



Województwo
Śląskie

Projekt zintegrowany LIFE „Śląskie. Przywracamy błękit”. Kompleksowa realizacja Programu ochrony powietrza dla województwa śląskiego realizowany jest przy dofinansowaniu z Programu LIFE Unii Europejskiej oraz Narodowego Funduszu Ochrony Środowiska i Gospodarki Wodnej.
LIFE20 IPE/PL/000007 - LIFE-IP AQP-SILESIA-SKY

LIFE integrated project

‘Silesia. Blue Sky Restored’.

Comprehensive implementation of the Air Protection Programme for the Silesian Voivodeship





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Report on the energy monitoring of buildings

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1 Introduction

This document describes the measures taken as part of the LIFE integrated project '*Silesia. Blue Sky Restored*'. *Comprehensive implementation of the Air Protection Programme for the Silesian Voivodeship*, measure C.3. 'Development of models to reduce environmental impact in public buildings'. The purpose of this document is to present data collected as part of the energy monitoring of buildings. The monitoring was conducted between February 2024 and February 2025. This report compiles the following data:

1. Energy consumption for heating
2. Energy consumption for the production of usable hot water (UHW)
3. Electricity consumption for purposes other than heating and UHW
4. Air quality inside buildings
5. Annual CO₂ emissions generated by the building.

1.1 Building parameters

Table 1 presents selected data on buildings collected through surveys, along with results concerning energy consumption. The names of cities, ordinal numbers assigned to them in the study, subregions, usable floor space, heat sources, and data on ventilation and air conditioning are listed here.



Table 1: Summary of selected data for buildings

No.	City	Subregion	Heat source	Area m ²	Air conditioning Comments usable units	Ventilation mechanical
1	Bojszowy	Central	Heating oil	636.18	1	
2	Bytom	Central	District heating network	1,765.89		
3	Chorzów	Central	District heating network	1,812.00	1	yes, rec.
4	Częstochowa	North	District heating network	2,372.39		
5	Dąbrowa G.	Central	District heating network	3,157.00		
6	Gliwice	Central	Gas	610.00		
7	Jastrzębie Zdr.	West	District heating network	735.02		
8	Katowice	Central	District heating network	9,540.00	1	
9	Koziegłowy	North	Gas	900.00		yes
10	Krzepice 2	North	Heating oil	1,967.00		
11	Krzyżanowice	West	Gas	93.18		
12	Gorzycze	West	Coal	411.39	4	
13	Nędza	West	Coal	1,265.00		
14	Opatów	North	Coal	365.00		
16	Piekary Śl.	Central	District heating network	330.01		yes
17	Pietrowice Wlk.	West	Gas	1,153.00	2	yes
18	Skoczów	South	Gas	1,397.00		yes
19	Radzionków	Central	District heating network	777.30	3	
20	Ruda Śl.	Central	District heating network	2,301.60		
21	Świerklaniec	Central	Gas	773.30	4	
22	Świerklany	West	Gas	650.90		yes, rec.
23	Tychy	Central	District heating network	462.00	1	
24	Wisła (Ustrońska)	South	Gas	405.56		
25	Wisła (Wyzwolenia)	South	Gas	373.00		
26	Zawiercie	Central	Gas	2,911.00	3	
27	Zory	West	District heating network	2,305.70		

2 Processing of monitoring data

The basic equation for the calculations carried out is the energy balance equation. It is solved for the heat needed to heat the building (CH) and prepare usable hot water (UHW), as well as for the electricity needed for domestic use, heating and air conditioning. The energy balance for heat can therefore be presented as follows:

$$\dot{Q}_{in}(\tau) = \dot{Q}_{co}(\tau) + \dot{Q}_{cwu}(\tau), \quad (1)$$

where Q_{in} is heat supplied (by the heating device), Q_{co} is heating expenditure and Q_{cwu} is the preparation of hot usable water. These values represent thermal outputs expressed in kW and are specific to a given moment in time. Internal heat generation has been omitted.

The balance for electricity is as follows:

$$N_{el,siec}(\tau) = N_{el,cwu}(\tau) + N_{el,uz}(\tau) + N_{el,klim}(\tau), \quad (2)$$

where instantaneous power N is expressed in kilowatts and the indices denote, respectively: *siec* - network, *cwu* - electric water heaters, *uz* - energy consumption for utility purposes, *klim* - energy consumption for air



conditioning purposes.

2.1 Electricity consumption

Data on instantaneous electricity consumption was obtained from the sensors listed in Table 2. Electricity consumption for purposes other than heating, air conditioning and



