FEDERAL STATE BUDGETARY EDUCATIONAL INSTITUTION OF HIGHER EDUCATION
STAVROPOL STATE AGRARIAN UNIVERSITY

APPROVED
Acting Rector, Professor
STAVROPOL STATE AGRARIAN UNIVERSITY
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(signature)
" ____ " _______________2022.

GREENHOUSE GAS EMISSION ASSESSMENT AND GREENHOUSE GAS EMISSION REDUCTION PROGRAM OF STAVROPOL SAU

Stavropol, 2022

1. GENERAL INFORMATION ON THE NATURAL USER

The Federal State Educational Institution of Higher Professional Education "Stavropol State Agrarian University" - the leading Russian center of education, science and culture, carrying out educational, research and consulting and methodological activities - is a state educational institution of federal jurisdiction. Founder - Ministry of Agriculture of the Russian Federation.

Table 1.1 – General information on Stavropol State Agrarian University

1	Name of business entity (full)	Federal State Educational Institution of Higher Education Stavropol State Agrarian University
2	Business entity name (short)	FBEI HE Stavropol State Agrarian University
3	TIN	2634003069
4	CCID	263401004
5	PSRN	1022601993468
6	RNNBO	00493221
7	ACTA	92110
8	RNCMT	07701000001
9	RNCTEA	80.30.1
10	Legal address	355017, Stavropol, Zootekhnichesky lane, 12
11	Postal address	355017, Stavropol, Zootekhnichesky lane, 12
12	Phone/fax	(8652) 715-815

The main activity is training in educational institutions of higher professional education (universities, academies, institutes, etc.).

The structure of the University includes: 9 faculties, 40 departments, educational laboratories and research centers, a scientific library, a sports and recreation complex; equestrian school; greenhouses; vivarium; canteen; 5 dormitories, educational and experimental station; garage, administrative divisions.

2. CHARACTERISTICS OF THE UNIVERSITY FROM THE POINT OF VIEW OF IMPACT ON ATMOSPHERIC AIR

Federal State Budgetary Educational Institution of Higher Education Stavropol State Agrarian University in three separate territories (production sites):

- Site No. 1 - The main building of the University with the territory of the Faculty of Agrobiology and Land Resources and auxiliary departments (Stavropol, Zootekhnichesky lane, block 112; Stavropol, Mira street, 302; 304/1; 306; 308)
- Site No. 2 – Territory of veterinary clinics (Stavropol, Serov st., 523);
- Site No. 3 – Training and Experimental Station (Shpakovsky district, Demino village, Komsomolskaya st., 1);
- Site No. 4 - Dormitory (SNIISH) (Shpakovsky district, Mikhailovsk, SNIISH, Nikonova st.).

Stavropol State Agrarian University belongs to the non-production sphere; however, because of the implementation of the main and auxiliary activities, pollutants may be released into the air.

In the course of the inventory of sources of pollutant emissions, it was revealed that the main technological processes - sources of emissions of harmful substances include: the activities of educational and scientific laboratories and centers, the maintenance of animals; work of vehicles, canteen; printing houses.

Stationary sources of pollutant emissions were identified at all production sites.

The main building, educational and laboratory buildings of 7 faculties, a sports and recreation complex are located **on the territory of the production site No. 1**; educational and scientific testing laboratory; canteen; 4 dorms, garage; department of current and major repairs of buildings and structures; administrative and auxiliary premises; green areas.

Table 2.1 shows the characteristics of the process equipment, which is the source of pollutant emissions at site No. 1.

Table 2.1 –Characteristics of technological equipment - sources of pollutant emissions located at the production site № 1

№	APS number	The name of the emission source	Characteristic of APS
Faculty of Ecology and Landscape Architecture			
1	0001	Fume hood (Department of Chemistry)	Exhaust system: Ø=315 mm; h = 18 m
2	0002	Fume hood (Department of Chemistry)	Exhaust system: Ø=315 mm; h = 18 m
Faculty of Agricultural Mechanization			
3	6001-01 – 6001-06	Vertical drilling machine	Fugitive emission source, natural ventilation
		Vertical milling machine	
		Horizontal milling machine	
		Screw-cutting lathe	
		Lathe	
		Grinding machine	
Faculty of Agrobiology and Land Resources			
4	0003-01 0003-02	Large exhaust hood (Department of Agrochemistry)	Exhaust system: Ø=315 mm; h = 9 m
5	0004-01 0004-02	Fume hoods (Department of Agrochemistry)	Exhaust system: Ø=315 mm; h = 9 m
6	0005	Fume hood (Department of Agriculture)	Exhaust system: Ø=315 mm; h = 9 m
7	0006-01 0006-02	Fume hoods (Department of FP from PPS)	Exhaust system: Ø=315 mm; h = 9 m
8	0007	Exhaust hood (Department of Soil Science)	Exhaust system: Ø=315 mm; h = 9 m
Educational and scientific testing laboratory			
9	0008-01 0008-02 0008-03	Fume cupboards for heating furnaces	Exhaust system: Ø=200 mm; h = 9 m
10	0009-01 0009-02	Fume hoods 1500x760x2300	Exhaust system: Ø=315 mm; h = 9 m

№	APS number	The name of the emission source	Characteristic of APS
Garage			
11	6002	Garage	Unorganized source
Department of maintenance and overhaul of buildings and structures (welding post)			
12	6003-01 6003-02	SAI inverter type welding machine 190 SAI inverter type welding machine 230 ADC	Manual arc welding
Canteen			
13	0010-01 0010-02	Cooking center Washing center	Exhaust system: Ø=600 mm; h = 7,5 m
Center for Youth Creativity FabLab Vector			
14	0011	Painting site	Exhaust system: Ø=335 mm; h = 4,5 m
15	0012-01 0012-02	Plasma cutting Laser engraving	Exhaust system: Ø=620 mm; h =5,5 m
Printing house AGRUS			
16	0013	Printing equipment	Exhaust system: Ø=335 mm; h = 4,5 m

Thus, in total, 16 sources of emissions of air pollutants were identified on the territory of the production site No. 1, including organized - 13, unorganized - 3.

