facilities in the municipalities of Calafat and Gruia is 78,099 and 600 cubic meters per day.

The distribution of thermal energy has been declining over the past 10 years from 423,151 to 154,271 gigacalories in Dolj County, while in Mehedinți County the reduction of production and distribution of thermal energy has been from 226,639 to 80,622 gigacalories.

6.1.1. Assessment of the health status of the population in the subject area

This section provides a comprehensive assessment of the health status of populations living in the vicinity of the proposed project site. The evaluation considers both baseline health indicators and potential health impacts arising from the project's construction and operation phases.

The subject area includes several communities located within a 15 km radius of the project site, both in Serbia and Romania. The population is characterized by a mixed rural and urban demographic, with key age groups being children under 14 years, adults between 20 and 60 years, and the elderly over 65 years.

Baseline data indicates that respiratory diseases, cardiovascular conditions, and chronic obstructive pulmonary disease (COPD) are prevalent among the population. This is consistent with regional health statistics, where industrial activities have historically contributed to such health issues (OECD).

The potential for increased air pollution due to emissions from the Waste-to-Energy plant and the Non-Hazardous Waste Landfill requires careful monitoring. Pollutants of concern include particulate matter (PM10, PM2.5), sulfur dioxide (SO_2), nitrogen oxides (NO_x), and dioxins[89].

The proximity to the Danube River necessitates stringent controls on wastewater discharge to prevent contamination of water resources used by local populations.

Construction and operational activities are expected to generate noise, particularly from heavy machinery and transport vehicles. Mitigation measures such as sound barriers and restricted operating hours will be essential (WHO Guidelines), as envissioned by the planned meassures.

Workers involved in the construction and operation phases may be exposed to occupational hazards. Proper training, protective equipment, and adherence to safety protocols will be mandatory to minimize risks, as envissioned by the planned meassures.

The region is served by several healthcare facilities, including primary care centers and hospitals. However, access to specialized medical care may be limited, particularly in rural areas.

The assessment of the health status of the population is significant for obtaining basic information about the health of the population. The objectives of the assessment of the health status of the population are:

- preservation and improvement of the health status of the population;
- monitoring changes in health status over time;
- identifying priority health problems;
- observation and analysis of differences between individual territories or population groups;

[89] https://health.ec.europa.eu/index_en

- rethinking health policy, health care strategy and health technology;
- improvement of health management.

From the available data on healthcare in the Dolj County area, there are 13 public and 15 private hospitals. One of them is a public hospital in the Municipality of Calafat, whereas Mehedinți County has 4 public and 1 private hospital.

In Dolj County there are 19 healthcare units, 13 specialized outpatient clinics and 16 hospital-integrated outpatient clinics. The number of polyclinics is 26, and 6 medical dispensaries. There are 3 mental health centers, 1 specialty medical centre and other smaller healthcare units. In this county, there are two public dental offices and 619 private ones. Likewise, there are 14 public pharmacies (one in Calafat municipality and 355 private pharmacies (9 in Calafat municipality).

In Mehedinți County there are 2 healthcare units, 4 hospital-integrated outpatient clinics, and 5 medical dispensaries. There are 2 mental health centers, 2 multifunctional health centers, 1 speciaity medical centar and other smaller healthcare units. The number of public dental offices in this county is one and 139 private ones (one in Gruia municipality). Likewise, there are 4 public pharmacies and 95 private ones (one in Gruia municipalty). There are no specialized outpatient clinics and polyclinics.

Given the proximity of the project to Romania, transboundary health impacts are a notable concern. Consultations with Romanian health authorities are ongoing to ensure that potential health risks are identified and managed in a coordinated manner. Specific joint monitoring programs and/or reporting obligations with Romanian institutions could be implemented if necessary to track air quality indicators in case of such request by Romanian authorities. Competent authorities within specialized govermental bodies can conduct health studies accoridng with national legal framework if considered necessary. To effectively address potential health impacts and ensure the well-being of communities in the affected area, a comprehensive monitoring program is proposed by the project holder. This program aims to track critical environmental indicators, facilitate cross-border cooperation reassurance, and engage local populations in the decision-making process. The key components of the program include:

- Air Quality Monitoring: Continuous measurement of air pollutants at emitters and key municipal location.
- Water Quality Monitoring: Regular sampling and analysis of water from the Danube River and nearby undergrounwater bodies.
- Community Engagement: Establishing a community health advisory board within civil control system (please be refered to Report on the conducted public consultations, 2024) to facilitate ongoing dialogue between project stakeholders and local populations.

6.1.2. The Health and Environment Report

The date for this study are taken from the Health and Environment Report for 2023, prepared by the National Center for Monitoring Community Environmental Risks, National Institute of Public Health, Romania.

Monitoring the quality of bathing water

To protect public health by preventing illnesses associated with risk factors from bathing waters.
Monitoring the presence of *Legionella spp.* to establish safe water distribution networks in recreational facilities (indoor/outdoor pools, jacuzzis) ensures the protection of the population from potential epidemiological outbreaks.

Specific Objectives

- Creation, updating, and completion of bathing water profiles;
- Assessment of bathing water quality in both arranged and unarranged areas across Romania;
- Evaluation of potential health risks associated with bathing activities in both arranged and unarranged areas across Romania;
- Preparation of the national report on the quality of bathing water in arranged and unarranged areas across Romania;
- Implementation of a screening program to detect the presence of *Legionella pneumophila* in recreational facilities connected to a centralized supply system, as a measure to reduce or eliminate the risk of epidemiological events affecting public health;
- Identification of physical-chemical factors that increase the potential for colonization by this microorganism in these infrastructures;
- Reporting bathing water quality in arranged areas across Romania to the European Commission (EC).

Methodology

The identified areas were evaluated and inspected, determining the duration of the bathing season and the number of people using the area during the bathing season. Subsequently, a monitoring schedule for bathing water quality was established for each natural bathing area, whether arranged or unarranged. This included determining the sampling points, the frequency of water sample collections, and monitoring parameters.

Results

Public Health Directorate (DSP) Dolj: Reported monitoring of natural bathing areas.

Public Health Directorate (DSP) Mehedinți: Reported no identification of natural bathing areas.

Table 16.The conclusions are summarized

Counties	Name of bathing area	Water type	Zone type	Water Quality – Microbiological Indicators Collected
Dolj	Bascov (Calafat)	Danube River	Unarranged, Unauthorized	8 Samples - GOOD
	Cetate Port	Danube River	Unarranged, Unauthorized	8 Samples - SATISFACTORY

Screening of well water and publicly used artesian water quality

Methodology

The methodology aims to monitor water quality by identifying, cataloging, and verifying relevant parameters to implement local measures for ensuring compliance with water quality standards for human consumption from public wells and artesian water sources. Reporting is conducted using a reporting form that includes data on the chemical and microbiological quality of the analyzed water.

Descriptive Analysis

Data were uploaded and processed using statistical functions in SPSS 18.0. The ANOVA test analyzed the variance of the dependent variable both within and between groups. For variables with continuous values, the coefficient of variation (CV%), combined with the mean value close to the median value, provides information about the homogeneity of the dataset. Skewness test values within the interval [-2÷2] validate the normality of the data series.

Analysis of Hygienic-Sanitary Conditions

The analysis of hygienic-sanitary conditions of the reported sources was based on responses regarding the measures taken to address nonconformities.

Public Well Sources:

- For all sources in Mehedinți County, hygienic-sanitary measures were either unspecified or insufficient.
- For all sources in Dolj County (96.4%), hygienic-sanitary measures were satisfactory.

Spring/Artesian Sources:

- Over 90% of the sources in **Dolj County** had satisfactory hygienic-sanitary measures.

Analysis of Physical-Chemical and Microbiological Parameters:

Table 17 - The physical-chemical analysis of the reported water sources was generally good. The percentage of physical-chemical parameters exceeding the Maximum Allowable Concentration (MAC) is presented.

Counties	pH	Turbidity	Oxidability	Conductivity	Total Hardness	Ammonium	Nitrites	Nitrates
Dolj	-	6,0	-	2,0	-	6,0	-	40,0
Mehedinti	-	5,5	1,8	-	-	-	-	32,7

Remediation Measures for Nonconformities

- **Removal of pollution sources** associated with the identified parameters was carried out at all sources in **Mehedinți County**.
- **Remediation of structural nonconformities** was completed for all sources in **Mehedinți County**.

- **Warning signs** with the message *"Water is Not Safe for Drinking"* were posted at all sources in **Mehedinți County**.

Table 18. A detailed summary of the remediation measures for nonconformities is presented.

Counties	Number of sources	Measure				
		Removal of Pollution Sources with These Parameters	**Remediation of Structural Nonconformities**	**Cleaning and Disinfection**	**Warning: "Water is Not Safe for Drinking"**	**Repetition of Analyses**
Dolj	50	6%	48%	94%	96%	96%
Mehedinti	55	100%	9,1%	-	100%	-

<u>Danube River</u>

The Danube is the second longest river in Europe. It originates in the Black Forest mountains (Germany) and flows southeast for approximately 2,860 km to the Black Sea.

The entire course of the Danube is divided into three parts: the upper course, the middle course, and the lower course. From Bazjaš, at the entrance to the territory of Romania, to the mouth of the Black Sea, the lower course of the river is defined (1,075 km). This section is divided into five characteristic morpho-hydrographic sectors:

- The Carpathian Gorge sector, stretching between Bazjaš and Gura Vaji;
- The South-Pontic sector, stretching between Gura Vaji and the Borcea depression;
- The East-Pontic sector with marshes, encompassing the Great Ialomița Marsh and the Great Braila Marsh, up to Braila-Smridan;
- The North-Dobrujan sector, encompassing the area between Braila and the entrance to the Danube Delta;
- The Delta sector, the Danube Delta with three main branches – Chilia, Sulina, and Sfântul Gheorghe.

On the main course of the Danube River, under the administration of ABA Jiu and ABA Dobrogea – Litoral, a total of 7 water bodies have been identified and assessed, of which:

- 2 natural water bodies
- 5 heavily modified water bodies

For the subject area the most important water bodies are three of them: **Porțile de Fier I (RORW14-1_B1)**, **Porțile de Fier II (RORW14-1_B2)** and **Porțile de Fier II – Chiciu (RORW14-1_B3)**.

<u>SUMMARY OF WATER QUALITY IN ROMANIA IN 2023– National Administration „Romanian Waters”</u>

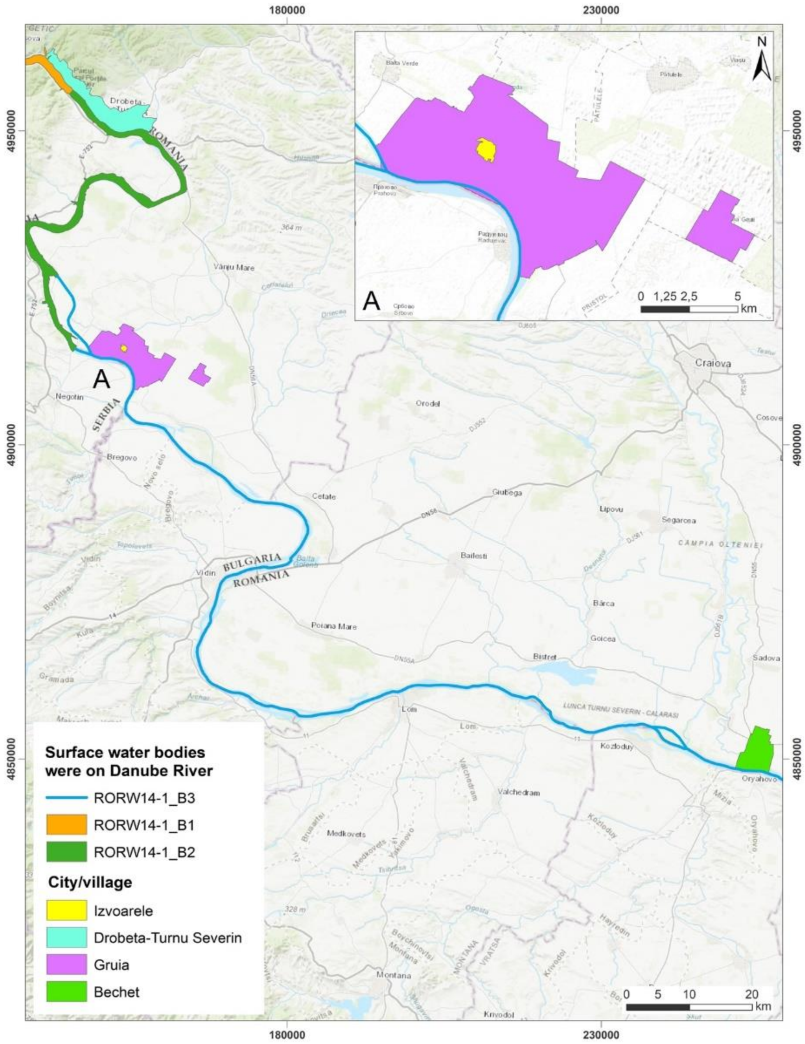


Figure 8. - Surface water bodies on Danube River

The figure above presents the surface water bodies on the Danube section between Drobeta-Turnu Severin and Calafat:

I - Porțile de Fier II – Chiciu (RORW14-1_B3), with a length of 547.62 km, classified under typology RO13, was monitored at 12 sections: Gruia (left bank, center, right bank); Pristol (left bank, center, right bank); Corabia; Turnu Măgurele; Calafat (upstream of the water intake); and Oltenița (left bank, center, right bank).

Biological Elements

Regarding biological elements (*phytoplankton, phytobenthos, benthic macroinvertebrates, and ichthyofauna*), the water body was classified as having **good potential**.

Physical-Chemical Elements

The general physical-chemical elements monitored recorded the following average values:

- BOD5: 3.504 mg/l, characteristic of good potential;
- Conductivity: 446.1 µS/cm, characteristic of good potential;
- $N-NO_3$ (Nitrate Nitrogen): 1.551 mg/l, characteristic of high potential;

- Total Phosphorus: 0.151 mg/l, characteristic of high potential.

From the perspective of general physical-chemical elements, the water body was classified as having **good potential**.

Specific Pollutants

Regarding specific pollutants, the water body was classified as having **high potential**.

Integrated Evaluation

The integrated evaluation of quality elements classified the **Porțile de Fier II – Chiciu** water body as having **good ecological potential**.

II - Porțile de Fier I (RORW14-1_B1) spans approximately 226 km, starting from Belgrade (rkm 1169 + 300) to rkm 973. On Romanian territory, it extends over 132 km, from Baziaș, where the Danube enters the country, to the hydrotechnical node at rkm 943. The Hydropower and Navigation System Porțile de Fier I is part of the Danube River Hydropower Development within the Danube hydrographic basin, located in Mehedinți County. Its uses include hydropower generation, navigation, fish farming, and recreational activities. It is classified under typological category ROLA03 and was monitored in 2023 at 4 sections: Șvinița, Dubova, Orșova, and Porțile de Fier I – dam.

Biological Elements

Regarding biological elements (*phytoplankton*), the reservoir was classified as having **good potential**.

Physical-Chemical Elements

The monitored physical-chemical elements recorded the following average values:

- COD-Cr (Chemical Oxygen Demand): 10.454 mgO_2/l, characteristic of good potential;
- BOD5 (Biochemical Oxygen Demand): 1.752 mgO_2/l, characteristic of high potential;
- $N\text{-}NO_2$ (Nitrite Nitrogen): 0.021 mg/l, characteristic of good potential;
- Total Phosphorus: 0.068 mg/l, characteristic of high potential.

From the perspective of general physical-chemical elements, the reservoir was classified as having **good potential**.

Specific Pollutants

Regarding specific pollutants, the reservoir was classified as having **high potential**.

Integrated Evaluation

The integrated evaluation of monitored quality elements classified the **Porțile de Fier I reservoir** as having **good ecological potential**.

III - Porțile de Fier II (RORW14-1_B2) is located at an average altitude of 36 mMN. The minimum emptying time (without damage) from NNR is 12 hours, with a catchment basin area of 578,300 km² and a length of 80 km. The Porțile de Fier II Hydropower and Navigation System is part of the Danube River Hydropower Development within the Danube hydrographic basin, located in Mehedinți County. Its functions include hydropower generation, navigation, fish farming, and recreational activities. The Hydrotechnical Node of SHEN PF-II is located on the Danube near Ostrovul Mare Island at km 875 (Gogoșu hydrotechnical node). The Porțile de Fier II water body is classified under typological category ROLA03 and was monitored at 4 sections: upstream of Drobeta Turnu Severin (water intake), downstream of Drobeta Turnu Severin, Porțile de Fier II dam, and Vrancea.

Biological Elements

Regarding biological elements (*phytoplankton*), the reservoir was classified as having **good potential**.

Physical-Chemical Elements

The monitored physical-chemical elements recorded the following average values:

- COD-Cr (Chemical Oxygen Demand): 9.597 mgO_2/l, characteristic of high potential;
- N-NO_2 (Nitrite Nitrogen): 0.024 mg/l, characteristic of good potential;
- Total Phosphorus: 0.078 mg/l, characteristic of high potential.

From the perspective of general physical-chemical elements, the reservoir was classified as having **good potential**.

Specific Pollutants

Regarding specific pollutants, the reservoir was classified as having **high potential**.

Integrated Evaluation

The integrated evaluation of monitored quality elements classified the **Porțile de Fier II reservoir** as having **good ecological potential**.

Chemical state of water bodies on the Danube River

The chemical state of water bodies on the Danube River was assessed through the monitoring of priority and priority dangerous substances, which enabled the identification and classification of water bodies according to their quality and compliance with standards.

The assessment of the chemical status of the 7 water bodies on the Romanian section of the Danube was carried out for 6 water bodies by analyzing the water, while for 1 water body, the analysis was performed both in the water and in the biota. Six water bodys are in good chemical status, one is not good. However, excluding PBT substances (persistent, bioaccumulative, and toxic, ubiquitous), all 7 water bodies are in good chemical status (100%).

In Table 19. summary of the chemical status evaluation for three monitored water bodies on the Danube, that are near the observed location is given.

Table 19. Chemical Status Evaluation for three Water Bodies on the Danube River

m	Water Body Name	Monitoring System	Water Body Character	Chemical Status Evaluation with PBT*	Chemical Status Evaluation WITHOUT PBT
RORW14-1_B1	Danube River – Iron Gate 1	Lake	CAPM***	GOOD	GOOD
RORW14-1_B2	Danube River – Iron Gate 2	Lake	CAPM	GOOD	GOOD
RORW14-1_B3	Danube River – Iron Gate 2 - Chiciu	Lake	CAPM	POOR**	GOOD
*PBT - Persistent Bioaccumulative and Toxic Substances **- Evaluation for Biota Investigation Environment ***CAPM – Heavily Modified Water Bodies					

<u>**Health impact assessment in relation to air pollutants**</u>

In the report for the health and environment for 2023, urban population mortality and morbidity associated with air pollutants were calculated to the extent allowed by the available data.

The data were collected and reported by the public health surveillance departments within the County Public Health Directorates and Bucharest Municipality, in collaboration with the medical statistics department and other local institutions. Data for Romania on the incidence of respiratory and cardiovascular diseases, as well as general mortality and mortality due to respiratory, cardiovascular diseases, and respiratory malignant tumors, were provided by the **National Center for Statistics and Informatics in Public Health** within the **National Institute of Public Health (INSP)**.

The analysis of data related to the specific incidence of respiratory and cardiovascular diseases, general mortality, and mortality due to respiratory, cardiovascular diseases, and respiratory malignant tumors was based on the calculation of crude rates and standardized rates. Standardization was conducted using data reported by the **National Institute of Statistics** for Romania and by local statistical offices and county statistical departments.

Specific Mortality from Cardiovascular Diseases

Only in 9 of the analyzed localities did standardized data reveal an excess of specific mortality due to cardiovascular diseases. As shown in Figure 9, observed deaths from cardiovascular diseases exceeded the calculated deaths that would occur if the studied population had the same mortality rates as the standard population, notably in the city of **Drobeta-Turnu Severin**.

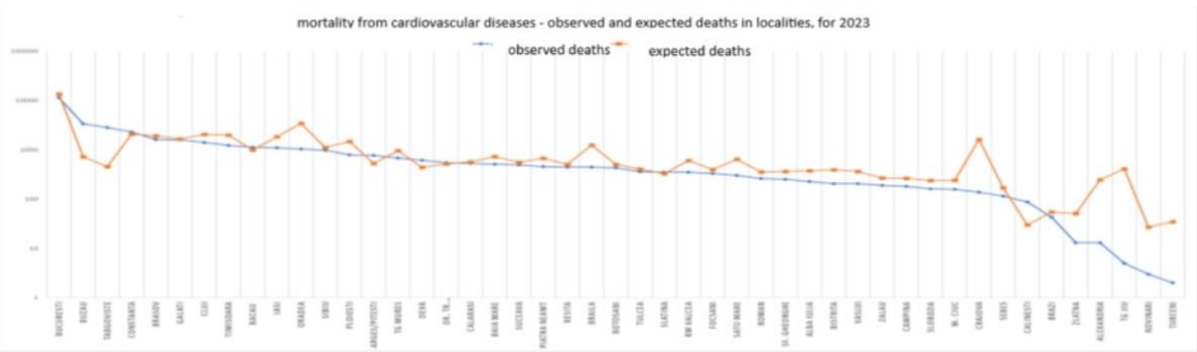


Figure 9 – Mortality from the cardiovascular diseases – observed and expected deaths in localities in Romania, year 2023.

Specific Mortality from Respiratory Malignant Tumors

In **16 of the analyzed localities**, there is an excess of specific mortality due to malignant tumors of the respiratory system (Figure 10). In these localities, the observed (actual) deaths reported for 2023 exceed the expected deaths (estimated to occur if the studied population had the same specific mortality rates for malignant respiratory tumors as the standard population of Romania). An excess of specific mortality from respiratory malignant tumors is also observed in **Drobeta-Turnu Severin**.

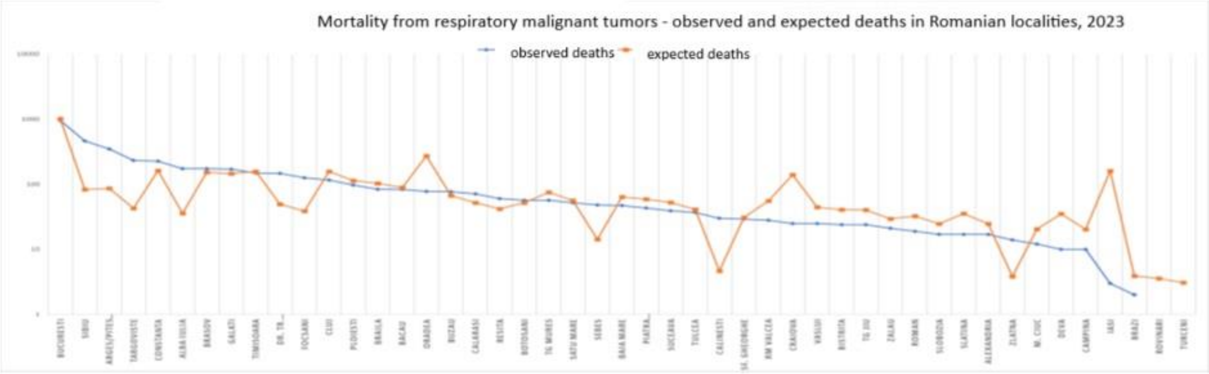


Figure 10 – Mortality from respiratory malignant tumors – observed and expected deaths in localities in Romania, year 2023.

Morbidity Assessment

To evaluate urban population morbidity associated with air pollution factors, new cases of respiratory diseases were monitored, including:

- Acute respiratory infections (IACRS)
- Pneumonia
- Bronchiolitis/Bronchitis (acute)
- Chronic bronchitis
- Pulmonary emphysema
- Bronchial asthma
- Malignant tumors of the bronchi and lungs

Additionally, cardiovascular diseases such as:

- Acute myocardial infarction (AMI)
- Stroke (CVA)

were analyzed for new case incidence.

Specific Incidence of AMI (Acute Myocardial Infarction)

In approximately half of the analyzed localities, after standardization, the rate of new cases of AMI is higher than expected. According to Figure 11, in 20 localities, the observed new cases of AMI are more frequent than the expected cases (estimated to occur if the studied population had the same specific incidence rate for AMI as the standard population used for comparison). In **Drobeta-Turnu Severin**, values also exceed the reference level.

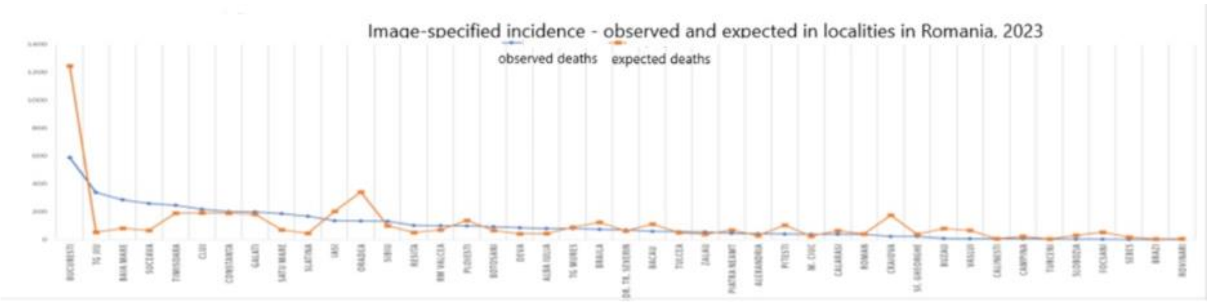


Figure 11 – Specific incidence – observed and expected deaths in localities in Romania, year 2023.

Specific Incidence of Stroke (CVA)

In approximately half of the analyzed localities, after standardization, the rate of new cases caused by stroke (CVA) is higher than expected. According to Figure 12, in 18 localities, the observed new cases of stroke are more frequent than the expected cases (estimated to occur if the studied population had the same specific incidence rate for CVA as the standard population used for comparison). In **Drobeta-Turnu Severin**, values exceed the reference level.

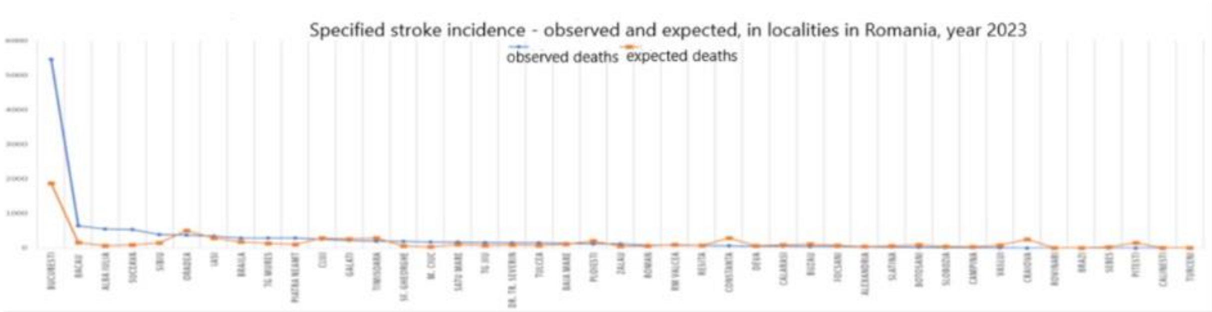


Figure 12 – Specific stroke incidence – observed and expected deaths in localities in Romania, year 2023.

Conclusions

Air pollution remains one of the critical environmental factors with significant effects on public health. Depending on the type of pollutant, its concentration, and exposure duration, health impacts can range from acute to chronic effects.

- **Acute Effects:** Short-term but high-level pollution can have immediate health impacts on the population.
- **Chronic Effects:** Long-term exposure, even at seemingly low levels, may result in chronic health issues that are difficult to detect and even harder to correlate with specific pollutants and exposure periods.

Key Challenges:

- Only continuous and systematic monitoring of health indicators, alongside tracking their evolution over time, can provide a comprehensive understanding of the potential health impacts on exposed populations.
- Correlating health impacts with specific atmospheric pollutants is challenging due to factors such as:
    - Dilution of pollutants in the air
    - Meteorological conditions
    - Variations in pollutant effects depending on their nature
    - Regional differences in traditions, habits, economic conditions, and exposure levels.

As a result, a national-level analysis of air pollution's health impact is difficult. It must be conducted locally, focusing on known pollution sources, the nature and level of emitted pollutants, and the exposed population.

Data Limitations in 2023:

- Incomplete, non-continuous, or inaccurate monitoring data (both for air pollutants and health indicators) hinder the accuracy of analyses and may lead to erroneous conclusions.
- The mortality and morbidity analyses for 2023, based on available data from the County Public Health Directorates and Bucharest Municipality, provide a general picture of diseases potentially influenced by air pollution.

Multifactorial Etiology:

- Many of these pathologies (e.g., respiratory and cardiovascular diseases) have multifactorial origins, including smoking, work conditions, meteorological factors, and air pollution. Since the collected data did not allow stratified analysis, results cannot be attributed exclusively to any single risk factor.

Future Perspectives:

- In the coming years, standardized data on Romania's urban population will be dynamically monitored, analyzed, and interpreted (including confidence intervals compared to previous years) to identify trends in mortality and morbidity associated with air pollution. This approach will help determine whether these rates are increasing or decreasing for pathologies impacted by atmospheric pollutants.

7. Identification and assessment of potential risk factors

This section identifies and assesses the key risk factors that may affect the health and well-being of populations in the vicinity of the project site. The analysis includes both environmental and occupational risk factors, along with proposed mitigation strategies.

The operation of a waste-to-energy plant and the associated non-hazardous waste landfill for the disposal of incineration residues presents a range of potential risks that may impact human health and the environment. These risks primarily stem from the release of emissions into the air, and water, as well as the handling and disposal of residual materials.

The main risk associated with air pollution arises from emissions during the operation of the Waste-to-Energy plant and the Non-Hazardous Waste Landfill (In compliance with Directive 2010/75/EU on industrial emissions, emission limits for PM10, SO2, NOx, and dioxins will be strictly enforced, with real-time monitoring to ensure adherence.). Pollutants of concern include:

- Particulate Matter (PM10, PM2.5): Can cause respiratory and cardiovascular diseases.
- Sulfur Dioxide (SO_2): Associated with respiratory irritation and exacerbation of asthma.
- Nitrogen Oxides (NOx): Can lead to respiratory infections and contribute to smog formation.
- Dioxins and Furans: Potentially carcinogenic and can accumulate in the food chain.

Potential risks to water quality stem from the discharge of untreated or insufficiently treated wastewater. Contamination of the Danube River could affect downstream communities, particularly in Romania. To mitigate this, the project will implement an advanced wastewater treatment system compliant with EU standards, ensuring minimal impact on the Danube River.

Leakage from the landfill or improper handling of waste residues could lead to soil contamination, affecting local agriculture and natural habitats. Regular inspections and the use of double liner systems will be employed to prevent contamination risks. Soil monitoring will be conducted periodically in collaboration with local environmental authorities.

Noise generated during construction and operation phases could impact nearby communities. Prolonged exposure to elevated noise levels is known to cause stress, sleep disturbances, and cardiovascular issues.

Given the pollutants identified, the primary public health risk include:

- Respiratory risks due to prolonged exposure to PM10, PM2.5, and NO_2, which can lead to increased incidence of asthma and chronic obstructive pulmonary disease (COPD).
- Oncological risks associated with long-term exposure to dioxins and furans, which are classified as potential human carcinogens.
- Vulnerable populations, such as children and the elderly, may experience more severe health impacts due to their increased sensitivity to environmental changes. Consultations with affected communities will be carried out to establish noise mitigation strategies, including sound barriers and scheduling restrictions.

Workers at the Waste-to-Energy plant and landfill may be exposed to hazardous substances, including heavy metals and volatile organic compounds (VOCs). Exposure risk will be minimized through strict adherence to occupational safety standards and regular health checks for workers. Construction and operational activities involve risks such as falls, equipment-related injuries, and heat stress.

To minimize the identified environmental and occupational risks, a comprehensive set of mitigation strategies will be implemented. These measures aim to address air, water, and soil pollution, as well as occupational hazards, ensuring compliance with regulatory standards and safeguarding public health and the environment.

- Air quality will be controlled through the installation of advanced emission control technologies. These include cyclons and bag filters, direct active carbin injection, 2 step scrubbers, and selective catalytic reduction (SCR) systems, which effectively reduce the release of particulate matter, sulfur dioxide, nitrogen oxides, and other pollutants. Continuous air quality monitoring will be conducted at key locations, and real-time data sharing will enable timely identification and mitigation of any deviations from regulatory standards.
- To safeguard water and soil resources, the project will incorporate a robust wastewater treatment system. This system will ensure that all effluents meet the required regulatory standards before discharge, thus minimizing the risk of water contamination, particularly in the Danube River and other nearby water bodies. Additionally, the landfill will be equipped with non-permeable membrane and leachate collection systems to prevent leakage, and regular soil quality monitoring will be conducted to detect and address potential contamination.
- Mitigation of noise pollution will involve the use of sound barriers to reduce noise levels in affected areas. Construction activities will be scheduled during daytime hours to limit disturbances to nearby communities. Regular maintenance of machinery will also be prioritized to minimize operational noise emissions.
- Worker safety will be ensured through strict adherence to occupational safety protocols. Personal protective equipment (PPE) will be provided to all workers, and regular safety training will be conducted to address the risks associated with both construction and operational activities. Inspections and monitoring will be carried out consistently to maintain a safe working environment and to mitigate risks such as exposure to hazardous substances and physical hazards, including equipment-related injuries.

These mitigation strategies are designed to not only comply with applicable regulations but also foster a sustainable and responsible approach to the project's environmental and occupational health challenges.

Table 20. provides a comprehensive summary of the identified risks associated with the project and the corresponding mitigation measures designed to address these challenges effectively.

Table 20: Identified risks associated with the project

Risk	Source	Impact	Proposed Measures
Air Pollution	Emissions from WtE and landfill	Respiratory illnesses, smog	Advanced filtration systems, continuous monitoring

Water Pollution	Insufficiently treated effluents	Contamination of drinking water	Modern treatment plants, periodic monitoring
Noise Pollution	Equipment and transport	Stress, sleep disturbances	Sound barriers, restriction of working hours

The transboundary location of the facility in Prahovo, close to the borders with Romania, increases the geographic scope of its potential impacts. Pollutants carried by prevailing winds or through waterways may affect not only local populations in Serbia but also communities in specific areas of Romania. This broader influence necessitates careful consideration of the facility's operational parameters and mitigation strategies to minimize its environmental footprint and health risks across borders.

Given the transboundary nature of the project, specific measures will be implemented to address potential cross-border risks, particularly those affecting air and water quality. Monitoring programs with reporting obligation to the authorities will be established to ensure early detection and effective management of any transboundary impacts. In accordance with the Espoo Convention, cross-border risk assessments will be carried out jointly with Romanian authorities within framework of Environmental Impact Assessment Study. These assessments is focused on air and water quality, ensuring the timely identification of potential risks and the implementation of mitigation measures and reporting in accordance with regulatory framework and cross-boarder collaboration requirements.

This chapter will focus on identifying these potential risks and their pathways, providing a foundation for assessing their significance and proposing strategies to mitigate their impacts. Through a detailed evaluation, this assessment will aim to address the concerns of all stakeholders while prioritizing the protection of human health and the environment.

The proposed measures and collaborative efforts are guided by key European Union directives to ensure compliance with international standards and best practices. These include:

- Directive 2002/49/EC on the assessment and management of environmental noise, which provides a framework for addressing noise pollution and its impact on public health.
- Directive 2000/60/EC, also known as the Water Framework Directive, which establishes a comprehensive approach to the protection and sustainable management of water resources.

These legislative instruments underscore the project's commitment to minimizing environmental and health risks while adhering to established regulatory requirements.

7.1. Project induced Air Emissions

During the regular operation of the Waste-to-Energy Plant, emissions of pollutants into the air may occur at various points, including the waste pretreatment facility, boiler plant, filter system for stabilization and solidification, and during material transportation.

The most significant emissions include:

- Particulate matter, TVOCs, heavy metals, HCl, HF, SO_2, NOx, CO, NH_3, dioxins (PCDD/F), PCBs, and Hg, resulting from the physical-mechanical treatment of waste, storage, and thermal treatment.
- Odors generated during the storage and transfer of waste.
- Emissions from transportation vehicles during the delivery and handling of waste materials.

In addition to emissions during the regular operation of the facility, the impact on air quality during construction activities within the complex must also be considered.

Air Emissions During Project Implementation

The construction of the Eco Energy complex represents an additional phase in the development of the facility, during which pollutant emissions can also be expected, but they are temporary. Anticipated emissions include suspended particles of inorganic origin (sand, cement, lime) and, to a lesser extent, organic particles (wood, soil). Additional pollutant emissions may arise during the welding of metal structures, painting, and the use of protective and anti-corrosion agents.

The use of diesel-powered machinery results in gas emissions, including carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NOx), particulate matter (PM), and soot. Particularly notable are emissions of polycyclic aromatic hydrocarbons (PAHs), which are known for their carcinogenic properties. The intensity of emissions depends on the type of machinery, fuel quality, and operating conditions.

The quantity and type of flue gases, harmful substances, and emissions are provided in Tables 21, 22, and 23. Table 24 presents data on the types of vehicles (machinery) to be used for constructing the Eco Energy complex, along with the estimated number of operating hours for each.

Table 21: Harmful substances from Diesel Fuel Combustion

Concentration kg/1000 liters of diesel fuel	CO	CH	NO_X	Particulate Matter
Diesel Engine	7,1	1,2	26,4	13,2

Table 22: Emission Values for Diesel Fuel Consumption 15-20 lit/h

	CO	CH	NO_X	Particulate Matter
Emission (g/s)	0,04	0,007	0,15	0,073

Table 23: Air Pollutant Emissions by Vehicle Type in the EU

Passenger Car				
Engine size/Load	CO (g/km)	CH (g/km)	NO_X (g/km)	PM (g/km)
Below 2000 cc	1,0	0,306	0,7	0,362
Above 2000 cc	1,0	0,306	1,0	0,362
Light Commercial Vehicle				
	CO (g/km)	CH (g/km)	NO_X (g/km)	PM (g/km)

	2,4	0,506	1,7	0,333
Heavy-Duty Vehicles				
Engine size/Load	CO (g/km)	CH (g/km)	NO_X (g/km)	PM (g/km)
3,6 – 16,0 t	18,8	2,79	8,7	0,95
Above 16,0 t	18,8	5,78	16,2	1,60

Table 24: Types of Vehicles (Machinery) to Be Used for the Construction of the Eco Energy Complex and Their Estimated Operating Hours

Vehicle Type	Operating Hours at the Construction Site
Excavator 22 t	925
Solo Truck 15 m^3	1850
Bulldozer D-7	170
Roller	170
Grader	60
Water Tanker	60
Crane 30 t	950
Crane 60 t	430
Crane 90 t	140
Man-Lift Basket	2450
Telehandler	330

Since the construction activities will be carried out within the existing industrial zone in Prahovo, emissions are expected to be localized and confined to the construction site and its immediate surroundings. The concentration of pollutants decreases rapidly with distance from the source, minimizing negative impacts.

Based on the assessment, it has been concluded that there will be no significant deterioration in air quality or the environment during the construction phase. The impacts are temporary and will cease upon the completion of the construction work.

Emissions from the Waste Pretreatment and Storage Facility

Emissions from the waste pretreatment and storage facility occur during unloading, storage, and the physical-mechanical treatment of waste. To reduce emissions of particulate matter and unpleasant odors, an extraction system with hoods and pipelines directs air to a filtration unit. This unit consists of a bag filter with pulse-jet cleaning using compressed air and an activated carbon filter. After treatment, the purified air is released into the atmosphere through an emission source (chimney).

Table 25 shows the key characteristics of the emission source for the filtration system, which are critical for proper direction and dispersion of the treated gases.

Table 25: Characteristics of the Emission Source for the Waste Pretreatment Filtration System and Activated Carbon Filter

Parameter	Value	Unit
Height of the emission source	12,5	m
Internal diameter of the emission source at the top	1,2	m

Temperature of flue gases at the top of the emission source	Ambient	°C
Volumetric flow rate of flue gases through the emission source	24.000	Nm^3/h

Table 26 provides an overview of pollutants and their limit values, ensuring compliance with national and international regulations, including BATC.

Table 26: Overview of the Type and Quantity of Emitted Pollutants at the Emission Source of the Waste Pretreatment Filtration System and Activated Carbon Filter

Emission Source	Pollutants	Expected Value	Mass Flow	Limit Value per Serbian Regulations	BAT WT	Testing Method per BAT-AELs in BREF WT
Chimney after bag filter with activated carbon	Particulate matter	< 5 mg/Nm^3	< 0,120 kg/h	10 mg/Nm^3	2-5 mg/Nm^3	EN 13284-1
	TVOC	< 30 mg/Nm^3	< 0,720 kg/h	20 mg/Nm^3	10- 30* mg/Nm^3	EN 12619

*BAT-AEL applies only when the relevant organic compounds are identified in the waste gas stream based on the regulations mentioned in BAT 3.

Reference methods for pollutant emission measurements are used in accordance with the Regulation on Emission Measurements[90] and the requirements of standard SRPS EN 15259. Periodic measurements are conducted twice a year, six months apart, under conditions of maximum facility load, by an authorized expert organization.

The operator is required to monitor the operation of waste gas treatment equipment and immediately notify the Republic Environmental Inspection in the event of exceeding limit values or accidents. Monitoring results must be submitted to the Environmental Protection Agency by March 31st for the preceding year.

Guarantee emission measurements are conducted between the third and sixth month of the trial operation phase under maximum load conditions to ensure compliance with prescribed limit values.

In addition to controlled emissions through the emission source specific processes in the facility generate additional emissions that require tailored measures for their reduction.

In solid waste storage facilities, emissions of particulate matter and unpleasant odors are reduced by maintaining constant underpressure in the storage hall. Extracted air is directed by fans to the boiler plant. During waste handling with cranes, misting with water spray further reduces dust emissions.

When the boiler plant is not operational, air from the hall is filtered through a bag filter with activated carbon and released through the emission source.

[90] "Official Gazette RS," Nos. 05/2016 and 10/24, Uredba o merenjima emisija zagađujućih materija (paragraf.rs)

In sludge waste storage facilities, unpleasant odors are controlled by directing air to the boiler plant or, in the case of boiler downtime, by inertizing the area with nitrogen (N_2).

Hazardous waste treatment lines are designed as closed systems, where nitrogen dosing ensures an inert atmosphere, eliminating the possibility of emissions during regular operation.

For the storage and transfer of liquid waste materials, emissions of volatile compounds and unpleasant odors are minimized using nitrogen blanketing systems, which maintain constant overpressure in the tanks and prevent evaporation. Exhaust gases are directed to thermal treatment in the boiler plant, while safety equipment ensures pressure relief in case of system failure. Ventilation of areas housing tanks, IBC containers, barrels, and jumbo bags is carried out through axial fans and facade louvers, ensuring proper air quality control.

All emission reduction measures applied to different segments of the facility are presented in Table 27.

Table 27: Overview of Emissions and Mitigation Measures by Waste Transfer and Storage Lines

Facility Segment	Type of Emissions	Emission Reduction Measures
Solid waste storage in bunkers	Particulate matter, unpleasant odors	- Halls under underpressure - Air extraction to the boiler plant for combustion (23,000–47,000 Nm³/h)
Crane operation and waste transfer	Particulate matter	- Water mist spraying during waste handling
When the boiler plant is not operating	Particulate matter, unpleasant odors	- Air filtered through a bag filter with activated carbon and released through the chimney emission source
Sludge storage	Unpleasant odors	- Air directed to the boiler plant (2,000 Nm³/h) - Nitrogen inertization in case of boiler downtime
Hazardous waste treatment lines	No emissions during operation	- Closed treatment system with nitrogen dosing into the shredder chamber
Liquid material transfer and storage	Volatile compounds, unpleasant odors	- Nitrogen blanketing system - Thermal treatment of exhaust gases in the boiler plant - Safety equipment for pressure relief
Ventilation of IBC container storage	Particulate matter, unpleasant odors	- Exhaust via axial fans (capacity 17,000 Nm³/h) - Air replenishment through facade louvers

All emissions are subject to regular monitoring in accordance with the Monitoring Plan and applicable regulations. The detailed monitoring plan includes tracking emission sources, pollutants, and applied mitigation measures, ensuring compliance with BAT standards and national regulations. The emission control system guarantees adherence to national regulations and BAT standards for waste treatment.

Emissions from Boiler Plant

The largest and most complex part of the Waste-to-Energy Plant is the flue gas cleaning systems generated during the combustion of waste, which include:

- Dry flue gas cleaning (cyclone, reactor with activated carbon, and bag filters)
- Wet flue gas cleaning in scrubbers
- Selective catalytic filter

The flue gas cleaning process in the boiler plant is carried out through a combination of dry and wet methods, after which the purified gases are directed to the stack (chimney). Stacks represent a key element of the system for releasing purified gases, and their characteristics, such as height, diameter, and gas flow, directly influence emission dispersion and ambient air quality. The parameters of the stacks are provided in Table 28.

Table 28: Characteristics of Boiler Plant Emission Source

Parameters	Value	Unit
Height of the Emission Source	56 m	m
Internal diameter of the Emission Source at the top	1,7	m
Flue gas temperature at the top of the Emission Source	147 ± 3	°C
Volumetric flow of flue gases through the Emission Source	70.000	Nm^3/h
Geographical coordinates of the Emission Source	44.284570 22.616845	Lat/Long

Dry flue gas cleaning begins in cyclones, where coarse particles are separated and collected in a collector. The released gases pass through a reactor with activated carbon, which absorbs heavy metals, dioxins, and furans, after which particles are removed by bag filters. The gases then enter the wet cleaning system. In the first scrubber, acidic gases (chlorides, fluorides, and heavy metals) are removed at pH 1, while in the second scrubber, sulfur oxides are neutralized with a lime milk solution (pH 7), producing gypsum. Finally, the gases pass through DeNOx filters, where NOx is reduced to nitrogen using a catalyst and ammonia water, along with the breakdown of remaining dioxins and furans.

Emission monitoring of pollutants from the facility is crucial for ensuring compliance with legislation and minimizing environmental impact. The monitoring system includes continuous measurement of basic pollutants, as well as periodic testing of specific components such as heavy metals and dioxins. Pollutant measurements are performed in accordance with the Regulation on Conditions for Thermal Waste Treatment[91] and the Conclusions on Best

[91] "Official Gazette of the RS," No. 103/2023, Available at about:blank (ekologija.gov.rs)

Available Techniques (BAT) for Waste Incineration (EU 2019/2010)[92]. Continuous measurements include NOx, NH_3, CO, particulate matter, TVOC, HCl, HF, SO_2, as well as process parameters such as combustion temperature, oxygen volume fraction, flow rate, pressure, and water vapor content in the flue gases.

The minimum temperature and gas retention must be verified during plant commissioning and under the most unfavorable conditions. Heavy metals (As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Sb, Tl, V), dioxins, furans, and benzo[a]pyrene are measured periodically, at least twice a year, and four times during the first year. Emissions are monitored according to the limit values specified in the Regulation[93] and BAT Conclusions (EU 2019/2010)[94], for dry gases under standard conditions (273.15 K, 101.3 kPa, O_2 = 11%). Table 29 presents the emission limit values of pollutants into the air from the thermal waste treatment facility.

Table 29: Overview of the Type and Maximum Concentration of Emitted Pollutants at the Boiler Plant Emission Point

Pollutant	Unit	Expected Emission Range		Emission Limit Values According to RS Regulations[95]	BAT-AELs According to BREF WI[96]		Measurement Method According to BAT-AELs	Mass Flow (kg/h)
		min	max		BAT-AEL	Averaging Period		
Emission values associated with BAT for dust, metals, and metalloids emissions from stationary sources into the air during waste incineration								
Dust	mg/Nm³	1	3	10	<2-5	Daily	General Standard and EN 13284-2	0,35
Cd+Tl	mg/Nm³	0,005	0,01	0,05	0,005-0,02	Sampling Period	EN 14385	0,0007
Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V	mg/Nm³	0,01	0,1	0,5	0,01-0,3	Sampling Period	EN 14385	0,007
Emission values associated with BAT for HCl, HF, and SO_2 emissions from stationary sources into the air during waste incineration								
HCl	mg/Nm³	1	3	10	<2-6	Daily Average	General EN standards	0,42
HF	mg/Nm³	0,05	0,1	1	< 1	Daily average or average	General EN standards	0,07

[92] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)

[93] "Official Gazette of the RS," No. 103/2023, Available at about:blank (ekologija.gov.rs)
[94] Implementing decision - 2018/1147 - EN - EUR-Lex (europa.eu)
[95] Regulation on Technical and Technological Requirements for the Design, Construction, Equipment, and Operation of Facilities and Types of Waste for Thermal Waste Treatment, Emission Limit Values, and Their Monitoring ("Official Gazette of the RS," No. 103 of November 21, 2023, Available at about:blank (ekologija.gov.rs)).
[96] Commission Implementing Decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration, Implementing decision - 2018/1147 - EN - EUR-Lex (europa.eu)

						during the sampling period		
SO_2	mg/Nm^3	10	30	50	5-30	Daily Average	General EN standards	2,1
Emission values associated with BAT for TVOC, PCDD/F emissions, and dioxin-like PCBs into the air from waste incineration processes								
TVOC	mg/Nm^3	1	5	10	<3-10	Daily Average	General EN standards	0,7
PCDD/F	Ng I-TEQ/Nm^3	0,01	0,04	0,1	<0,01-0,04 <0,01-0,06	Daily average or average during the sampling period	EN 1948-1, EN 1948-2, EN 1948-3	0,0000000028
PCDD/F+dioxin-like PCBs	ng WHO-TEQ/Nm^3	0,01	0,04	-	<0,01-0,06 <0,01-0,08	Average value during the sampling period Long sampling period Average value during the sampling period Long sampling period	EN 1948-1, EN 1948-2, EN 1948-4	0,0000000028
Emission values associated with BAT for mercury emissions from stationary sources into the air from waste incineration processes								
Hg	µg/Nm^3	2	10	50	< 5-20	Daily average or average during the sampling period	General EN standards and EN 14884	0,0014
					1-10	Long sampling period		

Emission limit values for pollutants have been established to control emissions from stacks and ensure environmental protection. Table 30 presents the half-hourly average limit values for key gaseous and particulate pollutants generated during waste combustion.