Table 2: List of electricity meters

Meter ID	function	Meter ID	function
01_Bojszowy_Socomec3f_Elekt_1	main	14_Opatow_Socomec3f_Elekt_1	main
01_Bojszowy_enginko_Elekt_2	-	14_Opatow_enginko_Elekt_2	-
01_Bojszowy_enginko_Elekt_3	UHW	14_Opatow_enginko_Elekt_3	-
01_Bojszowy_enginko_Elekt_4	UHW	14_Opatow_enginko_Elekt_4	-
01_Bojszowy_enginko_Elekt_5	UHW	15_Ornontowice_Socomec3f_Elekt_1	main
01_Bojszowy_konwerterE04_Elekt_6	air conditioning	15_Ornontowice_Socomec3f_Elekt_2	UHW
02_Bytom_Socomec3f_Elekt_1	main	15_Ornontowice_enginko_Elekt_3	UHW
02_Bytom_enginko_Elekt_2	-	15_Ornontowice_enginko_Elekt_4	UHW
02_Bytom_enginko_Elekt_3	UHW	15_Ornontowice_enginko_Elekt_5	UHW
02_Bytom_enginko_Elekt_4	UHW	15_Ornontowice_enginko_Elekt_6	UHW
02_Bytom_enginko_Elekt_5	UHW	16_Piekary_Slaskie_Socomec3f_Elekt_1	main
02_Bytom_enginko_Elekt_6	UHW	16_Piekary_Slaskie_Socomec3f_Elekt_2	-
02_Bytom_enginko_Elekt_7	UHW	17_Pietrowice_Wielkie_Socomec3f_Elekt_1	-
03_Chorzow_Socomec3f_Elekt_1	main	17_Pietrowice_Wielkie_Socomec3f_Elekt_2	air conditioning
03_Chorzow_Socomec3f_Elekt_2	-	17_Pietrowice_Wielkie_Socomec3f_Elekt_3	-
03_Chorzow_konwerterE04_Elekt_3	air conditioning	17_Pietrowice_Wielkie_Socomec3f_Elekt_4	pv
04_Czestochowa_Socomec3f_Elekt_1	main	17_Pietrowice_Wielkie_konwerterE04_Elekt_5	air conditioning
04_Czestochowa_Socomec3f_Elekt_2	-	18_Skoczow_Socomec3f_Elekt_1	main
04_Czestochowa_Socomec3f_Elekt_3	-	18_Skoczow_Socomec3f_Elekt_2	-
04_Czestochowa_Socomec3f_Elekt_4	-	19_Radzionkow_Socomec3f_Elekt_1	main
04_Czestochowa_Socomec3f_Elekt_5	UHW	19_Radzionkow_enginko_Elekt_2	air conditioning
04_Czestochowa_konwerterE04_Elekt_10_11	UHW	19_Radzionkow_enginko_Elekt_3	air conditioning
04_Czestochowa_konwerterE04_Elekt_12_13	UHW	19_Radzionkow_enginko_Elekt_4	air conditioning
04_Czestochowa_konwerterE04_Elekt_14_15	UHW	20_Ruda_Slaska_Socomec3f_Elekt_1	main
04_Czestochowa_konwerterE04_Elekt_16_17	UHW	20_Ruda_Slaska_Socomec3f_Elekt_2	main
04_Czestochowa_konwerterE04_Elekt_18_19	UHW	21_Swierklaniec_Socomec3f_Elekt_1	main
04_Czestochowa_konwerterE04_Elekt_20_21	UHW	22_Swierklany_Socomec3f_Elekt_1	main
04_Czestochowa_konwerterE04_Elekt_6_7	UHW	22_Swierklany_Socomec3f_Elekt_2	-
04_Czestochowa_konwerterE04_Elekt_8	UHW	22_Swierklany_enginko_Elekt_4	UHW
05_Dabrowa_Gomicza_Socomec3f_Elekt_1	main	22_Swierklany_enginko_Elekt_5	UHW
05_Dabrowa_Gomicza_Socomec3f_Elekt_12	UHW	22_Swierklany_enginko_Elekt_6	UHW
05_Dabrowa_Gomicza_enginko_Elekt_10	UHW	22_Swierklany_enginko_Elekt_7	air conditioning
05_Dabrowa_Gomicza_enginko_Elekt_11	UHW	22_Swierklany_enginko_Elekt_8	air conditioning
05_Dabrowa_Gomicza_enginko_Elekt_13	UHW	22_Swierklany_enginko_Elekt_9	air conditioning
05_Dabrowa_Gomicza_enginko_Elekt_14	UHW	23_Tychy_Socomec3f_Elekt_1	-
05_Dabrowa_Gomicza_enginko_Elekt_2	UHW	23_Tychy_enginko_Elekt_2	UHW
05_Dabrowa_Gomicza_enginko_Elekt_3	UHW	23_Tychy_enginko_Elekt_3	UHW
05_Dabrowa_Gomicza_enginko_Elekt_4	UHW	23_Tychy_enginko_Elekt_4	-
05_Dabrowa_Gomicza_enginko_Elekt_5	UHW	23_Tychy_enginko_Elekt_5	air conditioning
05_Dabrowa_Gomicza_enginko_Elekt_7	UHW	23_Tychy_enginko_Elekt_6	UHW
05_Dabrowa_Gomicza_enginko_Elekt_8	UHW	24_Wisla_Ustronska_Socomec3f_Elekt_1	main
06_Gliwice_Socomec3f_Elekt_1	main	25_Wisla_Wyzwolenia_Socomec3f_Elekt_1	main
06_Gliwice_enginko_Elekt_2	UHW	26_Zawiercie_Socomec3f_1f_Elekt_3	air conditioning
07_Jastrzebie_Zdroj_Socomec3f_1f_Elekt_1_5	main	26_Zawiercie_Socomec3f_1f_Elekt_4	air conditioning
07_Jastrzebie_Zdroj_Socomec3f_1f_Elekt_3_7	UHW	26_Zawiercie_Socomec3f_Elekt_1	main
07_Jastrzebie_Zdroj_Socomec3f_Elekt_2	pv	26_Zawiercie_Socomec3f_Elekt_2	air conditioning
07_Jastrzebie_Zdroj_Socomec3f_Elekt_4	-	26_Zawiercie_enginko_Elekt_5	UHW
07_Jastrzebie_Zdroj_enginko_Elekt_6	air conditioning	26_Zawiercie_enginko_Elekt_6	UHW
08_Katowice_Socomec3f_Elekt_1	main	26_Zawiercie_enginko_Elekt_7	UHW
08_Katowice_Socomec3f_Elekt_2	main	26_Zawiercie_enginko_Elekt_8	UHW
08_Katowice_Socomec3f_Elekt_3	air conditioning	26_Zawiercie_enginko_Elekt_9	UHW
09_Koziegłowy_Socomec3f_Elekt_1	main	27_Zory_Socomec3f_Elekt_1	main
09_Koziegłowy_konwerterE04_Elekt_2	-	27_Zory_Socomec3f_Elekt_13	UHW
10_Krzepice_Socomec3f_Elekt_1	main	27_Zory_enginko_Elekt_10	UHW
10_Krzepice_Socomec3f_Elekt_2	main	27_Zory_enginko_Elekt_11	UHW
10_Krzepice_Socomec3f_Elekt_3	-	27_Zory_enginko_Elekt_12	UHW
10_Krzepice_Socomec3f_Elekt_4	-	27_Zory_enginko_Elekt_2	UHW
10_Krzepice_Socomec3f_Elekt_5	-	27_Zory_enginko_Elekt_3	UHW
10_Krzepice_enginko_Elekt_10	-	27_Zory_enginko_Elekt_4	UHW
10_Krzepice_enginko_Elekt_11	air conditioning	27_Zory_enginko_Elekt_5	UHW
10_Krzepice_enginko_Elekt_12	air conditioning	27_Zory_enginko_Elekt_6	UHW
10_Krzepice_enginko_Elekt_8	air conditioning	27_Zory_enginko_Elekt_7	UHW
10_Krzepice_enginko_Elekt_9	heating	27_Zory_enginko_Elekt_8	UHW
11_Krzyżanowice_Socomec3f_Elekt_1	main	27_Zory_enginko_Elekt_9	UHW
12_Gorzycze_Socomec3f_1f_Elekt_2_4	air conditioning		



2.1 Electricity consumption

12_Gorzyce_Socomec3f_Elekt_1
12_Gorzyce_Socomec3f_Elekt_3

12_Gorzyce_enginko_Elekt_5
12_Gorzyce_enginko_Elekt_6

12_Gorzyce_enginko_Elekt_7

13_Nedza_Socomec3f_Elekt_1
13_Nedza_Socomec3f_Elekt_2
13_Nedza_Socomec3f_Elekt_3
13_Nedza_enginko_Elekt_4
13_Nedza_enginko_Elekt_5
13_Nedza_enginko_Elekt_6

main
air
conditioning
UHW
air
conditioning
air
conditioning
main
UHW
UHW
UHW
UHW
UHW

