BÜYÜKDÜZ HYDROELECTRIC POWER PLANT, TURKEY

Document Prepared by Life İklim ve Enerji Ltd. Şti.

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Prepared By	Life İklim ve Enerji Ltd. Şti.
Contact	Oğuzlar Mah. 1377. Sk. No:19/9 06520, Balgat, Çankaya/Ankara – Türkiye E-mail: info@life-climate.com Phone: +90 312 481 21 42 Fax : +90 312 480 88 10

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Büyükdüz Hydroelectric Power Plant (HEPP) is a run-of-river type hydraulic renewable energy facility project. It has an installed capacity of 70.844 MWm / 68.862 MWe, and an annual predicted average generation amount of 192,021,000 kWh. There are two turbines each having a capacity of 35.422 MWm / 34.431 MWe.

The Project field is located in the Black Sea region of Turkey, and in Eastern Black Sea regional basin, inside the borders of Gümüşhane province, and over Manastır (Dere kapı) creek that is a branch of Harşit River and confluences with that between Torul and Kürtün dams over Harşit River.

The project activity reduces greenhouse gas emissions as reference to the baseline scenario considering that it is a zero-carbon project. No greenhouse gas or particulate matter emission takes place within the project boundary and no leakage emissions occur. Hence, a net emission reduction from the baseline emission level to zero level arises with the energy generated by the project that displaces the energy that would otherwise be generated by the fossil fuel fired power plants in the national grid. Although many harmful gases including greenhouse gases and particulate matters are avoided by the emission reduction process, only CO2 is considered in the emission reduction.

The scenario existing prior to the start of the implementation of the project activity was no electricity generation since the project is a greenfield project. Without the implementation of the project, the same amount of energy would be generated by other power plants of the national grid. Considering the general fossil fuel domination in the national grid, a natural gas or coal fired thermal power plant on average would generate this energy. This imaginary power plant would also emit greenhouse gases including CO2 and particulate matter. Since the project emits no greenhouse gases within its boundary and no leakage is in question, an emission caused by the net electricity generation displaced by the project activity was produced prior to the implementation of the project.

The electrical energy generated by the project replaces the electrical energy of the national grid, based mainly on various fossil fuel sources like natural gas and coal. The Combined Margin Emission Factor is calculated to be EFgrid,CM,y = 0.4616[1] tCO2/MWh by using calculated and declared by Ministry of Energy and Natural Resources margins. Hence, the expected annual emission reduction of the second crediting period of the project is estimated to be around 88,708

[1] Please see https://enerji.gov.tr//Media/Dizin/EVCED/tr/ÇevreVeİklim/İklimDeğişikliği/TUESEmisyonFktr/Belgeler/Bform2020.pdf

tCO_2e. For a 10-year 2nd crediting period then, the expected emission reductions result in 886,856 tons of CO2e.

On the other hand, for this second monitoring period, net electricity generation was achieved as 684,086.98 MWh for the period in between 01/11/2017 and 31/12/2022. Moreover, according to this generation amount, actual emission reduction was realized as 361,957 tCO2e for the same period. Annual average emission reduction of the second monitoring period was achieved as 70,019 tCO2e.

The project was commissioned, and the operation of the project and electricity generation started on 31 May 2012. The expected operational life of the project is assumed to be 35 years.

Audit Type	Period	Program	VVB Name	Number of years
Verification	31-03-2012 - 31-10-2017	VCS	Re Carbon Gozetim ve Denetim Belgelendirme Ltd. Şti.	5 years
Validation	31-05-2012 – 30-05-2022	VCS	TÜV Rheinland Energie und Umwelt GmbH	10 years
Verification	01-11-2017 - 31-12-2022	VCS	Earthood Services Private Limited	5 years
Validation	31-05-2022 – 30-05-2032	VCS	Earthood Services Private Limited	10 years
Total	31-05-2012- 31-12-2022	VCS	-	10 years

1.2 Sectoral Scope and Project Type

Büyükdüz HPP is a grid connected hydro power plant with 70.844 MWm/68.862 MWe installed capacity. Regarding project emissions of hydro power plants, ACM0002 refers to where PD (power density) of the water reservoir is considered for determination of reservoir emissions. The defined thresholds and calculation procedures are only applicable to projects with new reservoir capacity.

Since the project activity is a hydro power plant, the respective sectoral scope is scope 1: “Energy Industry – Renewable/Non-renewable Sources”. Project participant hereby confirms that this is not a grouped project.

1.3 Project Eligibility

Büyükdüz HPP is classified in the Renewable Energy Source category as electricity from non-fossil and non-depletable energy sources, in this case from hydro power, is fed into the Turkish

electricity grid. Project meets all applicable rules and requirements and eligible methodologies set out under the VCS Standard Version 4.4. Section 2.1. and Section 3.1. [2]

1.4 Project Design

Eligibility Criteria

The project is not a grouped project.

1.5 Project Proponent

Organization name	Ayen Enerji A.S.
Contact person	Hakan Demir
Title	Project Representative
Address	Hülya Sokak No: 37, 06700 G.O.P./Ankara/TÜRKİYE
Telephone	+90 312 445 04 64 (Pbx) Extension: 2306
Email	ayen@ayen.com.tr; hakand@ayen.com.tr

1.6 Other Entities Involved in the Project

Organization name	Life İklim ve Enerji Ltd. Şti.
Role in the project	Project Consultant
Contact person	Nazire Gür
Title	Carbon Consultant
Address	Oğuzlar Mah. 1377. Sk. No:19/9 Balgat, 06520 Çankaya/Ankara – Türkiye
Telephone	+90 312 481 21 42
Email	nazire.gur@life-climate.com

1.7 Ownership

Ayen Enerji A.Ş. is the sole owner of the project.

[2] Please See: VCS Standard Version 4.4. Section 2.1. & Section 3.1.

1.8 Project Start Date

The Project was commissioned and started to feed energy to the grid on 31 May 2012. This is the date on which the project started to produce emission reductions.

1.9 Project Crediting Period

The first crediting period was 10 years; 31/05/2012-30/05/2022 (both days included). As in accordance with VCS version, the intention is to renew the crediting period. For this reason, the crediting period is renewable twice.[3] The second crediting period is 10 years and starts on 31/05/2022 and ends on 30/05/2032.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	**X**
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
2022 (215 days)	52,210
2023	88,636
2024	88,879
2025	88,636
2026	88,636
2027	88,636
2028	88,879
2029	88,636

[3] See [VCS Standard v4.4], Section 3.9.

2030	88,636
2031	88,636
2032 (151 days)	36,669
Total estimated ERs	**887,088**
Total number of crediting years	**10**
Average annual ERs	**88,708**

1.11 Description of the Project Activity

Büyükdüz Hydroelectric Power Plant (HEPP) is a run-of-river type hydraulic renewable energy facility project. It has an installed capacity of 70.844 MWm / 68.862 MWe, and an annual predicted average generation amount of 192,021,000 kWh. There are two turbines each having a capacity of 35.422 MWm / 34.431 MWe.

Turbines are of Alstom Hydro Pelton[4] brand and type. Pelton turbines are particularly well suited for heads between 200 m and 1800 m. Since 1927, Alstom Hydro has supplied over 300 Pelton turbines worldwide, with power ranges between 1.2 MW and 202 MW, for heads between 120 m and 1247 m. Alstom Hydro Pelton turbines have either one or two injectors for horizontal shaft and between one and six injectors for vertical shaft configuration. The technical properties of these turbines are summarized as follow:

Main Functions:

- Can store large amounts of energy for weeks or months.
- Act as a quick response for peak load energy supply
- Provide ancillary services (network frequency & voltage regulation, reserve capacity, black start capability, reactive power production)

Key Advantages:

- Clean, renewable power source
- Relatively low cost per installed MW
- High efficiency over a wide range of power output
- Fast output adjustment capability (very complementary to thermal power plants)

Two electricity meters are placed (one main and one reserve) at the TEIAS substation. Meters are Elster A1500 (2010) brand and type. These meters are sealed by TEIAS and intervention by

[4] Turbine specification brochure is provided among supported documents.

project proponent is not possible. The fact that two meters are installed in a redundant manner keeps the uncertainty level of the only parameter for baseline calculation low. High data quality of this parameter is in the interest of not only the emission reduction monitoring, but also paramount for the business relation between the plant operator and the electricity buyers.

The project activity has installed the latest state-of-art monitoring and control equipment that measure, record, report, monitor and control various key parameters. Real time data monitoring by SCADA takes place using these control system. All the monitoring equipments undergo the process of regular meter testing and calibration.

The project activity reduces greenhouse gas emissions as reference to the baseline scenario considering that it is a zero-carbon project. No greenhouse gas or particulate matter emission takes place within the project boundary and no leakage emissions occur. Hence, a net emission reduction from the baseline emission level to zero level arises with the energy generated by the project that displaces the energy that would otherwise be generated by the fossil fuel fired power plants in the national grid. Although many harmful gases including greenhouse gases and particulate matters are avoided by the emission reduction process, only CO2 is considered in the emission reduction.

There are two water intakes and one of the water intakes is located on the Demirkapi River at Tasoba on elevation 1189.50-1185.00 with a gated weir, an inlet structure with trash rack, gates and two sand traps for a maximum water discharge of ca. 8 m^3/s. Another water intake is located on the Kurtun River at Elmali on elevation 1189.50-1185.00 with a gated weir, an inlet structure with trash rack gates and two sand traps for a maximum water discharge of ca. 8 m^3/s.

There are 6.8 km and 4.9 km long Y-Type headrace tunnels present between the two water intakes on the reservoir. There is a reservoir with 3,000 m^3 capacity at the elevation of 1181.43 m. The waterways are with a 902 m long first part of penstock, with a 680 m long headrace tunnel and an 89 m long second part of penstock. The open-air powerhouse has an installed turbine capacity of 68.9 MW.

