

MINERAL RESOURCES OF HUNGARY AS OF 1 JANUARY, 2017

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 4,000 registered mining areas. Both resources and reserves as of 1 January 2017. as well as production of Hungary in 2016. are presented in the following 1. and 2. tables.

Mineral resource	Production in 2016		Geologic resources as of 1 Jan 2017		Exploitable reserves as of 1 Jan 2017	
	Mm ³	kt	Mm ³	kt	Mm ³	kt
Crude oil						
Conventional	0.86		274.91		23.09	
Non-conventional	0.00		537.11		58.52	
Natural gas						
Conventional	1980.46		190962.68		79113.95	

Non-conventional	5.91		3923326.27		1565337.61	
CO₂ gas	109.93		44787.12		28910.42	
Black coal		0.75		1625044		1915391**
Brown coal		68.06		3195939		2241172
Lignite		9164.00		5695103		4248745
Uranium ore		0		26769		26769
Iron ore		0		43151		43664
Bauxite		16.70		123847		79707
Lead - zinc ore		0		90775		100817
Copper ore		0		781170		726459
Precious metal ore		0		36588		36507
Manganese ore		19.00		78868		51982

Non-metallic mineral raw materials	Production in 2016	Geologic resources as of 1 January 2017	Exploitable reserves as of 1 January 2017
	Mm³	Mm³	Mm³
Industrial minerals (selected)	1.13	1711.43	544.99
Raw materials for cement and lime industry	1.18	1136.80	568.84
Raw materials for building and decoration stone industry	5.00	1921.09	1291.40
Sand	3.32	807.38	578.12
Gravel	12.30	3670.70	2343.77

Raw materials for ceramics industry	1.11	988.40	640.59
Peat, paludal mud, paludal lime	0.22	538.55	305.23
Others	0.18	52.88	41.99
<i>In total</i>	24.44	10827.23	6314.93

* 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 3.

Coals	Geologic resources as of 1 January 2016. (million tons)	Geologic resources as of 1 January 2017. (million tons)
Black coal	1625.00	1625.00
Brown coal	3194.50	3195.90
Lignite	5705.10	5695.10
<i>Hungary in total</i>	10524.60	10516.00

Table 3. Geologic resources of coals in Hungary

The total coal production (black and brown coal, lignite) of Hungary changed slightly in the past few years. Black coal production is negligible while brown coal production constantly decreased in recent years. Lignite

production was slightly increased. There are coal production data from 2015 and 2016 in Table 4., production of the past few years in Figure 1.

Coals	Production in 2015	Production in 2016
	1000 t	1000 t
Black coal	5.69	0.75
Brown coal	162.49	68.06
Lignite	9095.00	9164.00
<i>Hungary in total</i>	9263.18	9232.81