2 PROCESSING OF MONITORING DATA



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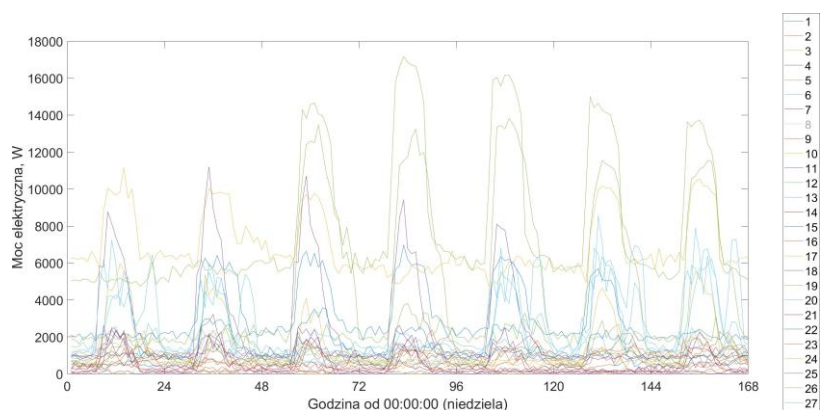


Figure 1: Examples of weekly electricity consumption profiles for individual buildings.

usable hot water preparation is not dependent on weather conditions. However, measurements have shown that the 'electrical power' of a building varies over time due to the use of the equipment located in it. This variability must therefore be taken into account in the calculations.

It was assumed that the electrical power depends on the time of day and the day of the week. The measurement data from the main meters was reduced by the consumption for heating, air conditioning and hot water preparation. The processed data was used to calculate the power, which was reduced to a temporal resolution of 1 hour. Based on hourly data, averaged profiles were created for each building separately in 168-hour windows (one week), starting at 0:00 on Sunday. Profiles for buildings, excluding the Marshal's Office (due to the order of magnitude), are shown in fig. 1 for illustrative purposes.

The variability depending on the time of day/day of the week can be clearly observed (including higher consumption during working hours and days), which was treated as confirmation of the assumptions made. The 'average weekly profiles' prepared in this way provide an overview of the building's use and serve as input data for calculations aimed at selecting renewable energy sources for the building.

In order to illustrate the levels of electrical power consumed by individual buildings, electrical power is also shown in organised charts. Due to the large amount of data, the charts are included in the **annex** to this report in order to improve readability.

2.2 Usable hot water

In order to compile data on energy consumption for the preparation of usable hot water, assumptions were made similar to those used in modelling electricity consumption for domestic purposes, i.e. weekly profiles were created. Data on energy consumption for UHW preparation was collected from three types of sources: electricity meters installed on boilers/continuous-flow heaters (i.e. meters marked as UHW in Table 2), heat meters dedicated to UHW preparation systems (Table 3), and heat meters combining CH and UHW measurement functions. In the case of the latter, only measurements taken during the summer months were used in order to eliminate the influence of



Table 3: List of UHW heat meters

Sensor ID 03_Chorzow_konwerter_santech_CWU
06_Gliwice_konwerter_cieplomierz_CWU
08_Katowice_konwerter_cieplomierz_CWU
09_Koziegłowy_konwerter_santech_CWU_solary
09_Koziegłowy_konwerter_cieplomierz_CWU
10_Krzepice_konwerter_cieplomierz_CWU
12_Gorzyce_konwerter_cieplomierz_CWU
16_Piekary_Slaskie_konwerter_cieplomierz_CWU
17_Pietrowice_Wielkie_konwerter_cieplomierz_CWU
18_Skoczow_konwerter_santech_CWU
19_Radzionkow_konwerter_cieplomierz_IR_CWU
20_Ruda_Slaska_konwerter_cieplomierz_CWU
21_Swierklaniec_konwerter_santech_CWU_1
21_Swierklaniec_konwerter_santech_CWU_2
24_Wisla_Ustronska_konwerter_santech_CWU
25_Wisla_Wyzwolenia_konwerter_santech_CWU

central heating. Weekly profiles for individual buildings are shown in Figures 2, 3, and 4.

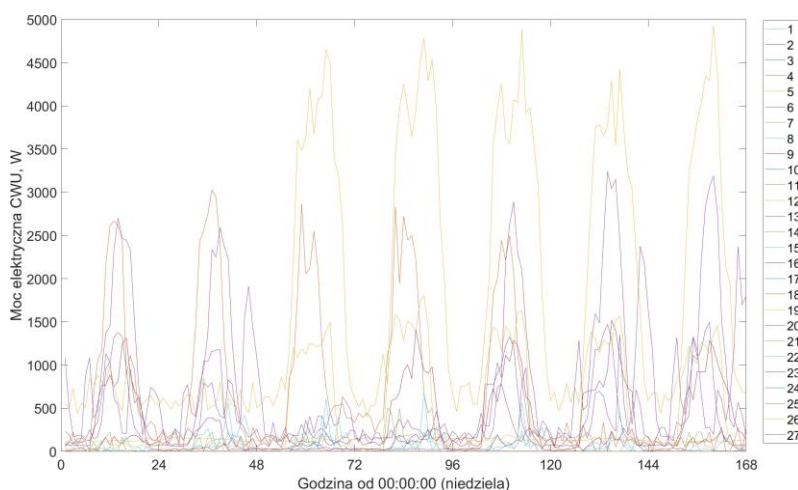


Figure 2: Weekly profile of average hourly power consumption of electric UHW heaters



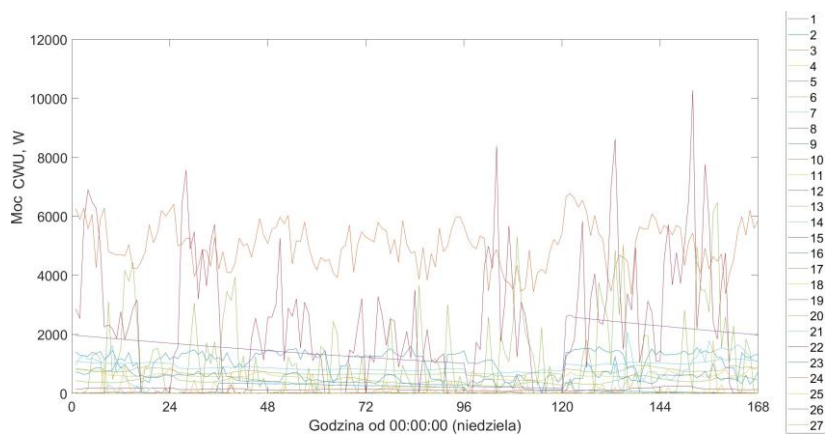


Figure 3: Weekly profile of average hourly power consumption of non-electric UHW heaters