Table 1 Technical specification summary

Item No	Description		
1	Stream Name / Main Branch Name	Kurtun, Cizere Streams / Harsit Brook	
2	Used Flow Observation Station No	DSI 22-009, DSI 22-84	
		Elmali Weir	Tasoba Weir
3	Precipitation Area (km^2)	155.8	139.6
4	Average Flow Rate (m^3/s)	3.928	2.594
5	Average Annual Total Flow (hm^3)	124.082	81.957
6	Q_{25} Bankfull Discharge (m^3/s)	94.04	67.78

Item No	Description		
7	Q_{100} Bankfull Discharge (m^3/s)	183.50	121.97
8	Weir Type	Radial gated solid webbed concrete with sluice outlet	
9	Crest elevation (m)	1191.3	1191.30
10	Maximum water elevation (m)	1190.00	1190.00
11	Spillway elevation (m)	1189.50	1189.50
12	Minimum water elevation (m)	1185..00	1185.00
13	Stream Bed Elevation (m)	1174.70	1177.80
14	Power Plant Tailrace Elevation (m)	672.00	
15	Diversion Tunnel Type	Basket handle section free surface	
16	Diversion Tunnel Length (m)	4,917.62 + 366.93	6932.65
17	Diversion Tunnel Slope	0.0005	0.00032
18	Headrace Length (m)	211.30	
19	Headrace Slope	0.0005	
20	Penstock Diameter (m)	2.00	
21	Penstock Length (m)	1677	
22	Penstock Wall Thickness (mm)	8 - 35	
23	Turbine Type	Vertical Axis Pelton	
24	Number of Units	2 identical	
25	Busbar Voltage (kV)	11	
26	Energy Transmission Line Section	(2x477) MCM	
27	Energy Transmission Line Length (m)	300	
28	Gross Head (m)	507.24	
29	Net Head (m)(Two Units)	488.512	
30	Project Flow Rate (m^3/s)	16.371	
31	Installed Capacity (MW)	34.431 * 2	
32	Firm Capacity (MW)	3.766	
33	Firm Energy (GWh)	32.993	
34	Secondary Energy (GWh)	159.027	

Item No	Description	
35	Total Energy (GWh)	192.021

General technical specifications of the project activity can be summarized as follows:

The plant load factor could be calculated as follows:

$$\frac{192{,}021MWh}{68.862MW * 365d * 24h} = \frac{x192{,}021MWh}{603{,}231.12MWh} = 0.318312 = 31.83\%$$

There is no descriptive information about the age and average lifetime of the equipment based on manufacturer's specifications. The technical lifetime of the equipment (hydro turbines) are 150,000 hours according to tool 10 "Tool to determine the remaining lifetime of equipment". To determine operational lifetime of the HPP firstly capacity factor of the HPP should be calculated because HPP will not be in operation for whole year. By dividing annual generation (192,021 MWH) to the installed capacity (68.862 MW), the operation time in a year will be found which is 2,788.5 h/year. Since operation lifetime is related to economic analysis, in the calculation of operational lifetime annual generation and installed capacity figures are taken from Generation License of the HPP. Finally dividing lifetime of the equipment (150,000 hours) to the operational time per year, lifetime of the equipment will be found in terms of year which is 53.7. However, the generation license was granted for 49 years. But general procedures applied by the General Directorate of State Hydraulic Works of Ministry of Forestry and Water Affairs impose that at least 85% of the equipment must be renewed after 35 years of operation and 35 years is a generally accepted and mentioned period in the industry standards and/or applications in Türkiye. Hence, 35 years is accepted as the expected lifetime of the project. [5]

The baseline scenario is the same as the scenario existing prior to the start of implementation of the project activity. Since the project is a greenfield project, not a retrofit or a capacity addition project, the same amount of energy that will be supplied by the project would be generated by other power plants of the national grid without the implementation of the project.

1.12 Project Location

The Project field is located in the Black Sea region, and in Eastern Black Sea regional basin, inside the borders of Gümüşhane province, and over Manastır (Dere kapı) creek that is a branch of Harşit River and confluences with that between Torul and Kürtün dams over Harşit River.

There are two weirs included in the project, namely Elmali and Tasoba Weirs. Elmali weir is located 11 km, and Taşoba weir is 10 km, and Büyükdüz HEPP is 5 km away, as air distance, from the center of Kürtün District.

[5] Please see registered Project Description document Section 1.8.

Elmalı weir is constructed as a radial gate concrete structure on the Kürtün branch of Manastır creek. The location of Elmalı weir is on the Kürtün branch of Manastır creek that is divided into two branches before it confluences with the Harşit River.

Taşoba weir is constructed on Cizere creek (Manastır branch) as a radial gate concrete structure. The location of Taşoba weir is on the main branch of Manastır creek that is divided into two branches before it confluences with the Harşit River.

Waters of Taşoba and Elmalı weirs and natural flows diverted from Manastır creek is fed into the turbines of Büyükdüz HEPP in order to generate electricity.

Table 2 Project Location Details of Büyükdüz Hydroelectric Power Plant

Item No	Item	Description
1	Province	Gümüshane
2	District	Kürtün
3	Basin Name	Harsit Basin
4	DSI (SHW) Region	22. Region
5	1/25 000 Map Names	G42 - d1, d3, d4
6	Elmali Weir 6° UTM Coordinates	4494210(N) / 503843(E)
7	Tasoba Weir 6° UTM Coordinates	4490395(N) / 510892(E)
8	Power Plant 6° UTM Coordinates	4498293(N) / 509514(E)
9	Brand and Models of the Turbines	Alstom Power Hydro - Iberica
10	Shaft Model	Vertical Pelton
11	Serial Numbers of the Turbines	2092 & 2093
12	Installed Capacity	(2x35.422) MWm / (2x34.431) MWe
13	Turbine Speed	600 rpm
14	Year of Turbines' Manufacturing	2011
15	Brand and Models of the Generators	Alstom PT/PE Hydro Synchronous Generator
16	Type	SAV 257/130/10
17	Serial Numbers of the Generators	G0N157 & G0N158
18	Rated Output	33,800 kVA / 23,660 kW
19	Frequency	50 Hz
20	Voltage	10,600 ± 10% V
21	Current	1,841A
22	Nominal/Runaway Speed	600/1,050 rpm
23	Year of Generators' Manufacturing	2011

Figure 1 Project site location google earth image

1.13 Conditions Prior to Project Initiation

The pre-project scenario is the same as baseline scenario. Please refer to the Section 3.4 (Baseline Scenario) for the description of baseline scenario.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project activity continued in compliance with all the applicable and relevant laws, statutes, and other regulatory frameworks during its operation. There is no new law or regulation that must be considered for the project for the second crediting period. The most important of these are listed below.

1. Electricity Market Law (6446, 30-03-2013) [6]

[6] See: https://www.resmigazete.gov.tr/eskiler/2013/03/20130330.pdf

2. Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electricity Energy (5346, 18-05-2005)[7]
3. Environment Law (2872, 11-08-1983)[8]
4. Occupational Health and Safety Law (6331, 30-06-2012) [9]
5. Forest Law (Nr. 6831)[10]

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The project has not been registered to or seeking registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

The project has not applied for crediting under any other GHG program, nor has it been rejected from any other GHG program.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Not applicable.

1.16.2 Other Forms of Environmental Credit

The project has not created any form of other credit and did not obtain any public funding.

1.16.3 Supply Chain (Scope 3) Emissions

Not applicable.

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

The project is expected to contribute 4 SDGs which are SDG 7, 8, 12 and 13 for the second crediting period.

[7] See: https://www.resmigazete.gov.tr/eskiler/2005/05/20050518-1.htm

[8] See http://www.mevzuat.gov.tr/MevzuatMetin/1.5.2872.pdf

[9] See: http://www.mevzuat.gov.tr/MevzuatMetin/1.5.6331.pdf

[10] See: https://www.mevzuat.gov.tr/MevzuatMetin/1.3.6831.pdf

SDG 7 Energy: The project contributes SDG Target 7.2 "By 2030, increase substantially the share of renewable energy in the global energy mix" and Indicator 7.2.1 by the utilization of hydro power as a renewable energy source.

SDG 8 Decent Work and Economic Growth: During the operation phase of the project, job opportunities are created. Therefore, the project contributes to SDG Target 8.8 "Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment" and Indicator 8.8.2 by providing employment and job-related training to the employees. SGK (Social Security Institution) Records and HSE training certificates will be provided during each monitoring period.

SDG 12 Responsible Consumption and Production: The project helps SDG Target 12.5 "By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse" and Indicator 12.5.1 by providing tons of material recycled. Waste declaration documents will be provided during each monitoring period.

SDG 13 Climate Change: The project produces clean renewable energy by diminishing CO2 emissions. Therefore, it contributes SDG Target 13.3 "Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning" and Indicator 13.3.2.

1.17.2 Sustainable Development Contributions Activity Monitoring

The project, located in Gümüşhane Türkiye, reduces GHG emissions by generating renewable energy while also increasing renewable energy share in the Turkish electricity grid. Without the project the same amount of energy would have been generated via fossil fuels. The project also creates equal and safe employment opportunities in the region.

The project helps Türkiye to stimulate and commercialize the use of grid-connected renewable energy technologies and markets. Furthermore, the project demonstrates the viability of grid-connected renewable energy project which can support improved energy security, improved air quality, alternative sustainable energy futures, improved local livelihoods and sustainable renewable energy industry development. The project reduces greenhouse gas emissions, helps growing renewable energy share, creates local employment and reduces pollution resulting from power generation industry in Türkiye.

As the project developer, Ayen Enerji believes that efficient utilization of all kinds of natural resources with a harmony coupled with responsible environmental considerations is vital for the sustainable development of Turkey and the World. This has been a guiding factor for the shareholders towards the concept of designation and installation of a hydropower project. Other than the objective of climate change mitigation through a significant reduction in greenhouse gas (GHG) emissions, the project has been carried out to provide a social and economic contribution to the region in a sustainable way. The benefits that are gained by the realization of

the project compared to the business-as-usual scenario can be summarized under some main indicators.

In addition to the contribution made by Büyükdüz HEPP to the climate action, project also contribute significantly to the solution of other environmental issues such as solid waste and wastewater management. In the scenario Büyükdüz HEPP is not implemented, the electricity is to be generated by a fossil fuel combustion procedure. This kind of conventional electricity generation processes requires use of significant amount of cooling water that consequently ends with a cooling wastewater discharge into the natural water bodies such as lakes or rivers. Thus, since this project does not employ such a procedure for electricity generation, there is no wastewater discharge as a side product of its operation. Also, all the domestic wastewater and solid/hazardous wastes, that are formed due to the project's operation, are being treated in line with the regulations.

In addition, the project helps to develop the renewable power industry and encouraged to the investment in the industry. Thus, for economical aspect, Turkey's increasing energy deficit and import dependency are reduced.

For social aspect, during the construction and operation of the project, local employment is enhanced and local poverty and unemployment can be partially eliminated by increasing job opportunities and project business activities. Also, the employment quality of via Büyükdüz HEPP has been enhanced by the social and technical trainings given to the employees during the monitoring period.

This project's contribution status to the UN SDGs and associated achieved value are given as follow:

SDG 7 Energy: The project contributes SDG Target 7.2 "By 2030, increase substantially the share of renewable energy in the global energy mix" and Indicator 7.2.1 by renewable energy share in the total final energy consumption. The project generated 684,086.98 MWh hydro power during the monitoring period.

