

MINERAL RESOURCES OF HUNGARY AS OF 1 JANUARY, 2018

The Hungarian Office for Mining and Geology keeps the records of mineral resources and reserves of Hungary pursuant to provisions of the multiple amended Section 25. of Act No. XLVIII. of 1993. on mining as well as Government decree No. 203/1998. for its implementation .

According to the present Act, mineral raw materials of Hungary in their natural occurrence shall be state property. Such treasures form a part of natural resources and national assets of our country, keeping records of them has been on by the Hungarian Office for Mining and Geology and its predecessors since 1953.

Balance-like registry of national mineral raw materials is based on the obligatory data delivery from mining entrepreneurs as well as the resolutions issued by the concerned County Government Offices (the Division of Mining Supervision and four Departments of Mining of Divisions for Authority Affairs). Raw data of the registry are the following:

- quality and quantity of mineral resources and reserves;
- annual change in mineral resources, reserves (production, exploration, reclassification, etc.) according to annual delivery;
- mineral resource, reserve left behind subsequent to mine closure, field abandonment.

Based on such available data, mineral resources and reserves are recorded separately by each raw material including occurrence(s).

The National Registry on Mineral Raw Materials and Geothermal Resources consists of more than 4,091 registered mining areas. Both resources and reserves as of 1 January 2018. as well as production of Hungary in 2017. are presented in the following table.

Mineral resource	Production in 2017		Geologic resources as of 1 Jan 2018		Exploitable reserves as of 1 Jan 2018	
	Mm ³	kt	Mm ³	kt	Mm ³	kt
Crude oil						
Conventional	0.84		275.03		24.21	
Non-conventional	0.00		537.11		58.52	
Natural gas						
Conventional	1879.54		186 445.06		76 196.49	

Non-conventional	5.17		3 923 322.0		1 565332.44	
CO₂ gas	112.3		44 674.82		28 798.12	
Black coal		0.789		1 625 044		1 915 321**
Brown coal		83.341		3 195 856		2 241 124
Lignite		7 890		5 686 865		4 240 870
Uranium ore		0		26 769		26 769
Iron ore		0		43 151		43 664
Bauxite		1.3		123 845		79 705
Lead - zinc ore		0		90 775		100 817
Copper ore		0		781 170		726 459
Precious metal ore		0		36 588		36 507
Manganese ore		0		78 868		51 982

	Mm³	Mm³	Mm³
Industrial minerals (selected)	1.13	1 711.90	544.67
Raw materials for cement and lime industry	1.16	1 135.44	567.48
Raw materials for building and decoration stone industry	5.07	1 998.68	1 360.22
Sand	7.45	866.47	628.96
Gravel	14.44	3 653.07	2 340.00
Raw materials for ceramics	1.34	999.66	648.98

industry			
Peat, paludal mud, paludal lime	0.27	538.35	305.09
Others	2.11	58.33	46.55
<i>In total</i>	32.97	10 961.90	6 441.95

* 1000 m³ natural gas equals to 1 ton

** Attenuation is higher than loss (Geologic reserve + attenuation - loss - pillar = Exploitable reserve)
/quantity of exploitable coal + interim waste rock may exceed the registered geologic reserve!//

Table 1.: Summary data of known mineral raw material resources and reserves of Hungary (based on provided data)

Coals

Geologic resources of coals in Hungary are presented in Table 2.

Coals	Geologic resources as of 1 January 2017. (million tons)	Geologic resources as of 1 January 2018. (million tons)
Black coal	1 625.00	1 625.00
Brown coal	3 195.9	3 195.90
Lignite	5 695.1	5 686.9
<i>Hungary in total</i>	10 516.0	10 507.8

Table 2. Geologic resources of coals in Hungary

Total coal production (black and brown coal, lignite) in Hungary has been 8-9 million tons in recent years. Our black coal production was insignificant, and brown coal production increased slightly in 2017 following a steady decline in recent years. Significant decrease was observed in lignite production in 2017.

