



**SOFIA MUNICIPALITY  
SUSTAINABLE ENERGY  
AND CLIMATE ACTION PLAN  
2021-2030**

**Including:**

**Energy Efficiency Programme  
of Sofia Municipality, 2021-2030**

**Long-term programme of Sofia Municipality to  
promote the use of renewable energy and bio-fuels,  
2021-2030**

**ANNEX 1:  
BASELINE INVENTORY OF THE GHG  
EMISSIONS ON THE TERRITORY OF SOFIA  
MUNICIPALITY**

**August 2021**

**Baseline Inventory of the GHG emissions  
on the territory of Sofia Municipality**

**to**

**Sofia Municipality Sustainable Energy  
and Climate Action Plan 2021-2030**

**March 2021**

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## **1. Summary**

As part of the commitments of Sofia Municipality under the Global Covenant of Mayors for Climate and Energy initiative in 2021 the municipality developed its Sustainable Energy and Climate Plan (SECAP) for the period 2021-2030. The scope of the sectors included in the plan is determined on the basis of analyses of the CO<sub>2</sub> emissions inventories prepared during the implementation of the Sofia Municipality Sustainable Energy Action Plan 2012-2020 (SEAP). The current Baseline Inventory is a part of the SECAP 2021-2030 and it is developed for year 2007 selected as a base year in SEAP 2012-2020 within the scope determined in the SECAP. Additionally, the last available CO<sub>2</sub> emissions inventory for 2018, developed for the monitoring of the SEAP implementation is recalculated within the scope of the Baseline Inventory in order to have a view for the starting position of implementation of SECAP 2021-2030.

The methodology from the guidelines for elaboration of Sustainable Energy and Climate Plan (SECAPs), the Global Protocol for GHG Emissions Inventory, the Guide of IPPC for National Inventory of GHG Emissions for 2006, as well as the EMEP/EEA Guide for Inventory of Air Pollutants from 2019, were used.

The inventory covers all 24 administrative regions located on the territory of Sofia Municipality.

The inventory of the GHG emissions covers:

- Direct emissions of CO<sub>2</sub> from stationary and mobile combustion processes (within the municipality);
- Indirect emissions from the generated and used heat and electricity energy (regardless of the location of its production);
- Other direct emissions (according to Table 1 of the Guidelines). For example such are the emissions of CH<sub>4</sub> and N<sub>2</sub>O from wastewater treatment and the emissions of CH<sub>4</sub> from municipal solid waste treatment.

The inventory of the direct GHG emissions is done on the basis of the final energy consumption within the municipality – electrical and heat energy, solid fuels and RES (including biomass) in the following categories:

- Buildings and facilities: tertiary (non-municipal); residential; public lighting. Tertiary (non-municipal) buildings, facilities /equipment are all buildings and facilities of the tertiary sector (services sector), that are not communally owned and are not managed by the local authorities (such as private companies offices, banks, small and medium size enterprises, commercial activities and retail, hospitals, etc.);s

## **Baseline inventory of the green gas emissions on the territory of Sofia Municipality | 2007**

- Industry: according to the requirements of the GHG emissions inventories the assessment of the emissions in this sector is not mandatory and the local authorities choose whether to include this sector in their ASAPs. Despite the limited capacity of the municipalities to develop measures targeted at industrial enterprises the Global Protocol requires the inclusion of this sector in the scope of the GHG inventory;
- Transport: municipal fleet; public transport; private and commercial transport.

The total energy consumption on the territory of Sofia Municipality amounts to 14 025 182 MWh in 2018 r. and 15 821 730 MWh in 2007 which represents a decrease of 1.4%. The total emissions are 5.6 million tons CO<sub>2</sub>equivalent in 2007 and 4.6 million tons in 2018 which represents a decrease of 18.2%. In 2007 the largest contribution of emissions belongs to electricity and liquid fuels consumption with 46.4% and 22.7% respectively and this trend continues in 2018, respectively with 51.7% and 21.0%.

Growth in the period 2007–2018 is observed in the consumption of solid fuels by 27.2%, electricity – 19.1% and liquid fuels – 4.6%. A decrease was observed in the consumption of liquid fuels - 52.1% and heat energy – 21.1%. By sectors the largest contribution to the emissions in 2018 have the household sector (37.4%), the industry and construction sectors (22.4%), followed by the road transport (20.6%), trade and services (13.9%), waste (4.1%), municipal enterprises, commercial companies, buildings and lighting (1.0%), and the rest of the sectors contribute with less than 1% to the total emissions. The emissions from waste (solid waste disposal, biologically treated solid waste, waste incineration, water treatment and discharge of wastewaters) in 2018 increased by 28.7% compared to 2007. An increase by 18.6% and 4.9% respectively is observed in the railway transport and in the trade and services sectors. A significant decrease of emissions was recorded in the sectors railway transport and industry - by 39.9% and 39.1% respectively. Significant investments were made in the period 2007–2018 aimed at reducing the energy consumption in municipal buildings, as a result of which the emissions from energy consumption in municipal enterprises, commercial companies, and buildings decreased by 34.4% compared to the 2007 base year.

## **2. Introduction**

Sofia Municipality pursues a long-term consistent policy of commitment and empathy with the global efforts against climate change, actively participating in the major international initiatives for climate and sustainable development oriented to the local authorities.

In 2011 the municipality joined the European Covenant of Mayors initiative, and according to the requirements of the initiative, developed its 2012-2020 Sustainable Energy Action Plan (SEAP). The plan is both a strategic and operational document, which defines the climate goals of Sofia Municipality until 2020 and presents the specific measures for emissions reduction, time frames and responsibilities assigned to achieve the set goals. Sofia Municipality chooses to adopt a higher target for emissions reduction than the minimum required by the participants in the initiative and is committed to achieve a reduction of 22% of the total GHG emissions in the sectors, covered by the plan by 2020, compared to the set 2007 base year.

In the performance of the SEAP, the municipality conducted three inventories of greenhouse gas emissions – in 2011, 2015 and 2018. Since 2015, Sofia Municipality has joined the UN Covenant of Mayors initiative, with which is committed to conduct inventories of greenhouse gas emissions in accordance with the requirements of the Global Protocol for Community Greenhouse Gas Emissions Inventories (GPCGGEI). This requires the expansions of the scope of the sectors included in the inventory compared to the baseline inventory under the SEAP. Therefore, the last two GHG inventories have been conducted in accordance with this scope.

After the establishment in 2015 of the Covenant of Mayors for Climate and Energy, which combines the initiatives the Covenant of Mayors and the Mayors Adapt Sofia Municipality becomes a member of the new initiative, in which the local authorities focus their efforts on implementing policies and measures to adapt to climate change. As a result, in 2019 the municipality adopts a Plan for Adaptation to Climate Change of Sofia Municipality, 2019-2025.

With Decision No 755/08.11.2018 of the Sofia Municipal Council Sofia Municipality joins the Global Covenant of Mayors for Climate and Energy for the period 2021-2030, as a continuation of its participation in the Covenant of Mayors and the implementation of the 2012-2020 SEAP. By joining the agreement, Sofia Municipality sets itself the ambitious task to reduce the GHG emissions by 40% compared to the 2007 levels within the scope of the plan and to plan and implement activities to the climate change adaptation.

This 2021-2030 Sustainable Energy and Climate Action Plan, has been developed in accordance with the participation of Sofia Municipality in GCMCE. The plan is the new strategic document in the field of energy and climate, which is in line with the municipality strategy for development, presented in

the Vision for Sofia. In line with the imposed by EU trends in planning, Sofia Municipality is committed to a new integrated approach to planning and reporting on the energy and climate activities. The SECAP integrates the municipality's policies regarding climate change, energy efficiency and the use of energy from renewable sources. This will create an opportunity to properly balance and prioritize the specific activities and projects in the two main areas - energy efficiency and energy use from renewable sources, which can help for the achievement of the ambitious goal of the GHG emissions reduction by 40%. The energy efficiency will also be highlighted as the top priority in the efforts for the achievement of this goal (by reducing the overall energy demand) and of RES as an additional tool that is increasingly replacing the conventional (especially fossil) energy sources.

The assessment of the GHG emissions in the atmosphere by sources on the territory of Sofia Municipality was prepared in accordance with the requirements of the guide “ How to develop Sustainable Energy and Climate Actions Plans (SECAP) – Part II: - Baseline Emissions Inventory (BEI) and Risk and vulnerability assessment (RVA)<sup>1</sup>, hereinafter referred to as Global Protocol for GHG emissions inventory Guidelines<sup>2</sup>, and further called Global Protocol.

### **2.1. Requirements according to the Global Covenant of Mayors for Climate and Energy**

According to the GHG Emissions Inventory Guidelines for this initiative the emissions reduction should be reported in comparison with the selected baseline year for the inventory. 2007 was selected as a baseline year for Sofia Municipality. The Covenant of Mayors requires the preparation of monitoring inventory of the emissions every four years in order to monitor the progress of the SEAP and the effectiveness of the measures set out in it.

An inventory of the GHG emissions was carried out within the project, that includes:

- Direct emissions of CO<sub>2</sub> from stationary and mobile combustion processes (within the municipality);
- Indirect emissions from the generated and used heat and electricity energy (regardless of the location of its production);
- Other direct emissions (according to Table 1 of the Guidelines). For example such are the emissions of CH<sub>4</sub> and N<sub>2</sub>O from wastewater treatment and the emissions of CH<sub>4</sub> from municipal solid waste treatment.

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<sup>1</sup> How to develop a SEAP – Guidelines. Part II: Baseline Emission Inventory

<sup>2</sup>[http://c40-production-images.s3.amazonaws.com/other\\_uploads/images/143\\_GHGP\\_GPC\\_1.0.original.pdf?1426866613](http://c40-production-images.s3.amazonaws.com/other_uploads/images/143_GHGP_GPC_1.0.original.pdf?1426866613)



The inventory of the direct GHG emissions is done on the basis of the final energy consumption within the municipality – electrical and heat energy, solid fuels and RES (including biomass) in the following categories:

- Industry;
- Transport: municipal fleet; public transport; private and commercial transport.
- The Global Protocol requires the GHG emissions inventory to be elaborated with a broader scope than the one defined in the Guide of the Covenant of Mayors. According to the requirements of the Global Protocol the emissions are categorized in three levels, that partially coincide with the classification of the GHG emissions sources according to the Guide of the Covenant of Mayors. Level 1 coincides with the direct GHG emissions from stationary and mobile combustion processes, but includes additional categories; Level 2 covers the indirect emissions from electricity and heat energy consumption and Level 3 includes other direct GHG emissions. In addition the Global Protocol defines different levels of reporting but according to the requirements of the contracting authority the “basic” level should be covered.

In addition to the sectors, covered by the inventory according to the Covenant of Mayors, the Global Protocol requires the following sectors, applicable to Sofia Municipality, be covered also:

- Stationary combustion processes in industry (explicitly excluded from the Covenant of Mayors), agriculture and forestry sectors and other sources on the territory of the municipality;
- Accidental emissions from natural gas supply networks ;
- Emissions from rail and air transport;
- Emissions from waste incineration plants

Another basic difference in the requirements of the Global Protocol is that the assessment of the GHG emissions should be done for all GHG gasses (CO<sub>2</sub>, CH<sub>4</sub> и N<sub>2</sub>O) and from all emission sources.

The agriculture and forestry sectors, the emissions from the networks for supply of natural gas and the aviation transport contribute with less than 1% to the total emissions of Sofia Municipality. After a SWOT analyses of the potential for GHG emissions reduction activities in the individual sector, they were excluded from the scope of the SECAP and from the scope of CO<sub>2</sub> emission baseline inventory.

### 3. Methodology

The **direct emissions from fuel consumption** are calculated according to the 2006 IPCC Guide for National GHG emissions Inventory, Volume 2, Chapter 2 – Stationary fuel combustion<sup>3</sup>, according to formula 1:

$$\text{Emissions}_{\text{GHG,fuel}} = AD_{\text{fuel}} * EF_{\text{GHG,fuel}} \quad (1)$$

where:

$\text{Emissions}_{\text{GHG,fuel}}$  are the emissions of the corresponding GHG by fuel type in tons;

$AD_{\text{fuel}}$  – quantity of a given type of fuel used in energy units (TJ or MWh);

$EF_{\text{GHG,fuel}}$  – emission factor for the corresponding GHG and for the corresponding fuel, expressed in t/TJ or t/MWh. For CO<sub>2</sub> this emission factor includes the oxidation factor, determined by default as 1.