Table 4. Coal production of Hungary in 2015 and 2016

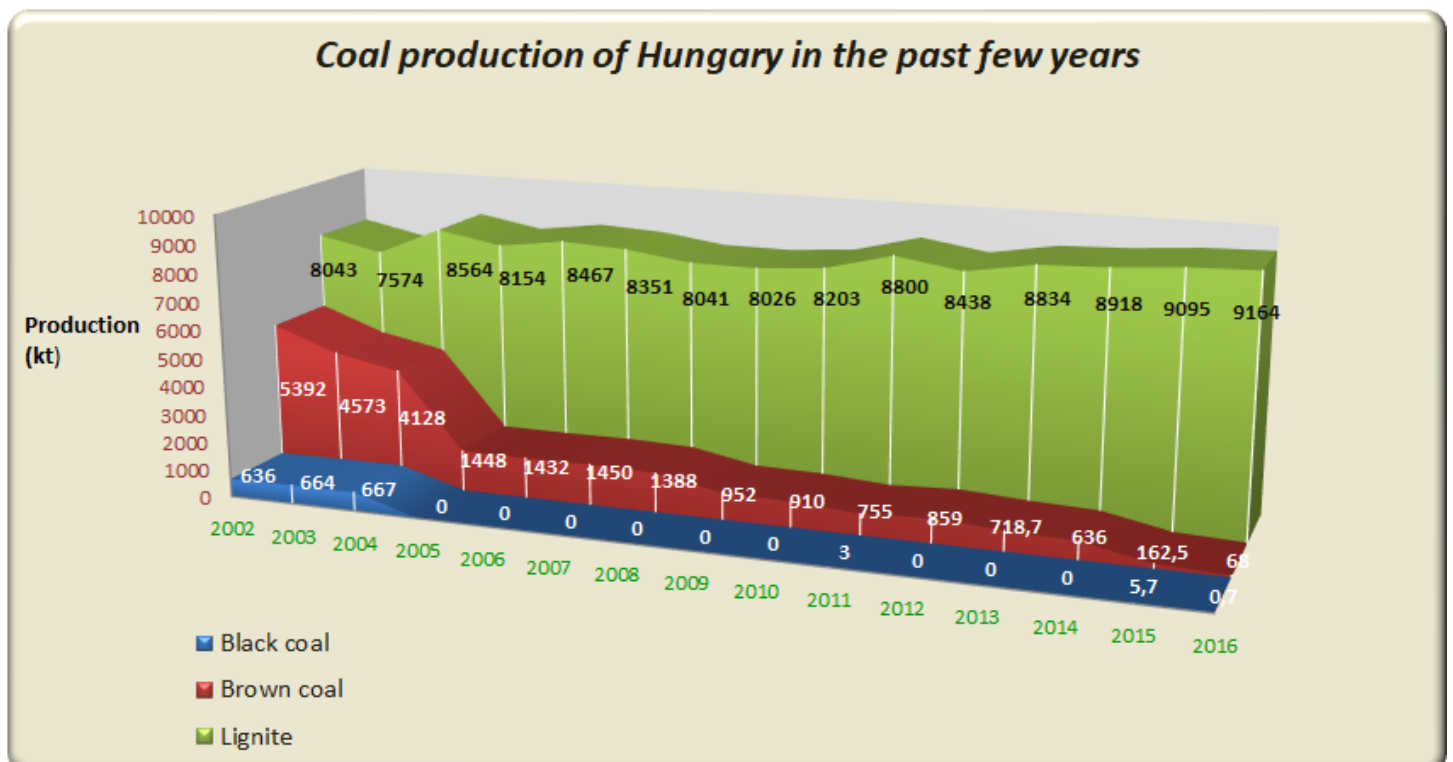


Figure 1. Coal production of Hungary in the past few years

Hydrocarbon and CO₂

As for the registered 311 crude oil and natural gas mining plots, all changes in mineral resources, reserves in 2016 are due to the activity of 21 mining entrepreneurs.

Practically, data of non-conventional crude oil as well as natural gas concerning resources, reserves were constant.

As for the 1% decrease in geologic resource concerning conventional crude oil, it was due to exploration, which also over-compensated the combined effect of the exploitation and the negative resource correction 15 times its volume. Exploitable reserve decreased by 9% due to mainly the negative resource correction, which over-compensated the combined effect of exploration and production analysis five times more in absolute terms than the exploitation.

As for conventional natural gas, registered resource data increased by 4%, while reserve data by 9.6% due to mainly correction.

Both geologic resource and exploitable reserve decreased concerning carbon dioxide resulted entirely by the decrease in production. The decrease was 0.4% taking the base number of the exploitable reserve.

Geologic resources of hydrocarbons and carbon dioxide of Hungary are shown in Table 5.

	Geologic resources as of 1 January 2017
Crude oil (Mm ³)	812.0
Natural gas (Gm ³)	4004.3
CO ₂ gas (Gm ³)	44.8