Coal production figures for 2016 and 2017 are shown in Table 3. Figure 1 shows graphically the production of the last few years

Coals	Production in 2016	Production in 2017
	1000 t	1000 t
Black coal	0.748	0.789
Brown coal	68.061	83.341
Lignite	9 164	7 890
<i>Hungary in total</i>	9 232.8.	7 974.13

Table 3. Coal production of Hungary in 2016 and 2017

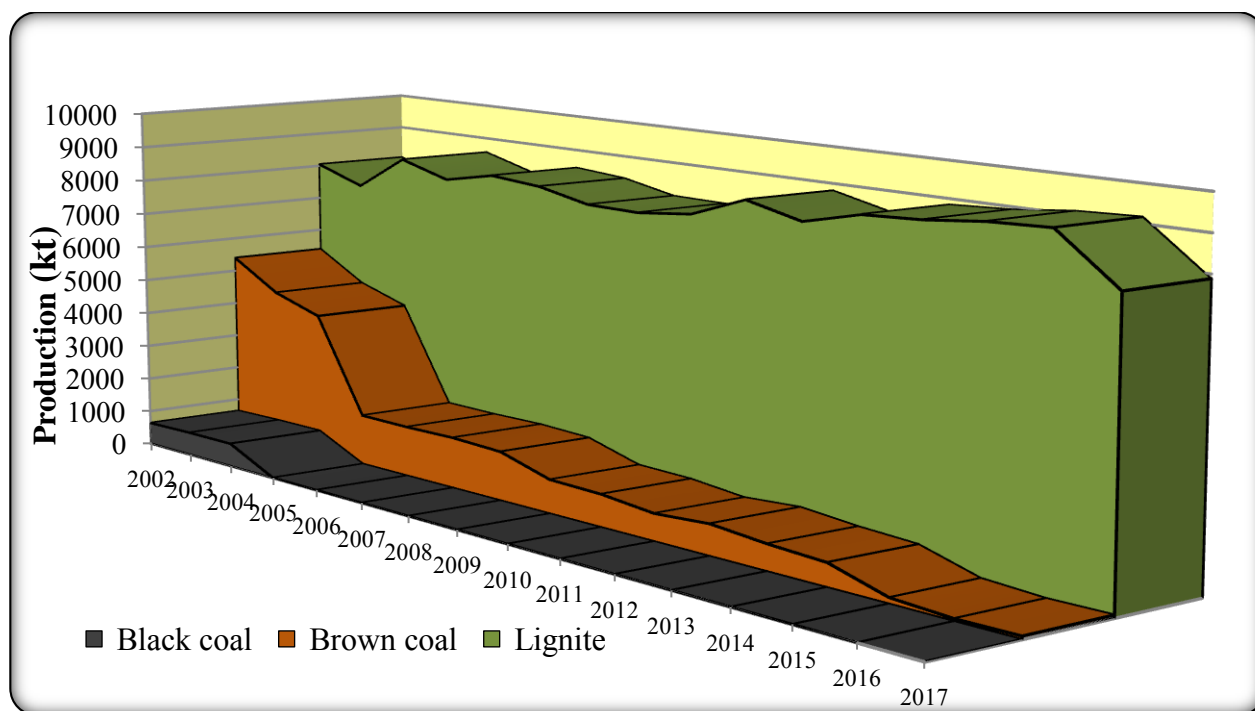


Figure 1. Coal production of Hungary in the past few years

Hydrocarbon and CO₂

As for the registered 324 crude oil and natural gas mining plots, all changes in mineral resources, reserves in 2017 are due to the activity of 22 mining entrepreneurs.

Practically, data of non-conventional crude oil as well as natural gas concerning resources were constant. In the case of conventional natural gas, the geological resource decreased by 2.4 %, the extractable resource decreased by 3.7%, compared to 2016.

The geological and extractable resource of carbon dioxide gas have hardly changed, with virtually the same production as last year.

Geologic resources of hydrocarbons and carbon dioxide of Hungary are shown in Table 4.

	Geologic resources as of 1 January 2018
Crude oil (Mm ³)	812.14
Natural gas (Gm ³)	4109.77
CO ₂ gas (Gm ³)	44.67

Table 4. Geologic resources of hydrocarbons and carbon dioxide of Hungary

Production and geologic resources of the past few years are presented graphically in Figure 2. and 3.