Table 30: Half-Hourly Average Limit Values for the Following Pollutants

Pollutant	(100% of Measured Values) A	(97% of Measured Values) B
Total particulate matter	30 mg/normal m^3	10 mg/normal m^3

Gaseous or vapor organic substances, expressed as total organic carbon (TOC)	20 mg/normal m^3	10 mg/normal m^3
HCl	60 mg/normal m^3	10 mg/normal m^3
HF	4 mg/normal m^3	2 mg/normal m^3
Sulfur dioxide, SO_2	200 mg/normal m^3	50 mg/normal m^3
Nitric oxide (NO) and nitrogen dioxide (NO_2), expressed as nitrogen dioxide for incineration plants with a nominal capacity exceeding 6 tons per hour or for new plants	400 mg/normal m^3	200 mg/normal m^3

Heavy metals and metalloids, although present in lower concentrations, pose a significant potential environmental hazard. Their monitoring is conducted in accordance with strictly prescribed standards, and the emission limit values are shown in Table 31.

Table 31: Average Emission Limit Values for the Following Heavy Metals During a Sampling Period of No Less Than 30 Minutes and No More Than 8 Hours

Cadmium and its compounds, measured as cadmium (Cd)	0,05 mg/normal m^3	Total 0,1 mg/normal m^3
Thallium and its compounds, expressed as thallium (Tl)		
Mercury and its compounds, expressed as mercury (Hg)	0,05 mg/normal m^3	Total 0,1 mg/normal m^3
Antimony and its compounds, expressed as antimony (Sb)	0,5 mg/normal m^3	Total 1 mg/normal m^3
Arsenic and its compounds, expressed as arsenic (As)		
Lead and its compounds, expressed as lead (Pb)		
Chromium and its compounds, expressed as chromium (Cr)		
Cobalt and its compounds, expressed as cobalt (Co)		
Copper and its compounds, expressed as copper (Cu)		
Manganese and its compounds, expressed as manganese (Mn)		
Nickel and its compounds, expressed as nickel (Ni)		
Vanadium and its compounds, expressed as vanadium (V)		

Dioxins and furans are among the most toxic pollutants, and the emission limit values for them are particularly strict. Table 32 presents the permissible concentrations of these substances during sampling.

Table 32: Average Emission Values for Dioxins and Furans During a Sampling Period of No Less Than 6 Hours and No More Than 8 Hours

Dioxins and furans	0,1 ng/Nm^3

The emission limit values apply to the total concentrations of dioxins and furans, calculated based on the toxicity equivalence factors outlined in Annex 1 of the Regulation on Technical and Technological Requirements for the Design, Construction, Equipment, and Operation of Facilities and Types of Waste for Thermal Waste Treatment, Emission Limit Values, and Their Monitoring ("Official Gazette of the RS," No. 103/2023).

In the flue gas purification system, the emission of pollutants is strictly controlled through the technical characteristics of the stack, the application of modern purification technologies, and detailed emission monitoring. These measures ensure that emissions remain within legally permissible limits, with minimal environmental impact:

- 50 mg/normal m^3 determined as a daily average;
- 100 mg/normal m^3 determined as a half-hour value;
- 150 mg/normal m^3 as a ten-minute average value.

The emission limit value for carbon monoxide (CO) may apply to incineration plants using fluidized bed combustion systems, provided that the emission limit for carbon monoxide is explicitly stated in the permit, with a maximum value of 100 mg/normal m^3, determined as the hourly average value. Emission limit values for gaseous or vapor organic substances, expressed as total organic carbon (TOC), must not exceed 20 mg/Nm^3 (100% of measured values) and 10 mg/Nm^3 (97% of measured values) for half-hourly averages, nor the carbon monoxide (CO) emission limit of 100 mg/Nm^3, as specified in point 5 for half-hourly averages.

Emissions from the stabilization and solidification process

Emissions from the stabilization and solidification process primarily relate to particulate matter generated during various operational phases, including storage, mixing, and material treatment. The key sources of these emissions are:

- The bunker for storing the ash mixture and dewatered sludge, where the stabilization process takes place.
- The mechanical treatment of slag, including the separation of ferrous and non-ferrous metals using magnetic and eddy current separators.
- The mixer reactor, where cement, ash, and water are mixed during solidification.
- The cement silo and scales for measuring cement and ash.

To reduce emissions, all these sources are equipped with bag filters, which efficiently remove particulate matter from the air. The purified air is then released into the atmosphere through the stack (chimney). Table 33 shows the basic characteristics of the stack of the filtration system used in this process.

Table 33: Characteristics of the Stack of the Filtration System for the Stabilization and Solidification Process

Parameters	Value	Unit
Height of stack	21,5 m	m
Internal diameter of stack at the top	1,2	m
Flue gas temperature at the top of the stack	Ambient	°C
Volumetric flow of flue gases through the stack	25.000	Nm^3/h
Geographical coordinates of the stack	44.284418 22.616549	Lat/Long

Table 34 provides an overview of the type and quantity of pollutants emitted from the stack of the filtration system in the stabilization and solidification process.

Table 34: Type and Quantity of Pollutants Emitted from the Stack of the Filtration System for the Stabilization and Solidification Process

Stack	Pollutants	Expected Value	Expected Mass Flow	Emission Limit Values According to RS Regulations	BAT WT	Measurement Method According to BAT-AELs (BREF WT)
Chimney after bag filter	Particulate matter	< 5 mg/Nm^3	0,125 kg/h	10 mg/Nm^3	2-5 mg/Nm^3	EN 13284-1

Monitoring of pollutant emissions in the stabilization and solidification process is conducted in accordance with national regulations and BAT standards. Key activities include:

- Periodic emission measurements: Conducted twice a year by authorized professional organizations, in accordance with SRPS EN 15259 and EN 13284-1 standards.
- Continuous monitoring of bag filter functionality: The operator regularly checks the operation of the filters to ensure maximum efficiency in reducing particulate matter.
- Reporting to competent authorities: Monitoring results are submitted to the Environmental Protection Agency and the national environmental inspection authority, in compliance with legal requirements.

In the event of emission limit exceedances or incidents, the operator is required to undertake immediate corrective measures and notify the relevant authorities.

<u>Emissions from Transport Vehicles During the Delivery of Waste Materials and Other Materials</u>

Air pollution at the site can also result from exhaust gas emissions from internal combustion engines of transport vehicles during the delivery and removal of waste materials, auxiliary raw materials, and products. Depending on the type of fuel and transport vehicle, the quantity and type of emitted flue gases are shown in Tables 21, 22, and 23.

The projected transport flows anticipate the unloading of waste material with the following capacities as individual maximum per type of delivery:

- Solid and sludge waste material: Approximately 10 trucks per hour.
- Liquid waste: 10 trucks daily in IBC containers, barrels, or jumbo bags, with an additional 6 tankers daily for liquid waste.
- For the transport and disposal of solidified residues to the non-hazardous waste landfill, a maximum of 360 m³ daily is planned, corresponding to the use of up to 50 dump trucks daily. Additionally, the delivery of auxiliary raw materials and chemicals includes:
- Cement: 2 tankers per day.
- Polyelectrolyte for wastewater treatment: 1 truck per day.
- Other raw materials and chemicals: As needed, e.g., one tanker of ammonia water every 2.5 months or one tanker of fluidization sand every 3 months.

To reduce air emissions during unloading and transfer:

- The unloading of bulk solid waste and sludge will take place inside the pretreatment facility, with the facility doors closed before unloading begins.
- During the transfer of liquid waste and raw materials, as well as during truck unloading, the engines of transport vehicles must be turned off..

Given these measures, gas emissions resulting from diesel fuel combustion are limited to the local area and are of a temporary nature. It can therefore be concluded that their impacts on air quality are negligible.

Air Emissions During Regular Operation of the Non-Hazardous Waste Landfill

The compacted solidified waste at the landfill is not prone to air pollution due to the hardened surface of the material. If dust emissions are observed during operation, the deposited material will be sprayed with water sourced from the atmospheric water basin. Water transport to the landfill will be conducted using equipment installed in a shaft pumping station, while long-range sprinklers will be used for water dispersion with the following characteristics: a rainfall intensity of 10 mm/h and an effective radius of 50 m. Along the perimeter of the landfill, a pipeline will be installed with a total of five connection points for flexible hoses up to 40 m in length, allowing the sprinklers to be positioned as needed on the landfill slopes.

The impact of emissions from the landfill has been thoroughly analyzed as part of the Impact Study of the Waste-to-Energy Plant and Non-Hazardous Waste Landfill on Air Quality within the wider area of the chemical industry complex in Prahovo (April 2024), with additional explanations provided in Chapter 7.1.3 .

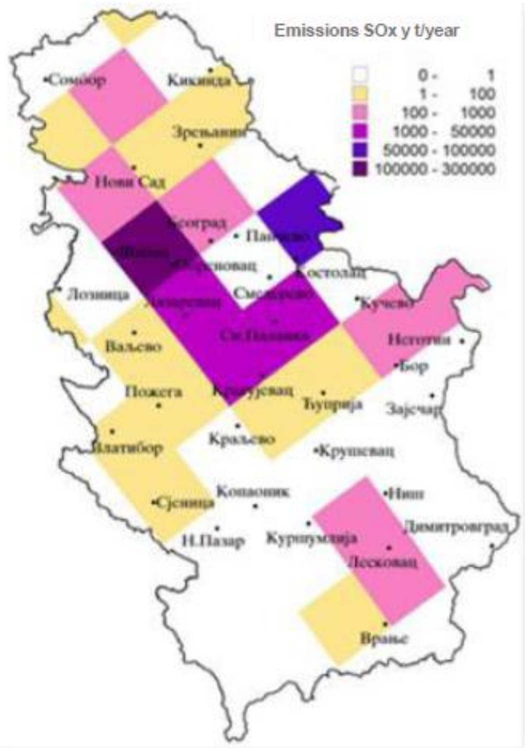
Physical barriers, such as the elevated terrain of the phosphogypsum storage site to the south and the Waste-to-Energy Plant complex to the east, further limit the spread of the landfill's impact on the surrounding land. Existing protective greenery within the industrial complex and in the phosphate fertilizer production zone helps mitigate adverse effects. This greenery acts as a buffer zone between the industrial complex and the state road, as well as between the industrial complex and the workers' residential area.

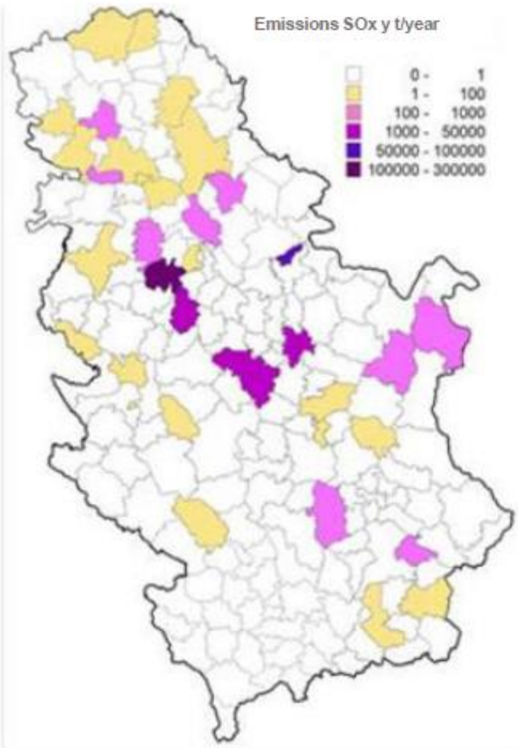
According to the amendments to the Detailed Regulation Plan for the Chemical Industry Complex in Prahovo[97], the additional planting of a protective green belt is planned along the boundary of the industrial complex, including the Waste-to-Energy Plant and the Non-Hazardous Waste Landfill. This protective belt serves to isolate the immediate surroundings from negative impacts, with the construction of buildings within this zone strictly prohibited. The construction of necessary underground installations and above-ground transport systems is permitted only in compliance with applicable regulations, ensuring that the protective belt's significance is not compromised.

7.1.2. Existing Situation of Air Quality on the Location

Air quality control is carried out in order to determine the level of air pollution and assess the impact of polluted air on human health, the environment and the climate, in order to take the necessary measures to protect the environment, human health and material goods.
The Environmental Protection Agency of the Republic of Serbia (hereinafter referred to as the Agency) performs continuous monitoring of air quality in the state air quality monitoring network at the level of the Republic of Serbia. Pursuant to the Law on Air Protection[98], the Agency is obliged to prepare and publish every year the Annual Report on the State of Air Quality in the Republic of Serbia, which can be downloaded from the official website of the Agency, and in which the values of monitoring in the state and local network of monitoring and assessment of air quality are verified.

The figures 13. and 14. show the spatial distribution of sulphur and nitrogen oxides [t/year] during the year 2022.





97 "Official Gazette of the Municipality of Negotin," No. 350-123/2022-I/07 of June 17, 2022
98 "Official Gazette of the RS", nos. 36/09, 10/13 and 26/21-other law, Available at Zakon o zaštiti vazduha (paragraf.rs)

Figure 13. Spatial distribution of sulphur oxide emissions, in t/year, during 2022 in the 50 x 50 km quadrant network (left) and by municipalities (right)

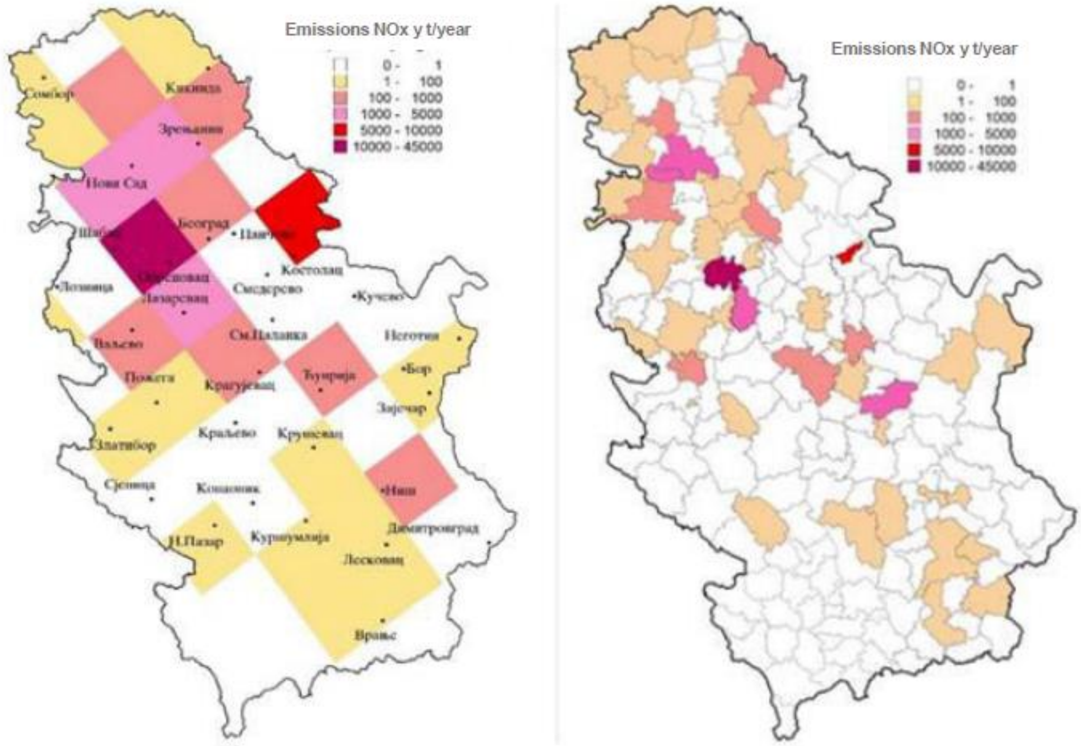


Figure 14. Spatial distribution of nitrogen oxides emissions, in t/year, during 2022 in the 50 x 50 km quadrant network (left) and by municipalities (right)

The air quality assessment is performed on the basis of exceeding the limit and tolerance values of pollutant concentrations. The assessment of air quality in 2022 was performed on the basis of mean annual concentrations of pollutants obtained by monitoring air quality in the state network and local air monitoring networks.

Air quality categories:

- First category - clean or slightly polluted air - air in which the limit values for any pollutant are not exceeded;
- Second category - moderately polluted air where the limit values of the level for one or more pollutants are exceeded, but the tolerance values of any pollutant are not exceeded;
- Third category - excessively polluted air, air where limit values for one or more pollutants are exceeded.

Categorization of air quality, by stations and measuring points for 2022, is shown graphically in the figure 15.

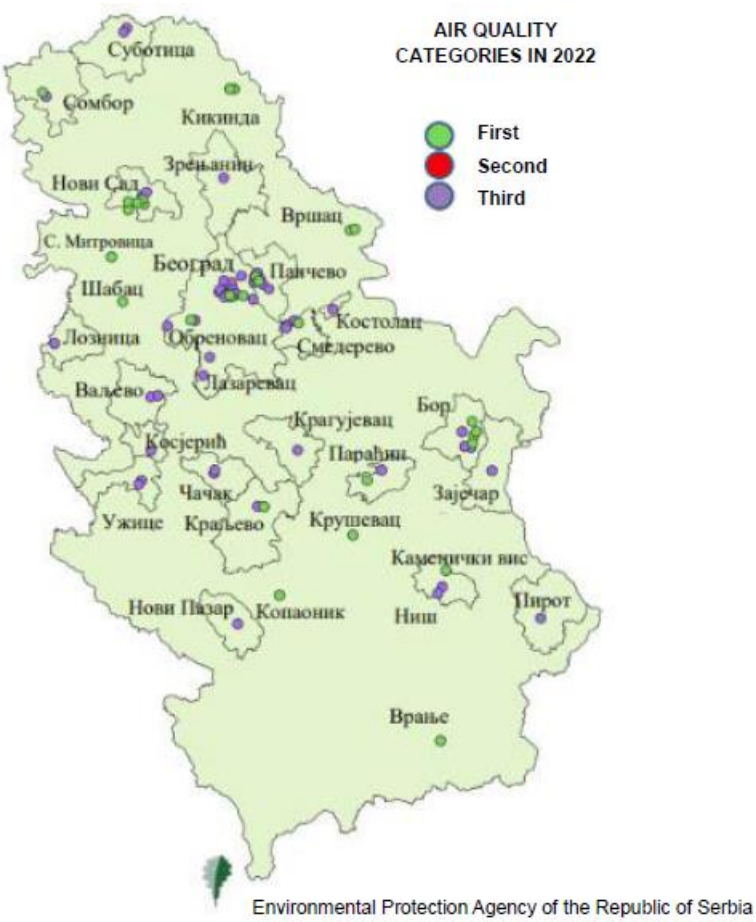


Figure 15. Categories of air quality in 2022 by stations

However, the municipality of Negotin, and therefore the settlement of Prahovo, is not covered by the network of automatic air quality monitoring stations (ASAQM). Figure 16. shows the network of the ASAQM Air Quality Monitoring Agency in the Republic of Serbia.

Figure 16. Network of stations and measuring points for air quality monitoring

The City Institute for Public Health Belgrade, at the request of Elixir Prahovo LTD, performed air quality monitoring for 15 days from April 19 - May 3 2023 at measuring point 1: Dragiša Brebulović-Žmiga, 11 Vuka Karadžića Street, Prahovo (N 44°17'40.6'', E 22°35'9.5''). The measuring point 1 (MP1) is 2.5 km northwest of the location of the project in question and is shown in Figure 17. During the measurement period, the following parameters were tested:

- Mass concentrations of suspended PM10 i PM2,5;
- Total metal content (As, Cd, Pb, Ni, Cr) in the PM10 suspended particle fraction;
- Hydrogen fluoride (HF) mass concentration;
- Total phosphorus (P) content in the PM10 suspended particle fraction

Figure 17. Location of air quality measurement

The results of the measurements show that all the tested parameters are in accordance with the Regulation on monitoring states and air quality requirements[99] except for one measurement (29 April, 2023) when the measured mean 24-hour value of PM10 suspended particles (51 μg/m^3) exceeded the limit value (50 μg/m^3, must not be exceeded more than 35 times in one calendar year).

7.1.2.1. Existing Situation of Air Quality in Romania

In the study area, there is a traffic monitoring station in the municipality of Calafat, Dolj County. DJ-6 - traffic station located in Calafat, near the cross-border area (Romanian-Bulgarian bridge and Calafat customs); the monitored pollutants are SO_2, NO, NO_2, NOx, CO, PM10, PM2.5. Besides the air quality indicators mentioned, meteorological parameters are also monitored, including temperature, wind direction and speed, atmospheric pressure, solar radiation, relative humidity, and precipitation levels. For the analyzed parameters, there were no exceedances of the limit values, either hourly or daily.[100]

Climatic Analysis of the Area[101]

From a climatic point of view, Dolj County is part of the temperate climate zone. Due to its location in the southwestern part of the country, specifically in the western part of the large depression within the Carpathian-Balkan arch, the vast open territory is predominantly affected

[99] "Official Gazette of the RS", no. 11/2010, 75/2010 i 63/2013, Available at Uredba o uslovima za monitoring i zahtevima kvaliteta vazduha (paragraf.rs)
[100] Information Regarding the State of the Environment in Craiova Municipality – Year 2023, https://www.anpm.ro/documents/19431/0/DJ_BCA_2023.pdf/ef98ce14-45d0-4c7f-8968-672afc87e178
[101] Air Quality Maintenance Plan for Dolj County (2020 - 2025), https://www.cjdolj.ro/portal/siteweb/documente%202020/Proiect%20PMCA%202020%20-2025%20Dolj.pdf

by Mediterranean maritime air masses and humid oceanic air, while being less influenced by the warm and dry eastern air masses, which are strongly continental. An analysis of the climatic elements clearly shows that there is a much higher frequency of Mediterranean-Adriatic air invasions descending on the eastern slope of the Carpathian Mountains of the Iron Gates and the Western Balkans compared to the northeastern air penetrations, which dominate the entire eastern half of the Danube Plain. The föehn effects that occur during the western and southwestern air invasions (felt especially along the terraces and floodplains of the Danube River) not only lead to a predominance of westerly winds but also result in higher annual average temperatures than those found in the eastern part of the Danube Plain.

Climatic Factors Impacting Atmospheric Pollutants

Climatic factors can act on atmospheric pollutants either directly or indirectly. The main climatic parameters that influence the dispersion of the analyzed pollutants area: air temperature, atmospheric precipitation, snow cover, wind regime, solar radiation, cloudiness, humidity, atmospheric pressure.

Meteorological Stations and Data Analysis

To analyze the climatic conditions of Dolj County, data from the following meteorological stations were analyzed:

1. Craiova (44°19' N, 23°48' E, 113 m altitude)
2. Calafat (43°59' N, 22°57' E, 68 m altitude)
3. Băilești (44°01' N, 23°21' E, 58 m altitude)
4. Bechet (43°46' N, 23°57' E, 40 m altitude)

For larger towns (Filiași, Calafat, Bechet), no directed emission sources were identified in the emissions inventory; even though the population is higher, the population density is lower, meaning that the emission sources are more dispersed, with a smaller impact on pollutant levels in the air.

For the following indicators: PM10 (measured gravimetrically), PM2.5, NO_2, CO, SO_2, benzene, heavy metals, O_3, the concentration levels reported in relation to the limit values and/or target values in the reference year for the analyzed area did not exceed the thresholds.

At the county level, the automatic air quality monitoring station is located in the municipality of Drobeta Turnu Severin, approximately 55 km away[102]. The station (44° 36' 99, 22° 40' 99˝; 77 m altitude) is equipped with continuous monitoring equipment for the following air pollutants: sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), ozone (O_3), volatile organic compounds (VOCs), suspended particulate matter (PM_{10} and $PM_{2.5}$), and sensors for determining meteorological parameters (wind speed, wind direction, air pressure, precipitation, solar radiation, air temperature, relative humidity).

7.1.3. Analysis of the Cumulative Impact of Emissions on Air Quality

In order to determine the impact of air emissions from the Waste-to-Energy Plant stacks and the non-hazardous waste landfill, as well as the potential cumulative impact with existing emissions from stacks within the chemical industry complex in Prahovo and the phosphogypsum storage

[102] Report on the Environmental Status of Mehedinți County, 2023

site (both existing and planned expansions), including the broader surroundings of the complex and the transboundary context of potential air quality impacts on neighboring Romania and Bulgaria, the following studies were prepared by a professional team from the University of Belgrade, Faculty of Mechanical Engineering:

- Impact Study of the Waste-to-Energy Plant and Non-Hazardous Waste Landfill on Air Quality in the Wider Area of the Chemical Industry Complex in Prahovo, April 2024.
- Impact Study of the Pretreatment Waste Filtration System and the Activated Carbon Filter within the Waste-to-Energy Plant on Air Quality in the Wider Area of the Chemical Industry Complex in Prahovo, June 2024.

The assessment of air quality impacts is based on the use of a computer-based dispersion model for calculating ground-level concentrations of pollutants in the analyzed area, utilizing the AERMOD software package. To provide a qualitative evaluation of contributions to the existing air quality conditions, model results were compared with relevant national standards (Regulation on Conditions for Air Quality Monitoring and Requirements[103].

As stated, the modeling was performed using the AERMOD software package, with appropriate input parameters for the existing and future conditions of the facility. AERMOD is a Gaussian dispersion model recommended by the U.S. Environmental Protection Agency (EPA) and includes a wide range of capabilities for modeling the impact of pollutants on air quality. This model allows for the simulation of multiple pollution sources, including point, line, area, and volumetric sources. It also incorporates algorithms for analyzing aerodynamic flow near and around buildings (building downwash).

The mentioned studies analyzed identified point and surface emission sources characteristic for the project scope, comprising of the following pollutants depending on the scenario: CO, SO_2, NO_2, PM_{10}, $PM_{2.5}$, HF, HCl, NH_3, Hg, PCDD/F from the boiler plant stacks; TVOC and PM_{10} from the pretreatment waste filtration system and activated carbon filter stacks; as well as PM_{10} from the stabilization and solidification filtration system stack. Table 35 presents the results of the study which includes the existing sources of emissions from the chemical complex.

Table 35: Overview of Pollutants Covered by the Study

Pollutant	Exceedances	Impact on Air Quality	Impact Zones
SO_2	Occasional during unfavorable weather conditions	Local increase during unfavorable conditions	Within the facility, occasional limit exceedance
NO_2	No exceedances in either scenario	Minimal impact on air quality	Within the industrial complex
PM_{10}	Occasional near phosphogypsum storage with unfavorable dispersion	High local concentrations, potential impact on neighboring zones	Within and near phosphogypsum storage, occasionally wider

[103] "Official Gazette of the RS", no. 11/2010, 75/2010 i 63/2013, Available at Uredba o uslovima za monitoring i zahtevima kvaliteta vazduha (paragraf.rs)

$PM_{2.5}$	No recorded exceedances in any scenario	Minimal impact on the wider area	Within the industrial complex
CO	Significantly below regulatory values in any scenario	Negligible contribution to overall pollution	Limited to the local area
HCl	No recorded exceedances in any scenario	Negligible impact, locally limited	Local, near emission sources
HF	Rare exceedances	Minor local effects and within storage zones	Local and near phosphogypsum storage boundaries
NH3	Far below limits in any scenario	Negligible contribution to overall pollution	Local
Hg	No recorded exceedances	Negligible impact	Local
PCDDF	No recorded exceedances	Negligible impact	Local

It is also important to note that a scenario was modeled where the boiler plant is not operational. In this case, it is not possible to maintain slight negative pressure and extract and combust air from the waste storage area. Instead, the air from the storage area is directed to the pretreatment filtration system and the activated carbon filter. Consequently, in addition to the aforementioned emissions, additional emissions of TVOC originating from the storage area can be expected at this stack. TVOC emissions also occur from the boiler plant stack during regular operation.

During modeling and determining the dispersion of pollutants and assessing the cumulative effect in the designated area, the maximum allowable pollutant concentrations prescribed by the conclusions on Best Available Techniques (BATC) were used as the initial concentrations at the stacks.

Since the purpose of air quality modeling within the studies is to provide a representative assessment of the project's impact on air quality within the model's analyzed domain, other sources not belonging to the chemical industry complex were not considered, nor was background pollution included in the presented modeling results.

It is also important to note that within the Prahovo chemical industry complex, there are emission sources from two companies, Elixir Prahovo and Phosphea. For the purposes of the mentioned studies, all point and surface emission sources from both companies were considered to provide the most representative assessment, given that they represent the dominant air emission sources in the analyzed domain. This approach enables a clear understanding of the future impact of the specific project on air quality, as well as the cumulative effect of emissions at the site.

Based on all the above, the following conclusions were made:

- Analysis of the obtained results indicates that for components currently emitted (CO, SO_2, NO_2, PM_{10}, $PM_{2,5}$, HF, HCl, NH_3) and those that will be emitted from the stacks of the future facility, including the non-hazardous waste landfill, the dominant impact comes from existing emitters (within the Elixir Prahovo and Phosphea complexes) or, in the case of particulate matter, surface sources both for current and future conditions (phosphogypsum storage sites). The impact of the future Waste-to-Energy Plant and non-hazardous waste landfill (solidified waste) is practically negligible.
- It was determined that for some components (SO_2, PM_{10}, and HF), there is a possibility of episodic high concentrations under extremely unfavorable meteorological conditions for dispersion. However, the number of hours/days with such concentrations is extremely small, and the probability of occurrence is minimal.
- It was found that the cause of these potential episodic elevated concentrations are the existing emitters of SO_2 and HF from the operations of Elixir Prahovo and phosphogypsum disposal sites in the case of PM_{10}, both for current and future conditions. Therefore, the mentioned episodic emissions are not a potential consequence of the operation of the future Waste-to-Energy Plant and the non-hazardous waste landfill.
- Potential zones with exceedances of limit values for the mentioned components occur on uninhabited areas in the immediate vicinity of the boundary of the Prahovo chemical industry complex.
- For components currently not emitted and that will be emitted in the future only from the stack of the waste combustion facility (Hg and PCDD/F), modeling results indicate that the concentrations of these pollutants will be far below the prescribed limit values.
- Analysis of the obtained results indicates that the impact of the pretreatment filtration system and activated carbon filter system within the Waste-to-Energy Plant on air quality in the broader area of the chemical industry complex in Prahovo is practically negligible in terms of PM_{10} and TVOC.
- Results also clearly show that within the mentioned facility, the dominant impact on air quality in both cases-whether the boiler plant is operational or not-comes from auxiliary system emitters (waste preparation and solidification).
- It should also be noted that for TVOC, there is no prescribed maximum allowable concentration in ambient air. Therefore, the study presents only indicative values for indoor air quality.

Regarding the potential transboundary impact of the analyzed facilities on air quality in neighboring Romania(please be refered to subsection 8), the following was concluded:

- Given the location of the Prahovo chemical industry complex, there is a potential transboundary impact on air quality. However, modeling results indicate that this impact is generally negligible for both current and future conditions.

7.2. Project induced Soil and Water emissions

The nearest watercourse is the River Danube. Basin – Danube; Water area - Danube. The Danube River is classified as 1. Interstate waters 1) natural watercourses. According to the

Regulation on the Categorization of Watercourses[104], the river section in question belongs to Class II for the Danube section: from the Hungarian border - to the Bulgarian border. The facilities in question are located in the area of water unit number 12, "Danube and Timok – Negotin", according to the Rulebook on the determination of water units and their boundaries, ("Official Gazette of the RS", no. 8/2018).

Groundwater levels change and directly depend on the height of the Danube, with a slight increase in levels near the river banks.

Planned Waste-to-Energy Comlex (Plant for incineration of non-recyclable waste and Landfill for non-hazardous waste) involves the generation of the following types of wastewater: sanitary water, fire (hydrant water), foul sewage, clean rain sewage from the roofs of facilities, oily rain sewage from roads and plateaus, process sewage, as well as leaching water from the landfill. The project envisages separate sewage with the collection of water from the complex separatly. All type of wastewater will be treated separatlly before their discharge into the collection conduit and then into the final recipient.

Type of wastewater envisaged from the subject project:

- **Atmospheric clean water** (rainwater sewerage for the collection of clean atmospheric water from the roofs of buildings and its drainage into the existing Central collector of the Elixir Prahovo industrial complex, which brings wastewater to the existing inlet structure and discharges it into the Danube River).
- **Atmospheric potentially oily wastewater** (rainwater sewerage for the collection of oily wastewater from roads, manipulative surfaces and parking lots takes water for treatment into the coalescent separator of grease and oil. After the separator, the purified water is connected to the clean rainwater sewage).
- **Sanitary – foul wastewater** (sewage system collects waste sanitary-foul wastewater and conducts it to the treatment plant (mechanical and biological treatment). Purified wastewater is connected to the drainage of conditionally clean rainwater sewerage and then discharged into the internal network of the Elixir Prahovo Industrial Complex).
- **Process wastewater from wastewater treatment plant of the boiler plant** – process sewage (T1); **General process wastewater** (water from the drain in W-C11, water from the drainage of the boiler, wastewater from fire extinguishing, leachate from the Landfill for non-hazardous waste, etc.); **Wastewater from washing of sand filters from the preparation of process water** – (T3); **Wastewater from washing of filters from the WWTP wastewater treatment plant** – (T4).

The project also envisages pumping leachate from the body of the Landfill for Non-hazardous Waste (solidificates) into the wastewater pool. Considering that these wastewaters may contain heavy metals from ash, alkaline oxides, organic matter, sulfates and chlorides, they will be purified in the aforementioned water treatment system to the quality for discharging into the existing Central Collector of the Elixir Prahovo industrial complex, which brings wastewater to the existing inlet structure and discharges it into the Danube River.

From the Waste-to-Energy plant complex, the total maximal amount of water that flows into the collector, is assessed to be:

[104] "Official Gazette of the RS" no. 5/1968, Available at Uredba o kategorizaciji vodotoka

- **233 l/s of conditionally clean (from the roofs of buildings) and oily atmospheric water** that is treated through two separators of oil derivatives NS10/100 ST1000 and NS15/150 ST1500 with BYPASS.
- **4 l/s of foul waste water** pre-purified through the BP ES 20 biological purifier.
- **5 l/s of cleaned technological water**.

Other wastewater generated at the Waste-to-Energy Plant complex

Washing of equipment in solidification - Wastewater generated by washing the process equipment used to solidify residues from the boiler plant (ash, slag, sludge) will be collected in the collection pit located in the W-C12 Stabilization and Solidification facility. The maximum amount of water from washing is about 2-3 m^3. Water from washing the equipment will be returned to the solidification process. In this way, the consumption of process water is saved, and the required humidity of the material is also achieved, as well as the prevention of dust emission when manipulating residues from the boiler plant.

No wastewater discharge is foreseen from the stabilization and solidification plant.

The ammonia water transfer point (W-C13) for liquid waste materials is provided with a grate that will be connected to the collection pit in which any leaked contents will be collected during transfer. In this way, the possibility of fluid leakage into the atmospheric sewer is avoided. The collected content will be pumped into an IBC container and taken to a temporary storage of liquid waste materials from where, together with other liquid waste, it will be sent for thermal treatment.

In addition to the transfer point (W-C13), it is also planned to **install the shower for** the purpose of rinsing hands and eyes in case of pouring on the operator when transfering liquid waste (in case of an accident). The water from the shower flows into the aforementioned manhole.

Within the facility W-C11 Waste Thermal Treatment Plant, an ammonia water storage tank is planned, which must be cooled in the summer months by spraying process water. The water from the cooling tank will be collected in the associated bundwall from where it is drained into the collection basin located in the immediate vicinity of the tank, and then reused for cooling purposes, thus achieving water recirculation. If there is a possible contamination of the cooling water with ammonia water, it will be pumped into the IBC container /tank and sent first to the liquid waste storage and then treated in the boiler plant together with other liquid waste.

Wastewater generated from washing dishes and equipment in the laboratory that will be collected and piped into a buried polypropylene tank (V=5 m^3), and then pumped into IBC containers and transported to liquid waste storage tanks by a forklift for unloading and then treated at the boiler plant in question.

The water from the washing of the wheels on trucks that deliver the waste material is drained into the collection shaft located within the bundled wheel washing unit. The wastewater is then pumped into a tank where solids are deposited by passing water through the overflow chamber. The purified water is then reused by the pump to wash the wheels and therefore no outflow of water into the recipient is foreseen.

Water reception tanks need to be periodically cleaned of precipitated substances, and the contents of the cleaning will be temporarily stored in the W-C08 facility until the treatment at the subject Waste-to-Energy Plant.

With the application of all envisaged measures for the protection and treatment of wastewater, the emissions into water from the plant will be in accordance with the highest standards of the European Union, the conclusions on the best available technologies and BREF documents from 201970 and are therefore lower than for the most of European plants built before 2019.

<u>Analysis of the impact of wastewater on water quality in the Danube River</u>

For the purpose of determining the impact of the discharge of wastewater from the Eco Energy complex into the collective collector of the Elixir Prahovo complex, and then into the Danube River, modelling of the effects of the emission of hazardous substances from the existing Elixir Prahovo complex and the Waste-to-Energy Plant on the possible pollution of the Danube was performed in EIS.

Analysis of the impact of wastewater on water quality in the Danube River. For the purpose of determining the impact of the discharge of wastewater from the Eco Energy complex into the collective collector of the Elixir Prahovo complex, and then into the Danube River, modelling of the effects of the emission of hazardous substances from the existing Elixir Prahovo complex and the Waste-to-Energy Plant on the possible pollution of the Danube was performed.

The examination of the wastewater impact on the Danube was considered through the analysis of the cumulative contribution of wastewater discharged from the existing Elixir Prahovo complex and wastewater that will be discharged from the future Waste-to-Energy plant (technological wastewater from the boiler plant wastewater treatment plant and atmospheric wastewater).

Details of methodology, input data for the calculation, and ELV emissions which are prescribed by RS regilations and the best aveilable techniques (BAT) are given in EIS.

By comparing the results of the Danube River pollution modeling due to the discharge of collective waste water from the Elixir Prahovo complex and the future Eco Energy complex, it can be observed that no parameters exceed the concentration limit values of the tested parameters. Also, it should be borne in mind that based on the results of the "zero state" of the Danube River water quality, it can be stated that in the tested water in its current state there is no load of any of the project characteristic polluting substances (As, Cd, Sb, Tl, Pb, Cr, Cu, Hg, Ni, Zn, PCDD/F).

Bearing in mind, as well as the fact that all pollutants in wastewater from WtE will be below the ELV prescribed by the conclusions on the best available technologies and BREF documents from 2019. (Commission implementing decision (EU) 2019/2010 of 12 Nov. 2019 establishing the best available techniques (BATC) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration)[105], it can be stated that after putting the plant in question into operation, there will be no cumulatively higher values of the concentration of polluting substances in the collective wastewater discharged into the Danube River. Flow modeling additionally shows that concentrations already 100 m downstream from

[105] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)

the wastewater outlet are negligible. At 100 m from the outlet is the relatively highest load (in relation to the limit value) of COD, which is 22 times less than defined by the Regulation on limit values of polluting substances in surface and underground waters and sediment and deadlines for reaching them. On the other hand, among the parameters not regulated by the Regulation, the highest relative load (in relation to the limit value) is Ti, which is 1667 times less than the concentration prescribed by the conclusions on the best available technologies and BREF documents from 2019.

Since the initial concentrations of pollutants in the wastewater originating from the WtE plant were taken based on the projected maximum allowable values, in this Study, as part of the planning of all emission streams monitoring, the monitoring of the wastewater quality from both the Eco Energy complex and monitoring the quality of the Danube River even after the realization of the project in the phase of operational functioning of the future complex are defined.

Modelling the effects of the emission of hazardous substances into the air from the Waste-to- Energy (WtE) plant on the pollution of the river course of the Danube

Concentrations of emission discharges of pollutants in the regular operation of the Waste-to-Energy Plant must be within the limits of the projected values, in accordance with the proven waste treatment technology.

Modeling of the effects of uncontrolled discharge of hazardous substances into the surrounding environment was performed and given in the EIS, from the aspect of the spread of endangered zones, both in the operator's area and in the nearby and distant surroundings.

The calculated emission values of these pollutants included in the turbulent diffusion equations, with the aim of calculating the "wet" (precipitation) fractions of the disperse stream (similar to the effect of "acid rain") give low values, so that they have no impact on the pollution of the Danube flow even under the most unfavourable weather conditions.

Additionally, it is important to emphasize that the soil in the surrounding area will not be affected by the operations of the Waste-to-Energy (WtE) plant. The infrastructure of the plant, including wastewater collection and management systems, is designed to ensure complete containment. The use of high-density polyethylene (HDPE) liners and concrete barriers provides an effective impermeable layer that prevents any leakage or seepage into the soil.

Potential impact of Landfill for non-hazardous waste on water an soil

In accordance with the results of geotechnical tests of the subject area, which are presented in the Geotechnical Study for the purpose of forming a Landfill for non-hazardous waste in the ICP Elixir complex in Prahovo[106], where it was determined that the groundwater level is 7-10 m below the level of the landfill area, the space, i.e. the bottom of the landfill body will be formed in such a way that the subject area is first well rolled by multiple passage of rollers and compactors, which will provide sufficient compaction that mimics the mineral barrier. A geomembrane made of high-density polyethylene (HDPE), with a thickness of not less than 1.5 mm, will be placed on the rolled surface, on which a protective layer of geotextile, with a minimum mass of 200 g/m^2, will be placed. Above the geotextile protective layer, a drainage

[106] "GT Soil inženjering d.o.o.", January 2023

and relief layer of gravel with a minimum thickness of 50 cm will be laid, and corrugated perforated drainage pipes will be laid on the gravel.

It is planned to establish on the landfill a completely closed system of water circulation from the landfill. Two separate water collection systems are envisaged: Leachate collection system by which water is transported to the wastewater pool provided in the space of the Waste-to-Energy plant and Atmospheric runoff collection system for collecting wastewater from the landfill slopes and usage for water spraying on the landfill slopes, thus achieving water recirculation.

Stabilized and solidified waste is disposed of at the landfill, which, according to its characteristics, must meet the requirements regarding the leaching of harmful substances. Leaching tests of stabilized and solidified waste prove. The applied system of protective layers, including the HDPE geomembrane and compacted base, ensures that there is no direct contact between potential contaminants and the underlying soil. These materials provide a continuous and impermeable barrier, effectively isolating the landfill contents from the natural ground. This setup prevents any risk of leachate infiltration, guaranteeing the preservation of soil quality throughout the landfill's operational lifespan.

It is not expected that the operation of the landfill will affect the quality of water and soil.

7.2.1. Existing situation of water and soil

Bearing in mind that the construction of the Eco Energy complex is planned in the immediate vicinity of the existing Elixir Prahovo complex, for the purpose of presenting the zero state of the site in question, the results of regular monitoring of soil quality performed by Elixir Prahovo were used.

From the reports following can be concluded:

- The work of the industry on the ICP Prahovo complex until privatisation in 2012 resulted in the occurrence of "historical pollution", with negative consequences for the environment;
- As a result of major construction-technical and technological interventions at the chemical industry complex in Prahovo after the privatisation in 2012, including the rehabilitation of sites where hazardous waste was inadequately disposed of, but also due to the process of migration of pollutants over time, along with physical-chemical and biological processes in soil and groundwater, today only point source pollution, uneven in terms of origin and type, is registered in the part of the site intended for expanding the activities of the company;
- The evaluation of the results of the examinations performed in the previous period and targeted for the purpose of expanding the activities at the complex enabled the basic processes in environmental factors of importance for the assessment of the condition of the environment in the area covered by the planned expansion and beyond and the need for possible interventions to be considered;
- The implementation of general environmental protection and improvement measures should limit any new emissions of pollutants that may cumulate with existing sources and thus adversely affect the condition of the environment;

- Qualification of identified sources of pollution and migration of pollutants using the ICSM model has shown that potential sources of pollution on land where waste pesticides and mineral oils were disposed of until privatisation and on land next to phosphogypsum storage, belong to the category for which it is necessary to plan special environmental protection and improvement measures, which include the limitation of certain activities, with appropriate exposure monitoring;
- Exposure monitoring should provide relevant data in order to take preventive and/or if necessary remedial protection measures.

In order to determine the zero state, in addition to the report of the Authors' Bureau "Analysis of the Environmental Factors", a physical and chemical analysis of soil samples was conducted in December 2023 by the Institute for Prevention, Occupational Health and Safety, Fire Protection and Development LTD. Novi Sad, Branch "27. January" Niš.

Table 36. Soil sampling sites

Measuring point	Sample #	Sampling point	Coordinates	
			N	E
S1	0092	North of the phosphogypsum storage at a distance of about 200 m	44º17'6.1''	22º36'53.3''
S2	0093	Southeast of phosphogypsum storage at a distance of about 250 m	44º16'40.8''	22º36'57.1''
S3	0094	South of phosphogypsum storage at a distance of about 500 m	44º16'43.9''	22º36'41.9''
S4	0095	West of the phosphogypsum storage at a distance of about 800 m	44º17'9.4''	22º35'54.5''
S5	0096	Northeast of phosphogypsum storage at a distance of about 400 m	44º17'1.9''	22º37'12.9''

Figure 18. Soil sampling locations

By analysing the results of the soil sample research, it can be concluded that the results comply with the corrected limit and delimitation values prescribed by the Regulation on Limit Values of Pollutants, Harmful and Hazardous Substances in Soil ("Official Gazette of the RS", nos. 30/2018 and 64/2019), except for the following, which are exiding the corrected limit values (CLV) but are below the corrected remedial values (CRV):

- *in the sample 0092 content:*
  - *cadmium 2.36 mg/kg, CLV: 0.53 mg/kg; CRV: 8.02 mg/kg*
  - *copper 107.97 mg/kg, CLV: 24.0 mg/kg; CRV: 126.67 mg/kg*
  - *nickel 33.84 mg/kg, CLV: 23.6 mg/kg; CRV: 141.6 mg/kg*
  - *zinc 230.40 mg/kg, CLV: 92.9 mg/kg; CRV: 477.77 mg/kg*
- *in the sample 0093 content:*
  - *copper 27.31 mg/kg, CLV: 24.0 mg/kg; CRV: 126.67 mg/kg*
  - *nickel 34.4 mg/kg, CLV: 23.6 mg/kg; CRV: 141.6 mg/kg*
  - *cobalt 7.52 mg/kg, CLV: 5.81 mg/kg; CRV: 154.88 mg/kg*
- *in the sample 0094 content:*

  - *nickel 30.46 mg/kg, CLV: 23.6 mg/kg; CRV: 141.6 mg/kg*
  - *cobalt 12.08 mg/kg, CLV: 5.81 mg/kg; CRV: 154.88 mg/kg*
- *in the sample 0095 content:*
  - *nickel 34.39 mg/kg, CLV: 23.6 mg/kg; CRV: 141.6 mg/kg*
  - *cobalt 8.19 mg/kg, CLV: 5.81 mg/kg; CRV: 154.88 mg/kg*
- *in the sample 0096, the content of:*
  - *copper 28.53 mg/kg, CLV: 24.0 mg/kg; CRV: 126.67 mg/kg*
  - *nickel 37.08 mg/kg, CLV: 23.6 mg/kg; CRV: 141.6 mg/kg*
  - *zinc 8.61 mg/kg, CLV: 92.9 mg/kg; CRV: 477.77 mg/kg*

Groundwater

In order to examine the state of groundwater during engineering-geological mapping of the area envisaged for the construction of the Eco Energy complex, 3 exploration wells (PBs-4, PBi-14 and PBi-15) were constructed in which piezometric structures were installed. Piezometers have the role of continuous monitoring of groundwater levels (GWL), as well as for the purpose of sampling and analyzing groundwater chemism in order to detect changes from the initial "zero state" before the start of the project. Sampling and physical and chemical testing of groundwater quality was carried out in June 2022 by the Institute for Prevention, Occupational Safety, Fire Protection and Development Ltd. Novi Sad, Branch "27. January" Niš (the reports of physical and chemical analyses are attached). The location of the piezometers for determining the zero state is given in Table 37. and Figure 19.

Table 37. Groundwater Sampling Sites

Sample #	Sampling point	Coordinates	
		N	E
0570	PBs-4	46°16'59''	22°37'22''
0571	PBi-14	44°17'07''	22°37'02''
0572	PBi-15	44°17'02''	22°36'54''

Figure 19. Groundwater Sampling Locations

The results of groundwater examinations from piezometers PBs-4, PBi-14 and PBi-15 show that all values of the tested parameters are in accordance with the average annual concentrations, prescribed by the Regulation on Limit Values of Pollutants in Surface and Groundwater and Sediment and Deadlines for Reaching Them[107] and remediation values prescribed by the Regulation on Limit Values of Pollutants, Harmful and Hazardous Substances in Soil[108].

Sampling and physical and chemical testing of groundwater quality from 8 piezometers was carried out in April 2024 by the Institute for Prevention, Occupational Safety, Fire Protection and Development DOO Novi Sad, Branch "27. January" Niš (the reports of physical and chemical analyses are attached). The sampling point is shown in Table 38. and in Figures 20. and 21.