SDG 8 Decent Work and Economic Growth: During the operation phase of the project, job opportunities are created. Therefore, the project contributes to SDG Target 8.8 "Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment" and Indicator 8.8.2 by providing employment and job-related training to the employees. SGK (Social Security Institution) Records and HSE training certificates will be provided during each monitoring period. Project provided employment 24 people in the monitoring period and provided H&S training to employees.

SDG 12 Responsible Consumption and Production: The project helps SDG Target 12.5 "By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse", and

Indicator 12.5.1 by providing tons of material recycled. Waste declaration documents will be provided during each monitoring period.[11]

SDG 13 Climate Change: The project produces clean renewable energy by diminishing CO2 emissions. Therefore, it contributes SDG Target 13.3 "Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning" and Indicator 13.3.2. Project generated clean energy that amounts to 361,957 tCO2e emission reduction during the monitoring period.

[11] The associated documents are submitted to VVB.

Table 3: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	13.3	13.3.1. Air Quality	Electricity generation from hydro power plant decreases CO_2 emission.	361,957 tCO_2e emission reduction during this MP	726,208 tCO_2e emission reduction over the project lifetime (31-05-2012 to 31-12-2022)
2)	12.5	12.5.1 National recycling rate	Providing tons of material recycled.	Waste declaration documents have been provided at monitoring period.	Waste declaration documents have been provided at monitoring period.
3)	8.8	8.8.2 Level of national compliance of labour rights	Increase in national compliance of labour rights (freedom of association and collective bargaining) based on International Labour Organization (ILO) textual sources and national legislation, by sex and migrant status.	24 people have been employed and H&S training have been provided to all employees during this MP.	More than 20 people are employed over the project lifetime (31-05-2012 to 31-12-2022)
4)	7.2	7.2.1 Renewable energy share in the total final energy consumption	Electricity generation from Hydro Power Plant.	684,086.98 MWh during this MP	1,364,875 MWh over the project lifetime (31-05-2012 to 31-12-2022)

1.18 Additional Information Relevant to the Project

Leakage Management

There is no leakage management as per applied methodology ACM0002, Version 21.0.

Commercially Sensitive Information

There is no commercially sensitive information excluded in the document.

Further Information

No relevant further information is applicable.

2 SAFEGUARDS

2.1 No Net Harm

No negative environmental and socio-economic impacts have been observed /recorded for this project. No further assessment was conducted prior to the commencement of the second crediting period. Detailed information of Büyükdüz HEPP's social and environmental performance can be gained via Sustainable Development chapter.

The project helps Turkey to stimulate and commercialize the use of grid connected renewable energy technologies and markets. The specific economic, social and environmental benefits are:

- Reducing Turkeys expanding energy deficit;
- Diversification of Turkish electricity generation mix and reduction of import dependency;
- Creation of local employment and income during construction and operation of HPP (directly as well as indirectly via contracts with local providers for supply of construction material);
- Foster infrastructural investments with connected development benefits to the local rural community in the remote project area;
- Making rural electricity supply more reliable, better available and cost efficient thanks to decreasing distances between generation and consumption points.

2.2 Local Stakeholder Consultation

This project has continued operation since 2012 and the project activities do not result in different impacts with respect to different vintages, the grievance mechanism does mainly rely on the existing grievance mechanism using logbook. Logbooks were delivered to Mukhtars in the

local stakeholder consultation meeting. There is no additional requirement to use further grievance tools throughout the project life cycle. During the monitoring time, there were no grievance has been recorded in the logbook.

Stakeholder engagement procedure was conducted at the plant during the site visit with the local stakeholders and Mukhtar of these village on 17/02/2023.

As validated during the site visit, mukhtars of (heads of the village) Demirciler Village and Demirkapı Village had already taken the contact information one of the executives in Büyükdüz Hydroelectric Power Plant that the local stakeholders will be able to reach company executive whenever they have any complaints, suggestions, or ideas about the project.

Since mukhtar is the head of the village, he will be the main contact person between the project owner and the local stakeholders. Mukhtars will make sure that there is continuous communication between the two parties. The communication, as it has been proceeded to date, will be based on either face-to-face contact or remote (via phone, email etc.)

During the site visit, it is validated that there were no negative comments on the implementation of the project from the stakeholders (Mukhtar and the locals).

2.3 Environmental Impact

The environmental matters in Türkiye are under the jurisdiction of the Ministry of Environment and Urbanization. The Law defines among others the general requirements of the Environmental Impact Assessment (EIA) states specific requirements according to the type of project, location, size, and other characteristics.

An Environmental Impact Assessment Study was performed according to the "Environmental Impact Assessment Regulation", and the outcome was found to be positive by the relevant authorities. The study was renewed when the installed capacity of the project was increased, and the outcome was again found to be positive. The results of the Environmental Impact Assessment Studies were indicated in an Environmental Impact Assessment Study Report[12], both in Turkish and English versions.

According to the report, the project was found to be compatible with regulations related to the environmental impact assessment, and no harmful effects to the environment could be found. The details are in the referred EIA reports and can be found among the supporting documents.

2.4 Public Comments

There are no public comments.

[12] Taşoba – Elmali Weirs, Büyükdüz HEPP and Construction Material Quarries Final EIA Report, prepared by Topcuoglu Mining, Industry and Trade Co. Ltd. Dated February 2008.

2.5 AFOLU-Specific Safeguards

Not applicable.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Title: Grid Connected Renewable Electricity Generation

Reference: ACM0002 (Version 21.0)[13]

For the determination of the baseline, Version 21 of CDM approved baseline and monitoring methodology ACM0002 – "Grid-connected renewable electricity generation" is applied. For baseline calculations, ACM0002 refers to the "Tool to calculate the emission factor for an electricity system", Version 7.0. Additionality is demonstrated via application of the "Tool for the demonstration and assessment of additionality", Version 07.0. The methodology is used in conjunction with the following tools:

1. Tool to calculate the emission factor for an electricity system (Version 07.0.0)[14]
2. Tool for the demonstration and assessment of additionality (Version 07.0.0)[15]
3. Tool to determine the remaining lifetime of the equipment (Version 01.0.0)[16]
4. Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (Version 03.0.1)[17]

3.2 Applicability of Methodology

The choice of methodology ACM0002 Version 21 and related tools are justified based on the fact that the proposed project activity meets the following relevant applicability conditions of the chosen methodology and tools:

The methodology is applicable under the following conditions:

- The project is a greenfield project. No power plant or a similar facility had been present on the project site when the project activity began.

[13] https://cdm.unfccc.int/UserManagement/FileStorage/ZPFJL01OU2RYC6N3HASIXV7K84QBG9

[14] Please see https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

[15] Please see https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf

[16] Please see http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-10-v1.pdf

[17] Please see https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf

- The project is a grid-connected renewable power generation project.
- The project activity does not involve any capacity addition or any retrofit or replacement of an existing power plant.
- The project activity is the installation of a run-of-river type hydroelectric power plant.
- There is no project emission or leakage related to the project activity.
- A clear grid boundary and grid characteristics can be identified for the relevant electricity system.
- Project Power Density is higher than 4 W/m2. (The power densities for the whole project, and for Elmali and Tasoba Weirs are all higher than, 10 W/m2, resulting in zero project emission.
- Project activity is not a biomass-fired power plant.

The project status is corresponding to the methodology ACM0002 version 21.0 and applicability of methodology ACM0002 version 21.0 are discussed below:

Applicability Criterion	Project Case
This methodology is applicable to grid-connected renewable power generation project activities that: • install a Greenfield power plant; • involve a capacity addition to (an) existing plant(s); • involve a retrofit of (an) existing operating plants/units; • involve a rehabilitation of (an) existing plant(s)/unit(s) or • involve a replacement of (an) existing plant(s)/unit(s).	The project activity is a Renewable Energy Project i.e. Hydro Power Project which falls under applicability criteria option 1(a) i.e., Install a Greenfield power plant; Hence the project activity meets the given applicability criterion.
In case the project activity involves the integration of a BESS, the methodology is applicable to grid-connected renewable energy power generation project activities that: • Integrate BESS with a Greenfield power plant; • Integrate a BESS together with implementing a capacity addition to (an) existing solar photovoltaic1 or wind power plant(s)/unit(s); • Integrate a BESS to (an) existing solar photovoltaic or wind power plant(s)/unit(s) without implementing any other changes to the existing plant(s); • Integrate a BESS together with implementing a retrofit of (an) existing solar photovoltaic or wind power plant(s)/unit(s).	The project activity does not involve the integration of a BESS, therefore this criteria is not applicable.

The methodology is applicable under the following conditions: • Hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit; • In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects) the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity; • In case of Greenfield project activities applicable under paragraph 5 (a) above, the project participants shall demonstrate that the BESS was an integral part of the design of the renewable energy project activity (e.g. by referring to feasibility studies or investment decision documents); • The BESS should be charged with electricity generated from the associated renewable energy power plant(s). Only during exigencies2 may the BESS be charged with electricity from the grid or a fossil fuel electricity generator. In such cases, the corresponding GHG emissions shall be accounted for as project emissions following the requirements under section 5.4.4 below. The charging using the grid or using fossil fuel electricity generator should not amount to more than 2 per cent of the electricity generated by the project renewable energy plant during a monitoring period. During the time periods (e.g. week(s), months(s)) when the BESS consumes more than 2 per cent of the electricity for charging, the project participant shall not be entitled to issuance of the certified emission reductions for the concerned periods of the monitoring period.	The project activity is the installation of a new run of the river hydro power plant. Therefore, first option is applicable.
In case of hydro power plants, one of the following conditions shall apply: • The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or	Since this is a Greenfield field project the first two options are not applicable. It is a new reservoir. Therefore, third option is applicable.

• The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density calculated using equation (3), is greater than 4 W/m2; or • The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m2. • The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3), is lower than or equal to 4 W/m2, all of the following conditions shall apply: o The power density calculated using the total installed capacity of the integrated project, as per equation (4), is greater than 4 W/m2; o Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; o Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m^3 shall be; a. Lower than or equal to 15 MW; and b. Less than 10 per cent of the total installed capacity of integrated hydro power project.	
In the case of integrated hydro power projects, project proponent shall: • Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or • Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output.	The project activity is constructed as a runoff-the-river hydropower project. Therefore, the said criteria is not applicable

This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.	
Methodology is not applicable to the following • Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; • Biomass fired power plants/units	The project activity is a greenfield activity which generates electricity from potential energy of water stored, there is no switching from fossil fuel involved. The project activity is not biomass fired power plant.
In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".	This project activity is a greenfield activity which generates electricity from run-of-the– river, this is not the case of retrofits, rehabilitations, replacements or capacity additions.
Applicability conditions of "Tool to calculate the emission factor for an electricity system"	
This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand side energy efficiency projects).	This condition is applicable. OM, BM and CM are estimated using the tool for calculating baseline emissions.
Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off grid power plants. In the latter case, the conditions specified in "Appendix 2: Procedures related to off-grid power generation" should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	Since project activity is grid connected, this condition is applicable and the emission factor has been calculated accordingly.
Under this tool, the value applied to the CO2 emission factor of biofuels is zero.	Each project activity is grid connected renewable energy project and CO2 emission factor is not considered for biofuels.