On the territory of **the production site No. 2**, educational and laboratory buildings of 2 faculties, 1 hostel, garage; parking; equestrian school; educational laboratory Teplitsa, scientific-diagnostic and medical veterinary center; vivarium; manure dumping site; administrative and auxiliary premises; green areas.

Table 2.2 shows the characteristics of the process equipment, which is the source of pollutant emissions at the site № 2.

Table 2.2 – Characteristics of technological equipment - sources of pollutant emissions located at the production site № 2

№	APS number	The name of the emission source	Characteristic of APS
Faculty of Veterinary Medicine			
1	0014	Fume hood (Department of Parasitology)	Exhaust system: Ø=315 mm; h = 14 m
2	0015	Fume hood (Department of Epizootology)	Exhaust system: Ø=315 mm; h = 5 m
Faculty of Technology Management			
3	0016	Fume hood (Department of Feeding)	Exhaust system: Ø=400 mm; h = 9 m
4	0017	Fume hood (Department of Feeding)	Exhaust system: Ø=400 mm; h = 9 m
5	0018	Fume hood (Department of Feeding)	Exhaust system: Ø=400 mm; h = 9 m
6	0019	Fume hood (Department of Feeding)	Exhaust system: Ø=400 mm; h = 9 m
7	0020	Fume hood (Department of Feeding)	Exhaust system: Ø=400 mm; h = 9 m
8	0021	Fume hood (Department of TPPAP)	Exhaust system: Ø=400 mm; h = 9 m
9	0022	Fume hood (Department of TPPAP)	Exhaust system: Ø=400 mm; h = 9 m
10	0023	Fume hood (Department of TPPAP)	Exhaust system: Ø=200 mm; h = 2 m

№	APS number	The name of the emission source	Characteristic of APS
Scientific-diagnostic and medical-veterinary center			
11	0024	Fume hood	Exhaust system: Ø=300 mm; h = 2 m
12	0025	Fume hood	Exhaust system: Ø=300 mm; h = 2 m
Animal sites			
13	6004-01	Vivarium 1 (small ruminants)	Unorganized source
	6004-02	Vivarium 1 (cattle)	Unorganized source
14	6005	Vivarium 2 (rabits)	Unorganized source
15	6006	Equestrian school	Unorganized source
Manure storage (a site for piled manure)			
16	6007	*Site for piled manure*	600 m^2
Guest parking			
17	6008	*Parking*	Unorganized source
Greenhouse complex			
18	0026-01 0026-02	Boiler №1 Boiler № 2	Труба котла: Ø=500 m; h = 4
Garage			
19	6009	Garage	Unorganized source

Thus, in total, 19 sources of atmospheric pollutant emissions were identified on the territory of the production site No. 2, including organized - 13, unorganized - 6.

On the territory of **the production site No. 3** there is an educational and experimental station of Stavropol State Agrarian University, including the educational laboratory and Greenhouse Complex, an educational building, a parking lot for equipment, a granary; experienced plots; administrative and auxiliary premises. Table 2.3 shows the characteristics of the process equipment, which is the source of pollutant emissions at site No. 3.

Table 2.3 – Characteristics of technological equipment - sources of pollutant emissions located at the production site № 3

№	APS number	The name of the emission source	Characteristic of APS
Greenhouse complex			
1	0027	Boiler Thermona	Boiler pipe: Ø=100 mm; h = 4
2	0028	Boiler Thermona	Boiler pipe: Ø=100 mm; h = 4
3	0029	Boiler Baxi	Boiler pipe: Ø=100 mm; h = 4
4	0030	Boiler Baxi	Boiler pipe: Ø=100 mm; h = 4
5	0031	Boiler Baxi	Boiler pipe: Ø=100 mm; h = 4
6	0032	Boiler Baxi	Boiler pipe: Ø=100 mm; h = 4
Parking for agricultural machinery			
7	6010	*Parking*	26 vehicles
Grain storage			
8	6011	Grain storage	Unorganized source of emission

Thus, in total, 8 sources of atmospheric pollutant emissions were identified on the territory of the production site No. 3, including organized - 6, unorganized - 2.

There are no sources of air pollution on the territory of **the production site No. 4**.

3. METHODOLOGY FOR QUANTIFYING GREENHOUSE GAS EMISSIONS IN ORGANIZATIONS

Given that at the national level, the current legislation of the Russian Federation does not contain mandatory requirements for business entities to provide information (report) on the volume of greenhouse gas emissions, the volume of indirect energy emissions, and also does not establish liability for failure to provide them, including in relation to non-production facilities spheres, this issue can be resolved at the University level by applying common methods.

On December 30, 2021, Federal Law No. 296-FL dated July 2, 2021 “On Limiting Greenhouse Gas Emissions” came into force, which establishes the principles and measures for limiting greenhouse emissions; provides for the phased introduction of a model for their regulation. Organizations that produce greenhouse gases, the mass of which is equivalent to 150 thousand tons of carbon dioxide or more per year, fall under state regulation.

It is important to take into account that today, by-laws are under development, and due to the lack of state regulation, each business entity has the right to choose for itself the optimal method for calculating greenhouse gases, taking into account the specifics of its activities.