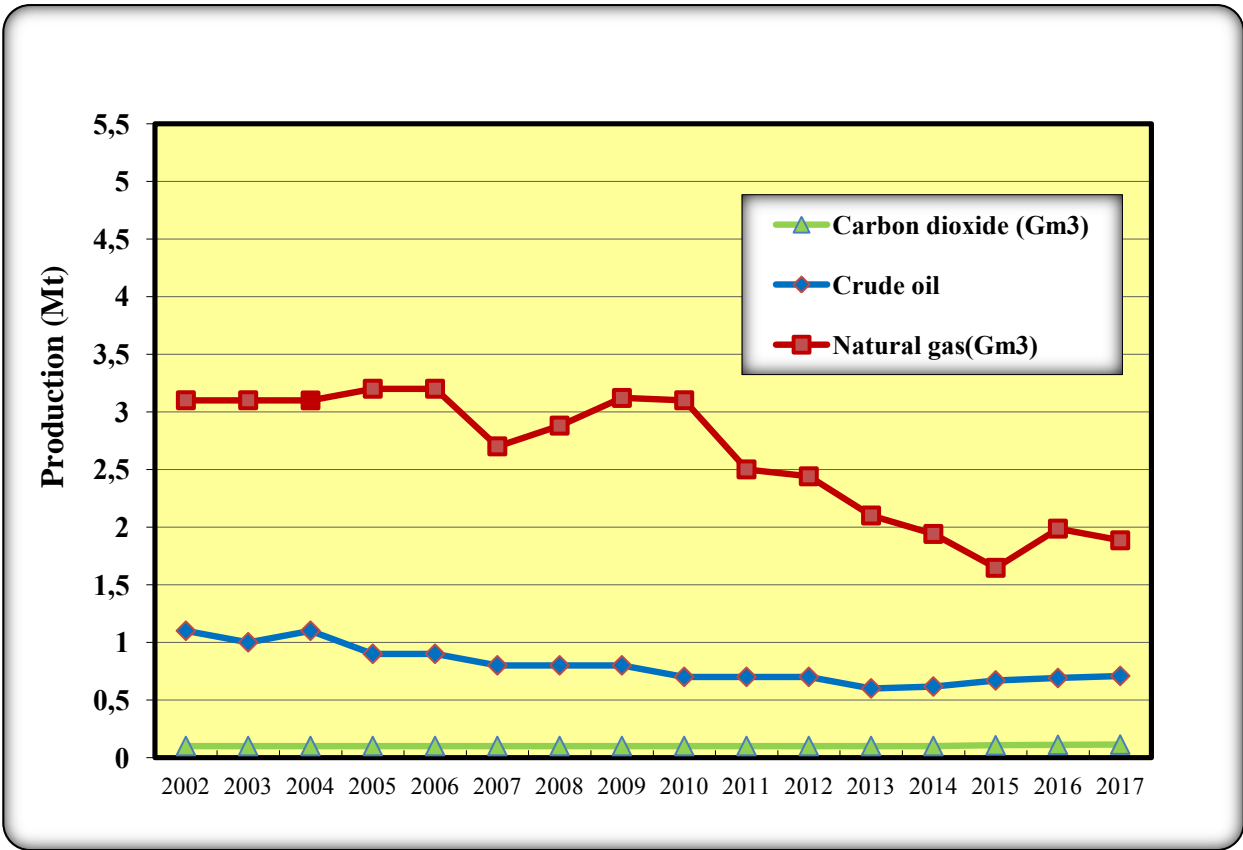


Figure 2. Production of crude oil, natural gas and carbon dioxide in Hungary between 2002-2017