Table 5. Geologic resources of hydrocarbons and carbon dioxide of Hungary

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

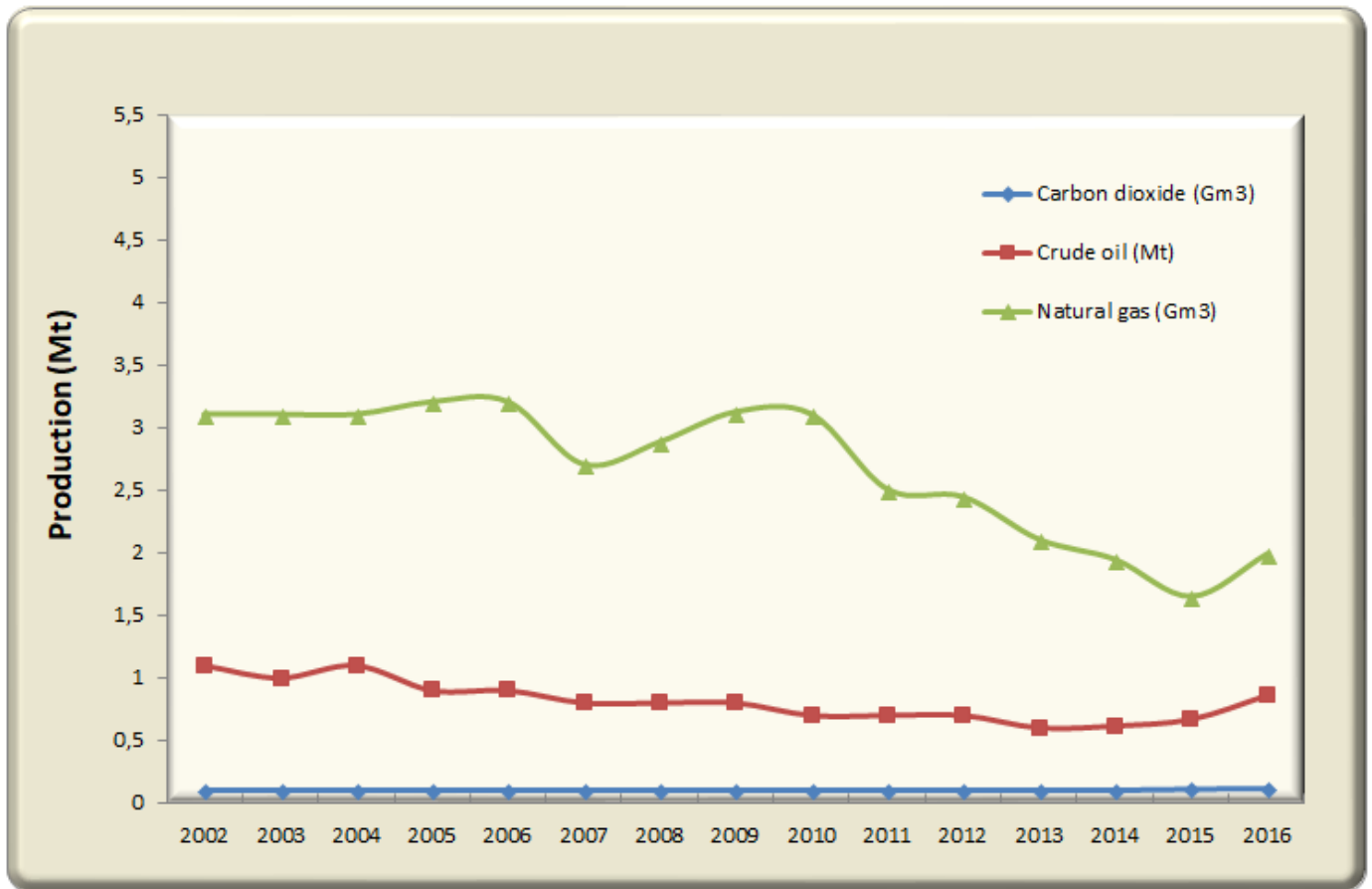


Figure 2. Production of crude oil, natural gas and carbon dioxide in Hungary between 2002-2016