To calculate the total GHG emissions of a relevant source category the emissions, calculated in formula (1) are summed for all fuels:

$$\text{Emissions}_{\text{GHG}} = \sum_{\text{fuels}} \text{Emissions}_{\text{GHG,fuel}} \quad (2)$$

The total emissions for a given source category are expressed in t CO<sub>2</sub> equivalent, applying the global warming potential which expresses how much 1 kg of GHG (CH<sub>4</sub> и N<sub>2</sub>O) contributes to the global warming expressed in kilograms of CO<sub>2</sub> equivalent for a period of 100 years according to the IPCC Assessment Report 4<sup>4</sup>. For the conversion of CH<sub>4</sub> and N<sub>2</sub>O emissions in CO<sub>2</sub> equivalent the values are 25 and 298 respectively.

The natural units - t, m<sup>3</sup>, l are converted in energy units - TJ or MWh using the Net Calorific Value (NCV), presented in Table 1.

For the purposes of the Covenant of Mayors MWh has been adopted as a measurement unit. Therefore it is necessary to convert the data and emission factors from TJ to MWh. The conversion factor is 0.0036 or 1 MWh = 0.0036 TJ.

The assessment of **the emissions from electricity used** is based on the electricity consumed and the emission factors are expressed in tCO<sub>2</sub>/MWh, kg CH<sub>4</sub>/MWh, kg N<sub>2</sub>O/MWh. The data for the activity is expressed in MWh consumed electricity. The emissions of the corresponding GHG are calculated by formula 3.

<sup>3</sup>[https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2\\_Volume2/V2\\_2\\_Ch2\\_Stationary\\_Combustion.pdf](https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf)

<sup>4</sup><https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-chapter2-1.pdf>

$$\text{Emissions}_{\text{GHG}} = AD * EF_{\text{GHG}} \quad (3)$$

where:

$\text{Emissions}_{\text{GHG}}$  are the emissions of the corresponding GHG in t;

AD – output data for the total electricity consumption (MWh);

$EF_{\text{GHG}}$  – national emission factor for electricity for the corresponding GHG expressed in t/MWh (see **Error! Reference source not found.**).

The total GHG emissions expressed in CO<sub>2</sub> equivalent are determined by formula 4 applying the global warming potential which expresses how much 1 kg of GHG (CH<sub>4</sub> и N<sub>2</sub>O) contributes to the global warming, expressed in kilograms of CO<sub>2</sub> equivalent, for a period of 100 years, according to the IPCC Assessment Report 4. For the conversion of the CH<sub>4</sub> and N<sub>2</sub>O emissions in CO<sub>2</sub> equivalent the values are 25 and 298 respectively.

$$\text{Emissions}_{\text{electricity}} = \sum_{\text{GHG}} \text{Emissions}_{\text{GHG,electricity}} \quad (4)$$

The evaluation of the emissions from the used heat energy is based on the consumed heat energy and the emission factors are expressed in tCO<sub>2</sub>/MWh, kg CH<sub>4</sub>/MWh, kg N<sub>2</sub>O/MWh. The activity data is expressed in MWh consumed heat energy. The emissions are calculated according to formula 5.

$$\text{Emissions}_{\text{GHG}} = AD * EF_{\text{GHG}} \quad (5)$$

where:

$\text{Emissions}_{\text{GHG}}$  are the emissions of the corresponding GHG in t;

AD – output data for the total consumption of heat energy (MWh);

$EF_{\text{GHG}}$  – national emission factor for heat energy for the corresponding GHG expressed in t/MWh (see **Error! Reference source not found.**).

The total emissions of GHG, expressed in CO<sub>2</sub> equivalent is determined according to formula 6, applying the potential for global warming which expresses with how much 1 kg of GHG (CH<sub>4</sub> и N<sub>2</sub>O) contributes to the global warming expressed in kilograms CO<sub>2</sub> equivalent for a period of 100 year, according to the IPCC Assessment Report 4. For the conversion of the CH<sub>4</sub> and N<sub>2</sub>O emissions in CO<sub>2</sub> equivalent the values are 25 and 298 respectively.

$$\text{Emissions}_{\text{heat}} = \sum_{\text{GHG}} \text{Emissions}_{\text{GHG,heat}} \quad (6)$$

### 3.1. Conversion factors

The following values for Net Calorific Values (NCV) for the conversion of used fuels data from natural (t) to energy (TJ) units. For the purposes of reporting to the Covenant of Mayors the use of MWh units has been adopted, which requires the conversion of the available primary data and emission factors from TJ to MWh. This is done by a factor of 0.0036 (1 MWh = 0.0036 TJ).

Fuel	GJ/t		MWh/t	
	2007	2018	2007	2018
Anthracite coal – other sectors	23.9	29.922	6.64	8.31
Anthracite coal – industry	24.76	29.922	6.88	8.31
Black coal – other sectors	22.94	27.178	6.37	7.55
Black coal – industry	23.55	27.178	6.54	7.55
Lignite and brown coal – other sectors	7.1	6.938	1.97	1.93
Lignite and brown coal – индустрия	12.39	8.354	3.44	2.32
Briquettes – other sectors	18.26	11.513	5.07	3.20
Briquettes – industry	18.51	16.714	5.14	4.64
Propane-butane (LPG)	46	46	12.78	12.78
Gas oil / Diesel fuel	42.3	42.3	11.75	11.75
Petrol	44	44	12.22	12.22
Fuel oil	40	40	11.11	11.11
Natural gas (1000 Nm <sup>3</sup> )	33.61	34.244	9.34	9.51

Table 1 Net calorific value of different fuels

The National Energy Balances, prepared by the National Statistical Institute, in the format for reporting to Eurostat, were. For solid fuels the corresponding Net Calorific Values (NCV) for fuels used in industry and other sectors were used.

For the conversion of the different fuels from volume to weight units the following densities with GHG Protocol<sup>5</sup> as a source were used.

Fuel	kg/l	
	2007	2018
Petrol	0.74	0.74
Diesel	0.84	0.84
Fuel oil	0.94	0.94
Propane-Butane(LPG)	0.54	0.54

Table 2 Fuel density

### 3.2. Emission factors for fuels

For the purposes of the emissions inventory the standard emission factors, specified in the 2006 IPCC<sup>6</sup> Guideline were used, as well as the specific for country emission factors for solid fuels and natural gas from the National GHG emissions Inventory Report<sup>7</sup>. With regard to the CH<sub>4</sub> and N<sub>2</sub>O emissions

<sup>5</sup><http://ghgprotocol.org/calculation-tools/all-tools>

<sup>6</sup><http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html>

<sup>7</sup><https://unfccc.int/documents/225472>

different emission factors for the sectors industry, services and households, according to the 2066 Guideline of IPCC of 2006, were used.

Гориво	t CO <sub>2</sub> /TJ		kg CH <sub>4</sub> /TJ	kg N <sub>2</sub> O/TJ
	2007	2018	2007-2018	2007-2018
Anthracite coal	97.5	105.1822	10 (industry, services)	1.5
Black coal	98.3	88.5682	300 (households)	
Lignite and brown coal	105	101.347		
Briquettes	97.5			
Propane-Butane (LPG)	63.1		1 (industry)	0.1
			5 (services, households)	
Gas oil / Diesel fuel	74.1		3 (industry)	0.6
			10 (services, households)	
Petrol	69.3		3 (industry)	0.6
			10 (services, households)	
Fuel oil	77.4		3 (industry)	0.6
			10 (services, households)	
Natural gas	55.2	55.539	1 (industry)	0.1
			5 (services, households)	
Biomass	112		30 (industry)	4
			300 (services, households)	

Table 3 Emission factors for fuels used

### 3.3. Emission factors for electricity

The emission factor for electricity for 2018 is taken from the Fifth National Progress Report of Bulgaria for the Promotion and Use of Energy from Renewable Sources<sup>8</sup>. For the previous years the estimated in the previous inventories emissions factor was used, based on the data from the national energy balances and the calculations for the National Report on GHG emissions.

	t CO <sub>2</sub> /MWh		kg CH <sub>4</sub> /MWh		kg N <sub>2</sub> O/MWh	
	2007	2018	2007	2018	2007	2018
Electricity	0.611	0.461	0.007	0.005	0.009	0.007

Table 4 Emission factors for electricity used

### 3.4. Emission factors for heat energy

The emission factor for heat energy is calculated on the base of the information presented by Sofia District Heating EAD for the total consumption of natural gas, fuel oil and industrial gas oil and the total amount of the supplied heat and electricity. The calculation of the GHG emissions is done on the base of the methodology from the 2006 IPCC Guidelines.

The following GHG emission values per MWh heat supplied were obtained:

<sup>8</sup>[https://www.me.government.bg/files/useruploads/files/vp\\_espuer\\_2017.pdf](https://www.me.government.bg/files/useruploads/files/vp_espuer_2017.pdf)

	t CO <sub>2</sub> /MWh		kg CH <sub>4</sub> /MWh		kg N <sub>2</sub> O/MWh	
	2007	2018	2007	2018	2007	2018
Heat energy	0.293	0.2402	0.0056	0.0043	0.0006	0.0004

*Table 5 Emission factors for heat energy used*

### 3.5. Primary data

The main source of primary data on the final fuel consumption is the National Statistic Institute (NSI). As the NSI cannot provide information on energy consumption on the territory of Sofia Municipality, but only at the national level, it is necessary to assess the consumption according to the approach described in Chapter 5.3.1 of the Global Protocol. The following chapters present in detail the approach by individual subsectors.

## 4. Sources of emissions

### 4.1. Households

To estimate the households consumption, the data on fuel consumption at the national level, the data about the number of households in the country and in Sofia Municipality, as well as the structure of the households heating according to the 2011 Population and Household Census<sup>9</sup>, were used. The data about the number of households for 2007 and 2018 are based on expert assessment.

	2007	2018
Bulgaria	2 969 531	2 708 000
Sofia	511 995	573 572
Share	17.2%	21.2%

*Table 6 Number of households in Sofia Municipality and the country*

The NSI also provided the structure of households heating patterns according to the 2011 Census:

	Bulgaria	Sofia
Central heating	15.48%	61.37%
Natural gas from a central source	1.30%	1.70%
Electricity	28.80%	23.87%
Diesel fuel	0.17%	0.13%
Propane-Burane	0.69%	0.78%
Coal	19.64%	6.48%
Wood	33.61%	5.17%
Others	0.31%	0.50%

*Table 7 Structure of the households heating*

Based on the above data, the number of the households on the territory of Sofia Municipality and the country, using various energy sourced for heating, were calculated. The number of households was used for the calculation of the share of total fuel consumption in Sofia Municipality compared to the national one.

<sup>9</sup><https://www.nsi.bg/statlib/bg/lister.php?iid=DO-010007636>

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	Bulgaria		Sofia		Share %	
	2007	2018	2007	2018	2007	2018
Central heating	459 683	419 198	314 211	352 001	68.40%	83.97%
Natural gas	38 604	35 204	8 704	9 751	22.50%	27.70%
Electricity	855 225	779 904	122 213	136 912	14.30%	17.55%
Diesel fuel	5 048	4 604	666	746	13.20%	16.20%
Propane-Butane	20 490	18 685	3 994	4 474	19.50%	23.94%
Coal	583 216	531 851	33 177	37 167	5.70%	6.99%
Wood	998 059	910 159	26 470	29 654	2.70%	3.26%
Others	9 206	8 395	2 560	2 868	27.80%	34.16%

*Table 8 Number of households and percentage of fuel consumption*

The total fuel consumption in the country was provided by NSI.