FSBEI HE Stavropol State Agrarian University is an object of non-production sphere, nevertheless, the analysis of technological processes in the organization showed that there are potential sources of greenhouse gases, albeit in a much smaller amount than the regulatory volume.

Sources of direct greenhouse gas emissions are:

- combustion of fuel in stationary installations;
- maintenance of animals;
- combustion of fuel by motor transport.

Indirect sources of greenhouse emissions include: consumption of electricity and heat by the structural divisions of the University

Quantitative determination of greenhouse gas emissions is carried out for the calendar year as a whole for the University, or separately for each separate division.

The boundaries for quantifying greenhouse gas emissions (Table 3.1) include direct greenhouse gas emissions from sources, that is, emissions that occur directly from the organization's production facilities and ongoing production processes.

Table 3.1 – Greenhouse gas global warming potential values *

N	Greenhouse gas	Substance code	Global warming potential
1	Carbon dioxide	0380	1
2	Methane	0410	25
3	Nitrous oxide	0381	298
4	Trifluoromethane (HFC-23)	0966	14800
5	Performethane (PFC-14)	0965	7390
6	Perfluoroethane (PFC-116)	0963	12200
7	Sulfur hexafluoride	0369	22800

* Decision 24 / CP.19 of the Conference of the Parties to the United Nations Framework Convention on Climate Change (hereinafter referred to as the UNFCCC), ratified by Federal Law No. 34-FL of 04.11.1994 "On Ratification of the UN Framework Convention on Climate Change" (Collected Legislation of the Russian Federation, 1994 , N 28 article 2927) (official website of the UNFCCC http://unfccc.int/).

Sources of greenhouse gas emissions in an organization should be identified and categorized.

The category of sources of greenhouse gas emissions are related types of economic activity or production and technological processes that lead to greenhouse gas emissions into the atmosphere, and combined on the basis of control by the organization.

Each production facility or production process of an organization must be assigned to one of the selected source categories or excluded from the quantification of greenhouse gas emissions based on established criteria.

Sources of greenhouse gas emissions are documented and included in the explanatory note to the information (report) on greenhouse gas emissions. The list of greenhouse gas emission sources is reviewed at least once every five years, as well as in the event of the emergence of new sources of greenhouse gas emissions, changes in technological processes, changes in methods for quantifying emissions, and other cases that significantly affect the results (more than 5% of total annual emissions).

The following can be excluded from the quantification of greenhouse gas emissions in an organization:

- insignificant sources of emissions - sources, emissions from which in total amount to less than 5% per year of the total emissions in the organization, but not more than 50 thousand tons of CO2 equivalent / year;

- sources of emissions and greenhouse gases for which methods for quantitative determination of greenhouse gas emissions are not provided in Appendix No. 2 to the guidelines approved by Order of the Ministry of Natural Resources of Russia No. 300 dated 30.06.2015.

Quantification of greenhouse gas emissions is carried out using methods established for the relevant categories of greenhouse gas emission sources, including:

- calculation method based on activity data and emission factors;
- method of calculation based on material and raw materials balance;
- calculation method based on periodic measurements of greenhouse gas emissions;
- a method for continuous monitoring of greenhouse gas emissions.

Quantitative determination of greenhouse gas emissions is carried out on the basis of the preparation of initial data and the performance of calculations of greenhouse gas emissions.

The initial data for quantitative determination of greenhouse gas emissions are the actual data characterizing the organization's activities for the reporting period (for example, fuel consumption by type, consumption of carbon-containing materials, product output), and other parameters necessary to determine the volume of emissions in accordance with the selected methods (for example, greenhouse gas emission factors, carbon content in raw materials and products, composition of gaseous fuels).

As sources of initial data for quantitative determination of greenhouse gas emissions, documents accounting for the consumption of raw materials, fuel and materials, production of products (for example, technical reports, balance sheets, statistical reporting forms and other documents), quality certificates, measurement protocols, technological regulations, inventory results, emission sources, production control data on emissions and waste generation and other sources of information are used.

4. LIMITS FOR QUANTIFYING GREENHOUSE GAS EMISSIONS

This report has been prepared in accordance with the guidelines and regulations for quantifying greenhouse gas emissions by organizations engaged in economic and other activities in the Russian Federation (hereinafter referred to as the Guidelines), approved by Order of the Ministry of Natural Resources of Russia No. 300 dated 30.06.2015.

The Methodological Guidelines establish the procedure for quantifying greenhouse gas emissions in organizations engaged in economic and other activities in the Russian Federation for the purposes of monitoring, reporting and verifying the volume of greenhouse gas emissions in accordance with the Concept for the formation of a system for monitoring, reporting and verifying the volume of greenhouse gas emissions in the Russian Federation , approved by the order of the Government of the Russian Federation of April 22, 2015 No. 716-r (Collected Legislation of the Russian Federation, 2015, No. 18, Art. 2737).

In accordance with the Guidelines, the limits for quantifying emissions include direct emissions of greenhouse gases from sources, that is, emissions that occur directly from the organization's production facilities and ongoing production processes.

Sources of greenhouse gas emissions in the organization should be identified and categorized according to Table 4.1.