[107] "Official Gazette of the RS", no. 50/2012, Appendix 2, Table 1, Available at Uredba o graničnim vrednostima zagađujućih materija u površinskim i podzemnim vodama (paragraf.rs)

[108] "Official Gazette of the RS" nos. 30/2018 and 64/2019, Appendix 2, Available at Uredba o graničnim vrednostima zagađujućih materija u zemljištu (paragraf.rs)

Table 38. Groundwater Sampling Sites

Sample #	Sampling point	Coordinates	
		N	E
0572	Piezometer X-1, location in the vicinity of the new phosphogypsum storage	44º17'05.4"	22º36'52.7"
0570	Piezometer X-2, location in the vicinity of the new phosphogypsum storage	44º17'1.97"	22º37'13.05"
0569	Piezometer X-3, location in the vicinity of the old phosphogypsum landfill	44º17'11.68"	22°38'50.0"
0573	Piezometer X-4, location in the vicinity of the new phosphogypsum storage	44º16'41.9"	22º36'42.9"
0568	Piezometer X-5, location in the vicinity of the old phosphogypsum landfill	44º17'3.68"	22º38'8.2"
0566	Groundwater from the PA-1 piezometer	44º17'09.31"	22°36'38.98"
0567	Groundwater from the PM-1 piezometer	44º17'10.03"	22º36'26.93"
0571	Groundwater from piezometer P-2, location in vicinity of sulphuric acid storage	44º17'19.34"	22º36'32.63"

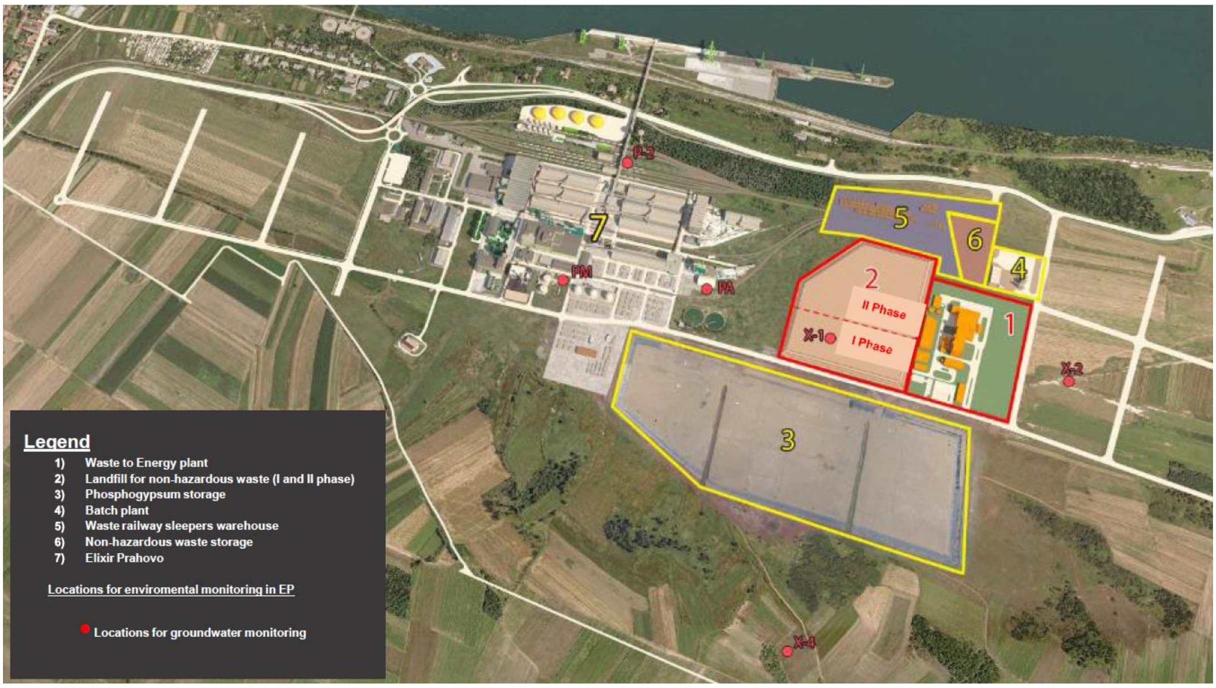


Figure 20. Groundwater Sampling Locations

Figure 21. Groundwater Sampling Locations

The results of groundwater examinations show that all values of the tested parameters are in accordance with the average annual concentrations, prescribed by the Regulation on Limit Values of Pollutants in Surface and Groundwater and Sediment and Deadlines for Reaching Them[109] and remediation values prescribed by the Regulation on Limit Values of Pollutants, Harmful and Hazardous Substances in Soil[110].
In order to provide a comprehensive insight into the water and sediment quality of the Danube River, data from the sediment and water monitoring report have been included below.

Surface and wastewater

Surface water quality can be expressed by classifying a given watercourse into one of the water quality classes. We distinguish four classes of surface water and out-of-class state:

The most important watercourse in the analysed area is the Danube River. The area in question belongs to the Danube River Basin, the Danube River Basin Area, according to Article 27 of the Law on Waters[111] and the Decision on Determining the Boundaries of Water Areas[112] ("Official Gazette of the RS", no. 92/17). According to the Decision on Determining the List of Waters of the First Order[113], the Danube River is classified under 1. Interstate waters 1, natural watercourses. According to the applicable regulations, the Danube near Prahovo is classified

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[109] "Official Gazette of the RS", no. 50/2012, Appendix 2, Table 1, Available at Uredba o graničnim vrednostima zagađujućih materija u površinskim i podzemnim vodama (paragraf.rs)
[110] "Official Gazette of the RS" nos. 30/2018 and 64/2019, Appendix 2, Available at Uredba o graničnim vrednostima zagađujućih materija u zemljištu (paragraf.rs)
[111] ''Official Gazete of the RS'', nos. 30/2010, 93/2012, 101/2016, 95/2018 and other law, Available at Zakon o vodama (paragraf.rs)
[112] "Official Gazette of the RS", no. 92/17
[113] "Official Gazette of the RS", no. 83/10

as a category II watercourse (from the Hungarian border to the Bulgarian border), which means that the water should meet the provisions of the class II of river waters.
Danube is an international river, the Convention on Cooperation on the Protection and Sustainable Use of the Danube River was signed, which entered into force in October 1998. Serbia became a contracting party by adopting the Law on Ratification of the Convention on Cooperation for the Protection and Sustainable Use of the Danube River[114].The Convention aims to ensure that surface and groundwater in the Danube River Basin is managed and used in a sustainable and equitable manner, including:

- conservation, improvement and rational use of surface and groundwater;
- preventive measures to control hazards arising from accidents involving floods, ice or hazardous substances;
- measures to reduce the burdenof pollution entering the Black Sea from sources in the Danube River Basin.

In order to prevent, control and reduce cross-border impact, and based on the Convention, multilateral cooperation has been achieved in developing, adopting and implementing appropriate legal, administrative and technical measures and ensuring national prerequisites and the necessary basis for ensuring effective protection of water quality and sustainable development.
Data on surface water quality for the territory of the Republic of Serbia, including the quality of the Danube River, are maintained by the Environmental Protection Agency and are publicly available through the website www.sepa.gov.rs. Currently, the website contains the data "Results of Surface and Groundwater Quality Testing for 2022", which also provides an assessment of the state of surface water quality. For the control of surface water quality in the area of Prahovo for the Danube River, the relevant measuring stations are shown in the table 39.

Table 39. Basic data of surface water quality monitoring stations for the Prahovo area

Station name	Station ID	Watercourse	Name of water body	Water body ID	Type of water body
Brza Palanka	42090	The Danube	Djerdap 1 accumulation	D2	Type 1
Radujevac	42095	The Danube	Danube downstream from HPP Djerdap 2 to the mouth of Timok	D1	Type 1

In 2024, in order to determine the zero state of waste water quality and surface water quality of the Danube River for the needs of construction of the Eco Energy complex, the Institute for Prevention, Occupational Safety, Fire Protection and Development LLC Novi Sad, Branch "27. January" Niš carried out sampling and physico-chemical testing of the quality of waste and surface water at four measuring points, as shown in Table 40. and Figure 22.

[114] "Official Gazette of the SRY - International Treaties", No. 2/2003

Table 40. Wastewater and surface water sampling points

Measuring point	Wastewater	Sampling point	Coordinates	
			N	E
OV1	Wastewater before treatment system	Sampling point manhole at inlet of neutralization pit	44°17'06.89"	22°36'35.39"
OV2	Wastewater after treatment system	Sampling point manhole located in an auxiliary facility at the outlet of waste water from the plant	44°17'07.78"	22°36'37.93"
PV1	Danube River 150 m upstream of the inlet of collective wastewater	The sampling point is located on the bank of the Danube River, 150 m upstream of the wastewater outflow	44°17'27.50"	22°36'58.08"
PV2	Danube River 100 m downstream of the inlet of collecting wastewater	The sampling point is located on the bank of the Danube River, 100 m upstream of the wastewater outflow	44°17'21.08"	22°37'25.39"

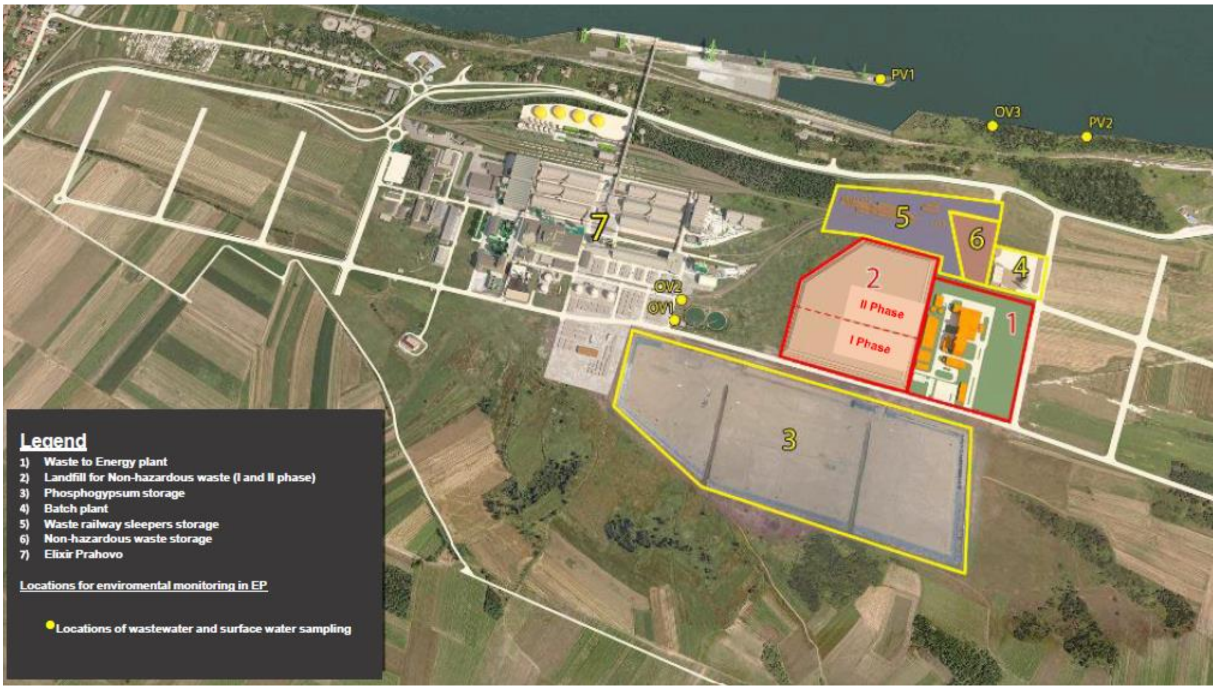

Figure 22. Wastewater and surface water sampling locations

The results of the examination of wastewater after the cleaning system from the Elixir Prahovo complex show that for all four quarters the concentrations of the tested parameters comply with the emission limit values prescribed by the Regulation on Limit Values of Emissions of Pollutants into Water and the Deadlines for Their Reaching[115]. Limit values for emissions of wastewater containing mineral oils and with emission limit values prescribed by the Commission implementing decision EU 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliaments and the Council for waste incineration (notified under documents C(2019)7987)[116].

[115] "Official Gazette of the RS", no. 67/2011, 48/2012 and 1/2016, Appendix 2, Other wastewater, 4, Available at Uredba o graničnim vrednostima emisije zagađujućih materija u vode (paragraf.rs)
[116] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)

The results of the examination of surface water from the Danube River upstream of the wastewater discharge show that the concentrations of the tested parameters comply with the limit values prescribed by the Regulation on Limit Values of Pollutants in Surface and Groundwater and Sediment and the Deadlines for Their Reaching ("Official Gazette of the RS", no. 50/2012, Appendix 1, Table 1 and 3)[117] and the Regulation on limit values of priority substances and priority hazardous substances polluting surface waters and the deadlines for their reaching[118]

The results of the examination of surface water from the Danube River upstream of the wastewater discharge show that the concentrations of the tested parameters comply with the limit values prescribed by the Regulation on Limit Values of Pollutants in Surface and Groundwater and Sediment and the Deadlines for Their Reaching ("Official Gazette of the RS", no. 50/2012, Appendix 1, Table 1 and 3) and the Regulation on limit values of priority substances and priority hazardous substances polluting surface waters and the deadlines for their reaching ("Official Gazette of the RS", no. 24/2014, Appendix, Table 1).

Review of the general state of the Danube River in target area

The Danube River in Serbia according to national classification (RSDW, 2023) belongs to Type 1 – Large Lowland Rivers with domination of fine bottom substrate. Target stretch belongs to water body (RS)D001 – Danube between Iron Gate II Dam and the Timok confluence.

Based on the data reported in the National River Basin Management Plan for period up to 2027 (RSDW, 2023), chemical status of target stretch has been assessed as good. Same situation has been identified for upstream stretch, for water bodies (RS)D002 and (RS)D003 (stretch from the confluence of the Neta River to Iron Gate II Dam). In contrary, all water bodies upstream the Nera River have been assessed as bad in respect to chemical status, except water body D008 (from Bačka Palanka/state border with Croatia to confluence of channel system Novi Sad-Savino selo) which is in good chemical status. Particular situation indicate that Iron Gate reservoirs serve as a sink for pollution from all upstream sources, contributing to better chemical status in the most downstream stretch of the Danube in Serbia.

Ecological status of water body (RS)D001 which is the target stretch of the project of concern is assessed as poor, as a consequence of presence of different stress factors (RSDW, 2023).

It could be generally concluded that the stretch of the Danube River which is under potential direct influence of the facility in question is under the influence of multiple stressors (Liška et al., 2021, 2015; Sommerwerk et al., 2022), which is the case with almost all big European rivers (Navarro-Ortega et al., 2015). Target stretch is under the influence of urban waste waters, pollution from agriculture, industrial pollution from different facilities situated in upstream stretch. Hydromorphological degradation is one of the most important stressors identified for the whole sector of the Danube in Serbia, which is particularly emphasized for Iron Gate Danube (RSDW, 2023).

[117] "Official Gazette of the RS", no. 50/2012, Appendix 2, Table 1, Available at Uredba o graničnim vrednostima zagađujućih materija u površinskim i podzemnim vodama (paragraf.rs)
[118] "Official Gazette of the RS", no. 24/2014, Appendix, Table 1, Available at Uredba o graničnim vrednostima prioritetnih i prioritetnih hazardnih supstanci (paragraf.rs)

Sediment and water monitoring, as well as monitoring of chemicals in biota according to Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC[119] as regards priority substances in the field of water policy, is a part of national water status monitoring in Serbia and data is already available for the stretch of the Danube River in Serbia, including those river segments shared with Romania and Croatia. It should be underlined that the full compliance with the WFD requirements and the parameters used for the chemical status assessment requires further upgrade (European Commission, 2022).

In context of above mentioned, as well as having in mind expected emissions of technological process in water, in respect of assessment of the state of the target Danube stretch, it is necessary to take into the consideration the comprehensive approach that involves monitoring of sediment and water quality, monitoring in biota, monitoring of biological quality elements, as well as ecotoxicological assessment. Thus, beside approach traditionally used, that link chemical (measurement of contamination) and community (measurements of community responses) data (Chapman, 1990), bioassay (assessment of toxicity) should be considered.

Measures of toxicity (bioassays and biomarkers), have been identified as the useful early warning tools enabling a better understanding of cause–effect relationships and providing a more comprehensive evaluation of ecosystem and community health[120]. Thus, the consideration of toxicity assessment should be complemented to data on sediment quantity, sediment quality, target chemicals in water and biota, as well as biotic community parameters. Thus, it is generally recommended to perform analyses of the selected parameters in each sampling matrix (sediment, water and biota), performing of eco/geno-toxicological tests (OECD TG 236; OECD Test Guideline 218/219; ASTM E1706 standard) in different matrixes – water, sediment and suspended solids.

Recently, two international Danube surveys provided results of toxicological situation of the more than 2,500 kilometres of the Danube River, including stretch that is of interest in respect to facility in question[121]. The results confirmed that using of battery of tests could improve our knowledge and assess potential risk to ecosystems using NORMAN network approaches[122] .

Out of Nineteen priority substances regulated by the EU WFD cypermethrin and cybutryne were found to be specifically relevant for the Danube River[123]. Same survey indicated that one pharmaceutical, four pesticides and one metabolite are relevant for the Danube River, as well as diclofenac, the natural hormone 17-beta-estradiol and the insecticide imidacloprid.

In respect to pollutants to be measured in biota, mercury and BDE were found to be of specific interests for monitoring along considerable stretch of the Danube[124].Both compounds are considered as ubiquitous persistent, bioaccumulative and toxic substances (uPBTs).

In addition, very low concentrations of 1,4-dioxane and 14 flame retardant substances were found to be present in waters, thus posing no risk to the Danube River Basin.

[119] Directive 2013/39 EU (EUR-Lex)
[120] European Commission, 2010; Martinez-Haro et al., 2022, 2015; Schuijt et al., 2021
[121] Liška et al., 2021, 2015
[122] Dulio et al., 2018
[123] Liška et al., 2021, 2015
[124] Liška et al., 2021, 2015

Fifth Joint Danube Survey is under preparation, and it is expected to be realized in July-August 2025. The survey will cover the ecogenotoxicological analyses of the Danube River at selected sites that will be provided by joint effort of several European laboratories.

The data mentioned above should serve to address effects of mixture toxicity (combined adverse effect of multiple contaminants) on confident level. The data will be considered as zero state of Danube on the project area of interes.

7.3. Noise

One of the important indicators of quality of the environment is noise. In May 2024, the noise level in the open space was measured during the operation of the production facilities of ICP Elixir Prahovo, by the Institute for Prevention, Occupational Safety, Fire Protection and Development ltd, Novi Sad, Branch 27 January Niš. The report on the performed test – measurement of noise in the environment is given in the EIS.

The results of the measurements show that the relevant noise level at the measuring points DO NOT EXCEED the noise limit values for the day, evening and night terms, i.e. the test results comply with the requirements of the relevant Regulation during the regular operation of the ICP Elixir Prahovo complex.

Noise can be one of the significant factors endangering the environment and human health. Excessive noise, when it comes to harmful effects on humans, is any noise whose sound pressure level exceeds 90 dB(A).

The negative impact of noise on human health depends on the intensity of the noise, the duration of noise exposure, the character of the noise and individual sensitivity to noise.

During the exploitation of the complex in subject, noise is expected from traffic on the complex (freight vehicles that deliver waste and passenger cars with which employees and visitors come), as well as due to the operation of process equipment (pumps, shredders, cranes, mixer, fans, etc.). The expected noise level from equipments is given in the EIS. Noise protection must comply with the equipment manufacturer's instructions. Most of the equipment that emits higher- intensity noise will be located in closed facilities. The envisaged distance between the equipment is sufficient so that the noise level does not increase. Facilities that are not part of an indivisible technological whole are separated, in order to minimize noise levels. The plant itself is not near other noise emitters.

Noise due to the performance of transportation activities on the complex is of a temporary nature. The transportation vehicles (trucks and tank trucks, etc.) that will be engaged represent a source of noise that reaches from 80 dB(A) to 90 dB(A), depending on the type of machine, degree of load, technical condition and method of handling. The noise level decreases with the square of distance, the soil and the vegetation both absorb and reflect the sound waves, so an increased noise level should not be expected at a distance of more than 50 m from the worksite.

Since the facilities in question are located in an industrial zone, noise will not have a significant impact on the environment. If the noise level prescribed for this zone is exceeded, measures will be taken to reduce it.

7.4. Waste generation

Regular operation of the subject fluidized bed boiler plant may result in the following solid (unburned) residues:

- Slag – bottom ash (coarse fraction of unburned material separated at the bottom under the firebox);
- Boiler ash (separated between the second and third passages of flue gases through the boiler);
- Cyclone ash (fraction of fly ash from the boiler that is separated from the emitted gases when passing through two cyclone separators, T>400˚C);
- Ash from the economizer (fine fraction of fly ash separated by the passage of flue gases through the economizer, T>150˚C);
- Filter ash (fine fraction of fly ash separated by the passage of flue gases through the bag filter system; so-called fly ash);
- Activated carbon with a fraction of fine particles from the flue gas;
- Sludge/thickened sediment from the treatment of wastewater from the wet flue gas cleaning system (which is separated in the form of thickened sediment by centrifugation).

In order to dispose of them in accordance with the governing law and related by-laws, the project in question envisages that all streams are collected in a controlled manner by a designed system of boiler conveyors that take solid residues to the stabilization and solidification plant (W-C12) for treatment, after which the obtained solidificate will be disposed of at the subject Landfill for non-hazardous waste designed exclusively for these purposes. A detailed description of the residue treatment process from the boiler plant is described in EIS.

The mean expected amount of solidificate production is 1.08 m3/h of production, while the maximum simultaneous logistic load is 3.08 m3/h of solidificate production. Taking into account the annual working hours of 8300 h/year, the average annual production of the storage solidificate is 8964 m3/year, i.e. a maximum of 25564 m3/year.

The Landfill for non-hazardous waste is designed for the disposal of solidificate resulting from the treatment of solid residues from waste thermal treatment plants generated as a product of the waste-to- energy process.

The preliminary design plans to divide the landfill into a total of 2 and 3 phases, since the initial phase I is divided into 2 (sub)phases:

1. PHASE I-A – net area at the base 1.82 ha
2. PHASE I-B – net area at the base 1.84 ha, and
3. PHASE II – additional 2.76 ha at the base.

A detailed description of the operation technology of the landfill is described in EIS. In table 41 is given volume of acumulation space by phases.

Table 41. *Basis area and volume of accumulation space by phases*

	I-A PHASE	I-B phase	Phase II	Total
A_os (ha)	1.82	1.84	2.76	6.42
V (m^3)	182,000	279,000	681,000	1,142,000
Z_max (masl)	70.00	73.00	94.00	-
h [m]	21.00	24.00	45.00	-
T_expected (yr)	20.1.	30.8	75.2	126.1
T_min (yr)	7.1.	10.9	26.6	44.6

The planned total height of the landfill is 46 m, relatively to the level of 48.00 masl (to the level of 94.00 masl), in order to align it with the height of the phosphogypsum storage, which is located in the immediate vicinity and enable smooth movement of machinery on the last floor.

In addition to the solidificate that would be disposed of at the landfill, the following waste may also be generated:

Secondary raw materials

Magnetic separation of waste intended for thermal treatment and coarse ash separates admixtures of metal that is directed to recycling as a secondary raw material, which will be temporarily stored on a concrete plateau until it is handed over to authorized operators for further disposal (recycling). Waste stretch film, metal frames/grids that are removed from IBC containers/barrels/jumbo bags and damaged wooden pallets before treatment, represent non-hazardous waste (secondary raw materials) and will be temporarily stored in designated containers (metal containers, etc.) on a concrete plateau until they are handed over to authorized operators for recycling.

The temporary storage of non-hazardous waste (separated secondary raw materials) provided in the open air is provided with a waterproof base from which all atmospheric water is collected and taken to the grease and oil separator.

Liquid waste generated by cleaning oil and grease separators and wastewater tanks

Cleaning of the contents of the petroleum product separator and wastewater basin will be performed regularly. After cleaning, the contents from the separator and the pool will be transferred to the appropriate tank and then treated in the subject waste-to-energy plant.

Commercial waste - will occur in very small amounts, due to daily work activities in the office (paper, cardboard, staples, clamps, wood in the form of disused chairs, tables, shelves, electrical and electronic equipment (telephones, computers, fax machines, printers) and other office supplies). For more efficient management of commercial waste, sorting will be carried out at the place of origin to paper and cardboard, PET, metal, wood that can be used as secondary raw materials and as such will be handed over to authorized operators for further treatment, and special waste streams will be disposed of in accordance with legal regulations.

Municipal waste - is waste generated due to the stay of employees at the complex as well as due to the temporary stay of truck drivers by whom waste material is delivered. It is estimated that on average 1 kg of municipal waste per employee will be generated. All municipal waste will be separately collected, recyclable fractions will be separated from municipal waste and handed over to authorized operators for recycling, while all non-recyclable fractions from municipal waste will be treated at the boiler subject plant.

7.5. Impact on intensities of vibration, heat and radiation

The equipment to be used will be placed on the appropriate substrate, which is why it is not expected to create vibrations, nor the impact of them on the environment. If new equipment is procured in the future, it will be taken into account that measures have been applied to prevent or reduce vibration.

If the characteristics of the project are taken into account, no increased level of heat or radiation emissions is expected during the exploitation of the Eco Energy complex, and there will be no impact of heat on the environment. At the location in question, devices that emit or produce ionizing radiation and non-ionizing radiation will not be used.

7.6. Accidental situations

A chemical accident is defined as a sudden and uncontrolled event resulting from the release, spillage, or dispersion of hazardous substances during activities such as production, use, processing, storage, disposal, or prolonged improper storage. In the event of an accident at the industrial complex, depending on the type of production process, chemicals used, and the type of emitted pollutants, certain risks to human life, health, and the environment may arise.

Significant negative impacts on the environment, as well as human life and health, can occur during accident scenarios such as fires, spills, or releases of hazardous substances. All accident scenarios will be minimized through prescribed accident prevention measures, proper risk management, and measures aimed at limiting the impacts of such accidents on human life, health, and the environment.

In the following text, accident scenarios are thoroughly examined through four key categories:

- Sources of hazards
- Possible consequences
- Preventive measures
- Remedial measures

7.6.1. Hazard Analysis of Acidents

The identification of potential hazard sources involves recording all critical activities, processes, and points in the facilities and equipment, particularly the risks of accidents within installations, between individual installations and structures, storage facilities, and the plant as a whole. This also includes risks of accidents during production activities, on-site transportation, and other processes.

The primary objectives of hazard identification and risk assessment were as follows:

- Determining causes that could lead to major accidents at the complex.
- Analyzing scenarios for the development of such accidents.
- Assessing consequences, likelihood, and risks for each scenario.
- Proposing measures, where necessary, to reduce risk.

To carry out the identification and risk assessment, a multidisciplinary expert team examined all procedures of the technological process and all parts of the facility, devices, transport equipment, and tools. Critical points in the plant, devices, and equipment were defined through an analysis of causes that may lead to disturbances, failures, or chemical accidents, including:

- Technical and technological specifics and deficiencies in transportation, storage, and production processes.
- Physical-chemical properties of stored materials, such as non-recyclable hazardous and non-hazardous waste, ammonia water, natural gas, activated carbon, etc.
- Component and material failures due to equipment deterioration (breakage, leaks) and human error during operations in the plant, storage areas, and handling of hazardous materials.
- Presence of external hazard sources (extreme temperatures, wind, precipitation, floods, fire).
- Analysis of accidents at similar facilities.

Hazard sources include all potential causes that may lead to accident situations. In industrial facilities, the most common hazard sources are summarized in Table 42.

Table 42: Sources of Hazards

Sources of Hazard	Description
Leakage of hazardous materials	Damage to tanks, barrels, or transfer systems. This can occur due to corrosion, poor maintenance, or human error.
Explosions	Chemical reactions of flammable substances, leakage of flammable gases, or inadequate ventilation in enclosed spaces.
Fires	Self-igniting materials, electrical equipment failures, or friction due to mechanical issues. Fires may also be caused by human error or external fire sources.
Equipment failures	Deterioration, faulty valves, system overload, or poor maintenance leading to breakage, leaks, or uncontrolled material release.
Human errors	Improper handling of chemicals or mistakes during transportation and storage processes.
External factors	Extreme weather conditions such as high temperatures, strong winds, heavy rainfall, or floods. Includes external fires that may spread to the complex.
Physical-chemical properties of materials	Hazardous properties of materials such as flammability, corrosiveness, toxicity, or explosiveness. Examples include ammonia water, natural gas, activated carbon, and non-recyclable hazardous waste.

Technical and Technological Specificities and Deficiencies in Transport, Storage, and Production Processes

The proposed project for the Waste-to-Energy Plant includes various technical and technological activities related to waste management, covering reception and temporary storage, transfer of liquid waste, mechanical and thermal treatment of non-recyclable hazardous and non-hazardous waste, physico-chemical treatment of residues from the boiler plant, and a range of other technical and operational activities necessary for the proper functioning of the facility. These include reception and storage of raw and auxiliary materials, water preparation, treatment of wastewater and waste gases, fluid distribution, transport and handling activities, fire protection, laboratory testing, and administrative activities.

The total capacity of the Waste-to-Energy Plant is designed for the thermal treatment of 100,000 tons/year of non-recyclable hazardous and non-hazardous waste, operating for 8,000 hours annually. The boiler capacity is 30 MW, with steam production of 35 t/h (P=13 barg, T=207°C).

The non-hazardous waste landfill is designed for the purpose of disposing of previously stabilized and solidified residues from the waste thermal treatment plant, which are generated as a product of the waste-to-energy process.

The characteristics of the solidificate disposed of in the non-hazardous waste landfill stem from the stabilization and solidification processes of the residues generated within the Waste-to-Energy Plant. These processes ensure compliance with the criteria defined by the Regulation on waste categories, testing, and classification[125], as well as with the Regulation on waste disposal in landfills[126] and the EU Directive on landfills[127].

To achieve these standards, the first step in the treatment of the residues involves the magnetic separation and eddy current separation of coarse ash (bottom ash), removing metal components, especially aluminum. The second step is the stabilization process, which prevents uncontrolled reactions, followed by solidification, ensuring the hardening of the material. These treatments aim to produce a material with high mechanical strength, low permeability, and encapsulation of pollutants, resulting in a reduced leaching rate of contaminants.

Coarse ash, recognized as an excellent material for binding other solid residues, contributes to the stability of the final solidificate due to its specific surface area. The stabilization process lasts from 7 to 14 days, during which hydrogen release, chromium (Cr(VI)) reduction, and other chemical processes occur. Special attention is given to the presence of aluminum, which, when reacting with water and carbonates, can cause hydrogen release. This risk is reduced by applying eddy current separation, which removes aluminum before the stabilization and solidification processes. This prevents the formation of explosive hydrogen mixtures in the landfill and ensures the integrity of the final material.

[125] "Official Gazette of RS", No. 56/2010, 93/2019, 39/2021, and 65/2024, Available at Pravilnik o kategorijama, ispitivanju i klasifikaciji otpada
[126] "Official Gazette of RS", No. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)
[127] Directive (EU) 2018/850

This method allows for the completion of all reactions under controlled conditions, preventing subsequent cracking of the solidificate and reducing the risk of contaminant leaching upon contact with water. The crystal lattice of the material, preserved during this process, plays a crucial role in preventing the migration of pollutants.

Based on the conducted analyses and applied measures, it is concluded that no conditions for the release of flammable and explosive gases, such as hydrogen (H_2) and methane (CH_4), will form at the non-hazardous waste landfill. Potential environmental impacts, such as dust lifting and the occurrence of leachate and rainwater, are temporary and minimized by the application of designed protective measures.

In the case of accident scenarios, such as the migration of contaminants and the leakage of leachate into underground layers, groundwater contamination may occur, which could indirectly affect surface waters of the Danube River. To assess the risk and consequences of such events, modeling has been performed that provides a detailed overview of potential scenarios and their impacts.

Specific Physical-Chemical Properties of Stored Materials (Non-Recyclable Hazardous and Non-Hazardous Waste, Ammonia Water, Natural Gas, Activated Carbon, etc.) That May Cause Accidental Situations

At the facilities on the Waste-to-Energy Plant site, management of non-recyclable hazardous and non-hazardous waste will be carried out. The waste will be classified into groups from 02 to 20 according to the Waste Catalogue and the provisions of the Rulebook on Waste Categories, Testing, and Classification[128].

In accordance with procedures for pre-acceptance and acceptance of waste, the types of waste that can be received at the facility are clearly and precisely controlled. As part of the incoming inspection, the radioactivity of delivered waste will be tested. If elevated radioactivity is detected, since the acceptance of this type of waste is strictly prohibited, the competent state inspection and ministry will be immediately notified. The driver will be instructed to park the vehicle in a designated truck parking area until the inspection arrives.

The project documentation specifies that waste containing more than 1% halogenated organic substances expressed as chlorine cannot be treated in the boiler. Strictly prohibited waste types include: Explosive waste, Flammable waste, Infectious waste, Radioactive waste, waste containing or contaminated with polychlorinated biphenyls (PCB), polybrominated triphenyls (PCT), and/or polybrominated biphenyls (PBB), waste containing cyanides, isocyanates, thiocyanates, waste containing asbestos, peroxides, biocides, or cytostatic agents, electronic waste.

This classification serves as the basis for determining the acceptability of waste at the facility, taking into account potential risks and the requirements for safe handling and treatment.

[128] "Official Gazette of RS," Nos. 56/2010, 93/2019, 39/2021, and 65/2024, Available at Pravilnik o kategorijama, ispitivanju i klasifikaciji otpada

7.6.2. Sources of Hazards

Leakage of Hazardous Materials

During the storage of hazardous and non-hazardous waste, minor liquid leaks may occur. Storage takes place in facilities with impermeable surfaces, equipped with systems for collecting spilled liquids, fire protection, ventilation, and physical security. Mobile containment tanks are placed under barrels and IBC containers to prevent leaks in the event of an incident.

For packaging, transportation, and storage of hazardous waste, certified containers are used to prevent structural failures. In cases of partial container damage, only minor liquid leaks along the vessel are possible. The spilled content is collected using containment tanks and absorbents such as sawdust, sand, or specialized absorbent materials. The operator performs regular checks on the structural integrity of equipment and packaging, and if necessary, measures are taken for container replacement and content remediation.

The storage of non-hazardous waste outdoors is organized on waterproof surfaces with systems for collecting atmospheric water, which is directed to oil and grease separators. Liquid substances, including waste liquids and ammonia water, are stored in closed facilities with waterproof floors. Tanks are placed within reinforced concrete containment basins capable of holding any spilled content, while ammonia water is stored in double-walled tanks and further cooled during summer months.

At liquid transfer stations, linear grates are installed to collect spilled substances and direct them into collection pits, preventing contamination of sewage systems and soil. In the event of a fire, the used water is collected in concrete basins and further treated within the boiler plant.

In the case of an emergency situation, uncontrolled releases of flue gases from the boiler plant may contain pollutants such as HCl, HF, PM, NO_x, and SO_2. Additionally, uncontrolled leakage of ammonia water may result in ammonia vapor emissions. All planned measures are designed to prevent these situations and to protect the environment.

Fire and explosion

In theoretical circumstances accidents at the facility may occur due to fire and explosions, where the key risk sources are waste materials that may contain flammable or reactive components, such as batteries. The process of mechanical pretreatment of waste in shredders presents a risk point, as does the human factor, electrical failures, or short circuits. Fires can result in the emission of toxic gases such as CO, NO_x, SO_2, HCl, and soot.

The facilities are designed with preventive measures, such as maintaining a minimum separation distance of 4 meters between buildings or implementing construction measures to prevent the spread of fire in adjoining structures. Specific facilities for pretreatment and thermal treatment of waste are technologically and fire-integrated; however, fire transfer is prevented through additional construction and technological solutions.

The project has obtained conditions from the Ministry of Internal Affairs, confirming the application of fire and explosion protection measures in accordance with applicable laws and standards. Systems for automatic fire detection and alarm, fixed fire suppression installations, a fire water reservoir, and detection systems for explosive gases and vapors are implemented.

These systems and measures minimize risks, and the operation and management of the facility adhere to the highest fire protection standards and safety regulations.

7.6.3. Hazard Analysis of Chemical Accidents Based on Defined Hazard Zones

The width of a zone for explosive vapor atmosphere is defined as the distance in any direction from the point of release/emission to the point where the hazard associated with that zone is present. The width of the zone is primarily influenced by physico-chemical parameters, some of which represent the inherent properties of the flammable material, while others are specific to the technological process.

In accordance with the technological process within the facility, the possibility of hazard zones and their classification was analyzed. The analysis considered hazard zones arising from dust and gases.

Dust hazard zones

The facilities where the occurrence of dust hazard zones was analyzed include:

- The dust filtration system in the stabilization and solidification facility,
- The dust filtration system for pretreatment of non-hazardous and hazardous waste in the pretreatment and storage facility,
- The activated carbon dosing system.

Dust in the stabilization and solidification facility originates from solid combustion residues that cannot create an explosive atmosphere. Therefore, there is no risk of a dust explosion in this system. However, since hydrogen is released during stabilization and solidification, the ventilation system creates a ZONE 2NE. Accordingly, the ventilation system fan is required to have Ex protection of class IIC T1.

In the pretreatment and storage facility, dust is generated from the reception, shredding, and transport of waste to the reception bunker, particularly in the event of a boiler shutdown. All equipment in the dust filtration system is designed to have explosion protection of class IIIC T165°C.

In the activated carbon dosing system, hazard zones are defined based on the recommendations of the equipment manufacturer. The activated carbon dosing units are mechanically designed with explosion protection, while the motors driving them do not require Ex protection since the system is closed, and dust generation outside the transport system is not expected. Only the electrical equipment in the storage bunker (such as the level gauge) must have Ex design.

Table 43: Hazard Zones by Facility

Facility	Position	Zones	Equipment Class
Stabilization and Solidification Facility	Dust extraction system	Hazard Zone 2 (NE) Hydrogen generation from the stabilization and solidification process.	No equipment requirements except for the ventilation fan, which requires IIC T1.

Pretreatment and Waste Storage Facility	Dust extraction system	Zone 21 inside the hopper. Zone 22 after the filter. Zone 22 within the filter, around leakage points, with a sphere radius of 1.5m.	IIIC T165 ˚C
Activated Carbon	/	Zone 21 within the activated carbon container, transport devices, dosing units, and ventilation system. Zone 22, 1m around the terminal vent opening of the activated carbon container.	IIIC T165 ˚C

*** Zone 21 represents an area where the presence of flammable dust is constant or occurs frequently during normal plant operation. These dust concentrations can form an explosive atmosphere.*
Zone 22 represents an area where the presence of flammable dust is occasional, occurring in the event of a malfunction or an emergency situation.

Hazard Zones Related to the Presence of Explosive Gases

The facilities where the occurrence of hazard zones due to explosive gases has been analyzed include:

- The pretreatment and waste storage facility (methane from sludge),
- The waste thermal treatment facility (natural gas),
- The stabilization and solidification facility (hydrogen),
- The tanker unloading area,
- The reduction station (natural gas).

Table 44 presents the hazard zones for explosive gases by facility.

Table 44: Hazard Zones for Explosive Gases by Facility

Facility	Position	Zones	Equipment Class
Waste Thermal Treatment Facility	Internal area	Zone 2 (NE) Secondary release at pipeline valves or flanges.	No equipment requirement.
Waste Thermal Treatment Facility	External area around vent valves	Zone 1; Exists in all directions from the release source (air discharge pipe - safety/relief valve) up to 1.0 m. Zone 2; Exists in all directions from the release source (air discharge pipe - safety/relief valve) up to 2.0 m.	IIA T1 (methane).
Tanker Unloading Station		Zone 0: Interior of pipelines, fittings, and parts of the unloading system not permanently filled or inertized.	IIC T5 (liquid waste, strictest class adopted for safety).

		Zone 1: - Area within 1.5 m in all directions around the unloading device, connection points, and tanker connection up to ground level. Area 0.5 m around the pump for unloading, measured in all directions to ground level. Inside all recesses and trenches below ground level. Zone 2: - Area within 3 m horizontally and 1 m vertically from Zone 1 around unloading devices, connection points, and tanker connections. Area within 3 m horizontally and 1 m vertically from Zone 1 around the pump. Area within 3 m horizontally from pipeline joints, fittings, and similar parts of the unloading system.	
Reduction Station		Zone 1; Exists in all directions, primary release during operation of safety/relief valves up to 1.0 m. Zone 2; Secondary release at pipeline valves or flanges, extending up to 2.0 m.	IIA T1(methane).
Pretreatment and Waste Storage	Internal area – pretreatment of hazardous waste	Zone 2 Secondary release at joints, valves, flanges within 1 m in all directions.	IIC T3 (n-dodecane ($C_{12}H_{16}$))
Stabilization and Solidification Facility	Internal area	Zone 2 (NE) Hydrogen generation during stabilization and solidification processes.	No equipment requirement except ventilation fan rated IIC T1.
Solidification Filter System	Dust collection system	Zone 2 (NE) Hydrogen generation during stabilization and solidification processes.	No equipment requirement except ventilation fan rated IIC T1.
Pretreatment Filter System	Dust collection system and activated carbon filter	Zone 21: Inside the hopper. Zone 22: After the filter and 1.5 m spherical radius around leakage points.	IIIC T165 °C
Activated Carbon System		Zone 21: Inside the activated carbon container, within transport devices,	IIIC T165 °C

		dosing systems, and ventilation systems. Zone 22: Area 1 m around the terminal ventilation outlet of the activated carbon container.	

7.6.4. Analysis of the Facility's Microlocation in Terms of Fire Spread and Accessibility for Fire Intervention Units

This analysis examines two critical aspects: preventing fire propagation to adjacent facilities and ensuring accessibility for firefighting vehicles during emergencies.

The safe distance between facilities is defined as the minimum spacing that prevents fire or explosion propagation from one facility to another. This is especially critical for facilities storing hazardous or flammable substances to reduce the likelihood of a domino effect. Structures housing flammable gases, fuels, or reactive substances are designed and positioned to minimize risk.

Accessibility for fire and rescue units has been assessed in accordance with the technical regulations and involves evaluating both public and internal road networks within the Elixir Prahovo and Eco Energy complexes. These roadways ensure firefighting vehicles have access to at least one facade of every building, while critical facilities such as the boiler plant are accessible from three sides, as required by fire safety norms for storage and processing facilities.

The internal road network meets the following technical requirements:

- Load-bearing capacity: 130 kN axle load.
- Road width: Minimum 3.5 m for one-way traffic, 6 m for two-way traffic.
- Clearance height: 4.5 m.
- Curve radius: 7 m inner, 10.5 m outer.
- Maximum gradient: 6%.

The nearest professional firefighting unit is located in Negotin, 10.5 km away. The estimated response time is as follows:

- Call time: 2 minutes.
- Preparation for departure: 1 minute.
- Travel time to the site: 15 minutes.
- Total response time: Approximately 18 minutes.

The Elixir Prahovo complex maintains its own internal firefighting unit equipped for rapid interventions. This service operates on a 24-hour shift basis with four firefighters per shift and is equipped with the following:

- A firefighting vehicle for initial response.
- A water tanker to supply large quantities of water.
- A utility terrain vehicle for transporting specialized equipment.

These measures, along with adherence to fire safety standards and the availability of advanced firefighting systems, ensure effective fire prevention, containment, and intervention within the facility.

7.6.5. Analysis of Consequences of Accidents at the Waste-to-Energy Plant

To determine the impact and assess the risks of potential accident scenarios at the Waste-to-Energy Plant on human health, the environment, and the possibility of cross-border impacts, a detailed evaluation was conducted based on the identified hazards. The analysis includes the development of event scenarios, the modeling of their effects, and a risk assessment of the consequences of chemical accidents.

The development of accident scenarios includes evaluating the extent of potential incidents and their possible effects on human health, the environment, and material assets. The scenarios reflect the complexity of the plant, the hazards of the processes, the level of dangerous activities carried out by the operator, and the potential outcomes.

Scenarios were selected based on identified critical points and the characteristics of hazardous materials, as well as the effects that could arise (e.g., fire, release and spread of vapors and gases, equipment failure). The consequences were modeled for each scenario, including possible chain reactions and secondary impacts. Maps of accidente influence are provided within EIS report for detailed analysis (please be refered to chapter 7 of EIS).

Below, Table 45 systematically describes each accident scenario, its effects, and relevant characteristics.

Table 45: Overview of Accident Scenarios, Effects, and Characteristics

Scenario No.	Scenario	Characteristics
Scenario 1	Accidents at the liquid waste transfer station	Minor accident: Burning of spilled waste with thermal radiation and toxic effects of combustion products. Major accident: BLEVE effect (boiling liquid expanding vapor explosion) with thermal, destructive, and fragmentation effects.
Scenario 2	Fire (ignition of waste in the entire bunker space) in waste storage areas	Ignition of waste inside the bunker with toxic effects of combustion products and direct thermal radiation.
Scenario 3	Fire in fuel storage tanks (upper level)	Direct fire and thermal radiation affecting equipment. Toxic effects of combustion products inside the room.
Scenario 4	Uncontrolled releases of liquid waste from IBC containers	Release and emission of toxic substances with dispersion. Combustion of flammable materials with toxic effects and thermal radiation.

Scenario 5	Accidents involving sludge waste (methane emissions from stored sludge)	Increased methane concentration in the reception bunker space with simulation of dynamic changes for different system operation modes.
Scenario 6	Accidents in the boiler facility and natural gas installation	Boiler: Release of flue gas or damage to the boiler causing content discharge. Gas installation: Ignition of gas outflow, explosion of a gas cloud, or subsequent ignition.
Scenario 7	Uncontrolled release of particulate matter from bag filters in the boiler facility	Release of PM particles from bag filters accompanied by emissions of pollutants (HCl, HF, SO_2, NO_2).
Scenario 8	Forced release of flue gases through the stack without scrubber treatment	Emission of HCl, HF, SO_2, and NOx concentrations in flue gases during discharge.
Scenario 9	Accidents at activated carbon dosing units	Accumulation of dust and occurrence of fire with potential for a detonation wave due to a dust cloud explosion.
Scenario 10	Accidents involving ammonia water	Transfer: Release and toxic effects of ammonia with subsequent ignition (Flash Fire). Storage: Release of ammonia and associated toxic effects.
Scenario 11	Accidents in the stabilization and solidification facility	Increased hydrogen concentration in the space with potential for fire.
Scenario 12	Modeling the effects of hazardous material emissions on the Danube River	Emission of ammonia and PM particles with spread of pollution to the environment (Danube watercourse).
Scenario 13	Migration of Contaminants from Non-Hazardous Waste Landfill	Migration of the contaminants due to the rupture of the HDPE (High-Density Polyethylene) geomembrane.
Scenario 14	Leakage of Contaminated Leachate from the Non-Hazardous Waste Landfill into the Aquifer, Causing Groundwater Contamination	Leakage of Contaminated Leachate from the Non-Hazardous Waste Landfill into the Aquifer, due to the rupture of the HDPE geomembrane.

Scenario 1 - Accidents at the liquid waste transfer station

Scenario 1 describes two potential incidents that may occur at the liquid waste unloading station due to technical failure or improper handling during the unloading process. The modeling results provide a detailed overview of the potential consequences and critical effects of these situations.

The first case involves a minor incident in which waste oil leaks due to an improper connection of the discharge pipeline to the tanker truck. In this scenario, the discharge pump remains on, causing the liquid to spill onto the concrete surface. Friction between metal debris and the surface triggers the ignition of the spilled oil, resulting in a pool fire. Modeling has determined that the thermal radiation from the fire can reach a range of up to 42 meters, while the levels of toxic combustion products remain below threshold values that would endanger human health. Rapid intervention can stop the leakage within two to ten minutes, mitigating the consequences of the incident.

The second case, significantly more severe, describes a major incident in which the tanker truck is exposed to fire for more than thirty minutes, leading to a BLEVE effect (Boiling Liquid Expanding Vapor Explosion). Modeling this situation identified three critical effects of BLEVE: thermal radiation, blast wave, and fragmentation effects. During the explosion, a fireball with a diameter of up to 44 meters forms, and its hemispherical part on the ground extends up to 57 meters. Consequences within this zone are fatal, while second-degree burns can occur at distances up to 32 meters, and first-degree burns up to 40 meters. Additional problems arise from fragments of the tanker shell, which, according to the modeling results, are scattered beyond the boundaries of the unloading station, while the blast wave damages nearby structures and equipment. The operational zone of the unloading station, where the driver and operator are present, is a critical area with a high risk of severe injury or fatality.

The conclusions of the modeling indicate that a minor incident has limited consequences, while a major incident causes serious effects within the facility that can endanger human life, infrastructure, and the environment. The BLEVE effect is particularly critical due to the combination of thermal radiation, overpressure, and fragmentation, highlighting the need for strict safety measures and protocols at the unloading station. Detailed information on mathematical models, input data, and risk assessments can be found in the Environmental Impact Assessment Study.

<u>Scenario 2 - Fire (ignition of waste in the entire bunker space) in waste storage areas</u>

Scenario 2 analyzes the potential consequences of a fire that may occur in the receiving bunkers or mixing bunkers for solid hazardous waste. This situation arises from the heterogeneous composition of the incoming waste and the possible presence of reactive impurities or foreign objects. Conditions such as intensive waste mixing, particle friction, and occasional mechanical impacts can trigger localized ignition of the waste.

The fire begins in one of the bunkers, spreading to engulf the entire bunker space. The cause may stem from inadequate sampling or the presence of reactive materials generating small amounts of hydrogen or methane. A particular challenge arises if the automatic fire detection and suppression system (thermal imaging cameras and foam-based firefighting cannons) fails or is not activated promptly. In such cases, the fire escalates, producing high temperatures and toxic combustion products in an enclosed space.

Fire Characteristics and Consequences in an only theorethical exercise (the amount of PVC cannot reach the modeled values due to waste accpetion restriction):

- The volume of the space above the waste in the bunker is 29,520 m³, providing ample room for heat accumulation and combustion products.
- It is assumed that the waste contains a mixture of polyethylene (PE) and polyvinyl chloride (PVC), making up approximately 20% of the total mass. These materials have a high potential to generate toxic gases, including carbon monoxide (CO), hydrogen chloride (HCl), and other combustion products.
- Under natural ventilation, the air exchange rate is 0.5 changes per hour, while forced ventilation ensures 2 changes per hour, which is insufficient to quickly dilute high gas concentrations.

Effects of the Incident:

- Toxic Effects of Combustion Products: Dangerous concentrations of gases such as CO and HCl may reach IDLH levels (Immediately Dangerous to Life or Health), posing a serious risk to workers, particularly in cases of inadequate protective equipment.
- Thermal Effects: High temperatures inside the bunker lead to damage to process equipment and structural elements, potentially halting the entire plant's technological process.
- Fire Spread Risk: If the fire is not localized, there is a risk of spreading to adjacent bunkers or other parts of the facility, amplifying the consequences of the incident.