Fuel	2007	2018
Anthracite coal (1000 t)	0.1	3.181
Black coal (1000 tr)	250.2	143.195
Lignite and brown coal (1000 t)	80.2	43.659
Briquettes (1000 t)	143.7	31.317
Wood (TJ)	25 415	30 480
Propane-Butane (1000 t)	22.7	20.014
Gas oil /diesel fuel (1000 t)	1.3	0.119

*Table 9 Total consumption of fuels by the households in Bulgaria*

Based on the above data the consumption of the households in Sofia Municipality was estimated. The conversion from natural to energy units was done using the values from Table 1.

The data on the consumption of natural gas, electricity and heat for household subscribers are provided by Overgas Networks AD, CEZ Electro Bulgaria AD and Toplofikatsiya Sofia EAD.

Fuel	Natural units		TJ	
	2007	2018	2007	2018
Anthracite coal (t)	7	222	0.2	6.65
Black coal (t)	14 232	10 007	326.5	271.97
Lignite and brown coal (t)	4 560	3 051	32.4	25.49
Briquettes (t)	8 174	2 189	149.2	36.58
Wood (TJ)			674	971.07
Propane-Butane (t)	4 434	4 792	204	220.43
Gas oil / Diesel fuel (t)	172	19	7	0.82
Natural gas (1000 Nm3)	10 723	29 528	360	1 011.16
Electricity (MWh)	1 978 000	2 039 502	7 121	7 342.21
Heat energy (MWh)	3 283 625	2 774 327	11 821	9 987.58
<b>TOTAL</b>			<b>1 753.3</b>	<b>19 873.95</b>

*Table 10 Consumption of energy by the households in Sofia Municipality*



The emission factors from **Error! Reference source not found.** were used to calculate the emissions, but the CO<sub>2</sub> emissions from biomass were excluded from the total amount according to the requirements of the Global Protocol, and those of CH<sub>4</sub> and N<sub>2</sub>O were taken into account.

Fuel	Emissions t CO <sub>2</sub> e	
	2007	2018
Anthracite coal	17	752
Black coal	34 700	26 249
Lignite and brown coal	3 656	2 786
Briquettes	15 737	3, 857
Wood	5 859	8, 441
Propane-Butane	12 901	13 943
Gas oil / Diesel fuel	541	61
Natural gas	19 945	56 315
<b>Electricity</b>	<b>1 213 588</b>	<b>943 377</b>
<b>Heat energy</b>	<b>963 181</b>	<b>667 045</b>
<b>Total solid fuels</b>	<b>59 969</b>	<b>42 085</b>
<b>Total liquid fuels</b>	<b>13 442</b>	<b>14 004</b>
<b>Total gaseous fuels</b>	<b>19 945</b>	<b>56 315</b>
<b>TOTAL</b>	<b>2 270 125</b>	<b>1 722 827</b>

Table 11 GHG emissions from the households in Sofia Municipality

The main sources of household emissions are the consumption of electricity (54.8%) and heat energy (38.7%), and the rest of the total emissions from fuel combustion are 6.5%. In 2018, compared to the 2007 baseline year, a decrease in the consumption of heat energy by 15.5% was observed, at the expense of that of gaseous fuels, whose consumption increased by 180.9%. Growth was also observed in the use of solid fuels (10.9%). As a final result, in the household sector, a slight decrease of energy consumption of 4.0% in 2018 compared to the 2007 baseline year is observed, mainly due to the decrease of heat energy consumption. The decrease of emissions by 24.1%, in result of the decrease in the electricity production emission factor due to the introduction of renewable energy capacities at the national level.

#### 4.2. Trade and services

For the estimation of the solid and liquid fuels in trade and services sectors, data provided by the NSI was used.

## Baseline inventory of the green gas emissions on the territory of Sofia Municipality | 2007

Fuel	2007	2018
Anthracite coal (1000 t)	0.3	1.1
Black coal (1000 t)	2.1	1.9
Lignite and brown coal (1000 t)	3.2	2.0
Briquettes (1000 t)	2.9	0.4
Wood (TJ)	625	352.0
Propane-Butane (1000 t)	0	9.2
Gas oil / Diesel fuel (1000 t)	32.6	13.8
Fuel oil (1000 t)	16.5	2.2

*Table 12 Total consumption of fuels from trade and services sectors*

When preparing the inventory for 2015 the possible approaches for redistribution of the consumption at the national and municipal levels were analyzed, and the following possibilities were considered:

- to make a redistribution on the base of economic indicators – for example, according to the gross value added by the sector, but since it amounts to 50% of the total for the country in 2015, this might lead to significant overestimation of the emissions from all sources;
- to make a redistribution on the base of the population, but it does not take into account the differences in the structure of heating in Sofia and in the country, which will again lead to overestimation of the emissions of solid and liquid fuels.

A decision was made<sup>3</sup> the total consumption of solid and liquid fuels to be redistributed B redistributed according to the percentages calculated in **Error! Reference source not found.** for the household sector.

The same approach was applied in the 2018 inventory to ensure consistency of the timeline.

The data for the natural gas consumption were provided by Overgas Networks AD. The data provided by Toplofikatsiya EAD contain information concerning the consumption of heat energy divided into household and business consumers, which include both the services sector and the industrial enterprises.

In the data presented by CEZ Electro Bulgaria AD the supplied energy is divided in household and industrial consumers. To the electricity supplied by CEZ Electro Bulgaria AD is added the electricity supplied to consumers registered on the free market, data for which was also provided by CEZ Distribution Bulgaria AD. As for the purposes of reporting to the Global Protocol it is necessary to indicate separately the consumption of the services sector and the industrial sector, the relative share of the two sectors, in relation to the data at the national level, was also calculated. However from the point of view of the total GHG emissions the conditional distribution of the consumption between the services and the industry sector does not matter.

To ensure the consistency of the timeline the same approach was applied in the preparation of the 2018 inventory.

	Services		Industry	
	2007	2018	2007	2018
Electricity (GWh)	7 067	8 470.55	10 179	9 871.65
Share of consumption (%)	41%	46%	59%	54%

Table 13 Total electricity consumption at the national level.

The consumption of the municipal enterprises, commercial companies and buildings (incl. schools, kindergartens, community centers, administrative buildings, etc.) is deducted from the total consumption of the services sector, as reporting to the Covenant of Mayors requires a separate assessment of their emissions.

Below is the final estimate of the consumption of the tertiary sector on the territory of Sofia Municipality.

Fuel	Natural units		TJ	
	2007	2018	2007	2018
Anthracite coal (t)	19	110	0.5	2.3
Black coal (t)	119	320	2.7	8.4
Lignite and brown coal (t)	185	222	1.3	1.9
Briquettes (t)	166	42	3	0.7
Wood (TJ)			17	10.3
Propane-Butane (t)	0	1 309	0	60.2
Gas oil / Diesel fuel (t)	2 843	2 069	120	87.5
Fuel oil (t)	1 346	3 248	54	129.9
Natural gas (1000 Nm3)	12 248	24 656	412	844.3
Electricity (MWh)	768 736	1 024 941	2 767	3 689.8
Heat energy (MWh)	341 396	398 337	1 229	1 434.0
TOTAL			4 606	6 270.7

Table 14 Energy consumption from trade and services sectors of Sofia Municipality (without municipal enterprises, commercial companies and buildings)

The emissions of the sector are calculated by the emission factors in **Error! Reference source not found..**

Fuel	Emissions t CO <sub>2</sub> e	
	2007	2018
Anthracite coal	45	2
Black coal	270	776
Lignite and brown coal	139	190
Briquettes	297	68
Wood	144	90
Propane-Butane	0	3 809
Gas oil / Diesel fuel	8 964	6 524
Fuel oil	4 192	10 110
Natural gas	22 784	47 023
<b>Electricity</b>	<b>471 653</b>	<b>474 089</b>
<b>Heat energy</b>	<b>100 141</b>	<b>95 774</b>
<b>Total solid fuels</b>	<b>894</b>	<b>1 126</b>
<b>Total liquid fuels</b>	<b>13 155</b>	<b>20 444</b>
<b>Total gaseous fuels</b>	<b>22 784</b>	<b>47 023</b>
<b>TOTAL</b>	<b>608 627</b>	<b>638 456</b>

Table 15 GHG emissions from trade and services sectors in Sofia Municipality

Main sources of emissions in the tertiary sector are the consumption of electricity with 58.8% and heat energy with 22.9%, followed by natural gas with 13.5%. The sector marks a significant increase of consumption in 2018 in comparison with the 2007 baseline year; and the main reason being the increase electricity consumption and growth in the consumption of natural gas and liquid fuels. As a final result in the tertiary sector, a considerable increase of energy consumption of 36.1% in 2018 compared to the 2007 baseline year is observed. due to the growth of gaseous fuels consumption. The emissions also increase by 4.9%. As the sector is expected to continue to expand future growth of emissions is also expected.

#### 4.3. Municipal buildings, equipment and facilities

For the needs of the elaboration of the 2021-2030 SEAP an organization was created for collection of the most reliable data for the energy consumption in the municipal buildings sector; building by building, including data for municipal companies and enterprises. Within the deadline for data collection a very good representative sample, with detailed information for the buildings was provided, covering over 47 % of the total built-up area. The data was carefully checked for reliability and all unreliable data was removed. Then the specific energy consumption, in relation to the total built-up area for each type of building, was calculated. From the cadastral map of Sofia Municipality were extracted data for the total built-up area of all municipal buildings by functional purpose. The total amount of energy for the whole sector was calculated according to the identified specific consumption by type of building

Fuel	TJ		Emissions t CO <sub>2</sub> e	
	2007	2018	2007	2018
Biomass	0	12	0	113
Gas oil / Diesel fuel	61	71	4 567	5 319
Fuel oil	33	0	2 562	0
Natural gas	38	83	2 092	5 734
Electricity, MWh	148	65	25 155	14 113
Heat energy, MWh	430	246	35 001	20 225
Coal	0	0	0	9
TOTAL	709	477	69 378	45 512

Table 16 Consumption of energy and GHG emissions from municipal enterprises, commercial companies and buildings

The main source of emissions from municipal enterprises, commercial companies and buildings is the consumption of electricity and heat energy. The data analyses shows that there is a decrease in the consumption by 15.5% and drop in the emissions by 34.4%. The basic reason for the drop is the decrease of liquid fuels, electricity and heat energy consumption, despite the increase of the gaseous and biomass consumption.

#### 4.4. Municipal street lighting and traffic lights

According to the requirements of the Covenant of Mayors the consumption of electricity for street lighting and traffic lights should be reported separately.

	MWh		Emissions t CO <sub>2</sub> e	
	2007	2018	2007	2018
Street lighting and Traffic lights	39 345	45 073	24 140	20 849

Table 17 Municipal street lighting and traffic lights

Despite the implemented measures for replacement of a large part of the traffic lights and the street lighting with energy saving ones, we have an increase in the total consumption due to the increased number of the lighting fixtures. The decrease of the GHG emissions is due to the reduction of the emission factor for electricity production following the introduction of RES capacities at the national level.

#### 4.5. Industry and construction

This is the most difficult sector to assess due to its diversity, including companies from the following main sectors:

- Black metallurgy;
- Non-ferrous metallurgy;
- Chemical industry;

- Paper production;
- Food industry;
- Non-metallic materials and raw materials;
- Manufacture of machinery and equipment;
- Manufacture of vehicles;
- Mining of ores, materials and raw materials;
- Production of timber and timber materials;
- Construction;
- Production of textiles and clothing;
- Others.
- In the previous inventory for 2015 an approach was applied , which is also used in the current inventory, in order to ensure the consistency of the timeline.

The approach in the 2015 inventory consists in the reviewing the verified reports of the enterprises on the territory of Sofia Municipality, participating in the EU Emission Trading System (ETS):

- „Druzba Glass Factories (present BAGlass Bulgaria) (glass production) – uses natural gas only;
- SofiaMed (non-ferrous metallurgy) – uses natural gas only;
- Interpaip (steel goods) – uses natural gas only, operated until 2010;
- Toplofikatsiya Sofia (energy generation) – uses natural gas, fuel oil and gas oil. Direct emissions are excluded from the assessment as they are redistributed to other sectors as emissions from heat energy consumption.