Table 4.1 – Categories of emission sources and greenhouse gases subject to mandatory accounting in organizations

№	GHG emission source category	Greenhouse gas	Availability of this emission category at the University
1	Stationary combustion	CO_2,CH_4	+
2	Flaring	CO_2,CH_4	-
3	Fugitive outliers	CO_2,CH_4	-
4	Oil refining	CO_2	-
5	Coke production	CO_2	-
6	Cement production	CO_2	-
7	Lime production	CO_2	-
8	Glass production	CO_2	-
9	Production of ceramic products	CO_2	-
10	Ammonia production	CO_2	-
11	Production of nitric acid, caprolactam, glyoxal and glyoxylic acid	N_2O	-
12	Petrochemical production	CO_2	-
13	Production of fluorine-containing compounds	SF_6, CHF_3	-
14	Ferrous metallurgy	CO_2	-
15	Ferroalloy production	CO_2	-
16	Primary aluminum production	cf_4, c_2f_6, co_2	-
17	Other industrial processes	CO_2	-
18	Air transport	CO_2	-
19	Railway transport	CO_2	-

In addition to the generally accepted and mandatory sources for evaluating the activities of the University, an assessment of emissions from sources has been introduced:

- located on the territory of veterinary clinics (production site No. 2) from keeping animals;

- transport of the University.

The classification of pollutant emission sources of Stavropol State Agrarian University by category is presented in Table 4.2.

Table 4.2. – List of emission sources with categorization of greenhouse gas emission source

Production division	The name of emission source	Name of pollutant emission source and its number	GHG emission source category number	Pollutant code	Pollutant name	Emission t/year
Main building	Motor transport	Garage (6002)	additional	0301	Nitrogen dioxide	0,00007412
				0304	Nitrogen oxide	0,00001204
				0330	Sulfur dioxide	0,00003430
				0337	Carbon oxide	0,01040122
				2704	Petrol	0,00132008
Territory of veterinary clinics	Animal keeping	Vivarium 1 (6004)	additional	0303	Ammonia	0,26429760
				0333	hydrogen sulfide	0,00433188
				0410	Methane	0,12326580
				1052	methanol	0,01115856
				1071	Phenol	0,00229824
				1246	Ethyl formate	0,01577016
				1314	Propanal	0,00510300
				1531	Caproic acid	0,00673596
				1707	Dimethyl sulfide	0,01382724
				1715	Methyl mercaptan	0,00003667
				1849	Methylamine	0,00363258
				2920	Fur dust	0,14817600
Territory of veterinary clinics	Animal keeping	Vivarium 2 (6005)	additional	0303	Ammonia	0,00005481
				0333	hydrogen sulfide	0,00000449
				0410	Methane	0,00176054
				1052	methanol	0,00001087
				1071	Phenol	0,00000213
				1246	Ethyl formate	0,00002882
				1314	Propanal	0,00000874
				1531	Caproic acid	0,00001394
				1707	Dimethyl sulfide	0,00001205
				1715	Methyl mercaptan	0,00000004
				1849	Methylamine	0,00000543
				2920	Fur dust	0,00071726
Territory of veterinary clinics	Animal keeping	Equestrian school (6006)	additional	0303	Ammonia	0,54432000
				0333	hydrogen sulfide	0,00907200
				0410	Methane	0,29484000
				1052	methanol	0,02540160
				1071	Phenol	0,00498960
				1246	Ethyl formate	0,04354560
				1314	Propanal	0,01088640

Production division	The name of emission source	Name of pollutant emission source and its number	GHG emission source category number	Pollutant code	Pollutant name	Emission t/year
				1531	Caproic acid	0,02540160
				1707	Dimethyl sulfide	0,03628800
				1715	Methyl mercaptan	0,00007258
				1849	Methylamine	0,00707616
				2920	Fur dust	0,25401600
Territory of veterinary clinics	Manure clamping	Clamping platform (6007)	additional	0303	Ammonia	0,80867241
				0333	hydrogen sulfide	0,01340837
				0410	Methane	0,41986634
				1052	methanol	0,03657103
				1071	Phenol	0,00728997
				1246	Ethyl formate	0,05934458
				1314	Propanal	0,01599814
				1531	Caproic acid	0,03215150
				1707	Dimethyl sulfide	0,05012729
				1715	Methyl mercaptan	0,00010928
				1849	Methylamine	0,01071417
				2920	Fur dust	0,40290926
Territory of veterinary clinics	Motor transport	Parking (6008)	additional	0304	Nitrogen oxide	0,000113
				0301	Nitrogen dioxide	0,000693
				0330	Sulfur dioxide	0,000330
				0337	Carbon oxide	0,097109
				2704	Petrol	0,009948
Territory of veterinary clinics	Motor transport	Garage (6009)	additional	0304	Nitrogen oxide	0,000113
				0301	Nitrogen dioxide	0,000693
				0330	Sulfur dioxide	0,000330
				0337	Carbon oxide	0,097109
				2704	Petrol	0,009948
Territory of veterinary clinics	Boiler (in greenhouse)	Boiler pipe (0026)	1	0337	Carbon oxide	0,23831808
				0301	Nitrogen dioxide	0,20406668
				0304	Nitrogen oxide	0,03316084
				0703	Benzopyrene	1,64E-09
Educational and experimental farm	Boiler (in greenhouse)	Boiler pipe (0027)	1	0337	Carbon oxide	0,04313309
				0301	Nitrogen dioxide	0,03629243
				0304	Nitrogen (II) oxide	0,00589752
				703	Benzopyrene	2,98E-10
Educational and experimental farm	Boiler (in greenhouse)	Boiler pipe (0027)	1	0337	Carbon oxide	0,04313309
				0301	Nitrogen dioxide	0,03629243
				0304	Nitrogen (II) oxide	0,00589752
				703	Benzopyrene	2,98E-10
Educational and experim	Boiler (in greenhouse)	Boiler pipe (0028)	1	0337	Carbon oxide	0,01437852
				0301	Nitrogen dioxide	0,01113900
				0304	Nitrogen (II) oxide	0,00181009
				703	Benzopyrene	9,92E-11