Modeling of this scenario confirms that a fire in the bunker generates significant amounts of toxic gases, which can severely threaten worker health and the structural integrity of the facility. Furthermore, the analysis highlights the critical importance of the automatic fire suppression system in preventing fire spread and mitigating consequences. Details regarding the modeling and mathematical calculations are available in the Environmental Impact Assessment Study, where concentration values for gases and the thermal load of the bunker are presented. The scenario is only theoretical as PVC will not be accepted for threatment at the plant, the model is used only to test the vonrreability of the system to HCl formation.

Scenario 3 - Fire in fuel storage tanks (upper level)

Scenario 3 describes a situation where a fire occurs in a room containing fuel storage tanks located on the upper floor of the facility. These tanks, designed for the temporary storage of liquid combustible waste, pose a potential hazard due to the heterogeneity of the stored waste. Although all safety measures have been implemented in the facility to prevent fires, the nature of hazardous waste makes it impossible to completely eliminate the risk of this type of incident.

The incident begins with the release of combustible waste from one of the two storage tanks. The waste spills into a shared bund, where it ignites, causing a fire in the room. Due to the room's volume of approximately 1,210 m³, the fire develops rapidly, generating high temperatures and filling the space with smoke gases. Modeling of this scenario has shown that the fire results in elevated concentrations of combustion products, including carbon monoxide (CO), nitrogen oxides (NOx), and sulfur dioxide (SO_2).

Concentrations of combustion products in the room exceed the lethal exposure thresholds (LC50) within 15 minutes:

- Carbon Monoxide (CO): 1.66×10^5 mg·min/m³ – significantly above LCt50.
- Nitrogen Oxides (NOx): 1.38×10^4 mg·min/m³ – values greatly exceed LCt50.

- Sulfur Dioxide (SO_2): 5.54 × 10^4 mg·min/m³ – concentrations are far above critical thresholds for lethal exposure.

These modeling results confirm that the concentrations of combustion products reach levels that endanger life and health for workers present, even over a short period. Given these values, without appropriate protective equipment, remaining in this zone could have fatal consequences.

A fire in the room containing fuel tanks has extremely serious consequences, primarily due to the release of high concentrations of toxic gases and intense thermal radiation. Modeling indicates that under fire conditions, concentrations quickly exceed critical thresholds for life-threatening exposure. This scenario highlights the necessity of continuous monitoring of fire detection and suppression systems, as well as the mandatory use of protective equipment during intervention.

Scenario 4 – Uncontrolled Release of Liquid Waste from IBC Containers

Scenario 4 analyzes a situation where damage or rupture of an IBC container containing hazardous materials occurs. This scenario encompasses two main outcomes: the uncontrolled release of toxic substances with emissions into the room and the burning of flammable materials, resulting in the generation of toxic combustion products and thermal radiation.

a) Scenario with Toxic Substances

The scenario assumes damage to a container holding waste tetrachloroethylene, leading to its spillage onto the floor and evaporation of the liquid. Modeling indicates that a liquid layer 10 mm thick forms relatively quickly, covering an evaporation surface area of approximately 100 m². These evaporations result in the accumulation of toxic gas concentrations in the enclosed space. Ventilation, which provides about 10 air changes per hour, is insufficient to prevent the formation of high concentrations.

Modeling shows that at a distance of 11 m from the release point, gas concentrations reach the Critical Exposure Limit (KGVI) of 40 ppm, while at a distance of 19 m, concentrations reach 0.1 IDLH (Immediately Dangerous to Life or Health). This indicates that individuals within the room are at risk, emphasizing the importance of an effective ventilation system and a rapid response in the event of a detected release.

b) Scenario with Flammable Materials

If a release and ignition of flammable materials from the IBC container occur, modeling confirms the formation of a burning pool. The flames produce thermal radiation that can endanger people and equipment in the immediate vicinity. Thermal radiation levels of 2 kW/m², which cause pain after 60 seconds of exposure, extend up to 26 meters from the burning pool. In the zone 11 meters away, radiation is intense enough to cause fatal consequences or burns within a few seconds.

Modeling this scenario confirms that the release of toxic substances can result in high concentrations of hazardous gases that pose a risk to human health, while the burning of flammable materials generates serious thermal radiation and toxic combustion products. Critical requirements include efficient detection systems, ventilation, and rapid fire suppression to minimize the consequences of such an incident.

Scenario 5 – Incident Situations with Waste Sludge

Scenario 5 describes a situation where methane emissions occur from stored sludge in reception bunkers. Sludge, as a heterogeneous mixture of organic matter, naturally releases methane during decomposition, which can accumulate in enclosed spaces and reach hazardous concentrations. Without adequate monitoring, ventilation, and timely response, methane poses a significant risk for explosion or fire.

Modeling confirms that under conditions of natural ventilation, when the gas extraction system is inactive, methane concentration in the bunker gradually increases. Within 40 minutes, dangerous concentrations reach the flammable range (between 5% and 15% by volume). Even the presence of a small spark or localized heat source can trigger an explosion, leading to significant damage to the bunker, equipment, and risks to personnel.

In conditions of forced ventilation, the model shows a significant reduction in methane concentrations, even with pronounced emissions. The ventilation system maintains the gas below the critical threshold, effectively eliminating the explosion risk. However, in case of:

- Technical failure of the ventilation system,
- Inadequate detection of methane,

concentration levels can rise rapidly, presenting a serious hazard.

Negative impacts and consequences:

- Explosive atmosphere: If methane concentration reaches the flammable range, there is a high probability of explosion, causing physical damage to the bunker, surrounding equipment, and infrastructure.
- Health risks: Methane displaces oxygen in enclosed spaces, posing a suffocation risk, particularly in lower air layers where methane accumulates.
- Prolonged risk: Without an efficient detection and alarm system, even lower concentrations of methane may remain unnoticed until they reach critical levels

Scenario 6 – Accident Scenarios at the Boiler System and Natural Gas Installation

Scenario 6 describes potential accident scenarios that may occur at the boiler system and the natural gas installation.

a) Boiler Accident

In this case, loss of hermeticity at the boiler joints results in the uncontrolled release of flue gases. Due to the high temperatures and pressures within the system, damage can lead to the release of steam and a mixture of liquid and solid phases, increasing the risk of thermal radiation and mechanical damage to the plant.

Modeling results show that such an accident can cause a sudden rise in temperature in the immediate vicinity of the boiler, creating conditions that endanger the integrity of process equipment and worker safety. The release of flue gases further complicates the situation due to the possible presence of toxic components such as nitrogen oxides (NO_x) and sulfur dioxide (SO_2), which pose a respiratory hazard to workers.

b) Accident at the Natural Gas Installation

The second part of the scenario considers a situation in which damage occurs to the gas installation, leading to the uncontrolled dispersion of natural gas. If the gas forms an exit stream and comes into contact with a heat source, ignition occurs, forming a flame jet. Alternatively, the gas cloud may explode or ignite later, generating a shockwave that can damage surrounding infrastructure.

Modeling confirms that the flame jet has exceptionally high thermal power, and its radiation can cause burns and damage to process equipment. In the event of a gas cloud explosion, the consequences include mechanical damage to buildings and risk to personnel located in the accident zone.

Modeling results for this scenario indicate severe consequences that may arise from accidents involving the boiler system and gas installation. The uncontrolled emission of flue gases and the dispersion of natural gas present critical risks due to the potential for explosions, fires, and toxic effects. Ignition of natural gas results in high thermal radiation, while a gas cloud explosion is particularly dangerous due to mechanical impact.

To prevent these situations, constant monitoring of boiler joints, gas leak detection, and an efficient fire suppression system are essential. A detailed analysis of the modeling results and recommendations for protective measures are available in the Environmental Impact Assessment Study, where all parameters and critical points of the scenario are described.

Scenario 7 – Uncontrolled Release of Particulate Matter from Bag Filters in the Boiler Plant

Scenario 7 examines the potential hazard of uncontrolled particulate matter (PM) emissions from the bag filter system located in the boiler plant. The cause of this incident lies in increased pressure and temperature within the system due to clogged filter bags, which may lead to their rupture. The document analyzes two possible variations of this scenario: rupture of a single filter bag and simultaneous rupture of two filter bags.

In the first variation, emissions of particulate matter are caused by damage to a single filter bag, resulting in the release of a portion of the flue gas mixture into the boiler plant space. This event has a relatively limited range and restricted impact on the surrounding environment but leads to an increase in PM concentrations within the plant's air. It is estimated that, in the closed volume of the plant, approximately 47,700 m^3, PM concentrations can exceed the permissible safety limits for workers.

In the case of two filter bags rupturing simultaneously, the consequences are significantly more pronounced. Modeling confirms that the increase in PM concentrations occurs more rapidly, reaching levels that can cause health problems for workers in the room. Alongside particulate matter, other pollutants, including HCl, HF, SO_2, and NO_2, may also be present in the flue gases, further exacerbating health and environmental impacts.

Modeling results indicate that the uncontrolled release of particulate matter is accompanied by increased concentrations that exceed permissible limits. These concentrations of PM and gaseous pollutants in the confined conditions of the boiler plant pose a risk to workers' respiratory systems and significantly degrade air quality.

The conclusions of this scenario confirm the importance of continuous monitoring of the bag filter system's operation to prevent clogging and pressure buildup within the system. Preventive measures, such as regular maintenance of filter bags and the ventilation system, are critical for reducing the risk of rupture and pollutant emissions. In the event of a release, swift action is necessary to reduce PM and pollutant concentrations using an effective ventilation and filtration system.

Scenario 8 – Forced Emission of Flue Gases to the Chimney Without Scrubber Treatment

Scenario 8 describes a situation where flue gases are forcibly released directly into the chimney without prior treatment in the scrubber system. This event can occur due to unforeseen technical failures, such as scrubber malfunction or breakdown in the gas purification system, leading to the emission of untreated gases into the atmosphere. Under normal conditions, flue gases are treated before release, but in this case, they contain harmful components such as hydrogen chloride (HCl), hydrogen fluoride (HF), sulfur dioxide (SO_2), and nitrogen oxides (NOx). Their uncontrolled release poses a potential risk to air quality and the surrounding environment.

Modeling analyzed the dispersion of gases and their spread in the immediate vicinity of the facility. The results indicate that, although the concentrations of harmful substances in emissions significantly exceed the values emitted during normal operation, at breathing height for humans, approximately 1.5 meters above the ground, concentrations do not reach levels that exceed immediate danger to life and health (IDLH). These estimates apply to a time frame of 30 minutes of emissions, which is identified as the critical duration for such an incident.

The negative impacts of this event are primarily reflected in the degradation of air quality in the vicinity of the facility. While no concentrations that pose an immediate threat to human health have been noted, emissions of sulfur dioxide and hydrogen chloride may cause respiratory irritation in sensitive populations, such as individuals with respiratory diseases. Additionally, the presence of these gases can harm plant life and ecosystems, which are particularly vulnerable to changes in the chemical composition of the air.

Scenario 9 – Incident Situations on Activated Carbon Feeders

Scenario 9 describes potential incidents that may occur on activated carbon feeders, with particular focus on fire and explosion hazards caused by the accumulation of carbon dust. Activated carbon, which is stored in containers and transported to reactors, poses a significant fire risk due to its physical-chemical properties. The most critical phases of this process involve filling the containers with activated carbon and its dosing, during which carbon dust can form and settle in the surrounding space.

Modeling confirmed that accumulated carbon dust, whether airborne or settled, represents a potential source of fire or explosion. If carbon dust ignites, it releases carbon monoxide, which can endanger workers' lives due to poisoning and oxygen depletion. Additionally, under unfavorable conditions, when the concentration of dust in the air is sufficiently high, there is a possibility of forming an explosive cloud. The explosion of such a cloud results in a detonation wave, which can cause severe mechanical damage to process equipment within the boiler plant and spread the fire to adjacent facilities.

The conclusions of the modeling highlight that controlling the accumulation of carbon dust is essential for preventing such incidents. As preventive measures, regular cleaning and maintenance of areas around the dosing system must be ensured, along with effective ventilation to reduce dust concentration in the air and the use of nitrogen inertization to minimize ignition potential. Additionally, a functional fire detection and automatic suppression system must be in place to localize and extinguish fires in their initial phase.

Scenario 10 – Incidents with Ammonia Water

Scenario 10 considers two potential incidents involving ammonia water: one at the unloading station and another in the storage system. These events analyze the effects of toxic ammonia release and subsequent ignition of vapors, known as a "Flash Fire."

In the case of an incident at the unloading station, ammonia emissions occur due to damage to the transfer system, leading to uncontrolled spillage of ammonia water and evaporation of ammonia into the surrounding area. Modeling confirmed that zones with toxic ammonia concentrations extend up to 182 meters for concentrations reaching the IDLH level (300 ppm) and up to 680 meters for lower concentrations (0.1 IDLH – 30 ppm). This indicates a high risk to the respiratory health of employees and any nearby individuals in the immediate vicinity of the unloading station. In addition to the toxic effects, the ignition of evaporated ammonia vapors results in a "Flash Fire," where critical concentration zones are observed at a distance of about 10 meters from the point of release.

For incidents in the ammonia water storage system, damage to the storage tank may lead to significant ammonia emissions into the atmosphere. The modeling results show that IDLH-level concentrations form at distances of up to 127 meters from the tank. The probability of fatal outcomes, estimated using the Probit function, reaches 10% at a distance of 16 meters, while the probability increases to 50% at 13 meters. These values highlight the severe hazard in the immediate vicinity of the tank, where the effects of toxic vapors could threaten workers' lives. Subsequent ignition of the vapors introduces additional risks, with flammable concentration zones forming at distances of approximately 10–11 meters from the point of release.

The modeling results indicate that ammonia emissions have severe consequences for human health and the environment, especially in cases of delayed detection and control system response. By implementing preventive measures such as regular maintenance of unloading and storage systems, gas detection, and automatic fire suppression systems, the likelihood and intensity of such events can be significantly reduced..

Scenario 11 – Incident Situations in the Stabilization and Solidification Facility

Scenario 11 describes potential incidents in the stabilization and solidification facility, where hazardous concentrations of hydrogen may form due to emissions from the process. Hydrogen, as a highly flammable gas with a low ignition energy, has a significant propensity to ignite in the presence of oxygen, which can lead to fires or explosions if its concentration reaches critical levels.

The modeling analyzes hydrogen behavior within the stabilization and solidification area, with a particular focus on the efficiency of forced ventilation designed to maintain safe gas concentrations. Input data indicates that the ventilation capacity is estimated at 15,000 m³/h, while the room volume is 6,780 m³, allowing approximately six air changes per hour, assuming that 60% of the space is occupied by process equipment.

Simulations show that significant hydrogen concentrations can only form in the case of high emissions exceeding 15 g/s. Critical concentration thresholds are defined through alarm levels: DGE (40,000 ppm) represents a dangerous level, while lower thresholds, such as 0.25 DGE (10,000 ppm) and 0.10 DGE (4,000 ppm), serve as early warning indicators that require an immediate response from detection and ventilation systems.

The modeling results demonstrate that forced ventilation effectively maintains hydrogen concentrations below critical levels, except in cases of sudden and high emissions. However, if the ventilation system fails or detection is delayed, hydrogen concentrations can rapidly reach levels that lead to fires or explosions. Therefore, continuous monitoring of the system is essential, along with the implementation of additional safety measures such as gas detection alarms and automatic process shutdown mechanisms in the event of emissions.

Scenario 12 – Modeling the Effects of Emissions of Hazardous Substances in Incident Situations at the Waste-to-Energy Plant on the Danube River

Scenario 12 examines the effects of hazardous substance emissions that occur during emergency situations at the waste-to-energy plant, with a particular focus on their impact on the flow of the Danube River. The modeling of these situations includes an analysis of pollutant dispersion, as well as their concentrations in the air and surface waters, considering two key emission scenarios: ammonia vapor emissions and PM particle emissions.

In the first scenario, ammonia vapor emissions occur due to the release of ammonia water from a tanker truck or storage tank. The modeling results show that, although emissions are significant in concentration near the release point, they do not result in pollution of the Danube River. The estimated emission rate from the tanker truck is approximately 0.17 kg/s, while the release from the storage tank is slightly larger. While toxic concentrations of ammonia are high in the immediate vicinity of the release site, gas dispersion through the atmosphere and dilution in the river flow reduce concentrations to levels well below the threshold values for pollutants in surface waters.

In the second scenario, the analysis considers PM particle emissions caused by the release of particulate matter from the boiler facility. Once released into the atmosphere, PM particles disperse and partially settle onto the surrounding land and water surfaces. The analysis confirms that PM emissions do not exceed the reference threshold values for surface waters, leading to the conclusion that such incidents do not result in significant pollution of the Danube River.

The modeling conclusions confirm that emissions of ammonia vapor and PM particles, although hazardous in the immediate vicinity of the release site, do not have a quantifiably negative impact on the quality of the Danube River. Emission control, concentration monitoring, and the implementation of preventive measures are critical for minimizing risks and preventing more severe consequences (for more information be refered to chapter 7 of EIS).

Scenario 13 – Migration of Contaminants from the Non-Hazardous Waste Landfill

Scenario of incident on the non-hazardous waste landfill describes a potential accident involving the migration of contaminants due to the rupture of the HDPE (High-Density

Polyethylene) geomembrane. This incident leads to the direct contact of contaminated waste with the soil, where the transport of pollutants begins through molecular diffusion from the waste layer to the clay layer beneath it. Pollutants move from the zone of high concentration to the zone of lower concentration, with geological conditions, such as low-permeability and clayey layers, significantly slowing the spread of contaminants.

The analysis confirmed that diffusion is the primary mechanism for contaminant transport in this case, meaning the risks of rapid and uncontrolled spread are minimal. The modeling results show that the concentrations of pollutants would be significantly reduced in relation to the initial values at distances of just a few meters, and at greater distances, they would become practically negligible. However, in the case of prolonged leachate discharge, there is a possibility of contamination of groundwater, and indirectly, surface waters of the Danube River.

To prevent such a scenario, preventive protection measures are implemented, including regular monitoring of the geomembrane layers, control of leachate, and groundwater quality monitoring. monitoring ensure that preventive meassures can be taken in the event of an incident (as outlined in EIS), the environmental consequences are minimized to the lowest possible level.

Scenario 14 - Leakage of Contaminated Leachate from the Non-Hazardous Waste Landfill into the Aquifer, Causing Groundwater Contamination

Scenario describes a situation in which contaminated leachate leaks from the non-hazardous waste landfill into the aquifer due to the rupture of the HDPE geomembrane. This accident scenario represents the most unfavorable situation, as it leads to groundwater contamination, which then moves through advective transport toward surface water bodies, including the Danube River.

In the described case, the rate of pollutant discharge remains constant, and the mass of the contaminant is proportional to the duration of the discharge. The transport process begins when the leachate containing pollutants comes into contact with the geological medium, with the movement of contaminants occurring through both advective and diffusive transport. In the initial phase, the concentration of dissolved pollutants in the aquifer rises from zero to the initial value, after which it continues along the groundwater flow.

Modeling results confirm that the spread of contaminants is limited due to the low permeability of the layer beneath the landfill and the presence of clayey layers, which significantly slow the migration of pollutants. However, in the case of prolonged discharge, there is a potential for groundwater contamination, which may further drain toward the Danube River, representing a secondary risk.

This scenario highlights the importance of regular monitoring of the geomembrane's condition and the efficiency of the leachate collection system. Measures such as continuous monitoring of groundwater quality and the implementation of preventive mechanisms are recommended to monitor the situation and prevent an accident by taking additional meassures (please be refered to EIS for more details).

7.6.6. Vulnerability Analysis – Affected Zones

The vulnerability analysis for the waste-to-energy plant identifies critical environmental areas within vulnerable zones, defined as hazard boundaries, both inside the plant perimeter and in its surroundings. Table 46 presents a summary of affected zones for all specified incident scenarios at the operator's waste-to-energy plant site.

Table 46: Affected Zones for Incident Scenarios at the Waste-to-Energy Plant Site

Scenario No.	Accident Scenario	Affected Zones
1	Accident at the liquid waste transfer station.	Pool fire: - Thermal radiation 2 kW/m² (range: 42 m), exposure duration 60 s. - Rapid evacuation of personnel ensures no health consequences, calculated via Probit-function. - Toxic effects: No formation of concentrations exceeding LC50, IDLH, or 0.1 IDLH for CO, NOx (as NO_2), SO_2, and soot at ground level and at 1.5 m above ground. BLEVE effect (tanker explosion): - Maximum fireball diameter: ~44 m; fire hemisphere on the ground: 57 m. - Fatality zone (28.5 m radius), thermal radiation 2 kW/m²: 40 m. - Second-degree burns: 32 m (20% probability). - First-degree burns: 40 m (25% probability). Shockwave and fragments may exceed plant boundaries.
2	Fire in waste bunkers or mixing bunkers for hazardous solid waste.	IDLH concentration levels of combustion products occur inside the bunker.
3	Fire involving combustible material tanks (on the upper floor).	LC50 concentration levels of combustion products occur within the room: - CO ≈ $1.66×10^5$ mg·min/m³ (exceeds LCt50). - NOx ≈ $1.38×10^4$ mg·min/m³ (exceeds LCt50). - SO_2 ≈ $5.54×10^4$ mg·min/m³ (exceeds PCt50).
4	Uncontrolled release of liquid waste from IBC containers.	Toxic substances: - IDLH concentrations (150 ppm) are reached inside the building. - Concentrations above KGVI (40 ppm) occur at 11 m; 0.1 IDLH (15 ppm) concentrations occur at 19 m. Flammable substances: - Toxic combustion products accumulate to IDLH levels. - Burning pool thermal radiation (2 kW/m²): 26 m. - Critical ranges: 11 m – life-threatening exposure, 16 m – second-degree burns.
5	Incidents with waste sludge (methane emissions).	Methane concentration exceeds DGE under natural ventilation.

		Under forced ventilation, methane concentrations remain below critical levels.
6	Incidents in boiler and natural gas installations.	Boiler incidents: Formation of hazardous pollutant concentrations (HCl, PM). PM emission levels reach 10 mg/m³ over a 347 m zone. Natural gas: - Gas discharge: 1 m flame jet. - No conditions for secondary ignition or gas cloud explosion.
7	Uncontrolled release of particulate matter from bag filters in the boiler plant.	PM concentrations exceed 5 mg/m³ under reduced ventilation but remain below thresholds under intensive ventilation. Particulate emissions outside the building remain within limits (5 mg/m³).
8	Forced release of flue gases through the stack without scrubber purification.	No IDLH concentrations form at ground level or at 1.5 m height (breathing zone) during 30-minute emissions.
9	Incidents at activated carbon dosing systems.	Risk of fire and accumulation of carbon dust. Explosion of a dust cloud results in a shockwave capable of damaging equipment.
10	Incidents with ammonia water.	Transfer station: - IDLH zone (300 ppm): 182 m. - 0.1 IDLH zone (30 ppm): 680 m. - Flash Fire (post-release ignition): critical zone up to 10 m. Storage tank: - IDLH zone: 127 m. - Fatality probabilities for 30 min exposure: 1% at 18 m, 10% at 16 m, 50% at 13 m, 90% at 11 m.
11	Incidents in the stabilization and solidification facility.	Critical H_2 concentrations (DGE) form only with emissions >15 g/s.
12	Modeling of hazardous substance emissions impacting the Danube River.	Calculated pollutant values (PM and NH_3) are far below reference thresholds for surface water contamination, ensuring no significant impact on the Danube River.
13	Migration of Contaminants from the Non-Hazardous Waste Landfill	Contamination is confined to the area directly beneath the HDPE geomembrane and adjacent clay layers saturated with water. Diffusion is a slow process, and significant impacts on groundwater or surrounding areas are highly unlikely within the first 100 years, except for localized effects directly under the landfill.
14	Leakage of Contaminated Leachate from the Non-Hazardous Waste Landfill into the Aquifer, Causing Groundwater Contamination	Contamination is primarily confined to the aquifer beneath the landfill, with potential migration towards the Danube through advective transport. While chloride contamination can spread over larger distances within 1-2 years, the migration of heavy metals like cadmium is

		significantly slower due to high sorption and retardation, especially in geological environments rich in clay.

As shown in Table 45, scenarios 2 and 10 include affected zones that extend beyond the boundaries of the waste-to-energy plant but do not reach cross-border zones affecting neighboring country of Romania.

7.6.7. Consequence Assessment

The assessment is expressed in accordance with the Rulebook on the Content and Methodology of the Accident Prevention Policy, Safety Report and Accident Protection Plan[129].

Table 47: Overview of possible consequences based on the Rulebook on the content and methodology of the Accident Prevention Policy, Safety Report and Accident Protection Plan.

Consequence indicators	Consequences				
	Of little importance	Significant	Serious	High	Catastrophic
Number of people with fatal outcome	None	None	1-3	3-5	More than 5
Seriously injured	None	1-2	3-6	7-10	More than 10
Slightly injured	None	1-5	6-15	16-30	More than 30
Dead animals	≤0,5 t	0,5-5 t	5-10 t	10-30 t	More than 30 t
Contaminated soil	≤0,1 ha	0,1-1 ha	1-10 ha	10-30 ha	More than 30 ha
Material damage in thousands of dinars	≤100	100-1000	1000-10000	10000-100000	More than 100000

7.6.8. Determination of possible level of accident

Possible accident levels and the width of vulnerable zones for the Elixir Craft Waste-to-Energy Plant have been determined based on the calculated magnitudes and limits of spread of energy or pollutant (concentration of importance) for certain types of accidents. In the event of an accident in the Waste-to-Energy plant, the limits of the toxic effect of combustion products, after fires and explosions of explosive mixtures, raw materials and finished products, as hazardous substances that can lead to accidents with the worst consequences, were analysed. The zones of distances reached by toxic and explosive substances or the products of matter combustion in the form of vapours, gases, and aerosols, were calculated.

Possible levels of accidents are expressed in five levels, as follows:

[129] Official Gazette of the RS, no. 41/2010, Available at Pravilnik o sadržini politike prevencije udesa

- Level I of the accident: level of hazardous installations - consequences of the accident limited to a part of the plant – there are no consequences for the entire complex,
- Level II of the accident: level of the complex – consequences of the accident limited to the entire complex - there are no consequences outside the boundaries of the complex,
- Level III of the accident: the level of the municipality or city – the consequences of the accident are extended to the municipality or the entire city,
- IV level of the accident: regional level – the consequences have spread to the territory of several municipalities or cities;
- Level V: international level – the consequences have spread beyond the boundaries of the RS.

Table 48: Estimation of the level of accidents at the Waste-to-Energy Plant according to defined accident scenarios

Scenario No.	Accident Scenario	Accident Level
1	Accident at the liquid waste transfer station.	II
2	Fire in waste bunkers or mixing bunkers for hazardous solid waste.	I
3	Fire involving combustile material tanks (on the upper floor).	I
4	Uncontrolled release of liquid waste from IBC containers.	I
5	Incidents with waste sludge (methane emissions).	I
6	Incidents in boiler and natural gas installations.	I
7	Uncontrolled release of particulate matter from bag filters in the boiler plant.	II
8	Forced release of flue gases through the stack without scrubber purification.	II
9	Incidents at activated carbon dosing systems.	I
10	Incidents with ammonia water.	III
11	Incidents in the stabilization and solidification facility.	II
12	Modeling of hazardous substance emissions impacting the Danube River.	III
13	Migration of Contaminants from the Non-Hazardous Waste Landfill	II
14	Leakage of Contaminated Leachate from the Non-Hazardous Waste Landfill into the Aquifer, Causing Groundwater Contamination	IV

7.6.9. Risk assesment

The risk of an accident is determined based on the probability of occurrence and consequences according to the Regulation on the contents of the accident prevention policy and the methodology for preparing safety reports and accident protection plans[130].

[130] Official Gazette of the RS, no. 41/2010, Available at Pravilnik o sadržini politike prevencije udesa

Thus, risk (R) is a function of the probability of an accident occurring (V) and the possible consequences (P), and it can be represented as follows:

$$R = f[V,P]$$

The risk of specific undesirable scenarios is assessed using the so-called risk matrix, which is defined by the Regulation on the contents of the accident prevention policy and the methodology for preparing safety reports and accident protection plans[131]. The matrix includes five categories of accident consequences, three categories of frequency or probability of an accident occurring, and five categories of risk.

For all events in recognized facilities or activities, where systematic observation has identified the hazard of a chemical accident, the possibility of the event unfolding and its consequences are analyzed to determine the risk and the acceptability of the risk.

Based on the determined acceptability of the risk, the need for further analysis of the possible consequences for the plant and the immediate surroundings is established. For events where it is determined that the risk is acceptable, no further analysis is needed, as measures have been taken and are in place to reduce the risk level. Acceptable risks in the risk matrix are all risks that are not very high risks.

The assessment of the probability of an accident occurring has been conducted in several ways for a large number of installation elements, parts of installations, and technical-technological units of the plant:

- A historical approach was applied: statistical data on failures of individual system elements and system components of the plant were used.
- Hazard identification and event tree analysis were carried out to gain insight into possible event developments and possible consequences.
- A combined method (historical, analytical, analysis of previous events) was also used.

The probability of an accident occurring is obtained by considering the probability of the initial event and the probability of possible event developments.

The criteria for assessing the probability of an accident occurring, according to the Regulation on the contents and methodology of preparing the Accident Prevention Policy, Safety Report, and Accident Protection Plan[132] are shown in Table 49.

Table 49: Crieria for assessing the likelihood of an accident

High probability (10^0 - 10^{-1} event frequency/yr)	Medim probability (10^{-1} - 10^{-2} event frequency/yr)	Low probability ($<10^{-2}$ event frequency/yr)
• leakage of hazardous substances at pipeline joints, valves, etc. • spillage during liquid transfer and	• cracking of the liquid material pipeline • cracking of the pressure gas • pipeline	• cracking of the transport vessels • cracking of the storage vessel fire of the entire plant

131 Official Gazette of the RS, no. 41/2010, Available at Pravilnik o sadržini politike prevencije udesa
132 Official Gazette of the RS, no. 41/2010, Available at Pravilnik o sadržini politike prevencije udesa

• spillage of solids during manipulation • damage to unit packing of packaging and spillage of contents • leakage of liquids and spillage of solids in internal transport • leakage of gases under pressure from pipelines and other pressurized systems • created conditions for causing a fire or explosion in the hazard ZONE 2 • initial fires on installations	• spilling of the entire contents • from the liquid tank • spilling of auto and railway tanks in the complex after an accident • created conditions for fire and explosion in the hazard ZONE 1 • fire and explosion of a part of the plant • two or more high probability accidents at one location at the same time	• fire of the entire storage • explosion of the entire plant • explosion of the entire storage • created conditions for fire and explosion in the hazard ZONE 0 • two or more medium probability accidents in one location at the same time

Table 50: Estimated risk based on the criteria of probability of accident and possible consequences for the seveso plant.

Probability of accident	Consequences				
	Of a little importance	Significant	Serious	High	Catastrophic
Low	Negligible risk	Low risk	Medium risk	High risk	Very high risk*
Medium	Low risk	Medium risk	Big risk	Very high risk*	Very high risk*
High	Medium risk	Big risk	Very high risk*	Very high risk*	Very high risk*

*risk is not acceptable

In the assessment of the acceptability of the risk of accidents for the specified Waste-to-Energy Plant, both the probability of accident scenarios and the possible consequences were considered. The highest possible number of vulnerable objects that could be present in the vulnerable zone during the duration of the accident for each modeled scenario was taken into account.

If the risk is deemed unacceptable, the operation of the facility with this level of risk is not acceptable. In such a case, the plant operator is required to implement additional technical, technological, and other protective measures for the facility, technological process, equipment, and the organization of the safety and operation system to bring the risk within acceptable limits. These additional protective measures must be defined and designed through amendments and additions to the facility's technical documentation and included in the Accident Protection Plan after a detailed analysis of their implementation. Based on the defined and designed additional measures, a re-assessment of the chemical accident risk must be conducted.

The following table provides an overview of the risk assessment for the Waste-to-Energy Plant for the defined accident scenarios, in accordance with the criteria shown in Table 51.

Table 51: Assessment of the risk of accidents at the waste-to-energy plant according to defined accident scenarios

Accident scenario	Probability	Consequences	Risk
1	Low	Serious	Medium risk
2	Low	Significant	Low risk
3	Low	Significant	Low risk
4	Medium	Significant	Medium risk
5	Low	Significant	Low risk
6	Medium	Significant	Medium risk
7	Medium	Of little importance	Low risk
8	Medium	Of little importance	Low risk
9	Low	Significant	Low risk
10	Medium	Significant	Medium risk
11	Low	Significant	Low risk
12	Medium	Of little importance	Low risk
13	Low	Of little importance	Low risk
14	Low	Of little importance	Low risk

The risk of a chemical accident, which is expressed according to the criteria of the reference Regulation on the contents and methodology for preparing the Accident Prevention Policy, Safety Report, and Accident Protection Plan[133] as: negligible, low, medium, high, and very high risk, has been assessed as MEDIUM RISK for the Waste-to-Energy Plant.

7.6.10. Most important implications

Based on the analysis of the provided data, the probability of an accident occurring at the Waste-to-Energy Plant site is estimated as low to medium. As for the potential consequences, they can range from minor to significant, and even serious, depending on the specific scenario. The overall risk of an accident at the Waste-to-Energy Plant site is assessed as medium. However, considering the designed preventive measures, accident response measures, and the operation within the safety management system, this risk is considered acceptable and can be adequately managed.

On the other hand, at the Non-Hazardous Waste Landfill site, the probability of an accident occurring is estimated as low. The consequences of an accident in this case are defined as minor. The overall risk of an accident at the landfill is assessed as low, with the designed

[133] Official Gazette of the RS, no. 41/2010, Available at Pravilnik o sadržini politike prevencije udesa

preventive measures, implementation of response measures, and operation within the safety management system ensuring that this risk is also acceptable and subject to effective management.

A detailed description of all the designed preventive measures, as well as the accident response measures to be implemented, along with the entire safety management system for the Waste-to-Energy Plant and Non-Hazardous Waste Landfill sites, is provided in Chapter 8.2 of the Environmental Impact Assessment Study.

8. Health risk assessment

This section provides a comprehensive health risk assessment for the Waste-to-Energy (WtE) plant and the Non-Hazardous Waste Landfill (NHWL). The assessment includes detailed methodologies, real data on air quality, contamination indices, and cross-border considerations.

The health risk assessment was mainly based on the results obtained by modelling the adverse effects of proposed development and reference studies that could be applied to the case study. References are crucial in health impact assessment studies to ensure credibility, accuracy, and scientific rigor. They provide a foundation for understanding potential health effects by drawing on established research and real-world data. When evaluating pollutants or environmental exposures, references allow comparisons with previous studies, regulatory limits, and health thresholds established by authoritative bodies like the WHO or EPA.

The "factor of safety" is frequently applied to extrapolate findings from non-human studies or from high-dose scenarios to predict safe exposure levels for humans. This factor accounts for inter-species differences, variability in human sensitivity, and uncertainties in data, ensuring conservative and protective health standards.

The health risk assessment follows a structured four-step process:

1. Hazard Identification: The main hazards include air pollutants (PM10, PM2.5, NO_2, SO_2, dioxins, furans, VOCs, and heavy metals), water pollutants, and noise emissions.
2. Exposure Assessment:
    a. Air Quality: Continuous air quality monitoring conducted on both sides of the border, focusing on key pollutants such as PM10, PM2.5, NO_2, and dioxins.
    b. Water Quality: Potential contamination of the Danube River and groundwater have been regularly assessed, ensuring compliance with both Serbian and Romanian water quality standards.
    c. Noise Exposure: Noise levels have been monitored at sensitive receptor locations, including residential areas, schools, and hospitals.
3. Dose-Response Evaluation: Dose-response relationship for key pollutants is based on guidelines from the World Health Organization (WHO) and the European Environment Agency (EEA).
4. Risk Characterization.

<u>Key Pollutants and Associated Health Risks</u>

The health risk assessment evaluates the impact of key pollutants on human health and the environment, focusing on both their sources and mitigation measures. The following section outlines the primary pollutants of concern and their associated health risks.

- Particulate Matter (PM10, PM2.5)
    - Health Risks: Respiratory and cardiovascular diseases, increased hospital admissions, and premature mortality
    - Mitigation: Advanced filtration systems and regular air quality monitoring

- Nitrogen Oxides (NO_2)
    - Health Risks: Respiratory infections and lung function impairment.
    - Mitigation: Use of selective catalytic reduction (SCR) technology to minimize emissions.
- Sulfur Dioxide (SO_2)
    - Health risks: Respiratory irritation and exacerbation of asthma.
    - Mitigation: Scrubbers and real-time emission control systems
- Dioxins and Furans
    - Health risks: Long-term exposure can lead to cancer and developmental issues.
    - Mitigation: Activated carbon injection and high-temperature combustion to minimize formation
- Volatile Organic Compounds (VOCs)
    - Health risks: Neurological and respiratory effects
    - Mitigation: Use of activated carbon filters
- Heavy Metals (Lead, Mercury, Cadmium)
    - Health risks: Chronic exposure can result in neurological and kidney damage.
    - Mitigation: Proper waste handling and monitoring

Given the project's proximity to Romania and the potential for cross-border impacts, detailed data from Romanian environmental and health authorities have been reviewed to provide a comprehensive understanding of transboundary conditions.

According to the Romanian National Environmental Protection Agency (ANPM) 2022 report, the average annual concentration of PM10 in Mehedinți County was 22 µg/m³, below the EU limit of 40 µg/m³. Similarly, PM2.5 levels averaged 12 µg/m³, under the EU threshold of 25 µg/m³. However, occasional exceedances of daily PM10 limits were recorded during winter months due to residential heating and traffic emissions.

Water quality monitoring by Romanian authorities indicates compliance with EU Water Framework Directive standards for key pollutants such as nitrates and heavy metals. No significant cross-border pollution incidents have been reported, monitoring initiatives are recommended to enhance early detection and prevention of potential risks.

To ensure cross-border collaboration, a synchronized aligned monitoring program is proposed, including air and water quality monitoring stations. Data from Romanian health authorities show no significant increase in respiratory illnesses linked to industrial activities in recent years. In case of particular recognized requirement, health surveys could be managed by competent authorities in accordance with national legal framework.

When assessing health risks, it is crucial to consider the unique vulnerabilities of certain population groups. These groups often face disproportionate exposure or are more susceptible to the effects of pollution due to physiological, age-related, or health-related factors. This section highlights specific considerations for these populations:

- Children: Due to their developing respiratory systems and higher rates of air intake relative to body size, children are especially sensitive to air pollutants. Long-term exposure may lead to impaired lung development and cognitive deficits.

- Elderly: Older adults are at a heightened risk of cardiovascular and respiratory complications as they are more vulnerable to the cumulative effects of prolonged exposure to pollutants.
- People with pre-existing conditions: Those with conditions such as asthma, chronic obstructive pulmonary disease (COPD), and cardiovascular diseases may experience worsening symptoms and more frequent health crises due to pollution exposure.

To mitigate potential health and environmental impacts identified through the exposure assessment, the following measures are proposed:

- Air Quality Control:
    - Verification of advanced air filtration system operation adopted by the project holder for reduce PM10 and PM2.5 levels.
    - Continuous air quality monitoring at key locations.
- Water Quality Management:
    - Verification of advanced wastewater treatment technologies operation adopted by the project holder.
    - Regular water sampling and analysis.
- Soil Protection:
    - Use of protective barriers and proper waste management to prevent soil contamination as adopted by the project holder.
    - Periodic soil quality assessments.
- Noise Control:
    - Use of noise barriers and scheduling construction activities during daytime hours as adopted by the project holder.
    - Periodic noise level assessments.
- Community Engagement:
    - Establishment of a health advisory board, including representatives from local communities as planned in collaboration with the local community (please be refered to Report on the conducted public consultations, 2024).

Within collaboration with the civil sector meetings will also be held to present monitoring results and address community concerns. These mitigation measures aim to ensure public health protection, transparency, and effective environmental management throughout the project's lifecycle.

Quantitative tools play a critical role in assessing environmental impacts and determining the effectiveness of mitigation strategies. The following indices provide a structured approach to evaluating contamination and pollution levels, as well as the benefits of implemented measures.

Contamination and Pollution Indices

1. Contamination Index (CI): This index is calculated by dividing the measured pollutant level by the baseline (reference) level:
    a. Measured Level: The concentration of the pollutant measured at the site
    b. Baseline Level: The acceptable or reference concentration based on regulatory standards.

2. Pollution Index (PI): The Pollution Index is derived by dividing the Contamination Index by a threshold value (typically 1.5 for significant pollution levels).
3. Benefit Index (BI): The Benefit Index evaluates the net positive impact of the project by taking the reciprocal of the Contamination Index.

These indices help to quantify the environmental impact and prioritize necessary mitigation measures.

1. Contamination Index (CI): The contamination Index measures the degree of contamination by comparing the measured pollutant levels to baseline levels
2. Pollution Index (PI): The Pollution Index quantifies the overall pollution level and indicates whether mitigation is required.
3. Benefit Index (BI): The Benefit Index evaluates the net positive impact of the project in terms of waste reduction and energy recovery.

Table 52 provides an overview of environmental factors assessed for contamination and pollution.

Table 52: Environmental Contamination and Pollution Indices

Environmental Factor	Baseline Level (Source)	Measured Level (Source)	Contamination Index (CI)	Pollution Index (PI)	Benefit Index (BI)
Air	20 µg/m³ PM10 (ANPM)	30 µg/m³ PM10 ([Project Monitoring])	1.5	1.0	0.67
Water	10 mg/L Nitrates ([EU Directive 98/83])	15 mg/L Nitrates ([Local Monitoring])	1.5	1.0	0.67
Soil	5 mg/kg Lead ([WHO Guidelines])	7.5 mg/kg Lead ([Soil Sampling Report])	1.5	1.0	0.67

Incorporating references ensures the assessment aligns with global best practices, builds upon validated methodologies, and upholds the principle of minimizing harm while making scientifically informed decisions. Calculated CI, PI and BI indexes impose a need to consider continued monitoring and mitigation strategies as envisioned by nation and international legislative framework as adopted and outlined in this report and EIS by the project holder.

8.1. Hazard identification

According to Science Report P6-011/1/SR1[134] the general public can be exposed to pollutants associated with incinerators through a number of routes, with direct inhalation and indirect entry via the food chain of particular importance. For many pollutants from a incinerator including some of the trace metals, and carcinogenic organic compounds (such as dioxins and furans), the major route of exposure is through the food chain.

[134] Environment Agency, Health Impact Assessment of Waste Management: Methodological Aspects and Information Sources,

A number of substances are subject to regulations associated with waste disposal (e.g. the Waste Incineration Directive), whilst others have been detected in landfill gas[135]. The contaminants that are prioritized based on both their intrinsic toxicities and concentrations detected in emissions from waste disposal operations are:

- Arsenic
- Cadmium
- Chromium
- Lead
- Mercury
- Nickel
- Dioxines
- PCBs
- Particulate Matter
- SO_2
- Oxides of nitrogen

[135] Parker et al., 2002

8.2. Exposure assessment

This section focuses on the exposure assessment of contaminants emitted from the Waste-to-Energy (WtE) facility. The analysis evaluates key pollutants, including heavy metals, persistent organic pollutants, and combustion byproducts, identifying their expected emission levels, acute health effects, and primary exposure pathways. This assessment provides essential data for understanding the potential health risks associated with facility operations and for ensuring compliance with regulatory standards. The following table summarizes the sources, emissions, health impacts, and exposure pathways for each identified contaminant.

Table 53: Exposure Assessment of Contaminants Emitted from the Waste-to-Energy Facility

Contaminant	Origin	Health effects due to acute exposure	Expected emissions from WtE	Probable pathways
Arsenic	Emissions from incinerators will contain small amounts of arsenic and arsenic is also present in the solid waste residue and wastewater discharges. Many materials sent to landfill (including solid waste residues from incineration) will also contain arsenic.	Inhalation exposure can cause coughing, breathing difficulty, chest pain, and severe damage to the respiratory tract. Nasal perforations have also been noted following acute inhalation exposure. Ingestion can result severe gastrointestinal irritation and symptoms typically include vomiting, esophageal and abdominal pain, bloody "rice water" diarrhea and shock. Facial swelling, muscle cramps, cardiac abnormalities, anemia, decreased white blood cell count, and enlargement of the liver have also been noted	Aligned with BATc of BREF WI BAT-AEL as the maximal value is expected for total emission of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V 0,01-0,3 mg/Nm^3. For arsenic emissions in direct discharge into a water body/recipient, the BAT-AEL limit is set at 0,01–0,05 mg/l. The project envisions applying both dry (cyclone, bag filter, activated carbon filter) and wet flue gas treatment (2 cyclones in series) techniques to limit the emissions to the maximum of technical capabilities on the boiler stack. Expected emissions according to project documents of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V	Emissions to air (inhalation) Drinking water (ingestion) As a result of monitoring and regulatory emission limits, it is extremely unlikely that the general population could be exposed to concentrations high enough to cause acute effects. The intake of arsenic from air will, typically, be only a minor portion of the total intake from all sources. The intake of arsenic (primarily inorganic) from water is also typically extremely low. The conclusions have been collaborated via diffusion modelling of air

		in acute ingestions[136] (Meditext, 2002). These effects can be immediate or delayed in onset.	is 0,01 – 0,1 mg/Nm^3. The dry treatment utilizes cyclone separators and bag filters to eliminate fly ash and pollutants such as heavy metals and dioxins through adsorption on activated carbon. The wet treatment includes a two-stage scrubber system for cooling the flue gases, absorbing halogen compounds and sulfur oxides, and neutralizing acidic components, while also recovering byproducts such as gypsum. The wastewater treatment process includes initial neutralization in the acid reactor (pH 3-4) with slaked lime and polyelectrolytes, secondary neutralization in the neutralization reactor (pH 6-8), and a tertiary stage for pH adjustment, heavy metal precipitation with sulfur-based agents, and flocculation with $FeCl_3$. Final sedimentation separates solids, with sludge sent to the ash slurry reactor and treated water recirculated or discharged.	emissions and wastewater release flow modelling.

136 MEDITEXT System in Chemknowledge System, 2002 Heitland, GW (Ed). MICROMEDEX, Englewood, Colorado (CD-ROM) Vol. 52. 31 May 2002.

			Additionally, the estimated mass flow of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V is expected to be approximately 0,007 kg/h, based on operational conditions.	
Cadmium	Cadmium is emitted to the atmosphere predominantly as elemental cadmium and cadmium oxide and from some sources as cadmium sulfide (coal combustion and nonferrous metal production) or cadmium chloride (refuse incineration). Cadmium is also found in the solid waste residues and wastewater discharges from incinerators and many materials sent to landfill (including solid waste residues from incineration) or composting will also contain sources of cadmium.	Cadmium is a severe lung and gastrointestinal irritant that can be fatal by inhalation and ingestion (Meditext, 2002[137]). The symptoms of acute poisoning after inhalation exposure may be delayed 12 to 36 hours and may include chest pain, cough (with bloody sputum), difficulty breathing, sore throat, 'metal fume fever' (shivering, sweating, body pains, headache) dizziness, irritability, weakness, nausea, vomiting, diarrhea, tracheobronchitis, pneumonitis and pulmonary edema (Meditext, 2002[138]). Cadmium is also toxic by ingestion, with symptoms usually appearing in 15 to 30 minutes. These include abdominal pain, burning sensation, nausea,	Aligned with BATc of BREF WI BAT-AEL as the maximal value is expected for total emission of Cd+Tl is 0,005 – 0,02 mg/Nm^3. The BAT-AEL for direct discharge into a water body/recipient sets the limit for cadmium emissions at 0,005 – 0,03 mg/l. The project envisions applying both dry (cyclone, bag filter, activated carbon filter) and wet flue gas treatment (2 cyclones in series) techniques to limit the emissions to the maximum of technical capabilities on the boiler stack. Expected emissions according to project documents of Cd+Tl 0,005 – 0,01 mg/Nm^3. The dry treatment utilizes cyclone separators and bag filters to eliminate fly ash and pollutants such as heavy metals and dioxins	Emissions to air (inhalation) Drinking water (ingestion) Food-chain (ingestion) As a result of monitoring and regulatory emission limits, it is extremely unlikely that the general population will be exposed to concentrations high enough to cause acute effects. The conclusions have been collaborated via diffusion modelling of air emissions and wastewater release flow modelling However, there is concern over long-term exposure to low levels of cadmium, particularly via the food chain.

[137] MEDITEXT System in Chemknowledge System, 2002 Heitland, GW (Ed). MICROMEDEX, Englewood, Colorado (CD-ROM) Vol. 52. 31 May 2002.
[138] MEDITEXT System in Chemknowledge System, 2002 Heitland, GW (Ed). MICROMEDEX, Englewood, Colorado (CD-ROM) Vol. 52. 31 May 2002.

		vomiting, salivation, muscle cramps, vertigo, shock, unconsciousness and convulsions (Hazardtext, 2002[139]).	through adsorption on activated carbon. The wet treatment includes a two-stage scrubber system for cooling the flue gases, absorbing halogen compounds and sulfur oxides, and neutralizing acidic components, while also recovering byproducts such as gypsum. The wastewater treatment process includes initial neutralization in the acid reactor (pH 3-4) with slaked lime and polyelectrolytes, secondary neutralization in the neutralization reactor (pH 6-8), and a tertiary stage for pH adjustment, heavy metal precipitation with sulfur-based agents, and flocculation with $FeCl_3$. Final sedimentation separates solids, with sludge sent to the ash slurry reactor and treated water recirculated or discharged. Additionally, the estimated mass flow of Cd+Tl is expected to be approximately 7×10^{-4} kg/h, based on operational conditions.	

[139] HAZARDTEXT System in Chemknowledge System, 2002 Heitland, G. W. (Ed). MICROMEDEX, Englewood, Colorado (CD-ROM) Vol. 52. 31 May 2002.

