

TEMPLATE

MONITORING REPORT

PUBLICATION DATE **14.10.2020**

VERSION **v. 1.1**

RELATED SUPPORT - **TEMPLATE GUIDE Monitoring Report v. 1.1**

This document contains the following Sections

Key Project Information

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KEY PROJECT INFORMATION

Key Project Information

GS ID (s) of Project (s)	GS4238
Title of the project (s) covered by monitoring report	"Methane Gas Capture and Electricity Production at Kubratovo Wastewater Treatment Plant, Sofia, Bulgaria"
Version number of the PDD/VPA-DD (s) applicable to this monitoring report	PDD ver.05 dated 30/03/2016 Annex 1 approved on 09/03/2020
Version number of the monitoring report	06
Completion date of the monitoring report	10/05/2023
Date of project design certification	01/04/2016
Date of Last Annual Report	21/09/2020
Monitoring period number	4 th
Duration of this monitoring period	01/09/2020-31/03/2021
Project Representative	Sofiyska voda AD (Project owner)
Host Country	Bulgaria
Activity Requirements applied	☒ Community Services Activities ☒ Renewable Energy Activities ☐ Land Use and Forestry Activities/Risks & Capacities ☐ N/A
Methodology (ies) applied and version number	AMS-III.H/Version 17: Methane recovery in wastewater treatment, dated 28 Nov 2014; AMS-I.D/Version 18 "Grid connected renewable electricity generation",dated 28/11/2014; AMS-I.C./Version 20: Thermal energy production with or without electricity, dated 01 June 2014;
Product Requirements applied	☒ GHG Emissions Reduction & Sequestration ☐ Renewable Energy Label ☐ N/A

Table 1 - Sustainable Development Contributions Achieved

Sustainable Development Goals Targeted	SDG Impact	Amount Achieved	Units/ Products
13 Climate action	13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries. VERs generated.	44,972	tCO _{2e}
11 Sustainable cities and communities	11.6: Release of pollutants. Used oil disposal.	4,030	kg
6 Clean water and sanitation	6.3.1 Impact on natural water patterns and flow. Waste water (sludge) treated.	412,917	m ³

Table 2 – Product Vintages

		Amount Achieved		
Start Dates	End Dates	VERs	Waste oil disposed	Waste water/sludge/ treated
01/09/2020	31/12/2020	24,146	660 kg.	233,907 m ³
01/01/2021	31/03/2021	20,826	3,370 kg.	179,010 m ³

SECTION A. DESCRIPTION OF PROJECT

A.1. General description of project

The project is both a methane emissions reduction and energy production project.

Methane produced in Kubratovo wastewater treatment plant is captured in common methane tanks serving as a buffer and then supplied to the newly installed CHP gas engines for electricity and heat production, which in turn will substitute both the plant's electricity purchases from the grid and diesel fuel usage. Excess electricity is supplied to the grid.

The main purpose of the project is to transform the existing low tech sludge treatment process at Kubratovo that existed before implementation of the project into a modern advanced treatment process matching the best sludge treatment practice available in Western Europe. This transformation has a major effect on the environment through dramatically reducing the existing methane gas emissions at the plant while also reducing the volume of sludge that needs to be transported, hence reducing GHG emissions from transportation as well (not included in GHG abatement calculations).

The overall objective of the project is to provide an environmentally friendly sludge treatment process reducing methane and carbon dioxide emissions that – under a business-as-usual scenario – would have continued.

A.2. Location of project

The project activity is situated at the site of Sofia central waste-water treatment plant near the village of Kubratovo, located some 20 km outside the centre of Sofia, the capital of Bulgaria, near the Iskar river.

The geographic coordinates of the project site are as follows:

Table 1: Geographic coordinates of the project.

Latitude	Longitude
42°45'13.25"N	23°22'11.15"E

Fig.1: Location of the project site.



The site is clearly visible in GOOGLE Earth as shown on Fig.1.

Fig.2: Location of the town of Sofia in Bulgaria



A.3. Reference of applied methodology

For determination of the baseline, the methodology AMS-III.H: Methane recovery in wastewater treatment (Version 17) and AMS-I.C, "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories – I.C. Thermal energy production with or without electricity", Version 20 ,

approved by the CDM Executive Board, are applied, using conservative options and data as presented in the following section.

To prove additionality, the official methodologies: "Guidelines on the Demonstration of Additionality of Small-scale Project Activities", Ver.09.0 (previously known as "Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities version 08") is used.

In addition, the following methodological tools are applied in this PDD:

- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"

Version 01;

- "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion"

Version 02;

- "Emissions from solid waste disposal site", Version 7.0.1;
- "Project emissions from flaring", Version 2.0.0;
- "Tool to calculate the emission factor for an electricity system", Version 04.0.0;
- "Tool to determine the remaining lifetime of equipment", Version 1;
- "Project and leakage emissions from anaerobic digesters", Version 1;

The project does not use a standardized baseline.

A.4. Crediting period of project

As per GS TAC decision from September 2014 the crediting period is a renewable 3*7 year period with a maximum of 21 years overall. The starting date of the first crediting period under JI and under a Green Investment Scheme is 1 January 2007. The baseline will get renewed retroactively 2 years prior to the date of registration of the project under Gold Standard.

The 6-week review by the Gold Standard expired on 31/03/2016 and the project is considered registered on 01/04/2016. According to the GS regulations the start date of the GS crediting period is 01/04/2014 (2 years prior GS registration).

The project was transferred to GS4GG standard after Annex 1 to the PDD has been approved on 09/03/2020.

The length of the 1st GS crediting period is 7 years 0 months (renewable).

As per the above GS TAC decision dated September 2014 the total crediting period of the project activity is 21 years for the period 01/01/2007 - 31/12/2028.

This period includes the following schemes:

01/01/2007 – 31/12/2007 – Green Investment Scheme;
 01/01/2008 – 31/12/2012 – Joint Implementation Scheme;
 01/04/2014 – 31/03/2021 – 1st 7-years GS crediting period;
 01/04/2021 – 31/03/2028 – 2nd 7-years GS crediting period (the project was approved by GS4GG for the second crediting period on 03/08/2021).

SECTION B. IMPLEMENTATION OF PROJECT

B.1. Description of implemented project

The project supplies Kubratovo waste-water treatment plant with thermal and electrical energy by combusting the bio-gas generated in anaerobic reactors for treatment of waste-water sludge.

The following overall measures have been implemented by the project in order to achieve its goals:

- Digesters for anaerobic sludge treatment

The project activity aimed the erection of a new digester system consisting of 4 digesters, 7,000 m³ each, designed, supplied and erected by PASSAVANT ROEDIGER Anlagenbau.

The anaerobic sludge treatment plant stabilises the sludge anaerobically. With this procedure the organic part of the sludge is reduced which also effects a reduction on the dry solid mass of the total sludge. This process has a positive influence on the sizing of the sludge treatment units following digestion and also on the properties of sludge regarding the ability to dewater and elimination of odour nuisance. The goal of anaerobic digestion is the stabilization of the sewage sludge in order to prevent odour nuisance and improve dewatering.

After the process of digestion the sludge is dewatered and afterwards transported to the temporary pits and then transported for land use as fertiliser.

The maximal biogas generating capacity of the digesters is 1,816 Nm³/h.

Fig.3: Digesters and raw sludge pumping house



- Raw Sludge Pumping Station

As part of the project 5 new raw sludge pumps have been installed in the existing raw sludge pumping station.

- Sludge Circulation System

For heating up the raw sludge and maintaining the process temperature at mesophilic conditions (35°C), a new combined heating and sludge circulation system is provided

within the basement of the new service building. 6 volute-casing pumps for dry-well installation have been installed, whereas 4 pumps are in operation and 2 are standby for emergency cases.

Fig.4: Dewatering house



- Heat Exchanger

The anaerobic digestion process takes place under mesophilic conditions, which means within a temperature range of about 33 to 37°C. The fresh incoming raw sludge has to be heated up to the required temperature conditions. Also the heat loss of the digester has to be compensated. For this purposes a double tube heat exchanger is installed for each digester.

The mixture of raw sludge and seeding sludge is transported from the seeding mixer via the heat exchanger where the sludge is indirectly heated in the counter-current flow with hot water. The heated sludge mixture is transported via the feeding line back into the digester.

- Combined Heat and Power Plant

The CHP comprises of 3 new co-generation sets GE JMS 320 GS-B.LC with 1,063 kW electric capacity and 1,088 kW thermal capacity each, for generation of electric and thermal energy by combusting biogas from digesters. The electric energy generated is used to cover the plant's need of electricity and replaces the energy supplied from the grid in the baseline. The thermal energy generated by the CHP is also used for internal needs and replaces the thermal energy that would have been generated by the on-site fossil-fuelled hot water boilers.

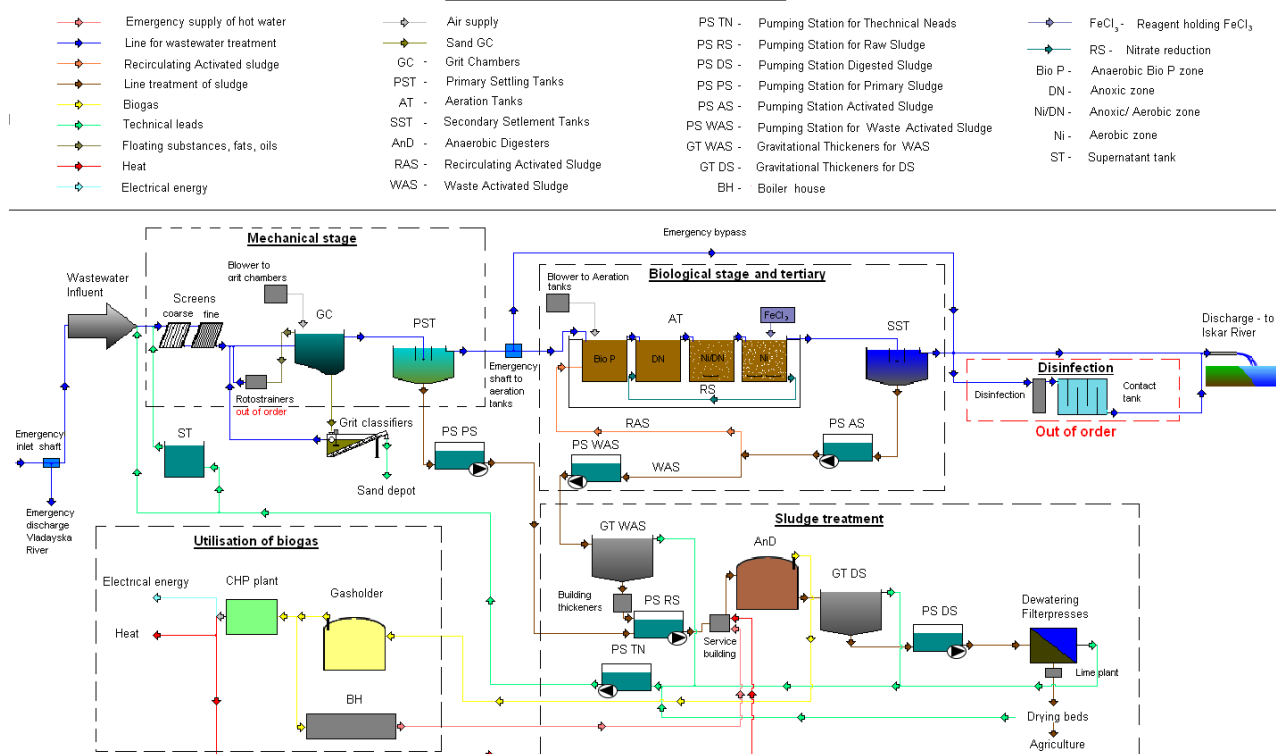
- Emergency flare system

An emergency flaring system have been implemented, consisting of 2 x DN150 flares, type Passavant-Roediger FAVAE.