Production division	The name of emission source	Name of pollutant emission source and its number	GHG emission source category number	Pollutant code	Pollutant name	Emission t/year
ental farm						
Educational and experimental farm	Boiler (in greenhouse)	Boiler pipe (0029)	1	0337	Carbon oxide	0,01437852
				0301	Nitrogen dioxide	0,01113900
				0304	Nitrogen (II) oxide	0,00181009
				703	Benzopyrene	9,92E-11
Educational and experimental farm	Boiler (in greenhouse)	Boiler pipe (0030)	1	0337	Carbon oxide	0,06666700
				0301	Nitrogen dioxide	0,05164675
				0304	Nitrogen (II) oxide	0,00839260
				703	Benzopyrene	4,60E-10
Educational and experimental farm	Boiler (in greenhouse)	Boiler pipe (0031)	1	0337	Carbon oxide	0,06666700
				0301	Nitrogen dioxide	0,05164675
				0304	Nitrogen (II) oxide	0,00839260
				703	Benzopyrene	4,60E-10
Educational and experimental farm	Vehicles and special equipment	Parking (6010)	additional	0301	Nitrogen dioxide	0,0033870
				0304	Nitrogen (II) oxide	0,0005504
				0330	Sulfur dioxide	0,0031993
				0337	Carbon oxide	0,0616766
				2704	Petrol	0,0039518
				2732	Kerosene	0,0126310
				0328	Carbon	0,0005330

In terms of categorizing sources according to Woo&Choi, 2013 (Table 4 of the UI GreenMetric Guidelines), the university has the following sources of greenhouse gas emissions:

Table 4.3 – List of sources of greenhouse gas emissions (Woo&Choi, 2013)

Source categories	Source data	Definition	Correlation with the activities of the University
Sources of the 1st type	Stationary sources	Stationary combustion refers to the combustion of fuel to produce electricity, steam and heat in a fixed location such as boilers, burners, heaters, furnaces and engines.	Yes, GHG emission is calculated
	Mobile sources	Combustion of fuel by vehicles owned by the organization	Yes, GHG emission is calculated

	Emissions in various processes	Direct greenhouse gas emissions from physical or chemical processes (not from fuel combustion)	No
	Fugitive emissions	Hydrofluorocarbon emissions from refrigeration and air conditioning equipment and methane leakage from natural gas transportation	No
Sources of the 2nd type	Purchased electricity	Indirect greenhouse gas emissions from electricity generation used by the organization	Yes, GHG emission is calculated
Sources of the 3rd type	Waste	Indirect greenhouse gas emissions from the incineration or disposal of institutional solid waste	No
	Purchased water	Indirect greenhouse gas emissions from water supplies purchased and used by the organization	Yes, calculation of GHG emissions is inexpedient
	Trips	Indirect greenhouse gas emissions from regular travel of students and employees to and from educational institutions	Yes, calculation of GHG emissions is carried out as part of sources of the 1st type
	Air travel	Indirect greenhouse gas emissions from air travel paid for by the organization	Yes, calculation of GHG emissions is inexpedient

Note: the inexpediency of calculating emissions from some sources is due to the insignificance of volumes, as well as the priority of regulation of direct greenhouse gas emissions over indirect ones.

5. CALCULATION OF DIRECT AND INDIRECT GREENHOUSE GAS EMISSIONS FOR 2021

5.1 CALCULATION OF DIRECT GREENHOUSE GAS EMISSIONS

Calculation of greenhouse gas emissions from stationary fuel combustion

The calculation was carried out on the basis of the Guidelines approved by the order of the Ministry of Natural Resources of Russia No. 300 dated 06.30.2015.

This category of greenhouse gas emission sources includes CO_2 emissions into the atmosphere resulting from the combustion of all types of gaseous, liquid and solid fuels in boiler units, furnaces and other heat engineering units, carried out in order to generate heat and / or electric energy for the own needs of organizations or consumers, as well as for other technological operations.

This category of emission sources does not include greenhouse gas emissions from stationary combustion of fuel in flares, from the combustion of biogas, biomass and its products, leaks associated with fuel distribution, emissions from accidents and emergencies.

Emissions of CH_4 and N_2O potentially arising from stationary fuel combustion are not taken into account.

Quantitative determination of CO_2 emissions from stationary fuel combustion is performed by the calculation method for individual sources, groups of sources or the organization as a whole according to the formula:

$$E_{CO2y} = \sum^{n}_{j=1}(FC_{jy} * EF_{CO2jy} * OF_{jy}),$$

where: E_{CO2y} – CO_2 emissions from stationary fuel combustion for the period *y*, т CO_2;

FC_{jy} – fuel consumption *j* for the period *y*, thous. m3 (accepted according to actual accounting data);

EF_{C02jy} – CO_2 emission factor from fuel combustion *j* for the period *y*, т CO_2/ ea;

OF_{jy} – fuel oxidation ratio *j*, percentage;

j – type of fuel consumed for payment;

n – number of fuels used for the period *y*.

The final results of the calculation of emissions from stationary fuel combustion are presented in the table 5.1.

