



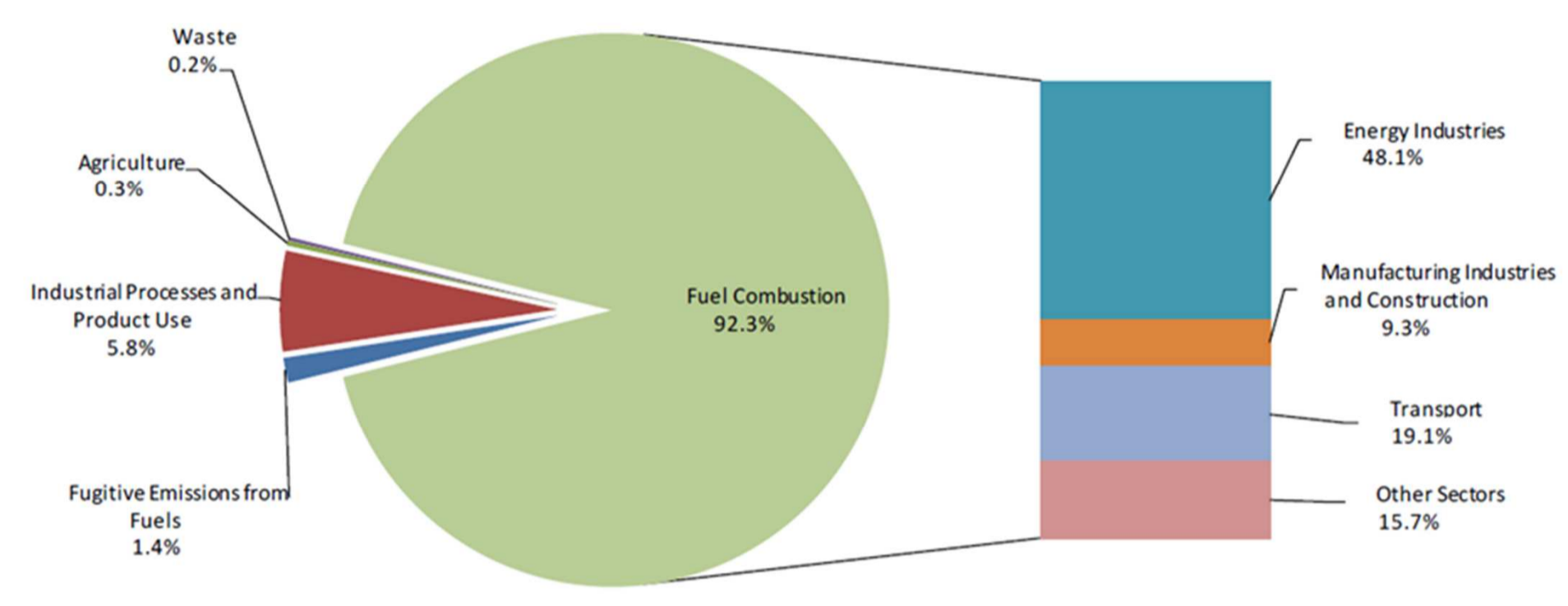
Upper Silesia (Poland)

GIG team: Krzysztof Stańczyk, Jarosław Chećko, Piotr Krawczyk, Agnieszka Leśniak, Aleksandra Strugała-Wilczek, Anna Śliwińska, Tomasz Urych

Characteristics of the region

- Area of 12 333 km² (3.9% of the country)
- Population of 4.5 million (11.8% of Poland's population)
- Highly urbanized region
- 76.6% of the population live in towns and cities
- Most industrialized region in Poland
- GDP: 260,532 million PLN (12.3% of Poland's GDP), of which 78,130 million PLN industry, 62,437 million PLN trade
- Rich biodiversity and a high level of forest cover (32.1%)
- Strong mining industry (16 coal mines) and a strong energy sector (about 7 GW of capacity – 20% of installed capacity in utility power plants in Poland)
- 79 500 workers employed in coal mines out of a total of 185 000 in the entire EU
- Low storage potential – total estimated storage capacity in the promising region is about 111.5 Mt