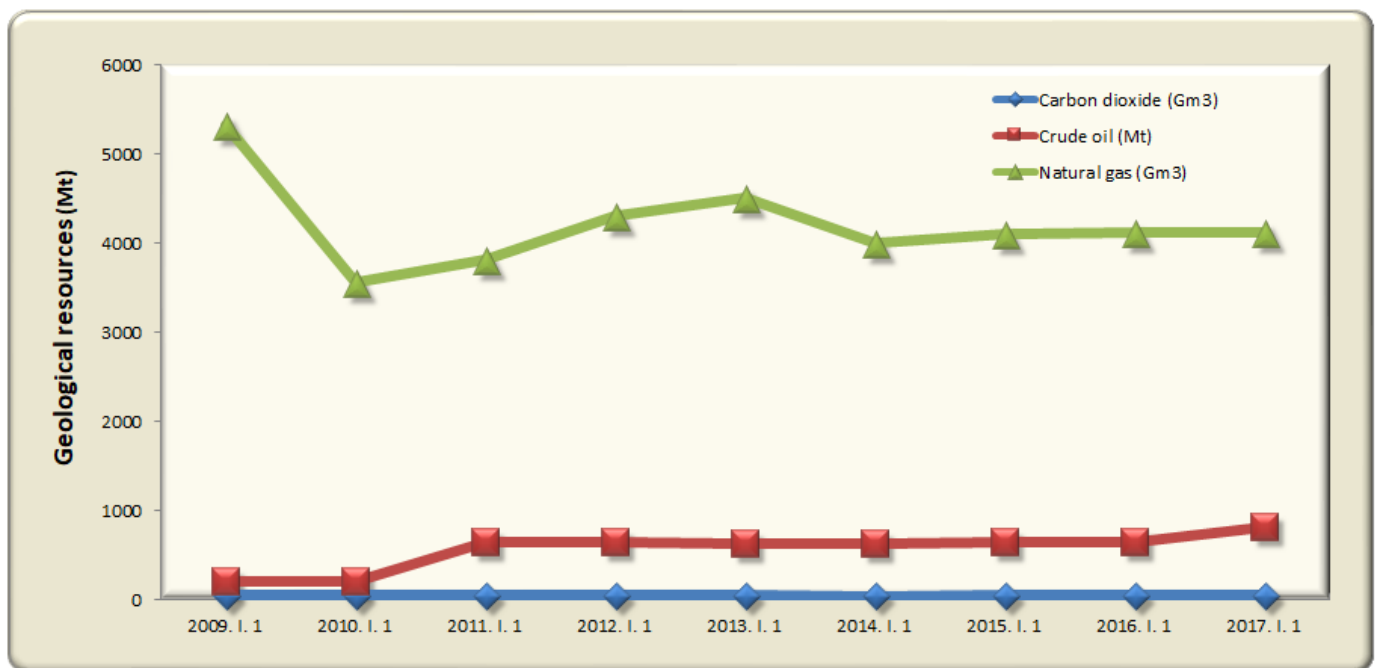


Figure 3. Geologic resources of Hungary concerning crude oil, natural gas and carbon dioxide

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 2017 may be seen in Tables 5 and 6, the production of bauxite from the past few years is in Figure 4.

	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 6. Iron, uranium and non-ferrous metal ore resources of Hungary as of 1 January 2017

	Geologic	Exploitable	Geologic	Exploitable	Production	Production
	resources and reserves (Mt)		resources and reserves (Mt)		(Mt)	(Mt)
	1 Jan 2016		1 Jan 2017		2015	2016
Bauxite	123.90	79.70	123.80	79.70	0.01	0.02
Manganese ore	78.90	52.00	78.90	52.00	0.06	0.02

Table 7. Bauxite and manganese ore resources and reserves of Hungary, production in 2015 and 2016