Based on the reviewed data a conclusion was made that a redistribution of the national fuel consumption for the subsectors food industry and construction could be made, as in the other industrial subsectors there are either no large emitters or the fuel used is natural gas most likely or they are participating in EETS.

In order to estimate the consumption of solid and liquid fuels in the industry and construction sectors in the current inventory, data provided by NSI at the national level, is used. The consumption of the food industry and construction was taken into account only and the installations, participating in the EETS, were excluded as required by the Convent.

The data about the natural gas consumption by the industrial sector was provided by Overgas Networks AD and Bulgargaz EAD and no redistribution was made for them. With regard to electricity and heat consumption the data provided by Toplofikatsiya Sofia EAD the consumption is divided into households and business consumers which include both enterprises from the services sector and industrial enterprises. The distribution between the two sectors is done on basis of their calculated shares in **Error! Reference source not found.**

## Baseline inventory of the green gas emissions on the territory of Sofia Municipality | 2007

In addition to the electricity supplied by CEZ Electro Bulgaria AD and CEZ Distribution Bulgaria AD, the electricity supplied by the Electricity System Operator EAD (ESO) to consumers connected directly to the electricity transmission network is added. It is assumed here that all consumers are from the industry sector (without redistribution to the trade and services sectors). With regard to the data received from ESO the problem with the provision of information on the consumption in the 2007 baseline year remains, as the term for which ESO has an obligation to store the information has expired and the reference cannot be provided. In order to correctly compare the trend the values for 2011 were taken as consumption for the 2007 baseline year.

Below is the final estimate of the industry and construction sectors consumption on the territory of Sofia Municipality.

Fuel	MWh	
	2007	2018
Total solid fuels	36 801	98 414
Total liquid fuels	340 390	92 912
Natural gas	3 464 337	1 067 305
Electricity	1 231 161	1 664 979
Heat energy	491 767	85 834
<b>TOTAL</b>	<b>5 564 457</b>	<b>3 009 444</b>

*Table 18 Consumption of energy from industrial and construction sectors in Sofia Municipality*

The emission of the sector are calculated by applying the emission factors from Table 3.

Fuel	Emissions t CO <sub>2</sub> e	
	2007	2018
Electricity	755 370	770 140
Heat energy	144 249	20 637
Total solid fuels	11 503	1 960
Total liquid fuels	92 989	24 831
Total gaseous fuels	688 915	213 948
<b>TOTAL</b>	<b>1 693 027</b>	<b>1 031 517</b>

*Table 19 GHG emissions from the industry and construction sectors of Sofia Municipality*

The main source of emissions in the industry and construction sectors is electricity with 55.3%, followed by natural gas with 35.5%. The sector registers a significant decline of 45.9% in consumption and 39.1% in emissions in the period 2007-2018, the main reason being the reduced consumption of natural gas, heat energy and liquid fuels, despite the increase of the consumption of solid fuels and electricity.

#### 4.6. Road transport

##### 4.6.1. Private and commercial transport

The output data for GHG emissions calculations of this sector were not provided that's why the assessment of the emissions was performed on the base of the methodology and the data used in the 2015 inventory.

Many parameters affect the emissions and those of CH<sub>4</sub> and N<sub>2</sub>O in particular. Such are for example the vehicles EURO category the engines cubic capacity, the speed of movement, the engine temperature, the quality characteristics of the fuels, etc. Although the data for the fuels used and the average annual mileage of the vehicles is available at the national level, no official estimate at the municipal level are made which requires assumptions to be made to estimate the emissions.

The calculation of the GHG emissions is performed according to the EMEP/EEA Air Pollutant Emission Inventory Guidebook<sup>10</sup> and the general formula:

$$E_i = AD_i * EF_i,$$

where

$E_i$  are the GHG emissions in t

$AD_i$  are the primary data for the total annual mileage of the specific vehicle category (in km).

$EF_i$  is the emission factor for the specific category, expressed in g/km

The total annual mileage in urban conditions for each category of vehicle can be calculated by multiplying the number of cars for the specific category by the average mileage in the city

The total number of vehicles in Sofia Municipality and their distribution by category and fuel type is provided by the Ministry of the Interior (Mol). Additional processing of the data was done, as in the information system of the Mol the vehicles are grouped in 21 categories (incl. trailers and semi-trailers). In addition the categories of fuels are 15, and the information for the exact fuel type for some of them is not sufficient (e.g. for the categories petrol/gas, diesel/gas and gas it cannot be determined whether the vehicle is fueled with methane or propane-butane). The vehicles are grouped in 4 categories: cars, vans, trucks, motorcycles and mopeds, distributed in 4 groups by fuel type: petrol, diesel oil, propane-butane and methane. Regarding the number of vehicles on propane-butane and methane they are all considered to be passengers cars, as the EMEP/EEA Air Pollutant Emission Inventory Guidebook does not provide emission factors for vans using these fuels. Buses are excluded from the calculations for this sector as a separate estimation is made for the public transport emissions.

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<sup>10</sup><http://www.eea.europa.eu/themes/air/emep-eea-air-pollutant-emission-inventory-guidebook>



As for the purposes of reporting under the Covenant of Mayors it is necessary to report separately the emissions from private and commercial transport, public and the one of municipal enterprises and commercial companies, below are presented only the results for private and commercial transport, applying the growth of consumption of the different types of fuels as applied growth for each fuel as reported in the National Inventory of GHG Emissions of Bulgaria for 2018.<sup>11</sup>

Fuel	Total fuels TJ		Emissions (t CO <sub>2</sub> e)	
	2007	2018	2007	2018
Liquid fuels	9 552	11 212	699 510	828 560
Gaseous fuels	148	405	8 465	23 268
<b>TOTAL</b>	<b>9 700</b>	<b>11 618</b>	<b>707 975</b>	<b>851 828</b>

*Table 20 Emissions from private sector and commercial transport (excluding public and departmental transport)*

The main source of GHG emissions in the private and commercial transport in 2018 is the diesel fuel whose share steadily increases at the expense of petrol. The total fuel consumption is growing which leads to an increase of the emissions by 20.3% in 2018 compared to the 2007 baseline year.

#### 4.6.2. Public transport

In order to estimate the GHG emissions from the public transport data on the annual mileage and the fuels used (diesel fuel and methane) was collected both for the buses of the Stolichen Transport EAD and for private carriers. As information for the shares of the total mileage of the diesel fuel and methane buses is not available separately, a redistribution was made based on the amount of fuel used.

Fuel	Total mileage (thousand kms)		Total fuel t		Total fuel TJ	
	2007	2018	2007	2018	2007	2018
Diesel	49 425	24 002	16 046	7 885	679	333.6
CNG	2 037	8 518	741	4 991	36	244.3
<b>TOTAL</b>	<b>51 462</b>	<b>32 520</b>			<b>715</b>	<b>577.9</b>

*Table 21 Total mileage and fuels used by the public transport*

In order to estimate the GHG emissions from the public transport data on the annual mileage and the fuels used (diesel fuel and methane) was collected both for the buses of the Stolichen Transport EAD and for private carriers. As information for the shares of the total mileage of the diesel fuel and methane buses is not available separately, a redistribution was made based on the amount of fuel used.

<sup>11</sup><https://unfccc.int/documents/225460>

Electric transport	Electricity (MWh)	
	2007	2018
Trams	30 503	27 200
Trolley buses	18 557	18 262
Underground (metro)	7 732	62 944.2
<b>TOTAL</b>	<b>56 792</b>	<b>108 406.2</b>

Table 22 Electricity used by the public transport

The GHG emissions from the public transport are calculated according to the same methodology as that for the private transport.

The total GHG emissions from the public transport are presented below:

	Emissions t CO <sub>2</sub> e	
	2007	2018
Electricity	34 844	50 190
Diesel fuel	50 740	25 301
Methane	2 070	14 408
<b>TOTAL</b>	<b>87 654</b>	<b>89 899</b>

Table 23 GHG emissions from public transport

The basic source of GHG emissions in the public transport in 2018 is the electricity consumption with 55.8%. Significant increase in the consumption of electricity and gaseous fuels is observed in the period 2007-2018 and a significant decrease in the consumption of liquid fuels. The main reason for the decrease of the emissions is the absorption of an increasing part of the passengers flow from the metro lines which leads to significant decrease in the use of diesel fuel.

#### 4.6.3. Interdepartmental transport

Data on the mileage and the consumed fuels from the interdepartmental transport of Sofia Municipality was collected for the calculation of the emissions. Although there are certain inconsistencies with regard to the data for municipal companies and enterprises the lack of data may lead to inaccuracies only with regard to the distribution between municipal and private transport, but would not be relevant for the total emissions from the road transport sector. According to the applied methodology of the total estimated emissions from road transport are subtracted the emissions from the interdepartmental transport and the rest is reported as emission from the private sector.

Fuel	Total fuels MWh		Емисии (t CO <sub>2</sub> e)	
	2007	2018	2007	2018
Liquid fuels	3 611	2, 331	3 025	5 499
Gaseous fuels	8 056	18 280	13	7
<b>TOTAL</b>	<b>11 667</b>	<b>20 996</b>	<b>3 039</b>	<b>5 506</b>

Table 24 Fuel consumption and emissions from departmental transport

The main source of GHG emissions from the interdepartmental transport is diesel fuel. The consumption of fuels from interdepartmental transport increased by 80.8% in 2018 r. compared to the 2007 baseline year and the emissions increased by 81.2%, although this is largely due to the lack of complete information for the consumption of municipal enterprises and companies during the baseline year.

#### 4.7. Railway transport

Data from the DP National Railway Infrastructure Company for the consumption of electricity, from substations on the territory of Sofia Municipality, is used for the assessment of the GHG emissions. Data from Holding Bulgarian State Railways EAD for the used diesel fuel, in directions with initial and terminal stations on the territory of Sofia Municipality, was also used. To be able to assess the fuels used within the municipality information was obtained on the total length of the routes in kilometers and their length in Sofia Municipality.

Fuel	Total fuels TJ		Emissions (t CO <sub>2</sub> e)	
	2007	2018	2007	2018
Diesel	19	19	1 435	1 453
Electricity	93	69	15 820	8 918
TOTAL	112	89	17 255	10 371

Table25 Energy consumption and GHG emissions from railway transport

#### 4.8. Waste

##### 4.8.1. Solid household waste

CH<sub>4</sub> emissions from solid household waste, are calculated on the base of the data provided by the Waste Management and Control Activities department of Sofia Municipality for the amounts of the waste generated, disposed of, biologically treated and incinerated for the period 1997-2018.

##### 4.8.2. Landfilling of solid household waste

*The calculation of the CH<sub>4</sub> emissions from the disposal of solid household waste are based on the data for the deposited solid household waste at the landfills, operating on the territory of Sofia Municipality in the period 1997-2018. From the total amount of all landfilled waste at Vrazdebna landfill the quantities of bulky waste were deducted (as they have nothing to do with the methane emissions formation) and only the quantities of the landfilled biodegradable waste were taken into account.*

The calculation methodology, described in the Guide for the National GHG Emissions Inventory with the International Panel on Climate Change (2006 IPCC Guidelines), according to the **First Order of Decay** method was used. The quantities of landfilled waste, the morphology of the waste, the organic content and the potential for methane formation of different types of waste, the utilized amount of

waste, are taken into account from the date of landfill opening. As the decomposition of the organic waste is a slow process and not all the landfill is decomposed in the same year, the annual methane emissions are calculated on the basis of the waste accumulated in the landfills for the whole period of operation.

The calculations are made using a calculation method developed by IPCC<sup>12</sup>. The method calculates the annual methane emissions based on a number of parameters, specific for the different geo-political and climatic zones. For the purpose of this inventory standard factors for Eastern Europe and temperate climate zone were used.