Table 5.1 – CO_2 emissions from stationary fuel combustion

Emission source	**FC_{jy} – fuel consumption j for the period y, thous. m^3**	**EF_{C02jy} – CO_2 emission factor from fuel combustion**	**E_{CO2y} – CO_2 emissions from stationary fuel combustion for the period y, t CO_2**
Boiler (greenhouse, veterinary clinics)	68,652	1,85	127,0062
Boiler 1 (greenhouse Demino)	17,375	1,85	32,14375
Boiler 2 (greenhouse Demino)	17,375	1,85	32,14375
Boiler 3 (greenhouse Demino)	5,792	1,85	32,14375
Boiler 4 (greenhouse Demino)	5,792	1,85	10,7152
Boiler 5 (greenhouse Demino)	26,855	1,85	10,7152
Boiler 6 (greenhouse Demino)	26,855	1,85	49,68175
		TOTAL	**312,0876**

Taking into account the requirements of item 14 of the Guidelines, the total greenhouse gas emissions by source categories and the organization as a whole are calculated taking into account the global warming potentials of greenhouse gases and are expressed in CO_2 equivalent. The calculation is performed according to the formula:

$$E_{CO2e,y} = \sum_{i=1}^{n}(E_{i,y} * GWP_i)$$

where:

$E_{CO2e,y}$ – greenhouse gas emissions in CO_2 equivalent for the period y, t CO_2 equivalent;

$E_{i,y}$ – emissions of the i-th greenhouse gas for the period y, t;

GWP_i – global warming potential of the i-th greenhouse gas, t CO2-equivalent/t (accepted according to Annex 3 of the Guidelines).

Thus, from the stationary combustion of fuel by stationary sources of the Stavropol State Agrarian University, the atmosphere in 2021 received:

$E_{CO2e,y}$ = 312,0876 * 1 = 312,088 t CO_2-equivqlent.

Calculation of greenhouse gas emissions from fuel combustion by motor vehicles

In accordance with the Order of the Ministry of Natural Resources of Russia dated June 30, 2015 No. 300 "On approval of guidelines for quantifying greenhouse gas emissions by organizations engaged in economic and other activities in the Russian Federation", calculations of greenhouse gas emissions from vehicles are not made due to the lack of relevant sections.

In this regard, the calculation was carried out on the basis of the Guidelines given in the National report of the Russian Federation on the inventory of anthropogenic emissions from sources and removals by sinks of greenhouse gases not regulated by the Montreal Protocol for 1990–2010. M., 2012; on the basis of the Guidelines approved by the order of the Ministry of Natural Resources of Russia No. 15-r dated April 16, 2015.

Calculation of carbon dioxide emissions from fuel combustion in internal combustion engines is recommended based on fuel types and engine types.

To determine the amount of greenhouse gas emissions, it is recommended to use a methodology based on the characteristics of the fuel burned. Greenhouse gas emissions from all combustion sources can be calculated from the quantities and types of fuels burned and the corresponding emission factors. Calculation of greenhouse gas emissions is carried out according to the formula:

$$E_i = A_i \times EF_i$$

where:

E_i – emission of the i-th gas into the atmosphere;

A_i – activity data (quantification of the activity leading to a emission over a specified period, usually a year);

EF_i – emission factor (specific emission of i-th greenhouse gas per unit of activity);

In Russian national statistics, motor fuels include only three types of fuel: gasoline, diesel fuel and other motor fuels. To calculate greenhouse gas emissions, some other fuels must also be classified as motor fuels: in the categories of water and rail transport, this is fuel oil, and in the category of road transport, liquefied gas.

Carbon dioxide emissions from this method are estimated as follows. First, the consumption of each type of fuel is estimated by type of transport (cars, trucks, buses, special vehicles). The total CO_2 emissions are then estimated by multiplying the amount of fuel consumed by the emission factor for each type of fuel and type of transport using the formula:

$$E = M \times К_1 \times ТН_3 \times К_2 \times 44/12$$

where:

E – annual CO_2 emission in weight units (tonnes/year);

M – actual fuel type consumption per year (tonnes/year);

$К_1$ – fuel carbon oxidation ratio (shows the proportion of carbon burned);

$ТН_3$ – net calorific value (J/ton), table 5.2;

$К_2$ – carbon emission factor (ton C/J), table 5.2;

44/12 – coefficient for converting carbon emissions C to carbon dioxide CO_2.

To estimate carbon dioxide emissions from the road transport sector for the fuels used (gasoline, diesel fuel, liquefied petroleum gas, compressed natural gas), regional factors for converting fuel burned to CO_2 emissions were calculated (net calorific values, carbon emission factors, oxidized carbon fraction) .

Calculations of the factors for recalculation, presented in Table 5.2, were carried out according to the composition of the fuel and their physical characteristics based on the following data sources: All Union State standard data for various types of fuel; reference data; data obtained from some oil and gas fields.

Table 5.2 – Factors for converting fuel burned to CO_2 emissions for motor vehicles

Fuel types	The net calorific value is the lowest,TH$_3$ TJ/thous. tons	Carbon emission factor, K$_2$, tC/TJ	Fraction of oxidized carbon, K$_1$
Petrol	44,21	19,13	0,995
Diesel fuel	43,02	19,98	0,995
Natural gas	34,78	15,04	0,995

The final results of the calculation of emissions from motor vehicles are presented in Table 5.3.

Table 5.3 – CO_2 emissions from stationary fuel combustion in motor vehicles

Fuel types	Actual fuel type consumption per year (tonnes/year)	Oxidation factor of carbon in fuel	Lowest net calorific value, TH$_3$ TJ/thous. tonnes	Carbon emission factor (tonnes C/J)	Annual CO_2 emissions in weight units (tonnes/year)
Petrol	46,633	0,995	44,21	19,13	143,888
Diesel fuel	54,801	0,995	43,02	19,98	171,850
Natural gas	5,842	0,995	34,78	15,04	11,149
				TOTAL	**326,886**

Taking into account the requirements of item 14 of the Guidelines, the total greenhouse gas emissions by source categories and the organization as a whole are calculated taking into account the global warming potentials of greenhouse gases and are expressed in CO_2 equivalent. The calculation is performed according to the formula:

$$E_{CO2e.y} = \sum_{i=1}^{n}(E_{i,y} * GWP_i)$$

where:

$E_{CO2e,y}$ – greenhouse gas emissions in CO_2-equivalent for the period y, t CO_2-equivalent;

$E_{i,y}$ – emissions of the i-th greenhouse gas for the period y, t;

GWP_i – global warming potential of the i-th greenhouse gas, t CO_2-equivalent/t (accepted according to Appendix 3 of the Guidelines).