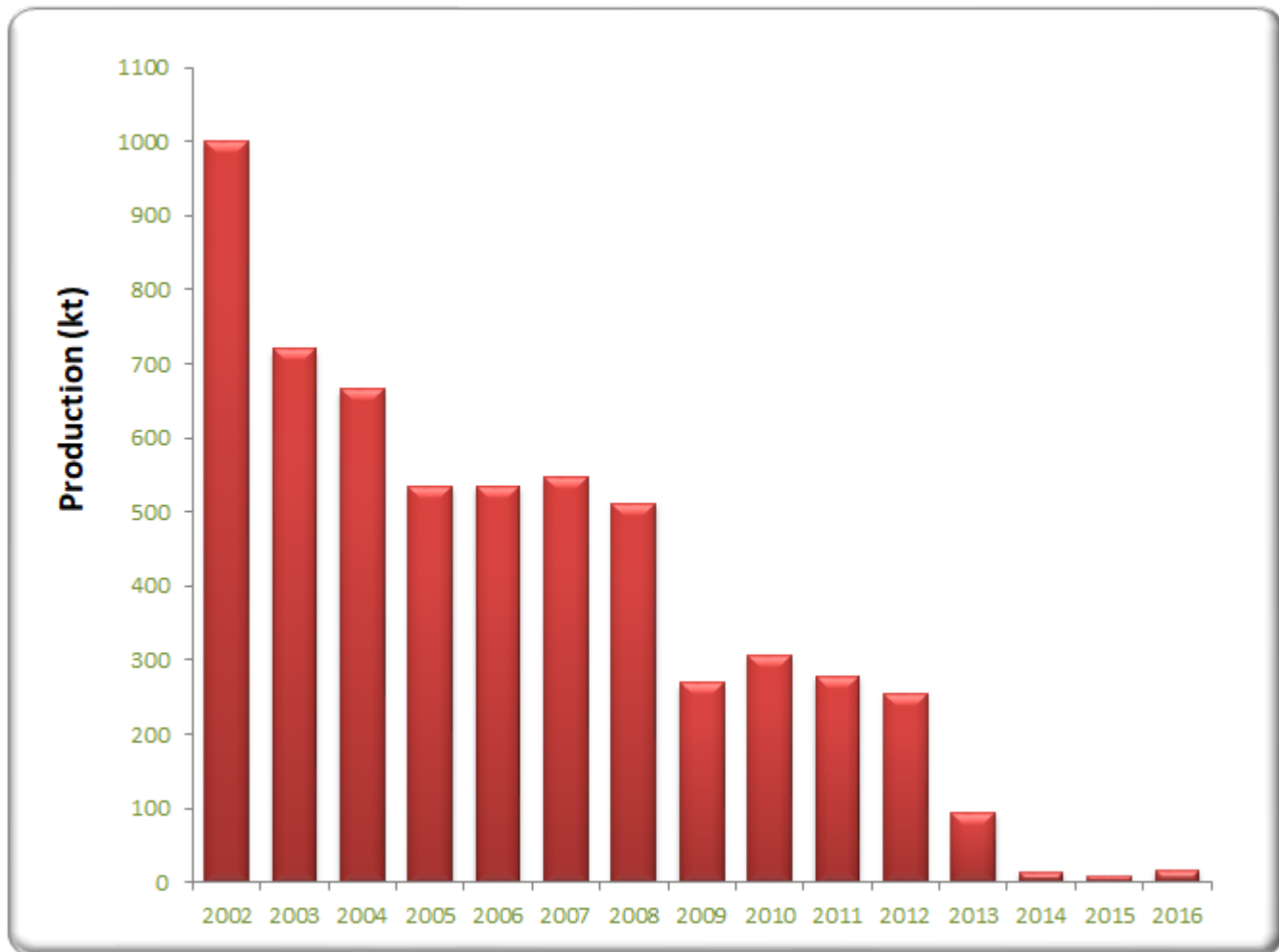


Figure 4. Bauxite production in Hungary in the past few years

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 10,827 Mm³ from which 6,314.9 Mm³ is exploitable. The present resources are split between 3,166 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 2015	Production in 2016
	1 Jan 2016	1 Jan 2017	1 Jan 2016	1 Jan 2017	1000 m ³	1000 m ³
Industrial minerals (selected)	1718.00	1711.43	551.81	544.99	1092.95	1130.23
Peat-Paludal mud-Paludal lime	1714.94	538.55	305.69	305.23	286.30	217.33
Raw materials for cement and lime industry	539.02	1136.80	570.02	568.84	1027.10	1181.66
Raw materials for building and decoration stone industry	1137.98	1921.09	1288.39	1291.40	5293.30	4996.67
Sand for building industry	1912.47	807.38	556.61	578.12	3398.54	3325.43
Gravel for building industry	764.19	3670.70	2351.43	2343.77	14230.20	12297.70
Raw materials for ceramics industry	3692.17	988.40	642.48	640.59	1286.05	1105.46
Others	990.51	52.88	31.63	41.99	589.20	179.67
Non-metallic raw materials in total	12469.28	10827.23	6298.06	6314.93	27203.64	24434.15

Table 8. Non-metallic resources and reserves of Hungary, with production

The production of non-metallic raw materials in 2016 is decreased by 2.77 million m³ as prepared to the previous year.