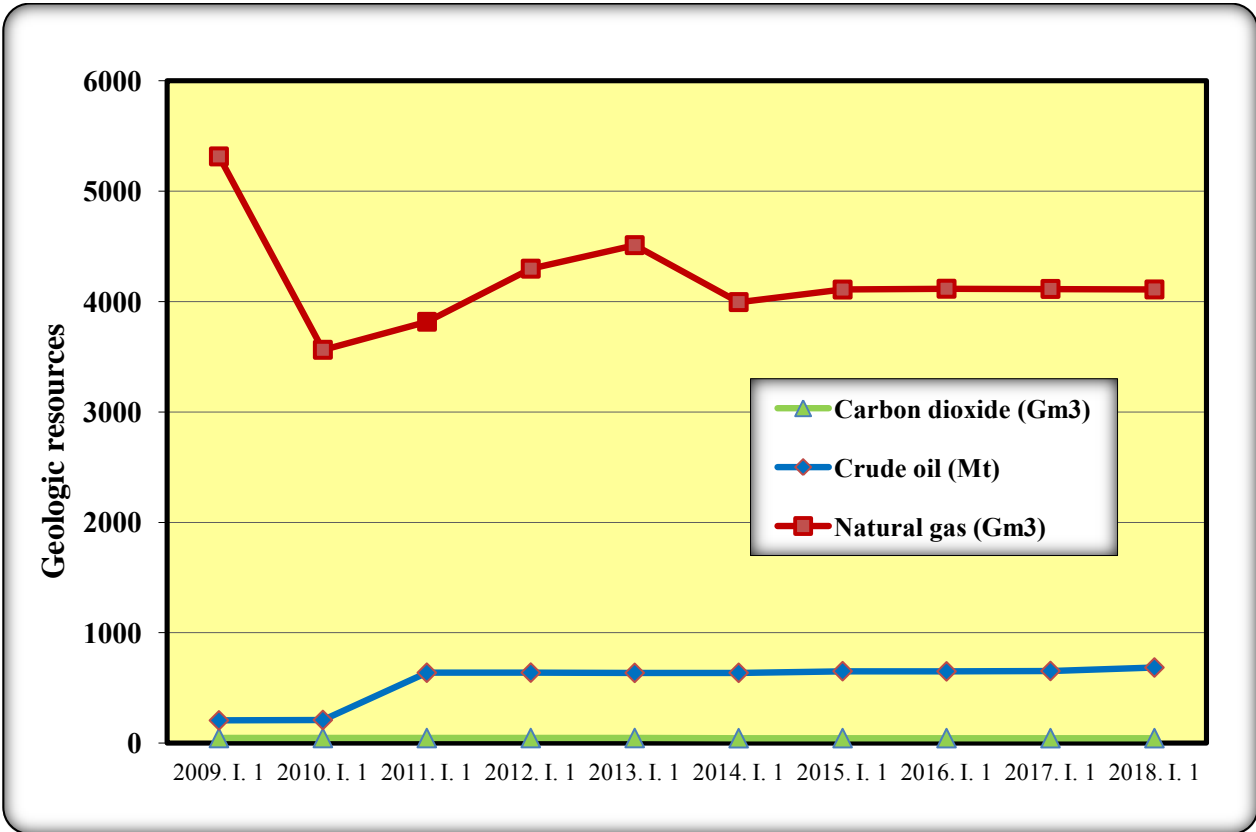


Figure 3. Geologic resources of Hungary concerning crude oil, natural gas and carbon dioxide

Ores

Ore mining in Hungary decreased significantly in the past few years. There was only a single mine producing bauxite in 2016, the production of manganese ore (Úrkút) terminated in mid-2016. The geologic ore resources as of 1 January 2018 may be seen in Tables 5 and 6, the production of bauxite from the past few years is in Figure 5.

	Geologic resources (Mt)
Iron ore	43.15
Lead-zinc ore	90.8
Copper ore	781.2
Precious metal ores	36.6
Uranium ore	26.8

Table 5. Iron, uranium and non-ferrous metal ore resources of Hungary as of 1 January 2018

	Geologic	Exploitable	Geologic	Exploitable	Production	Production
	resources and reserves (Mt)		resources and reserves (Mt)		(Mt)	(Mt)
	1 Jan 2017		1 Jan 2018		2016	2017
Bauxite	123.8	79.7	123.8	79.7	0.017	0.001
Manganese ore	78.9	52.0	78.9	52.0	0.019	0

Table 6. Bauxite and manganese ore resources and reserves of Hungary, production in 2016 and 2017