The full up-to-date flow diagram of the WwTP is listed below:

Fig.5: Flow diagram

Flow diagram - WWTP Kubratovo



B.1.1 Forward Action Requests

No Forward Actions Requests have been registered in the previous Monitoring Report.

B.2. Post-Design Certification changes

No deviations from the registered monitoring plan and applied methodology have been registered.

B.2.1. Temporary deviations from the approved Monitoring & Reporting Plan, methodology or standardized baseline

No deviations from the approved Monitoring & Reporting Plan and methodologies have been registered.

B.2.2. Corrections

No corrections are required.

B.2.3. Changes to start date of crediting period

There are no changes to the start date of the crediting period.

B.2.4. Permanent changes from the Design Certified monitoring plan, applied methodology or applied standardized baseline

No permanent changes have been registered.

B.2.5. Changes to project design of approved project

No changes to the project design are regarded.

SECTION C. DESCRIPTION OF MONITORING SYSTEM APPLIED BY THE PROJECT

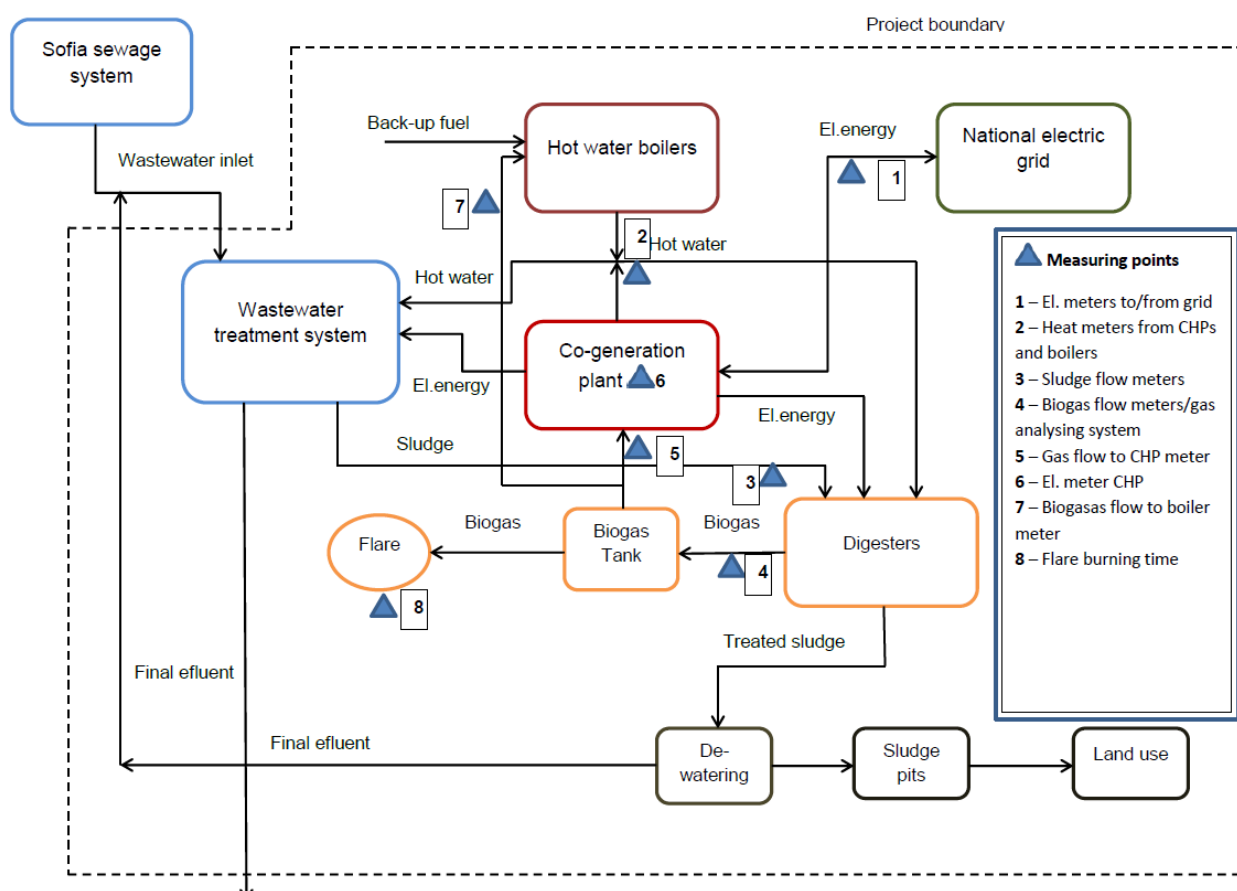
As an integral part of Sofiyska voda AD, Kubratovo WwTP is certified under ISO 14001:2015 by Tuev Nord and has certificate No 44 104 087290, valid until 15.01.2021. The WwTP is also certified under OHSAS 18001:2007 with certificate No 44 116087290, valid until 15.01.2021, ISO 45001:2018 No 44 126 087290, valid until 15.01.2021 and certificate ISO 9001:2015 No 44 100 087290, valid until 03.07.2022.

The scope of services of Sofiyska voda is:
"Management and maintenance of water supply and sewerage systems on the territory of Sofia Municipality. Water supply, sewerage and treatment of waste waters services on the territory of Sofia Municipality."

The operator of the Waste water Treatment Plant complied with the data collection, testing and analysis, and data management obligations of this MP. The operator integrated the following data collection requirements into the company's data basis and information collection policies.

The diagram below shows the main measuring points related to the project:

Fig.6: Measuring points



1. Data on CHP plant and boilers performance:

- Total electricity generation (MWh/yr)
- Total net heat production (MWh/yr)

The data has been collected and processed on yearly basis

2. Data on biogas generation and sludge:

- Quantity and quality of biogas generated (m³/year)
- Quantity of CH₄ flared (kg/year)
- Quantity of sludge entering digesters (m³/y)
- Quantity of dry substance in the sludge entering digesters (t/y)
- Flares working time period

The data was collected continuously and recorded and processed monthly and yearly.

The operator has the responsibility to input the required data feeds on a monthly and annual basis as required in the monitoring methodology and input data templates in the electronic workbook. The workbook was saved after each update. Back-up copies of the workbook were saved and stored on a secure system on a monthly basis to avoid loss of information.

The following measuring equipment was used for monitoring of the project activity:

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Table 2: List of measuring equipment

No	Measuring equipment	Measured parameter, variable	Equipment producer and type	Serial number	Installation date	Date of latest calibration	Periodicity of calibration	Measurement error data	Comments
1	Automatic gas analyser, flow-meter system	Methane concentration in the biogas $w_{CH_4,y}$ Methane – 0-100 Vol% Oxygen – 0-25 Vol% Carbon dioxide – 0-100 Vol% H ₂ S – 0-500 ppm Absolute pressure 0-1600 mbar	Draeger, Awite Awiflex	564_09	01 July 2009	27/05/2020 27/11/2020	6 months	+/- 1 % for Methane and Carbon Dioxide +/- 0.015 % for temperature	Analysis the content of the biogas (normalised)
2	Automatic gas analyser, flow-meter system	Biogas flow $BG_{burnt,y}$	FCI International LLC ST51 MASS FLOW METER	MODEL 022218-0620J1 S/N 642404	January 2018	N/A	N/A	+/- 2%	The flow-meter is integral part of the AWITE automatic gas analyzer, flow-meter system.
3	Digital electric meter	Electricity exported to the grid $EG_{grid,y}$	ZMQ 202C.8; L+G	Ser. No 95591212	27.10.2020	27.10.2020	4 years according to the regulation	+/- 0.5%	The commercial electric meter is property of the

									electric distribution company (CEZ)
4	Digital electric meter	Electricity exported to the grid EG _{grid,y}	ZMD402CT;L+G	Ser. No 95591181	23.10.2020	23.10.2020	4 years according to the regulation	+/- 0.5%	The commercial electric meter is property of the electric distribution company (CEZ)
5	Inlet sludge flow to digester	Sludge Flow in m3/h Qmax:600m3/h Tmax:90°C Q_DGs_inlet	ABB Electromagnetic Flowmeter FXE4000 (COPA-XE/MAG-XE) DE41F	000015791/X001	2006	N/A	Not required if there are no range changes	Standard Calibration +-0.5% of rate	Sludge flow meter for Digester 1
6	Inlet sludge flow to digester	Sludge Flow in m3/h Qmax:600m3/h Tmax:90°C Q_DGs_inlet	ABB Electromagnetic Flowmeter FXE4000 (COPA-XE/MAG-XE) DE41F	000015791/X003	2006	N/A	Not required if there are no range changes	Standard Calibration +-0.5% of rate	Sludge flow meter for Digester 2
7	Inlet sludge flow to digester	Sludge Flow in m3/h Qmax:600m3/h Tmax:90°C Q_DGs_inlet	ABB Electromagnetic Flowmeter FXE4000 (COPA-XE/MAG-XE) DE41F	000015791/X004	2006	N/A	Not required if there are no range changes	Standard Calibration +-0.5% of rate	Sludge flow meter for Digester 3
8	Inlet sludge flow to digester	Sludge Flow in m3/h Qmax:600m3/h Tmax:90°C Q_DGs_inlet	ABB Electromagnetic Flowmeter FXE4000 (COPA-XE/MAG-XE) DE41F	000015791/X002	2006	N/A	Not required if there are no range changes	Standart Calibration +-0.5% of rate	Sludge flow meter for Digester 4