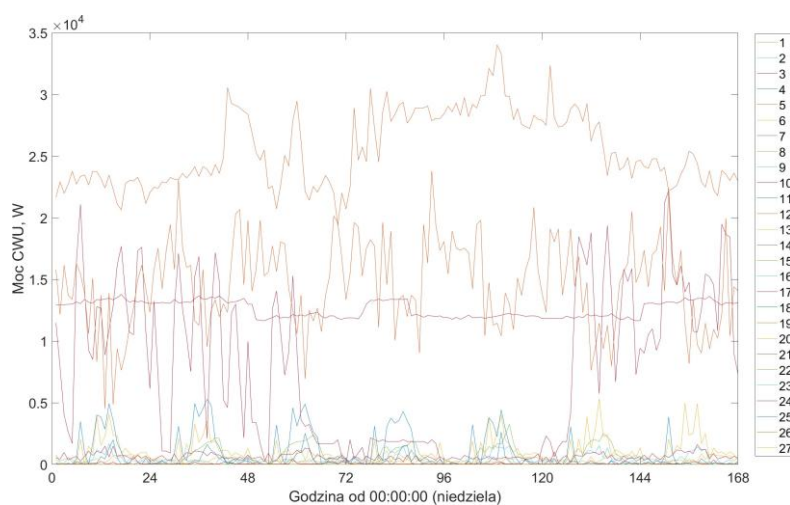


Figure 4: Weekly profile of average hourly heat consumption in the CH system for UHW purposes

In annual calculations, electricity consumption for UHW purposes is included in the electricity balance, while other energy consumption for UHW purposes is balanced together with the heat source. Charts showing energy consumption for UHW heating are included in the **annex** to this report.

2.3 Heating and cooling

Energy consumption for heating purposes is calculated using the following equation:

$$Q'_{in} = m'_{w} (i_1(t_1) - i_2(t_2)) Q'_{CWU}; \quad (3)$$



Where Q_{in} is momentary energy consumption, m_w is measured flow, i_1 , i_2 is enthalpy of circulating water determined based on measured temperatures using CoolProp libraries [1] and Q_{CWU} is instantaneous heat flow for UHW, if applicable. The list of sensors (heat meters) measuring energy consumption for heating purposes is shown in Table 4.

Table 4: List of CH heat meters

Sensor ID, 01_Bojszowy_konwerter_cieplomierz_CO
02_Bytom_konwerter_cieplomierz_IR_CO
03_Chorzow_konwerter_cieplomierz_CO_CWU
04_Czestochowa_konwerter_cieplomierz_IR_CO
05_Dabrowa_Gornicza_konwerter_cieplomierz_CO_2
05_Dabrowa_Gornicza_konwerter_cieplomierz_IR_CO
06_Gliwice_konwerter_cieplomierz_CO_CWU
07_Jastrzebie_Zdroj_konwerter_cieplomierz_CO
08_Katowice_konwerter_cieplomierz_CO_CWU
08_Katowice_konwerter_cieplomierz_IR_CO_CWU
09_Koziegłowy_konwerter_cieplomierz_CO_CWU
10_Krzepice_konwerter_cieplomierz_CO
10_Krzepice_konwerter_cieplomierz_CO_CWU
11_Krzyżanowice_konwerter_santech_CO
12_Gorzyce_konwerter_cieplomierz_CO_CWU
13_Nedza_konwerter_cieplomierz_CO
14_Opatow_konwerter_cieplomierz_CO
15_Ornontowice_konwerter_cieplomierz_CO
16_Piekary_Slaskie_konwerter_cieplomierz_CO
17_Pietrowice_Wielkie_konwerter_cieplomierz_CO
18_Skoczow_konwerter_cieplomierz_CO
20_Ruda_Slaska_konwerter_cieplomierz_CO_CWU
21_Swierklaniec_konwerter_cieplomierz_CO_1
21_Swierklaniec_konwerter_santech_CO_2
22_Swierklany_konwerter_cieplomierz_CO
23_Tychy_konwerter_cieplomierz_IR_CO
24_Wisla_Ustronska_konwerter_cieplomierz_CO
25_Wisla_Wyzwolenia_konwerter_santech_CO
26_Zawiercie_konwerter_cieplomierz_CO
27_Zory_konwerter_cieplomierz_CO

The available data was recorded every 5 minutes. For the purposes of the analysis, the data was averaged to hourly values. The heat consumption charts are presented in the **annex** to this report.

2.4 Ventilation

As part of the measurements, no air flow measurements were taken in the ventilation ducts. According to survey data, mechanical ventilation is installed in 6 out of 27 buildings, i.e. in the following buildings: 3 – Chorzów, 9 – Koziegłowy, 16 – Piekary Śląskie, 17 – Pietrowice Wielkie, 18 – Skoczów, 22 – Swierklany, with heat recovery present in buildings 3 and 22. Certain information about the operation of ventilation systems is contained in measurements of CO₂ concentration in rooms. Data on CO₂ concentrations are presented in the form of organised charts included in the **annex**. It is important to note the large number of hours per year during which the limit value of 1,000 ppm is exceeded. The total duration of such indications is also included in the tables and charts presented in the last chapter of the study.



2.5 Network emissions

Drawing power from the national electricity grid and heat from local heating systems involves CO₂ emissions. It can be assumed that, in line with climate policy goals, these systems will be zero-emission from 2050 [4], which would put emissions at 0 kg/kWh. On the other hand, these assumptions will not be met in the near future, and the estimation of emissions generated by buildings is valuable information for further analysis.

Similar to other calculations, emissions were estimated on an hourly basis using data for the base year. Public data from Polskie Sieci Elektroenergetyczne (PSE, Polish Power Grid) was used [2]. PSE data contains information on generated power and its sources on an hourly basis. This allows for the calculation of the fraction of total power generated by non-renewable sources. The product of the non-renewable fraction and the average emissions per unit of energy from non-renewable sources published by the National Centre for Emissions Balancing and Management [3] constitutes the estimated instantaneous CO₂ emissions per kWh:

$$m_{CO_2/kWh}(\tau) = \frac{N_{n-ren}(\tau)}{N_{n-ren}(\tau) + N_{ren}(\tau)} \cdot W_{em,kobize},$$

where N_{n-ren} is power generation from non-renewable sources (MW), N_{ren} is power generation from renewable sources (MW), and $W_{em,kobize}$ is average emissions per unit of energy generated in Poland from non-renewable sources, amounting to 788 kg CO₂=MWh. It is assumed that power generation from renewable sources does not involve emissions.

CO₂ emissions associated with energy consumption from local heating networks were estimated at 111.26 kg CO₂=GJ according to the KOBiZE report [3].

These values refer to units of energy. Since the calculations are based on power values, it is assumed that the power during a given hour is constant, so the energy consumed from the grid is the product of power and time. Data on the amount of CO₂ emitted in individual hours are summed up for the entire year.

$$m_{CO_2/kWh}(\tau) = \frac{N_{n-ren}(\tau)}{N_{n-ren}(\tau) + N_{ren}(\tau)} \cdot W_{em,kobize},$$

where $E_{el} ()$ is the energy consumed in a given hour of the year in kWh ($E_{el} () = N_{el;sec}()$ assuming constant power in a given hour).