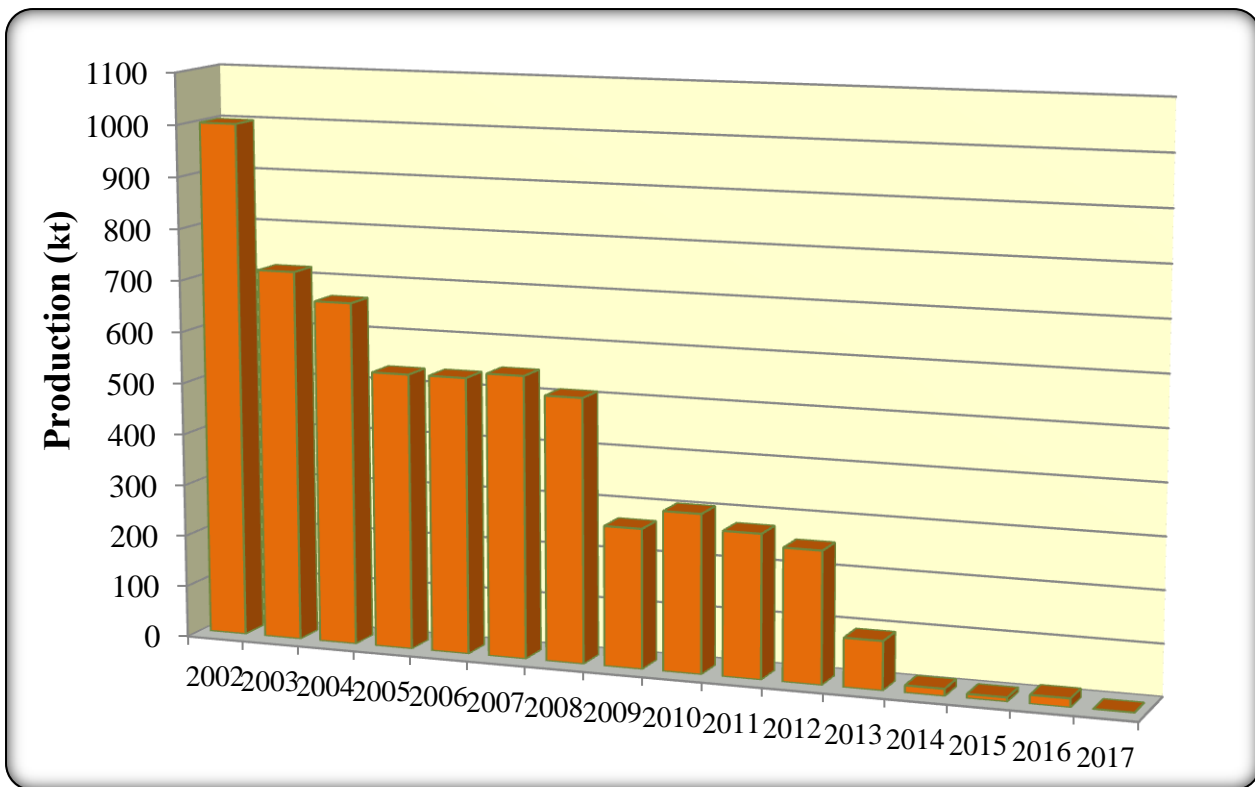


Figure 4. Bauxite production in Hungary in the past few years

Non-metallic mineral raw materials

Non-metallic mineral raw materials are recognized as more than 60, solid mineral types (of various geologic age and generation, except fuels and ores) used in many areas of national economy.

The total recognized non-metallic geologic resource is 10,962 Mm³ from which 6,442 Mm³ is exploitable. The present resources are split between 3,233 deposits.

Based upon utilization, non-metallic mineral raw materials are classified into 7 main raw material categories as follows:

1. **Industrial minerals (selected):** such as alginite, fire- and acid proof clay, industrial and glass sand, different quality limestones and dolomites, kaoline, etc.; main users are: chemical industry, metallurgy, ceramics industry, agriculture, building/construction industry (facing plasters, insulating materials).
2. **Peat, paludal mud, paludal lime**
3. **Raw materials for cement and lime industry:** basic materials of cement and lime industry such as limestone, marl.
4. **Raw materials for building and decoration stone industry:** main users are: building/construction (material) industry, transport, water engineering, sculpture.
5. **Sand for building industry**
6. **Gravel for building industry:** concrete component, basic material for road construction.
7. **Raw materials for ceramics industry:** main users are: brick-, tile- and porcelaine factories, small ceramics industry.