Thus, from the stationary combustion of fuel by motor vehicles of Stavropol State Agrarian University, the atmosphere in 2021 received:

$E_{CO2e,y}$ = 326,886* 1 = 326,886 t CO_2-equivalent.

Calculation of CO_2 emissions from animal husbandry

The calculation was carried out on the basis of the Guidelines approved by the Decree of the Ministry of Natural Resources of Russia No. 15-r dated April 16, 2015.

This methodology considers the following categories of emission sources in the agricultural sector:

- CH_4 emissions from internal fermentation of farm animals and poultry;
- CH_4 emissions from collection, storage and use systems for manure and poultry droppings;

– N2O emissions from collection, storage and use systems for manure and poultry droppings.

To calculate methane emissions from animals, a simplified method can be used, which is generally represented by the equation:

$$E = \sum (N_i * K_i)$$

where: E – methane emissions in kilograms or tons CH_4;

N_i - number of animals of the i-th group in the farm;

K_i – methane emission factor from animals of the i-th group in kg CH_4 per head or, which is the same, in tons of CH_4 per 1000 heads per year

Table 5.4 – CO_2 emissions from animal husbandry

Kind of animal	livestock population	methane emission factor from animals of the i-th group in kg CH_4 per head	CO_2 emissions, t
Horses	6	18	0,108
Cows	5	56	0,28
Sheep	8	8	0,064
Rabbits	50	1	0,05
		TOTAL	**0,502**

Calculations of methane emissions from manure are made according to the formula using methane emission factors:

$$E = EF * livastock\ population * 10^{-6}$$

where EF - emission factor for a specific livestock, kg/head/year.

Then the calculations for each group of animals must be summed up. In order to express the missions of methane in CO_2 equivalent, it is necessary to multiply the resulting product by the global warming potential of methane, equal to 21.

Table 5.5 – CO_2 emissions from animal manure storage systems

Kind of animal	livestock population	methane emission factor from animals of the i-th group in kg CH_4 per head	CO_2 emissions, t
Horses	6	18	0,108
Cows	5	56	0,28
Sheep	8	8	0,064
Rabbits	50	1	0,05
		TOTAL	**0,502**

The calculation of nitrous oxide emissions from manure and manure collection, storage and disposal systems is carried out taking into account the nitrogen emission factors from animal manure and is presented in Table 5.6.

Table 5.6 – N_2O emissions from animal manure storage systems

Kind of animal	livestock population	methane emission factor from animals of the i-th group in kg N_2O per head	N_2O emissions, t
Horses	6	18	0,32136
Cows	5	56	0,4482
Sheep	8	8	0,128
Rabbits	50	1	0,05
		TOTAL	**0,94756**

To obtain methane emissions in CO_2-equivalent, the resulting product must be multiplied by the GWP of methane, equal to 21.

To obtain nitrous oxide emissions, the amount of nitrogen produced must be multiplied by 44/28. To convert nitrous oxide emissions to CO_2-equivalent, the resulting product must be multiplied by the GWP of nitrous oxide, equal to 310.

Thus, from the animal husbandry in the Stavropol State Agrarian University, the atmosphere in 2021 received:

$E_{CO2e,y}$ = 1,004 * 21 + 0,94756 * 44/28*310 = 21,084 + 461,597 = 482,681 т CO_2-equivalent.

5.2 - CALCULATION OF INDIRECT GREENHOUSE GAS EMISSIONS

Guidelines for the quantitative determination of the volume of indirect energy emissions of greenhouse gases were approved by order of the Ministry of Natural Resources of Russia No. 330 dated June 29, 2017.

The Guidelines are intended for organizations engaged in economic and other activities on the territory of the Russian Federation and establish the procedure for quantifying the volume of indirect energy emissions resulting from the consumption of electric and thermal energy by organizations received from external generating facilities.

Quantitative determination of the volume of indirect energy emissions by the regional method when consuming electrical energy is carried out according to the formula:

$$E^{per}_{CO2,\text{элек},k,y} = EC_{k,y} \times EF^{per}_{CO2,\text{элек},k,y} \times 10^{-3}$$

where:

$EC_{k,y}$ – consumption by an organization located in the power system k consumes electric energy received from external generating facilities over a period of time (year);

EF^{per}_{CO2} – regional coefficient of indirect energy emissions, when an organization located in the energy system k consumes electric energy received from external generating facilities over a period of time y, kg.

In accordance with Table 2.1 of Appendix 2 to the Guidelines for Quantifying the Volume of Indirect Energy Emissions of Greenhouse Gases for the Stavropol Territory, the regional coefficient of indirect energy emissions from electricity consumption is 676 kg CO_2/MWh.

In accordance with Table 2.2 of Appendix 2 to the Guidelines for Quantifying the Volume of Indirect Energy Emissions of Greenhouse Gases for the Stavropol Territory, the regional coefficient of indirect energy emissions from heat consumption is 314 kg CO_2/Gcal.

The structure of actual costs for fuel energy resources was adopted according to the primary accounting data of the University (Table 5.7).

Table 5.7 – The structure of actual costs for fuel energy resources

	Item	unit of measurement	Previous years				Reporting year 2021
			2017	2018	2019	2020	
1	Electric energy	thous. kW. h	2365,401	2319,602	2529,415	2421,909	2237,395
2	Thermal energy	Gcal	14124	13723	13780	15128	15200

The corresponding calculation is presented in Table 5.8.