2.6 Emissions related to fuel combustion

Emissions related to fuel combustion are estimated on the basis of KOBiZE data, which show the amount of CO₂ emissions per unit of energy from a given fuel for a given type of building. These values are presented in Table 5. They are specific to the category 'institutions/commerce/services'.



Table 5: Summary of emission indicators for selected fuels

	CO2 emissions
Heating oil	77.75
Natural gas	55.39
Hard coal	94.25

These values are multiplied by the annual energy consumption for heating in a given building, taking into account the heat consumption for usable hot water preparation:

$$m_{CO2,pal,rok} = \sum_{i=1}^{8760} Q_{in}(\tau) W_{pal},$$

where W_{pal} is the emission factor for a given fuel, $Q_{in}(\tau)$ is the energy consumed for heating purposes in a given hour, expressed in GJ.

3 Measurement results

Table 6 shows the current heat sources in kg/year in absolute terms and in relation to the usable area. Emissions were calculated based on data on fuel consumption or heat drawn from the district heating network. Additionally, emissions calculated from measurements are shown in the charts in Figures 5, 6, 7, and 8. The results in the charts are presented in descending order. They show emissions related to heating (relative and absolute) and total emissions (relative and absolute), respectively. Relative values refer to the usable floor area of the building. Table 7 shows the annual heat demand of buildings, ranked according to the relative annual demand per unit of floor area. With regard to the above data, attention should be paid to the two parallel values from the building in Gorzyce – the readings were separated, taking into account and disregarding the UHW heat meter due to the high values measured on it.

Tables 8 and 9 show the total time during the entire measurement period in which a given CO₂ sensor detected a concentration greater than 1,000 ppm. The time is given in the format: hours:minutes:seconds. The data is arranged by subregion. This data is also shown in descending order in the chart in Figure 9.



Table 6: List of buildings with CO₂ emissions related to heating and electricity consumption on an annual basis by subregion

No.	Building	Subregion	Heat source	Emissions caused el. cons., kg/year	Emissions related heating, kg/year	Usable area, m ²	Emissions from consumption of el. per unit of area, kg/yearm ²	Emissions related to heating. per unit of area, kg/yearm ²	Emissions related to heating. Total emissions kg/year
19	Radzionków	Central	District heating network	9248.78	62695.01	777.30	11.90	80.66	71943.79
8	Katowice	Central	District heating network	260416.33	497956.36	9540.00	27.30	52.20	758372.70
5	Dąbrowa G.	Central	District heating network	30707.73	190815.84	3157.00	9.73	60.44	221523.57
16	Piekary Śl.	Central	District heating network	2442.85	18031.26	330.01	7.40	54.64	20474.11
3	Chorzów	Central	District heating network	41131.95	50044.95	1812.00	22.70	27.62	91176.90
23	Tychy	Central	District heating network	3819.37	19247.98	462.00	8.27	41.66	23067.35
1	Bojszowy	Central	Heating oil	19022.59	6105.57	636.18	29.90	9.60	25128.15
6	Gliwice PM	Central	Gas	11622.91	8865.92	610.00	19.05	14.53	20488.83
2	Bytom	Central	District heating network + gas	6530.05	52759.49	1765.89	3.70	29.88	59289.54
26	Zawiercie	Central	Gas	47907.85	10537.89	2911.00	16.46	3.62	58445.74
20	Ruda Śl.	Central	District heating network	16168.29	25633.25	2301.60	7.02	11.14	41801.54
21	Świerklaniec	Central	Gas	2534.53	9531.44	773.30	3.28	12.33	12065.97
14	Opatów	North	Coal	2602.58	45937.63	365.00	7.13	125.86	48540.21
10	Krzepice 2	North	Heating oil	8666.49	141948.71	1967.00	4.41	72.17	150615.21
4	Częstochowa SP	North	District heating network	15366.46	119459.86	2372.39	6.48	50.35	134826.32
9	Koziegłowy	North	Gas	4873.67	17605.03	900.00	5.42	19.56	22478.71
24	Wisła (Ustrońska)	South	Gas	5421.93	19804.29	405.56	13.37	48.83	25226.22
25	Wisła (Wyzwolenia)	South	Gas	3431.14	11128.84	373.00	9.20	29.84	14559.98
18	Skoczów	South	Gas	6302.58	10954.92	1397.00	4.51	7.84	17257.51
12	Gorzyce	West	Coal	5024.71	103375.61	411.39	12.21	251.28	108400.32
12	Gorzyce (without UHW)	West	Coal	5024.71	18680.78	411.39	12.21	45.41	23705.49
7	Jastrzębie Zdr.	West	District heating network	2490.63	27963.82	735.02	3.39	38.04	30454.45
22	Świerklany Jankowice	West	Gas	8571.79	13829.51	650.90	13.17	21.25	22401.30
27	Żory	West	District heating network	12044.88	49895.42	2305.70	5.22	21.64	61940.29
13	Nędza	West	Coal	9428.14	21818.54	1265.00	7.45	17.25	31246.68
11	Krzyżanowice	West	Gas	416.01	1883.26	93.18	4.46	20.21	2299.27
17	Pietrowice Wlk.	West	Gas	2620.22	18633.65	1153.00	2.27	16.16	21253.87

Table 7: List of buildings by heat demand per unit of floor area, by subregion.

No.	Building	Subregion	Heat source	Usable area, m ²	Heat demand kWh/year	Heat demand per unit of area kWh/year m ²
19	Radzionków	Central	District heating network	777.30	156529.03	201.38
5	Dąbrowa G.	Central	District heating network	3157.00	476405.03	150.90
16	Piekary Śl.	Central	District heating network	330.01	45018.18	136.41
8	Katowice	Central	District heating network	9540.00	1243234.93	130.32
23	Tychy	Central	District heating network	462.00	48055.94	104.02
2	Bytom	Central	District heating network + gas	1765.89	131723.28	74.59
6	Gliwice PM	Central	Gas	610.00	44462.45	72.89
3	Chorzów	Central	District heating network	1812.00	124945.94	68.95
21	Świerklaniec	Central	Gas	773.30	47800.02	61.81
1	Bojszowy	Central	Heating oil	636.18	21813.56	34.29
20	Ruda Śl.	Central	District heating network	2301.60	63997.89	27.81
26	Zawiercie	Central	Gas	2911.00	52847.33	18.15
14	Opatów	North	Coal	365.00	135390.49	370.93
10	Krzepice 2	North	Heating oil	1967.00	507144.87	257.83
4	Częstochowa SP	North	District heating network	2372.39	298252.39	125.72
9	Koziegłowy	North	Gas	900.00	88288.97	98.10
24	Wisła (Ustrońska)	South	Gas	405.56	99318.23	244.89
25	Wisła (Wyzwolenia)	South	Gas	373.00	55810.95	149.63
18	Skoczów	South	Gas	1397.00	54938.78	39.33
12	Gorzyce	West	Coal	411.39	304675.62	740.60
12	Gorzyce (without UHW)	West	Coal	411.39	55057.26	133.83
22	Świerklany Jankowice	West	Gas	650.90	69354.78	106.55
11	Krzyżanowice	West	Gas	93.18	9444.52	101.36
7	Jastrzębie Zdr.	West	District heating network	735.02	69816.57	94.99
17	Pietrowice Wlk.	West	Gas	1153.00	93447.47	81.05
27	Żory	West	District heating network	2305.70	124572.62	54.03
13	Nędza	West	Coal	1265.00	64305.08	50.83