The option for calculation of emissions, based on the organic component in different types of solid waste, was used. A morphology of the waste, provided by the Waste Management department of Sofia Municipality, was applied. As the morphology is not measured on annual bases, the model includes the morphology made in 2008 and 2015 r.<sup>13</sup>

Type of waste	Food waste	Garden waste	Paper and Cardboard	Wood waste	Textile waste	Plastic and other inert materials
<b>2008</b>	12%	2%	19%	2%	5%	60%
<b>2015</b>	20%	8%	23%	3%	3%	44%

Table 26 Waste morphology of the waste in Sofia Municipality

The global warming potential factor 25 was used for the conversion of the CH<sub>4</sub> emissions and the resulting emissions were expressed in tones of CO<sub>2</sub> equivalent (t CO<sub>2</sub>e). The results from the calculations are presented in the Table below:

	2007	2018
Emissions in t CH <sub>4</sub>	4 945	6 519
Emissions in t CO <sub>2</sub> e	123 633	162 963

Table 27 Emissions from waste treatment

#### 4.8.3. Biological treatment of solid household waste

According to the data from the Sofia Waste Treatment Plant (SWTP) the total amount of generated methane is used for energy recovery or flare incineration. Methane is not released into the atmosphere except in the case of biogas overproduction and it cannot be utilized or due to emergency situation. Since the commissioning of the plant until the moment of this inventory preparation, such cases have not occurred. Therefore the CH<sub>4</sub> emissions from bio-recovery should not be taken into account in the inventory. Emissions of carbon dioxide, in result of burnt biogas, are not included in the emissions from fuel combustion, as they are of biogenic origin. As stated in Section 6.2.1 of the Waste

<sup>12</sup>[http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5\\_Volume5/IPCC\\_Waste\\_Model.xls](http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/IPCC_Waste_Model.xls)

<sup>13</sup> Some of the waste types are combined to match the waste types of the model.

Good Practices Guide (2006 IPCC Guidelines), an estimate of the CH<sub>4</sub> and N<sub>2</sub>O emissions, from recovery and combustion of biogas, is not required as they are insignificant.

4.8.4. Incineration from clinical and hazardous waste

Data on the quantities of waste , provided by the Executive Environment Agency (EEA) for 2015 was used to determine the GHG emissions from the incineration of clinical and hazardous waste. As such data was not provided it was assumed that the quantities of incinerated waste have remained unchanged.

	2007	2018
Quantities of incinerated waste without energy recovery (D10), tons	1 120	751
Quantities of incinerated waste with energy recovery (R01), tons	0	0
Quantities of incinerated hazardous waste without energy recovery (D10), tons	243	83
Quantities of incinerated hazardous waste with energy recovery (R01), tons	0	0

Table 28 Quantities of incinerated waste

All GHG emissions should be reported in section Waste as there are no waste incinerated with energy recovery.

The approach, described in the GHG Emissions Inventory Guide for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions calculation, was applied.

CO<sub>2</sub> emissions are calculated according the following formula:

$$CO_2 \text{ Emissions} = \sum_i ( SW_i \cdot dm_i \cdot CF_i \cdot FCF_i \cdot OF_i ) \cdot 44 / 12$$

where:

**CO<sub>2</sub>Emissions** = CO<sub>2</sub> emissions in the year of the inventory

**SW<sub>i</sub>** = total quantity of solid waste of each type incinerated waste *i* (wet mass)

**dm<sub>i</sub>** = dry matter content of incinerated waste *i* (fraction)

**C<sub>f</sub>*i*** = carbon fraction of the total amount of waste (standard factors: for clinical waste = 60%, for hazardous waste = 50%)

**FCF<sub>i</sub>** = fraction of fossil carbon form the total amount of carbon (standard factors: for clinical waste = 40%, for hazardous waste = 90%)

**OF<sub>i</sub>** = oxidation factor (standard factor = 100%)

**44/12** = conversion of C to CO<sub>2</sub>

***i*** = type of incinerated waste: hazardous waste or clinical waste

The CH<sub>4</sub> emissions are calculated according to the following formula:

$$CH_4 \text{ Emissions} = \sum_i (IW_i \cdot EF_i)$$

where:

**CH<sub>4</sub>Emissions** = CH<sub>4</sub> emissions in the year of inventory

**IW<sub>i</sub>** = quantity of incinerated waste by type *i*

**EF<sub>i</sub>** = aggregated emission factor for CH<sub>4</sub> (standard factors: for clinical waste = 6 kg/Gg,  
for hazardous waste = 6 kg/Gg)

*i* = type of incinerated waste: hazardous waste or clinical waste

The N<sub>2</sub>O emissions are calculated according to the following formula:

$$N_2O \text{ Emissions} = \sum_i (IW_i \cdot EF_i)$$

where:

**N<sub>2</sub>O Emissions** = N<sub>2</sub>O emissions in the year of the inventory

**IW<sub>i</sub>** = quantity of incinerated waste by type *i*

**EF<sub>i</sub>** = aggregated emission factor for N<sub>2</sub>O (standard factors: for clinical waste = 50 kg/Gg,  
for hazardous waste = 450 kg/Gg)

*i* = type of incinerated waste: hazardous waste or clinical waste

The total emissions form incinerated clinical and hazardous waste are presented in the following Table:

	2007	2018
Carbon dioxide emissions (t CO <sub>2</sub> )	1 387	798
Methane emissions (t CH <sub>4</sub> )	0	0
Nitrous oxide emissions (t N <sub>2</sub> O)	0	0
<b>EMISSIONS TOTAL (t CO<sub>2</sub>e)</b>	<b>1 437</b>	<b>820</b>

Table 29 Emissions from waste incineration

#### 4.8.5. Wastewaters treatment

*In 2007 the water treatment was done in aerobic conditions. In 2011 a project for rehabilitation and modernization was implemented and then the water treatment became aerobic / anaerobic, with removal of nitrogen and phosphorous and production of heat and electricity from the biogas obtained in the process of the sludge treatment. In 2007 the aerobic stage was the main one while the methane tanks were partially operated.*

#### Emissions of CH<sub>4</sub>

The amounts of CH<sub>4</sub>, released in the atmosphere, are zero as the total amount of generated biogas was utilized for energy. Emissions of carbon dioxide, as a result of the burned biogas, are not included in the emissions from fuels combustion as they are of biogenic origin. As stated in section 6.2.1 of the Waste Good Practices Guide (2006 IPCC Guidelines), an estimate of the CH<sub>4</sub> and N<sub>2</sub>O emissions from biogas recovery and combustion is not required, as they are insignificant.

#### Emissions of N<sub>2</sub>O

The calculation of the N<sub>2</sub>O emissions from the wastewaters treatment is based on the data about the number of population and the annual, for the country, average daily protein intake per capita. Specific data for Bulgaria of the Food and Agriculture Institute (FAO) and the national inventory of the GHG emissions 2020 report were used. The following formula for the calculation of the N<sub>2</sub>O emissions (2006 IPCC) was used:

$$\text{N}_2\text{O emissions} = [(P * \text{Protein} * F_{\text{NPR}} * F_{\text{NON-CON}} * F_{\text{IND-COM}}) - N_{\text{SLUDGE}}] * EF_{\text{EFFLUENT}} * 44/28,$$

where:

**N<sub>2</sub>O emissions** = N<sub>2</sub>O emissions from household waste (kg N<sub>2</sub>O/P.A.)

**P** = population (number)

**Protein** = annual protein intake per capita (kg/person/P.A.)

**F<sub>NPR</sub>** = nitrogen fraction in protein (standard factor = 0.16 kg N/kg protein)<sup>14</sup>

**F<sub>NON-CON</sub>** = factor for unconsumed protein (standard factor = 1.4)

**F<sub>IND-COM</sub>** = factor for sewage discharged protein from industrial systems (standard factor = 1.25)

**N<sub>SLUDGE</sub>** = nitrogen removed from sludge (standard factor = 0 kg N/P.A.)

**EF<sub>EFFLUENT</sub>** = emission factor (standard factor 0.01 kg N<sub>2</sub>O-N/kg N)

**44/28** = conversion from kg N<sub>2</sub>O-N to kg N<sub>2</sub>O

The total emissions from the wastewater treatment and the output data are presented in the Table below:

	2007	2018
Protein intake (g/person/day)	76	83.41
Population of Sofia Municipality (number)	1 240 788	1 328 120
Nitrous oxide emissions (t N <sub>2</sub> O)	76	89
Emissions total (t CO <sub>2e</sub> )	22 746	26 509

Table 30 Emission from wastewater treatment and output data

<sup>14</sup> All standard data is taken from Chapter 6 of the Guide for GHG Emissions Inventory (2006 IPCC Guidelines).

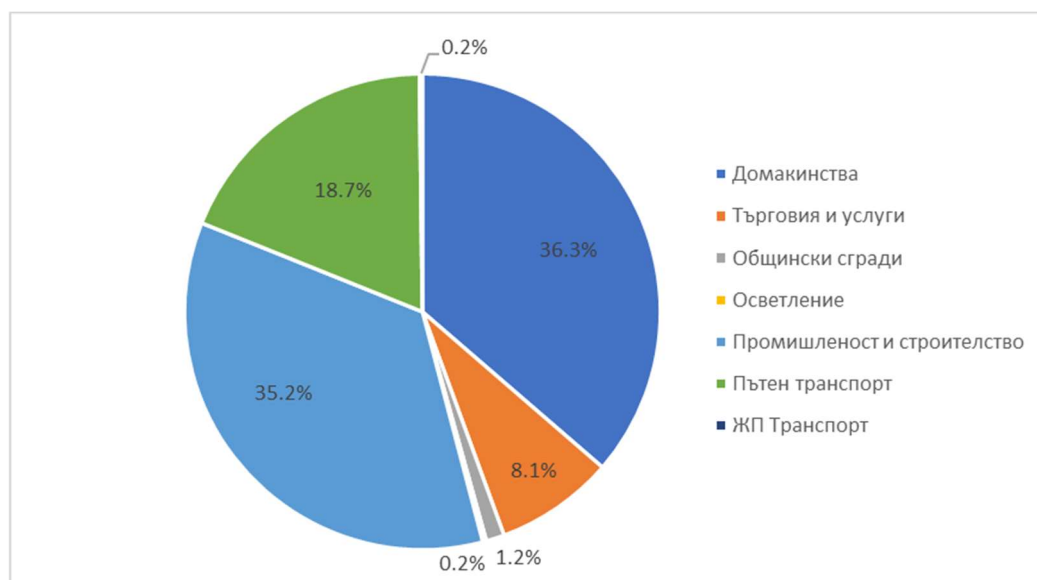
## 5. General results

The inventory of the GHG emissions of Sofia Municipality and the output data are presented in Annex 1 and is available in electronic format in two versions: one includes categorized emissions at three levels, as required by the Global Protocol, and the other one is part of the Sustainable Energy and Climate Action Plan form under the Covenant of Mayors.

### 5.1. Energy consumption during the 2007 baseline year

The total energy consumption on the territory on the municipality in 2007 is 15 821 731 MWh, and the distribution by sectors is as follows:

Sector	Energy consumption in MWh	Share of the total energy consumption %
Households	5 748 842	36.3%
Trade and Services	1 279 559	8.1%
Municipal buildings	196 995	1.2%
Lighting	39 345	0.3%
Industry and Construction	5 564 457	35.2%
Road transport	2 961 397	18.7%
Railway transport	31 136	0.2%
<b>TOTAL</b>	<b>15 821 731</b>	



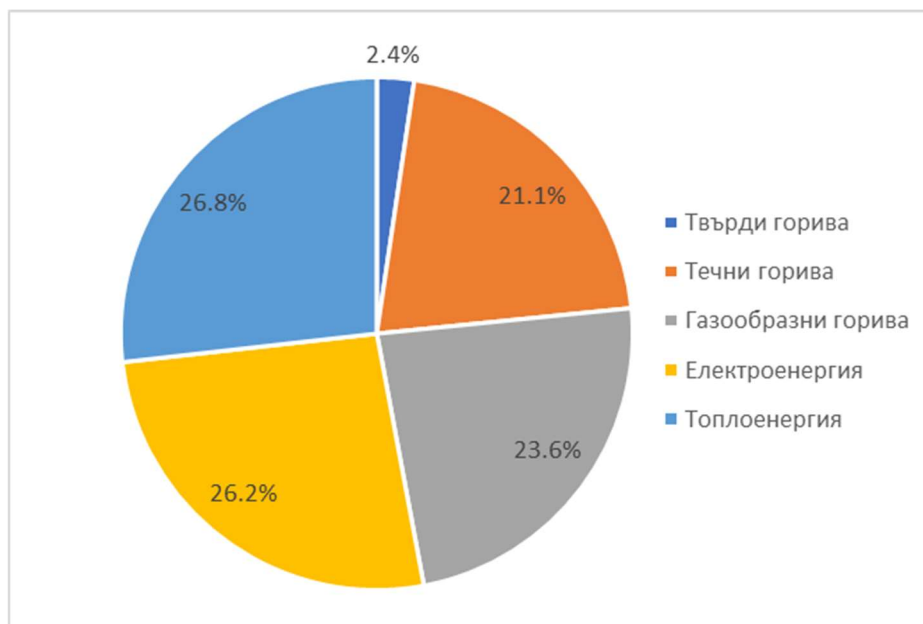
The largest share in energy consumption during the 2007 baseline year had the sectors of the households (36.3%), industry and construction (35.2%), followed by the road transport (18.7%) and the trade and services (8.1%) sector. The share of the other sectors is below 2%.