Main raw material category	Geologic resources /million m ³ /		Exploitable reserves /million m ³ /		Production in 2016	Production in 2017
	1 Jan 2017	1 Jan 2018	1 Jan 2017	1 Jan 2018	1000 m ³	1000 m ³
Industrial minerals (selected)	1711.43	1711.90	544.99	544.67	1130.23	1126.70
Peat-Paludal mud-Paludal lime	538.55	538.35	305.23	305.09	217.33	269.49
Raw materials for cement and lime industry	1136.80	1135.44	568.84	567.48	1181.66	1160.72
Raw materials for building and decoration stone industry	1921.09	1998.68	1291.40	1360.22	4996.67	5073.05
Sand for building industry	807.38	866.47	578.12	628.96	3325.43	7450.39
Gravel for building industry	3670.70	3653.07	2343.77	2340.00	12297.7	14442.14
Raw materials for ceramics industry	988.40	999.66	640.59	648.98	1105.46	1341.57
Others	52.88	58.33	41.99	46.55	179.67	2108.65
Non-metallic raw materials in total	10827.20	10961.90	6314.9	6441.95	24434.2	32972.7

Table 7. Non-metallic resources and reserves of Hungary, with production

The production of non-metallic raw materials in 2017 is increased by 8.54 million m³ as prepared to the previous year.

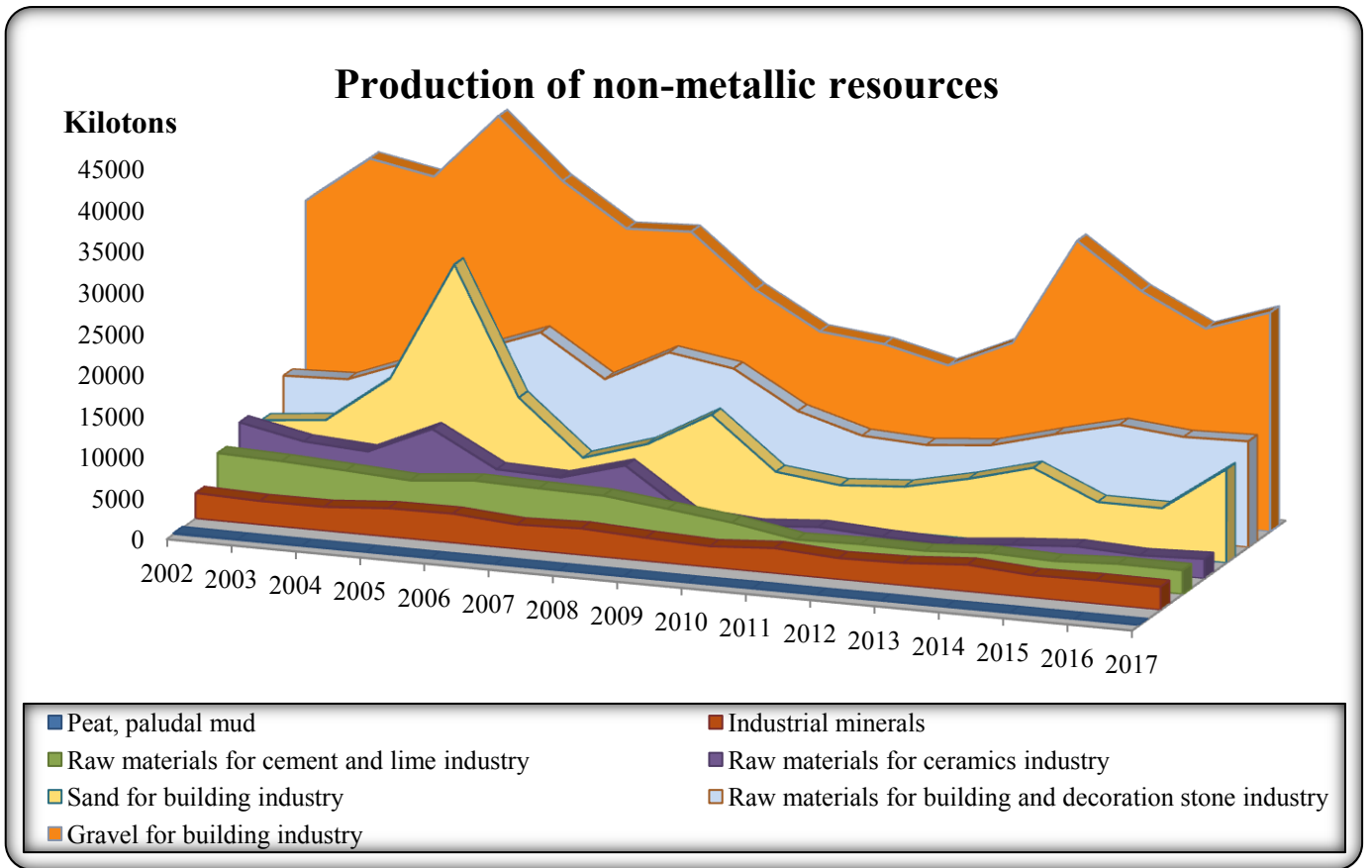


Figure 5. (Cumulated) production of non-metallic raw materials in Hungary in the past few years