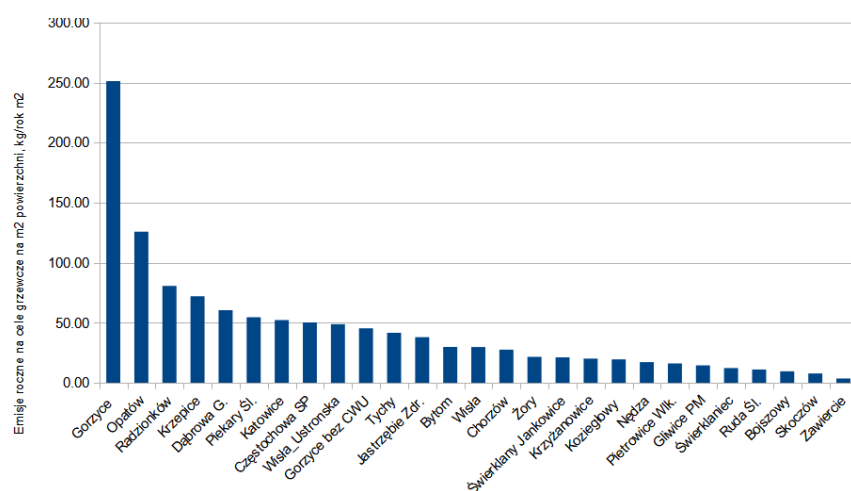


Figure 5: Annual CO₂ emissions from buildings related to heating in relation to usable floor area

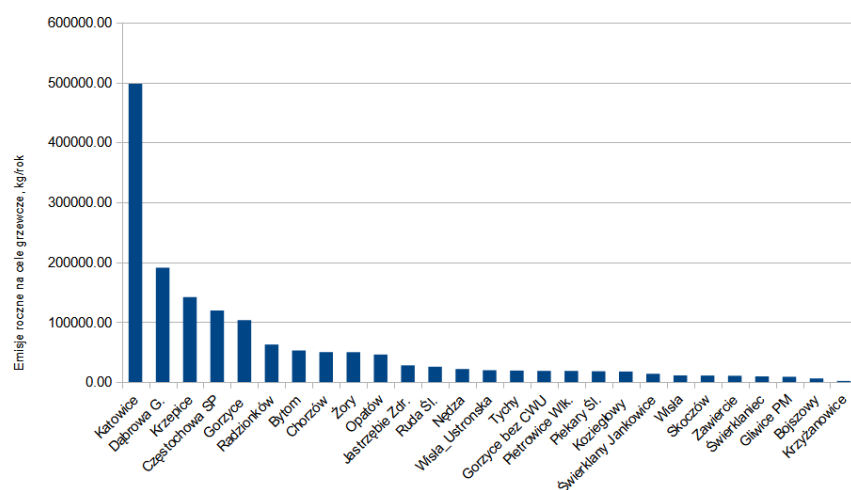


Figure 6: Annual CO₂ emissions from buildings related to heating in absolute terms



Projekt zintegrowany LIFE „Śląskie. Przywracamy błękit”. Kompleksowa realizacja Programu ochrony powietrza dla województwa śląskiego realizowany jest przy dofinansowaniu z Programu LIFE Unii Europejskiej oraz Narodowego Funduszu Ochrony Środowiska i Gospodarki Wodnej.
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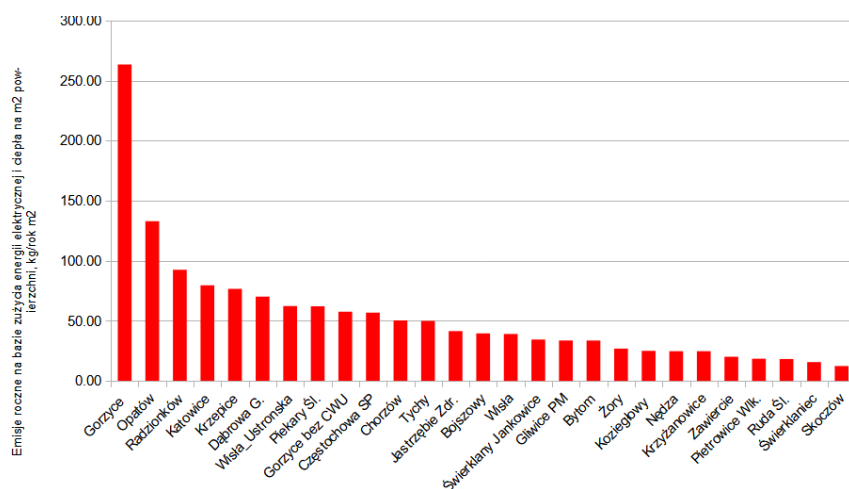
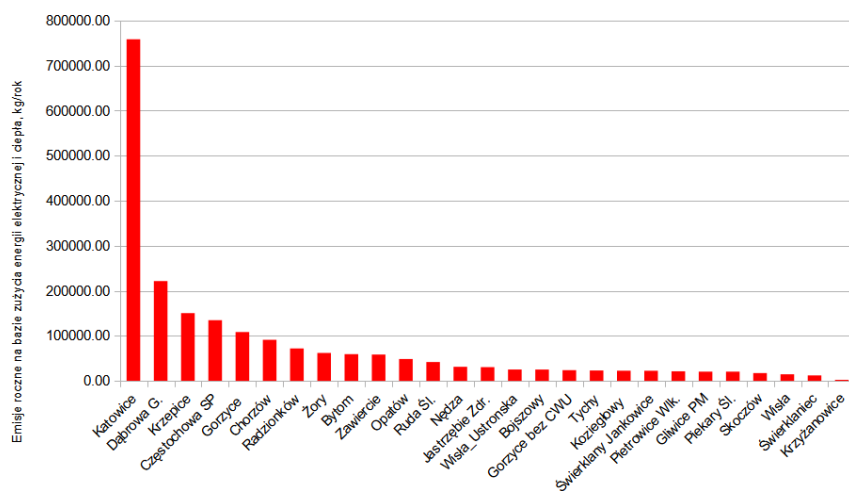
Figure 7: Total annual CO₂ emissions from buildings in relation to usable floor areaFigure 8: Total annual CO₂ emissions from buildings in absolute terms

Table 8: Total time per year during which CO₂ sensor readings above 1,000 ppm were recorded, central subregion.