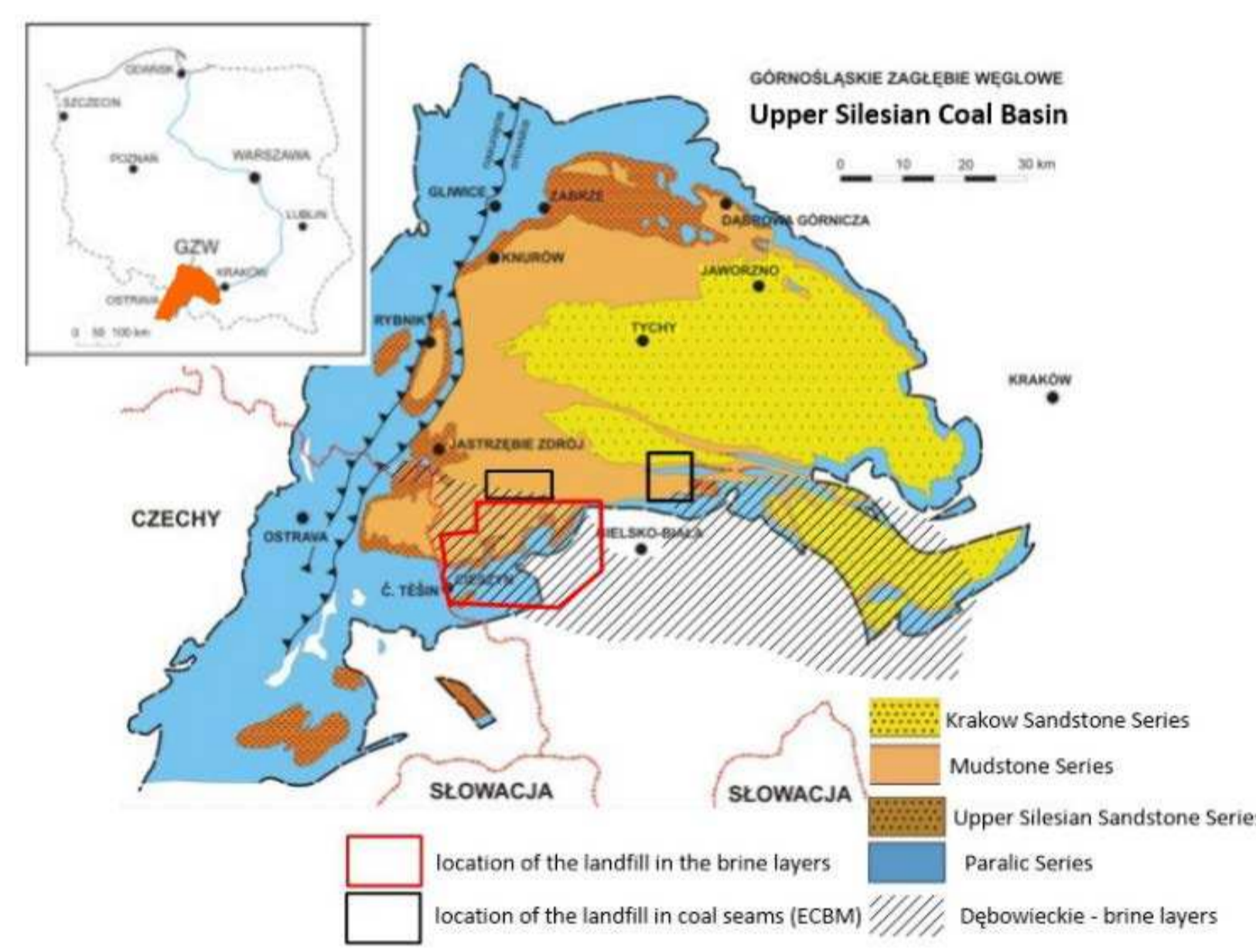
CO₂ emission in the region



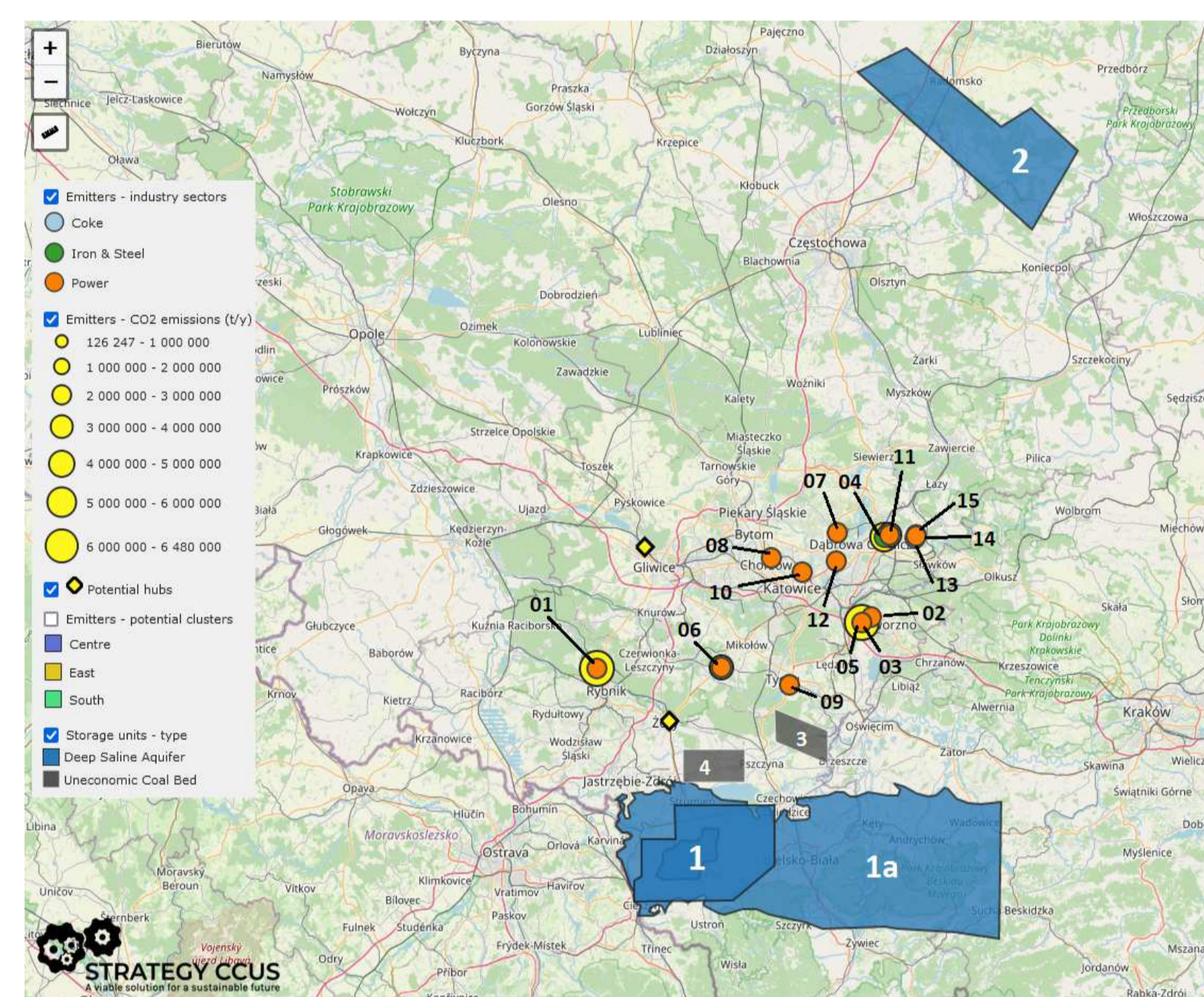
CO₂ emissions excluding LULUCF by sectors in 2018

Source: Poland's National Inventory Report 2020, Greenhouse Gas Inventory for 1988-2018, Submission under the UN Framework Convention on Climate Change and its Kyoto Protocol. Report elaborated by: National Centre for Emission Management (KOBIZE) at the Institute of Environmental Protection – National Research Institute, Ministry of Climate, Warszawa 2020