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9	Automatic gas analyser, flow-meter system	Biogas flow 24 V DC ; max. 3 W; IP 65 by EN 60529 -20 oC to +60 °C BG_{burnt,y}	Binder , Combimass eco basic switch bio EEx de Messystems	S.No.C080650	01 July 2009	N/A	Not required if there are no range changes	+/-1%	Biogas flowmeter for Digester 1 (normalised)
10	Automatic gas analyser, flow-meter system	Biogas flow 24 V DC ; max. 3 W; IP 65 by EN 60529 -20 oC to +60 °C BG_{burnt,y}	Binder , Combimass eco basic switch bio EEx de Messystems	S.No.C080647	01 July 2009	N/A	Not required if there are no range changes	+/-1%	Biogas flowmeter for Digester 2 (normalised)
11	Automatic gas analyser, flow-meter system	Biogas flow 24 V DC ; max. 3 W; IP 65 by EN 60529 -20 oC to +60 °C BG_{burnt,y}	Binder , Combimass eco basic switch bio EEx de Messystems	S.No.C080649	01 July 2009	N/A	Not required if there are no range changes	+/-1%	Biogas flowmeter for Digester 3 (normalised)
12	Automatic gas analyser, flow-meter system	Biogas flow 24 V DC ; max. 3 W; IP 65 by EN 60529 -20 oC to +60 °C BG_{burnt,y}	Binder , Combimass eco basic switch bio EEx de Messystems	S.No.C080648	01 July 2009	N/A	Not required if there are no range changes	+/-1%	Biogas flowmeter for Digester 4 (normalised)
13	Automatic gas analyser, flow-meter system	Biogas flow to CHPs, Nm ³ /h	Binder , Combimass eco ver.2014-02	S.No.C120564	July 2014	N/A	Not required if there are no range changes	+/-0.25%+0.025% of max calibrated value(4245,24Nm ³ /h)	The flowmeter is measuring the gas used in the CHPs (normalised) For crosschecking purposes
14	Turbine gas meter	Biogas flow to boilers 50-1000m ³ /h	Common Turbine gas meter	450345/2011	09.2014	N/A	Not required if there are no range changes	0.2Q _{max} -Q _{max} <+/- 1% Q _{min} -0.2Q _{max} <+/- 2%	The flowmeter is measuring the gas used in the boiler.

									For crosschecking purposes
15	Digital thermal energy meter	Thermal energy generated by the CHP units. $EG_{thermal,y}$	Kamstrup, Type 602C00070D1233	Ser.No: 69303430	30.12.2013 (with factory calibration)	23.05.2017 21.10.2020	5 years	$EC \pm (0.5 + \Delta\Theta_{min}/\Delta\Theta) \%$	The heatmeter is installed at the delivery side of the CHP unit to measure the generated useful heat.
16	Digital thermal energy meter	Thermal energy generated by the CHP units. $EG_{thermal,y}$	Kamstrup, Type 602C00070D1233	Ser.No: 69303431	30.12.2013 (with factory calibration)	23.05.2017 21.10.2020	5 years	$EC \pm (0.5 + \Delta\Theta_{min}/\Delta\Theta) \%$	The heatmeter is installed at the delivery side of the CHP unit to measure the generated useful heat.
17	Digital thermal energy meter	Thermal energy generated by the CHP units. $EG_{thermal,y}$	Kamstrup, Type 602C00070D1233	Ser.No: 69303432	30.12.2013 (with factory calibration)	23.05.2017 21.10.2020	5 years	$EC \pm (0.5 + \Delta\Theta_{min}/\Delta\Theta) \%$	The heatmeter is installed at the delivery side of the CHP unit to measure the generated useful heat.
18	Digital thermal energy meter	Thermal energy generated by the boiler. $EG_{thermal,y}$	Kamstrup, Type 602C00020C1233	Ser.No: 69303436	30.12.2013 (with factory calibration)	23.05.2017 26.10.2020	5 years	$EC \pm (0.5 + \Delta\Theta_{min}/\Delta\Theta) \%$	The heatmeter is installed at the delivery side of the boiler units to measure the generated useful heat.

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The management and operation of the project is a responsibility of Sofiyska voda AD (the project operator). Ensuring the environmental credibility of the project through accurate and systematic monitoring of the project's implementation and operation, for the purpose of achieving trustworthy VERs is the key responsibility of the operator.

The project operator had the responsibility to procure and install all the necessary equipment and data acquisition systems to enable the collection and of the stipulated data at the required frequency, and to manage and present this data in the electronic workbook as part of a wider data management system that would be sufficient to meet the needs of the monitoring and the independent verifier.

The establishment of transparent, auditable systems for the collection and storage of data, including adequate record keeping and data monitoring systems was also a responsibility of the operator. The operator developed and implemented a protocol that provided for these critical functions and processes, fit for independent auditing.

For electronic and paper based data entry and record keeping system, there was clarity in terms of the procedures and protocols for collection and entry of data, use of workbooks and spreadsheets and any assumptions made, so that compliance with requirements could be assessed by a third party. Stand-by processes and systems, e.g. paper based systems, were outlined to provide for the possibility of electronic system failures and used in the event of such failure. The record keeping system provided for a paper trail that could be audited.

The operator appointed a competent manager who has been in charge of and accountable for the generation of VERs including monitoring, record keeping, computation of VERs, audits and verification. The operator officially signed off on all official paper versions of GHG emission worksheets.

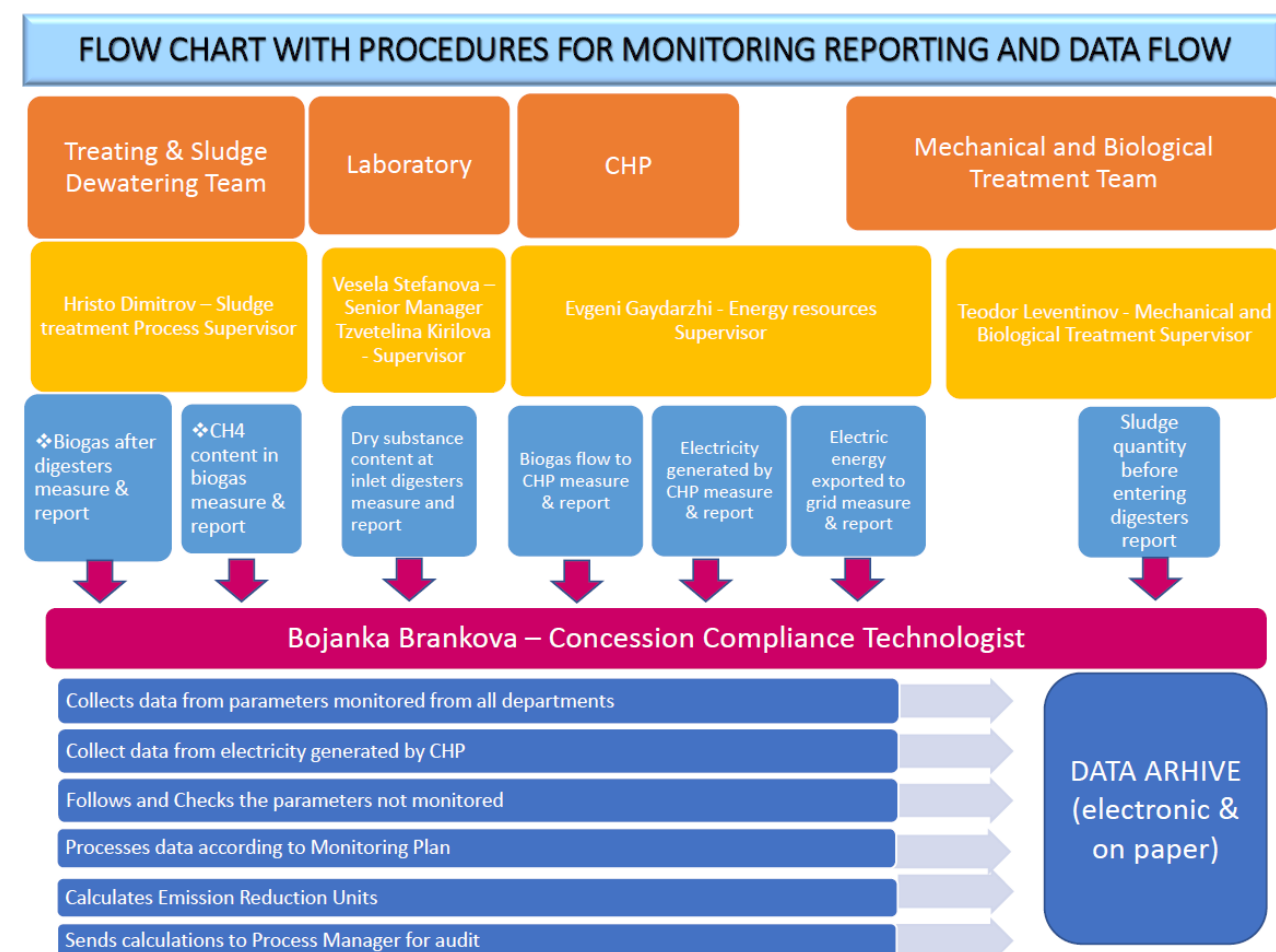
The general project management was implemented by Mr. Jelyaz Rangelov – Manager of Kubratovo WwTP through supervising and coordinating activities of his subordinates, such as head of laboratory, head of Process Management dept., head of accounting department, head of planning unit. During the daytime a group of mechanics who were responsible for maintenance of all technological and measuring equipment as well as automation tools were present on-site.

On-line information was transmitted to the Concession compliance technologist Mrs. Bojanka Brankova who calculated finally emission reductions based on that data and archived all information.

The personnel of Treating and Dewatering of the sludge process, listing 32 people and headed by the Process manager Mr. Hristo Dimitrov were authorized to take all measurements related to the generation of biogas.

The plant laboratory managed by Mrs. Vesela Stefanova and Mrs. Tzvetelina Kirilova measured the dry substance content in the sludge at inlet of anaerobic digesters. The data were transferred to the Process Management dept. for further processing.