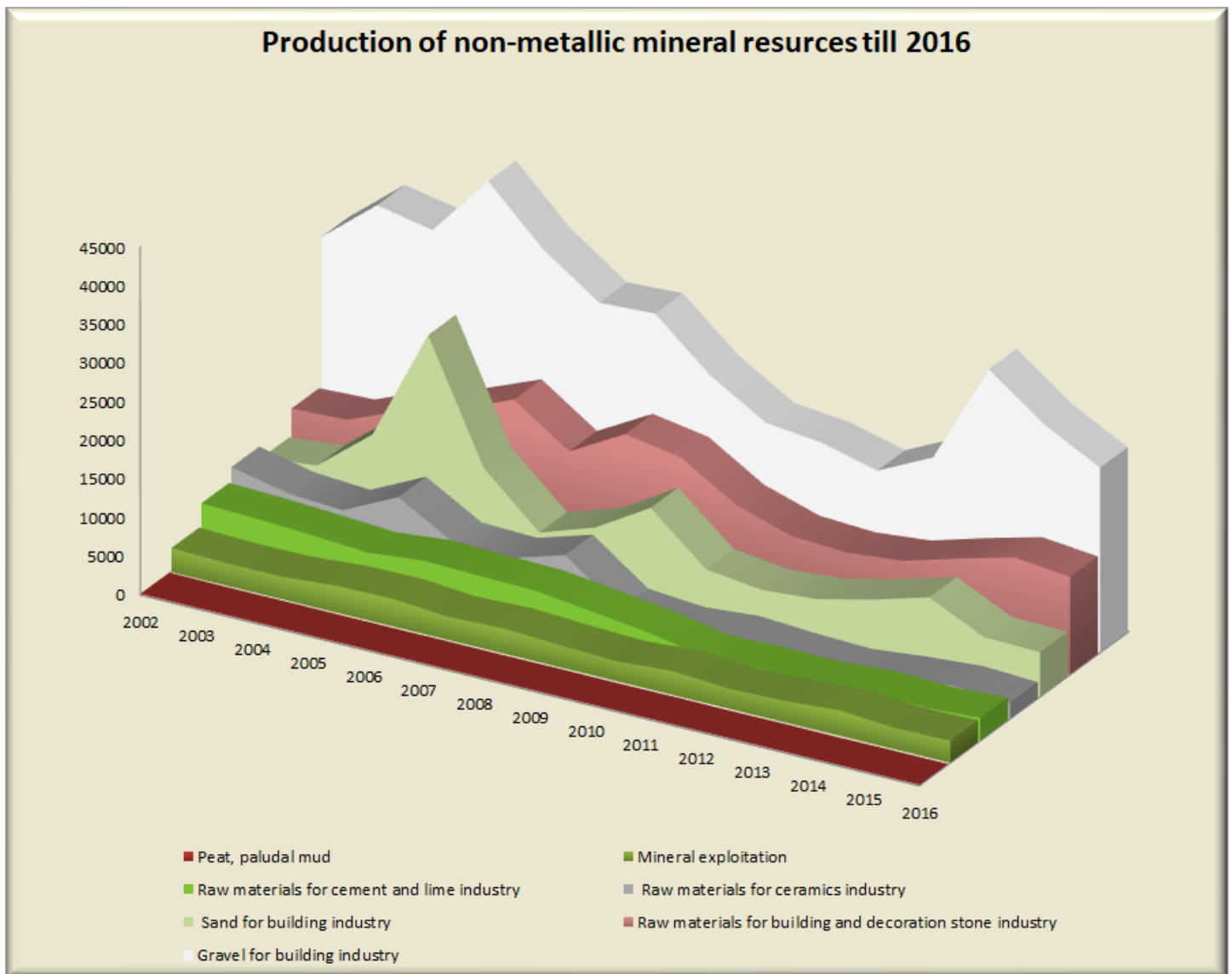


Figure 5. (Cumulated) production of non-metallic raw materials in Hungary in the past few years