In addition, for the emission factors, that were used to calculate estimated emission reductions, publication of Turkish Ministry of Energy and Natural Resources, which is indicating Türkiye's National Electric Grid Emission Factor for the year of 2020[18] was used. Publication includes calculated Emission Factor values that are Operating Margin (OM), Growth Based Margin (Build Margin-BM) and Combined Margin (CM) Emission Factors, for the relevant year (which is 2020) with usage of the IPCC's Clean Development Methodology Tool 07-V06.0.

In brief, the latest version of the Turkish National Electricity Grid Emission Factor was published in 2020 and the Emission Factors included in this document belong to the 2020 calculation period. Therefore, the recent available data of the emission factors (the data set used for calculation of emission factors also belongs to 2020.) used in the calculation of the baseline scenario belongs to 2020.

Emission factor calculation is not given in detail in the document published by the Turkish Ministry of Energy and Natural Resources. However, the most recent data and official values for emission factor of Türkiye are those published in the report.

3.3 Project Boundary

The project utilizes hydropower as the primary energy source to generate electricity. During normal operation when enough water flow is present to generate electricity, the project activity draws no energy from the grid to meet its auxiliary electricity consumption need. The project meets its auxiliary electricity consumption need from its own generated electricity. When there is not sufficient water to generate electricity, the project will draw some electricity from the grid to use for auxiliary electricity consumption. There is a backup power generator using diesel fuel to be used only when power cannot be supplied from the grid due to a connection loss, grid maintenance, or a power outage in the grid. Under only very such rare occasions will the backup power generator operate and produce emissions. These emissions are expected to be very low and can be neglected; so assumed to be zero.

Apart from the backup diesel power generator, there is no equipment or machinery related with the project activity that can produce any emissions.

[18] https://enerji.gov.tr//Media/Dizin/EVCED/tr/ÇevreVeİklim/İklimDeğişikliği/TUESEmisyonFktr/Belgeler/Bform2020.pdf

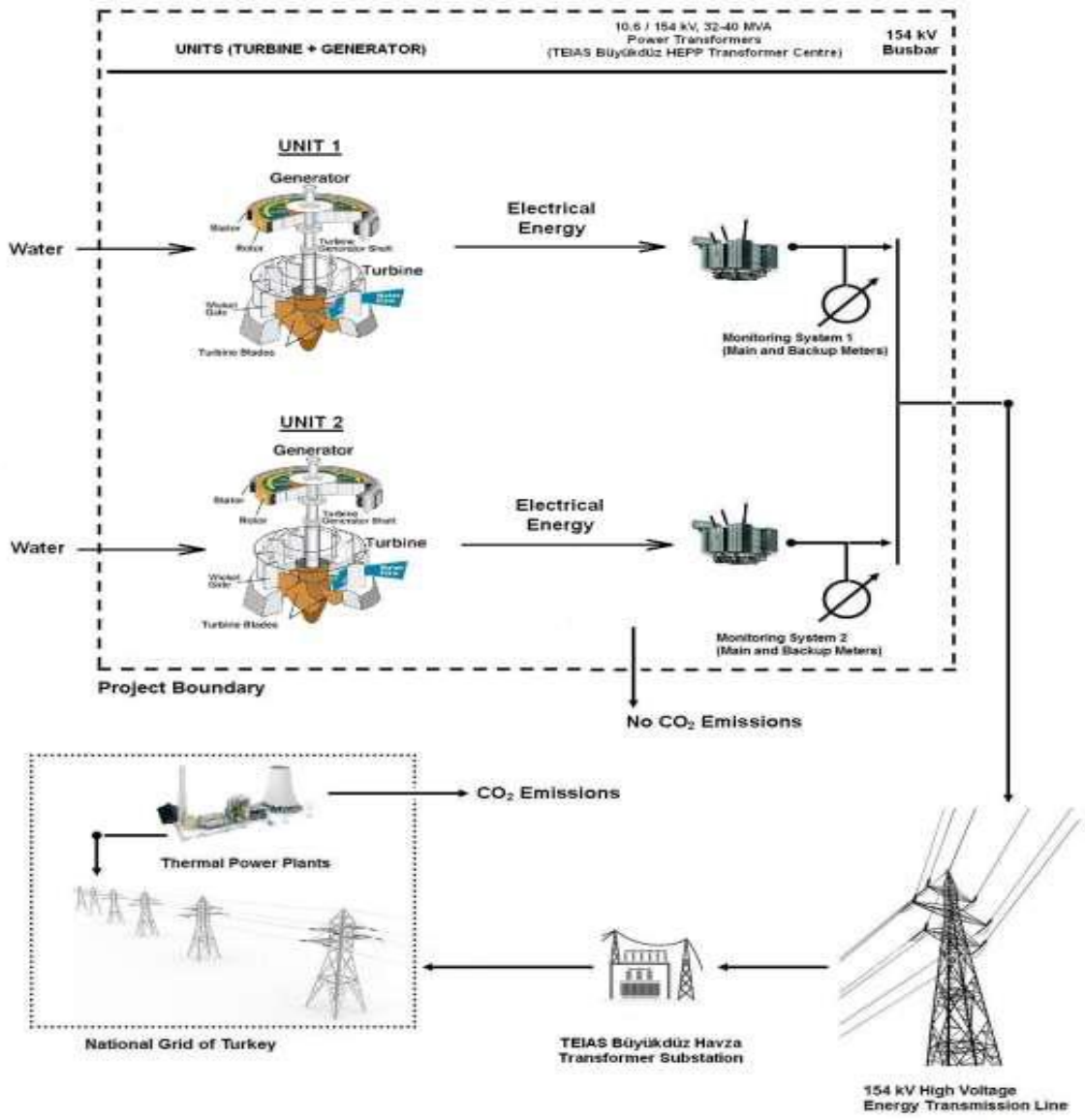

Figure 2 Project Boundary Diagram of Büyükdüz HPP

The greenhouse gases and emission sources included in or excluded from the project boundary are listed in the table below:

Table 4 The justification of the project boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Electricity generation mix of national	CO_2	Yes	Major GHG emission from the power plants in the fossil-fuel dominated national grid in the absence of the project activity is CO2. The amount of other gases and pollutants are very low compared to CO2. So, CO2 is included in the baseline emission calculation.

Source		Gas	Included?	Justification/Explanation
	grid displaced by project activity	CH_4	No	Although there may be CH4 or N2O emissions from the power plants in the grid during electricity generation in the absence of the project activity, these emissions would be very low and trivial as compared to CO2. As a result, CH4 or N2O emissions in the baseline emission calculations are neglected and assumed as zero.
		N_2O	No	
		Other	No	
Project	Electricity generation mix of national grid displaced by project activity	CO_2	No	Under normal conditions, no CO2, CH4 or N2O emissions will occur apart from normal domestic activities of the personnel like heating and cooking. And those emissions resulting from these domestic activities will be very low to be taken into account in the calculations. So, these are neglected and not included.
		CH_4	No	
		N_2O	No	
		Other	No	

3.4 Baseline Scenario

The methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (version 03.0.1) is adopted to assess the continued validity of the baseline and to update the baseline. This tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period, as required by paragraph 49 (a) of the modalities and procedures of the clean development mechanism. According to this tool, the following steps are applied.

Step 1: Assess the validity of the current baseline for the next crediting period

The validity of the current baseline is assessed using the following Sub-steps:

Sub Step 1.1 Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies.

The project baseline is the "Grid-connected electricity generation". It complies with the current legal framework. There are no additional laws that came into force that have an impact on the project activity and the project activity is still in line with the available law and regulations.

Sub Step 1.2 Assess the impact of circumstances.

The new national circumstances have an impact on the EF of the grid and thus on the project's current baseline emissions. Accordingly, the EF is updated for the second crediting period in conformity with the latest version of the publication of the Türkiye's National Electric Grid Emission Factor for the year 2020. There has been no major deviation or change in the market characteristic during the first crediting period.

Sub Step 1.3 Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

The technical lifetime of the equipment, (hydro turbines) are 150,000 hours. In order to determine operational lifetime of the HPP firstly capacity factor of the HPP should be calculated because HPP will not be in operation for whole year. By dividing annual generation (192,021 MWH) to the installed capacity (68.862 MW), the operation time in a year will be found which is 2,788.5 h/year. Since operation lifetime is related to the economic analysis, in the calculation of operational lifetime annual generation and installed capacity figures are taken from Generation License of the HPP. Finally dividing lifetime of the equipment (150,000 hours) to the operational time per year, lifetime of the equipment will be found in terms of year which is 53.7. Therefore operational lifetime exceeds the crediting period for which renewal is requested. Equipment only requires regular maintenance. The baseline scenario identified at the validation of the project activity was the continuation of grid-connected electricity generation. Under this scenario, no investment from the project's proponent or third party (or parties) has been envisioned later specifically for the project.

Sub Step 1.4 Assessment of validity of the data and parameters.

The emissions reduction calculations are based on two main parameters: the energy produced and the grid emission factor. The latter will be updated as explained in the next paragraph. As a requirement of the methodology, only the grid emission factor has been updated during the crediting period renewal.

Step 2: Update the current baseline and the data and parameters

Sub Step 2.1: Update the current baseline

As confirmed in Step 1, under the current context of the sectoral policies and circumstances, the project baseline for the next crediting period is the use of electricity from the national grid. This conforms to the provisions of the latest version of the approved applicable methodology. Therefore, there has been no deviation in the baseline scenario.

Sub Step 2.2: Update the data and parameters

The grid emission factor is updated according to the publication of Turkish Ministry of Energy and Natural Resources that is indicating Türkiye's National Electric Grid Emission Factor for the year of 2020.

Only parameter will be monitored for second crediting period is "$EGPJ$,fac$ility$,y" which is related to electricity production.

3.5 Additionality

In the implementation of the project the revenues from VER credits were taken into account before the electromechanical equipment order agreement and credit agreement. Investment

analysis that was made at the time indicated that the project was not financially feasible without the incentive coming from the VER revenues.

The energy sector in Turkey has been privatized and the installation of hydro power plants is under the initiative of private companies and legislation, law or regulatory framework in Turkey does not oblige hydro power plant installations. The private sector can only provide clean energy with the incentive carbon credits provide. Thus, the project activity is not mandated by any state or national laws. The project proponent is not bound by any legislative mandate to implement the project activity.