Fig.7: Procedures and reporting responsibilities



SECTION D. DATA AND PARAMETERS

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data/parameter:	EF _{EL}
Unit	tCO _{2e} /MWh
Description	Emission factor of the national power grid of Bulgaria
Source of data	Calculated value
Value(s) applied)	1.0190
Choice of data or measurement methods and procedures	The project activity involves displacement of grid electricity. As per the AMS-I.D, version 18 methodology, the EFCO ₂ of the grid is calculated based on a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the Emission Factor for an electricity system"
Purpose of data	Calculation of baseline emissions

Additional comments	This parameter has been fixed ex-ante for the whole crediting period.
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Data/parameter:	$MCF_{S,BL,final}$
Unit	-
Description	Methane correction factor of the disposal site that receives the final sludge in the baseline situation,
Source of data	IPCC 2006 Guidelines for national Greenhouse Gas Inventories
Value(s) applied)	0.4
Choice of data or measurement methods and procedures	CDM Tool "Emissions from solid waste disposal sites", Version 07
Purpose of data	Calculation of baseline emissions
Additional comments	

Data/parameter:	DOC_s
Unit	-
Description	Degradable organic content of the untreated sludge generated in the year y (fraction, dry basis)
Source of data	IPCC 2006 Guidelines for national Greenhouse Gas Inventories
Value(s) applied)	0.5
Choice of data or measurement methods and procedures	Default value from AMS-III.H
Purpose of data	Calculation of baseline emissions
Additional comments	

Data/parameter:	DOC_F
Unit	-
Description	Fraction of DOC dissimilated to biogas
Source of data	IPCC 2006 Guidelines for national Greenhouse Gas Inventories
Value(s) applied)	0.5
Choice of data or measurement methods and procedures	Default value from AMS-III.H
Purpose of data	Calculation of baseline emissions
Additional comments	

Data/parameter:	F
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Unit	-
Description	Fraction of CH ₄ in biogas
Source of data	IPCC 2006 Guidelines for national Greenhouse Gas Inventories
Value(s) applied)	0.5
Choice of data or measurement methods and procedures	Default value from AMS-III.H
Purpose of data	Calculation of baseline emissions
Additional comments	

Data/parameter:	UF _{BL}
Unit	-
Description	Model correction factor to account for model uncertainties
Source of data	AMS-III.H
Value(s) applied)	0.89
Choice of data or measurement methods and procedures	Default value from AMS-III.H
Purpose of data	Calculation of baseline emissions
Additional comments	

Data/parameter:	GWP _{CH4}
Unit	-
Description	Global Warming Potential for methane
Source of data	IPCC
Value(s) applied)	25 – up to 31/12/2020 28 – after 01/01/2021
Choice of data or measurement methods and procedures	Default value from IPCC Fifth Assessment Report: Climate Change 2013 is used as per the applied methodology
Purpose of data	Baseline/project emissions calculation
Additional comments	

Data/parameter:	η _{flare}
Unit	%
Description	Flare efficiency
Source of data	"Project emissions from flaring" , Version 02.0.0
Value(s) applied)	80%

Choice of data or measurement methods and procedures	Default value from "Project emissions from flaring" , Version 02.0.0. The flare efficiency for the minute m ($\eta_{\text{flare},m}$) is 80% when the following two conditions are met to demonstrate that the flare is operating: (1) The temperature of the flare (TEG_m) and the flow rate of the residual gas to the flare (FRG_m) is within the manufacturer's specification for the flare ($\text{SPEC}_{\text{flare}}$) in minute m ; and (2) The flame is detected in minute m (Flamem). Otherwise $\eta_{\text{flare},m}$ is 0%.
Purpose of data	Project emissions calculation
Additional comments	The value is 10% less the default value for conservativeness.

Data/parameter:	$\eta_{\text{BL,thermal}}$
Unit	%
Description	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity determined as per paragraph 39 or 40
Source of data	Manufacturer's specifications ¹
Value(s) applied)	92%
Choice of data or measurement methods and procedures	The value is presented in the specifications provided by the manufacturer of the boilers. The baseline fuel is changed from light oil to natural gas.
Purpose of data	Baseline emissions calculation
Additional comments	The baseline fuel is changed from light oil to natural gas. The standard efficiency of newly built natural gas boilers is 92%.

Data/parameter:	$\text{EF}_{\text{FF},\text{CO}_2}$
Unit	$\text{tCO}_{2e}/\text{TJ}$
Description	CO_2 emission factor of the fossil fuel that would have been used in the baseline plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used
Source of data	2006 IPCC Guidelines for national Greenhouse Gas Inventories, Volume 2.2 Stationary Combustion, Table 2.2
Value(s) applied)	54.30
Choice of data or measurement methods and procedures	Lower value at 95% confidence interval
Purpose of data	Baseline emissions calculation

¹ <http://www.kotlostroene.com/kotliKV>

Additional comments	The baseline fuel is changed from light oil (naphta) to natural gas
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Data/parameter:	NCV _{i,y}
Unit	GJ/t
Description	Net calorific value of the light oil used for emergency cases in year y
Source of data	2006 IPCC Guidelines on National GHG Inventories
Value(s) applied)	46.50
Choice of data or measurement methods and procedures	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Purpose of data	Project emissions calculation
Additional comments	

Data/parameter:	EF _{CO₂,i,y}
Unit	tCO ₂ e/GJ
Description	CO ₂ emission factor of the light oil (naphta) used for emergency cases in year y
Source of data	2006 IPCC Guidelines on National GHG Inventories
Value(s) applied)	76.30
Choice of data or measurement methods and procedures	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Purpose of data	Project emissions calculation
Additional comments	

Data/parameter:	PE _{fugitive,s,y}
Unit	Nm ³ leaked/Nm ³ produced
Description	
Source of data	AMS-III.H, paragraph 42(b)
Value(s) applied)	0.05
Choice of data or measurement methods and procedures	Default value
Purpose of data	Project emissions calculation
Additional comments	

Data/parameter:	D _{CH₄}
Unit	Kg/m ³
Description	Density of methane
Source of data	AMS-III.D

Value(s) applied)	0.670
Choice of data or measurement methods and procedures	0.670 kg/m ³ at 20 °C and 1 atm pressure
Purpose of data	Project emissions calculation including emissions from incomplete flaring.
Additional comments	

D.2 Data and parameters monitored

Relevant SDG Indicator	SDG 13(Climate action)– Target 13.1
Data/parameter:	$S_{final,PJ,y}$
Unit	t
Description	Amount of dry matter in the sludge in the year y
Measured/calculated/default	Measured
Source of data	Plant records
Value(s) of monitored parameter	See Attachment 1; Table 3; Column 7 01/09/2020 – 31/12/2020: 10,908.44 01/01/2021 - 31/03/2021: 9,167.00
Monitoring equipment	See Table 2
Measuring/reading/recording frequency:	Measured continuously. Recorded monthly and yearly.
Calculation method (if applicable):	N/A
QA/QC procedures:	The activities outlined here are undertaken under the OHSAS 18001:2007 (valid up to 15/01/2021. After 01/01/2020 OHSAS is replaced by ISO 45001:2018), ISO 45001:2018 and the internal quality procedures implemented. This will ensure that all management and operational systems will meet the requirements of external auditors. QA/QC internal procedures are implemented in the plant and all measurement processes, as device technical description and documentation, position, calibration, training, temporally replacing procedures etc. are included.
Purpose of data:	Calculation of baseline emissions
Additional comments:	The quantity of sludge delivered to the digesters is equal to the quantity of sludge delivered for dewatering in the baseline.

Relevant SDG Indicator	SDG 13(Climate action)– Target 13.1
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Data/parameter:	EG _{thermal,y}
Unit	TJ
Description	The net quantity of heat supplied by the project activity
Measured/calculated/default	Measured
Source of data	Plant records
Value(s) of monitored parameter	See Attachment 1; Table 3; Column 2 01/09/2020 – 31/12/2020: 29.42 01/01/2021 - 31/03/2021: 22.44
Monitoring equipment	See Table 2.
Measuring/reading/recording frequency:	Measured continuously. Recorded monthly and yearly.
Calculation method (if applicable):	N/A
QA/QC procedures:	The activities outlined here are undertaken under the OHSAS 18001:2007, ISO 45001:2018 and the internal quality procedures implemented. This will ensure that all management and operational systems will meet the requirements of external auditors. QA/QC internal procedures are implemented in the plant and all measurement processes, as device technical description and documentation, position, calibration, training, temporally replacing procedures etc. are included.
Purpose of data:	Calculation of baseline emissions
Additional comments:	

Relevant SDG Indicator	SDG 13(Climate action)– Target 13.1
Data/parameter:	EG _{grid,y}
Unit	MWh
Description	Electricity generated by the CHP
Measured/calculated/default	Measured
Source of data	Plant records
Value(s) of monitored parameter	See Attachment 1; Table 3; Column 3 01/09/2020 – 31/12/2020: 7,969.82 01/01/2021 - 31/03/2021: 5,852.82
Monitoring equipment	See Table 2
Measuring/reading/recording frequency:	Measured continuously. Recorded monthly and yearly.
Calculation method (if applicable):	N/A

QA/QC procedures:	The activities outlined here are undertaken under the OHSAS 18001:2007 (valid up to 15/01/2021. After 01/01/2020 OHSAS is replaced by ISO 45001:2018), ISO 45001:2018 and the internal quality procedures implemented. This will ensure that all management and operational systems will meet the requirements of external auditors. QA/QC internal procedures are implemented in the plant and all measurement processes, as device technical description and documentation, position, calibration, training, temporally replacing procedures etc. are included.
Purpose of data:	Calculation of baseline emissions
Additional comments:	In case records are missing due to meters failure or replacement the electricity consumption for that period and that part of the installation will be estimated by multiplying the installed capacity of the electric motors and devices involved times the working hours of the installation as per plant's records.

Relevant SDG Indicator	SDG 13(Climate action)– Target 13.1
Data/parameter:	BG _{burnt,y}
Unit	Nm ³
Description	Quantity of biogas generated by the anaerobic digesters
Measured/calculated/default	Measured
Source of data	Plant records
Value(s) of monitored parameter	See Attachment 1; Table 3; Column 4 01/09/2020 – 31/12/2020: 3,476,600.00 01/01/2021 - 31/03/2021: 2,725,073.00
Monitoring equipment	See Table 2
Measuring/reading/recording frequency:	Measured continuously. Recorded monthly and yearly.
Calculation method (if applicable):	N/A
QA/QC procedures:	The activities outlined here are undertaken under the OHSAS 18001:2007 (valid up to 15/01/2021. After 01/01/2020 OHSAS is replaced by ISO 45001:2018), ISO 45001:2018 and the internal quality procedures implemented. This will ensure that all management and operational systems will meet the requirements of external auditors. QA/QC internal procedures are implemented in the plant and all measurement processes, as device technical description and documentation, position, calibration, training, temporally replacing procedures etc. are included.