Building	Subregion	Sensor	hour	minute	second	Mechanical ventilation
Bojszowy	Central	01_Bojszowy_CWT_Internal_Sensor_1	304	50	40	
		01_Bojszowy_CWT_Internal_Sensor_2	216	40	15	
		01_Bojszowy_CWT_Internal_Sensor_3	438	50	27	
		01_Bojszowy_CWT_Internal_Sensor_4	507	11	18	
Bytom	Central	02_Bytom_CWT_Internal_Sensor_1	476	45	48	
		02_Bytom_CWT_Internal_Sensor_2	926	13	17	
		02_Bytom_CWT_Internal_Sensor_3	1184	59	48	
		03_Chorzow_CWT_Internal_Sensor_1	404	30	34	
Chorzów	Central	03_Chorzow_CWT_Internal_Sensor_2	80	59	41	yes, rec.
		03_Chorzow_CWT_Internal_Sensor_3	199	25	27	
		05_Dabrowa_Gornicza_CWT_Internal_Sensor_1	621	0	49	
		05_Dabrowa_Gornicza_CWT_Internal_Sensor_2	419	35	7	
Dąbrowa Górnicza	Central	05_Dabrowa_Gornicza_CWT_Internal_Sensor_3	468	36	26	
		05_Dabrowa_Gornicza_CWT_Internal_Sensor_4	452	31	8	
		05_Dabrowa_Gornicza_CWT_Internal_Sensor_5	147	9	41	
		06_Gliwice_CWT_Internal_Sensor_1	508	4	38	
Gliwice	Central	06_Gliwice_CWT_Internal_Sensor_2	373	17	38	
		06_Gliwice_CWT_Internal_Sensor_3	326	15	17	
		08_Katowice_CWT_Internal_Sensor_1	79	37	51	
		08_Katowice_CWT_Internal_Sensor_10	87	35	11	
Katowice	Central	08_Katowice_CWT_Internal_Sensor_2	851	40	9	
		08_Katowice_CWT_Internal_Sensor_3	76	41	11	
		08_Katowice_CWT_Internal_Sensor_4	223	19	24	
		08_Katowice_CWT_Internal_Sensor_5	103	35	27	
		08_Katowice_CWT_Internal_Sensor_6	335	2	6	
		08_Katowice_CWT_Internal_Sensor_7	245	51	32	
		08_Katowice_CWT_Internal_Sensor_8	344	21	44	
		08_Katowice_CWT_Internal_Sensor_9	672	7	19	
		15_Ornontowice_CWT_Internal_Sensor_1	2317	35	40	
		15_Ornontowice_CWT_Internal_Sensor_2	2295	16	28	
Ornontowice	Central	15_Ornontowice_CWT_Internal_Sensor_3	143	9	27	
		15_Ornontowice_CWT_Internal_Sensor_4	209	40	19	
		16_Piekary_Slaskie_CWT_Internal_Sensor_1	665	11	16	
		16_Piekary_Slaskie_CWT_Internal_Sensor_2	298	45	4	
Piekary Śląskie	Central	19_Radzionkow_CWT_Internal_Sensor_1	50	10	32	yes
		19_Radzionkow_CWT_Internal_Sensor_2	194	24	21	
		19_Radzionkow_CWT_Internal_Sensor_3	464	14	57	
		20_Ruda_Slaska_CWT_Internal_Sensor_1	311	55	58	
Ruda Śląska	Central	20_Ruda_Slaska_CWT_Internal_Sensor_2	680	15	55	
		20_Ruda_Slaska_CWT_Internal_Sensor_3	288	46	1	
		20_Ruda_Slaska_CWT_Internal_Sensor_4	1245	5	53	
		20_Ruda_Slaska_CWT_Internal_Sensor_5	31	24	56	
		20_Ruda_Slaska_CWT_Internal_Sensor_6	660	46	44	
		21_Swierklaniec_CWT_Internal_Sensor_1	3805	26	4	
SŚwierklaniec	Central	21_Swierklaniec_CWT_Internal_Sensor_2	313	45	20	
		21_Swierklaniec_CWT_Internal_Sensor_3	378	43	52	
		23_Tychy_CWT_Internal_Sensor_1	688	34	29	
		23_Tychy_CWT_Internal_Sensor_2	991	29	16	
Tychy	Central	23_Tychy_CWT_Internal_Sensor_3	1239	4	51	
		26_Zawiercie_CWT_Internal_Sensor_1	321	50	43	
		26_Zawiercie_CWT_Internal_Sensor_2	2111	54	8	
		26_Zawiercie_CWT_Internal_Sensor_3	121	55	21	
Zawiercie	Central					



Table 9: Total time per year during which CO₂ sensor readings above 1,000 ppm were recorded, subregions West, North and South.