In the end there is no change in the additionality since it is a renewal of the crediting period.

3.6 Methodology Deviations

There has not been any deviation with respect to the project's methodology.

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

The Project started to generate and supply electricity to the Turkish national grid on 31/05/2012 and it continues operation without outside interruption. In the monitoring period there were no events that may impact the GHG emission reductions or removal and monitoring.

The 4 meters (2 main, 2 spare) that measure electricity generation are replaced with new meters and calibrated on 07/10/2020. This is in line with the monitoring plan and national requirements. National authority TEIAS decides when to carry out the next calibration. The Project owner has no control over or access to the measurement devices and is not entitled to perform any type of maintenance or calibration.

Table 5 Meter specifications

Name	Brand & Model	Serial Number	Accuracy Class	Protocol Date
New Main Meter 1	EMH & LZQJ-XC	10013671	P: C Q:1 S	07/10/2020 07/10/2022
New Back-up Meter 1	EMH & LZQJ-XC	10013672	P: C Q:1 S	07/10/2020 07/10/2022

Name	Brand & Model	Serial Number	Accuracy Class	Protocol Date
Old Main Meter 1	ELSTER & A1500	419678	0.5S	01/06/2012 19/12/2013 17/10/2014 26/11/2015 25/10/2016 11/10/2017 03/10/2018
Old Back-up Meter 1	ELSTER & A1500	419679	0.5S	01/06/2012 19/12/2013 17/10/2014 26/11/2015 25/10/2016 11/10/2017 03/10/2018
New Main Meter 2	EMH & LZQJ-XC	10013673	P: C Q:1 S	07/10/2020 07/10/2022
New Back-up Meter 2	EMH & LZQJ-XC	10013674	P: C Q:1 S	07/10/2020 07/10/2022
Old Main Meter 2	ELSTER & A1500	419680	0.5S	01/06/2012 19/12/2013 17/10/2014 26/11/2015 25/10/2016 11/10/2017 03/10/2018
Old Back-up Meter 2	ELSTER & A1500	419681	0.5S	01/06/2012 19/12/2013 17/10/2014 26/11/2015 25/10/2016 11/10/2017 03/10/2018

The following table provides an outline on the activities that took place within the Büyükdüz HEPP.

Table 6 Project Milestones

Activity	Date
Local Stakeholder and Public Participation Meeting	18/09/2007

Activity	Date
Positive Environmental Impact Assessment for Büyükdüz HEPP.	08/02/2008
Water Usage Agreement between General Directorate of State Hydraulic Works of Ministry of Forestry and Water Affairs and Ayen Enerji A.S. for Buyukduz HEPP	04/03/2008
Board Decision regarding Verified Emission Reductions	12/03/2008
Initial Issuance of the Generation Lincense	20/03/2008
The First Amendment in the Generation License. The subject of the amendment is the extension of construction and facility completion periods	18/09/2009
Construction activities commenced in the project site (Project Site Delivery to the Contractor Construction Company (Aydiner Insaat A.S.). Although the actual constructional works started later, this is the earliest date that can be documented as the construction beginning date. Hence, the date the start of constructional works has been accepted as this date).	01/11/2009
Turbine purchase and service agreement with turbine supplier (Alstom). This date is also the investment decision date, since the order of the electromechanical equipment, the main component of which are the Pelton turbines is the most important milestone for investment.	19/03/2010
Contract Agreement about the Supply of Electrical Equipment for the Power Plant (Control Systems and Control Cables, Auxiliary Equipment, AC/DC Supplies and Power Cables, 12 kV Medium Voltage, except HV switchyard and main transformers) for Büyükdüz Hydroelectric Power Plant made between the Supplier Company (ABB Austria) and the Project proponent.	07/04/2010

Activity	Date
Contract Agreement about the Supply of Electrical Equipment for the Power Plant (154 kV Switchyard and TEIAS Havza Substation) for Büyükdüz Hydroelectric Power Plant made between the Supplier Company (ABB Türkiye) and the Project Proponent.	13/04/2010
Contract for Supplying Power Transformers for Büyükdüz Hydroelectric Power Plant made Between the Supplier Company (ABB Türkiye) and the Project Proponent.	14/04/2010
Completion and Submission of Financial Feasibility Report to Creditor Bank (Turkiye Is Bankasi A.S.)	15/04/2010
Credit Agreement with Creditor Bank (Turkiye Is Bankasi A.S.)	12/08/2010
Connection Agreement made between the Project Proponent and TEIAS (Turkish Electricity Transmisson Company).	20/12/2010
Additional Water Usage Agreement between General Directorate of State Hydraulic Works of Ministry of Forestry and Water Affairs and Ayen Enerji A.S. for Buyukduz HEPP regarding some new regulations.	07/02/2011
The Second Amendment in the Generation Lincense. The subject of the amendment is the increase in the installed capacity and the predicted average annual generation amount.	04/08/2011
Additional Water Usage Agreement between General Directorate of State Hydraulic Works of Ministry of Forestry and Water Affairs and Ayen Enerji A.S. for Büyükdüz HEPP regarding the increase in the installed capacity and the predicted average annual generation amount.	08/09/2011
Validation agreement signed between the Project Proponent and the Validator DOE.	30/11/2011

Activity	Date
Positive Environmental Impact Assessment Decision about Büyükdüz HEPP regarding the increase in the installed capacity and the predicted average annual generation amount.	24/01/2012
The Third and the Last Amendment in the Generation Lincense. The subject of the amendment is the extension of construction and facility completion periods.	01/03/2012
Partial Commissioning of Büyükdüz Hydroelectric Power Plant. Beginning of Operation.	31/05/2012
Start date of first monitoring period	31/05/2012
Construction activities ended in the project site.	02/07/2012
Project Description Completed and the documents uploaded to the Registry.	06/05/2014
Validation Site Visit	20/05/2014
First Verification Site Visit	18/10/2017
End date of first monitoring period	31/10/2017
Start date of second monitoring period	01/11/2017
End date of first crediting period	30/05/2022
Start date of second crediting period	31/05/2022
Electricity Meter Change/Test Protocol	07/10/2020
End date of second monitoring period	31/12/2022
Second Validation/Verification Site Visit	17/02/2023
End date of second crediting period	30/05/2032

5 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

For the emission factors, that were used to calculate estimated emission reductions, publication of Turkish Ministry of Energy and Natural Resources, which is indicating Türkiye's National Electric Grid Emission Factor for the year of 2020 is used. Publication includes calculated Emission Factor values for Operating Margin (OM), Growth Based Margin (Build Margin-BM) and

Combined Margin (CM) for the relevant year using CDM's Clean Development Methodology Tool 07-V07.0. For this calculation, information regarding used data set is given below in detail:

- TEİAŞ Türkiye's electricity generation-consumption and loss statistics,
- Common prepared report under Türkiye's National Greenhouse Gas Inventory Reporting Format. - Common Reporting Format (CRF) tables for electricity generation (1.A.1.a.i) emission values
- Chronological order of power generation plants from TEİAŞ Load Dispatch Department with commissioning dates, plant names, fuel types, installed power values, electricity generation for the calculated year.
- Websites of Gold Standard (GS) and Verified Carbon Standard (VCS) are checked to determine the ownership status of the carbon reduction certificates,
- Power plant efficiency figures are taken from Clean Development Mechanism (CDM) Tool 009- V03.0.

Operating Margin-OM; 0.7424 tCO2/MWh[19]

Build Margin-BM; 0.3680 tCO2/MWh

Combined Margin-CM (other renewables); 0.4616 tCO2/MWh

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity, calculated as follows:

$BEy = EG_{PJ,y} \times EF_{grid,CM,y}$

Where:

BEy = Baseline emissions in year y (tCO_2e/yr).

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh).

$EF_{grid,CM,y}$ = Combined margin CO2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system". (tCO2e/MWh).

The project activity is the installation of a new grid-connected renewable power plant so, EGbaseline=0

If the project activity is the installation of a Greenfield power plant, then:

$EG_{PJ,y} = EG_{facility,y}$

[19] https://enerji.gov.tr//Media/Dizin/EVCED/tr/ÇevreVeİklim/İklimDeğişikliği/TUESEmisyonFktr/Belgeler/Bform2020.pdf

Where:

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr).

$EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)

Calculation of the Operating Margin Emission Factor

By using all of the data which were given above, Turkish Ministry of Energy and Natural Resources calculated EFgrid,OMsimple,y :

$$EF_{grid,OMsimple,y} = 0.7424\ tCO_2/MWh$$

Calculation of the Build Margin Emission Factor

For BM factor calculation, Chronological order of power generation plants from TEİAŞ Load Dispatch Department with commissioning dates, plant names, fuel types, installed power values, electricity generation for the calculated year were used as input data. Consequently, Turkish Ministry of Energy and Natural Resources calculated EFgrid,BM,y.

$$EF_{grid,OMsimple,y} = 0.3680\ tCO_2/MWh$$

Calculating of the Combined Margin Emission Factor

Emission factor calculations have been corrected with the relevant weighted calculations as stipulated by the methodology for the second crediting period. According to "Tool to calculate the emission factor for an electricity system" (Version 07), Article 86 clause (b), calculation of the combined margin for renewable energy projects (except wind and solar) second crediting period, the following values need to be used for wOM and wBM. "All other projects [...] wOM = 0.25 and wBM = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool."

The data used to calculate the combined margin were published by Türkiye's Energy and Natural Resources Ministry in September 2022. The data -which includes build margin and operating margin factors - have been obtained from the ministry's most recent factsheet. This document contains the latest available data in the country and is issued by the highest authority to make such calculations and determine the factors.

$$EFgrid,CM,y= 0.25*0.7424 + 0.75*0.3680 = 0.4616\ tCO2/MWh$$

Then:

$ERy = BEy - PEy = EG_{facility,y} * EF_{grid,CM,y}$ = 192,021 MWh/year * 0.4616 tCO2/MWh = 88,708 tCO_2e/year

Baseline scenario is identified and described in this section. Emission reductions due to project activity is calculated according to "Tool to calculate the emission factor for an electricity system" (Tool 07) version 07.0.

A brief explanation of this methodology is given in Tool as:

This methodological tool determines the CO2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the "combined margin" emission factor (CM) of the electricity system.

5.2 Project Emissions

The proposed project activity involves the generation of electricity by development of a hydro power plant. Büyükdüz HPP has 80,766 m2 reservoir area and 68,862,000 W capacity. Its density is calculated as 852.61 W/m2 which is above 10 W/m2 threshold. The generation of electricity does not result in greenhouse gas emissions and therefore is taken as 0 tCO2e/year.