Purpose of data:	Project emissions calculation including emissions from incomplete flaring
Additional comments:	The analyser takes into consideration the pressure and temperature of the biogas. The final result is normalized.

Relevant SDG Indicator	SDG 13(Climate action)- Target 13.1
Data/parameter:	$Q_{DG_{s_inlet}}$
Unit	m^3
Description	Quantity of sludge entering the anaerobic digesters
Measured/calculated/default	Measured
Source of data	Plant records
Value(s) of monitored parameter	See Attachment 1; Table 3; Column 5 01/09/2020 – 31/12/2020: 233,907.00 01/01/2021 - 31/03/2021: 179,010.00
Monitoring equipment	See Table 2
Measuring/reading/recording frequency:	Measured continuously. Results are integrated hourly, recorded monthly and yearly.
Calculation method (if applicable):	N/A
QA/QC procedures:	The activities outlined here are undertaken under the OHSAS 18001:2007 (valid up to 15/01/2021. After 01/01/2020 OHSAS is replaced by ISO 45001:2018). ISO 45001:2018 and the internal quality procedures implemented. This will ensure that all management and operational systems will meet the requirements of external auditors. QA/QC internal procedures are implemented in the plant and all measurement processes, as device technical description and documentation, position, calibration, training, temporally replacing procedures etc. are included.
Purpose of data:	Baseline emissions calculation.
Additional comments:	

Relevant SDG Indicator	SDG 13(Climate action)- Target 13.1
Data/parameter:	ρ_{sludge}
Unit	t/m^3
Description	Dry substance content in the sludge
Measured/calculated/default	Measured/calculated
Source of data	Plant records
Value(s) of monitored parameter	See Attachment 1; Table 3; Column 6 (monthly records)

Monitoring equipment	The tests are made by an accredited laboratory on-site the plant.
Measuring/reading/recording frequency:	Laboratory samples taken every hour. Results are recorded hourly, monthly and yearly
Calculation method (if applicable):	Calculated based on the laboratory samples taken every hour
QA/QC procedures:	The activities outlined here are undertaken under the OHSAS 18001:2007 (valid up to 15/01/2021. After 01/01/2020 OHSAS is replaced by ISO 45001:2018). ISO 45001:2018 and the internal quality procedures implemented. This will ensure that all management and operational systems will meet the requirements of external auditors. QA/QC internal procedures are implemented in the plant and all measurement processes, as device technical description and documentation, position, calibration, training, temporally replacing procedures etc. are included.
Purpose of data:	Baselines emissions calculation.
Additional comments:	

Relevant SDG Indicator	SDG 13(Climate action)– Target 13.1
Data/parameter:	wCH _{4,y}
Unit	%
Description	Methane content in biogas in the year y
Measured/calculated/default	Measured
Source of data	Plant records
Value(s) of monitored parameter	See Attachment 1; Table 3; Column 8 (monthly records)
Monitoring equipment	See Table 2
Measuring/reading/recording frequency:	Measured continuously. Aggregated hourly and recorded monthly and yearly.
Calculation method (if applicable):	N/A
QA/QC procedures:	The activities outlined here are undertaken under the OHSAS 18001:2007 (valid up to 15/01/2021. After 01/01/2020 OHSAS is replaced by ISO 45001:2018). ISO 45001:2018 and the internal quality procedures implemented. This will ensure that all management and operational systems will meet the requirements of external auditors. QA/QC internal procedures are implemented in the plant and all measurement processes, as device technical description and documentation, position, calibration, training, temporally replacing procedures etc. are included.

Purpose of data:	Project emissions calculation including emissions from incomplete flaring
Additional comments:	The analyser takes into consideration the pressure and temperature of the biogas. The final result is normalized.

Relevant SDG Indicator	SDG 13(Climate action)- Target 13.1
Data/parameter:	FC _y
Unit	t
Description	Quantity of fossil fuel (naphta) used for emergency needs.
Measured/calculated/default	Measured/Calculated
Source of data	Plant records
Value(s) of monitored parameter	01/09/2020 – 31/12/2020: 0 01/01/2021 - 31/03/2021: 0
Monitoring equipment	Tank level indicator/meter
Measuring/reading/recording frequency:	yearly
Calculation method (if applicable):	The yearly quantity is calculated using accounting documents for the purchased quantity of fuel during the reported period the initial and the residual content of the reservoirs.
QA/QC procedures:	The activities outlined here are undertaken under the OHSAS 18001:2007 (valid up to 15/01/2021. After 01/01/2020 OHSAS is replaced by ISO 45001:2018). ISO 45001:2018 and the internal quality procedures implemented. This will ensure that all management and operational systems will meet the requirements of external auditors. QA/QC internal procedures are implemented in the plant and all measurement processes, as device technical description and documentation, position, calibration, training, temporally replacing procedures etc. are included.
Purpose of data:	Project emissions calculation
Additional comments:	

Relevant SDG Indicator	SDG 13(Climate action)- Target 13.1
Data/parameter:	V _{t,db}
Unit	m ³ CH ₄
Description	Volumetric flow of the gaseous stream (methane) to the flares
Measured/calculated/default	Calculated
Source of data	Plant records (quantity of biogas generated)

Value(s) of monitored parameter	See Attachment 1; Table 3; Column 13 01/09/2020 – 31/12/2020: 12,080.29 01/01/2021 – 31/03/2021: 41,449.25
Monitoring equipment	
Measuring/reading/recording frequency:	Integrated hourly, recorded hourly and monthly.
Calculation method (if applicable):	Calculated based on the measured content of methane in the biogas $w_{CH_4,y}$, the time flares have been in operation and the capacity of the flares.
QA/QC procedures:	The activities outlined here are undertaken under the OHSAS 18001:2007 (valid up to 15/01/2021. After 01/01/2020 OHSAS is replaced by ISO 45001:2018). ISO 45001:2018 and the internal quality procedures implemented. This will ensure that all management and operational systems will meet the requirements of external auditors. QA/QC internal procedures are implemented in the plant and all measurement processes, as device technical description and documentation, position, calibration, training, temporally replacing procedures etc. are included.
Purpose of data:	Project emissions calculation.
Additional comments:	

Relevant SDG Indicator	SDG 13(Climate action)– Target 13.1
Data / Parameter	F_{CH_4}
Unit	KgCH ₄
Description	Mass flow of methane in the residual biogas flared
Source of data	Plant's records
Value(s) of monitored parameter	See Attachment 1; Table 3; Column 15 01/09/2020 – 31/12/2020: 8,093.79 01/01/2021 – 31/03/2021: 27,771.00
Measurement methods and procedures	The quantity and quality of biogas is measured continuously and normalized. The mass flow is calculated based on above measurements.
Monitoring frequency	Continuously, calculated for every minute interval
QA/QC procedures	The procedure is integrated in the ISO 9001:2015 system implemented by the plant. The meters are checked and calibrated every year.
Purpose of data	Ex-post project emissions calculation.
Additional comment	

Relevant SDG Indicator	SDG 11: Sustainable cities and communities / 11.6-By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.
Data / Parameter	Emissions of SO ₂ ,NO _x and CO in the stack flue gas. (As per the approved Transition Annex 1 to the initial PDD (p.13, SDG 11): The project combusts biogas containing CH ₄ and no measurement of its content as well as dust content in the flue gas is required.) Waste oil disposed
Unit	mg/Nm ³ kg
Description	Emissions in the air by the project activities. Quantity of waste oil disposed by the project
Source of data	Plant records
Value(s) applied	Last available data from measurements are documented in Protocols NoNo 095,096 & 097 dated 26/10/2020 and protocols NoNo 109,110 & 111 dated 09/11/2020 issued by Ecological test laboratory "LABLAND" at "LABEXPERT" Ltd. 1. Engine 1; No 59115371 NO _x – 198 +/-16 mg/Nm ³ SO ₂ – <1.39 mg/Nm ³ CO – 97+/-5 mg/Nm ³ 2. Engine 2; No 59115391 NO _x – 221 +/-18 mg/Nm ³ SO ₂ – <1.42 mg/Nm ³ CO – 97+/-5 mg/Nm ³ 3. Engine 3; No 59115381 NO _x – 209 +/-17 mg/Nm ³ SO ₂ – <1.39 mg/Nm ³ CO – 99+/-5 mg/Nm ³ Waste oil disposed: 1. 04.09.2020 – 660 kg. 2. 19.02.2021 – 3,370 kg.
Measurement methods and procedures	Measured according to plant internal procedures
Monitoring frequency	Every 2 years for exhaust gases as by local law, yearly for waste oil
QA/QC procedures	As per internal procedures, ISO 14001: 2015, OHSAS 18001:2007 (valid up to 15/01/2021. After 01/01/2020 OHSAS is replaced by ISO 45001:2018) and ISO 45001:2018.

Purpose of data	Ex-post monitoring of dangerous emissions and pollutants
Additional comment	The project combusts biogas containing CH ₄ and no measurement of its content as well as dust content in the flue gas is required. Corresponding to Indicator 001 of the GS Passport of the project. Relevant to Target 11.6 of the SDG11.