Building	Subregion	Sensor	hour	minute	second	Mechanical ventilation
Częstochowa	North	04_Czestochowa_CWT_Internal_Sensor_1	132	44	36	
		04_Czestochowa_CWT_Internal_Sensor_2	258	5	36	
		04_Czestochowa_CWT_Internal_Sensor_3	527	30	22	
		04_Czestochowa_CWT_Internal_Sensor_4	326	16	8	
Koziegłowy	North	09_Koziegłowy_CWT_Internal_Sensor_1	160	5	12	yes
		09_Koziegłowy_CWT_Internal_Sensor_2	746	49	7	
		09_Koziegłowy_CWT_Internal_Sensor_3	616	40	18	
		10_Krzepice_CWT_Internal_Sensor_1	89	10	2	
Krzepice	North	10_Krzepice_CWT_Internal_Sensor_2	39	5	10	
		10_Krzepice_CWT_Internal_Sensor_3	215	50	5	
		10_Krzepice_CWT_Internal_Sensor_4	77	20	8	
		10_Krzepice_CWT_Internal_Sensor_5	756	52	39	
Opatów	North	10_Krzepice_CWT_Internal_Sensor_6	114	0	10	
		10_Krzepice_CWT_Internal_Sensor_7	442	45	40	
		14_Opatow_CWT_Internal_Sensor_1	16	50	11	
		14_Opatow_CWT_Internal_Sensor_2	48	40	3	
Jastrzębie Zdrój	West	14_Opatow_CWT_Internal_Sensor_3	337	20	7	
		07_Jastrzebie_Zdroj_CWT_Internal_Sensor_1	119	46	2	
		07_Jastrzebie_Zdroj_CWT_Internal_Sensor_2	304	59	49	
		07_Jastrzebie_Zdroj_CWT_Internal_Sensor_3	263	35	53	
Krzyżanowice	West	07_Jastrzebie_Zdroj_CWT_Internal_Sensor_4	99	6	5	
		11_Krzyzanowice_CWT_Internal_Sensor_1	15	15	16	
Gorzyce	West	12_Gorzyce_CWT_Internal_Sensor_1	36	45	4	
		12_Gorzyce_CWT_Internal_Sensor_2	41	0	21	
Nedza	West	12_Gorzyce_CWT_Internal_Sensor_3	403	29	2	
		13_Nedza_CWT_Internal_Sensor_1	2422	29	33	
		13_Nedza_CWT_Internal_Sensor_2	0	5	30	
		13_Nedza_CWT_Internal_Sensor_3	64	49	21	
Pietrowice Wielkie	West	13_Nedza_CWT_Internal_Sensor_4	41	34	29	
		17_Pietrowice_Wielkie_CWT_Internal_Sensor_1	0	54	59	
		17_Pietrowice_Wielkie_CWT_Internal_Sensor_2	48	35	25	
		17_Pietrowice_Wielkie_CWT_Internal_Sensor_3	107	39	48	
Świerklany Jankowice	West	17_Pietrowice_Wielkie_CWT_Internal_Sensor_4	35	30	9	yes, rec.
		22_Swierklany_CWT_Internal_Sensor_1	245	24	32	
		22_Swierklany_CWT_Internal_Sensor_2	336	30	47	
		22_Swierklany_CWT_Internal_Sensor_3	433	16	10	
Zory	West	27_Zory_CWT_Internal_Sensor_1	333	30	20	
		27_Zory_CWT_Internal_Sensor_2	359	57	9	
		27_Zory_CWT_Internal_Sensor_3	865	45	42	
		27_Zory_CWT_Internal_Sensor_4	603	40	38	
Skoczów	South	27_Zory_CWT_Internal_Sensor_5	296	5	23	
		27_Zory_CWT_Internal_Sensor_6	268	16	49	
		27_Zory_CWT_Internal_Sensor_7	491	21	30	
		27_Zory_CWT_Internal_Sensor_8	670	26	21	
Wisła (Ustroniska)	South	20_Skoczow_CWT_Internal_Sensor_1	532	0	42	yes
		18_Skoczow_CWT_Internal_Sensor_2	313	41	13	
		24_Wisla_Ustronska_CWT_Internal_Sensor_1	2	15	9	
		24_Wisla_Ustronska_CWT_Internal_Sensor_2	0	10	2	
Wisła (Wyzwolenia)	South	25_Wisla_Wyzwolenia_CWT_Internal_Sensor_1	413	20	59	
		25_Wisla_Wyzwolenia_CWT_Internal_Sensor_2	124	51	46	
		25_Wisla_Wyzwolenia_CWT_Internal_Sensor_3	59	4	53	
		25_Wisla_Wyzwolenia_CWT_Internal_Sensor_4	1167	36	22	



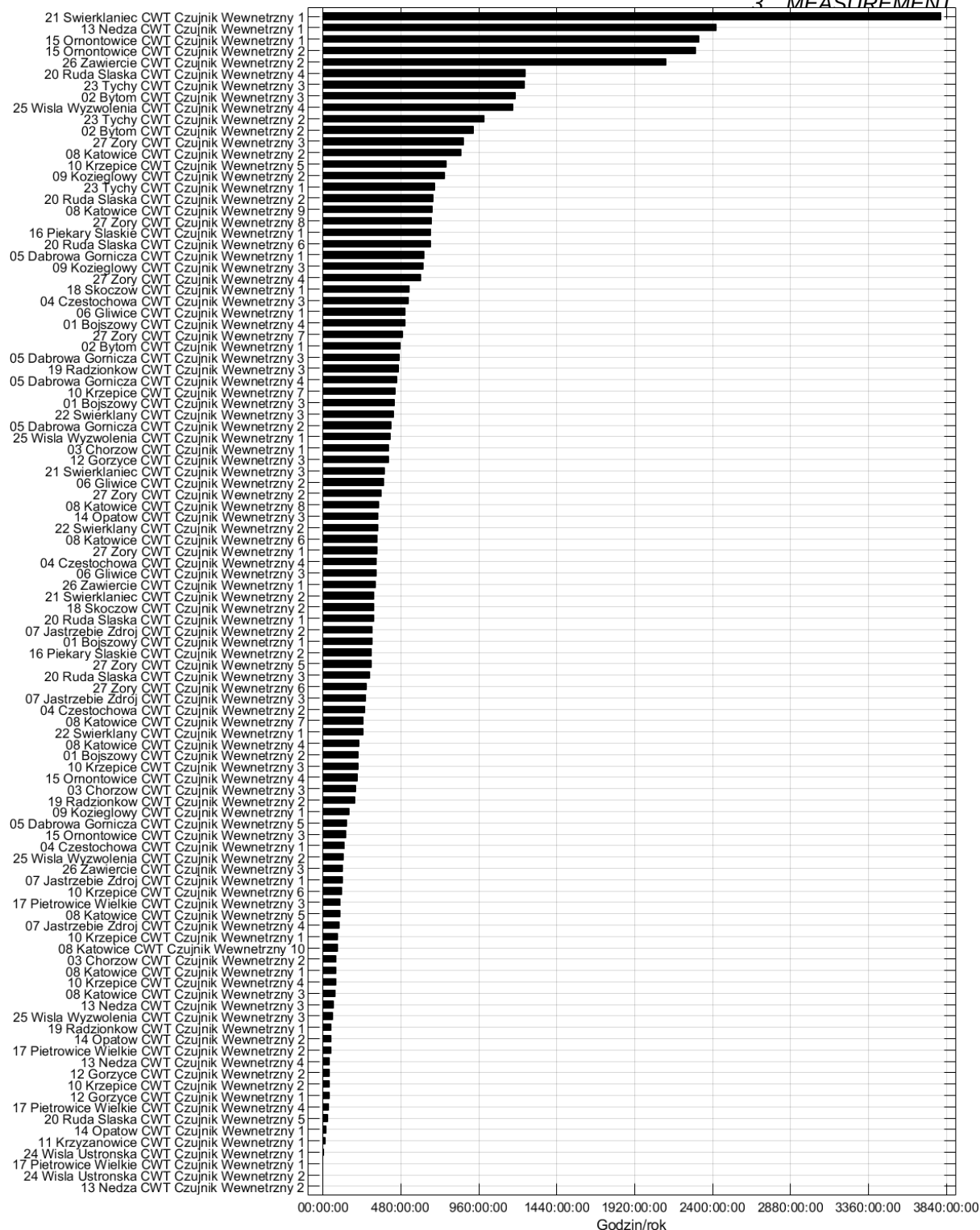


Figure 9: Time of year when CO₂ sensor readings above 1,000 ppm were recorded.



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Województwo
Śląskie

Projekt zintegrowany LIFE „Śląskie. Przywracamy błękit”. Kompleksowa realizacja Programu ochrony powietrza dla województwa śląskiego realizowany jest przy dofinansowaniu z Programu LIFE Unii Europejskiej oraz Narodowego Funduszu Ochrony Środowiska i Gospodarki Wodnej.
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