Chromium	Emissions from incinerators will contain small amounts of chromium compounds and chromium is also present in the solid waste residue and wastewater discharges. Many materials sent to landfill (including solid waste residues from incineration) will contain sources of chromium.	Hexavalent chromium is corrosive by ingestion, inhalation and dermal contact and tissue damage, irritation and allergic reactions are all well documented. Acute toxicity can result in irritation causing wheeze and cough and in severe cases chest pain and fever. Hexavalent chromium can cause chronic respiratory tract irritation and can result in chronic ulceration of the nasal septum, and chronic rhinitis and laryngitis. However, acute toxicity resulting from environmental exposure is extremely uncommon, but chronic exposure to chromium may result in undesirable toxic effects.	Aligned with BATc of BREF WI BAT-AEL as the maximal value is expected for total emission of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V is 0,01-0,3 mg/Nm^3. The BAT-AEL for direct discharge into a water body/recipient sets the limit for chromium emissions at 0,01 – 0,1 mg/l. The project envisions applying both dry (cyclone, bag filter, activated carbon filter) and wet flue gas treatment (2 cyclones in series) techniques to limit the emissions to the maximum of technical capabilities on the boiler stack. Expected emissions according to project documents of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V is 0,01 – 0,1 mg/Nm^3 The dry treatment utilizes cyclone separators and bag filters to eliminate fly ash and pollutants such as heavy metals and dioxins through adsorption on activated carbon. The wet treatment includes a two-stage scrubber system for cooling the flue gases, absorbing halogen compounds and sulfur oxides, and neutralizing acidic components, while also	Emissions to air (inhalation and skin contact). As a result of monitoring and regulatory emission limits, it is extremely unlikely that the general population will be exposed to concentrations high enough to cause acute effects. The conclusions have been collaborated with diffusion modelling of air emissions. However, there is concern over the long-term effects of low-level exposure to chromium.

			recovering byproducts such as gypsum. The wastewater treatment process includes initial neutralization in the acid reactor (pH 3-4) with slaked lime and polyelectrolytes, secondary neutralization in the neutralization reactor (pH 6-8), and a tertiary stage for pH adjustment, heavy metal precipitation with sulfur-based agents, and flocculation with $FeCl_3$. Final sedimentation separates solids, with sludge sent to the ash slurry reactor and treated water recirculated or discharged. Additionally, the estimated mass flow of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V is expected to be approximately $7x10^{-3}$ kg/h, based on operational conditions.	
Lead	Emissions from incinerators will contain small amounts of lead and lead will also be present in the solid waste residue and wastewater discharges. Many materials sent to landfill (including solid waste residues from incineration) or	Lead is a cumulative toxin that affects a wide range of biochemical processes in the body. Pregnant women, the fetus, the new-born, infants and children up to the age of six are most susceptible to lead poisoning.	Aligned with BATc of BREF WI BAT-AEL as the maximal value is expected for total emission of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V is 0,01-0,3 mg/Nm^3. The BAT-AEL for direct discharge into a water body/recipient sets the limit for lead emissions at 0,02-0,06 mg/l.	Emission to air (inhalation) Food-chain from depositions on crops (ingestion) Food is the main source of lead intake for most people with beverages, vegetables and milk being the main food

	composting will also contain sources of lead.	The major effects of lead include anemia and effects on the nervous, reproductive, cardiovascular, hepatic, renal, endocrinal and gastrointestinal systems. Acute poisoning from a single exposure is rare.	The project envisions applying both dry (cyclone, bag filter, activated carbon filter) and wet flue gas treatment (2 cyclones in series) techniques to limit the emissions to the maximum of technical capabilities on the boiler stack. Expected emissions according to project documents of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V is 0,01 – 0,1 mg/Nm^3 The dry treatment utilizes cyclone separators and bag filters to eliminate fly ash and pollutants such as heavy metals and dioxins through adsorption on activated carbon. The wet treatment includes a two-stage scrubber system for cooling the flue gases, absorbing halogen compounds and sulfur oxides, and neutralizing acidic components, while also recovering byproducts such as gypsum. The wastewater treatment process includes initial neutralization in the acid reactor (pH 3-4) with slaked lime and polyelectrolytes, secondary neutralization in the neutralization reactor (pH 6-8), and a tertiary stage for pH adjustment,	groups containing lead. Lead may enter food through the deposition of dust and rain, containing the metal, on crops. In root crops, the contribution of deposited lead to the lead content of the edible portion of the plant is probably slight, but in leafy crops and cereals it may be more important. The diffusion modelling indicated negligible cumulative effect of air emissions to the environment.

			heavy metal precipitation with sulfur-based agents, and flocculation with $FeCl_3$. Final sedimentation separates solids, with sludge sent to the ash slurry reactor and treated water recirculated or discharged. Additionally, the estimated mass flow of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V is expected to be approximately $7x10^{-3}$ kg/h, based on operational conditions.	
Mercury	Mercury is found in the solid waste residues and wastewater discharges from incinerators and many materials sent to landfill (including solid waste residues from incineration) or composting will also contain sources of mercury.	Vapor inhalation can cause coughing, chest pains, dyspnea, nausea, vomiting and hemoptysis (coughing up of blood), diarrhea and general malaise. Exposure to high concentrations causes severe respiratory damage including corrosive bronchitis and interstitial pneumonitis and death from respiratory insufficiency. Other symptoms, which may appear within a few hours of vapor exposure, include weakness, chills, metallic taste and visual	Aligned with BATc of BREF WI BAT-AEL as the maximal value is expected for total emission of Hg is < 5 – 20 µg/m^3 Reception of electronic waste which is a frequent carrier of Hg will not be allowed. The project envisions applying suitable dry (activated carbon filter) and wet (2 cyclones in series) flue gas treatment techniques to limit Hg emissions to the maximum of technical capabilities on the boiler stack. Expected emissions according to project documents of Hg is 2 – 10 µg/m^3. Additionally, the estimated mass flow of Hg is	Emission to air (inhalation and skin contact). As a result of monitoring and regulatory emission limits, it is extremely unlikely that the general population will be exposed to concentrations high enough to cause acute effects. However, chronic exposure can have health effects. Symptoms of chronic exposure include mouth and gum inflammation, excess salivation, loose teeth, kidney damage, muscle tremors, jerky gait, and limb spasms. Chronic effects can include central nervous system

		disturbances (Meditext, 2002)[140]. Delayed effects from acute exposure include central nervous system effects and renal damage, gingivitis, and stomatitis (Meditext, 2002)[141]. Psychotic reactions characterized by delirium, hallucinations, and suicidal tendency have been reported. Both metallic mercury vapor and mercury compounds have given rise to contact dermatitis (WHO, 1991b)[142].	expected to be approximately 1,4x10^{-3} kg/h, based on operational conditions.	effects such as personality changes, hallucinations, delirium, insomnia, decreased appetite, irritability, headache and memory loss (Meditext, 2002; WHO, 1991b). The diffusion modelling indicated negligible cumulative effect of air emissions to the overall air quality.
Nickel	Nickel is also found in the solid waste residues and wastewater discharges from incinerators and many materials sent to landfill (including solid waste residues from incineration) or composting will also contain sources of nickel.	In terms of human health effects, nickel carbonyl is the most acutely toxic nickel compound. The effects of acute nickel carbonyl poisoning include frontal headache, vertigo, nausea, vomiting, insomnia, and irritability, followed by pulmonary symptoms similar to those of a viral pneumonia	Aligned with BATc of BREF WI BAT-AEL as the maximal value is expected for total emission of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V is 0,01-0,3 mg/Nm^3. The BAT-AEL for direct discharge into a water body/recipient sets the limit for nickel emissions at 0,03 – 0,05 mg/l. The project envisions applying both dry (cyclone, bag filter, activated carbon filter) and wet flue	As a result of monitoring and regulatory emission limits, it is extremely unlikely that the general population will be exposed to concentrations high enough to cause acute effects. However, some nickel compounds are considered to be possible human carcinogens, particularly in some occupational situations and IARC have classified

[140] MEDITEXT System in Chemknowledge System, 2002 Heitland, GW (Ed). MICROMEDEX, Englewood, Colorado (CD-ROM) Vol. 52. 31 May 2002.
[141] MEDITEXT System in Chemknowledge System, 2002 Heitland, GW (Ed). MICROMEDEX, Englewood, Colorado (CD-ROM) Vol. 52. 31 May 2002.
[142] World Health organization, 1991

		(WHO, 1991a)[143]. Pathological pulmonary lesions include hemorrhage, oedema, and cellular derangement. Liver, kidneys, adrenal glands, spleen, and brain are also affected. Cases of nickel poisoning have also been reported in patients dialyzed with nickel contaminated dialysate and in electroplaters who accidentally ingested water contaminated with nickel sulfate and nickel chloride (WHO, 1991a)[144].	gas treatment (2 cyclones in series) techniques to limit the emissions to the maximum of technical capabilities on the boiler stack. Expected emissions according to project documents of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V is 0,01 – 0,1 mg/Nm^3 The dry treatment utilizes cyclone separators and bag filters to eliminate fly ash and pollutants such as heavy metals and dioxins through adsorption on activated carbon. The wet treatment includes a two-stage scrubber system for cooling the flue gases, absorbing halogen compounds and sulfur oxides, and neutralizing acidic components, while also recovering byproducts such as gypsum. The wastewater treatment process includes initial neutralization in the acid reactor (pH 3-4) with slaked lime and polyelectrolytes, secondary neutralization in the neutralization reactor (pH 6-8), and a tertiary stage for pH adjustment,	inhaled nickel compounds as carcinogenic to humans. However, there appears to be little or no carcinogenic risk associated with current occupational exposure levels (WHO, 1991a). There is a lack of evidence regarding the possibility of carcinogenicity by the oral route. Nickel does not appear to be mutagenic, but it may cause chromosome aberrations following exposure to very high levels. However, the levels of nickel associated with emissions from waste management could not be great enough to pose a health risk to the public. The conclusions have been collaborated with diffusion modelling of air emissions.

143 World Health organization, 1991
144 World Health organization, 1991

			heavy metal precipitation with sulfur-based agents, and flocculation with $FeCl_3$. Final sedimentation separates solids, with sludge sent to the ash slurry reactor and treated water recirculated or discharged. Additionally, the estimated mass flow of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V is expected to be approximately 7×10^{-3} kg/h, based on operational conditions.	
Dioxins	Dioxins are found as trace contaminants in some chlorinated industrial and agricultural chemicals. They are also formed by combustion of some wastes, by burning fossil fuel and in forest fires. Dioxins are a family of substances with similar properties, and they are ubiquitous in the environment, although at very low levels. Dioxins have low volatility and water solubility, a high lipophilicity, an extremely long environmental half-life and can accumulate in biological tissues leading to	The effects of acute exposure are typically dermal, characterized by the disfiguring skin condition, chloracne, but data from occupational or accidental exposures suggest other symptoms such as liver fibrosis, nausea, vomiting, headaches, severe muscular aches and pains, fatigue, loss of appetite and weight loss. However, acute toxicity resulting from environmental exposure is extremely uncommon, but there are concerns that chronic exposure	Aligned with BATc of BREF WI BAT-AEL as the maximal value is expected for total emission of PCDD/F is <0,01-0,04 ng I-TEQ/Nm^3 for new facilities/over average sampling period. The temperature range of operations are designed on the flue gas side to avoid dioxins reformation. Moreover, the design of active carbon adsorption, wet scrubbing and selective catalytic reduction unit actively reduces dioxin levels on the emitting stack Expected emissions according to	Food-chain (ingestion) The principal pathway for exposure to dioxin-like chemicals is food. Food contamination occurs mainly through the contamination of plants by airborne dioxins, which because of their hydrophobicity and extreme persistence accumulate in the lipid reservoirs of animals consuming those plants. Actual plant uptake of dioxins from soil is minimal because dioxins become strongly bound to soil, which greatly reduces their bioavailability. Contamination of

	bioconcentration in the food-chain. They will tend to adsorb to particles, soils and sediment. For example, airborne dioxins will attach to particles and will be deposited from the air with the particles.	to low levels of dioxins may have serious consequences.	project documents of PCDD/F is 0,01-0,04 ng I-TEQ/Nm^3. Additionally, the estimated mass flow of dioxins is expected to be approximately 2,8x10^{-9} kg/h, based on operational conditions.	the food chain may also occur when animals consume soil containing dioxins during feeding. This may result in increases in the levels in milk, meat and eggs over the normal background levels. Approximately 95% of human exposure is estimated to occur through the diet with the consumption of fats and fatty foods being the predominant sources. Exposure to dioxins in drinking water is considered negligible because of the hydrophobic properties of dioxin-like chemicals. Likewise, inhalation exposure is low owing to the low vapor pressures of these contaminants. The diffusion modelling indicated negligible cumulative effect of air emissions to the environment.
Polychlorinated Biphenyls (PCBs)	They were used widely in electrical equipment such as transformers and capacitors, but manufacture ceased in the	The assessment of health effects in humans because of exposure to PCBs is complicated by the presence of	Aligned with BATc of BREF WI BAT-AEL is expected for total emission of PCDD/F+dioxin-like PCB as the maximal value is	There is a potential for exposure of individuals living near sources of PCBs from dust and soil to which PCBs

	1970s and they were gradually phased out. They are now banned from use but continue to be introduced into the environment in electrical waste, although significant controls have been introduced in most countries. They always occur in mixtures and are frequently associated with chlorinated dibenzodioxins and dibenzofurans. There are 209 theoretical congeners but in practice only 130 are found in commercial PCB mixtures.	differing congeners of differing toxicity and the presence of PCDDs and PCDFs. In addition, some PCBs are included in the risk assessment of PCDDs as dioxin like PCBs. These are included in the WHO Toxicity Equivalents for dioxins and consist of 4 “non-ortho” PCBs and 8 “mono-ortho” PCBs. The majority of these compounds are significantly less active than 2,3,7,8-tetrachlorodibenzodioxin, which is the benchmark against which the others are measured. However, 3,3,’4,4,’5-pentachlorobiphenyl and 3,3’,4,4’5,5’-hexachlorobiphenyl are much more active than the others (WHO JECFA, 2001)[145].	<0,01-0,06 ng WHO-TEQ/Nm^3 for new facilities/over average sampling period. There will be no treatment of waste containing PCBs on the facility as well as material with more than 1 wt.% organic halogenates which could be precursors for PCB formation. Moreover, the design of active carbon adsorption, wet scrubbing and selective catalytic reduction unit actively reduces POPs (including PCBs) levels on the emitting stack Expected emissions according to project documents of PCDD/F+dioxin-like PCB is 0,01-0,04 ng WHO-TEQ/Nm^3. Additionally, the estimated mass flow of PCBs is expected to be approximately 2,8x10^{-9} kg/h, based on operational conditions.	may be adsorbed. Since they are also of varying volatility, there is also potential for deposition in particles washed from the atmosphere by rainfall. The diffusion modelling indicated negligible cumulative potential of air emissions to the environment.
Particulate Matter	Emissions from incinerators can be a source of particles and there are strict regulatory limits on the number of particles emitted. Combustion	Toxicological studies indicate that it is the fine and particularly the ultra-fine particles (<0.10 µm) that are most strongly associated with	Aligned with BATc of BREF WI BAT-AEL as the maximal value is expected for total emission of dust < 2 – 5 mg/m^3	Air emission Inhalation is the major route of exposure to airborne particles and those particles that

[145] World Health Organization, Joint FAO/WHO Expert Committee on Food Additives (JECFA), 2001.

	sources tend to produce small particles made up mainly of carbon with other material adsorbed onto the surfaces of the particles and blended in their interiors.	adverse health effects. The ultra-fine particles appear to be capable of producing inflammatory reactions in the lungs and of promoting the clotting of blood. Even though they would account for only a small proportion of the total mass of PM10, they may represent a high proportion of the number of particles present. The main sources of other such particles are road transport and combustion processes.	Project document has envisioned treatment of the flue gases before releasing into the atmosphere. The treatment includes system for dry treatment (bag filters and activated carbon reactor), wet treatment system of gases (scrubber system/ HCl systema and SO_2 system) and catalytic reduction of NO_x. Expected emissions according to project documents of dust is between 1 and 3 mg/m^3. Additionally, the estimated mass flow of dust is expected to be approximately 0,35 kg/h, based on operational conditions.	penetrate deep into the lungs are of greatest concern. The diffusion modelling indicated negligible cumulative effect of air emissions to the overall air quality.
Sulphur dioxide	Emissions from combustion plants including incinerators can also be a source of SO_2 and there are strict regulatory limits on the amount of SO_2 emitted. Other waste disposal options are unlikely to be major emitters of SO_2.	Typically, asthmatics may experience tightness of the chest, coughing and a deterioration of lung function on exposure to SO_2 concentrations exceeding 262 µg/m3 (100-200 ppb over a few minutes). An annual mean concentration of SO_2 of 60-140 µg/m3 is associated with increased respiratory symptoms in adults and there are reports that concentrations of between 140-200 µg/m3	Aligned with BATc of BREF WI BAT-AEL as the maximal value is expected for total emission of SO_2 is 5 – 30 mg/m^3. Project document has envisioned treatment of the flue gases before releasing into the atmosphere. The treatment includes system for dry treatment (bag filters and activated carbon reactor), wet treatment system of gases (scrubber system/ HCl systema and SO_2 system) and catalytic reduction of NO_x.	Air emission Inhalation is the major route of exposure and SO_2 is a potent respiratory irritant, and both causes and aggravates symptoms particularly in subjects with pre-existing asthma. Typically, atmospheric levels of SO_2 tend to fluctuate widely from day to day and show a marked seasonal pattern with levels tending to be higher during the winter. Existing emitters are the

		increase respiratory illness in children. Current evidence suggests that there is not a threshold of effect of SO_2 for either mortality or hospital admissions. In addition, the effects of SO_2 may be magnified during co-exposure to other air pollutants such as particulates and nitrogen dioxide (NO_2). There is evidence that children may be more susceptible to SO_2 when co-exposed to particulates, while co-exposure to SO_2 and NO_2 can increase the sensitivity to allergens of some patients with asthma.	Expected emissions according to project documents of SO_2 is between 10 and 30 mg/m^3. Additionally, the estimated mass flow of SO_2 is expected to be approximately 2,1 kg/h, based on operational conditions.	dominant factor influencing Sulphur dioxide emissions. Very rare episodic elevated values might be noted in the vicinity of the Industrial complex due to unfavorable meteorological conditions.
Oxides of Nitrogen	Emissions from combustion plants including incinerators can also be a source of NO and there are strict regulatory limits on the amount of NO emitted. Other waste disposal options are unlikely to be major emitters of NO.	Exposure to concentrations of approximately 560 µg/m^3 (300 ppb) for 30 minutes can produce small effects on the lung function of asthmatics, while in non-asthmatics exposure to concentrations of 1800 µg/m^3 (1 ppm) is necessary to produce the same response (EPAQS, 1996)[146]. Adverse effects are unlikely to occur below a concentration of	Aligned with BATc of BREF WI BAT-AEL as the maximal value is expected for total emission of NOx is 50 – 120 mg/m^3. Project document has envisioned treatment of the flue gases before releasing into the atmosphere. The treatment includes system for dry treatment (bag filters and activated carbon reactor), wet treatment	Inhalation is the main source of exposure and NO_2 is an irritant of the airways. Exposure to high concentrations can produce narrowing of the airways (bronchoconstriction) in both asthmatic and non-asthmatic individuals. The diffusion modelling indicated negligible cumulative effect of

[146] EPAQS, Expert Panel on Air Quality Standards; 1996.

		200 ppb (400 µg/m^3) for a 1-hour exposure.	system of gases (scrubber system/ HCl systema and SO_2 system) and catalytic reduction (SCR) of NO_x. Expected emissions according to project documents of NOx is between 30 and 50 mg/m^3.	air emissions to the overall air quality.

The provided figures below illustrate the modeled maximum ground-level concentrations of key pollutants emitted by the Waste-to-Energy facility. These visualizations capture the spatial distribution and intensity of emissions, including particulate matter (PM10), mercury, dioxins, PCBs, sulfur dioxide (SO_2), and nitrogen dioxide (NO_2), over defined time periods such as daily averages or hourly peaks. The data highlights areas with the highest potential exposure and provides critical insights into the effectiveness of emission control measures in minimizing environmental and health risks.

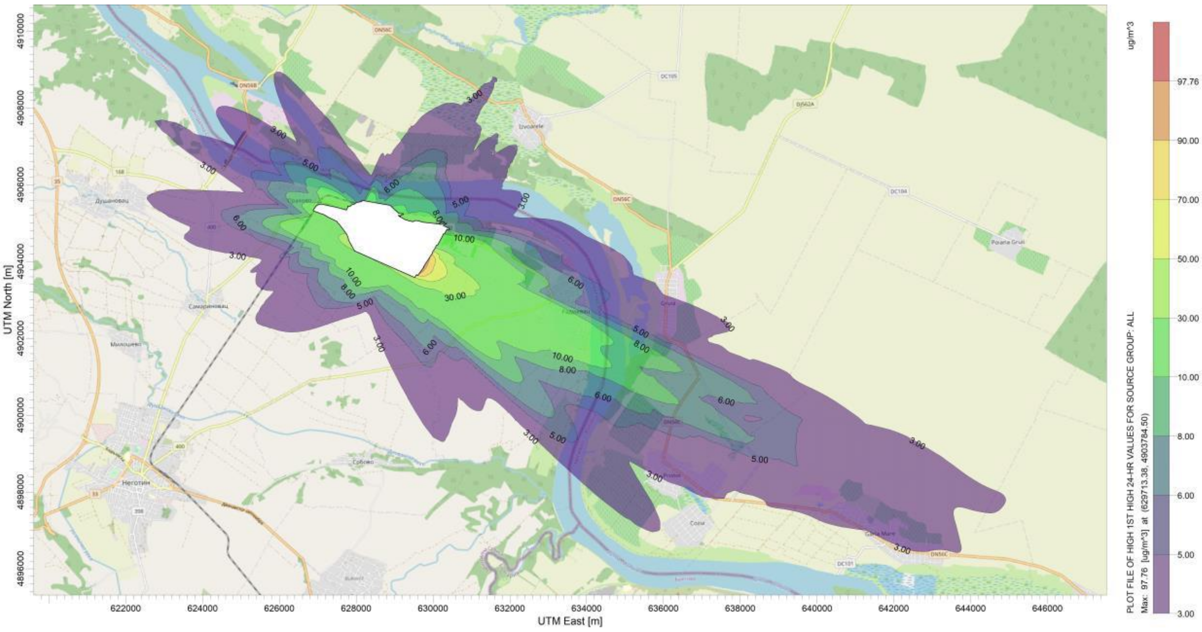

Figure 23. Max concentration of ground PM10 for average period of one day (μg/m³)

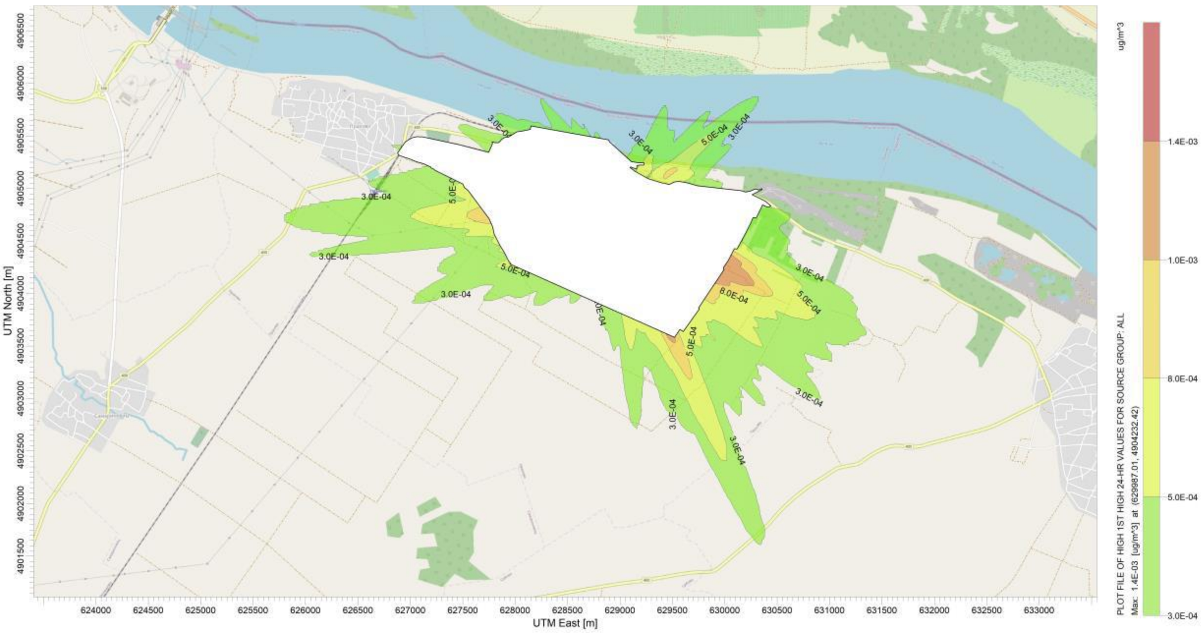

Figure 14. Max ground concentration of mercury for average period of one day (μg/m³)

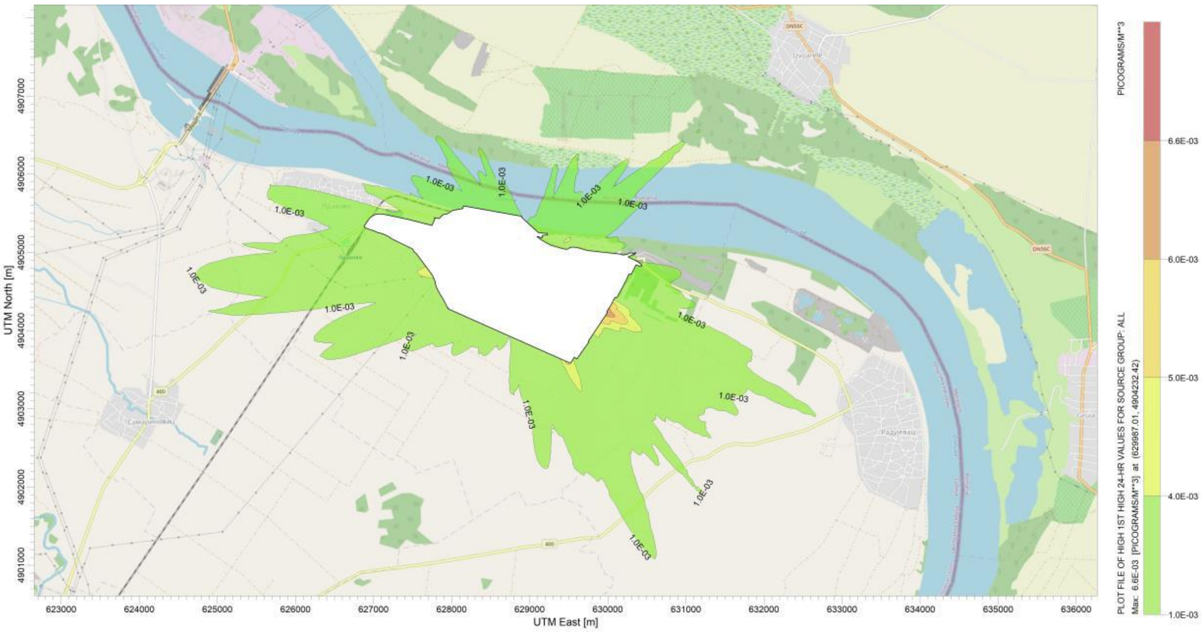

Figure 25. Max ground concentration of PCDD/F and dioxins as PCBs for average period of one day (pg/m^3)

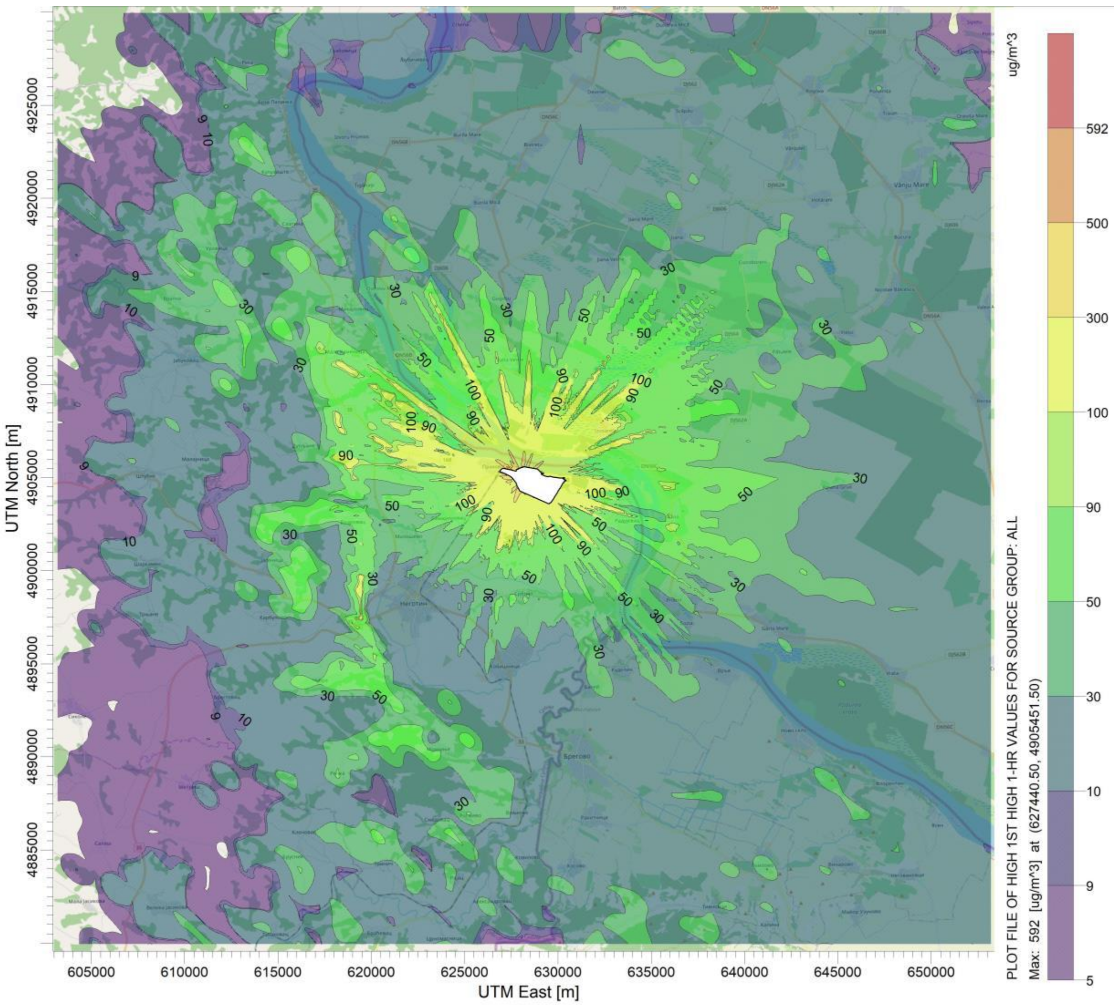

Figure 26. Max concentration of ground SO_2 for period of one hour [μg/m^3]

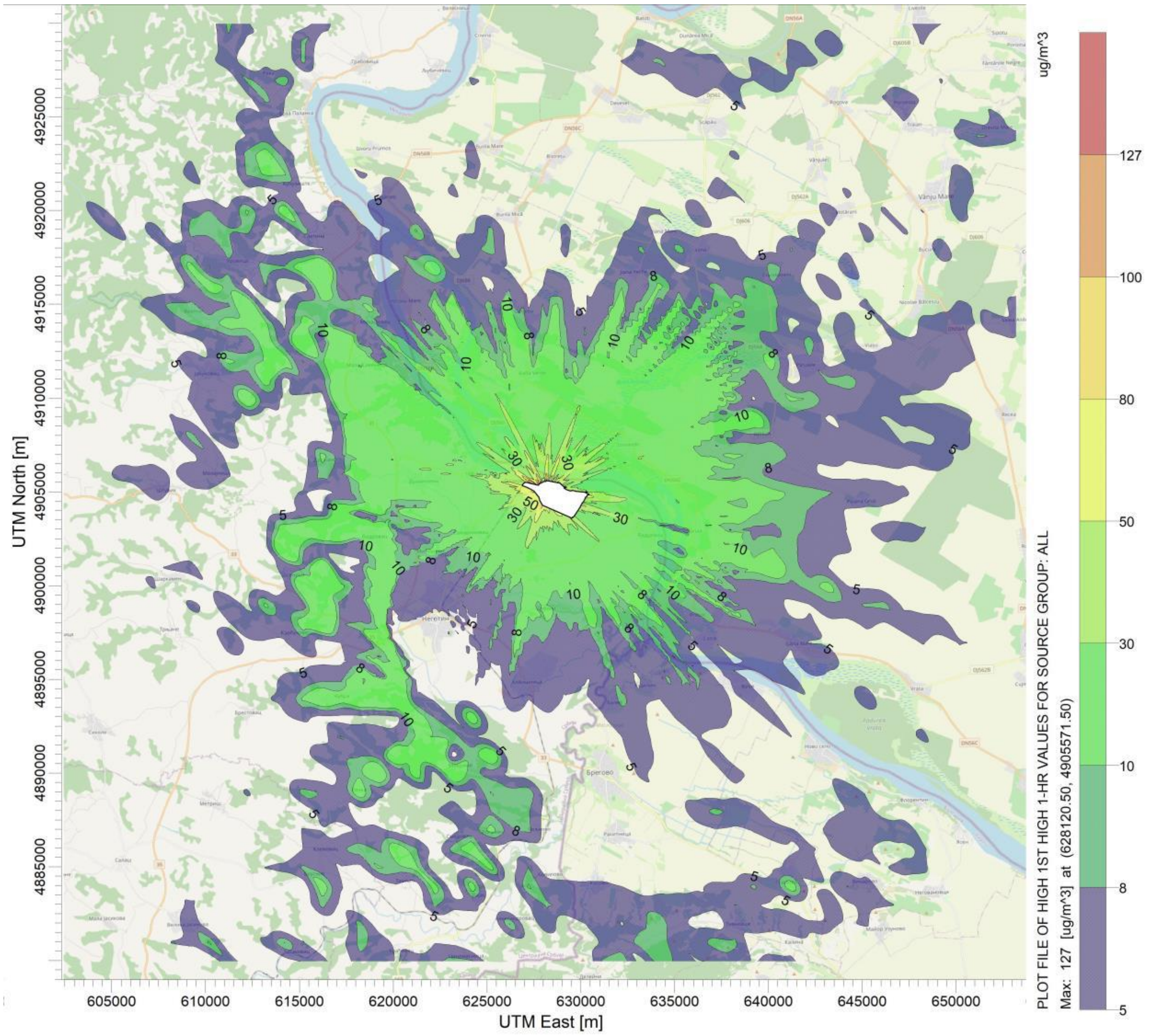

Figure 27. Max concentration of ground NO_2 for average period of 1 hour [μg/m^3]

The exposure assessment indicates that the emissions from the WtE facility, as outlined in project documents, are expected to remain within permissible regulatory limits with negligible to no impact on the air quality in Romania, minimizing the likelihood of acute health effects among the general population. Monitoring and emission control technologies, including dry and wet treatment systems and catalytic reduction processes, significantly reduce potential risks.

For most contaminants, the primary pathway of exposure is through inhalation of airborne particles, with secondary pathways involving ingestion via the food chain or drinking water. While acute health effects from these emissions are unlikely, the assessment underscores the importance of long-term monitoring to address potential cumulative and chronic effects, particularly for vulnerable groups such as children and individuals with pre-existing conditions.

Figure 28. shows modelling resultes for TVOC in the case when the boiler plant is not in operation, i.e whet this pollutant is emitted from the emitter of the waste preparation plant. The highest concentrations obtained by modelling, for the averaging period of one day, can be observed imediately next to the northern limit of the property amount of 5.59 μg/m^3. Bearing in

mind the stated indicative limit value (400 μg/m³) for the concentration of TVOC indoors, it can be concluded that the model gives values far below this thershold.

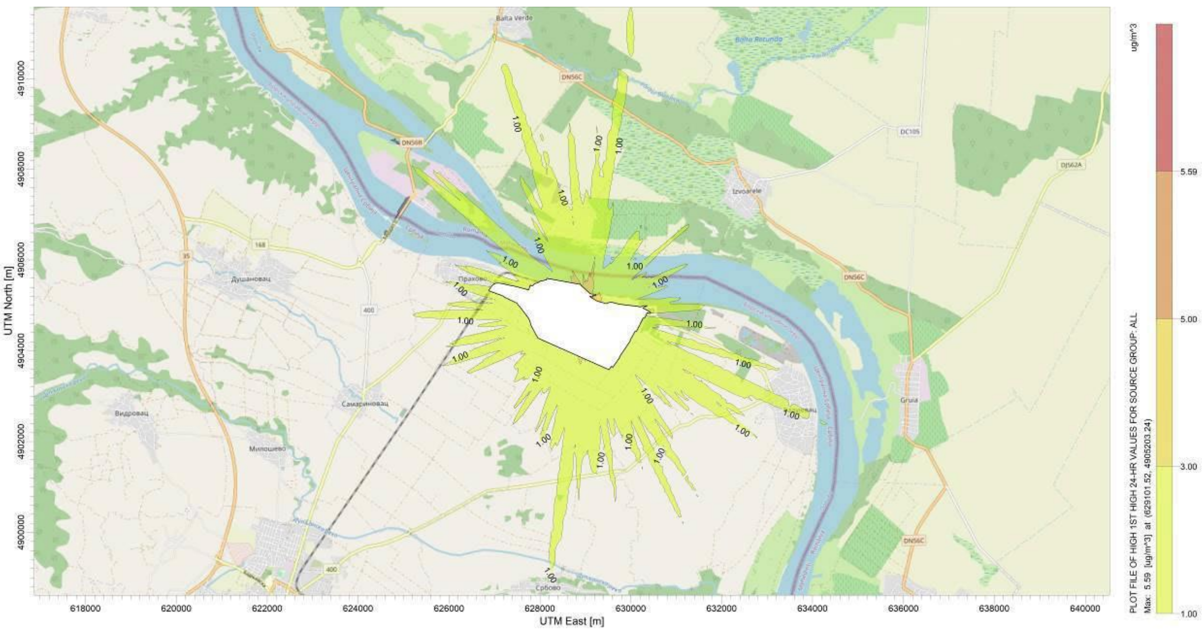

Figure 28. Maximum ground level TVOC concentrations for averaging period of one day [μg/m³]

These results provide a robust confirmation that the emission levels of TVOC are far below the threshold associated with odor detection, ensuring that no odor impact will occur in the surrounding areas. This includes neighboring regions and the Romanian population, thereby affirming that air quality remains well within acceptable regulatory limits and free from any perceptible odors, even under the modeled worst-case conditions.

In conclusion, the data support that with the proper implementation of emission control systems and adherence to regulatory standards, the risks associated with the facility's emissions can be effectively managed, ensuring protection for both public health and the environment. Further recommendations include enhanced monitoring of sensitive pathways, such as the food chain and water sources, to mitigate any unforeseen risks.

8.3. Dose-response evaluation

This section focuses on dose-response evaluation, examining the relationship between exposure to specific contaminants and their potential health effects. This evaluation integrates epidemiological data, toxicological benchmarks, and modeling results to determine the risks associated with contaminants such as arsenic, cadmium, chromium, lead, mercury, nickel, dioxins, PCBs, particulate matter (PM10 and PM2.5), sulfur dioxide, and nitrogen oxides. The analysis includes the projected concentrations of these substances in air and water, as well as their potential pathways of exposure, such as inhalation, ingestion, and deposition in the food chain. This comprehensive evaluation is critical for understanding the potential health impacts on exposed populations and informing risk mitigation strategies.

Table 54: Dose-response Evaluation of Contaminants and Modeled Exposure Results

Contaminant	Evaluation	Results from the modelling
Arsenic	Epidemiological studies strongly indicate a clear dose-response relationship between drinking water concentrations and the risk of skin cancer. Increased risks of lung and bladder cancer and of arsenic-associated skin lesions have been observed at drinking-water concentrations of less than 50 µg/l (WHO, 2001b). The World Health Organization considers a drinking water concentration of 10 µg/l to be associated with an estimated excess lifetime risk of skin cancer of 6 x 10^{-4} (WHO, 1996a; WHO, 2001b[147]). Routine monitoring of drinking water supplies in the UK makes the potential for exposure to such concentrations above the water quality standard highly unlikely.	Arsenic has not been addressed separately in modelling of future air emissions but through modelling of PM10 and PM2.5. The analysis of ground-level PM10 concentrations shows that the rarely expected maximum observed value is 97.76 µg/m³, exceeding the regulatory limit of 50 µg/m³. This high concentration, primarily caused by meteorological conditions and the phosphogypsum disposal site as the source, is localized along the eastern part of the planned landfill and the southeastern industrial boundary. Most other areas remain well below the regulatory limit. The 90.40th percentile of maximum PM10 values is 38.5 µg/m³, which is within acceptable limits. Further analysis over a five-year period (1826 days) indicates a maximum of 96 days with daily

[147] WHO, 1996a Guidelines for Drinking-Water Quality, Volume 2: Health criteria and other supporting information. Second Edition. Geneva: WHO; WHO, 2001b World Health Organization Fact Sheet No 2010. Arsenic in drinking water. May 2001. Geneva: WHO.

		average exceedances at specific receptors, averaging less than 20 days annually. These exceedances are rare and occur only under extreme meteorological conditions (Figure 23). The annual average PM2.5 concentrations shown in the analysis indicate a maximum modeled value of 2.38 µg/m³ near the southern industrial boundary. This value is significantly below the regulatory limit of 25 µg/m³, confirming that the concentrations are well within safe limits. Considering that the origin of the PM2.5 and PM10 is dominantly phosphogypsum, the exposure to arsenic cannot be expected. Arsenic emission was indirectly estimated using PM10 modeling data. It was assumed that all PM emissions are from stacks and then relative concentration of arsenic was used to calculate the fraction of PM belonging to arsenic. The highest modeled PM10 concentration of 97.76 µg/m^3 was used to calculate a maximal one time exposure of 1.15 µg/m^3, assuming a consistent contribution of arsenic within PM10 emissions under worst-case meteorological conditions. This is an exaggerated estimate considering that for the calculation it was asssumed that stacks are the only contributors in order to calculate a theoretical exposure, while the modelling results prove that surface source, phosphogypsum, is the dominant PM10/PM2,5 source. The modelling of contaminants in Danube 100 and 200 m downstream from discharge resulted in expected concentration of As between 1,4x10^{-5} mg/l and 7x10^{-6} mg/l respectively. Therefore, the values are more than 7000 and 14000 times lower respectively than the concentration with noted risk of health complications. Obviously, the dilution downstream from the

		calculation points of 200m from discharge is significantly higher further lowering any potential for drinking water exposure.
Cadmium	The US Environmental Protection Agency Integrated Risk Information System (IRIS) has derived an inhalation unit risk for cancer of 1.8 x 10-3 per µg/m3 (IRIS, 2002)[148]. However, emissions to atmosphere from waste disposal operations should only represent a small part of the overall background level of cadmium in ambient air. IRIS sets an oral reference dose (RfD) (based on the assumption that a threshold exists for certain effects) of 3 µg/kg/day (food) and 0.5 µg/kg/day (water) (IRIS, 2002)[149]. The Joint FAO/WHO Expert Committee on Food Additives (JECFA)[150] has established a Provisional Tolerable Weekly Intake of 0.015 mg/kg bodyweight (WHO, 2002a)[151]. Average daily intake from food in most countries is probably at the lower end of the range of 10-25 µg (WHO, 1992) and in the UK the estimated general population exposure to cadmium through the diet is about 12 µg/day (approximately 0.17µg/kg/day for a 70 kg adult) (FSA, 2000a)[152]. The recent recommendation by the World Health Organization of a guideline of 5 ng/m^3 specifically to prevent any further increase of cadmium in agricultural soils, which could increase the dietary intake of future generations, also reduces the potential for exposure to potentially harmful concentrations (WHO, 2000a)[153]. Rigorous monitoring of drinking water supplies	Cadmium has not been addressed separately in modelling of future air emissions but through modelling of PM10 and PM2.5. (see under Arsenic for details). Cadmium emission was indirectly estimated using PM10 modeling data. It was assumed that all PM emissions are from stacks and then relative concentration of cadmium was used to calculate the fraction of PM belonging to cadmium. The highest modeled PM10 concentration of 97.76 µg/m^3 was used to calculate a maximal one time exposure of 0.115 µg/m^3, assuming a consistent contribution of cadmium within PM10 emissions under worst-case meteorological conditions. This is an exaggerated estimate considering that for the calculation it was asssumed that stacks are the dominant contributors in order to calculate a theoretical exposure, while the modelling results prove that surface source, phosphogypsum, is the dominant PM10/PM2,5 source. The modelling of contaminants in Danube 100 and 200 m downstream from discharge resulted in expected concentration of Cd between 1x10^{-5} mg/l and 5x10^{-6} mg/l respectively. With the assumption of 2 l per day of drinking water intake the values are 600 and 1200 times lower respectively than UK diet exposure.

[148] United States Environmental Protection Agency. (2002). Integrated Risk Information System (IRIS) Database. Washington, DC: US EPA.
[149] United States Environmental Protection Agency. (2002). Integrated Risk Information System (IRIS) Database. Washington, DC: US EPA.
[150] Joint FAO/WHO Expert Committee on Food Additives. (2001). Evaluation of Certain Food Additives and Contaminants. WHO Technical Report Series No. 909, Geneva: WHO.
[151] World Health Organization. (2002). Safety Evaluation of Certain Food Additives and Contaminants (WHO Food Additives Series 48). Geneva: WHO.
[152] UK Food Standards Agency. (2000). Food Surveillance Information
[153] World Health Organization. (2000). Air Quality Guidelines for Europe. 2nd ed. WHO Regional Office for Europe, Copenhagen.

	makes the potential for exposure above the oral reference dose highly unlikely.	Obviously, the dilution downstream from the calculation points of 200m from discharge is significantly higher further lowering any potential for drinking water exposure.
Chromium	The World Health Organization does not recommend a safe level for inhalation exposure and estimates the lifetime risk of cancer at an air concentration of 1 µg/m³ to be 4 x 10^{-2} (WHO, 2000a)[154]. The USEPA IRIS reference concentration for chronic inhalation exposure to chromic acid mists and dissolved hexavalent chromium aerosols is 0.008 µg/m³ and for hexavalent chromium particulates it is 0.1 µg/m³ (IRIS, 2002)[155].	Chromium has not been addressed separately in modelling of future air emissions but through modelling of PM10 and PM2.5. (see under Arsenic for details). Chromium emission was indirectly estimated using PM10 modeling data. It was assumed that all PM emissions are from stacks and then relative concentration of chromium was used to calculate the fraction of PM belonging to chromium. The highest modeled PM10 concentration of 97.76 µg/m³ was used to calculate a maximal one time exposure of 1.15 µg/m³, assuming a consistent contribution of chromium within PM10 emissions under worst-case meteorological conditions. This is an exaggerated estimate considering that for the calculation it was asssumed that stacks are the only contributors in order to calculate a theoretical exposure, while the modelling results prove that surface source, phosphogypsum, is the dominant PM10/PM2,5 source. Moreover, it was assumed that maximal potential emitted concentration of Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V is equivalent to concentration of chromium further exaggerating the potential emission. In conclusion it is obvious that chromium exposure is below the set threshold. The modelling of contaminants in Danube 100 and 200 m downstream from discharge resulted in expected concentration of Cr between 1,4x10^{-5} mg/l and 7x10^{-6} respectively.

154 World Health Organization. (2000). Air Quality Guidelines for Europe. 2nd ed. WHO Regional Office for Europe, Copenhagen.
155 United States Environmental Protection Agency. (2002). Integrated Risk Information System (IRIS) Database. Washington, DC: US EPA.