Relevant Indicator	SDG	SDG6: Clean water and sanitation/6.3.1-Proportion of waste water safely treated					
Data / Parameter		1.COD (Chemical Oxygen Demand) of the inlet wastewater; 1a.BOD5 (Biochemical Oxygen Demand for 5 days) of the inlet wastewater; 2.COD (Chemical Oxygen Demand) of the effluent water; 2a.BOD5 (Biochemical Oxygen Demand for 5 days) of the effluent water; Quantity of waste water (sludge) treated					
Unit		mgO ₂ /l m ³					
Description		Water quality and quantity					
Source of data		Plant records					
Value(s) applied		The average values recorded monthly for 2020 & 2021 are given in the table below:					
		Period	COD inlet [mgO ₂ /l]	BOD inlet [mgO ₂ /l]	COD effluent [mgO ₂ /l]	BOD effluent [mgO ₂ /l]	Quantity of waste water (sludge) treated [m ³]
		2020					
		September	517+/-48	213.7+/-74.1	20+/-2.0	6.6+/-2.0	54,640.00
		October	324+/-30	132.2+/-38.9	22+/-2.0	4.9+/-1.4	59,520.00
		November	384+/-36	168.2+/-58.3	20+/-2.0	8.9+/-2.6	58,800.00
		December	320+/-32	144.2+/-42.4	21+/-3.5	7.9+/-2.3	60,947.00
		Total 233,907.00					
		2021					
		January	175+/-18	92.5+/-27.2	21+/-3.5	9.7+/-2.9	60,970.00
		February	238+/-24	69.8+/-20.5	24+/-4.0	12.4+/-3.7	56,000.00
		March	137+/-14	58.5+/-13.9	23+/-3.9	6.1+/-1.5	62,040.00
		Total 179,010.00					
		Total for the monitoring period 412,917.00					
Measurement methods and procedures		As per VLM NoWW-17/27.05.2008 and BDS EN 1899-1:2004, B.4.2					

Monitoring frequency	As per approved internal procedures
QA/QC procedures	As per ISO 9001:2015
Purpose of data	Ex-post monitoring of the water quality
Additional comment	Corresponding to Indicator 002 of the GS Passport of the project. Quantity of waste water (sludge) treated is given in Attachment 1, Table 3, Column 5

D.3. Comparison of monitored parameters with last monitoring period

Data/Parameter	Value obtained in this monitoring period	Value obtained last monitoring period
Quantity of biogas burnt (BG _{burnt,y})	10,631,439 m ³ /year	9,540,865 m ³ /year
Waste oil disposed	4,030 kg	5,213.5 kg
Waste water (sludge) treated	707,857.71 m ³ /year	660,937.5 m ³ /year

1. Quantity of biogas burnt: Average annual quantity of biogas generated and burnt in this monitoring period is higher compared on yearly basis than the quantity in the previous monitoring period due to the fact that this parameter is highly volatile and strongly depends on climate conditions and the quality and quantity of the wastewater and sludge entering the plant.
2. Waste oil disposed:
3. Quantity of sludge treated: Average annual quantity of wastewater (sludge) treated in this monitoring period is higher compared on yearly basis than the quantity in the previous monitoring period due to the fact that this parameter depends on the quality and quantity of the wastewater coming from the city of Sofa and surrounding villages.

D.4. Implementation of sampling plan

N/A, Left blank intentionally

SECTION E. CALCULATION OF SDG IMPACTS

E.1. Calculation of baseline value or estimation of baseline situation of each SDG Impact

SDG 13

The baseline emissions due to methane avoidance are calculated according to the formula below:

$$BE_{s,final,y} = S_{final,BL,y} * DOC_s * UF_{BL} * MCF_{s,BL,final} * DOC_F * F * 16/12 * GWP_{CH4} \quad [tCO_{2e}]$$

Where

$S_{final,BL,y}$	Amount of dry matter in the final sludge generated by the baseline wastewater treatment systems in the year y (t). If the baseline wastewater treatment system is different from the project system, it will be estimated using the monitored amount of dry matter in the final sludge generated by the project activity ($S_{final,PJ,y}$) corrected for the sludge generation ratios of the project and baseline systems
$MCF_{s,BL,final}$	Methane correction factor of the disposal site that receives the final sludge in the baseline situation, estimated as per the procedures described in the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" – 0.4
UF_{BL}	Model correction factor to account for model uncertainties (0.89)
DOC_s	Degradable organic content of the untreated sludge generated in the year y (fraction, dry basis). Default values of 0.5 for domestic sludge shall be used
DOC_F	Fraction of DOC dissimilated to biogas (IPCC default value of 0.5)
F	Fraction of CH ₄ in biogas (IPCC default of 0.5)

The ex-post calculation of the baseline emissions from CH₄ avoidance is as follows:

$BE_{s,final,2020}$: **16,180** tCO_{2e} (for the period 01/09/2020 – 31/12/2020)

$BE_{s,final,2021}$: **15,229** tCO_{2e} (for the period 01/01/2021 – 31/03/2021)

The baseline emissions from thermal and electricity displacement are calculated as follows:

$$BE_{grid,y} = EG_{grid,y} \times EF_{grid,y}$$

Where:

$BE_{grid,y}$	=	Baseline emissions for the grid electricity displaced by the project in year y (t CO _{2e})
$EG_{grid,y}$	=	Amount of grid electricity displaced by project in year y (MWh)
$EF_{grid,y}$	=	Emission factor of the grid (t CO _{2e} /MWh)

And

$$BE_{thermal,CO_2,y} = \left(\frac{EG_{thermal,y}}{\eta_{BL,thermal}} \right) \times EF_{FF,CO_2}$$

Where:

$BE_{thermal,CO_2,y}$	=	Baseline emissions from thermal energy displaced by the project activity during the year y (t CO _{2e})
$EG_{thermal,y}$	=	Net quantity of thermal energy supplied by the project activity during the year y (TJ)
EF_{FF,CO_2}	=	CO _{2e} emission factor of the fossil fuel that would have been used in the baseline plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (t CO _{2e} /TJ)
$\eta_{BL,thermal}$	=	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity determined as per paragraph 39 or 40

The ex-post calculation of the baseline emissions from thermal and electricity displacement is as follows:

BE_{grid,2020}: **8,121** tCO_{2e} (for the period 01/09/2020 – 31/12/2020)

BE_{grid,2021}: **5,964** tCO_{2e} (for the period 01/01/2021 – 31/03/2021)

BE_{thermal, CO₂,2020}: **1,736** tCO_{2e} (for the period 01/09/2020 – 31/12/2020)

BE_{thermal, CO₂,2021}: **1,324** tCO_{2e} (for the period 01/01/2021 – 31/03/2021)

The total baseline emissions estimated for the project are:

BE₂₀₂₀: **26,037** tCO_{2e} (for the period 01/09/2020 – 31/12/2020)

BE₂₀₂₁: **22,517** tCO_{2e} (for the period 01/01/2021 – 31/03/2021)

Total for the monitored period 01/09/2020 – 31/03/2021: 48,554 tCO_{2e}

The calculation of the baseline emissions is presented in details in the excel file named "Sofiyska_voda_VER_Calculation_ver.02_2020-2021.xlsm" which is attached to this Monitoring report.

SDG 6

1. COD (Chemical Oxygen Demand) of the inlet wastewater;
- 1a. BOD5 (Biochemical Oxygen Demand for 5 days) of the inlet wastewater;
2. COD (Chemical Oxygen Demand) of the effluent water;
- 2a. BOD5 (Biochemical Oxygen Demand for 5 days) of the effluent water;

Quantity of waste water (sludge) treated:

The parameter did not exist prior the project implementation.

SDG 11

Emissions of NO_x in the stack flue gas.

Waste oil disposed

The parameter did not exist prior the project implementation.

E.2. Calculation of project value or estimation of project situation of each SDG Impact

SDG 13

The project emissions are determined as per the formula:

$$PE_y = PE_{power,y} + PE_{fugitive,y} + PE_{flare}$$

Where

$PE_{power,y}$ = Project emissions from combustion of fossil fuel (naphtha) in case of emergency;

$PE_{fugitive,y}$ = Project emissions from leaking methane from capturing system;

PE_{flare} = Project emissions from incomplete flaring.

And

$$PE_{power,y} = PE_{FC,y} = FC_{,y} \times COEF_{,y}$$

$$COEF_{,y} = NCV_{,y} \times EF_{CO2,,y}$$

Where

$PE_{FC,y}$ Are the CO₂ emissions from emergency fossil fuel (naphtha) combustion (tCO₂/yr);

FC Is the quantity of naphtha combusted (mass or volume unit/yr);

COEF Is the CO₂ emission coefficient of naphtha (tCO₂/mass or volume unit)

NCV Is the net calorific value of the emergency fuel, (GJ/mass or volume unit)

EF_{CO2} Is the CO₂ emission factor of emergency fuel (naphtha), (tCO₂/GJ)

For the monitored period there was no use of emergency fuel, hence

$$PE_{power} = 0$$

$PE_{fugitive}$ are calculated as follows:

The fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year y will be determined as per paragraph 42 (b) of AMS-III.H: a default value of 0.05 m³ biogas leaked/m³ biogas produced will be used as an alternative.

$$PE_{fugitive,2020} = 1,850 \text{ tCO}_{2e} \text{ (for the period 01/09/2020 – 31/12/2020)}$$

$$PE_{fugitive,2021} = 1,535 \text{ tCO}_{2e} \text{ (for the period 01/01/2021 – 31/03/2021)}$$

PE_{flare} are determined as follows:

$$F_{CH4,t} = V_{t,db} * V_{CH4,t,db} * \rho_{CH4,t}$$

which is equivalent to

$$F_{CH4,t} = V_{t,db} * w_{CH4,y} * D_{CH4}$$

Where:

$F_{CH_4,t}$	Mass flow of the methane in the gaseous stream in time interval t (kg CH ₄ /h)
$V_{t,db}$	Volumetric flow of the gaseous stream in time interval t on a dry basis (m ³ CH ₄ /h)
$V_{CH_4,t,db} = W_{CH_4}$	Volumetric fraction of methane in the gaseous stream in a time interval t on a dry basis (m ³ CH ₄ /m ³ dry gas)
$\rho_{CH_4,t} = D_{CH_4} = 0.670$	Density of CH ₄ in the gaseous stream in time interval t (kg CH ₄ /m ³ CH ₄)
η_{flare}	80%

and

$$PE_{flare} = F_{CH_4,t} * GWP_{CH_4} * ((100 - \eta_{flare})/100)$$

$PE_{flare,2020}$: **41** tCO_{2e} (for the period 01/09/2020 – 31/12/2020)

$PE_{flare,2021}$: **156** tCO_{2e} (for the period 01/01/2021 – 31/03/2021)

The project emissions during the monitored period are as follows:

PE_{2020} : **1,891** tCO_{2e} (for the period 01/09/2020 – 31/12/2020)

PE_{2021} : **1,691** tCO_{2e} (for the period 01/01/2021 – 31/03/2021)

Total project emissions for the monitored period 01/09/2020 – 31/03/2021:

3,582 tCO_{2e}

The calculation of the project emissions is presented in the excel file named "Sofiyska_voda_VER_Calculation_ver.02_2020-2021.xlsm" which is attached to this Monitoring report.

Calculation of leakage

No leakage emissions are generated by the project.