- Total annual CO₂ emissions exceeding 33 Mt
- Over 100 carbon dioxide emitters covered by the EU ETS
- Large industrial emitters (coal-fired power plants, heating plants, steelworks, coking plant)
- Air pollution associated with industrial sector and household heating
- Electricity and heat produced mainly from hard coal and natural gas
- Increasing share of RES



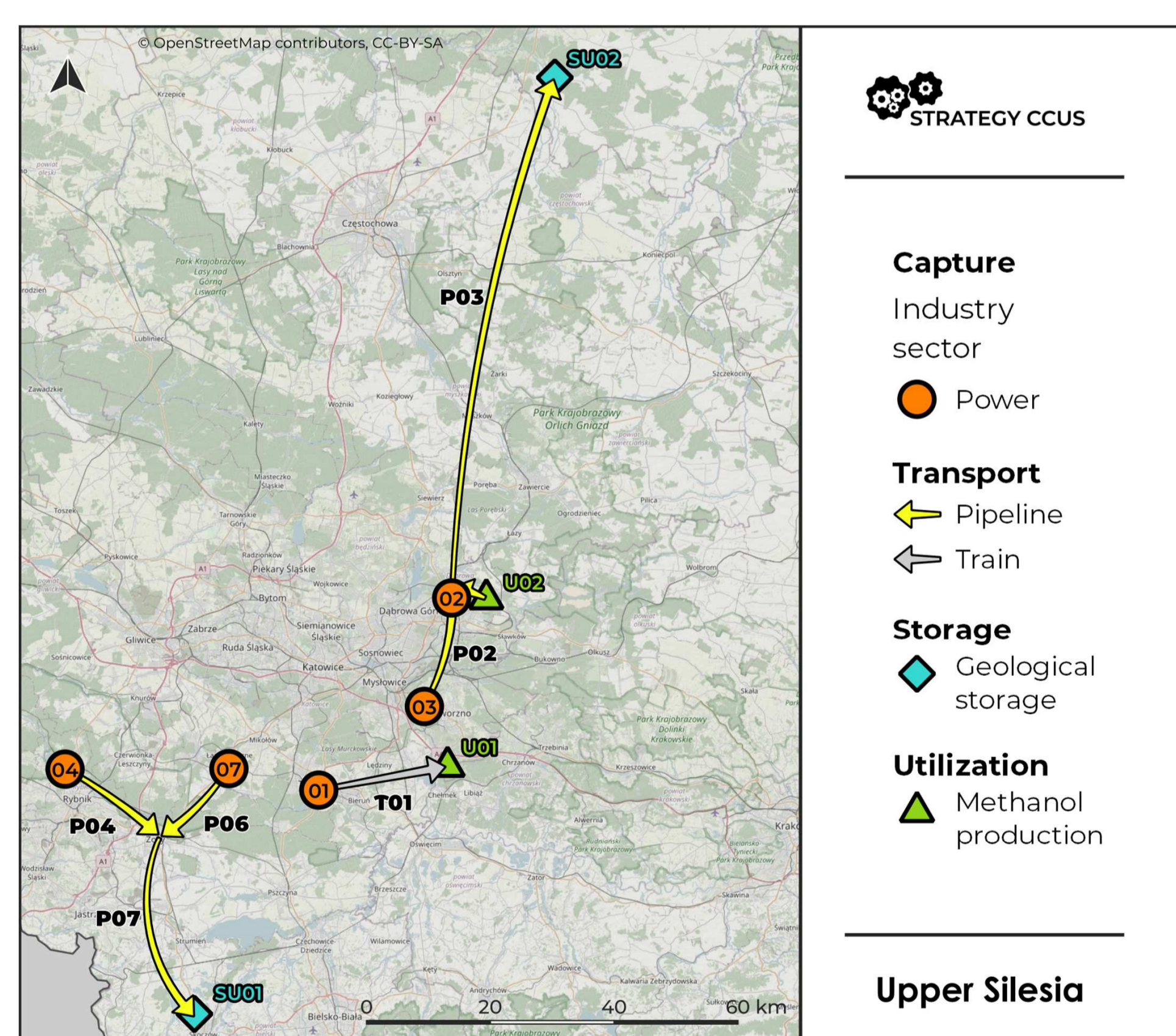
Main geological formations in Upper Silesia region