Lead	WHO have established a provisional tolerable weekly intake for lead of 25 µg/kg body weight for infants and children. This value was derived from a study in infants and is the intake at which no accumulation is expected to occur (WHO, 1993c)[156].	Lead has not been addressed separately in modelling of future air emissions but through modelling of PM10 and PM2.5. (see under Arsenic for details). Lead emission was indirectly estimated using PM10 modeling data. It was assumed that all PM emissions are from stacks and then relative concentration of lead was used to calculate the fraction of PM belonging to lead. The highest modeled PM10 concentration of 97.76 µg/m^3 was used to calculate a maximal one time exposure of 1.15 µg/m^3, assuming a consistent contribution of lead within PM10 emissions under worst-case meteorological conditions. This is an exaggerated estimate considering that for the calculation it was asssumed that stacks are the dominant contributors in order to calculate a theoretical exposure, while the modelling results prove that surface source, phosphogypsum, is the dominant PM10/PM2,5 source. The modelling of contaminants in Danube 100 and 200 m downstream from discharge resulted in expected concentration of Pb between 1,1x10^{-5} mg/l and 5,6x10^{-6} mg/l respectively. With the assumption of 2 l per day of drinking water intake (14 l per week) the values are 1600 and 3200 times lower respectively than WHO max diet exposure for 10 kg child body weight. Obviously, the dilution downstream from the calculation points of 200 m from discharge is significantly higher further lowering any potential for drinking water exposure.
Mercury	The United States Environmental Protection Agency's IRIS reference concentration for chronic inhalation exposure is 0.3 µg/m3. However,	Based on the modeling results, the highest obtained value for the prescribed daily average is 0.0014 µg/m³, which is significantly

[156] World Health Organization. (1993). Evaluation of Certain Food Additives and Contaminants (WHO Technical Report Series No. 837). Geneva: WHO.

	emissions to atmosphere from waste disposal operations should only represent a small part of the overall background level of mercury in ambient air. The WHO guideline for drinking-water is 1 µg/l (Water Supply Regulations, 2000[157]; WHO, 1996b[158]).	below the regulatory limit of 2 µg/m³ and more over indicated IRIS reference indicating safe levels of emissions. The modelling of contaminants in Danube 100 and 200 m downstream from discharge resulted in expected concentration of Hg between $9{,}3 \times 10^{-7}$ mg/l and $4{,}7 \times 10^{-7}$ mg/l respectively. The values are more than 1000 and 2000 times below the limit respectively. Obviously, the dilution downstream from the calculation points of 200 m from discharge is significantly higher further lowering any potential for drinking water exposure.
Nickel	With regards to dietary exposure, no tolerable intakes for nickel have been established, although the WHO have established a provisional guideline value for drinking water of 20 µg/l based on a tolerable daily intake of 5 mg/kg body weight and an allocation of 10% of that value to water (WHO, 1993b[159], 1998b[160]).	Nickel has not been addressed separately in modelling of future air emissions but through modelling of PM10 and PM2.5. (see under Arsenic for details). Nickel emission was indirectly estimated using PM10 modeling data. It was assumed that all PM emissions are from stacks and then relative concentration of nickel was used to calculate the fraction of PM belonging to nickel. The highest modeled PM10 concentration of 97.76 µg/m3 was used to calculate a maximal one-time exposure of 1.15 µg/m3, assuming a consistent contribution of nickel within PM10 emissions under worst-case meteorological conditions. This is an exaggerated estimate

[157] The Water Supply (Water Quality) Regulations 2000. UK Statutory Instrument
[158] World Health Organization. (1996). Air Quality Guidelines for Europe. 2nd ed. WHO Regional Office for Europe, Copenhagen
[159] World Health Organization. (1993). Guidelines for Drinking-water Quality. Geneva: WHO
[160] World Health Organization. (1998). Guidelines for Drinking-water Quality, Second Edition, Addendum to Volume 2: Health Criteria and Other Supporting Information. Geneva: WHO

		considering that for the calculation it was assumed that stacks are the only contributors in order to calculate a theoretical exposure, while the modelling results prove that surface source, phosphogypsum, is the dominant PM10/PM2,5 source. The modelling of contaminants in Danube 100 and 200 m downstream from discharge resulted in expected concentration of Ni between 7,2x10^{-5} and 3,6x10^{-5} mg/l. The values are more than 250 and 500 times below the limit respectively. Obviously, the dilution downstream from the calculation points of 200 m from discharge is significantly higher further lowering any potential for drinking water exposure.
Dioxins	The provisional tolerable monthly intake (PTMI) proposed by WHO is 70 pg TEQ/kg body weight and in the UK COT have recommended that a provisional tolerable daily intake of 2 pg TEQ/kg body weight derived on a similar basis to the WHO figure be adopted. The use of a PTMI by WHO reflects the long-term nature of the toxicity of dioxins and the concept of an average exposure over time. Exceeding the tolerable intake will not necessarily give rise to any health effects but the margin of safety will be gradually reduced. This is particularly so with short-term exceedances of the tolerable intake.	Based on the modeling results, the highest obtained value for the prescribed daily average is 6,6x10^{-3} pg/m³ of PCDD/F and dioxin-like PCB, which is vastly below the regulatory limit of 2 µg/m³, confirming negligible emission levels. The modelling of contaminants in Danube 100 and 200 m downstream from discharge resulted in expected concentration of PCDD/F is between 2,8x10^{-6} and 1,4x10^{-6} ng/l. With the assumption of 2 l per day of drinking water intake the values are 3500 and 7000 times lower respectively than UK tolerable intake for 10 kg child body weight. Obviously, the dilution downstream from the calculation points of 200 m from discharge is significantly higher further lowering any potential for drinking water exposure.
PCBs	The biological half-life also varies significantly between congeners. The higher chlorinated congeners have a much longer biological half-life and show bioconcentration factors of up to about 70,000. In terms of health effects from PCBs, there is some uncertainty.	Based on the modeling results, the highest obtained value for the prescribed daily average is 6,6x10^{-3} pg/m³ of PCDD/F and dioxin-

	However, there is evidence from animal studies that PCBs can cause suppression of the immune system in mammals. The doses at which this is likely to occur in humans is uncertain (WHO, 1993a). PCBs do not appear to be teratogenic but Rhesus monkeys given 0.03 mg/kg body weight per day of the commercial PCB mixture Aroclor 1016, showed reduced birthweight in the offspring. At a dose of 0.01 mg/kg body weight, hyperpigmentation of the skin was observed (WHO, 1993a[161]).	like PCB, which is vastly below the regulatory limit of 2 µg/m³, confirming negligible emission levels. The modelling of contaminants in Danube 100 and 200 m downstream from discharge resulted in expected concentration of PCDD/F is between 2,8x10^{-6} and 1,4x10^{-6} ng/l. The values obtained by modelling indicate less exposure with respect to the WHO reference in the range of 10^{11}.
Particulate matter	The current air quality standard for PM10, as set by the Expert Panel on Air Quality Standards (EPAQS) in 1996, identified a level of 50 µg/m³ at which one might expect one additional hospital admission (for respiratory disorders) per day in a population of one million (EPAQS, 1996a[162]).	The analysis of ground-level PM10 local concentrations shows that the maximum observed value is 97.76 µg/m³, exceeding the regulatory limit of 50 µg/m³. This high concentration, primarily caused by meteorological conditions and the phosphogypsum disposal site, is localized along the eastern part of the planned landfill and the southeastern industrial boundary. Most other areas remain well below the regulatory limit. The 90.40th percentile of maximum PM10 values is 38.5 µg/m³, which is within acceptable limits. Further analysis over a five-year period (1826 days) indicates a maximum of 96 days with daily average exceedances at specific receptors, averaging less than 20 days annually. These exceedances are rare and occur only under extreme meteorological conditions (Figure 23). The annual average PM2.5 concentrations shown in the analysis indicate a maximum modeled value of 2.38 µg/m³ near the southern industrial boundary. This value is significantly below the regulatory limit of 25 µg/m³, confirming that the concentrations are well within safe limits.

[161] World Health Organization. (1993). Polychlorinated biphenyls and terphenyls (2nd ed.)
[162] Expert Panel on Air Quality Standards. (1996). Airborne Particles. Department of the Environment, London, UK.

Sulphur dioxide	The WHO air quality guidelines are 500 µg/m³ for a 10-minute averaging period, 125 µg/m³ for a 24-hour averaging period and an annual guideline of 50 µg/m³ (DETR, 2000[163]; WHOROE, 2000[164]). Emissions from incinerators are well regulated and ground-level concentrations arising from incineration should only be a relatively small proportion of the existing background concentration.	The maximum one-hour SO_2 concentration of 592 µg/m³ exceeds the regulatory limit of 350 µg/m³ and is localized near the northern, northeastern, and southern industrial boundaries due to specific meteorological conditions and dominantly existing emission sources. However, the 99.73rd percentile value is 210 µg/m³, well below the limit, indicating that high concentrations are rare and localized. Over a five-year period (43,824 hours), exceedances of the hourly SO_2 limit occurred only three times at any receptor, indicating that such events are extremely rare and happen only under extreme meteorological conditions. For the annual average, the modeled SO_2 concentration is 8.57 µg/m³, which is significantly below the regulatory limit of 50 µg/m³. This demonstrates that while short-term peaks may occur under exceptional circumstances, the overall long-term impact of emissions is well within acceptable levels across the modeled area.
Oxides of Nitrogen	Adverse effects are unlikely to occur below a concentration of 200 ppb (400 µg/m³) for a 1-hour exposure.	Modeled NO_2 concentrations across all averaging periods are well below regulatory limits, with maximum values primarily influenced by existing emitters. The highest modeled concentrations for each averaging period are as follows: 127 µg/m³ for the 1-hour maximum, 44.8 µg/m³ for the 99.79th percentile of the 1-hour maximum, 31.1 µg/m³ for the daily average, and 1.8 µg/m³ for the annual average. All these values remain significantly below the regulatory thresholds across all periods and model domains.

[163] Department of the Environment, Transport and the Regions. (2000). Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Working Together for Clean Air. London: The Stationery Office
[164] WHO Regional Office for Europe. (2000). Air Quality Guidelines for Europe, 2nd Edition. Copenhagen: WHO

The dose-response evaluation indicates that while some contaminants, such as PM10 and SO_2, may exceed regulatory limits in localized areas under specific meteorological conditions, however the long term exposure and expected normal emission values are within acceptable limits. For contaminants like mercury, dioxins, and PCBs, emissions are well below regulatory limits, confirming negligible health risks under typical operating conditions. The cumulative air emission impact on air quality is modeled with substantially exaggerated parameters, as the modeling assumptions considered that all emissions will be simultaneous through each emission source in its maximum limit values and under most unfavorable meteorological conditions. Nevertheless, according to the modelling results, performed air emission study comprehensively concludes that the impact of the subject project installations would be marginal with limited synergistic effect due to existing installation dominant emissions. The potential influence on the larger area air quality is marginal, meaning that there is barely detectable potential influence in neighboring area of Romania. In real operating conditions, Elixir intends to decarbonize its energy sources and use Waste-to-Energy source as a substitute for fossil fuels. Thereby, it should be pointed out that by using the Waste-to-Energy Plant instead of a coal boiler the emission situation will in general improve in comparison with current practices. Namely, if one compares PM emission from existing source E3 (please be referred to supplementary study issued by Faculty of Mechanical Engineering, University of Belgrade) and potentially new sources E18, E19 and E20, it can be concluded that net PM emissions reduction of 0,276 kg/h (23% of E3 emissions) can be expected. Executing the same exercise for SOx, the net reduction of emissions of 42,72 kg/h (95% of E3 emissions) can be expected.

The analysis underscores the importance of ongoing monitoring and strict adherence to emission control measures to minimize exposure risks. Additionally, the findings highlight that cumulative and long-term exposure, particularly through secondary pathways should be evaluated to ensure comprehensive health protection. This assessment forms the basis for targeted mitigation strategies and reinforces the need for regulatory compliance to safeguard public health. Therefore, within a supporting study (please refer to the Analysis of Environmental Factors, 2023) measurement of mass concentrations of dioxins and furans (PVDDS/PCDFS) in ambient air in the vicinity of the production plant "Elixir Prahovo" in Prahovo was determined as a baseline in 2 points, south-west and north-east of the production facilities of the factory at the distance of about 200 m. Test for 17 toxic dioxins and furans, in all four samples and four blank trials, were below the detection limits of the analytical method. The intention of the operator is to execute a follow up location measurement every 3 years with a reporting obligation. Contamination levels can only be associated to emissions to air, thereby clear baseline follow up provides adequate level of precaution.

8.4. Risk characterization

The overall risk assessment indicates that most contaminants, including arsenic, cadmium, chromium, lead, mercury, nickel, dioxins, and PCBs, are present at levels well below regulatory limits in both air and water, posing minimal health risks. Particulate matter (PM10) shows localized exceedances near industrial boundaries, primarily under extreme meteorological conditions, but annual averages for PM10 and PM2.5 remain within safe limits. Similarly, sulfur dioxide exhibits occasional short-term spikes above regulatory thresholds, though these events are rare and localized. With effective monitoring and controls in place, the risks associated with these contaminants appear to be low for the general population, though localized areas near emission sources may require targeted mitigation strategies.

Table 55: Characterization of Contaminant Risks Based on Modeled Exposure

Contaminant	Characterization
Arsenic	**Low risk overall due to stringent monitoring and low predicted exposure.** According to the results of modelling and analysis of PM10 and PM2.5 ground concentrations, it is extremely unlikely that the general population will be exposed to concentrations high enough to cause acute effects. Even in the case of extreme meteorological conditions the area where are shown exceedance of the limit values is mainly nonresidential and with no agricultural activities. The intake of arsenic from air will, typically, be only a minor portion of the total intake from all sources. The relative contribution of arsenic within PM10 emissions is minor, further supporting the low overall risk (please be referred to report Analysis of the environmental factors, 2023). The intake of arsenic (primarily inorganic) from water as shown in concentrations in Danube downstream from the proposed facilities is also very low thus cannot affect the population using the water supply.
Cadmium	**Minimal risk for chronic exposure due to low environmental concentrations and dietary controls.** According to the results of modelling and analysis of PM10 and PM2.5 ground concentrations, it is extremely unlikely that the general population will be exposed to concentrations high enough to cause acute effects. Even in the case of extreme meteorological conditions the area where are shown exceedance of the limit values is mainly nonresidential and with no agricultural activities. The intake of cadmium from air will, typically, be only a minor portion of the total intake from all sources. The very low contribution of cadmium to total PM10 emissions highlights its limited role in overall exposure (please be referred to report Analysis of the environmental factors, 2023). The intake of cadmium (primarily inorganic) from water as shown in concentrations in Danube downstream from the proposed facilities is also very

	low and thus cannot affect the population using the water supply. It is not expected to have cadmium entering the food chain due to the limited concentration in deposition outside of industrial area.
Chromium	**Low environmental presence and compliance with air quality standards indicate minimal risk.** According to the results of modelling and analysis of PM10 and PM2.5 ground concentrations, it is extremely unlikely that the general population will be exposed to concentrations high enough to cause acute effects. Even in the case of extreme meteorological conditions the area where are shown exceedance of the limit values is mainly nonresidential and with no agricultural activities. The intake of chromium from air will, typically, be only a minor portion of the total intake from all sources. Chromium's limited contribution to PM10 emissions indicates negligible influence on exposure risks (please be referred to report Analysis of the environmental factors, 2023). Predicted water concentrations downstream of the facility are negligible with respect to exposure risk. Due to the fact that chromium is bound to soil in case of depositions it is unlikely that it will enter the food chain.
Lead	**Negligible risk given stringent water quality controls and low environmental concentrations.** According to the results of modelling and analysis of PM10 and PM2.5 ground concentrations, it is extremely unlikely that the general population will be exposed to concentrations high enough to cause acute effects. Even in the case of extreme meteorological conditions the area where are shown exceedance of the limit values is mainly nonresidential and with no agricultural activities. The low contribution of lead to PM10 supports its minimal role in health risks related to particulate matter (please be referred to report Analysis of the environmental factors, 2023). Predicted water concentrations downstream of the facility are negligible with respect to exposure risk. It is not expected to have led in the food chain due to the characteristics of the area where deposition can occur.

Mercury	**No significant risk due to low predicted exposure levels.** Predicted air concentrations and water concentrations) are significantly below thresholds and exposure risk values. As a result of monitoring and regulatory emission limits, it is extremely unlikely that the general population will be exposed to concentrations high enough to cause acute effects.
Nickel	**Negligible risk due to low predicted environmental concentrations.** Predicted water concentrations downstream of the facility are negligible with respect to exposure risk. According to the results of modelling and analysis of PM10 and PM2.5 ground concentrations, it is extremely unlikely that the general population will be exposed to concentrations high enough to cause acute effects. Even in the case of extreme meteorological conditions the area where are shown exceedance of the limit values is mainly nonresidential and with no agricultural activities. The minor role of nickel within PM10 emissions further confirms the negligible risk.
Dioxins and PCBs	**Minimal risk due to negligible environmental levels.** Predicted air concentrations and water concentrations are vastly below regulatory limits. The operator plans to place stringent control on waste acceptance (no reception of PCB containing waste and waste with more than 1 wt.% of organic halogenates expressed as chlorine) thus leading to no emissions that could cause depositions and effects on the food chain. The flue gas treatment and emissions limits are designed in accordance with best available techniques presented in the reference document.
Particulate Matter	**Localized, short-term risks exist for PM10 in industrial zones; overall risk is low for broader areas** Localized PM10 exceedances (maximum 97.76 μg/m³) are rare and confined to specific areas under extreme conditions. Annual PM2.5 averages (maximum 2.38 μg/m³) are well within safe limits. Even in the case of extreme meteorological conditions the area where are shown exceedance of the limit values is mainly nonresidential and with no agricultural activities. Moreover, the operating

	practices on the complete industrial park will lead to reduced emissions compared to current practices.
Sulphur dioxide	**Limited short-term risk for localized areas; overall compliance with annual limits indicates low chronic risk.** Maximum observed concentrations (592 µg/m³) exceed hourly limits but are rare (3 exceedances over 5 years). Long-term averages remain below limits. Even in the case of extreme meteorological conditions the area where are shown exceedance of the limit values is mainly nonresidential and with no agricultural activities. Moreover, the operating practices on the complete industrial park will lead to reduced emissions compared to current practices.
Oxides of Nitrogen	**Negligible risk due to compliance with air quality standards**. Predicted concentrations across all periods are significantly below prescribed limits and human exposure risk values

The characterization of contaminants indicates that the overall risks to public health and the environment are minimal to nun. Particular risk to the neighburing Romanian popullation is almost unotable due to very low diffusion induced emission deterioration of air quality and Danube quality deterioration due to treated wastewater release. For most substances, such as mercury, nickel, and dioxins, predicted air and water concentrations are significantly below regulatory thresholds, demonstrating effective emission control measures. Localized exceedances for particulate matter (PM10) and sulfur dioxide (SO_2) are confined to non-residential areas and occur only under extreme meteorological conditions, posing limited risk to the general population of Prahovo village .

Predicted concentrations of contaminants in water downstream from the facility are negligible and unlikely to contribute significantly to human exposure through drinking water or the food chain. The comprehensive flue gas treatment system and adherence to best available techniques further minimize potential impacts. Overall, the findings confirm that the facility's operations are unlikely to pose significant acute or chronic health risks, provided that monitoring and regulatory compliance are maintained.

8.5. Recommendations and mandatory measures to minimize negative impacts and maximize positive ones

The necessary measures to reduce or prevent harmful impacts can be systematized into the following categories:

- Measures prescribed by laws, regulations, standards, and deadlines for their implementation;
- Measures to be taken in case of accidents;
- Plans and technical solutions for environmental protection (recycling, treatment, and disposal of waste materials, reclamation, remediation, etc.)
- Other measures that may prevent or reduce harmful environmental impacts:
    - Protection measures during project construction
    - Protection measures during regular project operation.
    - Protection measures in case of project decommissioning or removal.

8.5.1. Air

Air protection from pollution represents a key aspect of environmental preservation and human health. These measures are defined by legislation, standards, and guidelines to ensure control of pollutant emissions into the atmosphere. This chapter provides an overview of the importance of air protection and the main objectives of the measures.

The legal framework and standards regulating air protection in waste-to-energy plants ensure compliance with national and international requirements. These measures include obligations regarding pollutant emission control and the implementation of preventive activities.

- The Law on Air Protection[165] defines obligations concerning air quality and emission limit values.
- The Regulation on Emission Limit Values of Pollutants into the Air from Stationary Sources[166] sets standards for emissions from waste incineration plants.
- Directive 2010/75/EU and the corresponding BAT Conclusions on Waste Incineration[167].

Measures implemented in accordance with these legal frameworks include the following:

- The WtE plant is designed and will be equipped, constructed, and operated so that after the final injection of air into the combustion process, process gases, even under the most unfavorable conditions, will reach a temperature of at least 850°C for a duration of two seconds in a controlled and homogeneous manner.
- Ventilation of the space in which IBC containers/barrels/jumbo bags are located, as well as the space of the transfer station from IBC containers/barrels is provided throuh axial wall fans for suction from the space with floating blinds. The air compensation is from the facade of the building over 4 rain blinds.
- The air from the sludge compartment should be taken to the boiler plant using a combustion air fan, in order to keep the storage under pressure and prevent the spread

[165] "Official Gazette of RS," No. 36/2009, 10/2013, 26/2021 - other law, Available at Zakon o zaštiti vazduha (paragraf.rs)
[166] "Official Gazette of RS," No. 103/2023, Available at about:blank (ekologija.gov.rs)
[167] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)

of unpleasant odours otside the facility. Air compensation is from the facade of the building. When the boiler plant does not work, nitrogen is automatically introduced into the sludge reception bunker in order to inertize the space.

- In order to reduce air emissions from storage tanks, the tanks are equipped with:
    - nitrogen maintains a constant overpressure of 0.3 barG in tanks, which ensures that there are no unpleasant odours or vapours of stored liquids in the room.
    - exhaust gas drainage system via automatic valves on the outlet pipelines from the gas tank space. When reaching a pressure of 0.4 barG in the tank, the valve is opened and the gas is discharged, which is taken by pipeline to the intake of the combustion air fan in the boiler installation, and then to the thermal treatment. As the vessels are maintained under nitrogen overpressure, the composition of the exhaust gas is predominantly nitrogen.
    - If for any reason these systems fail, the tanks are equipped with safety and relief valve that allows pressure relief, i.e. prevents the occurrence of vacuum.
- Ventilation of the space in which the storge tanks (of combustile and easily volatile liquids) are located is provided whrough 2 channels with associated elements for inserting and exhausting air from the space.
- Ventilation of the space in which the storage tanks for oily and bilge water are located is foreseen through the suction ducts by which the air is taken to the intake of the combustion air fan in the boiler plant, and then to the thermal treatment. In case of downtime of the boiler plant, an axial wall fan is provided for ventilation of this space for suction from the space with a floating blind. The compensation of air is from the external roller doors from this room, as well as the rooms for unloading waste and service reception of the rake and pretreatment of non-hazardous and hazardous waste.
- When transferring liquid waste from tank trucks to the gas phase arm, a pressure balancing line is connected, which represents the connection with the gas space of the tank to which the transfer is carried out in case that the discharge is carried out into one of the tanks under overpressure of nitrogen, in order to prevent the evaporation of easily volatile liquids when discharging.
- When transferring waste, the engine of the transport vehicle must be switched off, and the tank truck must be properly grounded.
- The project envisages a flue gas cleaning plant from the boiler plant, and before discharge into the atmosphere, which includes:
    - dry flue gas cleaning system (cyclone, bag filter system and activated carbon filter) in which the separation of first, larger particles of fly ash, and then the separation of dioxins and heavy metals by adsorption of said particles into the pores of activated carbon, and finally the removal of particulate matter.
    - wet flue gas cleaning system (scrubber system - HCl Scrubber and SO_2 Scrubber). In the HCl scrubber, cooling of flue gases to saturation temperature in contact with water and absorption of halogen and SO_3 compounds takes place. The second (SO_2) scrubber is used to remove sulfur oxide from the flue gases.
    - NOx catalytic reduction system (SCR system)
- The waste incineration plant is designed and equipped so that the limit values of emissions into the air from Appendix 2 LIMIT VALUES FOR EMISSIONS OF POLLUTANTS INTO the AIR of the aforementioned Regulation are not exceeded

during operation, as well as the values prescribed by the conclusions on the best available techniques Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control Commission Implementing Decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration.[168]

- Waste gases from the waste incineration plant will be discharged in a controlled manner through a smokestack whose height has been calculated in such a way as to protect human health and the environment.
- It is envisaged that measurements of pollutants into the air from the incineration plant are carried out in accordance with Annexes 2, 3 and 6 of the Regulation on technical and technological conditions for the design, construction, equipping and operation of plants and types of waste for waste thermal treatment, emission limit values and their monitoring[169], in accordance with the monitoring prescribed in Chapter 9 of this Study and the Integrated Permit.
- Measurement will be performed by standardized methods in accordance with the conditions of measurement referred to in Article 15 of the Regulation, the method of calculation referred to in Article 17 of the Regulation and Annex 5. FORMULA for calculating the EMISSION CONCENTRATION UNDER NORMAL OXYGEN CONCENTRATION PERCENTAGE CONDITIONS
- The measuring points will be determined in accordance with the regulation governing the emission of pollutants into the air (Regulation on the measurement of emissions of pollutants into the air from stationary sources of pollution[170]).
- Dedusting of the solid residue storage from the boiler plant and its solidification equipment should be carried out through a bag filter system where particulate matter was separated.
- The cement silo, mixer, cement weighing scale and solid residue weighing scale are equipped with a filter that prevents the emission of powdered substances into the atmosphere. Measurement of differential pressure with a high value alarm is provided on the aforementioned filters. If there is an increase in differential pressure, the alarm and the self-shaking system are activated (the filter self-shaking system is part of the filters themselves).

8.5.2. Water

Protection measures to prevent the possible negative impact of the planned projects on the environment represent one of the most important things in environmental protection. The Waste-to-Energy plant, including the storage areas for waste within the plant area, is designed in such a way as to prevent unintentional leakage of pollutants into the soil, surface waters or groundwater, in accordance with the regulations.

In order to protect water and soil within the plant, a separate sewerage system is envisaged for:

168 Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)
169 Official Gazette of the RS," No. 103/2023, Available at about:blank (ekologija.gov.rs)
170 "Official Gazette of the RS", no. 5/2016, Available at Uredba o merenjima emisija zagađujućih materija u vazduh

- Atmospheric water from the roof of the facility;
- Oily atmospheric waters;
- Sanitary-foul wastewater,
- Technological wastewater,
- Wastewater from extinguishing possible fires.

Monitoring of the concentration of pollutants in wastewater is planned and will be carried out in the manner and within the deadlines determined in accordance with the relevant regulation.

All type of wastewater will be treated separatlly. In all water treatment systems, devices are provided for measuring water flow, as well as measuring water quality at the inlet and outlet of the plant, before discharge to colector and final recipient.

Generated technological water from wet flue gas cleaning should be treated at the wastewater treatment plant in the boiler plant consisting of:

- three-stage neutralization,
- the settling of heavy metals,
- flocculation,
- sedimentation and
- filtration.

The discharge of wastewater into the recipient is maximally limited to the extent possible, so that the emission limit values are in accordance with Appendix 4. LIMIT VALUES FOR POLLUTANT EMISSIONS IN WASTEWATER FROM THE WASTE GAS TREATMENT PROCESS GENERATED IN THE PLANT FOR INCINERATION AND CO-INCINERATION OF WASTE of the regulation, as well as in accordance with the conclusions on the best available techniques Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control Commission Implementing Decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BATc) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration[171].

Wastewater may be discharged into the recipient after special treatment, in accordance with a permit, if:

1) the discharge is carried out within the prescribed emission limit values, in accordance with the regulation (Law on Waters[172], and Regulation on Limit Values of Pollutant Emissions into Water[173]).

2) mass concentrations of pollutants do not exceed the emission limit values set out in relevant Regulation.

Emission limit values are applied at the point where the wastewater generated in the waste gas treatment process containing pollutants referred to in Annexes 2 and 3 of the Regulation

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171 Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)
172 Official Gazette of RS, Nos. 30/2010, 93/2012, 101/2016, 95/2018, and 95/2018 - other law, Available at Zakon o vodama (paragraf.rs)
173 Official Gazette of RS, Nos. 67/2011, 48/2012, and 1/2016, Available at Uredba o graničnim vrednostima emisije zagađujućih materija u vode (paragraf.rs)

on Limit Values of Pollutant Emissions into Water[174] is discharged, in this case at the point of discharge of wastewater into the collector of all clean and treated waters of the Waste-to-Energy Plant.

The project solved the wastewater treatment. Wastewater cannot be diluted in order to achieve the emission limit values from Annex 4 of the Regulation on technical and technological conditions for the design, construction, equipment and operation of plants and types of waste for thermal treatment of waste, limit values of emissions and their monitoring [175]. Within the subject complex, a wastewater reception pool with separate chambers is planned to provide 100 % generated water representative sampling and checking of water quality before discharge to the recipient.

In case that the quality of wastewater collected in the pool does not meet the criteria defined for the discharge of water into the recipient (Danube River), the project envisages returning the water back to the wastewater treatment boiler plant via a sand filter system and an activated carbon filter. In case that it is still not possible to purify the water to the required quality for discharge into the final recipient, the contaminated wastewater should be diverted to the liquid waste tank and from there to thermal treatment in the boiler.

Before discharging into the clean water collector, sanitary-foul wastewater must be treated at the mechanical and biological treatment plant. Buried biological purifier with continuous recirculation of activated sludge with a capacity of 20 PE (40 employees) is planned. Purified wastewater should be discharged into the collector of conditionally clean rain sewage and then into the internal network of the Elixir Prahovo Industrial Complex, which ends with a discharge into the Danube River. Two bypass separators are planned for the efficiency of separating light petroleum products - light liquids in the separator outlet water up to 5mg/l. Potentially oily atmospheric water from all manipulative surfaces, roads and parking lots should be drained to the grease and oil separator for treatment before discharge into the recipient (with the collector of conditionally clean rainwater, purified water is conducted to the drainage Central collector for the entire Elixir Prahovo complex, and through it is discharged into the Danube).

It is the obligation of the Project Holder to regularly clean and maintain the grease and oil separators and to treat the resulting sediment in accordance with the Law on Waste Management[176] and by-laws in this field. An appropriate document shall be drawn up/completed on the amount and type of waste.

Facility operator will regularly test the quality of wastewater on the grease and oil separator 4 times a year, through an authorized legal entity. The quality of wastewater must be in accordance with the relevant Law on Waters and the Rulebook on the manner and conditions for measuring and testing the quality of wastewater and the content of the report on the performed measurements.

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[174] ‘’Official Gazette of RS’’, Nos. 67/2011, 48/2012, and 1/2016, Available at Uredba o graničnim vrednostima emisije zagađujućih materija u vode (paragraf.rs)
[175] ‘’Official Gazette of the RS" No. 103/2023, Available at about:blank (ekologija.gov.rs)
[176] "Official Gazette of RS" No. 36/2009, 88/2010, 14/2016, 95/2018 - other law, and 35/2023, available at Zakon o upravljanju otpadom (paragraf.rs)

The dynamics of discharge and cleaning of the separator depends on the amount of sludge and petroleum products separated, i.e. on the method of operation and manipulation at the site itself (the interval must not exceed 6 months);

Wastewater generated by washing the process equipment used for solidification of residues from the boiler plant should be collected in the collection pit located in the facility W-C12 Stabilization and solidification. Return the collected water from washing the equipment to the solidification process. In this way, the consumption of process water is saved, and the required humidity of the material is also achieved, as well as the prevention of dust emission when manipulating residues from the boiler plant.

Wastewater from fire extinguishing and other contaminated water that cannot be purified to the required quality for discharge into the final recipient (Danube River) must be thermally treated at the boiler plant in question.

8.5.3. Soil and groundwater

A landfill of non-hazardous waste for the disposal of stabilized and solidified residues from the boiler plant at the location in Prahovo was designed in order to meet the necessary conditions for preventing pollution of soil, underground and surface water, air and to ensure controlled management of leachate. The protection of soil, groundwater and surface water is achieved by the combination of the geological barrier and the bottom impermeable layer during the active phase of the landfill and the combination of the geological barrier and the upper impermeable layer during the passive phase after the landfill closure.

The landfill operation procedure will be carried out in accordance with the technical and technological conditions provided for in the design and technical documentation, permit, law and regulation.

Waste can be accepted at the landfill only if it meets the criteria for accepting waste at the Landfill for non-hazardous waste. The criteria for accepting or not accepting waste at the landfill are the limit values of the parameters for the disposal of solid, non-reactive hazardous waste (stabilized and solidified). Solid non-reactive hazardous waste is one whose leachate is equivalent to that for non-hazardous waste and which meets the limit values of the parameters for the disposal of non-reactive hazardous waste at landfills for non-hazardous waste in accordance with Annex 8, item 2. Disposal of non-reactive hazardous waste at landfills for non-hazardous waste in cassettes that are not used for disposal of biodegradable waste and Annex 10. List of parameters for waste testing for disposal, Rulebook on waste categories, examination and classification[177].

Testing of waste intended for disposal should be carried out by hiring an authorized professional waste testing organization in accordance with the Law on Waste Management[178]. The data obtained from waste testing are an integral part of the waste testing report for disposal submitted by the Project Holder to the competent authority.

[177] "Official Gazette of the RS", nos. 56/2010, 93/2019, 39/2021, 65/2024, Available at Pravilnik o kategorijama, ispitivanju i klasifikaciji otpada (paragraf.rs)
[178] "Official Gazette of RS," No. 36/2009, 88/2010, 14/2016, 95/2018 - other law, and 35/2023, available at Zakon o upravljanju otpadom (paragraf.rs)

A unit for washing the wheels of trucks delivering waste, as well as the machinery used within the landfill, is planned. A standard washing facility for truck wheels, featuring high-pressure water with water recirculation, will be installed. When the washing water becomes contaminated, it will be pumped into an IBC container and transported to a plant for treatment.

To ensure environmental protection, the washing facility will be constructed on a surface lined with a high-density polyethylene (HDPE) membrane. This impermeable layer prevents the infiltration of contaminants into the soil and groundwater. Additionally, leachate generated during washing or from other landfill operations will be collected through a network of drainage systems installed over the HDPE liner. The collected leachate will then be directed to an on-site wastewater treatment facility, where it will undergo appropriate treatment to remove pollutants before either being reused in the washing system or safely discharged in compliance with environmental regulations.

8.5.4. Noise

In order to reduce air emissions and noise, unloading of bulk solid waste material and sludge will be carried out by entering the vehicle inside the object for pre-treatment in facility, after which the door of the facility is closed and only then unloading begins. When transfering liquid waste and liquid raw materials, as well as when unloading trucks, the engines of the means of transportation must be switched off.

All activities related to waste handling as well as equipment that can emit noise are located in closed facilities. Regularly monitor the condition of noise-emitting equipment through a regular maintenance plan. Additional verification of the integrity of the equipment should be carried out by establishing an inspection plan, as well as an equipment testing plan. Noise at the boundary of the complex must not exceed the limit value for the zone it borders:

- For day and evening 60 dB(A)
- For the night 50 dB(A).

Facilities that are not part of an indivisible technological whole are separated, in order to minimize noise levels. The plant itself is not near other noise emitters. The obligation of the Project Holder is to perform noise measurement at the nearest residential buildings during the commissioning of the plant. In case of exceeding the permissible noise level, the Project Holder is obliged to implement additional measures in order to reduce and achieve the permissible noise level.

8.5.5. Residual Waste management

Thermal treatment of non-recyclable hazardous and non-hazardous waste must be carried out in accordance with the Regulation on technical and technological conditions for the design, construction, equipment and operation of facilities and types of waste for thermal treatment of waste, emission limit values and their monitoring[179]. Waste treatment is carried out using the best available technique conclusions (BATc) and technologies for waste treatment and waste incineration.

The first step in the solid residue treatment process is the removal of metals from coarse ash (“bottom ash”) using magnetic separation and separation induced by a magnet (eddy current).

[179] Official Gazette of the RS," No. 103/2023, Available at about:blank (ekologija.gov.rs)

The second step is the process of stabilization (when reactions take place in which controlled hydrogen release occurs, chromium (Cr(VI)) reduction reaction, etc.) and solidification by adding cement, water and, if necessary, additives. The aim of the treatment is to process solid residues from the boiler plant, curing and obtaining material that is formed at the landfill into a material with high mechanical strength, low permeability and encapsulated pollutants, i.e. low leaching rate.

Before the very beginning of the solidification process, examine the physical and chemical characteristics of previously stabilized residues from the boiler plant, in accordance with the Rulebook on Waste Categories, Examination and Classification[180], Appendix 8 List of parameters for determining the physico-chemical properties of hazardous waste intended for physico-chemical treatment.

In order to reduce the retention time of solid residues from the boiler plant in the stabilization and solidification facility, the project envisages a mixer for solidification of appropriate capacity, and for the purpose of disposal of solidificates

In accordance with the Regulation on the disposal of waste at landfills[181] a landfill of non-hazardous waste for the disposal of stabilized and solidified residues from the boiler plant at the location in Prahovo was designed.

Waste can be accepted at the landfill only if it meets the criteria for accepting waste at the Landfill for non-hazardous waste. The criteria for accepting or not accepting waste at the landfill are the limit values of the parameters for the disposal of solid, non-reactive hazardous waste (stabilized and solidified). Only pre-treated waste will be disposed of at the landfill in accordance with the Law on Waste Management and other regulations. The acceptance of waste into a landfill is carried out according to a procedure that includes: disposal waste examination, compliance check and on-site check.

Solid non-reactive hazardous waste is one whose leachate is equivalent to that for non-hazardous waste and which meets the limit values of the parameters for the disposal of non-reactive hazardous waste at landfills for non-hazardous waste in accordance with Annex 8, item 2. Disposal of non-reactive hazardous waste at landfills for non-hazardous waste in cassettes that are not used for disposal of biodegradable waste and Annex 10. List of parameters for waste testing for disposal, Rulebook on waste categories, examination and classification[182].

For waste regularly produced in the same process (S/S) in the plant in question, for which there is data specified in relevant Regulation on the disposal of waste at landfills, if the measurement results show small deviations from the limit values of the disposal parameters, testing should be performed at the first delivery, and then periodic compliance verification in accordance with the Regulation. The compliance check shall be performed periodically, at least

[180] "Official Gazette of the RS", nos. 56/2010, 93/2019, 39/2021, 65/2024, Available at Pravilnik o kategorijama, ispitivanju i klasifikaciji otpada (paragraf.rs)
[181] "Official Gazette of the RS", no. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)
[182] "Official Gazette of the RS", nos. 56/2010, 93/2019, 39/2021, 65/2024, Available at Pravilnik o kategorijama, ispitivanju i klasifikaciji otpada (paragraf.rs)

once a year, in order to check the waste that is regularly delivered for disposal in order to determine whether the parameters of that waste correspond to the parameters obtained by testing the waste for disposal and whether they meet the limit values of the parameters for waste disposal. The compliance check should be performed only for those parameters that are determined as critical when testing waste for disposal. For waste whose characteristics are variable, waste to be disposed of shall be tested for each batch of waste and shall not be subject to compliance checks.

The project holder must not accept waste at the Landfill for non-hazardous waste if it does not meet the requirements for disposal set out in the permit. Project holder will prepare a location plan of the landfill during the disposal of waste.

The authority responsible for issuing the permit shall be informed of the non-acceptance of waste at the landfill if such case occurs. Waste that, upon analysis, is found not to meet the prescribed criteria for disposal at the Landfill for non-hazardous waste shall, upon obtaining the results, be removed from the landfill in the period define by local regulation (Law on Waste Management[183], Regulation on Landfill Waste Disposal[184], and handed over to an authorized operator for further processing, either domestically or abroad.

[183] "Official Gazette of RS," No. 36/2009, 88/2010, 14/2016, 95/2018 - other law, and 35/2023, available at Zakon o upravljanju otpadom (paragraf.rs)
[184] "Official Gazette of the RS", no. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)

9. Alternatives

The overview of the main alternatives considered by the project holder with an explanation of the main reasons for the choice of a particular solution and the environmental impacts in terms of choice is fully disclosed in the EIS report study, while in this document only most important aspect from the perspective of human health impact assessment are outlined:

- Location or route: The selected location was chosen based on multiple criteria, including proximity to waste sources, environmental sensitivity, and community acceptance. Rejected sites included areas with high ecological sensitivity and insufficient infrastructure, as detailed in the EIS report. Impact on human health: The chosen site minimizes potential health risks by ensuring sufficient distance from sensitive receptors (e.g., residential areas, schools).
- Various technologies for waste treatment and energy recovery were considered, including: Mechanical-Biological Treatment (MBT), Anaerobic Digestion, Incineration with Energy Recovery (WtE). The selected technology, WtE with advanced emission control systems, was chosen due to its superior performance in reducing waste volume, generating energy, and meeting strict EU emission standards.
- Operation methods: The operation of the WtE plant includes continuous monitoring of emissions and adherence to best available techniques (BAT) guidelines. Measures to reduce occupational health risks include regular health checks for workers and mandatory safety training
- Site plans and project plans: The site layout was optimized to include buffer zones, leachate management systems, and dedicated areas for waste sorting and treatment.
- Type and selection of materials: The construction materials for the plant and landfill were selected based on durability, environmental performance, and safety standards.
- Project execution timetable: The project is planned to be executed in phases, ensuring minimal disruption to local communities and allowing for periodic health and safety evaluations. This phased approach also facilitates regular feedback from local stakeholders and timely adjustments to operational plans.
- Functioning and termination of functioning: The WtE plant is designed for a lifespan of 25 years, with periodic maintenance and upgrades. A detailed decommissioning plan will be implemented at the end of the project's life, including site regeneration and future land use.
- Pollution control: Advanced filtration systems and scrubbers will be used to control air emissions. Leachate and runoff water will be treated to prevent soil and water contamination. Noise pollution will be mitigated through sound barriers and restricted working hours. Additionally, noise monitoring stations will be installed near sensitive areas to ensure compliance with local regulations.
- Arrangement of waste disposal: Residual ash from the incineration process will be treated and disposed of in dedicated landfill cells designed to prevent leachate leakage
- Arrangement of access and traffic roads: Access roads will be constructed to ensure safe and efficient transportation of waste. Traffic management plans include designated routes and schedules to minimize congestion and reduce road safety risks.

- Environmental management responsibility and procedure; A dedicated environmental management team will oversee the implementation of mitigation measures and compliance with regulatory standards
- Training: Regular training programs will be conducted for staff, covering health and safety, emergency response, and environmental protection.
- Monitoring: Continuous monitoring of air quality, water quality, and noise levels will be conducted. Monitoring data will be shared with local authorities and made available to the public through periodic reports.
- Emergency plans: An emergency response plan will be developed, covering potential fire incidents, chemical spills, and equipment failures.
- Method of decommissioning, site regeneration and further use: The decommissioning process includes the safe removal of equipment, site cleanup, and soil restoration. The regenerated site may be repurposed for industrial or community use, depending on local needs and regulations.

9.1. Reason for choosing a location

9.1.1. Selection of the location for the implementation of the project (proximity to larger and smaller cities and villages, population density)

When analysing the conditions and determining the environmental protection measures, the Project Holder has considered all the limitations imposed by the Project, the location as well as the mutual relations of the Project and the state of the environment before the construction of the Project.

Considering that the area planned for the construction of the Waste to Energy Plant and Landfill for non- hazardous waste in Prahovo is defined by the Second Amendment to the Detailed Regulation Plan for the Chemical Industry Complex in Prahovo[185] as **Zone IV - Energy and Ecological Island**, within which, among other things, the construction of facilities for the provision of thermal energy and various types of auxiliary fluids, raw materials and fuels used in the technology of the complex in question is allowed, including storage, pyrolysis and **thermal treatment of non-hazardous and hazardous industrial and non-recyclable waste with the use of thermal energy** and the production of alternative fuels and dry saturated steam for the needs of the existing complex, industrial and chemical park, as well as the construction of infrastructure systems that are in the service of temporary storage, treatment and **disposal of waste and residues from storage, pyrolysis and waste thermal treatment**, the Project Holder has chosen this location.

According to the aforementioned plan, the subject location was determined on the basis of the previous analysis of spatial possibilities, limitations and technical suitability of the space, taking into account the relevant criteria - infrastructure, traffic suitability, physical conditions, contextuality, natural conditions, cost- effectiveness of construction, landscapes and quality of public space, and their integral consideration in the area of the entire industrial zone in Prahovo.

[185] "Official Gazette of the Municipality of Negotin", no. 17/2022

Compared to other possible locations in Serbia which were considered, this location has a number of advantages. First of all, the advantages are reflected in the fact that the location in question is fully integrated into the existing industrial zone and corresponds to the planned purpose; the proximity of the Elixir Prahovo complex gives the possibility to use the thermal energy produced from the waste to energy process for the evaporation of phosphoric acid in the plants of the Elixir Prahovo complex, which reduces the use of fossil fuels currently used. A comprehensive analysis of these advantages is provided in Chapter 10, which focuses on the Life Cycle Assessment (LCA).

Further, the **construction of residential buildings is prohibited** within the subject area (except for possible apartment units for temporary stay of guards, on-call services, etc.);

Therefore, one of the most important positive sides of the location in question is that there are **no settlements in the immediate vicinity and that the Eco Energy complex itself is directly surrounded by industrial facilities and devastated undeveloped land planned for the expansion of the industrial zone.**

A smaller group of residential buildings, belonging to the workers' settlement, is located along the border of the expansion of the chemical industry complex in Prahovo, in the direction of the west at a distance of about 1,300 m from the planned Eco Energy complex. All other settlements are located at a distance of more than 2 km as shown in Table 56.

Table 56: Proximity to larger and smaller towns and villages, no. of inhabitants

Settlement name	Distance from the Eco Energy complex, km	Direction in relation to the Eco Energy complex	No. of inhabitants
Settlement Prahovo	2	West	799
Village Radujevac	4	East Southeast	735
Settlement Samarinovac	5	Southwest	616
Settlement Srbovo	6	South	289
Settlement Dušanovac	7	Northwest	548
Negotin Town	10	Southwest	14,647

The site in question is located at a distance of about 750 m from the border with Romania and about 9 km from the Bulgarian border, therefore, when analysing the site, the distances of the nearest cross-border settlements were taken into account (distances are shown in Table 57.). On the other side of the Danube, on the Romanian side, there is undeveloped land.

Table 57: Proximity to larger and smaller towns and villages in Romania and Bulgaria, no. of inhabitants

Settlement name	Distance from the Eco Energy complex, km	Direction in relation to the Eco Energy complex	No. of inhabitants
Romania			
Settlement Izvoarele	4	North	951
Settlement Gruja	7	North (Seat of the eponymous	1,890

		municipality of Gruja in Mehendinci and Oltenia district)	
Bulgaria			
Village Balej	10.5	(In the northwest of Bulgaria in the municipality of Bregovo, Vidin district)	437
Village Kudelin	10.6	In the northwest of Bulgaria as well, in the municipality of Bregovo in the Vidin district	229

Given the characteristics of the site, the capacity and size of the project and the characteristics of the project operation, the expected scope of impact is minimized with the application, the best available techniques, prevention and protection measures, as well as compliance with the norms and standards for the activity in question in the analysed zone and at the site in question, which leads to the conclusion that the regular operation of the project in question will not have a temporary or permanent impact on the health of the population (a detailed description of the impact of the project on the population is described in Chapter 8 of this Study).

When selecting the location, the Project Holder also considered the socio-demographic characteristics of the population. The municipality of Negotin has extremely unfavourable demographic trends which are reflected in the appearance of an above-average negative natural increase, a high rate of emigration and higher average age of the population compared to the rest of the Republic of Serbia. With a population of around 28,000 inhabitants (according to the 2022 census), it is in the group of the most sparsely populated areas of Serbia. A large number of residents in origin from the municipality of Negotin live abroad. However, returnees from abroad do not represent significant demographic potential due to their unfavourable age structure and generational weakening of the returnee wave. The key preconditions for young people to stay in Negotin are secure employment and better income. The potential for the development of new jobs is reflected in the expansion of the chemical industry complex by building an industrial park, a chemical park, an energy island and an ecological island.

In order to make a decision regarding the selection of the site for the construction of the Eco Energy complex, the Project Holder also carried out field research, IN SITU tests and laboratory research at the site in question. Geotechnical studies were prepared, which were prepared by GT Soil Inženjering d.o.o., based on the existing documentation and purpose-built investigations. The geotechnical conditions for the construction of the complex facilities were analysed, from the aspect of load-bearing capacity, subsidence and safety during the execution of foundation excavations. In the conclusion of the text, geotechnical recommendations for the safe construction of the facilities of the Waste to Energy Plant and the Landfill for Non-hazardous Waste are given. An examination of the zero state of environmental parameters was also performed.

Also, when choosing the location for the implementation of the project in question, meteorological, hydrological and hydrographic characteristics were considered: wind rose, frequency and wind speed with maximum, minimum and arithmetic mean and silence; mean and maximum annual temperature with the duration and number of winter days with a temperature below 0°C; number of days with snow cover, average height of snow cover, precipitation in normal and extreme conditions in millimetres, and no obstacles were identified for the implementation of the project in this area.

9.1.2. Restrictions caused by the locations of protected areas, sensitive receptors, the Danube River

In order to determine the current state of flora and fauna on the site and the existence of possible restrictions related to the construction of the complex in question, the Project Holder hired the Institute for Biological Research "Siniša Stanković", which carried out the necessary analyses and research of the area in question and prepared the Biodiversity Study. In the preparation of the study, the potential impact of the construction and operation of the Eco Energy complex on the biological diversity of the subject area, which included an area of 20 km^2 downstream of HPP Đerdap 2, the area of the former Eco Energy complex, as well as the area of nearby areas of neighbouring states of Romania and Bulgaria (in Romania: Blahnița - ROSPA0011, Gruia – Gârla Mare - ROSPA0046, Dunărea la Gârla Mare - Maglavit - ROSAC0299, Jiana- ROSAC0306 and Blahnița – ROSMS0013, and in Bulgaria: Timok – BG0000525 and Novo selo – BG0000631), was considered.

It was concluded that the presence of rare, endangered, protected species of flora and fauna was not registered at the location of the future Eco Energy complex, and that the location in question was not within the protected area for which the protection procedure was carried out or initiated, as well as within the spatial coverage of the ecological network of the Republic of Serbia.

When selecting the location, the presence of archaeological sites was also considered. Based on the defined boundaries of the aforementioned Detailed Regulation Plan for the subject area, and therefore the boundaries of the scope of the subject projects, it was determined that there are no recorded natural and ambient units, as well as recorded archaeological sites.

The analysed location in Prahovo is located near the bank of the Danube (at a distance of about 500 m in the north direction from the plant boundary), near the port of Prahovo. The Danube River flows in a west- east direction and at the same time represents the state border with Romania. Basin – Danube; Water district - Danube according to Art. 27. of the Law on Waters, Decision on determining the boundaries of river basin districts ("Official Gazette of the RS" no. 75/2010) and the Rulebook on Determination of Sub- basins ("Official Gazette of the RS" no. 54/2011). According to the Decision on Determining the List of Waters of the First Order ("Official Gazette of the RS" No. 83/10), the Danube River is classified as 1. Interstate waters 1) natural watercourses. According to the Regulation on the Categorization of Watercourses ("Official Gazette of the RS" no. 5/1968), the river section in question belongs to Class II for the Danube section: from the Hungarian border - to the Bulgarian border. The facilities in question are located in the area of water unit number 12, "Danube and Timok – Negotin", according to the Rulebook on the determination of water units and their boundaries, ("Official Gazette of the RS", no. 8/2018).

Groundwater levels change and directly depend on the height of the Danube, with a slight increase in levels near the river banks.

Taking into account all of the above, the project documentation complies with all measures prescribed by the obtained Water Conditions, provides for the measure of protection and treatment of wastewater, and emissions into water from the plant will be in accordance with the highest standards of the European Union, conclusions on the best available technologies and BREF documents and regulations of the Republic of Serbia.

Therefore, based on the analyses performed, it was concluded that the proximity of the Danube River is not a limiting factor for the implementation of the project.