SDG 11

Air pollutants:

Last available data from measurements are documented in Protocols NoNo 095,096 & 097 dated 26/10/2020 and protocols NoNo 109,110 & 111 dated 09/11/2020 issued by Ecological test laboratory "LABLAND" at "LABEXPERT" Ltd., and are as follows:

1. Engine 1; No 59115371

NOx – 198 +/-16 mg/Nm³

SO2 – <1.39 mg/Nm³

CO – 97+/-5 mg/Nm³

2. Engine 2; No 59115391

NOx – 221 +/-18 mg/Nm³

SO2 – <1.42 mg/Nm³

CO – 97+/-5 mg/Nm³

3. Engine 3; No 59115381

NO_x – 209 +/-17 mg/Nm³
 SO₂ – <1.39 mg/Nm³
 CO – 99+/-5 mg/Nm³

Acceptable values by the law:

NO_x - 500 mg/Nm³
 SO₂ – 35 mg/Nm³
 CO – 100 mg/Nm³

As demonstrated by the protocols the content of NO_x gases in the stack flue gas of the co-generator units is in the permitted range according to the relevant Regulation No1 of 27.06.2005 for gaseous fuels.

In order to keep values inside permitted limits the operating personnel is paying higher attention to the operating regime of the gas engines in order to provide optimal conditions for the combustion of the biogas. In order to reduce emissions the operating team cleans at a regular base the oxidizing catalyst and adjusts the combusting process to reach optimal performance of the process.

The project combusts biogas containing CH₄ and no measurement of its content as well as dust content in the flue gas is required.

The data is measured on 2 years as by local law and per internal procedures, ISO 14001: 2015, OHSAS 18001:2007 (valid up to 15/01/2021. After 01/01/2020 OHSAS is replaced by ISO 45001:2018) and ISO 45001:2018.

Waste oil disposal:

Waste oil is disposed according to the Decision for Waste Treatment No 12-OO-1204-00 dated 20.02.2013, issued by the Regional Inspection for Environment.

According to the delivery documents the WwTP has delivered for further utilization to the authorized company "Industrialni surovini" Ltd (Permission No 12-DO-1440-05 of 09.08.2019) the following amounts of waste mineral motor oil (code No 13 02 05):

1. 04/09/2020 – 660 kg.
2. 19/02/2021 – 3,370 kg.

Total for the monitoring period: 4,030 kg.

The waste oil has been transported in steel barrels by trucks.

All protocols for waste oil delivery are available at the plant for inspection.

The process follows strictly all requirements of the Decision for Waste Treatment No 12-OO-1204-00 dated 20/02/2013, issued by the Regional Inspection for Environment.

SDG 6

The average values recorded monthly for 2020 & 2021 are given in the table below:

Table 3: Waste water (sludge) quality

Period	COD inlet [mgO ₂ /l]	BOD inlet [mgO ₂ /l]	COD effluent [mgO ₂ /l]	BOD effluent [mgO ₂ /l]	Quantity of waste water (sludge) treated

					[m ³]
2020					
September	517+/- 48	213.7+/- 74.1	20+/- 2.0	6.6+/- 2.0	54,640.00
October	324+/- 30	132.2+/- 38.9	22+/- 2.0	4.9+/- 1.4	59,520.00
November	384+/- 36	168.2+/- 58.3	20+/- 2.0	8.9+/- 2.6	58,800.00
December	320+/- 32	144.2+/- 42.4	21+/- 3.5	7.9+/- 2.3	60,947.00
Total					233,907.00
2021					
January	175+/- 18	92.5+/- 27.2	21+/- 3.5	9.7+/- 2.9	60,970.00
February	238+/- 24	69.8+/- 20.5	24+/- 4.0	12.4+/- 3.7	56,000.00
March	137+/- 14	58.5+/- 13.9	23+/- 3.9	6.1+/- 1.5	62,040.00
Total					179,010.00
Total for the monitoring period					412,917.00

Acceptable values by the standard (effluent water):

2. COD – 125 mgO₂/l

2a.BOD₅ – 25.0 mgO₂/l

As demonstrated by the table all measured values of effluent water are lower than the values permitted by the standard.

Data is collected following plant internal procedures and as per VLM NoWW-17/27.05.2008 and BDS EN 1899-1:2004, B.4.2.

E.3. Calculation of leakage

No leakage emissions are generated by the project.

E.4. Calculation of net benefits or direct calculation for each SDG Impact

SDG	SDG Impact	Baseline estimate	Project estimate	Net benefit
13	VERs	48,554	3,582	44,972
11	Waste oil disposed	0	4,030 kg.	4,030 kg.
6	Waste water (sludge) treatment	0	412,917 m ³	412,917 m ³

E.5. Comparison of actual SDG Impacts with estimates in approved PDD

SDG	Values estimated in ex ante calculation of approved PDD for this monitoring period	Actual values achieved during this monitoring period
13	40,994 tCO _{2e}	44,972 tCO _{2e}

11	0	4,030 kg.
6	0	412,917 m ³

E.5.1. Explanation of calculation of value estimated ex ante calculation of approved PDD for this monitoring period

There is no difference in the way and methodology the ex-ante and the ex-post values monitored, estimated and calculated.

E.6. Remarks on increase in achieved SDG Impacts from estimated value in approved PDD

SDG 13: The quantity of VERs generated in this monitoring period is some 13.9 % higher than estimated in the PDD.

This can be explained with the fact that all processes in the plant depend on the quality and quantity of the incoming wastewater as well as on the weather conditions, namely the ambient temperature.

The increase of the emission reductions generated by the project can also be explained with the higher value of the GWP of methane which in the approved PDD is 25 but for this monitoring period it is 28 as recommended by 5th IPCC Report and GS. Never-the-less, as the increase of VERs generated is higher than 10% compared to the value in the approved PDD it is necessary to assess the IRR of the project using current data for the electricity generation, which gives the direct financial income of the project and compare it to the approved IRR calculation sheet and PDD.

The approved equity IRR of the project is calculated as 12.35 % before taxes and the benchmark is estimated at 16.40% in the approved PDD (ver.05 of 30/03/2016).

The annual electricity generation in the approved PDD is estimated at 15,348 MWh.

The electric energy generated during this monitoring period of 7 months is 13,823 MWh total as follows:

In 2020 for 4 m. (01/09-31/12) – 7,970 MWh (monitored real generation)

In 2021 for 3 m. (01/01-31/03) - 5,853 MWh (monitored real generation)

The annually adjusted electricity generation for 2020 and 2021 is as follows:

2020: $(15,348:12)*8^2+7,970=18,202$ MWh/year

2021: $(15,348:12)*9^3+5,853=17,364$ MWh/year

Replacing this value in the IRR calculation sheet of the project for the current monitoring period in the Investment analysis gives a value of 12.43% for the equity IRR before taxes which is only 0.8 % higher than the IRR in the approved PDD and is still much lower than the benchmark of 16.40%. The project can still be considered not financially viable without income from VERs and additional.

The corresponding IRR calculation sheet is attached to this Monitoring Report (filename: IRR_Kubratovo_ver.03_05052022.xlsx).

SDG 6: The value of COD and BOD of the effluent water is well below the limits allowed by the law (COD – 125 mgO₂/l; BOD₅ – 25.0 mgO₂/l).

² Generation based on PDD and IRR calculation sheet for part of 2020 before start of this monitoring period (8 months)

³ Generation based on PDD and IRR calculation sheet for part of 2021 after the end of this monitoring period (9 months)

SDG 11: The values of SO₂, NO_x and CO gasses during the monitoring period are lower than maximal values allowed by the environmental law (500 mg/Nm³ for NO_x; 100 mg/Nm³ for CO and 35 mg/Nm³ for SO₂).

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SECTION F. SAFEGUARDS REPORTING

The safeguarding principles relating to the project are included in Annex 1 to the initial PDD. The Annex 1 was approved by GS on 09/03/2020.

Table 4: Safeguarding principles

Safeguarding principles	Assessment questions	Assessment of relevance to the project (Yes/potentiall y/no)	Justification	Mitigation measure (if required)
3.2 Gender Equality and Women's Rights	- Is there a possibility that the Project might reduce or put at risk women's access to or control of resources, entitlements and benefits? - Is there a possibility that the Project can adversely affect men and women in marginalised or vulnerable communities (e.g., potential increased burden on women or social isolation of men)? - Is there a possibility that	- No - No - No	The project respects Women's rights, including dignity, cultural property and uniqueness of indigenous people. Participation is completely voluntary and the project respects personal freedom and liberty. The project respects internationally proclaimed human rights. Bulgaria has ratified all relevant conventions on human rights, including, without limitation: - The European Convention of Human Rights, and Protocols	Not required The project involves women on responsible positions. The project has provided 32 working positions of which 9 are occupied by women. There was a potential possibility that

	the Project might not take into account gender roles and the abilities of women or men to participate in the decisions/designs of the project's activities (such as lack of time, child care duties, low literacy or educational levels, or societal discrimination)? • Does the Project take into account gender roles and the abilities of women or men to benefit from the Project's activities? • Does the Project design contribute to an increase in women's workload that adds to their care responsibilities or that prevents them from engaging in other activities? • Would the Project potentially reproduce or further deepen discrimination against women based on gender, for instance, regarding their full participation in design and implementation or access to opportunities and benefits? • Would the Project potentially limit women's	• Yes • Potentially • No • No	1 (protection of property), 4 7 and 13 - International Covenant on Civil and Political Rights; - International Covenant on Economic, Social and Cultural Rights; - Convention on the Elimination of all forms of Racial Discrimination; - Convention on the Elimination of all forms of Discrimination Against Women; - Convention on the Elimination of All Forms of Discrimination Against Women; - Convention on the Rights of the Child. The personnel of 32 engaged in the running of the project includes 9 women that occupy positions requiring high level of education and abilities. - The project takes into account the roles of women and men and their possibilities to work for the project following the requirements of the Ministry of Labour and Social Care; - The project has a potential to contribute to the increase of	the project increased the load on women involved but as a member of the European Union Bulgaria has ratified all conventions on labour conditions and European llaws concerning safe and suitable working conditions. Safety regulations are strictly followed and regarded during operation of the project.
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	ability to use, develop and protect natural resources, taking into account different roles and priorities of women and men in accessing and managing environmental goods and services? Is there a likelihood that the proposed Project would expose women and girls to further risks or hazards?	Potentially	women's workload, having in mind that working for the project is a full-time job which can influence the possibility to take care for children and family. In this respect the government and local authorities are taking all possible measures to provide care for children in kindergartens and schools. The project involves operation of mechanical, electrical and biological equipment which potentially can expose women workers to some risks and hazards in case of accidents or not following safety rules. However the company policy in that respect is very strict and involves regular trainings in safety measures and safety knowledge improvement.	
3.4.3 Land Tenure and Other Rights	Does the Project require any change to land tenure arrangements and/or other rights?	No	The land on which the Project is situated is property of Sofia Municipality and the whole equipment based on it is issued for operation to Sofiyska Voda AD (the Project owner – part of Veolia group) under a General concession contract for 25 years until 2025.	Not required
3.6.2 Negative Economic Consequences	Does the project demonstrate financial sustainability?	Yes	The economic impact of the project is positive in terms of reduced expenses for heat and	Not required