No	Facility	Mt CO ₂ e/y
01	PGE GIEK S.A Power Plant 'Rybnik'	6.48
02	Tauron Wytwarzanie S.A. Power Plant Jaworzno III, power plant II	0.91
03	Tauron Wytwarzanie S.A. Power Plant branch Jaworzno III	6.04
04	ArcelorMittal Poland S.A. Ironworks in Dąbrowa Górnicza	4.64
05	Tauron Wytwarzanie S.A. Power Plant New Jaworzno	4.7
06	Tauron Wytwarzanie S.A. Power Plant Łaziska	3.88
07	Tauron Wytwarzanie S.A. Power Plant Łaziska in Będzin	1.87
08	CEZ Chorzów S.A.	1.35
09	Tauron Ciepło Sp. z o.o. Combined heat and power plant Tychy	0.20
10	Tauron Ciepło Sp. z o.o. Combined heat and power plant Katowice	0.27
11	TAMEH Polska Sp. z o.o. Zakład Wytwarzania Nowa in Dąbrowa Górnicza	3.34
12	Combined heat and power plant Będzin Sp. z o.o.	0.61
13	JSW Koks S.A. Coke Plant 'Przyjaźń' in Dąbrowa Górnicza	0.43
14	JSW Koks S.A. Power Plant of Coke Plant in Dąbrowa Górnicza	0.23
15	JSW Koks S.A. Combined heat and power plant of Coke Plant in Dąbrowa G.	0.13

Location of largest emitters

CCUS long term scenario



Capture of carbon dioxide from seven emitters (large power and heating plants)

Storage in two DSA

Utilization in two methanol plants

Transport
One rail connection - distance c.a. 20km
Seven pipelines of the total length 170km and diameter in the range 114-227mm.

Two hubs – common infrastructure benefits

Total estimated captured CO₂ in the scenario equal to 106Mt
Period from 2025 to 2050
- 91.4 Mt to be stored in DSA
- 13.2 Mt used for methanol production

Key Performance Indicators

Analysis of the CCS system		Analysis of CO ₂ volumes (Mt)		Analysis of ETS allowances	
Total CCS value chain	-25	Total CO ₂ Captured	106.1	EU ETS parameters	
CCS value chain (€/CO ₂ avoided)	-25	CO ₂ utilized	13.2	Price of allowances in 2025 (€/tonCO ₂)	70
Total CAPEX per block	-14	CO ₂ for mineralization (perm. avoided)	0.0	Price of allowances in 2045 (€/tonCO ₂)	212
Cost of Capture (€/tonCO ₂ avoided)	-11	Stored	91.4		
Cost of Transport (€/tonCO ₂ avoided)	-1	Total emitted with CCS	176.4	Whole regional expense without CCUS:	
Cost of Storage (€/tonCO ₂ avoided)	-3	Total avoided emission	92.3	ETS costs without CCUS (M€)	22 184.6
OPEX per block	-11	BIO CO ₂ captured, neg. Emissions	0.0	Whole region expense with CCUS	
Total CO ₂ fed into transport network	-6	Total CO ₂ fed into transport network	106	ETS costs with CCUS, remaining emissions (M€)	16 033.3
Cost of Transport (€/tonCO ₂ avoided)	0	CCUS National Objectives		Cost of CCUS (M€)	2 344.2
Cost of Storage (€/tonCO ₂ avoided)	-5	Share in national objectives		TOTAL costs with CCUS (M€)	18 377.5
Transport cost (€/tonCO ₂ transported)	-1.0			Cost difference, with minus without CCUS (M€)	-3 807.0
Utilisation (income from CO ₂ sales) (M€)	1328.7			Whole region expense with CCUS	
EUA/ETS credit savings in the region (M€)	6151.4			ETS costs with CCUS, remaining emissions (M€)	16 033.3