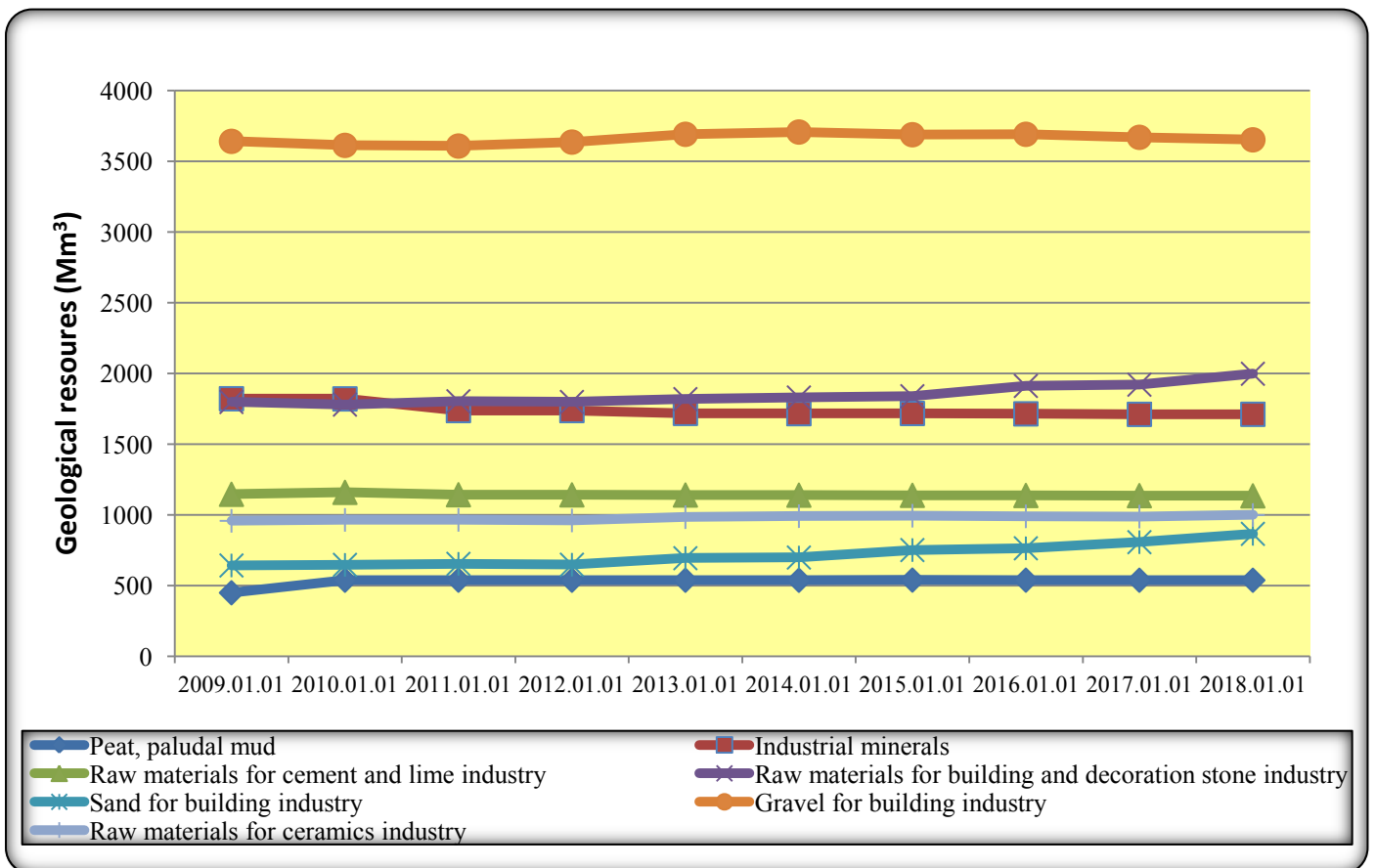


Figure 6. Geologic resource of non-metallic raw materials in Hungary

Geothermal energy

Geothermal energy is a plus heat quantity stored in geologic formations as a result of their higher temperature as compared to the superficial average temperature. In Hungary the value of geothermal gradient is $5\text{ }^{\circ}\text{C}/100\text{ m}$ on average which is one-and-the-half times higher as the world average. The superficial average temperature is about $11\text{ }^{\circ}\text{C}$. Considering the before-mentioned geothermal gradient, the temperature of rocks in 1 km depth is $60\text{ }^{\circ}\text{C}$, in 2 km depth is $110\text{ }^{\circ}\text{C}$, together with waters stored within. The reason is that the Earth's crust in the Pannonian basin is thinner than the world average (24-26 km thick, approx. 10-15 km thinner than other areas). Thus the hot mantle is closer to the surface. The reason is that the Earth's crust is thinner in the Pannonian basin (24-26 km, 10-15 km thinner as compared to other areas) than the world average, thus the hot mantle is closer to the surface. The measured thermal flow values are also one-and-the-half times higher ($90,4\text{ mW}/\text{m}^2$) as the European average ($60\text{ mW}/\text{m}^2$). Geothermal gradients are higher on the southern part of Transdanubia and the Hungarian Great Plain than the national average, while the lowest on the north-western part of Hungary and the mountainous areas.

Pursuant to Government decree No. 54/2008.: "Geothermal energy: The inner thermal energy of Earth's crust which can be utilized for energetic purposes. Geothermal energy is recovered by either the transfer of fluids or gases above $30\text{ }^{\circ}\text{C}$ (geothermal fuels), direct exploitation of such fuels or reinjection."

The exploited volume and recovered energy in total reported to the Department of Mining and Royalty Income Affairs of the Mining and Geological Survey of Hungary are as follows:

Exploited volume : **33,431,344 m³**

Recovered energy : **3,618,878 GJ**