5.3 Leakage

No Leakage emissions are considered. The main emission potentially giving rise to leakage in the context of electrical sector projects is emission arising due to activities arising such as power plant construction and upstream emission from fossil fuel use (e.g. extraction, processing, and transport). These emission sources are neglected.

Then: $ER_y = BE_y$

5.4 Estimated Net GHG Emission Reductions and Removals

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
31-May-2022 – 31-December-2022	52,210	0	0	52,210
Year 2023	88,636	0	0	88,636
Year 2024	88,879	0	0	88,879
Year 2025	88,636	0	0	88,636

Year 2026	88,636	0	0	88,636
Year 2027	88,636	0	0	88,636
Year 2028	88,879	0	0	88,879
Year 2029	88,636	0	0	88,636
Year 2030	88,636	0	0	88,636
Year 2031	88,636	0	0	88,636
01-January-2032 – 30-May-2032	36,669	0	0	36,669
Total	887,088	0	0	887,088

6 MONITORING

6.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2/MWh
Description	For the emission BM factor, that were used to calculate estimated emission reductions, publication of Turkish Ministry of Energy and Natural Resources which is indicating Türkiye's National Electric Grid Emission Factor for the year of 2020 was used. Publication includes calculated Emission Factor values that are Operating Margin (OM), Growth Based Margin (Build Margin-BM) and Combined Margin (CM) Emission Factors, for the relevant year with usage of the CDM's Clean Development Methodology Tool 07-V07.0.
Source of data	Please see: https://enerji.gov.tr//Media/Dizin/EVCED/tr/ÇevreVeİklim/İklimDeğişikliği/TUESEmisyonFktr/Belgeler/Bform2020.pdf

Value applied:	0.3680
Justification of choice of data or description of measurement methods and procedures applied	The Ministry of Energy and Natural Resources makes available the official data in Türkiye. The latest data available during this document preparation was for 2020. Please see section 5.1 for details.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2/MWh
Description	For the combined margin CO_2 emission factor that were used to calculate estimated emission reductions, publication of Turkish Ministry of Energy and Natural Resources which is indicating Türkiye's National Electric Grid Emission Factor for the year of 2020 was used.
Source of data	Please see: https://enerji.gov.tr//Media/Dizin/EVCED/tr/ÇevreVeİklim/İklimDeğişikliği/TUESEmisyonFktr/Belgeler/Bform2020.pdf
Value applied:	0.7424
Justification of choice of data or description of measurement methods and procedures applied	The baseline emissions are the product of electrical energy baseline expressed in MWh of electricity produced by the renewable generating unit multiplied by an emission factor. Please see section 5.1 for details.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh

Description	For the combined margin CO_2 emission factor that were used to calculate estimated emission reductions, publication of Turkish Ministry of Energy and Natural Resources which is indicating Türkiye's National Electric Grid Emission Factor for the year of 2020 was used.
Source of data	Please see: https://enerji.gov.tr//Media/Dizin/EVCED/tr/ÇevreVeİklim/İklimDeğişikliği/TUESEmisyonFktr/Belgeler/Bform2020.pdf
Value applied:	0.4616
Justification of choice of data or description of measurement methods and procedures applied	The baseline emissions are the product of electrical energy baseline expressed in MWh of electricity produced by the renewable generating unit multiplied by an emission factor. Please see section 5.1 for details.
Purpose of Data	Calculation of baseline emissions
Comments	The value 0.4616 tCO_2/MWh will be used for the second crediting period).

6.2 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$
Data unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	The data from the Electricity Meters are the basis for the settlement notification of EPIAS. Data are gathered electronically from the meters by TEIAS and stored in secured website of EPIAS, which is accessible to project developer with a private password. For monitoring, the monthly settlement notification of EPIAS shall be used as source of data.
Description of measurement methods and procedures applied	Regarding the electricity meters: two meters are placed (one main and one reserve) at the TEIAS substation. These meters are sealed by TEIAS and intervention by project proponent is not possible. The fact that two meters are installed in a redundant manner keeps the uncertainty level of the only parameter for baseline calculation

<table>
<tr><td></td><td>low. High data quality of this parameter is in the interest of not only the emission reduction monitoring, but also paramount for the business relation between the plant operator and the electricity buyers.</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Continuous monitoring, hourly measurement, and at least monthly recording</td></tr>
<tr><td>Value applied:</td><td>192,021 MWh/year</td></tr>
<tr><td>Monitoring equipment</td><td>Calibration frequency: According to the Article 9 of the relevant regulation, periodical inspections of “gauges for electric, water, coal gas, natural gas and, current and voltage measuring transformers will be made once in 10 years”. This is in line with the monitoring plan and national requirements. TEIAS will decide when to carry out the next calibration. The Project owner has no control over or access to the measurement devices and is not entitled to perform any type of maintenance or calibration.

The specification of the previous meters is provided below:
<table>
<tr><th>Name</th><th>Serial Number</th><th>Brand - Model</th><th>Accuracy Class</th></tr>
<tr><td>Old Main Meter 1</td><td>419678</td><td>ELSTER & A1500</td><td>0,5 S</td></tr>
<tr><td>Old Back-up meter 1</td><td>419679</td><td>ELSTER & A1500</td><td>0,5 S</td></tr>
<tr><td>Old Main Meter 2</td><td>419680</td><td>ELSTER & A1500</td><td>0,5 S</td></tr>
<tr><td>Old Back-up meter 2</td><td>419681</td><td>ELSTER & A1500</td><td>0,5 S</td></tr>
</table>
On 07.10.2020, the meters have been changed in line with the Article 9 of the 'Regulation of Metering and Testing of Metering Systems'[20]. Changing protocol has been provided.

The specification of new meters is provided below:
<table>
<tr><th>Name</th><th>Serial Number</th><th>Brand - Model</th><th>Accuracy Class</th></tr>
</table></td></tr>
</table>

[20] Please see, http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.6381&MevzuatIliski=0&sourceXmlSearch=

	<table><tr><td>Main Meter 1</td><td>10013671</td><td>EMH & LZQJ-XC</td><td>P: C Q:1 S</td></tr><tr><td>Back-up meter 1</td><td>10013672</td><td>EMH & LZQJ-XC</td><td>P: C Q:1 S</td></tr><tr><td>Main Meter 2</td><td>10013673</td><td>EMH & LZQJ-XC</td><td>P: C Q:1 S</td></tr><tr><td>Back-up meter 2</td><td>10013674</td><td>EMH & LZQJ-XC</td><td>P: C Q:1 S</td></tr></table>
QA/QC procedures applied	According to the Article 2 of the 'Communiqué Regarding the Meters to be used in the Electricity Market '[21] (Communiqué): '*The meters to be used in the electricity market shall be compliant with the standards of Turkish Standards Institute or IEC and have obtained* ***"Type and System Approval" certificate from the Ministry of Trade and Industry.'*** Therefore, Ministry of Trade and Industry (Ministry) is responsible from control and calibration of the meters. Paragraph b) of the Article 9 of the 'Regulation of Metering and Testing of Metering Systems'[22] (Regulation) of Ministry states that: ' *b) Periodic tests of meters of electricity, water, coal gas, natural gas and current and voltage transformers are done* ***every 10 years****.'* Therefore, periodic calibration of the meters will be done every 10 years. Also, according to Article 67 (page 20) of this regulation, the calibration shall be done in calibration stations which have been tested and approved by Ministry of Trade and Industry. Article 10-d) of Communiqué requires the meters shall be three-phase four wire and Article 64 of Regulation clearly states how calibration shall be performed for this kind of meters. As above mentioned, the data acquisition and management and quality assurance procedures that are anyway in place, no additional procedures have to be established for the monitoring plan. EPİAŞ data is used as a main source, and cross-check is done by using the TEİAŞ receipts.
Purpose of data	To exhibit renewable electricity generation performance the plant.
Calculation method	Regarding the electricity meters: two meters are placed (one main and one reserve) at the Büyükdüz HPP which meters the electricity transferred to TEİAŞ substation. These meters are sealed by TEIAS

[21] Please see, https://www.epdk.gov.tr/Detay/DownloadDocument?id=+6B2PMv4N4A=

[22] Please see, http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.6381&MevzuatIliski=0&sourceXmlSearch=

	and intervention by project proponent is not possible. The fact that two meters are installed in a redundant manner keeps the uncertainty level of the only parameter for baseline calculation low. High data quality of this parameter is not only in the interest of the emission reduction monitoring, but paramount for the business relation between the plant operator and the electricity buyers. Measured hourly and readings monthly. Monthly settlement notifications of EPİAŞ consist of hourly electricity production and withdrawal from the grid. Since the meters are reading electricity supplied to the system and withdrawn from the system separately, the net electricity amount supplied to the grid is calculated by electricity supplied minus electricity withdrawn which is taken from monthly settlement notifications. Thus, with this procedure is monitored sufficient and no extra Monitoring has to be implemented.
Comments	-

6.3 Monitoring Plan

Monitoring will be done according to the methodology "ACM0002: Grid-connected electricity generation from renewable sources --- Version 21.0.0". As per the methodology, all data collected as part of monitoring has been archived electronically and kept at least for two years after the end of the last crediting period. All measurements have been conducted with calibrated measurement equipment according to relevant industry standards.

The only relevant data that has to be monitored is the net electricity generation ($EG_{facility,y}$) per year, There is no sampling procedures and all the data related with the electricity measurements will be used for monitoring purposes.

At the end of each month, the data about the electricity measurements from EPİAŞ has been collected from the official web site after it has become definite. This data will be copied to spreadsheets to make the calculations easier. The web pages containing the relevant data will be saved as screenshots and/or in suitable file formats and be kept for future reference. The monthly electricity meter reading protocols signed by authorized TEIAS officials are kept. This procedure also applied monthly.

The collected data will be kept by Ayen Enerji during the crediting period and until two years after the last issuance of VERs for the Büyükdüz HEPP activity for that crediting period. Given a data vintage based on ex ante monitoring and selection of a renewable 7-year crediting period, the Combined Margin will be recalculated at any renewal of the crediting period using the valid baseline methodology.

Potential leakage emissions in the context of power sector projects are emissions arising due to activities such as power plant construction, fuel handling and land inundation. However, according to the methodology, those emis sion sources are treated as negligible.

Moreover, there are always internal reviews of the meters data that is checked by different parties. First, data of the meters is collected by technicians daily in written forms. The data collected daily is saved on the plant manager's computer and backed up. Besides the data that can be taken from meters, production amount can be checked from the SCADA system. SCADA figures differ a bit from meter data due to internal losses.

The single line diagram of the power plant is provided in the following figure.