By types of energy carriers the distribution is as follows:



## Baseline inventory of the green gas emissions on the territory of Sofia Municipality | 2007

Energy carriers	Consumption MWh	Share of the total energy consumption
Solid fuels	371 922	2.4%
Liquid fuels	3 332 404	21.1%
Gaseous fuels	3 740 474	23.6%
Electricity	4 140 818	26.2%
Heat energy	4 236 112	26.8%
TOTAL	15 821 730	



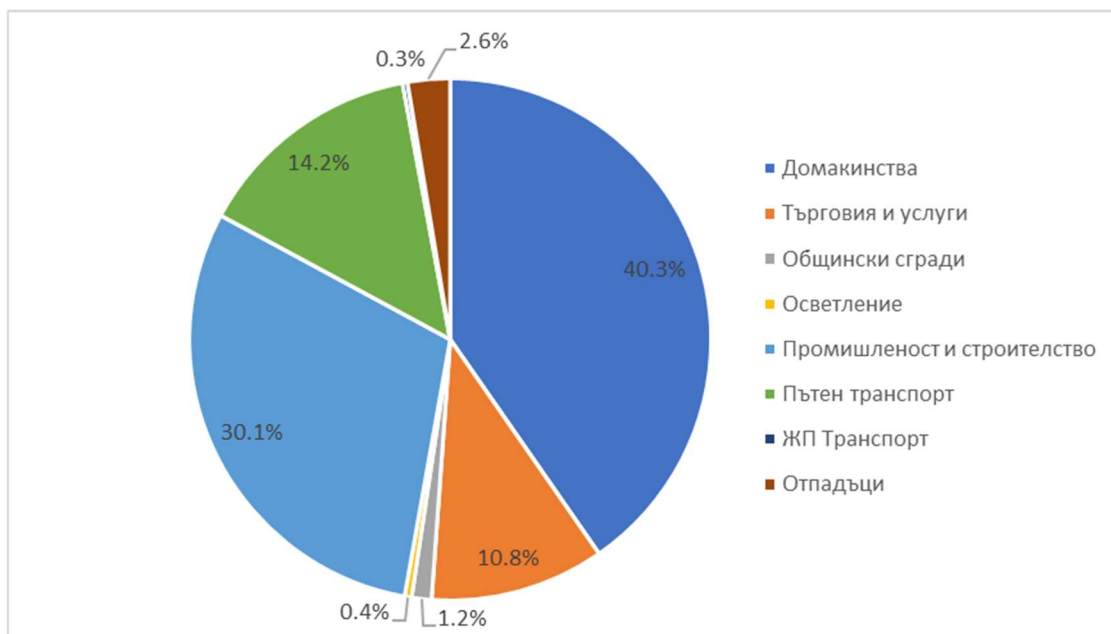
The largest share in the total energy consumption have: heat energy (26.8%), electricity (35.2%) and gaseous fuels (natural gas) (23.6%), followed by liquid fuels (21.1%). Solid fuels have a share of only 2.4%.

### 5.2. GHG emissions during the 2007 baseline year

The total calculated GHG emissions in Sofia Municipality during the 2007 baseline year by sectors are presented in the table below:

Sector	Emissions (tCO <sub>2</sub> eq)	Share of the total GHG emissions %
Households	2 270 125	40.3%
Trade and Services	608 627	10.8%
Municipal buildings	69 378	1.2%
Lighting	24 140	0.4%
Industry and Construction	1 693 027	30.1%
Road transport	798 669	14.2%
Railway transoirt	17 255	0.3%
Waste	147 815	2.6%
TOTAL	5 629 036	

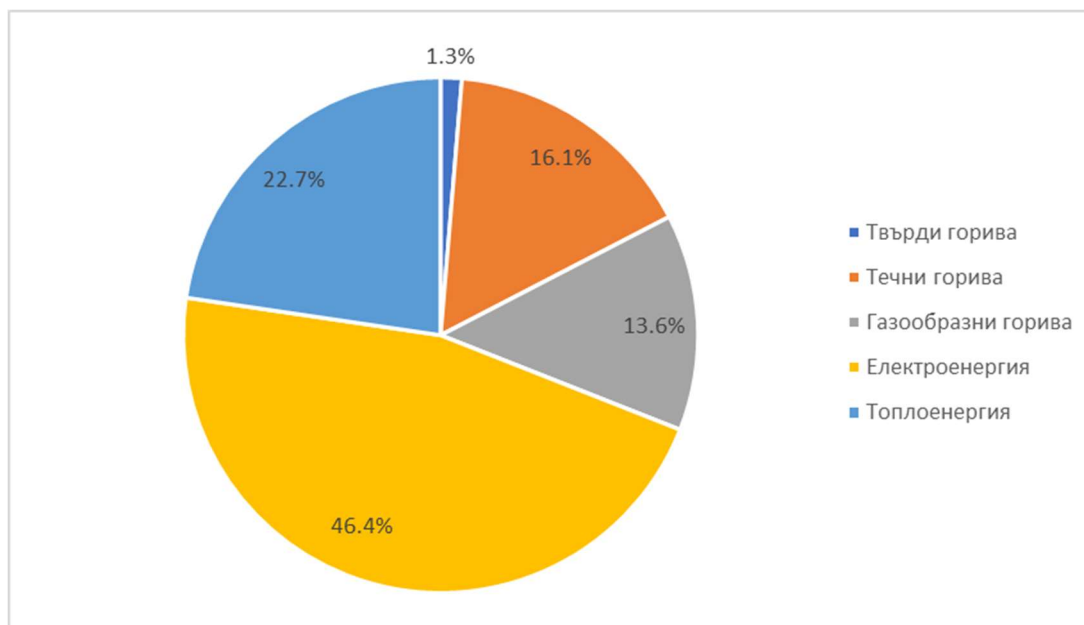
## Baseline inventory of the green gas emissions on the territory of Sofia Municipality | 2007



The largest contribution to emissions during the 2007 baseline year have the sectors households (40.3%) and industry and construction (30.1%), followed by the road transport (14.2%) and the trade and services (10.8%) sectors.

The emissions by energy carriers are as follows:

	Емисии (tCO <sub>2</sub> eq)	Дял от общите емисии на ПГ %
Solid fuels	72 366	1.3%
Liquid fuels	881 428	16.1%
Gaseous fuels	744 285	13.6%
Electricity	2 540 570	46.4%
Heat energy	1 242 573	22.7%
TOTAL	5 481 222	



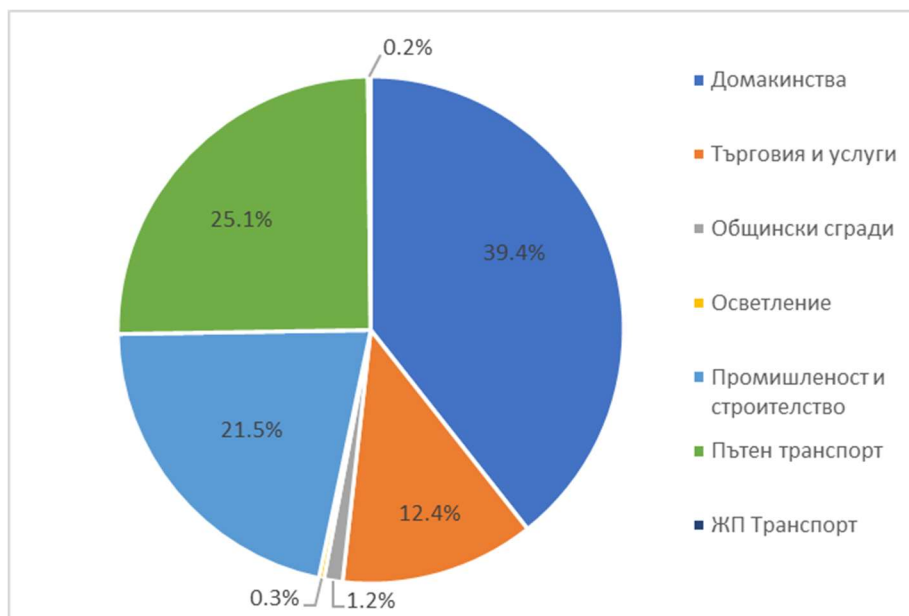
The largest contribution to the GHG emissions during the 2007 baseline year have the consumption of electricity (46.4%), heat energy (22.7%), liquid and gaseous fuels with 16.1% and 13.6 % respectively. The emissions from the consumption of solid fuels are only 1.3% of the total emissions from energy use.

### 5.3. Energy consumption during the reporting in 2018

The total energy consumption on the territory of the municipality in 2018 is 14 025 182 MWh and the distribution by sectors is as follows:

Sector	Energy consumption	Share of the total energy consumption
	MWh	%
Households	5 520 542	39.4%
Trade and Services	1 741 849	12.4%
Municipal buildings	166 455	1.2%
Lighting	45 073	0.3%
Industry and Construction	3 009 444	21.5%
Road transport	3 517 123	25.1%
Railway transport	24 696	0.2%
<b>TOTAL</b>	<b>14 025 182</b>	

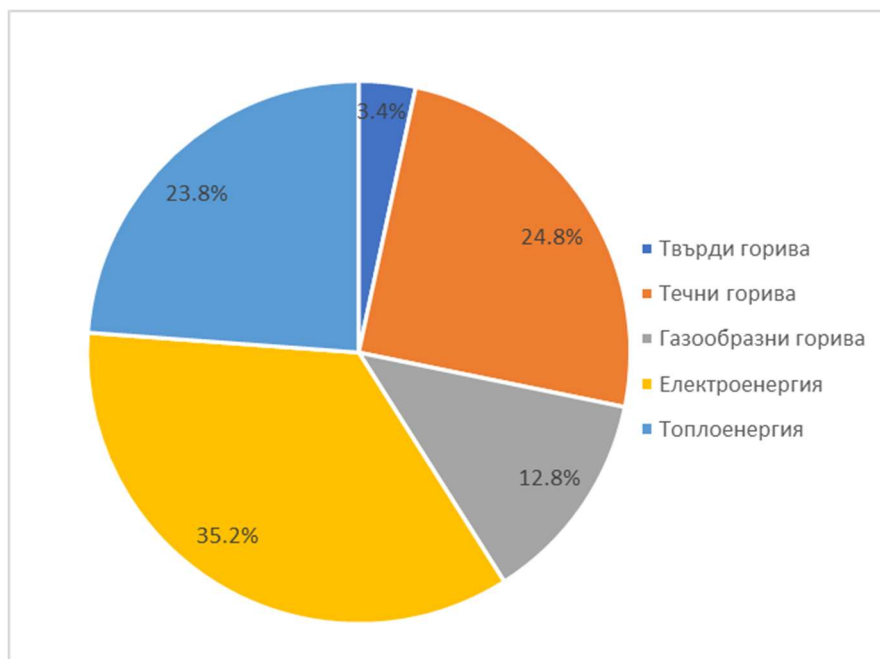
## Baseline inventory of the green gas emissions on the territory of Sofia Municipality | 2007



The largest share in the energy consumption in 2018 have the sectors households (39.4%) and road transport (25.1%), followed by the industry and construction (21.5%), trade and services (12.4%) sectors. The share of the other sectors is below 2%.