The National Registry of Mineral Raw Materials and Geothermal Resources also keeps records of geothermal resource/reserve, geothermal protective pillars, facilities utilizing geothermal energy as well as volume of exploited and utilized geothermal energy. Some data of the borehole database (facility identifier /rokarec/ and EOV coordinates /RX, RY/) were added to the records on facilities in 2017. The completion of registries - except geothermal energy reserve - was done for 2010-2017. based on data sheets submitted by the licensees utilizing geothermal energy.

Exploited energy for other purposes (non-mining royalty) for 2010-2017: **60,367,159 GJ**

Utilized energy for other purposes for 2010-2017: **20,958,507 GJ**

Waste rock/waste

Upon an obligation from the European Union, there is an obligation for servicing data pursuant to paragraph (3) of Section 14 of Ministerial decree No. 14/2008. on mining wastes in case of any change in mining waste. So we started to register all data in 2009. referring to any changes either in volume or in quality.

At request, mining entrepreneurs - in the frame of annual data delivery - submit data on waste rock and waste

generated in the reference year, sorting them in different groups.

National cumulated data for 2017 as of 01. 01. 2018

Volume of deposited material either in depository or in tailing pond (thousand m³)

on 1 January 2017	55210.9
on 31 December 2017	55343.8

Humiferous topsoil (thousand m³)

Sold upon an authority permit	47.1
Used for land remediation in mine	468.4
Deposited (with earlier volume)	449.8
Total extracted volume in the reference year	1344.0

Total volume used for backfilling and land remediation (thousand m ³)	2676.2
From previous year	323.4
In the reference year	2350.1

WASTE ROCK/WASTE in total (thousand m³)

	Inert	Non-inert, non-hazardous	Hazardous
Sold upon a permit from the Mining Authority	340.7	1.5	

Deposited in waste heap/tailing pond	701.6	4.8	0
Red mud deposition in temporary depository	0	0	0

Total volume of generated drilling mud (thousand m³)

on 1 January 2017	1034.5
on 31 December 2017	1056.8*

** out of this 736.8 thousand m³ were generated in 2008*

Total volume of drilling mud in the reference year (thousand m³)

	Inert	Non-inert, non- hazardous	Hazardous	Total
Deposited in self-managed mud treatment facility	-	-	-	-
Deposited in external waste facility (deposed), or recycled	20.8	0.1	1.4	22.3
IN TOTAL	20.8	0.1	1.4	22.3