9.1.3. Proximity to existing and future constructed utility instalations

Before deciding on the location where the project for the construction of the Waste-to-Energy plant and the Landfill for non-hazardous waste will be implemented, the project holder considered both “Greenfield” and “Brownfield” locations.
“Greenfield” investments are characterized by the fact that the business starts from the beginning, without infrastructure, business premises and workers. These investments include the construction of new facilities and plants at the observed location with the launch of a new plant and the employment of new people.
"Brownfield" sites are sites of industrial and commercial facilities, which are not used for a long period of time, and have the potential for urban renewal. Therefore, these are unused, originally industrial, abandoned and neglected sites that the Project Holder has considered and which represent construction land, endangered by previous use, are no longer used, and can create pollution problems and require investment in order to be brought to another purpose.
Analysing these two types of locations, the Project Holder decided on the "Brownfield" location within the chemical industry complex in Prahovo, which is located in the industrial zone owned by the Elixir Group. The project implementation area is appropriate and defined by the Detailed Rugulation Plans (DRP, or planed zoning documents), where the expansion of the chemical industry complex is envisaged by the construction of an industrial park, a chemical park, an energy island, an ecological island, the expansion of phosphogypsum storage, as well as the provision of a buffer zone of greenery and the relocation of local roads outside the industrial complex, which ensures the isolation of the impact of the industrial complex and the production process. Within this location, **the construction of areas/facilities and infrastructure systems** that are in the service of temporary storage, treatment and disposal of waste and residues from **storage, pyrolysis and thermal treatment plants is allowed.**

The suitability of the selected location is also reflected in the existence of a complete infrastructure network (transformer station, telecommunications network, compressed natural gas installations, water supply and sewerage network, roads, etc.) within the industrial zone, and therefore it can be used to connect the planned Eco Energy complex to it.

Disadvantage of "Greenfield" locations is reflected in the need for additional investments and the construction of a completely new infrastructure.

Additional advantage of the selected location for the construction of the Waste to Energy Plant is reflected in the proximity of the production facilities of the Elixir Prahovo complex, since the thermal energy obtained from the waste thermal treatment, as stated earlier, will be used for the production of steam (35 t/h, p=13 barg and T=207 °C), and further supplied and used for the evaporation of phosphoric acid within Elixir Prahovo. In this way, sustainable local energy is obtained, the emission of GHG gases from the existing elixir Prahovo plants is reduced, and at the same time the amount of waste disposed of at landfills is reduced.

When determining the location for the Landfill for non-hazardous waste in question, the general conditions and criteria for determining the location for the waste landfill prescribed by Annex 1 of the Regulation on disposal of waste on landfills[186] were taken into account. The project holder was also guided by the main goal of the realization of the project for the construction of the Landfill for non-hazardous waste, which is the ultimate disposal of solid residues from the boiler plant that have been previously stabilized and solidified, which minimizes any potential impact on soil and groundwater. The construction of a landfill in the immediate vicinity of the Waste to Energy Plant solves the issue of residues disposal from the boiler **plant as close as possible to the place of origin, all in accordance with the principles and hierarchy of waste management**, in accordance with legal regulations in the field of environmental protection and waste management.

9.1.4. Proximity to contaminated sites within the chemical industry complex in Prahovo and proximity to the Elixir Prahovo Plant

When choosing the location for the construction of the Eco Energy complex, the so-called historical pollution at the chemical industry complex in Prahovo was also considered, which was identified in 2012 shortly after the privatization of the Elixir Prahovo complex. The report "ANALYSIS OF THE ENVIRONMENTAL FACTORS" prepared by the company for copyright protection and engineering, "Autorski biro Beograd", presents the activities on the existing industrial complex within Phase I (from privatization in 2012 to 2014 when the first DRP was adopted), activities within Phase II (2014-2020) and Phase III (targeted environmental research for the needs of new extensions of the chemical industry complex in Prahovo).

As a result of major construction-technical and technological interventions at the chemical industry complex in Prahovo, and thus at the location in question, after privatization, including the rehabilitation of locations where hazardous waste was inadequately disposed of, but also due to the process of migration of pollutants over time, along with physico-chemical and biological processes in soil and groundwater, in the part of the complex intended for the expansion of the company's activities, only point source pollution is registered, uneven in terms of origin and type due to which special interventions are not required, except for soil and groundwater monitoring. Within the Elixir Prahovo complex, regular examinations of all environmental parameters are carried out in accordance with the applicable regulations of the Republic of Serbia (air emissions, air quality, wastewater quality and surface and groundwater quality, soil quality, noise levels).

The realization of the project in question also includes a complete monitoring of the state of the environment in the subject area, which will monitor the potential impact of the plant on the environment.

[186] "Official Gazette of the RS", no. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)

9.2. Production processes or technologies

9.2.1. Technological processes of different types of waste treatment and expected emissions of waste gases, wastewater, incineration process residues

Principle of waste management hierarchy, defined by the Law on Waste Management[187], clearly defines that the first and most important goal must be the prevention of waste generation, after which, if it is not possible to prevent waste from being generated, it is necessary to provide conditions for its reuse, recycling, energy utilization and processing. Only in the end, when all the previous steps have been implemented, what remains should be disposed of, i.e. deposited in a safe and environmentally and human health safe manner.

Alternative in waste management process

Compared to municipal waste landfills, the waste-to-energy processing of non-recyclable waste by waste incineration has a lower environmental impact. One of the primary benefits of waste incineration is that it significantly reduces greenhouse gas emissions. Waste incineration can also contribute to climate change by emitting carbon dioxide into the air. Although incineration produces emissions, they are significantly lower than emissions produced by landfills. A comprehensive analysis is provided in Chapter 10 of this Study. In addition, waste incineration does not contaminate soil and groundwater, which is a major environmental benefit. A significant advantage of waste incineration is that it can produce energy. As waste is incinerated, the heat generated can be used to generate electricity and thermal energy. Energy produced by waste incineration reduces the need for fossil fuels, which contributes to control of greenhouse gas emissions and climate change. Landfills on the other hand, do not produce energy. Instead, the waste is disposed of, decomposed over time, and produces methane as a gas. This gas can be captured and used to produce energy, but the amount of energy produced is relatively small compared to the incineration of waste. In addition, the disposal of waste in unsanitary landfills leads to soil and groundwater contamination and thus endangering the environment. Uncontrolled fires in landfills not only lead to significant releases of pollutants into the air, including toxic gases and particulate matter, but also exacerbate climate impacts through the uncontrolled combustion of methane and other organic materials. Such fires are difficult to extinguish, pose risks to nearby communities, and result in long-term environmental damage. Also, the establishment of waste incineration technology can create jobs in the construction, operation and maintenance of plants. The economic benefits of waste incineration can be significant, contributing to local economic growth and development.

It is estimated that over a period of 20 years, which is a time frame that is increasingly considered relevant to the fight against climate change, the effect of methane emissions in landfills is 84 times stronger than carbon dioxide emissions. Diverting 1 t of solid waste to Waste to Energy Plants instead of landfill can save an average of 1 t of carbon dioxide.

[187] "Official Gazette of RS," No. 36/2009, 88/2010, 14/2016, 95/2018 - other law, and 35/2023, available at Zakon o upravljanju otpadom

The current method of waste management in the Republic of Serbia is based mainly on the disposal of waste at non-sanitary and wild landfills with minimal processing, which leads to waste being a burning problem that needs to be solved.

In modern waste management systems, obtaining energy from waste, i.e. incineration, is one of the significant steps towards neutralizing the harmful effects that waste can have on the environment and human health, while contributing to meeting growing energy needs. When obtaining energy from waste, the mass of waste is reduced by 75% and the volume by 90%. This significantly reduces the quantities of waste sent to landfills and helps to preserve the landfill capacities and duration of their use. During the process of obtaining energy from waste, the amount of greenhouse gases released, which are the causes of climate change, is far lower compared to state-of-the-art sanitary landfills. In this way, the application of thermal waste treatment technology also contributes to reducing greenhouse gas emissions and slowing climate change.

Due to the lack of waste treatment and poor conditions for its disposal, fires at landfills are a common occurrence, often resulting in significant releases of toxic gases, particulate matter, and other harmful pollutants into the atmosphere. Such fires contribute to both acute and long-term health risks for nearby populations and cause extensive environmental damage. Additionally, the uncontrolled burning of waste at landfills, especially plastics and organic materials, exacerbates climate change by emitting large quantities of greenhouse gases, including carbon dioxide and methane. These uncontrolled fires are difficult to extinguish and can smolder for extended periods, further compounding their environmental impact. Waste that causes fires in landfills, thanks to its energy potential and the creation of landfill gas, due to uncontrolled conditions and the absence of an environmental protection system, is a significant source of pollution and danger. Obtaining energy from waste in a specially designed, strictly controlled and equipped plant, with the application of the envisaged protection measures, enables the use of energy from waste without harmful consequences for human health and the environment. Solid municipal waste prepared for thermal treatment has a thermal value of lignite, and residues from sorting waste that are rich in plastics can reach the thermal value of hard coal.

The technology of thermal treatment of waste represents an advantage in relation to the technologies of depositing municipal non-recyclable waste in landfills, despite the fact that, given that methods and technologies for the use of certain thermal treatment residues have not been developed, the construction of a landfill for non-hazardous waste for the disposal of S/S residues from the boiler plant are still necessary in addition to incineration.

The current situation in waste management in the Republic of Serbia is such that certain types of waste are generated in large quantities for which treatment is not provided, which creates a problem for both waste producers and operators who go through complicated and slow export procedures. On the other hand, the European Green Deal has set an ambitious roadmap for transforming the European Union into a sustainable, resource-efficient and climate-neutral economy. The Circular Economy Action Plan highlighted the need for action to ensure that shipments of waste for reuse and recycling in the Union are facilitated, and that the Union does not export waste to third countries. In addition to environmental and social benefits, such action may result in a reduction of the Union's strategic dependence on raw materials. By setting the priorities of the necessary activities: creating a well-functioning EU market for secondary raw materials and solving the export of waste - which is a loss of resources and economic opportunities for the recycling industry in the EU, a revision of the Regulation on the transboundary movement of waste was adopted, which aims to limit the export of waste that can be treated in country, within the EU. Also, the Basel Convention, which was ratified by the RS, in Article 4, which refers to the general obligations of the members, defines that each member state will take appropriate measures to ensure the availability of adequate facilities for disposal, for environmentally acceptable management of hazardous and other waste, which, as far as is possible, located within the country, regardless of the place of their disposal and to ensure that the transboundary movement of hazardous waste and other waste is reduced to a minimum in accordance with environmentally acceptable and efficient management of such waste, and that it is carried out in a way that will protect health people and the environment from the harmful effects that may be a consequence of such movement.

There are other different waste treatment processes on the market with reuse that could potentially be an alternative to waste incineration; to this group of procedures belongs co-incineration, mechanical- biological treatment, pyrolysis, gasification, etc. Some of them require pretreatment of waste, others are only applicable to certain fractions of waste that would otherwise be subject to incineration, while some show insufficient overall performance and applicability. Few alternative processes for waste treatment have worked successfully in industrial plants, while others have shown so far a lack of economic and environmental sustainability.

The following table 58 provides an overview of the most commonly used alternative procedures for treating waste, which cannot be reused or recycled.

Table 58. Overview of alternative processes, for types of waste used in incineration

	Non-recyclable flammable waste								
Treatment procedure	Solid municipal waste	Plastic waste	Old tires	Hazardous waste	Wood waste	Organic waste	Waste oil	Waste solvents	Sewage sludge
Depositing	X	X	X	[X]	X	X			(X)
Co-incineration	(X)	(X)	[X]	X	(X)	(X)	X	X	(X)
Mechan. Biological treatment (MBT)	X				(X)	X			(X)
Anaerobic digestion (AD)	X				(X)	X			(X)
Aerobic digestion (Composting)					(X)	X			(X)
Pyrolysis	X	X	X	X	(X)	X	X	X	(X)
Gasification	X	X	X	X	(X)	X	X	X	(X)
Plasma process	X	X	X	X	(X)	X	X	X	(X)

X ... Applied
(X) ... Applied after pretreatmen / with certain limitations
[X] ... Applied with or without pretreatment

Waste thermal treatment provides the possibility of treating fractions of waste that cannot be used for production purpose or recycle due to concentrations of harmful substances in them.

In the case of the existence of a system for efficient use of energy, as provided for in the subject project, thermal treatment (incineration) is classified as a reuse operation (R1 "Use of waste mainly as fuel or other means of energy production").

Incineration of waste without efficient use of energy is classified as a landfill operation (D10 "Incineration of waste on land"). Compared to treatment R1, D10 is an inferior, less sustainable operation, which should be avoided if there are technical possibilities.

Bearing in mind the need for thermal energy in the production facilities of "Elixir Prahovo - Industrija hemijskih proizvoda d.o.o. Prahovo", the Project Holder decided to introduce the technology of thermal treatment of non-recyclable waste, which will use the obtained thermal energy for the production of steam (35 t/h, p=13 barg and T=207 ºC), and further deliver and use it for the evaporation of phosphoric acid within Elixir Prahovo. In this way, cheap and sustainable local energy is obtained, the emission of GHG gases from the existing Elixir Prahovo plants is reduced. A comprehensive analysis is provided in Chapter 10

Thus, the key advantages of waste thermal treatment are: sanitation of waste, reduction of its volume and mass, high level of environmental protection through emission control (especially compared to alternative treatment options), protection of human health, mitigation of climate change, preservation of natural resources, energy recovery from waste, complementarity with recycling and extraction of hazardous substances from waste.

Alternatives regarding Waste Incineration Technology

When it comes to the choice of thermal treatment technology and technological equipment at the plant in question, for the pretreatment of waste, waste thermal treatment and treatment of residues from thermal treatment, the Project Holder considered certain alternatives. The same can be concluded for the choice of fuel and equipment for reducing the emission of harmful and hazardous substances, waste water treatment, waste disposal, etc., all in accordance with the best available techniques in the field in question:

- Commission implementing decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration (notified under document C (2019) 7987)[188];
- European Commission, Best Available Techniques (BAT) Reference Document for **Waste Incineration**, 2019[189]'
- Commission Implementing Decision (EU) 2018/1147 of 10 August 2018 establishing the best available techniques (BAT) conclusions for waste treatment, under Directive

[188] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)
[189] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)

2010/75/EU of the European Parliament and of the Council (notified under document C (2018) 5070) (Text with EEA relevance.)[190];

- European Commission, Best Available Techniques (BAT) Reference Document for **Waste Treatment**, Industrial Emissions Directive 2010/75/EU, 2018[191];
- European Commission, Integrated Pollution Prevention and Control Reference Document on Best Available Techniques on **Emissions from Storage**, July 2006[192];
- European Commission, Integrated Pollution Prevention and Control Reference Document on **Economics and Cross-Media Effects**, July 2006[193];
- European Commission, Reference Document on Best Available Techniques for **Energy Efficiency**, February 2009 (corrected version as of 09/2021)[194];
- JRC Reference Report on Monitoring of Emissions to Air and Water from IED Installations;
- **Industrial Emissions Directive** 2010/75/EU (Integrated Pollution Prevention and Control), 2018[195];
- Best Available Techniques (BAT) Reference Document for **Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector**, Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control).
- BREF Industrial **Cooling Systems** (ICS), published in December 2001;
- BREF **Monitoring of Emissions to Air and Water from IED Installations** (ROM), published in July 2018;
- BREF **Large Combustion Plants** (LCP), published in December 2021.

During the selection of technology and equipment for the thermal treatment of unusable and non-recyclable hazardous and non-hazardous waste and the provision of environmental protection measures, market research was carried out, numerous consultations were carried out with experts in this field, and in order to better understand the plant and its operation, visits to similar plants in Europe were carried out and their experiences were taken into account.

Waste-to-energy plants are designed to use different types of waste, including solid waste, liquid waste and hazardous waste. The types of waste that can be used to obtain energy in thermal treatment plants vary depending on factors such as: technology used, environmental regulations and safety aspects.

There are certain criteria for checking the acceptability of waste for the incineration process. The minimum and maximum energy values that are suitable for incineration of waste depend on the selected incineration technology and its process parameters. Other criteria include waste size, homogeneity, water content, content of inert compounds (e.g. stones, ceramics, glass, ash) and content of hazardous substances such as heavy metals and halogenated organic compounds.

The technology of obtaining energy from waste has been applied in Europe for decades in more than 500 installed plants. The operational work of the mentioned facilities complies with

190 Implementing decision - 2018/1147 - EN - EUR-Lex (europa.eu)
191 Directive - 2018/850 - EN - EUR-Lex (europa.eu)
192 EFS BREF, July 2006
193 Economics and Cross-Media Effect
194 https://eippcb.jrc.ec.europa.eu/reference/energy-efficiency
195 Directive 2010/75 - EN - EUR-LEX (europa.eu)

the strictest legal regulations and the highest environmental standards. For industry sector obtaining energy from waste is subject to the most stringent standards compared to all other industrial sectors in the EU.

The process diagram of a typical waste-to-energy plant (Figure 4.3) shows that only the firebox is a relatively small part of the waste thermal treatment plant. Most of the plant, such as subsequent heating surfaces, flue gas cleaning units, wastewater treatment plants and plants for separate collection and treatment of solid incineration residues, is intended for energy recovery and environmental protection.

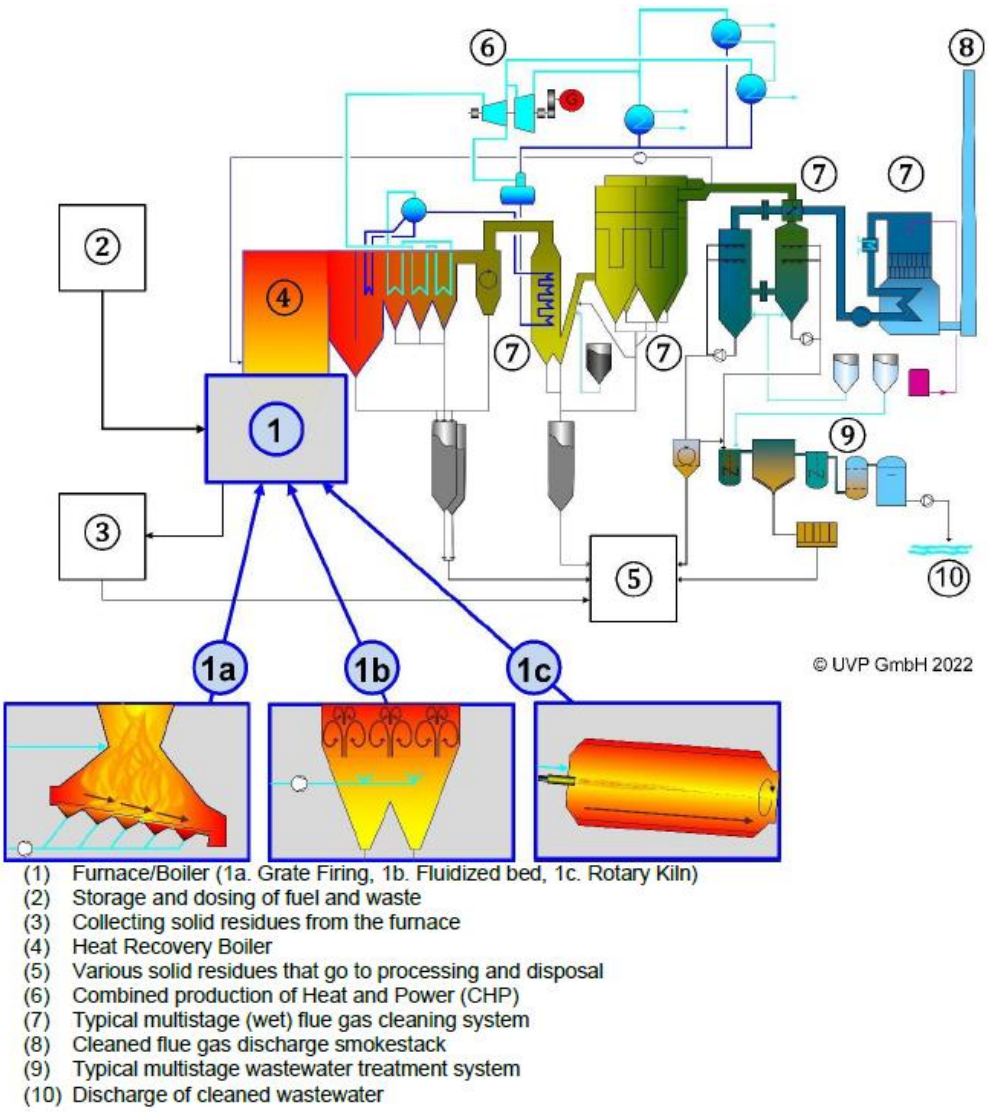

Figure 29: Process scheme of a typical waste incineration plant (UVP GmbH)

As shown in Figure 29, waste-to-energy plants are based on three combustion technologies (Figure 30):

- Grate Firing,
- Rotary Kiln and
- Fluidized Bed

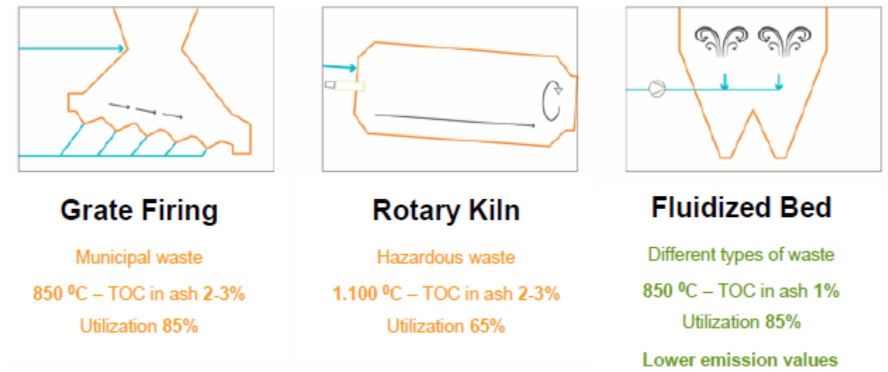

Figure 30. Waste incineration technologies with direct energy utilization

All three specified types of furnaces represent stable and well-proven technical solutions that have been operating for decades. A brief comparison of the considered waste incineration technologies (Table 59) is given below and an overview of the possibilities of processing individual types of waste by different thermal treatment processes is given (Table 60).

Table 59: Types and characteristics of waste incineration furnances

	Grate Firing	Rotary Kiln	Fluidized Bed furnaces
Type of waste to be treated	Incineration technology commonly used for untreated municipal solid waste	Hazardous waste: • Non-recyclable • Infectious • Radioactive • Highly flammable • Explosive It is also used to incinerate slaughterhouse waste and infectious hospital waste including “sharp objects” in sealed plastic containers. Rotary furnaces are also used to incinerate other special waste fractions, such as waste solvents, waste oil, waste oil sludge, waste varnish, chemical waste, medical waste and other liquid waste and high viscosity waste.	Different types of non- recyclable waste can be treated: • Industrial • Commercial • Household waste • Railway sleepers • Sludges from wastewater treatment Cannot be treated: • Recyclable • Infectious • Radioactive • Highly flammable • Explosive
Incineration method	Incineration takes place on the grate, as part of usually slowly moving iron tubular segments that must be cooled from the inside by air or water. The waste is dosed to the grate at one end and is slowly transported through the furnace using a	Incineration in a rotary furnace is performed in a long, cylindrical furnace that is very similar to the rotary furnaces used in the cement industry for the production of cement clinker.	The incineration process takes place in the fluidized bed itself and in the zone above it. Due to the strong, continuous movement of the bed material, the reaction conditions (temperature profile, contact of chemical reactants) are very uniform and constant throughout the reaction zone, vertically and radially. Sand

	movable grate, while incinerating. The waste retention time in the furnace is usually about one hour.		shreds waste into smaller particles and serves as a heat reservoir that can absorb and release heat. Both help to reduce emissions to air, e.g. nitrogen oxides (NOx) and volatile organic compounds (VOCs).
TOC in ash	2-3% (850 °C)	2-3% (1100 °C)	1% (850 °C)
Utilization of energy from fuel	85%	65%	85%
„Fly ash" (Boiler ash and filter ash)	Hazardous waste (undergoes treatment processes: stabilization, solidification, decontamination, etc. and is disposed of at the landfill)	Hazardous waste (undergoes treatment processes: stabilization, solidification, decontamination, etc. and is disposed of at the landfill)	Hazardous waste (undergoes treatment processes: stabilization, solidification, decontamination, etc. and is disposed of at the landfill)
„Bottom ash" (Ash from the bottom of the boiler)	Ash accounts for 80- 90% by weight of the total incineration residue consists predominantly of non-combustible (inert) materials (glass, earth minerals, metals and metal alloys as part of non-combustible materials and glass, silicate minerals and oxide minerals) The mineral fraction makes up a significant proportion of ash (BA), typically about 50-75% The mineral fraction can be reused as aggregate or incorporated into building materials such as cement, concrete or asphalt.	The ash from the Rotary Kiln plant is slightly sintered or melted at the end of the rotary kiln. Systems in which only sintered slag is created are designed similarly to grate furnaces Ash composition (BA) from Rotary Kiln plants, show measured values for different parameters, especially for elements of potential environmental hazards in ash In general, it can be assumed that the ash from Rotary Kiln plants is potentially more contaminated than the ash from Fluidized Bed plants.	All material fractions of aluminium, magnetic ferrous metals, weak-magnetic ferrous metals, brass, copper, glass, unburned organic matter and recovered mineral materials, except magnetic ferrous metals and mineral material, show higher concentrations in ash from Fluidized Bed plants than in ash from Grate Firing plants. In the composition of glass and weak-magnetic ferrous metals, ash from a Fluidized Bed plant contains 2.8 times more glass than ash from a Grate Firing plant.

	Metal fractions, including ferrous and non-ferrous metals, can be recycled as a secondary raw material in the respective metalworking industries		Ash from fluidized bed incinerator tends to be finer and more granular. The ash metal recovery potential from a Fluidized Bed plant is higher than the ash potential from a Grate Firing plant or a Rotary Kiln plant. From the perspective of recycling, larger particles are preferable because metals are more easily separated from them. In addition, metals obtained from the ash of a Fluidized Bed plant are qualitatively preferred for recycling because they are generally less oxidized than metals from the ash of a Grate Firing plant, since waste particles in the fluidized bed are usually exposed to lower maximum temperatures compared to the grate
Advatages	Grate technology is a fairly simple and stable system for incineration of untreated waste. Treatment. Incineration on the grate does not require prior preparation of waste, which can be considered its main advantage.	Preferred technology for the incineration of hazardous waste with a high content of halogenated organic compounds, where a higher incineration temperature of 1100°C is required under EU legislation (instead of 850°C). Waste incineration in Rotary Kiln incinerator is a special technology that is usually only applied for the incineration of hazardous waste or for	The Fluidized Bed technology allows significantly greater flexibility of the fuel in terms of its thermal power: if the waste has a high moisture content and low thermal power (such as drained sewage sludge, which contains 75- 80% water), the heat contained in the sand layer helps the water to evaporate, so that the remaining dry matter can be incinerated. If, on the contrary, waste

		the thermal treatment of contaminated soil.	has a very high thermal power (such as residues from sorting plastic for recycling), sand absorbs the heat of incineration of these materials. In both cases, this does not significantly affect the reaction temperature within the fluidized bed, since the sand layer acts as an energy storage device and keeps the temperature in the furnace constant. This can be a significant economic advantage. The highest degree of control at the reception and preparation of incoming fuel Higher incineration efficiency with lower total organic carbon (TOC) values in ash. Better utilization of waste to energy and better controlled incineration.
Disadvantages	Grate technology is an incineration system with less flexibility when it comes to waste types. The grate system must be cooled by air or water and can only work with waste of a fairly narrow range of energy content, that is, on the grate usually incinerates waste whose lower thermal power is between 8 and 12 MJ/kg. Waste with higher thermal power would thermally damage the grates, while waste with lower thermal	Incinerators with rotary kilns have large and heavy rotating parts, which is generally mechanically challenging, and also expensive in operation and maintenance. Due to the higher content of corrosive components in the flue gas, rotary kilns for the incineration of hazardous waste must operate at lower steam parameters, making them less energy efficient than incinerators with gratings or with a fluidized bed.	In fluidized bed furnaces, the waste must be previously mechanically prepared to a certain granulation, so that the waste particles can be fluidized together with the sand. A combination of shredding, sieving and metal removal is usually chosen to obtain particles that are suitable for fluidization in terms of material density and particle size. Incineration in the fluidized bed usually consumes more energy than incineration on the grate, since the

	value, such as mechanically dewatered sewage sludge, would extinguish the fire on the grate.		waste must be previously mechanically treated, and part of the energy is also spent on compressing the primary combustion air that is injected into the furnace with nozzles and provides fluidization of the sand layer.

Table 60: Overwiew of the posssibilities of treatment individual types of waste by different thermal treatment processes (BMLFUW, 2015)

	Incineration technology		
Waste type	Grate Firing	Fluidized Bed	Rotary Kiln
Residual waste (municipal waste)	Suitable	Pretreatment required	Suitable
Sewage sludge	Limited in terms of quantity	Suitable	Suitable
Sediment from the primary phase of wastewater treatment (from the mechanical wastewater treatment grate)	Suitable	Pretreatment required	Limited suitability
Shredded plastic	Limited in terms of quantity	Suitable	Limited suitability
Whole tires	Limited suitability	Unsuitable	Limited suitability
Crusher waste	Limited in terms of quantity	Suitable	Limited Suitability
Shredded waste wood	Suitable	Suitable	Suitable
Varnish and paint residue	Unsuitable	Suitable	Suitable
Hazardous waste in small containers (e.g. laboratory waste)	Limited suitability	Pretreatment required	Suitable

In accordance with all the above, and taking into account the advantages of the technology with a fluidization bed, as well as based on the analysis of the waste market and the availability of waste suitable for the technology with a fluidization bed, the Project Holder opted for the construction of the Waste to Energy Plant specifically with Fluidized Bed, with a capacity of 30 MW, based on the technology of the Austrian company "TBU Stubenvoll" GMBH, which has proven references with plants of a similar type. Different equipment manufacturers were consulted and the most appropriate solutions were selected in accordance with the best available techniques.

One line for waste thermal treatment is planned, with a max temporary capacity of 17 t/h (yearly 100,000 t/year). The thermal treatment line contains an incineration chamber in the fluidized bed, to which the heating surfaces of the boiler are connected in three flue gas passages, which then pass through the evaporator and economizer. The heat treatment chamber consists of a fluidization part, the lower and upper zones.

<u>Alternatives regarding of the Transport and Storage of Hazardous Waste</u>

Non-recyclable hazardous waste is delivered directly from the generator or via a licenced waste operator storage facility. Hazardous waste will be transported in ADR certified means of transportation to the Waste to Energy Plant in Prahovo. As part of the reception procedure, strict controls which include laboratory analyses before giving permission for the waste to be accepted for treatment.

The selection of transportation, storage and dosing equipment is an important part of the engineering process. It depends on several factors:

- Physical properties of waste, e.g.:
    - physical state, water content, particle size, particle size distribution, angle of repose, viscosity, pumpability and dynamic properties of the fluid, heating capacity, dust release during handling;
- Chemical properties of waste, e.g.:
    - pH value, corrosivity, chemical reactivity, liquid mixing characteristics (avoidance of chemical reactions, gas separation, gas formation, temperature rise), halogen content, heavy metal content, toxicity, flammability, explosiveness;
- Properties of the waste incineration site, e.g.:
    - logistic possibilities of access to the location, incineration technology (grate firing, fluidized bed, rotary kiln), presence of sensitive environment or surrounding;
- Specific requirements defined by licensing authorities, e.g.:
    - Restriction or prohibition of waste transport activities at certain time periods (e.g. during the night), sensitive environment (e.g. hospital, nursing home).

Transport within the complex includes:

- Transport to the place of thermal treatment (delivery of waste materials),
- Transport from the place of thermal treatment (shipment of residues and secondary raw materials), and
- Transport at the place of thermal treatment (e.g. from the waste bunker to the furnace/boiler or from the furnace/boiler to the ash reception facility).

Depending on the physical and chemical properties, waste is transported by trucks in IBC containers, barrels, jumbo bags, or in the case of transport of liquid waste, by tank trucks.

For the needs of waste transport within the plant, moving floors, conveyor belts, forklifts are provided.

From the standpoint of the organization of the storage and the selection of thermal treatment equipment, several conceptual solutions were considered. Open and closed type warehouses were considered, as well as different types of equipment and all their advantages and disadvantages were analysed:

Thermal treatment with grate Firing	Rotary Kiln for thermal treatment	Fluidized Bed for thermal treatment
The delivered waste is unloaded into a bunker, which provides enough storage space for a few days. The combustion air required for the process itself is usually sucked out of the waste bunker. Therefore, there is always a small under pressure in the bunker, so that	Solid waste delivery, dosing and storage systems used in rotary kiln incinerators are basically similar to those with grates. Dosing of waste liquids (e.g. waste oils, waste solvents) and sludge is done using separate tanks/bunkers, precipitators	Solid waste delivery, dosing and storage systems applied in fluidized bed incinerators are essentially similar to those described for grate incinerators. But unlike a grate firing system, a fluidized bed system requires waste of a certain granulation and density.

contaminated air with an unpleasant odor cannot escape from the bunker. Instead, ambient air is sucked into the bunker, which helps reduce odors near the installation. Incineration of waste in a grate firing plant generally does not require any pretreatment of waste. In the event that the plant is also intended for bulky waste, shredders or grinders are used for its shredding. In the waste bunker, the waste is mixed using a crane that can accommodate several tons of waste. The crane grabs the waste in the bunker and disposes of it in the waste entrance channel, in which the waste slowly slides down and falls on the grate in the furnace. The waste layer in the waste channel provides air sealing between the incineration chamber and the bunker. In the event that there is insufficient waste in the duct, a mechanical shutter is installed to close the duct. At the lower end of the channel, there are dispensers (allocators) that evenly distribute the waste on the grate.	and dosing pumps that bring them into the incinerator via its (non- rotating) front wall. For safety reasons, steel barrels containing toxic waste, as well as small plastic containers for "sharp objects" containing infectious waste are most often directly inserted into a rotary kiln, without opening containers and exposing employees to potential risks and hazards. Steel barrels are collected at the end of the rotary kiln as secondary metal that can be recycled, while plastic containers are incinerated in the rotary kiln, and only metals (e.g. scalpels) are left in the ashes at the furnace outlet, which are also separated as secondary raw materials for recycling.	Therefore, waste delivered to fluidized bed incinerators must either be mechanically pre-treated prior to delivery to the plant, or mechanically treated at the incinerator site. Mechanical pretreatment of solid waste before incineration in the fluidized bed usually consists of the following technological operations: • shredding, • sieving, • removal of iron and iron alloys (so-called ferrous metals), • removal of non-ferrous metals. If mechanical pretreatment takes place on site, the installation must be equipped with at least two different waste bunkers, one to deliver untreated input waste and the other to store mechanically pre-treated waste. In addition, smaller bunkers and/or containers are installed to store sorting residues and secondary raw material. Waste cranes are used for the capture of untreated waste and its delivery to mechanical pretreatment equipment, and also for the dosing of previously treated waste to conveyors that transport the waste to the furnace kilns or boilers in which it is incinerated. Waste dosing is usually done using a rotary dispenser located at the bottom of the dosing channel and also serves as a hermetic seal that prevents the ignition of waste within the transport line. Below the rotary dispenser, there is a device or channel for the rapid transport

		of waste through which the waste is distributed to the surface of the hot fluidized bed, in which it incinerates. In the event that waste liquids (e.g. waste oils, waste solvents), sewage sludge or other sludge are also incinerated, they are stored in separate tanks/bunkers and dosed via separate pumps and supply lines directly into the furnace.

The selection of a closed facility (hall) for the storage of solid and liquid waste and mechanical preparation of solid waste materials was carried out by the Project Holder in order to prevent the emission of unpleasant odours and dust into the surrounding area. Concrete waterproof bunkers for solid waste storage are planned in the hall, one of which will be used for mixing waste according to predefined recipes for thermal treatment, and one for storing mixed fuel that is dosed into the boiler. Removal of dust and unpleasant odours and prevention of their emission outside the facility is achieved by keeping the hall constantly under pressure, drawing air from the hall and burning it in the boiler plant. In cases where the boiler plant does not work (due to overhaul, downtime, etc.), the air from the waste storage facility will be directed to the bag filter system and activated carbon filter by means of a fan, where it is purified, and then the purified air is discharged into the atmosphere via the emitter (smokestack) of the filter unit. A rack warehouse for IBC containers / barrels is also planned in the closed part of the facility intended for this purpose. Appropriate tanks are provided for the storage of liquid waste, which will also be located in watertight concrete tanks within the closed facility of the Waste storage. Ventilation of the space in which the storage tanks are located is provided through a duct with associated elements for inserting and sucking air from the space. Equipment for unloading, storage and dosing of sludge waste is a package unit and consists of: a reception bunker with a movable floor; a spiral conveyor and a piston pump with which the sludge waste is dosed to the boiler plant. The process of unloading, storage and pretreatment of waste materials is a fully automated process, in a closed system therefore, under regular operating conditions, there are no significant environmental impacts.

The project envisages a separate Hazardous Waste Treatment Line (IBC containers, barrels, etc.). This line is closed type. It is envisaged that the container/barrel is automatically inserted into the shredder chamber using a forklift and an IBC lift, after which the first door is closed and nitrogen (N_2) is introduced into the chamber at that moment. When the atmosphere in the chamber is inertised, a second door opens and the vessel is then inserted into the primary shredder. The primary shredded material reaches the secondary shredder, after which the shredded waste enters the mixer/ spiral conveyor and is dosed directly into the boiler. The envisaged technology achieves the avoidance of waste pumping. Namely, when pumping the liquid fraction, there is a possibility of contamination during manipulative actions, as well as toxication, therefore, the application of the designed closed system allows for unified dosing, without the possibility of cross-contamination with accompanying reactions. Also, the application of the aforementioned liquid waste dosing system delivered in IBC containers/barrels enables the prevention of mixing of potentially reactive hazardous waste with non-reactive solid waste fractions.

Alternatives regarding Waste Gas Treatment

In addition to the positive effects of obtaining energy from waste and valuable materials ready for recycling processes, it is important to remember that this technology produces pollutants during its operation that must be adequately "captured" and safely disposed of. In accordance with the above, the Project Holder considered the best available techniques and technologies related to the treatment of waste gases, wastewater and the treatment of solid residues from the boiler plant.

Table 61 provides an overview of flue gas cleaning techniques considered Best Available Techniques (European Commission, Best Available Techniques (BAT) Reference Document for Waste Incineration, Industrial Emissions Directive 2010/75/EU, 2019)[196].

In accordance with the recommendations of the best available techniques, flue gases are purified in a multi-stage system (wet cleaning, dry cleaning) and subsequently discharged via a smokestack into the atmosphere. An example is the wet flue gas cleaning system, which consists of a cyclone for pre-dust removal, a gas stream adsorption system with a bag filter for the removal of acid gases and heavy metals, two wet purifiers for the removal of acid gases, and a selective catalytic reduction system (SCR) for the removal of nitrogen oxides (DeNOx). The described techniques are applicable regardless of the incineration technology applied (grate firing, fluidized bed, rotary kiln) and the type of waste to be incinerated.

Table 61: Overview of flue gas cleaning techniques considered as Best Available Techniques (European Commission, Best Available Techniques (BAT) Reference Document for Waste Incineration, Industrial Emissions Directive 2010/75/EU, 2019).)

Best available techniques	Mitigation of the parameter
Bag filters	Dust, heavy metals
Dry sorbent injection	Acid gases (SO_x, HCl, HF)
Bag filters with catalyst	PCDD/F, NO_x
Direct desulfurization	SO_x
Dry sorbent injection	Acid gases (SO_x, HCl, HF), PCDD/F and Hg
Electrostatic filter (ESP)	Dust, heavy metals
Adsorption with fixed or movable layer	TOC, PCDD/F, Hg and others
Flue gas recirculation	NO_x
Selective Catalytic Reduction (SCR)	NO_x
Selective Non-Catalytic Reduction (SNCR)	NO_x
Semi-moist absorber	Acid gases (SO_x, HCl, Hf)
Wet scrubber	Acid gases (SO_x, HCl, HF), PCDD/F and Hg

The individual components of the flue gas cleaning system (FGC) are combined to ensure the efficient removal of pollutants contained in the flue gases. A large number of different components and ways of designing the system allows a large number of combinations.

Analysing the available techniques and technologies related to the treatment of waste gases, in order to protect the environment, the Project Holder has decided that the largest and most complex part of the Waste to Energy Plant should be flue gas cleaning systems generated during the incineration of waste. These systems are designed on the basis of the defined chemical composition of the recipes of different types of waste entering the incineration process and include:

- Dry flue gas cleaning (cyclone and activated carbon reactor and bag filters)
- Wet flue gas cleaning in scrubbers
- Selective catalytic filter (SCR)
-

[196] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)

Alternative solutions related to NO_x removal technologies

Analysis of the NO_x reduction equipment shown in the Best Available Techniques (BAT) Reference Document for Waste Incineration shows that plants equipped with SCR (Selective catalytic reduction) generally achieve significantly lower levels of NO_x emissions than plants equipped with SNCR (Selective non-catalytic reduction). The main disadvantages are its higher purchase price and the energy consumption required to support the reheating of the flue gases to the reaction temperature with the catalyst. It is additionally necessary to regenerate the catalyst after a certain time of exploitation. However, the use of a heat exchanger reduces the additional energy required to achieve the appropriate temperature. Tables 62, 63 and 64 show a comparison of NO_x and NH_3 emissions using SCR and SNCR taken into consideration by the Project Holder at the earliest stages of project development.

Table 62: Comparison of NO_x and NH_3 emissions using SCR and SNCR

Substance	SNCR					SCR			
	Achieved emission range				Note	Achieved emission range			
	Annual maximums		Annual average Mg/Nm3	Specific emission (g/t of input waste)		Annual maximum		Annual average Mg/Nm3	Specific emission (g/t of input waste)
	Average half-hourly mg/Nm3	Average daily mg/Nm3				Average half-hourly mg/Nm3	Average daily mg/Nm3		
NO_x	155-300	80-180	70-180	390-1000	Depending on the dosing rate, waste and type of furnace	50-200	40-150	40-120	220-660
NH_3	5/60	3-15	1-6	6-33	Lowest where wet scrubbers are used	3-30	3-10	<3	<17

Table 63: Evaluation of SNCR and SCR usage ecriteria

Criterion	Description of the factors influencing the determination of the criteria	SNCR		SCR	
		Rank (high/medium/low)	Note	Rank (high/medium/low)	Note

Complexity	Additional process unit required Critical operational aspects	Medium	Reagent injection equipment is mandatory but not separate reactors as with SCR Temperature and optimization of reagent injection is important	High	
Flexibility	Ability of the technique to operate under a range of input conditions	Medium	Good NO_x reduction over input concentration range Temperature critical	High	In general, high reduction rates are achieved. Sensitive to input concentrations of SO_2, SO_3 and P. Multifunctional reduction of NO_x and PCDD/F.
Required skills	Additional training required	Medium	Necessary control and optimization of the injection rate	High/Medium	

Table 64: Consumption levels associated with the use of SNCR and SCR

Criterion	Unit	SNCR		SCR	
		Range of achieved values	Note	Range of achieved values	Note
Energy requirements	kWh/t waste input	45-50 thermal	Furnace injection cooling effect	65–100 thermal for high temperature SCR, 3–5 for	Thermal refers to reheating, electrical to additional

				low temperature SCR 10–15 electric	pressure drop via catalyst
Reagent consumption	kg/t of waste input	1-4	Ammonia, urea or ammonia water	1-3	25% ammonia solution
Reagent stoichiometry	Scale	2-3	/	1-1.1	Refers to the inlet pollutant concentration

<u>Alternatives regarding Waste Water Treatment generated by Wasto to Energy Plant</u>

The generation and composition of wastewater in the incinerator may vary depending on the design, techniques and equipment used. Some of the known sources of wastewater in such facilities are:

- Flue gas cleaning system (scrubber),
- Ash handling system,
- Water Cooling System
- Wastewater generated during ash washing (filter ash pretreatment method),
- Atmospheric waters

When it comes to thermal waste treatment plants with a wet flue gas cleaning system that uses aqueous solutions to remove pollutants, as is the case in the plant in question, it is also necessary to design a wastewater treatment plant, which prevents water and environmental pollution. Wet cleaning is usually performed in two phases. In the first acid scrubber, hydrogen halides (mainly HCl but also HF, HBr and HI in traces) are separated from the flue gases by physical absorption in water. In another neutral scrubber, SO_2 that is less soluble in water is chemically absorbed with a sodium hydroxide solution. The acid scrubber effluent usually shows a pH well below 1 and contains small amounts of fine particles and metal compounds (e.g. Hg). Neutral scrubber effluent contains mainly sodium sulphites/sulphates. Conventionally, these effluents are mixed and then sent to the pH correction phase, where $Ca(OH)_2$ is added to the wastewater to convert HCl to $CaCl_2$ and $NaSO_4$ to $CaSO_4$ and NaCl.

Various combinations of several best available techniques, which are described in Table 65, have been considered to control the quality of wastewater discharged from the boiler plant.

Table 65: Wastewater treatment technologies which are Best Available Techniques (European Commission, Best Available Techniques (BAT) Reference Document for Waste Incineration, Industrial Emissions Directive 2010/75/EU, 2019).

Best available technique	Mitigated water contaminants
Adsorption on activated carbon	Soluble substances, organic compounds, Hg
Precipitation	Sulphates, fluorides, metals
Coagulation and flocculation	Suspended Solids
Equalization	All parameters

Filtration	Suspended Solids
Flotation	Suspended Solids
Ionic exchange	Ionic pollutants
Neutralization	Adjusting pH to approx. 7
Oxidation	Sulphite SO_3^{2-}
Reverse osmosis	Pollutants dissolved in water, e.g. salts
Sedimentation	Suspended Solids
Pollutant stripping	Cleanable contaminants, e.g. NH_3

The project envisages separate sewerage for separate collection of water from the complex as well as plants for the treatment of all wastewater before their discharge first into the collection conduit and then into the final recipient.

Wastewater collection and treatment: **Sanitary – foul wastewater** (sewerage system collects waste sanitary-foul wastewater and conducts it to the treatment plant (mechanical and biological treatment). Purified wastewater is connected to the shaft of conditionally clean rainwater sewage and then discharged into the internal network of the Elixir Prahovo Industrial Complex); **Atmospheric clean water** (rainwater sewerage for the collection of clean atmospheric water from the roofs of buildings and its drainage into the existing Central collector of the Elixir Prahovo industrial complex, which brings wastewater to the existing inlet structure and discharges it into the Danube River); **Atmospheric potentially oily wastewater** (rainwater sewerage for the collection of oily wastewater from roads, manipulative surfaces and parking lots takes water for treatment into the coalescent separator of grease and oil. After the separator, the purified water is connected to the clean rainwater sewage); **Process wastewater from wastewater treatment plant of the boiler plant** – process sewage (T1); **General process wastewater** (water from the drain in W-C11, water from the drainage of the boiler, leachate from the Landfill for non-hazardous waste, etc.) – general process sewage (T2); **Wastewater from fire extinguishing** – system of collection and drainage of FP wastewater; **Wastewater from washing of sand filters from the preparation of process water** – (T3); **Wastewater from washing of filters from the WWTP wastewater treatment plant** – (T4).

When designing the basin for the reception of waste water, it was also considered to build the basin without a chamber water collection system, but due to better control of the quality and quantity of water discharged into the common collector, it was decided to work with 4 chambers. The application of a chamber system for the collection of technological waste water from the plant enables monitoring of water quality and control of water management depending on the obtained results with, in case of need, the possibility of applying appropriate corrective measures (referring a smaller amount of water to re-treatment in the plant or, if necessary, thermal treatment).

Alternatives regarding the treatmnet of residues form the Boiler Plant (Stabilization adn Solidification)

After incineration, solid residues are separated. These include bottom ash residues, fly ash and flue gas cleaning residue, each of which requires special handling procedures. The composition of the incineration residues may vary depending on the type of waste being incinerated and the technologies used. Proper management of waste incineration residues is essential to minimize environmental impact, ensure compliance with regulatory standards and, if applicable, obtain materials for recycling.

As mentioned above solid incineration residues are collected as boiler ash and cyclone ash (coarse fly ash), economizer ash and bag filter ash containing adsorbent (i.e. fine ash collected in bag filter and activated carbon), gypsum from SOx removal in wet scrubber and filter cake (neutralizing sludge) from wastewater treatment plant. Ferromagnetic and non-ferrous metals, gypsum and mineral residues can be extracted and sent for recycling.

Effective management of waste incineration residues must prioritise minimising the environmental impact, exploring alternative disposal methods and promoting circular economy principles to derive value from these residues where possible.

In line with previous experience in the same or similar plants, solid residues from incineration of waste are usually disposed of in landfills (see table 66) or used in some European countries as replacement material (e.g. Denmark, Netherlands, Germany, UK).

Table 66: Typical method of disposal and use of solid residues from waste incineration

<table>
<tr><th>Type of solid residue</th><th>Landfill for non-hazardous waste</th><th>Landfill for Hazardous waste</th><th>Use</th></tr>
<tr><td>Bottom ash from grate firing incineration</td><td rowspan="2">x (no curing/stabilization)</td><td rowspan="2"></td><td rowspan="2">in road construction (e.g. DK, NL, IT, P, UK, DE)
in the cement industry (e.g. IT, CH)</td></tr>
<tr><td>Bottom ash from waste incineration with fluidized bed</td></tr>
<tr><td>Bottom ash from the waste incineration in rotary kiln</td><td>x
(no curing/ stabilization)</td><td></td><td></td></tr>
<tr><td>Fly ash (Boiler ash and filter ash)</td><td>x
(with fixation/ stabilization)</td><td>X</td><td></td></tr>
<tr><td>Flue gas cleaning residues Activated carbon</td><td>x
(with fixing/ stabilization)</td><td>X</td><td></td></tr>
<tr><td>Filter cake (neutralizing sludge)</td><td>x
(with fixing/ stabilization)</td><td>X</td><td></td></tr>
</table>

Regular operation of the subject fluidized bed boiler plant may result in the following solid residues:

- Bottom ash (large fraction of unburnt material that is separated at the bottom of the boiler under the furnace);
- Boiler ash (separated between the second and third passages of flue gases through the boiler);
- Cyclone ash (fraction of fly ash from the boiler that is separated from the emitted gases when passing through two cyclone separators, T>400°C);
- Ash from the economizer (fine fraction of fly ash separated during the pass of flue gases through the economizer, T>150°C);

- Filter ash (fine fraction of fly ash separated during the pass of flue gases through the bag filter system; so-called fly ash);
- Activated carbon with a fraction of fine particles from the flue gases;
- Sludge/thickened sediment from the treatment of wastewater from the wet flue gas cleaning system (which is separated in the form of thickened sediment by centrifugation),

which must be disposed of in an adequate manner and in accordance with the regulations of the Republic of Serbia and the EU.