By types of energy carriers the distribution is as follows:

Енергоносител	Потребление	Дял от общото потребление на енергия
	MWh	%
Solid fuels	473 105	3.4%
Liquid fuels	3 484 837	24.8%
Gaseous fuels	1 791 829	12.8%
Electricity	4 932 792	35.2%
Heat energy	3 342 618	23.8%
TOTAL	14 025 182	



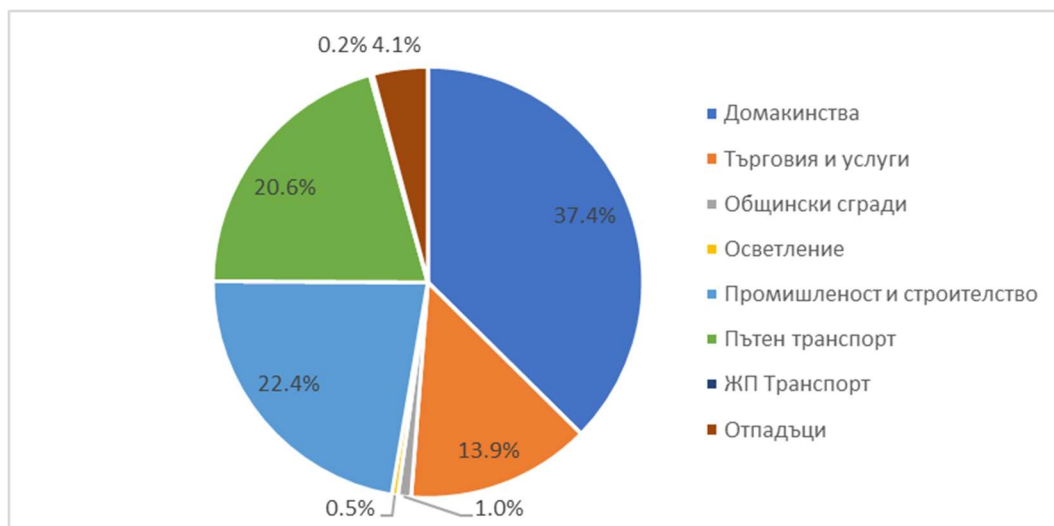
The largest share in the total energy consumption have: electricity (35.2%), liquid fuels (24.8%), heat energy (23.8%) and gaseous fuels natural gas (12.8%). Solid fuels have a share of only 3.4%.

#### 5.4. GHG emissions in 2018

The total calculated GHG emissions in Sofia Municipality in 2018 by sectors are presented in the table below:

Sector	Emissions (tCO <sub>2eq</sub> )	Share of the total GHG emissions
		%
Households	1 722 827	37.4%
Trade and Services	638 456	13.9%
Municipal buildings	45 512	1.0%
Lighting	20 849	0.5%
Industry and Construction	1 031 517	22.4%
Road transport	947 234	20.6%
Road transport	10 371	0.2%
Waste	190 291	4.1%
<b>TOTAL</b>	<b>4 607 056</b>	

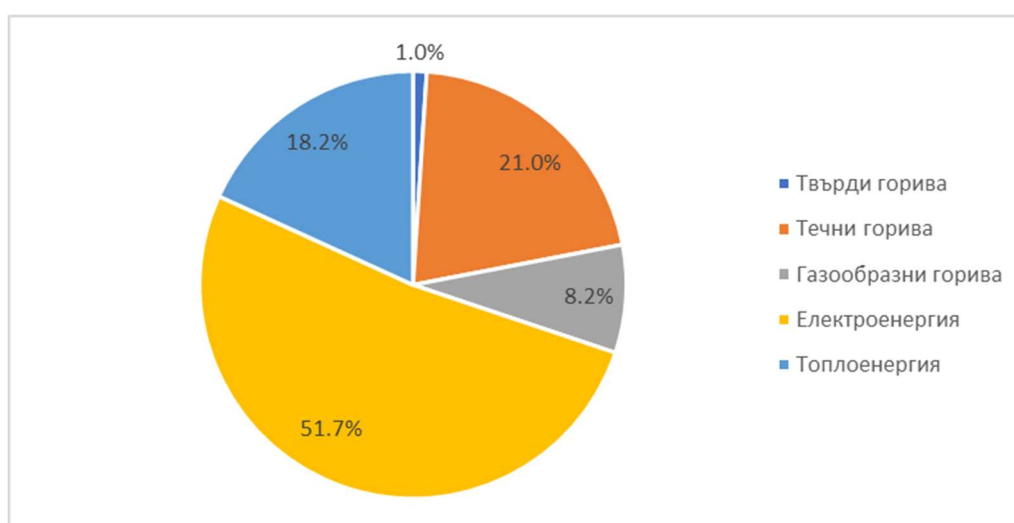
## Baseline inventory of the green gas emissions on the territory of Sofia Municipality | 2007



The largest share of the GHG emissions in 2018 have the sectors households (37.4%) and industry and construction (22.4%), followed by the road transport (20.6%), trade and services (13.9%) sectors.

The emissions by energy carriers are:

Sector	Emissions (tCO <sub>2eq</sub> )	Share of the total GHG emissions
		%
Solid fuels	45 293	1.0%
Liquid fuels	925 411	21.0%
Gaseous fuels	360 703	8.2%
Electricity	2 281 676	51.7%
Heat energy	803 682	18.2%
TOTAL	4 416 765	



The largest share of the GHG emissions in 2018 have the consumption of electricity (51.7%), liquid fuels (21.0%), heat energy (18.2%) and gaseous fuels (8.2%). The emissions from the use of solid fuels are only 1.0% of the total energy consumption.

## Baseline inventory of the green gas emissions on the territory of Sofia Municipality | 2007

The total consumption and emissions by energy carrier types for 2007 and 2018 for Sofia Municipality are presented in the following table:

	MWh		Emissions (t CO <sub>2</sub> e)		Energy consumption growth in 2018 compared to 2007	GHG emissions growth
	2007	2018	2007	2018	%	%
Solid fuels	371 922	473 105	72 366	45 293	27.2%	-37.4%
Liquid fuels	3 332 404	3 484 837	881 428	925 411	4.6%	5.0%
Gaseous fuels	3 740 474	1 791 829	744 285	360 703	-52.1%	-51.5%
Electricity	4 140 818	4 932 792	2 540 570	2 281 676	19.1%	-10.2%
Heat energy	4 236 112	3 342 618	1 242 573	803 682	-21.1%	-35.3%
<b>TOTAL</b>	<b>15 821 730</b>	<b>14 025 182</b>	<b>5 481 222</b>	<b>4 416 765</b>	<b>-11.4%</b>	<b>-19.4%</b>

Table 31 Total consumption and emissions by types of energy carriers

Regarding the distribution by sectors, it is as follows:

Sector	Energy Consumption, MWh		Emissions (t CO <sub>2</sub> e)		Energy consumption growth in 2018 compared to 2007	GHG emissions growth
	2007	2018	2007	2018	%	%
Households	5 748 842	5 520 542	2 270 125	1 722 827	-4.0%	-24.1%
Trade and services	1 279 559	1 741 849	608 627	638 456	36.1%	4.9%
Municipal buildings	196 995	166 455	69 378	45 512	-15.5%	-34.4%
Lighting	39 345	45 073	24 140	20 849	14.6%	-13.6%
Industry and construction	5 564 457	3 009 444	1 693 027	1 031 517	-45.9%	-39.1%
Road transport	2 961 397	3 517 123	798 669	947 234	18.8%	18.6%
Railway transport	31 136	24 696	17 255	10 371	-20.7%	-39.9%
Waste	0	0	147 815	190 291	0	28.7%
<b>TOTAL</b>	<b>15 821 730</b>	<b>14 025 182</b>	<b>5 629 037</b>	<b>4 607 056</b>	<b>-11.4%</b>	<b>-18.2%</b>

Table 32 Total consumption and emissions by sectors

The total energy consumption on the territory of the municipality is 15 821 730 MWh for 2007 and 14 025 182 MWh for 2018 with a decrease of 11.4% compared to the baseline year. The total emissions are 5.7 million tons CO<sub>2</sub>-equivalent for 2007 and 4.6 million tons for 2018 which is a **decrease of 18.2%**.

The consumption of solid fuels increased by 27.2%, electricity - 19.1% and liquid fuels - 4.6%. A decrease was observed in gaseous fuels consumption by 52.1% and heat energy – 21.1%. In the sector distribution the largest contribution to emissions in 2018 have the sectors households (37.4%) and industry and construction (22.4%), followed by road transport (20.6%), trade and services (13.9%), wastes (4.1%), municipal enterprises, commercial companies, buildings and lighting (1.0%), with the other sectors contributing with less than 1% to the total emissions. The emissions from waste (municipal solid waste and wastewaters treatment) in 2018 increased by 28.7% compared to 2007. An

## **Baseline inventory of the green gas emissions on the territory of Sofia Municipality | 2007**

increase of 18.6% and 4.9% is observed in the road transport sector and trade and services sectors respectively. A significant decrease of emissions was recorder in the railway transport and industry, respectively by 39.9% and 39.1% in comparison with 2007. Significant investments were made in the period 2007–2018 aimed at reducing energy consumption in municipal buildings. As a result the emissions, due to energy consumption by municipal enterprises, commercial companies and buildings were decrease by 34.4% compared to the baseline year.

The emissions decrease of Sofia Municipality in 2018 compared to the 2007 baseline year is 18.2%.