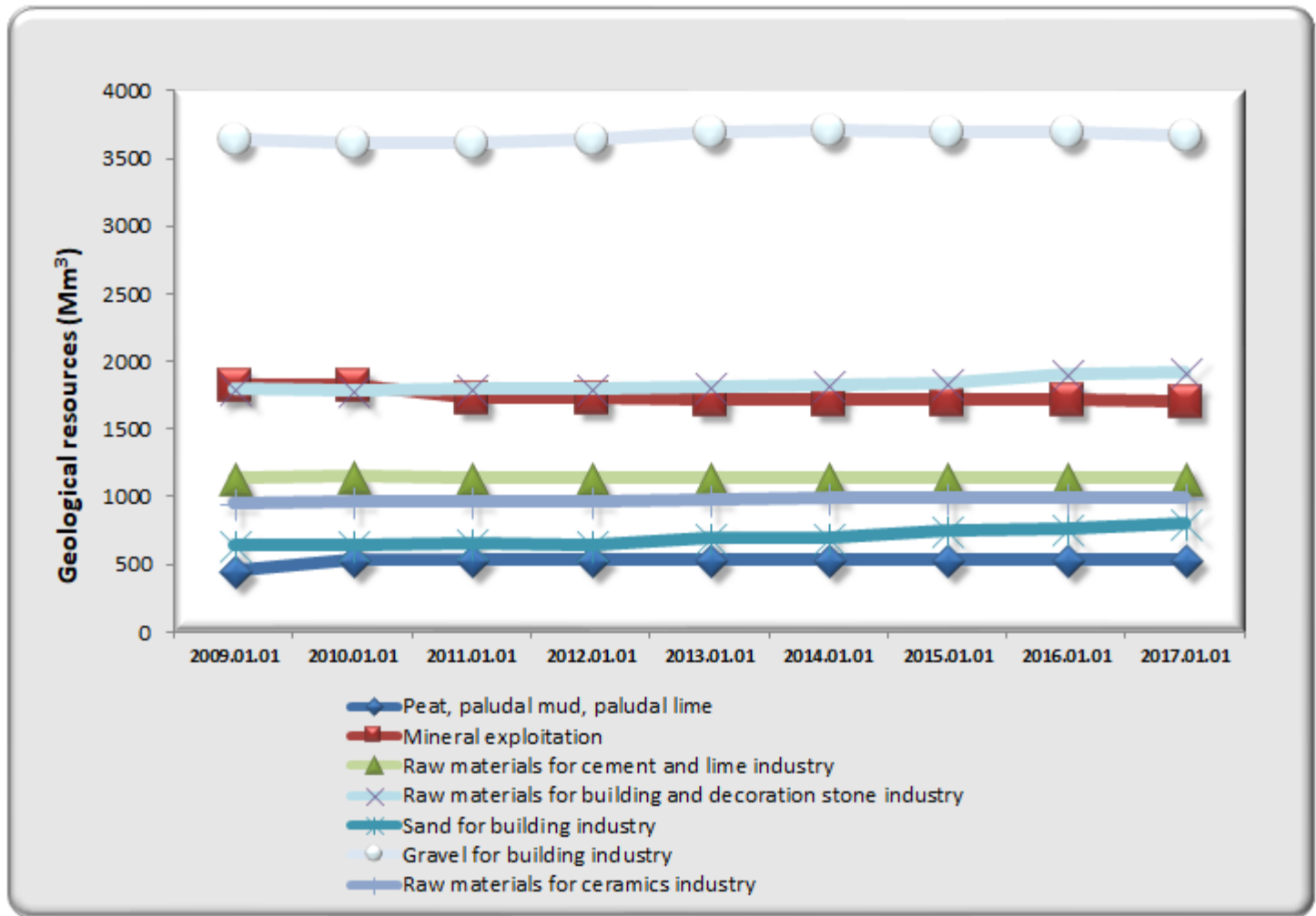


Figure 6. Geologic resource of non-metallic raw materials in Hungary

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 °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 : **30,080,144 m³**

Recovered energy : **3,280,999 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 2016. The completion of registries - except geothermal energy reserve - was done for 2010-2016. based on data sheets submitted by the licensees utilizing geothermal energy.

Exploited energy for other purposes (non-mining royalty) for 2010-2016: **34,052,743 GJ**

Utilized energy for other purposes for 2010-2016: **10,661,108 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 2016 as of 01. 01. 2017

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

on 1 January 2016	53951.5
on 31 December 2016	54310.7

Humiferous topsoil (thousand m³)

Sold upon an authority permit	11.3
Used for land remediation in mine	231.7

Deposited (with earlier volume)	449.8
Total extracted volume in the reference year	612.8

Total volume used for backfilling and land remediation (thousand m ³)	1422.9
From previous year	422.9
In the reference year	1018.9

WASTE ROCK/WASTE in total (thousand m³)

	Inert	Non-inert, non-hazardous	Hazardous
Sold upon a permit from the Mining Authority	204.6	1.0	
Deposited in waste heap/tailing pond	372.5	157.9	0
Red mud deposition in temporary depository	0	157.9	0

Total volume of generated drilling mud and cuttings (thousand m³)

on 1 January 2016	1017.5
on 31 December 2016	1034.5*

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

	Inert	Non-inert,	Hazardous	Total
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		non-hazardous		
Deposited in self-managed mud treatment facility	-	-	-	-
Deposited in external waste facility (deposed), or recycled	8.9	7.4	0.7	17.0
IN TOTAL	8.9	7.4	0.7	17.0