In order to harmonize the characteristics of the aforementioned solid residues from the boiler plant and bring them to a state suitable for disposal at the subject Landfill for non-hazardous waste in accordance with the criteria defined by the Rulebook on Waste Categories, Examination and Classification[197], the Regulation on disposal of waste on landfills[198], i.e. With the EU Landfill Directive (Directive (EU) 2018/850 of the European Parliament and of the Council of 30 May 2018 amending Directive 1999/31/EC on the landfill of waste)[199], the first step in the process of treating solid residues is the separation of bottom ash in order to separate metal, glass, stone, etc., and the second step is the process of stabilization (prevention of uncontrolled reactions) and solidification (curing).

The aim of the treatment is to process solid residues from the boiler plant and obtain material that is formed at the landfill into a material with high mechanical strength, low permeability and encapsulated pollutants, i.e. low leaching rate.

Separated metal fractions from bottom ash will be handed over to authorized operators for recycling, while the rest will be merged with other residues from the boiler plant in the stabilization and solidification facility.

One of the considered alternatives was the special separation of non-hazardous coarse ash ("bottom ash") in order to reuse it (for filling roads, as building materials, etc.). Based on the analysis of the RS market, it was concluded that the market currently does not provide the opportunity for the application and reuse of this type of waste and that even if it would be separated, it would still eventually be disposed of at one of the landfills for non-hazardous waste without prior treatment (S/S), and therefore the Project Holder abandoned the said solution.

In favour of the above decision of the Project Holder, regarding the management of coarse ash, the fact that it is recognized that non-hazardous coarse ash has excellent binding characteristics of other materials, and as such is a desirable factor in the solidification recipe, and at the same time the method of disposal and use of this type of waste is solved, for which there is currently, as stated, no commercial method of use in the RS. Such procedure settings are harmonized with the European Commission Directorate- General environment The

[197] "Official Gazette of the RS", nos. 56/2010, 93/2019, 39/2021, 65/2024, Available at Pravilnik o kategorijama, ispitivanju i klasifikaciji otpada (paragraf.rs)
[198] "Official Gazette of the RS", nos. 56/2010, 93/2019, 39/2021, 65/2024, Available at Pravilnik o kategorijama, ispitivanju i klasifikaciji otpada (paragraf.rs)
[199] Implementing decision - 2019/2010 - EN - EUR-Lex (europa.eu)

Director-General Guidance on the interpretation of key provisions of Directive 2008/98/EC on waste, 2012.

The use of a large fraction of unburned material that is separated at the bottom of the boiler without prior sieving and with the separation of metals and other non-metallic recyclable materials, in the process of solidification instead of the separation of large fractions and their direct disposal on the landfill body, ensures the full utilization of this material as a binder in solidificates, and thus reduces the emission of particulate matter in the event that this material is directly disposed of at the landfill.

Disposal of residues from the boiler plant to the landill

As stated above, the goal of the realization of the project for the construction of the Landfill for non- hazardous waste in the immediate vicinity of the Waste to Energy Plant is the ultimate disposal of solid residues from the boiler plant that have been previously stabilized and solidified, thus minimizing any potential impact on soil and groundwater. In this way, the issue of disposal of residues from the boiler plant is resolved as close as possible to the location of origin, all in accordance with the principles and hierarchy of waste management.

The technical and technological conditions for the construction of the landfill in question are defined in accordance with the Regulation on disposal of waste on landfills[200] ,Appendix 2. – Technical and technological conditions for the design, construction and commissioning of the landfill and they have been fully implemented in the project in question, therefore the Project Holder did not consider other alternative solutions.

9.3. Operation methods

9.3.1. Method and procedure of plant operation

Liquid and solid non-hazardous and hazardous waste will be taken over from the waste generator or authorized operators who have the permission of the relevant authority for the collection, transport and/or storage of waste. During the contracting process, all generators and operators will be provided with clear instructions and guidelines on the types of waste, the way the waste should be packaged and labelled, and the required accompanying documentation, so that the waste can be received and treated at the location of Waste to Energy Plant. Bearing in mind the above, pre-sorted and adequately packaged waste that meets all the requirements for admission to the plant will be delivered to the WtE plant in question.

In accordance with the conclusions on best available techniques, the Project Holder shall provide all waste suppliers with clear and precise procedures and guidelines for waste examination and characterization and submission of waste data before its delivery to the location of WtE plant, all as part of the prior waste acceptance procedure. These procedures and guidelines are intended to ensure the technical suitability of waste treatment operations for a particular waste before the waste arrives at the plant. This procedure includes procedures for collecting information on waste coming to the plant and may include waste sampling and characterization to achieve sufficient knowledge of waste composition. The previous waste

[200] "Official Gazette of the RS", no. 92/2010, Available at Uredba o odlaganju otpada na deponije

acceptance procedures are also based on a risk assessment taking into account e.g. hazardous properties of the waste, risks which waste represent in terms of process safety, occupational safety and environmental impact, as well as information provided by the previous waste owner. Also, in accordance with the conclusions on the best available techniques, as well as in accordance with the Regulation on technical and technological conditions for the design, construction, equipping and operation of plants and types of waste for waste thermal treatment, emission limit values and their monitoring[201], the Project Holder will carry out a clearly defined procedure for the reception and acceptance of waste at the subject plant when receiving waste. These procedures define the elements that are checked and verified when accepting the waste in the plant. These procedures may include sampling, inspection and analysis of waste.

The delivery of waste to the subject Waste to Energy Plant will be carried out by the operator itself and/or other operators, with their means of transportation in accordance with the Law on Waste Management[202] and the Law on the Transport of Dangerous Goods[203]. At the very entrance to the Waste to Energy Plant, before reception of waste, the radioactivity of the delivered waste will be tested. If the meter detects elevated radioactivity, the relevant republic inspection and the ministry are immediately notified, and the driver is instructed to park the vehicle in the designated truck parking lot until the authorized inspection arrives.

The preparation of the Plant Management and Operation Manual will define all activities, precise environmental protection policy, waste management quality guarantee policy, organization, work protocols, working conditions, conditions and method of treatment of residues from the thermal treatment process, reporting, Environment Managment System (EMS), work procedures in emergency situations, etc.

Monitoring of received, stored and treated types and quantities of waste will be carried out through the keeping of Daily Records on Waste and the formation of Annual Waste Reports, which will be submitted to the Environmental Protection Agency within the prescribed deadline.

The work methods within Waste-to-Energy plant are coordinated and designed according to the valid regulations of the Republic of Serbia and in accordance with the conclusions on the best available techniques, therefore the Project Holder did not consider other alternative solutions.

9.3.2. Method and procedure of Landfill operation

The method and procedures of operation of the landfill, i.e. the working plan of the landfill, the designation of a qualified person for work at the landfill, the obligations of the landfill operator, the technical and technological conditions for the design, construction, operation and equipment of the landfill, the organization of waste management at the landfill, disposal operations, the issuance of a waste disposal permit, daily records, the annual report on waste, the costs of design, construction, operation, decommissioning of the landfill and its

[201] "Official Gazette of the RS," No. 103/2023, Available at about:blank (ekologija.gov.rs)
[202] "Official Gazette of RS," No. 36/2009, 88/2010, 14/2016, 95/2018 - other law, and 35/2023, available at Zakon o upravljanju otpadom
[203] "Official Gazette of the RS", nos. 104/2016, 83/2018, 95/2018 - other law and 10/2019 - other law, Available at Zakon o transportu opasne robe

maintenance after decommissioning, are carried out in accordance with the Regulation on disposal of waste on landfills[204], the Law on Waste Management[205] and special regulations.

Procedures and mode of operation of the landfill carried out during the technological process of exploitation of the landfill in question will be carried out in accordance with Appendix 5. – Procedures and mode of operation of the landfill of the aforementioned regulation, therefore, the Project Holder did not consider other alternative solutions.

9.4. Functioning and termination of functioning

With regular maintenance, the expected service life of the WtE plant is about 50 years.

The planned total height of the landfill is 46 m, in order to align it with the height of the existing phosphogypsum storage, which is located in the immediate vicinity, and enable smooth movement of machinery on the last floor. After the closure of the landfill until its decommissioning, the landfill operator shall take the measures provided for in this study and regulations in this area. In this way, potential air pollution will be prevented and the surface runoff slowed down, which can be significant in the case of higher landfill heights.

Based on the averaged values, the expected time of exploitation of the landfill is 126 years, while at the maximum expected load, the calculated time of exploitation is about 44 years.

9.5. Production volume

During the elaboration of the Preliminary Design, the Project Holder first considered the phased construction (2 phases) of the waste-to-energy plant. During the elaboration of the Preliminary Design, the total plant capacity of 200,000 (t/g) was initially envisaged for 8,000(h) per year, with two boiler plant production lines with an individual capacity of 100,000 (t/g), i.e. a capacity of 2 x 30 MW. Two identical pretreatment plant lines were also considered.

After analysing the types and quantities of waste generated in the territory of the Republic of Serbia, and reviewing the originally adopted solution, the Project Holder decided to modify the Preliminary Design by reducing the capacity of the Waste to Energy Plant in accordance with the actual situation and market needs. In accordance with the above, one line of the boiler waste-to-energy plant with a capacity of 100,000 t/year of thermal treatment of non-recyclable hazardous and non-hazardous waste, with a total boiler capacity of 30 MW for the production of steam of 35 t/h, has been designed.

In accordance with the aforementioned changes in the capacity of the Waste to Energy Plant, corrections were also made in the Landfill for non-hazardous waste project in terms of the phase construction of the landfill for the disposal of previously stabilized and solidified solid residues from the thermal treatment process, gross area of about 8.5 ha.

[204] "Official Gazette of the RS", no. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)

[205] "Official Gazette of RS," No. 36/2009, 88/2010, 14/2016, 95/2018 - other law, and 35/2023, available at Zakon o upravljanju otpadom (paragraf.rs)

9.6. Monitoring

Monitoring is carried out by systematic monitoring of the indicators values, i.e. monitoring of emissions to the environment, the state of the environment, measures and activities undertaken in order to reduce negative impacts and raise the level of environmental quality.

All members of the Elixir Business System apply the best available technologies and perform continuous monitoring of the environmental impact, both independently in its scope of accreditation and through the relevant authority, an authorized organization that meets the requirements prescribed by law and performs monitoring.

The environmental monitoring program includes:

- Monitoring the emission of pollutants into the air;
- Monitoring of wastewater, surface water and groundwater;
- Monitoring of soil quality;
- Monitoring of noise;
- Monitoring of ionizing and non-ionizing radiation, vibration;
- Regular annual reporting and submission of data on the performed monitoring to the Environmental Protection Agency, by entering data through the NRIZ web portal within the prescribed deadlines.

The monitoring of received, stored, generated and treated types and quantities of waste, as well as the quantities of waste disposed of at the landfill, shall be carried out through the keeping of Daily Records on the types and quantities of waste pursuant to Article 75 of the Law on Waste Management[206] and the Rulebook on the form of daily records and annual report on waste with instructions for its completion[207] andby submitting a regular annual report on the quantities of waste to the Environmental Protection Agency by 31 March of the current year for the previous year by directly entering the data into the information system of the National Register of Pollution Sources at the address of the Environmental Protection Agency:

http://www.sepa.gov.rs/index.php?menu=20170&id=20004&action=showAll

9.6.1. Selection of locations for environmental quality monitoring

The selection of measuring points, control and monitoring of environmental quality is carried out in accordance with the Law on Environmental Protection[208] and the Law on Integrated Prevention and Control of Environmental Pollution[209],as well as other laws and by-laws from the field of environmental protection. The monitoring plan will define the number and schedule of measuring points, networks of measuring points, scope and frequency of measurements, classification of phenomena to be monitored, methodology of work and indicators of

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[206] "Official Gazette of RS," No. 36/2009, 88/2010, 14/2016, 95/2018 - other law, and 35/2023, available at Zakon o upravljanju otpadom (paragraf.rs)

[207] "Official Gazette of the RS", nos. 7/2020 and 79/2021, Available at Pravilnik o obrascu dnevne evidencije i godišnjeg izveštaja (paragraf.rs)

[208] "Official Gazette of the RS", nos. 135/2004, 36/2009, 36/2009 - other law, 72/2009 - other law, 43/2011 - CC, 14/2016, 76/2018 and 95/2018 - other law , available at Zakon o zaštiti životne sredine (paragraf.rs)

[209] "Official Gazette of the RS", no. 135/2004, 25/2015, 109/2021, available at Zakon o integrisanom sprečavanju i kontroli zagađivanja životne sredine (paragraf.rs)

environmental pollution and their monitoring, deadlines and manner of submitting data, based on specific laws.

According to the provisions of the Law on Environmental Protection, the obligations related to environmental monitoring are as follows:

- The Republic, the Autonomous Province and the local self-government unit, within their competencies, ensure continuous control and monitoring of the environment, as well as financial resources for monitoring. The Government in cross-boarder collaboration in accordance with Espoo convention shall determine the criteria for determining the number and arrangement of measuring points, the network of measuring points, the scope and frequency of measurements, the classification of phenomena to be monitored, the methodology of work and environmental pollution indicators and their monitoring, deadlines and the manner of data submission.
- A legal and natural person who is the owner or user of an installation that is a source of emission and environmental pollution, shall, in accordance with Article 72 of the Law on Environmental Protection[210], through the relevant authority or authorized organization:
    - monitor emission indicators, i.e. indicators of the impact of their activities on the environment, indicators of the effectiveness of applied measures to prevent the occurrence or reduction of the pollution levels;
    - provides meteorological measurements for large industrial complexes or facilities of special interest to the Republic of Serbia, an autonomous province or a local self-government unit.
- The Government shall determine the types of emissions and other phenomena that are the subject of pollutant monitoring, the methodology of measurement, sampling method, the method of recording, the deadlines for submission and the requirements for data storage. The polluter plans and provides financial resources to perform emission monitoring, as well as other measurements and monitoring of the impact of its activity on the environment.

9.6.2. Monitoring the operation of the Waste to Energy Plant

In addition to the obligations prescribed by laws and by-laws and which are binding, related to monitoring, the Project Holder considered additional alternative solutions that could apply in regular operation with the aim of constant monitoring of the operation and control of all emissions from the plant in question.

The method of managing the process of thermal waste treatment, waste preparation and defining appropriate recipes is one of the important issues that were considered during the preparation of the project documentation.

Alternative solutions considered when it comes to monitoring are reflected in the selection of persons who perform sampling, analysis and reporting on the examination conducted. Monitoring may be performed by an authorized organization, if it meets the requirements in

[210] "Official Gazette of the RS", nos. 135/2004, 36/2009, 36/2009 - other law, 72/2009 - other law, 43/2011 - CC, 14/2016, 76/2018 and 95/2018 - other law , available at Zakon o zaštiti životne sredine (paragraf.rs)

terms of personnel, equipment, premises, accreditation for measuring a given parameter and SRPS-ISO standards in the field of sampling, measurement, analysis and reliability of data, in accordance with the law. Alternatively, the operator itself can be accredited and obtain approval from the relevant ministry to perform monitoring.

During 2023, as part of the Elixir Group business system, a laboratory of the Centre for Applied Circular Economy (CPCE) was established, as a control accredited laboratory of the Elixir Group. In order to ensure the best possible product quality and the most accurate examination results in the field of analysis of mineral fertilizers, raw materials for the production of mineral fertilizers and raw materials of the circular economy, wastewater, waste, etc. the Laboratory was equipped the latest instruments, state- of-the-art equipment, and a team of professionals gathered in the laboratory guarantees a high level of expertise and knowledge of each analysis.

In accordance with all of the above, monitoring and control of environmental quality during the operation of the Waste to Energy Plant will be carried out in the form of:

- external controls by authorized accredited institutions
- internal controls by the authorized laboratory of the Centre for Applied Circular Economy (CPCE)

In order to monitor the work process and establish a secure system, the following is envisaged on the complex as an imperative:

- stationary and mobile video surveillance
- automatic gas and fire detection
- automatic fire detection
- stable fire extinguishing systems
- trained and equipped fire brigade.

Independent control of the operation of the Waste to Energy Plant by representatives of the local community in the form of the Civil Control is also envisaged. The Civil Control of citizens is envisaged in the form of:

- establishment of a kind of civil control that is in accordance with the best practices of similar plants in the EU, thus guaranteeing that the operation of the plant remains transparent, responsible and compliant with high environmental and social standards.
- training before the start of operation of the plant to supervise the operation of the plant and monitor the results of monitoring.
- organized study visits of interested citizens to similar facilities
- insight into the best practices and choice of solutions for organizing Civil Control in Prahovo

The impact on air quality in the subject area is based on the monitoring of ambient air quality. Currently, in accordance with the adopted environmental monitoring plan and program, the operator Elixir Prahovo performs monitoring of ambient air quality in the vicinity of the subject location through an authorized accredited laboratory of the City Institute for Public Health Belgrade. Air quality monitoring is carried out once a year for 15 days at the measuring point 1: Dragiša Brebulović-Žmiga, 11 Vuka Karadžića Street, Prahovo (N 44°17'40.6'', E 22°35'9.5 ''), which is about 2.5 km northwest of the location of the Elixir Prahovo complex, and therefore from the future Waste to Energy Plant and Landfill for non-hazardous waste.

In order to continuously monitor the impact on air quality, as a result of the operation of industrial facilities within the chemical industry complex in Prahovo, the need for the procurement and installation of an automatic measuring station in the municipality of Negotin has been imposed as an alternative solution. In accordance with the above, the procedure of donating an automatic measuring station to the municipality of Negotin was covered by Elixir, which is a part of the network of the Environmental Protection Agency on whose initiative an adequate location has been defined and relevant measurement parameters have been determined. The automatic station measures the basic pollutants: sulphur dioxide, nitrogen dioxide (nitrogen monoxide and total nitrogen oxides), carbon monoxide, suspended PM10 and PM2.5 particles, as well as meteorological parameters – temperature, pressure, relative humidity, direction and wind speed.

Bearing in mind that the monitoring of environmental quality is strictly defined by regulations, the Project Holder did not consider other alternatives in terms of monitoring.

9.6.3. Monitoring of the operation of the Landfill for non-hazardous waste

In order to put the subject Landfill for non-hazardous waste into functional and intended use, it is necessary to establish an effective system of monitoring and control of work in order to increase environmental safety and protection of human health. Mandatory and continuous monitoring of the operation of the Landfill for non-hazardous waste will be carried out in accordance with the Regulation on disposal of waste on landfills[211].

In accordance with the above, the monitoring of the operation of the landfill will be carried out during the active and passive phase of the landfill and will include the following:

- monitoring of meteorological parameters;
- monitoring of surface waters;
- monitoring of leachate;
- monitoring of gas emissions;
- monitoring of groundwater;
- monitoring of the amount of rainwater;
- monitoring of the landfill body stability;
- monitoring of protective layers;
- monitoring of pedological and geological characteristics.

The monitoring will be carried out by sampling and measurement in the manner defined in Appendix 6. – Monitoring the operation of the landfill, the Regulation on disposal of waste on landfills[212].

The specified sampling and measurement will be carried out:

- in the internal laboratory provided within the plant, where particular examinations are performed on a daily basis;

[211] "Official Gazette of the RS", no. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)
[212] "Official Gazette of the RS", no. 92/2010, Available at Uredba o odlaganju otpada na deponije (paragraf.rs)

- in an accredited laboratory at specific intervals prescribed by the aforementioned regulation or more frequently, if the data in the internal laboratory show that there has been any accident situation or deviation from the zero state of specific parameters.

All data obtained from the conducted monitoring will be submitted to the Environmental Protection Agency. In addition to the aforementioned regular monitoring, daily visual control of the operation of the landfill will be carried out, maintenance of all facilities within the landfill complex, maintenance of machinery as well as control of the efficiency of the truck wheel washing unit.

9.7. Method of decommissioning, site regeneration and further use

The term "decommissioning" means "withdrawal from regular use", i.e. dismantling of the plant and bringing the land to another purpose.

In the event of a decision on the termination of the operation of the plant in question, the equipment will be dismantled and, if necessary, the land will be remediated in accordance with legal regulations and the land will be able to be used for some other purpose.

When performing works on the development of the site in the event of termination of the Project, it is mandatory to organize the collection of municipal waste, construction waste, waste with the characteristics of secondary raw materials, waste with the properties of hazardous substances, with mandatory treatment and evacuation in accordance with the regulations of the Republic of Serbia.

All works on the removal and demolition of facilities shall be carried out in accordance with the Construction and Demolition Waste Management Plan prepared in accordance with the Regulation on the Method and Procedure of Construction and Demolition Waste Management[213] and to which the approval of the relevant authority was previously obtained.

Also, it is the obligation of the Project Holder to address the relevant authority in this case with a request for decision-making on the need for environmental impact assessment of the removal of the project in question and the development of a Study on the Environmental Impact Assessment of the Closure of the Waste to Energy Plant and the Landfill for Non-Hazardous Waste in accordance with Article 3 of the Law on Environmental Impact Assessment[214].

[213] "Official Gazette of the RS", No. 93/2023 and 94/2023 – corr, available at Uredba o načinu i postupku upravljanja otpadom od građenja i rušenja (paragraf.rs)
[214] "Official Gazette of the RS", nos. 135/2004, 36/2009, 36/2009 - other law, 72/2009 - other law, 43/2011 - CC, 14/2016, 76/2018 and 95/2018 - other law , available at Zakon o zaštiti životne sredine (paragraf.rs)

10. LCA results

Life Cycle Assessment (LCA) is a standardized methodology for quantifying and assessing the environmental impacts of products, processes, or services throughout their entire life cycle. This analysis encompasses stages starting from raw material extraction and processing, through production, distribution, and use, to the final disposal or recycling of the materials contained in the product. The primary goal of LCA is to provide comprehensive and quantitative information on environmental impacts, enabling informed decision-making that contributes to reducing the overall environmental footprint.

The main phases of LCA include defining the goal and scope of the analysis, inventorying inputs and outputs (LCI), assessing environmental impacts (LCIA), and interpreting the results. The goal and scope clarify the purpose of the study and the system boundaries (e.g., "cradle to grave" or "cradle to gate"), while the inventory phase collects data on materials, energy, emissions, and waste throughout the product's life cycle. The LCIA phase uses this data to evaluate potential impacts, such as global warming, acidification, and resource depletion.

The Elixir Sustainability team conducted the LCA analysis in accordance with ISO 14067, relying on data from internal operational systems, strategic plans, and publicly available sources such as the Regulation on Conversion Factors of Final Energy to Primary Energy and CO_2 Emission Factors, the International Energy Agency (IEA), and guidelines for calculating greenhouse gas (GHG) emissions in waste and waste-to-energy projects.

For this analysis, three scenarios were examined:

- Substitution of fossil fuels
- Transportation savings
- Avoidance of landfill disposal

These scenarios explore different approaches to reducing the carbon footprint through optimizing energy use, implementing the "Waste to Energy" concept, and transitioning from fossil fuels to renewable energy sources. This analysis serves as a foundation for evaluating the environmental profile of existing technologies and identifying opportunities for business improvement aligned with the sustainable development strategy and achieving carbon neutrality by 2030.

Scenario 1 - Substitution of fossil fuels

This scenario focuses on projecting the potential reductions in greenhouse gas (GHG) emissions through the substitution of fossil fuels with alternative energy sources. The analysis compares the production of steam in the current power plant, which predominantly relies on fossil fuels, to a proposed Waste-to-Energy (WtE) facility designed to utilize alternative energy sources. This approach targets not only reducing dependence on conventional fossil fuels like coal and fuel oil but also achieving significant decarbonization in the steam production process.

The scenario evaluates the shift from high-carbon energy sources currently used in the plant to a system where non-recyclable waste is converted into energy. By utilizing WtE technology, this model aims to demonstrate the environmental benefits of using alternative energy sources while maintaining the same operational output in terms of steam generation.

The calculation is based on emission factors for current fossil fuel consumption and compares them to the emission factors associated with WtE operations. Specific considerations include:

- The thermal energy requirements for steam production in the existing setup.
- The expected efficiency of the WtE plant.
- Emission factors for both fossil fuel and alternative energy use, derived from publicly available and operational data sources.

The focus is on emissions reductions quantified across Scope 1 (direct emissions from fuel combustion, Table 67) and Scope 2 (indirect emissions from purchased energy, Table 68).

Table 67 provides an overview of the energy mix utilized in the existing power plant, focusing on the emission factors associated with different fuel types, the amount of fuel required to produce one ton of steam, and the resulting greenhouse gas emissions per ton of steam produced.

Table 67: Energy mix of the existing power plant

	Emission factor tCO_2e / t of fuel	Standard t of fuel/ t of steam	Emission factor tCO_2e/ t of steam	% in Steam Source Structure
Coal	1,27	0,164	0,209	48%
Dried Lignite (36%)	1,74			
Brown Coal (64%)	1,01			
Fuel Oil	3,17	0,071	0,226	38%
LPG	3,02	0,064	0,194	2%
CNG	1,85	0,058	0,108	12%

This table highlights the significant reliance on fossil fuels for steam production, which leads to substantial carbon dioxide emissions. The total greenhouse gas emissions from fuel consumption in the existing power plant amount to 0.203 tCO_2e per ton of steam. This value reflects the cumulative impact of emissions from various fossil fuels, such as coal, fuel oil, and natural gas. The reliance on these fuels underscores the substantial carbon footprint of steam production in the existing setup.

Table 68. Compared electricity consumption and corresponding greenhouse gas emissions between the Waste-to-Energy (WtE) facility and the existing power plant.

Table 68: Electricity Consumption in WtE Facility and Existing Power Plant

		WtE	Power Plant
Electricity consumption for steam production	MWh / t steam	0,11	0,02
Emission factor of electricity	t CO_2e / MWh	0,71	0,71
GHG emissions from electricity per ton of steam	t CO_2e / t steam	0,076	0,013

The analysis reveals that the WtE facility consumes significantly more electricity per ton of steam produced, at 0.11 MWh compared to 0.02 MWh in the existing power plant. This higher consumption translates into greater greenhouse gas emissions from electricity use, with the WtE facility emitting 0.076 tCO_2e per ton of steam compared to only 0.013 tCO_2e in the current setup. Despite the increased reliance on electricity in the WtE facility, this operational difference must be considered in light of the broader reductions in emissions achieved through the elimination of fossil fuel use in Scope 1 emissions.

Table 69 integrates data from Scope 1 and Scope 2 emissions, offering a comprehensive view of the total greenhouse gas emissions per ton of steam for both the WtE facility and the existing power plant units.

Table 69: Carbon Footprint Scope 1 and 2 in WtE Facility and Existing Power Plant Units

Parameter	Unit	WtE	Power Plant	WtE vs Power Plant
Fuel for steam production	tCO_2e/t steam	0,000	0,203	-0,203
Electricity for steam	tCO_2e/t steam	0,076	0,013	0,063
TOTAL Scope 1+2	tCO_2e/t steam	0,076	0,216	Savings per ton of steam: -0.140 tCO_2e in emissions achieved in the WtE facility compared to the existing power plant.
Annual steam production: 280,000 tons in the WtE facility.				
Annual emission savings: -39,282 tCO_2e total emissions reduction on a yearly basis.				

The total emissions for the WtE facility are calculated at 0.076 tCO_2e per ton of steam, a significant reduction compared to 0.216 tCO_2e per ton in the existing power plant. The reduction of 0.140 tCO_2e per ton of steam underscores the environmental benefits of transitioning from fossil fuel-based systems to WtE technology. On an annual basis, with a production of 280,000 tons of steam, this results in a total emission reduction of 39,282 tCO2e. This outcome highlights the effectiveness of the WtE approach in significantly lowering the carbon footprint of industrial operations.

The analysis of demonstrates the substantial environmental benefits of replacing the existing fossil fuel-dependent power plant with a Waste-to-Energy facility. The elimination of fossil fuels in the WtE facility results in zero Scope 1 emissions, which represents a major improvement over the current system's high levels of greenhouse gas emissions. While the WtE facility shows higher electricity consumption and associated emissions under Scope 2, the overall reduction in total emissions far outweighs this increase. By achieving a reduction of 0.140 tCO_2e per ton of steam, the WtE facility not only lowers the carbon footprint but also contributes to a more sustainable and efficient energy model. This transition aligns with decarbonization goals and showcases the potential for integrating alternative energy sources into industrial processes to achieve significant environmental improvements.

Scenario 2 - Transportation savings

The model projects potential GHG savings by analyzing transportation routes for alternative fuels to Prahovo compared to Vienna where most of the industrial waste from Serbia is currently treated. It considers the distances, transportation modes, and emission factors associated with road transport. The analysis provides a detailed breakdown of emissions per ton of waste transported and evaluates the savings achieved by selecting Prahovo as the destination.

Table 70 provides a detailed analysis of greenhouse gas emissions from the transportation of waste to Prahovo. It includes data on emission factors for road transport, the quantity of waste transported, the distances involved, and the resulting emissions per ton of waste. This table highlights the efficiency of shorter transport distances to Prahovo from a theoretical location point within Serbia, resulting in lower emissions compared to alternative routes.

Table 70: Transport Emissions to Prahovo

From	**To**	**Transport**	**Emission Factor** kg CO_2e / t-km	**Waste Amount** t	**Distance** km	**Total Emissions** tCO_2e	**Emissions per ton of Waste** $kgCO_2e/t$
Niš	Prahovo	Road	0,0648	40.000	160	415	10,4
Kragujevac	Prahovo	Road	0,0648	30.000	221	430	14,3
Belgrade	Prahovo	Road	0,0648	25.000	300	486	19,4
Loznica	Prahovo	Road	0,0648	5.000	441	143	28,6
Novi Sad	Prahovo	Road	0,0648	5.000	406	132	26,3
Weighted Average			**0,0648**	**105.000**	**236**	**1.605**	**15,3**

The emissions associated with transporting waste to Prahovo are relatively low, with an average of 15.3 kg CO_2e per ton of waste transported. This is due to the shorter distances from key collection points to Prahovo. The total annual emissions for transporting 105,000 tons (elevated amount with respect to maximum to capture amounts of waste separated and prepared for treatment of other operators) of waste amount to 1,605 tCO_2e, reflecting the environmental advantage of localizing waste transportation routes.

Table 71 presents greenhouse gas emissions data for transporting waste to Vienna. It compares emission factors, waste quantities, transport distances, and the resulting emissions per ton of waste. The data reveals significantly higher emissions for Vienna due to the longer distances involved.

Table 71: Transport Emissions to Vienna

Form	**To**	**Transport**	**Emission Factor** kg CO_2e / t-km	**Waste Amount** t	**Distance** km	**Total Emissions** tCO_2e	**Emissions per ton of Waste** $kgCO_2e/t$
Niš	Vienna	Road	0,0648	40.000	851	2.206	55,1
Kragujevac	Vienna	Road	0,0648	30.000	754	1.466	48,9
Belgrade	Vienna	Road	0,0648	25.000	616	998	39,9
Loznica	Vienna	Road	0,0648	5.000	652	211	42,2
Novi Sad	Vienna	Road	0,0648	5.000	532	172	34,5
Weighted Average			**0,0648**	**105.000**	**743**	**5.053**	**48,1**

Transporting waste to Vienna results in an average of 48.1 kg CO_2e per ton of waste, which is over three times higher than the emissions associated with transporting waste to Prahovo. The total annual emissions for transporting 105,000 tons of waste to Vienna reach 5,053 tCO_2e. These results underline the inefficiency of choosing Vienna as a destination for waste transport.

Table 72 quantifies the savings in greenhouse gas emissions achieved by choosing Prahovo over Vienna as the transportation destination. It provides a comparison of total emissions, emissions per ton of waste, and percentage savings.

Table 72: Transport Emission Savings from each city to Prahovo compared to current treatment preferences transport to Vienna.

Savings in transport emissions vs. Vienna tCO_2e	**Savings in transport emissions vs. Vienna** kg CO_2e/t	**% savings in transport emissions**
-1.791	-44,8	-81%
-1.036	-34,5	-71%
-512	-20,5	-51%
-68	-13,7	-32%
-41	-8,2	-24%

-3.448 (total)	**-32,8 (average)**	**-68% (average)**

The transport emissions savings by selecting Prahovo over Vienna amount to 3,448 tCO_2e annually, with a reduction of 33 kg CO_2e per ton of waste transported. This represents a 68% decrease in transport emissions for the selected scenario, demonstrating the substantial environmental benefit of prioritizing Prahovo for waste transportation. By reducing long-distance transport, this approach contributes significantly to minimizing the overall carbon footprint of waste management.

Scenario 3 - Avoidance of landfill disposal

Scenario 3 examines the potential greenhouse gas savings achieved by properly managing non-recyclable, non-hazardous waste through energy recovery instead of landfilling. The model compares waste treatment at a Waste-to-Energy (WtE) facility with both sanitary and non-sanitary landfilling options.

Table 73 presents key operational data for the WtE facility, including thermal capacity, the lower calorific value of waste, and the annual mass of municipal solid waste (MSW) treated. Table 74 presents the difference in emissions related to WTE project with respect to sanitary and/or non-sanitary landfilling (emission adopted from Calculation of GHG Emissions in Waste and Waste-to-Energy Projects, Joint Assistance to Support Projects in European Regions, 2013).

Table 73: Comparison of total GHG Emissions for Waste-to-Energy and Landfilling

Thermal power of WtE, MW	**Lower calorific value of waste, MJ/kg**	**Mass of waste treated annually, t/year**
30	10,0	86400,0
Emission Factor of WtE, t CO_2e/t waste	**Emission Factor of Sanitary Landfill t CO_2e/t waste**	**Emission Factor of Non-Sanitary Landfill, t CO_2e/t waste**
0,253	0,298	0,833
WtE Emissions, t CO_2e/year	**Sanitary landfill emissions, t CO_2e/year**	**Emissions from an unsanitary landfill, t CO_2e/year**
21859,2	25747,2	71971,2

Table 74: Results of f GHG Emissions comparision for Waste-to-Energy and Landfilling

Carbon footprint of WtE Plant	**In relation to the sanitary landfill**	**In relation to an unsanitary landfill**

Relative emissions, t CO_2e/t waste	-0,045	-0,580
Total emissions, t CO_2e/year	-3.888	-50.112
Expressed in %	**-15,1**	**-69,6**

The table demonstrates the clear environmental advantages of Waste-to-Energy (WtE) over both sanitary and non-sanitary landfilling. With an annual treatment capacity of 86,400 tons of waste, the WtE facility operates at a thermal power of 30 MW and achieves an emission factor of 0.253 tCO_2e per ton of waste treated. In contrast, sanitary landfilling results in an emission factor of 0.298 tCO_2e per ton, while non-sanitary landfilling generates a significantly higher emission factor of 0.833 tCO_2e per ton.

The total greenhouse gas emissions from the WtE facility amount to 21 859.2 tCO_2e annually, compared to 25 747.2 tCO_2e for sanitary landfilling and 71 971.2 tCO_2e for non-sanitary landfilling. This reduction is even more pronounced when analyzing relative emissions per ton of waste treated. Compared to sanitary landfilling, the WtE facility avoids 0.045 tCO_2e per ton of waste, resulting in total annual savings of 3 888 tCO_2e, a reduction of 15.1%. The benefits are even more substantial when compared to non-sanitary landfilling, with a reduction of 0.580 tCO_2e per ton of waste, translating into total annual savings of 50 112 tCO_2e, or 69.6%.

This analysis underscores the significant environmental benefits of utilizing Waste-to-Energy technology as an alternative to landfilling, particularly in regions where non-sanitary landfilling remains prevalent. By reducing emissions at both the per-ton and total levels, WtE contributes to a more sustainable approach to managing non-recyclable waste reducing Scope 4 emissions (avoided emissions).

10.1. Most important implications

The Life Cycle Assessment provides a comprehensive understanding of how Waste-to-Energy (WtE) technology can transform waste management practices to significantly reduce greenhouse gas emissions. By examining scenarios focused on the substitution of fossil fuels, optimization of transportation routes, and proper management of non-recyclable waste, the analysis offers a multi-faceted perspective on achieving decarbonization goals.

The findings emphasize that integrating WtE technology not only addresses the high emissions associated with fossil fuel dependency but also mitigates the environmental impact of improper waste disposal practices. Through the thermal treatment of waste, WtE facilities achieve lower emission factors compared to landfilling, especially in regions where non-sanitary landfills dominate. This process prevents methane emissions - a significant contributor to climate change - from decomposing waste in landfills while simultaneously generating energy. The data further supports the argument that shifting to localized solutions, such as the Prahovo facility, reduces transportation-related emissions, underscoring the importance of regional strategies in minimizing Scenario 2 impacts.

Incorporating WtE solutions requires a systematic approach that accounts for operational efficiency, regulatory compliance, and the socio-economic context of waste management. However, the results of this LCA demonstrate that such an investment delivers tangible environmental benefits while contributing to broader decarbonization efforts. By addressing the challenges of fossil fuel reliance, transport inefficiencies, and landfill emissions, WtE technology establishes itself as a pivotal strategy for reducing the carbon footprint of industrial operations and advancing global sustainability objectives.

11. Conclusions and mandatory conditions

The Human Health Impact Assessment Study confirms that the proposed Waste-to-Energy (WtE) Plant and Non-Hazardous Waste Landfill will operate with minimal risks to human health and the environment, provided mandatory conditions and preventive measures are strictly implemented. These installations are designed to meet the highest standards of environmental safety and align with national and EU regulations.

The project's emissions, including air and water pollutants, are projected to remain significantly below regulatory thresholds. Advanced air filtration systems, such as scrubbers, bag filters, and selective catalytic reduction, ensure minimal emissions of pollutants like PM10, SO_2, NOx and Hg. Cumulative modeling demonstrates no adverse impacts on regional air quality, including transboundary regions in Romania and Bulgaria. In the case of wastewater, all discharges, including leachate and process water, undergo multi-stage treatment before release into the Danube River. Modeling confirms that pollutant levels in treated wastewater are negligible and far below limits potentially affecting human health even 100 meters downstream from the discharge point, ensuring no degradation of water quality.

Solid residues from thermal treatment undergo stabilization and solidification to encapsulate contaminants before landfill disposal. The landfill, equipped with impermeable HDPE membranes and advanced leachate drainage systems, eliminates risks of groundwater contamination. To ensure compliance, mandatory testing of waste for leaching criteria is required before landfill acceptance, with non-compliant materials redirected to specialized hazardous waste facilities. Continuous monitoring through piezometers will verify landfill safety and groundwater protection.

Comprehensive accident scenarios, including chemical spills, gas leaks, and fires, have been analyzed. Mitigation measures, such as advanced fire prevention systems and robust containment infrastructure, limit the consequences of potential incidents. The most severe scenarios, such as ammonia leaks, extend only 680 meters from the site. All other incidents are contained within the industrial complex. To comply with Seveso Directive requirements, the investor is mandated to prepare a Safety Report and Accident Protection Plan, ensuring rapid emergency response and minimizing risks.

The following mandatory conditions have been established to safeguard environmental and public health:

- Continuous Monitoring: Air, water, and soil quality must be regularly monitored. Any deviations from permissible values must be addressed immediately.
- Operational Protocols: Strict adherence to waste acceptance criteria, including mandatory testing and verification procedures, is required for all incoming materials.
- Emergency Preparedness: Detailed emergency response plans must be developed, including fire safety protocols and rapid containment measures.
- Compliance with BAT: All operations must align with Best Available Techniques (BAT) requirements as defined by EU directives.
- Training: Staff must undergo specialized training in waste handling, stabilization, and emergency response to maintain operational safety and compliance.
- Reporting: Regular submission of environmental monitoring data and compliance reports to relevant authorities is mandatory.

The Waste-to-Energy Plant and Non-Hazardous Waste Landfill present a sustainable and environmentally sound solution for waste management. The project supports resource efficiency, decarbonization, and public health protection. By adhering to mandatory conditions and implementing preventive measures, the facilities will deliver significant environmental benefits while mitigating potential risks, contributing to Serbia's alignment with EU environmental and sustainability goals.

11.1. Health Impact Assessment Conclusions

This section summarizes the key findings of the Health Impact Assessment (HIA) and outlines the mandatory conditions required to ensure minimal risk to human health and compliance with regulatory standards.

Impact on Air Quality

The implementation of the Waste-to-Energy (WtE) plant and the Non-Hazardous Waste Landfill (NHWL) is expected to result in localized emissions of particulate matter (PM10, PM2.5), nitrogen oxides (NOx), and sulfur dioxide (SO_2). Advanced emission control technologies, including scrubbers, bag filters, and selective catalytic reduction (SCR) units, will be utilized to minimize emissions. Scrubbers are highly effective in removing sulfur dioxide (SO_2), achieving up to 99% efficiency. Bag filters capture particulate matter (PM10 and PM2.5) with an efficiency of over 99.9%, while SCR units reduce nitrogen oxides (NOx) emissions by up to 90%. These technologies ensure that pollutant levels remain significantly below regulatory limits. Continuous monitoring of these pollutants will be conducted using automated measurement systems. Emission data will be collected in real time and reported monthly to authorities to ensure compliance with regulatory limits. Cumulative modeling results confirm that pollutant levels will remain significantly below legal thresholds, ensuring minimal health risks.

Impact on Water Quality

Potential risks to water quality are associated with leachate generation and runoff from the landfill. Proper leachate management systems, including soil leak protection and leachate treatment, will mitigate the risk of groundwater contamination. The leachate treatment process involves a series of steps, including multi-stage filtration, sedimentation, and chemical neutralization to remove contaminants effectively. Regular monitoring will focus on key chemical parameters such as heavy metals, nitrates, ammonium, and total organic carbon (TOC) to ensure that treated water meets regulatory standards before discharge. The leachate treatment process involves multi-stage filtration and chemical neutralization. Regular monitoring of chemical parameters will ensure compliance with water quality standards.

Impact on Soil

The primary risk to soil quality is contamination from leachate and improper waste handling. Implementation of strict waste management protocols and periodic soil monitoring will reduce the risk of soil contamination.

Noise Pollution

Noise will be generated during both construction and operational phases, primarily from transport and machinery. Mitigation measures, such as noise barriers and restricted working hours, will ensure compliance with noise regulations and reduce impact on local communities. Additionally, a detailed noise monitoring plan will be implemented, including a map of noise monitoring stations placed near sensitive receptors (e.g., residential areas, schools) to ensure transparency and compliance with regulations. Additionally, noise monitoring stations will be placed at strategic locations, with sharing protocols with respect to the authorities.

Health Risks

Short-term risks include respiratory irritation and stress due to construction activities. Long-term health risks are expected to be minimal with the implementation of mitigation measures, regular monitoring and established operating practices.

11.2. Mandatory Conditions

To ensure the sustainable development and operation of the project, a comprehensive set of mandatory conditions has been established. These conditions are designed to address key environmental, social, and operational aspects, ensuring compliance with regulatory standards while mitigating potential risks. The outlined measures prioritize the protection of air, water, soil, and community well-being, as well as the safety of workers and the broader population.

By implementing these mandatory conditions, the project aims to minimize environmental impacts, enhance transparency through community engagement, and maintain alignment with regulatory requirements. The conditions also include robust mechanisms for emergency preparedness, occupational health and safety, and post-operational site management to ensure long-term sustainability and land use compatibility.

The following subsections detail the specific measures required across various domains, including air quality monitoring, water and soil protection, noise control, community engagement, emergency response, occupational safety, regulatory collaboration, and site decommissioning.

- Air Quality Monitoring:
  - Continuous monitoring of key pollutants with data reporting protocols to the authorities.
- Water and Leachate Management:
  - Installation of a liner system in the landfill.
  - Regular sampling and analysis of groundwater and surface water.
- Soil Protection:
  - Implementation of a leachate collection and treatment system.
  - Periodic soil quality assessments.
- Noise Control:
  - Use of noise barriers in sensitive areas.
  - Scheduling construction and operation activities during daytime hours.
- Community Engagement:
  - Establishment of a civil community advisory board. Public consultations will be organized with meetings involving local stakeholders. Feedback collected during these consultations will be systematically reviewed, and summary reports will be made publicly available. The reports will include key issues raised by the community and actions taken to address them, ensuring transparency and continuous improvement. Feedback collected during these consultations

    will be systematically reviewed and integrated into operational plans to improve transparency and responsiveness to community concerns.
  - Regular public consultations to inform the community about project progress and monitoring results.
- Emergency Response:
  - Development of an emergency response plan for potential incidents (e.g., fire, chemical spills). Scenarios covered in the plan will include fires, chemical spills, gas leaks, and equipment failures. Specific simulations for transboundary incidents will also be conducted, given the proximity to the border, ensuring coordination with neighboring countries in emergency situations.
  - Regular drills and training for staff and local emergency services, simulating various emergency scenarios to ensure readiness and effective response in critical situations. Simulations will include scenarios such as fires, chemical spills, and major equipment failures to ensure readiness for various types of emergencies.
- Occupational Health and Safety:
  - Provision of personal protective equipment (PPE) for all workers.
  - Regular health checks and safety training programs.
- Collaboration with Authorities:
  - Regular reporting to environmental authorities.
  - Joint inspections with regulatory agencies.
- Decommissioning and Site Regeneration:
  - Development of a detailed decommissioning plan.
  - Site regeneration and restoration to ensure future land use compatibility.

12. Summary

The proposed project involves the development of two technologically interconnected facilities: a Waste-to-Energy (WtE) Plant and a Non-Hazardous Waste Landfill, both located in the industrial chemical complex in Prahovo, Serbia. The WtE Plant is designed to thermally treat 100,000 tons of non-recyclable hazardous and non-hazardous waste annually, employing advanced bubbling fluidized bed technology to produce 30 MW of thermal energy. The energy generated will be converted into low-pressure steam, which will replace fossil-fuel-based energy sources for industrial processes at Elixir Prahovo, a producer of phosphoric acid and mineral fertilizers.

The Non-Hazardous Waste Landfill, is engineered for the disposal of stabilized and solidified residues from the WtE Plant. Its phased construction includes robust containment measures, such as high-density polyethylene (HDPE) membranes and leachate collection systems, to prevent environmental contamination. The landfill design ensures multi-layer utilization with strict leachate management and continuous monitoring of soil and groundwater.

Key project components include:

- Waste Pre-treatment Facilities:
  - Systems for shredding, homogenization, and temporary storage of solid and liquid waste.
- Air Emission Control Systems:
  - Cyclone, bag filters, activated carbon filters, scrubbers, and selective catalytic reduction (SCR) systems to minimize air pollution.
- Wastewater Treatment Plant:
  - Employs multi-stage neutralization, sedimentation, and flocculation to treat process wastewater and leachate before discharge into collector and final recipient the Danube River
- Stabilization and Solidification Units: To encapsulate contaminants in residues, ensuring they meet non-hazardous waste criteria before landfill disposal.

Public Health Impact Analysis

The project's impact on public health within its area of influence has been comprehensively analyzed, and findings indicate minimal risks due to its advanced technological design and strict operational controls:

- Air Quality:
  - Emissions of key pollutants, including PM10, SO_2, and Hg, remain significantly below permissible limits.
  - Modeling confirms negligible corss-border impacts with emissions far below EU regulatory thresholds.
- Water Quality:
  - All treated wastewater streams, including leachate and process water, comply with EU BAT standards.

  - Modeling of wastewater discharge confirms negligible downstream impacts on water quality, with pollutant concentrations well below regulatory limits and limits expressed as a risk factor for human health even 100 meters from the discharge point.
- Soil and Groundwater Protection:
  - The landfill design incorporates impermeable membranes, leachate drainage systems, and regular monitoring via piezometers to prevent contamination.
  - Stabilized and solidified residues meet stringent non-hazardous waste criteria, ensuring no risks to soil and groundwater.
- Accident Scenarios:
  - Potential incidents, such as chemical spills or gas leaks, are confined within the project site.
  - Advanced containment measures and emergency response plans limit public health risks even in worst-case scenarios.

Sustainability and Environmental Protection

The Waste-to-Energy Plant and Non-Hazardous Waste Landfill represent a sustainable and environmentally sound solution for waste management in Serbia. By employing advanced technologies and complying with strict regulatory standards, the project ensures negligible impacts on public health and the environment. These facilities significantly contribute to decarbonization by replacing fossil fuels with recovered thermal energy, enhancing resource efficiency, and improving national waste management practices. Furthermore, the project adheres to EU environmental and health regulations, ensuring best practices in waste management.

Key Contributions:

- Decarbonization:
  - The project significantly contributes to decarbonization by replacing fossil fuels with recovered thermal energy.
- Resource Efficiency:
  - Enhances resource efficiency by recovering energy from waste that would otherwise be landfilled.
- Compliance with EU Standards:
  - Adheres to EU environmental and health regulations, ensuring best practices in waste management. Alingment with a principle of local waste managment, treatment, preference.

Cumulative analyses confirm that the project will not exacerbate existing environmental conditions, with minimal contributions to air and water pollution. The robust design of the landfill and the implementation of advanced wastewater and air treatment technologies underscore the project's commitment to environmental protection and public health.

Key Recommendations

- Strict Adherence to Operational Protocols:
  - Waste acceptance and treatment must comply with regulatory requirements, including mandatory testing to ensure environmental and health safety.

- Continuous Monitoring:
  - Regular monitoring of air, water, and soil quality is essential to promptly detect and mitigate any potential deviations from permissible limits.
- Emergency Preparedness:
  - Updated and rigorously tested emergency response plans must be maintained to address potential incidents.
- Transparent Communication:
  - Continuous engagement with local authorities and communities is vital to foster trust and demonstrate the project's commitment to environmental and public health protection.
- Specialized Training:
  - Regular training for operational staff in waste management, accident prevention, and emergency response will ensure high standards of safety and regulatory compliance.

The proposed Waste-to-Energy Plant and Non-Hazardous Waste Landfill are cornerstones of sustainable industrial practices in Serbia. By leveraging advanced technologies, adhering to stringent regulations, and prioritizing continuous monitoring and preparedness, the project demonstrates a steadfast commitment to sustainability, resource efficiency, and public health protection. The combination of robust operational protocols, transparent communication, and specialized training ensures the project's alignment with environmental goals and the promotion of long-term ecological well-being.