Table 5.8 – Greenhouse gas emissions from indirect sources

Source items of indirect greenhouse gases	unit of measurement	Indicator for 2021	Gas emission factor	Annual CO_2 emissions in weight units (tonnes/year)
Electric energy	thous. kW. h	2237,395	676	1512,479
Thermal energy	Gcal	15200	317	4818,400
			TOTAL	6330,879

Thus, the volume of indirect greenhouse gases in the Stavropol State Agrarian University in 2021 amounted to: **6330,879 t CO_2-equivalent.**

5.3 GREENHOUSE GAS EMISSION STRUCTURE ANALYSIS FOR 2021

As part of this work, an inventory and quantitative determination of the volumes of emissions of direct and indirect greenhouse gases was carried out for the Stavropol State Agrarian University.

Data on greenhouse gas emissions from Federal State Budgetary Educational Institution of Higher Education Stavropol State Agrarian University are presented in Table 5.9.

Table 5.9 – The structure of greenhouse gas emissions from the activities of the University

№	Greenhouse gas emissions	2021 year
1	Total from Stavropol State Agrarian University	**7452,835**
	including:	-
2	Direct greenhouse gas emissions, tons of CO_2-equivalent	**1121,956**
2.1	burning fuel in vehicles	326,887
2.2	stationary fuel combustion	312,088
2.3	for animal husbandry	482,681
3	Indirect energy emissions, tons of CO_2-equivalent	**6330,879**
3.1	consuming electrical energy	1512,479
3.2	consuming thermal energy	4818,400

Thus, the total amount of greenhouse gases released into the atmosphere for 2021 from the activities of the departments of the Federal State Budgetary Institution of Higher Education Stavropol State Agrarian University amounted to **7452,835 tons CO_2-equivalent**.

This indicator shows that the University is not an object, subjected to mandatory state regulation in the field of limiting greenhouse gas emissions: **the actual volume of emissions is below the regulatory threshold of state regulation (150 thousand tons of CO_2 equivalent) by almost 20 times.**

Nevertheless, given the "green" agenda, Stavropol State Agrarian University assumes obligations to reduce greenhouse gases from direct and indirect sources.

6. GREENHOUSE GAS REDUCTION PROGRAM

Based on the analysis of the calculated values of greenhouse gas emissions, a **“Program for Reducing Direct and Indirect Greenhouse Gas Emissions”** is proposed for implementation until 2025.

The purpose of this program is to minimize greenhouse gas emissions from stationary combustion of fuel in boiler units, combustion of fuel by vehicles, as well as from the receipt of electrical and thermal energy from external heat and power supply facilities.

The program provides for **two blocks of measures** aimed at reducing both direct and indirect energy emissions, planned for implementation until 2025.

Measures aimed at reducing direct greenhouse gas emissions include:

1. Minimization of emissions from vehicles:

- adjustment and maintenance in good condition of the fuel equipment of the internal combustion engine of vehicles,
- improving the fuel efficiency of vehicles,
- optimization of vehicle operation time;
- transition to gaseous fuel transport, according to its characteristics allowing it.

2. Territorial planning activities aimed at the rational planning of the location of various University facilities and the absorption of greenhouse gases from the surface layer of the atmosphere, including through the installation of green spaces, planting trees and shrubs that actively absorb CO2. These activities are implemented both on the territory of the Main Building of the University by maintaining the existing landscaping), and on the territory of the Veterinary Clinics, educational and experimental farm (by planting and maintaining the existing state of alleys, gardens, etc.).

At the moment, it seems possible to evaluate the effectiveness of these measures aimed at reducing direct greenhouse gas emissions only with annual monitoring of greenhouse gas emissions.

Measures aimed at reducing indirect energy emissions of greenhouse gases include:

- continuous audit of energy efficiency and improvement of energy efficiency of technological processes;
- installation of modern energy-efficient lighting systems both in buildings and at production sites;
- replacement of existing non-energy efficient office equipment with a new one with energy efficiency class A, A +.

To assess the effectiveness of the proposed measures, an analysis was made of the forecast of energy consumption for the period 2022-2025, the achievement of which is mandatory for the university in accordance with the Order of the Ministry of Economic Development of the Russian Federation of October 24, 2011 No. 591 (Table 6.1).

Table 6.1 – Forecast of energy consumption volumes for the period 2022-2025

Items of indirect GHG source	unit of measurement	Actual indicator of 2021	Annual CO_2 emissions in weight units (tonnes/year)			
			2022	2023	2024	2025
Electric Energy	thous. kW. h	2641,415	1777,74	1724,41	1672,67	1622,49
Thermal energy	Gcal	11498	7738,46	7506,31	7281,12	7062,68

The forecast of emissions of indirect greenhouse gases from measures to reduce the consumption of energy resources of the University is presented in Table 6.2.

Table 6.2 – Forecast of indirect greenhouse gas emissions for the period 2022-2025

Type of energy resource	unit of measurement	Basic consumption (2009)	Consumption forecast			
			2022	2023	2024	2025
Electric Energy	thous. kW. h	1512,479	1201,752	1165,701	1130,725	1096,803
Thermal energy	Gcal	4818,400	2453,092	2379,500	2308,115	2238,870
		TOTAL	3654,844	3545,201	3438,840	3335,673

Thus, the cumulative effect of measures aimed at reducing indirect energy emissions of greenhouse gases will be expressed in a decrease in electricity consumption from external generating facilities in 2022–2025 and a gradual reduction in greenhouse gas emissions by 20–27% (depending on the unit and the period of measures).