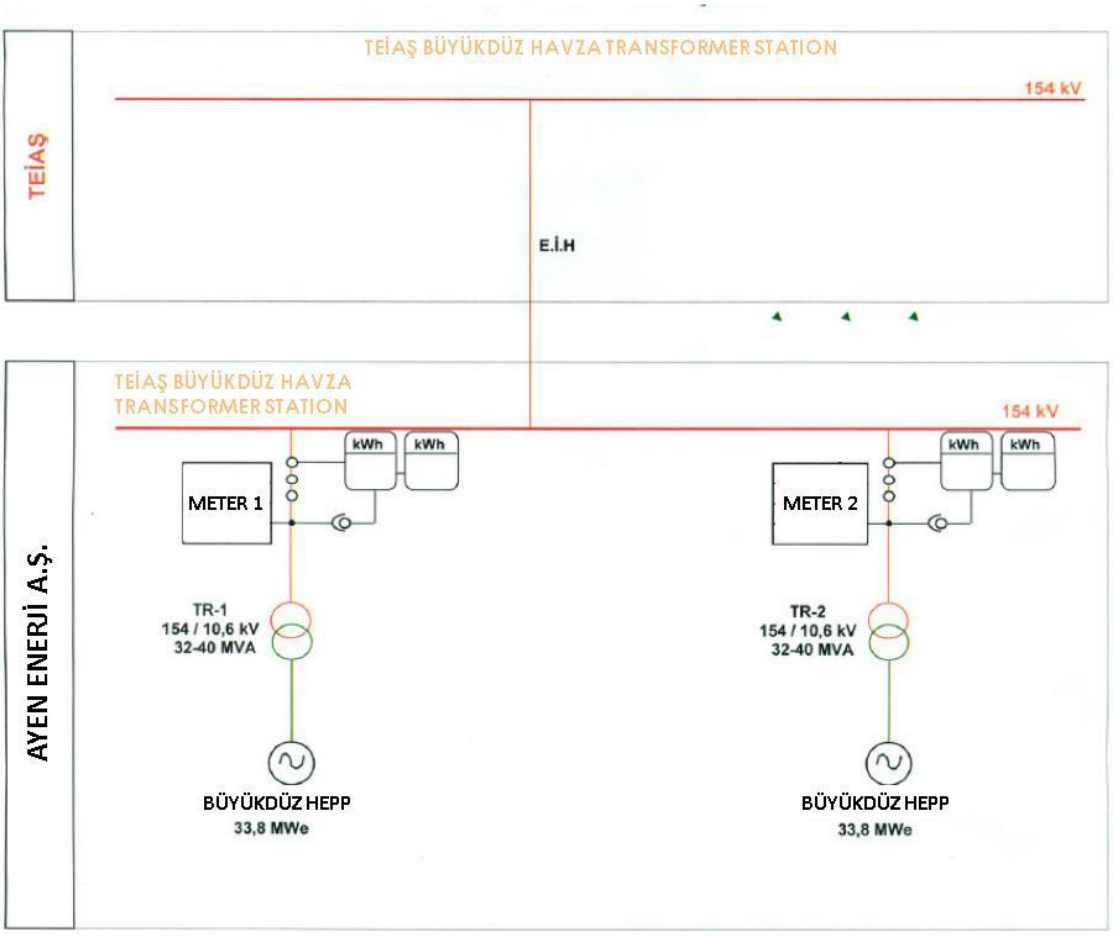

Figure 3 Single Line Diagram of Büyükdüz HEPP

As described before, there are two main factors important for the calculation of emission reductions. The only relevant data that have to be monitored is only net electricity generation (EGfacility,y) per year. Since project emission is zero no additional monitoring is required. The generation data is subject to the strict internal quality control systems of both parties. The monthly meter reading documents are stored by Büyükdüz HEPP and TEİAŞ. The settlement notification, which is issued by TEİAŞ and includes the meter reading data, is stored on a TEİAŞ

file server and accessible for Büyükdüz via a secured website. The meters themselves can always be read as plausibility check for verification. The other important parameter is the emission factor. It is approved according to strict quality control parameters from an independent external party. With this, no additional structures or processes have to be implemented to insure the availability and high quality of the necessary data for monitoring.

At the end of each monitoring period, from the monthly meter reading records the net electricity generation amounts as calculated by electricity supplied to the grid minus withdrawn from the system is added up to the yearly net electricity generation and total project emissions is subtracted from this amount and result data is multiplied with the combined margin emission factor with the help of an excel spread sheet that also contains the combined margin calculation. Thus, the complete baseline approach is always transparent and traceable. For the elaboration and quality assurance of the monitoring report, Life Enerji, an expert in the project mechanisms who already supported in the project design, is assigned. However, in order to continue improving the monitoring procedures and therefore also the future monitoring reports, internal quality check shall be fulfilled by Life Enerji. The monitoring reports are checked and in cases of mistakes and inconsistencies in the monitoring report, revisions with improvements shall be done. Furthermore, external year verification assures that the emission reductions calculations are transparent and traceable.

There are 24 employees within Büyükdüz HEPP covering this monitoring period. 12 of them are responsible for conducting maintenance and operations tasks. Also, 5 workers have been assigned for security and 4 workers for service tasks. All these workers from the maintenance & operation, security and service departments are reporting to two administrative employees. The simplified organizational structure is provided in the following figure.

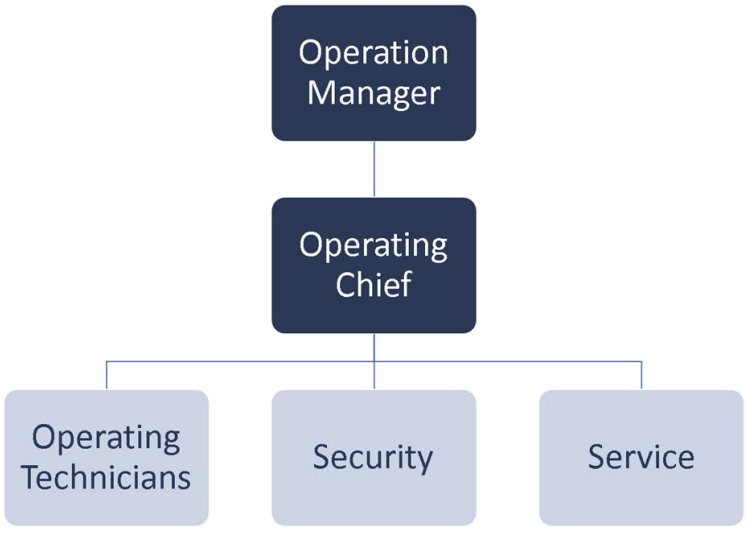

Figure 4. The Operational Flow of Büyükdüz HEPP

Employee	Department
KORKUT İSKENDER	Manager

Employee	Department
SİNAN GÜMRÜKÇÜ	Manager
TAYFUR İBİŞOĞLU	Maintenance & Operation
AYHAN (TAYFUN) GÜMRÜKÇÜ	Maintenance & Operation
HASAN İSKENDER	Service
OZAN ÖZDEMİR	Maintenance & Operation
HAKAN KOCA	Maintenance & Operation
EMİR KAHVECİ	Maintenance & Operation
AYHAN GÜMRÜKÇÜ	Maintenance & Operation
ÇETİN YILMAZ	Maintenance & Operation
İSMAİL SARI	Maintenance & Operation
SÜLEYMAN İSKENDER	Maintenance & Operation
ZEYDİ VURAL	Service
ZAFER ÖZEN	Service
SERDAR COŞKUN	Maintenance & Operation
SONER GÜMRÜKÇÜ	Maintenance & Operation
TUNCER NARİN	Maintenance & Operation
CEMİL ATALAY	Service
HALİL OLGUN	Security
ÖZCAN BAYRAM	Security
YAVUZ BAHADIR	Security
ALİ KARAKAŞ	Security
SONER ARAZ	Security

Büyükdüz HEPP keeps all the data needed for the calculation of emission reductions during the crediting period and until two years after the last issuance of GS VERs for Büyükdüz HEPP.

Because of the data acquisition and management and quality assurance procedures that are anyway in place, no additional procedures have to be established for the monitoring plan. Dedicated emergency procedures are not provided, as there is no possibility of overstating emission reductions due to emergency cases.

7 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y

Value applied:

684,086.98 (for this monitoring period)

Vintage		Electricity supplied to the grid (MWh)	Electricity consumption from the grid (MWh)	Net electricity supplied to the grid (MWh)
01/11/2017	31/12/2017	6,385.84	110.75	6,275.08
01/01/2018	31/12/2018	168,866.32	358.75	168,507.57
01/01/2019	31/12/2019	136,300.59	455.89	135,844.71
01/01/2020	31/12/2020	123,780.73	459.54	123,321.19
01/01/2021	31/12/2021	105,766.75	488.07	105,278.69
01/01/2022	31/12/2022	145,290.31	430.57	144,859.74
Total		**686,390.55**	**2,303.57**	**684,086.98**

Comments

The specification of the previous meters is provided below:

Name	Serial Number	Brand - Model	Accuracy Class
Old Main Meter 1	419678	ELSTER & A1500	0,5 S
Old Back-up meter 1	419679	ELSTER & A1500	0,5 S
Old Main Meter 2	419680	ELSTER & A1500	0,5 S
Old Back-up meter 2	419681	ELSTER & A1500	0,5 S

First protocol & calibration date is 01/06/2012 for previous meters.

On 07.10.2020, the meters have been changed in line with the Article 9 of the 'Regulation of Metering and Testing of Metering

Systems'[23]. Changing protocol has been provided. The protocol dates of the all meters have been provided on Table 5 Meter specifications.

First protocol & calibration date is 07.10.2020 for new meters.

The specification of new meters is provided below:

Name	Serial Number	Brand - Model	Accuracy Class
Main Meter 1	10013671	EMH & LZQJ-XC	P: C Q:1 S
Back-up meter 1	10013672	EMH & LZQJ-XC	P: C Q:1 S
Main Meter 2	10013673	EMH & LZQJ-XC	P: C Q:1 S
Back-up meter 2	10013674	EMH & LZQJ-XC	P: C Q:1 S

Paragraph b) of the Article 9 of the 'Regulation of Metering and Testing of Metering Systems' (Regulation) of Ministry states that: ' b) Periodic tests of meters of electricity, water, coal gas, natural gas and current and voltage transformers are done every 10 years.' Therefore, periodic calibration of the meters will be done every 10 years. The Project owner has no control over or access to the measurement devices and is not entitled to perform any type of maintenance or calibration.

7.2 Baseline Emissions

The baseline scenario is identified according to the "Baseline Methodology Procedure" of ACM0002 Version 21. Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants.

The emission reduction is equal to the baseline emissions minus project emissions and leakage emissions. Leakage emissions in this project are negligible. There are no project emissions in this kind of project. Thus, the baseline emissions are to be calculated via the following formulae:

[23] Please see, http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.6381&MevzuatIliski=0&sourceXmlSearch=

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \quad (1)$$

Where:

BE_y = Baseline emissions in year y (tCO_2e/yr).