	The Projects shall consider economic impacts and demonstrate a consideration of potential risks to the local economy and how these have been taken into account in Project design, implementation, operation and after the Project.	Yes	electricity for internal use. No potential risks for the local economy are observed. Just the opposite - 32 employees are working on the project, some of them from the local communities.	
4.1.1 Emissions	Will the Project increase greenhouse gas emissions over the Baseline Scenario?	No	The methane produced by the WWTP is captured in methane tanks and utilised as a fuel for energy production. This leads to the reduction of high amounts of CH ₄ (powerful greenhouse gas). In addition the production of electricity and heat from biogas replaces the use of fossil fuels thus reducing greenhouse gases such as CO ₂ .	Not required
4.1.2 Energy Supply	Will the Project use energy from a local grid or power supply (i.e., not connected to a national or regional grid) or fuel resource (such as wood, biomass) that provides for other local users?	No	The project is self-sufficient in energy terms. It produces electricity, which in the absence of the project would have been supplied from the local grid. The fuel resource (methane) could not be used by local users in the absence of the project.	Not required
4.2.1 Impact on natural water patterns and flow	Will the Project affect the natural or pre-existing pattern of watercourses, ground-water and/or the watershed(s) such as high seasonal flow variability,	No	The project does not affect the natural water pattern and flow. No depletion or contamination of local reservoirs/ aquifers occurs. Water consumed in the whole	Not required

	flooding potential, lack of aquatic connectivity or water scarcity?		range of the project is to prepare a solution of a flocculent for compression and dewatering of the treated sludge, as well as for washing the machines and to supplement the heating system if necessary. Part of the water used is technical water. The wastewater formed in the process is returned to the entrance of the plant for processing. The plant possesses Permission for deposition of the effluent outlet water into the Iskar river No 1295/14.04.2014, issued by the Ministry of Environment and Water. The Permission defines the quantity of inlet and outlet water and the quality of the effluent water. The quality of the effluent water and heavy metals content is monitored and measured according to the plan and frequency part of the Permission. The quality of the water is monitored by the accredited laboratory part of Kubratovo Wastewater Treatment Plant.	
4.2.1 Erosion and/or water body stability	Could the Project directly or indirectly cause additional erosion and/or water body	No	The project does not result in soil erosion, and does not contribute to soil contamination	Not required

	instability or disrupt the natural pattern of erosion?		by pollutants. The deactivated sludge coming out of the digesters is dewatered, dried and used as fertilizer.	
4.3.1 Landscape modification and soil	Does the Project involve the use of land and soil for production of crops or other products?	• No	The project does not involve the use of any land and soil for production of crops or other production. The equipment needed for the project is situated on the land of the WWTP.	Not required
4.3.2 Vulnerability to Natural Disaster	Will the Project be susceptible to or lead to increased vulnerability to wind, earthquakes, subsidence, landslides, erosion, flooding, drought or other extreme climatic conditions?	• Potentially	The project is a municipal wastewater treatment and has no any direct relation to vulnerability to natural disaster. However in case of very heavy and long lasting rains in the area there is a potential threat of flooding the premises. That threat exists for the whole area around the capital of Sofia and is taken into account by the Municipality authorities.	Not required The potential hazard of natural disaster is regarded in general and is not specifically connected to the project and its operation.
4.3.3 Genetic Resources	N/A	N/A	N/A	N/A
4.3.4 Release of pollutants	• Could the Project potentially result in the release of pollutants to the environment?	• Potentially	The project has major positive effect on the air quality through dramatically reducing the existing methane gas emissions at the plant while also reducing the volume of sludge (to as much as 50%) that needs to be transported, hence reducing	Not required The monitoring of potential pollutants is connected with the parameter included in the PDD and the

			GHG emissions from transportation as well. Waste oil is disposed according to the Complex permission for Operation , issued by the Bulgarian Ministry of Environment and Water.	approved Annex 1 and are connected to the regarded SDG 6 and SDG 11. All data from the monitoring are reported and stated in Section D.2 above.
4.3.5 Hazardous and Non-hazardous Waste	Will the Project involve the manufacture, trade, release, and/ or use of hazardous and non-hazardous chemicals and/or materials?	No	One of the products as a result of the project is the deactivated sludge coming out of the digesters. It is dewatered, dried and used as fertilizer. The quality of the deactivated sludge is monitored and checked regularly by an accredited third party and the results are issued in a special Protocol for testing. The tests guarantee that the deactivated sludge corresponds to all requirements for use as a fertilizer and does not contaminate the soil whatsoever. The Protocols are available for inspection at the plant. The quantity of deactivated sludge shipped for use as fertilizer on the field is monitored by recording the trucks shipped and the tonnage of sludge shipped.	Not required

			Another waste product from the project is the waste oil used in the equipment. The collection of the waste oil is done by an authorized company certified for collection and treatment of waste oil. The waste oil is disposed according to the requirements of the Decision for Waste Treatment No 12-ДО-1204-00 dated 20.02.2013, issued by the Regional Inspection for Environment.	
4.3.6 Pesticides and fertilizers	N/A	N/A	N/A	N/A
4.3.7 Harvesting of forests	N/A	N/A	N/A	N/A
4.3.8 Food	N/A	N/A	N/A	N/A
4.3.9 Animal Husbandry	N/A	N/A	N/A	N/A

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SECTION G. STAKEHOLDER INPUTS AND LEGAL DISPUTES

G.1. List all Inputs and Grievances which have been received via the Continuous Input and Grievance Mechanism together with their respective responses/mitigations.

No inputs/grievances have been registered during the current monitoring period

G.2. Report on any stakeholder mitigations that were agreed to be monitored.

No inputs/grievances have been registered from the previous monitoring period that require any follow up action.

G.3. Provide details of any legal contest that has arisen with the project during the monitoring period

Request for Deviation ref. No DEV_388 dated 27/03/2023 has been submitted by the Verification body RINA with a subject "Deviation of VALIDATION AND VERIFICATION BY SAME VVB (RU 2020 PR – PR V1.2)".

RINA's request was for a stand-alone extraordinary deviation (i.e. project-specific) from the VVB-requirements for the 4th monitoring period only, because the verifier is the same as validator.

After an assessment by RINA, a low impact on the project can be determined. The only impact can be assessed on the impartiality of the verifier but due to the small period of verification the impact is estimated to be minimal.

Based on the assessment above, no impact occurs.

A Decision by GS has been issued on 26/04/2023 stating that the Request for Deviation had been partially approved.

Following the Decision the VVB shall:

- a. Conduct a supplementary audit (remote audit may also be conducted) with a new team leader. VVB shall provide a proper justification in case a remote audit is not conducted. If findings suggest over-estimation of emission reduction, it shall be retrospectively adjusted in the first monitoring period of the second crediting period of the project activity. If the emission reduction is found to be underestimated, then no adjustment shall be made.
- b. Use an entirely different team for the next verification and shall not repeat any member that has been involved in any of the previous verifications.

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ATTACHMENT 1

Plant records

<i>Month/Year</i>	Net thermal energy by cogenerators & boilers EGthermal,y	El. Energy produced by cogenerators EGgrid,y	Biogas generated BGburnt,y	Quantity of sludge at inlet digesters Q_DGs_inlet	Specific content of dry matter in the sludge psludge	Quantity of dry matter in the sludge at inlet digesters Sfinal,PJ,y	CH4 content in the biogas WCH4,y	Quantity of CH4 in the biogas BGCH4burnt	Quantity of CH4 in the biogas BGCH4burnt	Quantity of emergency fuel used FCy	Flare debit	Quantity of CH4 to flare Vt,db	Flare working hours	Quantity of CH4 in the biogas to flare FCH4
	[TJ]	[MWh]	[Nm3]	[m3]	[t/m3]	[t]	[%]	[m3]	[t]	[t]	[m3/h]	[m3CH4]	[h]	[kg]
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sep 2020	7.02	1 902.30	813 100.00	54 640.00	0.043393	2 370.98	63.74	518 238.11	347.22	0.00	500.00	3 526.73	11.07	2 362.91
Oct 2020	7.53	2 040.87	890 400.00	59 520.00	0.048608	2 893.13	66.00	587 664.00	393.73	0.00	500.00	4 774.00	14.47	3 198.58
Nov 2020	7.59	2 054.18	901 700.00	58 800.00	0.043050	2 531.34	64.00	577 088.00	386.65	0.00	500.00	1 861.33	5.82	1 247.09
Dec 2020	7.28	1 972.47	871 400.00	60 947.00	0.051077	3 112.99	60.26	525 090.97	351.81	0.00	500.00	1 918.22	6.37	1 285.21
TOTAL	29.42	7 969.82	3 476 600.00	233 907.00	0.046636	10 908.44	63.51	2 208 081.08	1 479.41	0.00		12 080.29		8 093.79
Jan 2021	6.58	1 779.06	830 202.00	60 970.00	0.051367	3 131.86	59.00	489 819.18	328.18	0.00	500.00	8 353.42	28.32	5 596.79
Feb 2021	7.71	2 020.37	939 892.00	56 000.00	0.050550	2 830.80	59.00	554 536.28	371.54	0.00	500.00	8 673.00	29.40	5 810.91
Mar 2021	8.16	2 053.39	954 979.00	62 040.00	0.051650	3 204.35	62.00	592 086.98	396.70	0.00	500.00	24 422.83	78.78	16 363.30
TOTAL	22.44	5 852.82	2 725 073.00	179 010.00	0.051209	9 167.00	60.05	1 636 442.44	1 096.42	0.00		41 449.25		27 771.00
TOTAL for the period	51.86	13 822.64	6 201 673.00	412 917.00	0.048619	20 075.45	61.99	3 844 523.52	2 575.83	0.00		53 529.54		35 864.79