## Baseline inventory of the green gas emissions on the territory of Sofia Municipality | 2007

### 6. Annex 1

Inventory of the GHG emissions on the territory of Sofia Municipality												
Base year - 2007												
Reporting year - 2018												
Submission year 2020												
Sector	TJ				MWh				GHG emissions (t CO2e)			
	2007	2011	2015	2018	2007	2011	2015	2018	2007	2011	2015	2018
<b>BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES</b>	46 185	38 722	39 646	37 616	12 829 197	10 755 981	11 012 685	10 483 363	4 665 298	4 418 873	3 976 252	3 459 160
<b>Residential buildings</b>	<b>20 696</b>	<b>21 177</b>	<b>20 372</b>	<b>19 874</b>	<b>5 748 842</b>	<b>5 882 625</b>	<b>5 658 970</b>	<b>5 520 542</b>	<b>2 270 125</b>	<b>2 245 173</b>	<b>1 960 569</b>	<b>1 722 827</b>
Solid fuels	1 182	1 543	1 226	1 312	328 428	428 667	340 607	364 377	59 969	73 503	43 826	42 085
Liquid fuels	211	250	308	221	58 671	69 393	85 447	61 458	13 442	15 881	19 492	14 004
Gaseous fuels	360	702	767	1 011	100 118	195 136	213 165	280 877	19 945	38 930	42 807	56 315
Electricity	7 121	7 178	7 299	7 342	1 978 000	1 994 000	2 027 610	2 039 502	1 213 588	1 207 429	1 026 693	943 377
Heat	11 821	11 504	10 772	9 988	3 283 625	3 195 428	2 992 141	2 774 327	963 181	909 430	827 751	667 045
<b>Total Tertiary and Municipal</b>	<b>5 457</b>	<b>7 901</b>	<b>7 700</b>	<b>6 908</b>	<b>1 515 899</b>	<b>2 194 807</b>	<b>2 138 972</b>	<b>1 953 377</b>	<b>702 145</b>	<b>1 036 404</b>	<b>882 018</b>	<b>704 817</b>
<i>Tertiary (non municipal) buildings, equipment/facilities</i>	4 606	7 013	6 833	6 271	1 279 559	1 947 949	1 898 168	1 741 849	608 627	938 775	795 387	638 456
Solid fuels	24	23	22	25	6 693	6 507	6 163	6 909	894	1 305	1 323	1 126
Liquid fuels	174	153	195	278	48 370	42 577	54 232	77 129	13 155	10 827	14 325	20 444
Gaseous fuels	412	668	714	844	114 364	185 453	198 413	234 533	22 784	36 999	39 845	47 023
Electricity	2 767	4 509	4 488	3 690	768 736	1 252 623	1 246 674	1 024 941	471 653	758 502	631 261	474 089
Heat	1 229	1 659	1 414	1 434	341 396	460 789	392 687	398 337	100 141	131 142	108 634	95 774
<i>Municipal buildings, equipment/facilities</i>	709	732	709	475	196 995	203 374	196 895	166 455	69 378	71 299	64 398	45 512
Solid fuels	0	0	6	10	0	123	1 737	3 406	0	53	755	122
Liquid fuels	94	95	55	71	26 168	26 287	15 305	19 823	7 130	7 096	4 106	5 319
Gaseous fuels	38	41	48	83	10 503	11 495	13 385	28 597	2 092	2 293	2 688	5 734
Electricity	148	166	169	65	41 000	46 000	47 000	30 511	25 155	27 854	23 799	14 113
Heat	430	430	430	246	119 324	119 468	119 468	84 119	35 001	34 001	33 050	20 225
<i>Public lighting</i>	142	157	158	162	39 345	43 484	43 908	45 073	24 140	26 331	22 233	20 849
Electricity	142	157	158	162	39 345	43 484	43 908	45 073	24 140	26 331	22 233	20 849
<b>Industry</b>	<b>20 032</b>	<b>9 643</b>	<b>11 573</b>	<b>10 834</b>	<b>5 564 457</b>	<b>2 678 550</b>	<b>3 214 743</b>	<b>3 009 444</b>	<b>1 693 027</b>	<b>1 137 295</b>	<b>1 133 666</b>	<b>1 031 517</b>
Solid fuels	132	78	249	354	36 801	21 677	69 100	98 414	11 503	2 249	1 376	1 960
Liquid fuels	1 225	506	398	334	340 390	140 419	110 435	92 912	92 989	37 188	29 514	24 831
Gaseous fuels	12 472	2 451	3 946	3 842	3 464 337	680 787	1 095 990	1 067 305	688 915	135 574	219 698	213 948
Electricity	4 432	4 934	5 432	5 994	1 231 161	1 370 546	1 508 869	1 664 979	755 370	829 909	764 025	770 140
Heat	1 770	1 674	1 549	309	491 767	465 121	430 348	85 834	144 249	132 375	119 052	20 637
<b>TRANSPORT</b>	<b>10 773</b>	<b>10 356</b>	<b>12 007</b>	<b>12 751</b>	<b>2 992 532</b>	<b>2 876 609</b>	<b>3 335 145</b>	<b>3 541 819</b>	<b>815 924</b>	<b>781 834</b>	<b>892 672</b>	<b>957 604</b>
<b>Total Transport</b>	<b>10 661</b>	<b>10 296</b>	<b>11 945</b>	<b>12 662</b>	<b>2 961 397</b>	<b>2 859 971</b>	<b>3 318 007</b>	<b>3 517 123</b>	<b>798 669</b>	<b>772 170</b>	<b>884 125</b>	<b>947 234</b>
<i>Private and commercial transport</i>	9 700	9 435	10 990	11 618	2 694 339	2 620 743	3 052 717	3 227 090	707 975	687 719	798 723	851 828
Liquid fuels	9 552	9 174	10 588	11 212	2 653 365	2 548 316	2 941 037	3 114 477	699 510	672 745	775 594	828 560
Gaseous fuels	148	261	402	405	40 974	72 428	111 679	112 613	8 465	14 973	23 129	23 268
<i>Municipal fleet</i>	42	49	52	76	11 614	13 524	14 555	21 003	3 039	3 561	3 839	5 506
Liquid fuels	42	48	52	75	11 547	13 462	14 522	20 969	3 025	3 548	3 832	5 499
Gaseous fuels	0	0	0	0	67	63	34	34	13	13	7	7
<i>Public transport</i>	920	813	903	969	255 444	225 703	250 735	269 030	87 654	80 891	81 563	89 899
Liquid fuels	679	557	445	334	188 542	154 624	123 566	92 654	50 740	41 611	33 213	25 301
Gaseous fuels	36	34	192	244	10 111	9 389	53 295	67 869	2 070	1 923	10 944	14 408
Electricity	204	222	266	391	56 792	61 691	73 874	108 507	34 844	37 356	37 407	50 190
<b>Railway transport</b>	<b>112</b>	<b>60</b>	<b>62</b>	<b>89</b>	<b>31 136</b>	<b>16 639</b>	<b>17 138</b>	<b>24 696</b>	<b>17 255</b>	<b>9 664</b>	<b>8 547</b>	<b>10 371</b>
Liquid fuels	19	4	2	19	5 352	1 219	547	5 416	1 435	327	147	1 453
Electricity	93	56	60	69	25 784	15 419	16 590	19 280	15 820	9 337	8 401	8 918
<b>WASTE</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>147 815</b>	<b>195 670</b>	<b>226 163</b>	<b>190 291</b>
Waste management									123 633	169 067	198 601	162 963
Other non-energy related									1 437	1 270	820	820
Wastewater treatment									22 746	25 333	26 741	26 509
<b>TOTAL</b>	<b>56 958,23</b>	<b>49 077,33</b>	<b>51 652,19</b>	<b>50 366,78</b>	<b>15 821 729,65</b>	<b>13 632 590,59</b>	<b>14 347 829,85</b>	<b>14 025 182,18</b>	<b>5 629 036,81</b>	<b>5 396 377,34</b>	<b>5 095 087,11</b>	<b>4 607 056,17</b>

# Baseline inventory of the green gas emissions on the territory of Sofia Municipality | 2007

**Baseline Emission Inventory**

1) Inventory year: **2007**

2) Number of inhabitants in the inventory year: **1240788**

3) Emission factors:
 

- IPCC
- LCA (Life Cycle Assessment)

4) Emission reporting unit:
 

- tonnes CO<sub>2</sub>
- tonnes CO<sub>2</sub> equivalent

5) Methodological notes: IPCC 2006, CORINAIR

**A. Final energy consumption**

Please note that for separating decimals dot (.) is used. No thousand separators are allowed.

Sector	Electricity	Heat	Fossil fuels													Renewable energies					Total			
			Gaseous fuels (without industry)	Gaseous fuels industry	Gaseous fuels Commercial and private transport	Gaseous fuels Interdepartmental transport	Gaseous fuels Public transport	Solid fuels Municipal buildings	Solid fuels Tertiary	Solid fuels Residential	Solid fuels Industry	Liquid fuels Municipal	Liquid fuels Tertiary	Liquid fuels Residential	Liquid fuels Industry	Liquid fuels Commercial and private transport	Liquid fuels Interdepartmental transport	Liquid fuels Public transport	Plant oil	Biofuel		Other biomass	Solar thermal	Geothermal
<b>BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES</b>																								
Municipal buildings, equipment/facilities	41 000,00	119 324,00	10 502,92						0,00															196994,979
Tertiary (non-municipal) buildings, equipment/facilities	769 736,06	341 395,50	114 364,18							6 692,80														1279558,52
Residential buildings	1 978 000,00	3 283 625,00	100 110,00								328 427,89													3748841,77
Public lighting	39 345,29																							39345,248
Industry	1 231 161,09	491 767,10		3 464 337,4																				5564456,76
	Non-EIS																							0
	EIS (and non-energetic)																							0
Subtotal	4058242,406	4236112	224985,0923	3464337,358	0	0	0	0	0	6692,799394	328427,889	36801,19838	26168,06281	48369,578	58670,88242	340390,0132	0	0	0	0	0	0	0	1282919,3
<b>TRANSPORT</b>																								
Municipal fleet							66,99380361																	11613,5891
Public transport	82575,861							10110,649																193893,416
Private and commercial transport					40973,72103																			2694338,86
Subtotal	82575,861	0	0	0	40973,72103	66,99380361	10110,649	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2694338,86
<b>OTHER</b>																								
Agriculture, Forestry, Fisheries																								0
TOTAL	4140818,267	4236112	224985,0923	3464337,358	40973,72103	66,99380361	10110,649	0	6692,799394	328427,889	36801,19838	26168,06281	48369,578	58670,88242	340390,0132	2653365,14	11546,5953	193893,416	0	0	0	0	0	15821729,7

**C. CO<sub>2</sub> emissions**

C1. Please insert the CO<sub>2</sub> emission factors adopted [t/MWh]:

Click here to visualise fuel emission factors

Electricity	Heat	Fossil fuels													Renewable energies								
		National	Local	Gaseous fuels (without industry)	Gaseous fuels industry	Gaseous fuels Commercial and private transport	Gaseous fuels Interdepartmental transport	Gaseous fuels Public transport	Solid fuels Municipal buildings	Solid fuels Tertiary	Solid fuels Residential	Solid fuels Industry	Liquid fuels Municipal	Liquid fuels Tertiary	Liquid fuels Residential	Liquid fuels Industry	Liquid fuels Commercial and private transport	Liquid fuels Interdepartmental transport	Liquid fuels Public transport	Plant oil	Biofuel	Other biomass	Solar thermal
0,614	0,614	0,293	0,199	0,199	0,207	0,199	0,205	0,000	0,134	0,183	0,313	0,272	0,272	0,229	0,273	0,264	0,262	0,269	0,000	0,000	0,000	0,000	0,000

C2. Please complete in case non-energy related sectors are included:

Non-energy related sectors	CO <sub>2</sub> eq. emissions [t]
Waste management	123632,65
Waste water management	22745,92
Other non-energy related	1436,64

**Emission Inventory**

Sector	Electricity	Heat/cold	CO <sub>2</sub> emissions [t] / CO <sub>2</sub> eq. emissions [t]													Renewable energies					Total			
			Gaseous fuels (without industry)	Gaseous fuels industry	Gaseous fuels Commercial and private transport	Gaseous fuels Interdepartmental transport	Gaseous fuels Public transport	Solid fuels Municipal buildings	Solid fuels Tertiary	Solid fuels Residential	Solid fuels Industry	Liquid fuels Municipal	Liquid fuels Tertiary	Liquid fuels Residential	Liquid fuels Industry	Liquid fuels Commercial and private transport	Liquid fuels Interdepartmental transport	Liquid fuels Public transport	Plant oil	Biofuel		Other biomass	Solar thermal	Geothermal
<b>BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES</b>																								
Municipal buildings, equipment/facilities	25155	35001	2092	0	0	0	0	0	0	0	0	7130	0	0	0	0	0	0	0	0	0	0	0	69378
Tertiary (non-municipal) buildings, equipment/facilities	471653	100141	22784	0	0	0	0	0	894	0	0	0	13155	0	0	0	0	0	0	0	0	0	0	608627
Residential buildings	1213588	963181	19945	0	0	0	0	0	0	59969	0	0	0	13442	0	0	0	0	0	0	0	0	0	2270125
Public lighting	24140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24140
Industry	755370	144249	0	688915	0	0	0	0	0	0	11503	0	0	0	92989	0	0	0	0	0	0	0	0	1693027
	Non-EIS																							0
	EIS (and non-energetic)																							0
Subtotal	2489906	1242573	44821	688915	0	0	0	0	894	59969	11503	7130	13155	13442	92989	0	0	0	0	0	0	0	0	465298
<b>TRANSPORT</b>																								
Municipal fleet	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	3025	0	0	0	0	0	3039
Public transport	50664	0	0	0	0	0	2070	0	0	0	0	0	0	0	0	0	0	52176	0	0	0	0	0	104910
Private and commercial transport	0	0	0	0	8465	0	0	0	0	0	0	0	0	0	0	699510	0	0	0	0	0	0	0	707975
Subtotal	50664	0	0	0	8465	13	2070	0	0	0	0	0	0	0	699510	3025	52176	0	0	0	0	0	0	815924
<b>OTHER</b>																								
Agriculture, Forestry, Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>OTHER NON-ENERGY RELATED</b>																								
Waste management																								123633
Waste water management																								22746
Other non-energy related																								1437
TOTAL	2540570	1242573	44821	688915	8465	13	2070	0	894	59969	11503	7130	13155	13442	92989	699510	3025	52176	0	0	0	0	0	5629037