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity of the CDM project activity in year y (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y and validated value = 0.4616 tCO_2/MWh.

Because the Project is a greenfield renewable energy power plant.

$$EG_{PJ,y} = EG_{facility,y}$$

$$ER_y = BE_y - PE_y \quad (2)$$

Where:

ER_y : Emission reductions in year y (tCO_2e/yr).

BE_y : Baseline emissions in year y (tCO_2e/yr).

PE_y : Project emissions in year y (tCO_2e/yr); validated value = 0.

$BEy = EG_{facility,y} * EF_{grid,CM,y}$ = 629,669.36 MWh * 0.535 tCO_2/MWh[24] = 336,841 tCO_2e (Round-downed)

$BEy = EG_{facility,y} * EF_{grid,CM,y}$ = 54,417.62 MWh * 0.4616 tCO_2/MWh[25] = 25,116 tCO_2e (Round-downed)

Total BE_y = 336,841tCO_2e + 25,116 tCO_2e = 361,957 tCO_2e

7.3 Project Emissions

The project activity involves no emissions, except emissions from a diesel generator used for emergency backup purposes. The possible emissions from the use of fossil fuels for the back up or emergency purposes by the operation of this diesel generator are neglected according to the methodology.

The power density (PD) for the Büyükdüz HEPP is calculated according to the directions given in the methodology:

[24] EF for the 1st crediting period is taken from the PDD.

[25] EF is calculated for the 2nd Crediting period.

$$PD(W/m^2) = \frac{Installed\ Capacity}{Reservoir\ Surface\ Area}$$

$$PD\ (W/m^2) = \frac{68{,}862{,}000}{80{,}766}$$

Installed capacity and the surface area of the Project remains the same and project's power density did not change. There are no project emissions in this project. Büyükdüz HPP has 80,766 m^2 reservoir area and 68,862,000 W capacity. Its density is calculated as 852.6 W/m_2 which is above 10 W/m_2 threshold.

7.4 Leakage

Leakage emissions are neglected and assumed as zero as per the Methodology.

7.5 Net GHG Emission Reductions and Removals

Emission reductions are calculated as per ACM0002.

$ERy = BEy - PEy$ Equation (17)

Where:

ERy: Emission reductions in year y (tCO_2e/yr).

BEy: Baseline emissions in year y (tCO_2e/yr).

PEy: Project emissions in year y (tCO_2e /yr); validated value = 0.

BEy = EGfacility,y * EFgrid,CM,y

With actual project electricity generation data provided in the Appendix 1 of this report, and EFgrid,CM,y (during first crediting period it was calculated and fixed as 0.535 tCO_2/MWh and for this monitoring period it is calculated as 0.4616 tCO_2/MWh), net GHG emission reductions/removals are provided in the following table.

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
(01-November-2017 - 31-1December-2017)	3,356	0	0	3,356

Year 2018	90,144	0	0	90,144
Year 2019	72,669	0	0	72,669
Year 2020	65,970	0	0	65,970
Year 2021	56,318	0	0	56,318
(01-January-2022 - 30-May-2022)	48,384	0	0	48,384
Total	**336,841**	**0**	**0**	**336,841**

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
(31-May-2022 - 31-December-2022) (2nd CP)	25,116	0	0	25,116
Total	**25,116**	**0**	**0**	**25,116**

Actual emissions reductions /removals	Estimated emissions reductions /removals	Percent difference	Justification for the difference
361,957 tC02e	522,804 tC02e	-30.77%	External physical conditions, i.e. the precipitation amount, the flow rate…

The Project is a run-of-river HPP, the electricity amount supplied to the grid depends on external physical conditions, i.e. the flow rate. That is why, actual emission reduction amounts are 30.77% lower than the estimated amount since electricity generated is also lower than the estimated amount of electricity. As a result, the actual emission reductions are less than the estimated emission reduction amount. The difference is due to change in plant load factor and the same is dependent on water availability. Thus it is not under control of PP and no changes in project design.

APPENDIX 1: MONTHLY ELECTRICITY GENERATION DATA

Months	Electricity supplied to the grid (MWh) (A1) Meter1	Electricity drawn from the grid (MWh) (B1) Meter1	Electricity supplied to the grid (MWh) (A2) Meter2 Group	Electricity drawn from the grid (MWh) (B2) Meter2	Net electricity supplied to the grid[MWh] (C)=(A1+A2)-(B1+B2)
Nov.17	0.00	13.09	1,426.78	41.39	1,372.30
Dec.17	1,004.25	16.90	3,954.81	39.38	4,902.78
Sum 2017	1,004.25	29.98	5,381.59	80.77	6,275.08
Jan.18	168.91	13.43	2,525.29	49.21	2,631.56
Feb.18	156.83	14.88	4,136.19	34.12	4,244.02
Mar.18	13,731.23	7.62	5,653.19	8.48	19,368.32
Apr.18	14,842.05	0.87	10,528.94	3.93	25,366.18
May.18	24,395.36	0.15	24,159.64	0.07	48,554.78
Jun.18	18,503.34	0.12	18,323.86	0.28	36,826.79
Jul.18	6,074.54	12.03	4,221.90	11.80	10,272.60
Aug.18	645.18	15.29	1,891.83	25.22	2,496.50
Sep.18	0.00	14.29	1,446.15	28.90	1,402.97
Oct.18	1,427.85	12.73	3,876.11	24.99	5,266.24
Nov.18	4,002.87	23.92	1,108.37	16.89	5,070.42
Dec.18	6,155.25	25.25	891.47	14.27	7,007.19
Sum 2018	90,103.40	140.59	78,762.92	218.16	168,507.57

Months	Electricity supplied to the grid (MWh) (A1) Meter1	Electricity drawn from the grid (MWh) (B1) Meter1	Electricity supplied to the grid (MWh) (A2) Meter2 Group	Electricity drawn from the grid (MWh) (B2) Meter2	Net electricity supplied to the grid[MWh] (C)=(A1+A2)-(B1+B2)
Jan.19	4,065.75	33.56	1,015.41	21.90	5,025.71
Feb.19	3,514.40	38.67	251.04	15.98	3,710.79
Mar.19	1,692.33	17.29	5,680.49	27.19	7,328.34
Apr.19	10,752.79	4.60	12,773.81	8.22	23,513.78
May.19	24,745.50	1.10	24,161.84	0.38	48,905.86
Jun.19	16,779.68	0.02	17,226.03	0.30	34,005.39
Jul.19	2,021.83	12.44	6,691.40	18.22	8,682.57
Aug.19	87.80	13.86	1,859.41	28.73	1,904.63
Sep.19	66.36	14.42	974.04	26.25	999.73
Oct.19	288.33	23.43	316.66	23.19	558.38
Nov.19	90.96	13.29	612.40	44.85	645.21
Dec.19	0.00	13.91	632.35	54.10	564.33
Sum 2019	64,105.73	186.59	72,194.86	269.30	135,844.71
Jan.20	0.00	14.02	298.95	58.91	226.03
Feb.20	1,454.52	30.55	481.40	30.09	1,875.29
Mar.20	6,224.43	16.78	7,331.76	10.61	13,528.80
Apr.20	8,898.93	5.38	12,007.25	6.85	20,893.95
May.20	23,571.25	0.12	24,182.69	0.15	47,753.67
Jun.20	13,136.54	2.92	14,591.87	2.24	27,723.25

Months	Electricity supplied to the grid (MWh) (A1) Meter1	Electricity drawn from the grid (MWh) (B1) Meter1	Electricity supplied to the grid (MWh) (A2) Meter2 Group	Electricity drawn from the grid (MWh) (B2) Meter2	Net electricity supplied to the grid[MWh] (C)=(A1+A2)-(B1+B2)
Jul.20	6,892.05	13.74	312.23	13.32	7,177.22
Aug.20	2,184.73	27.28	0.00	13.73	2,143.73
Sep.20	641.08	30.64	0.00	13.19	597.26
Oct.20	286.08	34.02	0.00	13.38	238.68
Nov.20	1,131.18	37.70	0.00	12.95	1,080.53
Dec.20	153.80	58.10	0.00	12.91	82.80
Sum 2020	64,574.59	271.24	59,206.14	188.31	123,321.19
Jan.21	502.07	59.70	0.00	13.72	428.65
Feb.21	66.89	20.72	924.25	40.89	929.53
Mar.21	4,020.32	41.77	1,439.18	12.21	5,405.52
Apr.21	15,975.24	6.53	13,434.10	4.70	29,398.12
May.21	17,225.91	0.43	17,808.81	1.61	35,032.68
Jun.21	10,680.70	8.89	1,394.08	12.04	12,053.86
Jul.21	4,036.77	23.52	205.25	13.36	4,205.14
Aug.21	1,428.58	22.73	543.44	18.40	1,930.89
Sep.21	143.80	12.81	1,523.26	28.99	1,625.26
Oct.21	880.79	12.56	4,857.04	26.12	5,699.15
Nov.21	113.73	13.04	4,068.58	35.87	4,133.40
Dec.21	2,228.85	31.60	2,265.08	25.85	4,436.48

Months	Electricity supplied to the grid (MWh) (A1) Meter1	Electricity drawn from the grid (MWh) (B1) Meter1	Electricity supplied to the grid (MWh) (A2) Meter2 Group	Electricity drawn from the grid (MWh) (B2) Meter2	Net electricity supplied to the grid[MWh] (C)=(A1+A2)-(B1+B2)
Sum 2021	57,303.66	254.31	48,463.09	233.76	105,278.69
Jan.22	2,411.36	53.04	32.06	13.71	2,376.67
Feb.22	3,290.98	34.05	0.00	12.393	3,244.54
Mar.22	3,443.99	26.77	1,886.38	14.885	5,288.72
Apr.22	19,498.06	1.02	21,082.88	1.506	40,578.42
May.22	18,259.55	0.88	20,696.51	1.410	38,953.77
Jun.22	16,054.38	2.53	21,130.00	0.216	37,181.63
Jul.22	626.68	13.16	9,113.12	9.698	9,716.93
Aug.22	1,116.84	21.07	1,358.67	18.947	2,435.50
Sep.22	567.41	20.68	609.61	21.489	1,134.85
Oct.22	69.28	13.71	1,651.73	32.554	1,674.75
Nov.22	4.35	13.20	1,369.00	36.819	1,323.33
Dec.22	922.26	50.78	95.22	16.063	950.64
Sum 2022	71,333.74	250.88	73,949.57	179.69	144,859.74
Total Sum	*343,356.76*	*1,133.58*	*343,033.79*	*1,169.98*	684,086.98