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Research Report

Demand for Raw Materials in 2045: Securing Resources, Building the Future. Prospects for Mineral Primary and Secondary Raw Materials

RWI Project Report

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RWI – Leibniz Institute for Economic Research

Demand for Raw Materials in 2045: Securing Resources, Building the Future

PROSPECTS FOR MINERAL PRIMARY AND SECONDARY RAW MATERIALS

SUMMARY

Study commissioned by the German Building Materials Association (bbs)

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RWI Project Report

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Demand for Raw Materials in 2045: Securing Resources, Building the Future

PROSPECTS FOR MINERAL PRIMARY AND SECONDARY RAW MATERIALS

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Preliminary remarks

Since 2012, the German Building Materials Association has commissioned a study every three years to examine the future demand for raw materials in the non-metallic minerals sector for various scenarios of overall economic development. This relates to questions about securing the supply of mineral raw materials required by the economy for the upcoming renewal of infrastructure, housing construction or the transformation of the economy towards climate neutrality.

Previous studies were carried out by the German Institute for Economic Research Berlin (DIW) and SST Engineering Company Aachen; the present study was carried out for the first time by the RWI - Leibniz Institute for Economic Research.

The study shows how the demand for primary raw materials and the volume of secondary raw materials in the non-metallic minerals sector are expected to develop. To this end, raw material matrices were used to estimate the demand for non-metallic minerals until 2045 for two scenarios of overall economic development. The projection of demand development expresses the extent to which demand for primary raw materials will change, taking into account the expected volume of secondary raw materials from the recycling of mineral construction waste and from by-products of industrial production.

Finally, recommendations are made on how the nationwide supply of non-metallic raw materials can be secured in the long term.

Methodology

A model is used that estimates the demand for raw materials for the various projection dates using differentiated raw material matrices. In order to estimate the quantities for the individual projection periods, the model considers, among other factors, the expected overall economic development, the development of the economic sectors that demand raw materials, the supply of secondary raw materials and the changes in raw material productivity.

Based on the quantities of primary and secondary raw materials and their use in the relevant economic sectors, the demand for non-metallic minerals in Germany is estimated for the years 2030, 2035, 2040 and 2045. For this purpose, two scenarios for the overall economic development are created, an upper and a lower variant. Therefore scenarios are formed on the basis of the demographic and economic developments. In the second step, the development of production in different economic sectors that are particularly relevant for the demand for raw materials is estimated. Relevant sectors are building construction and civil engineering, the iron and steel industry, the chemical industry, agriculture, construction materials as well as glass production.

Based on this, the distribution of raw material requirements across the upstream segments is determined in order to be able to draw conclusions about different raw materials. For this purpose, mass flow diagrams are created for all regarded raw materials and merged into a calculation matrix.

The estimate of the development of the market segments is based on real monetary production figures. However, this does not yet allow conclusions to be drawn about the quantitative demand for raw materials, as production growth is not only based on volume increases, but also on the change in raw material productivity, which is taken into account by corresponding sectoral adjustment factors.

Finally, primary and secondary raw materials are calculated together. Secondary raw materials can substitute primary raw materials. The volume of the secondary raw materials does not depend on demand, but on factors such as demolition activity (RC building materials), coal-fired power generation (FGD gypsum, hard coal fly ash) and the decarbonisation of the steel industry. Specific assumptions were made in the study regarding those individual factors.

Results

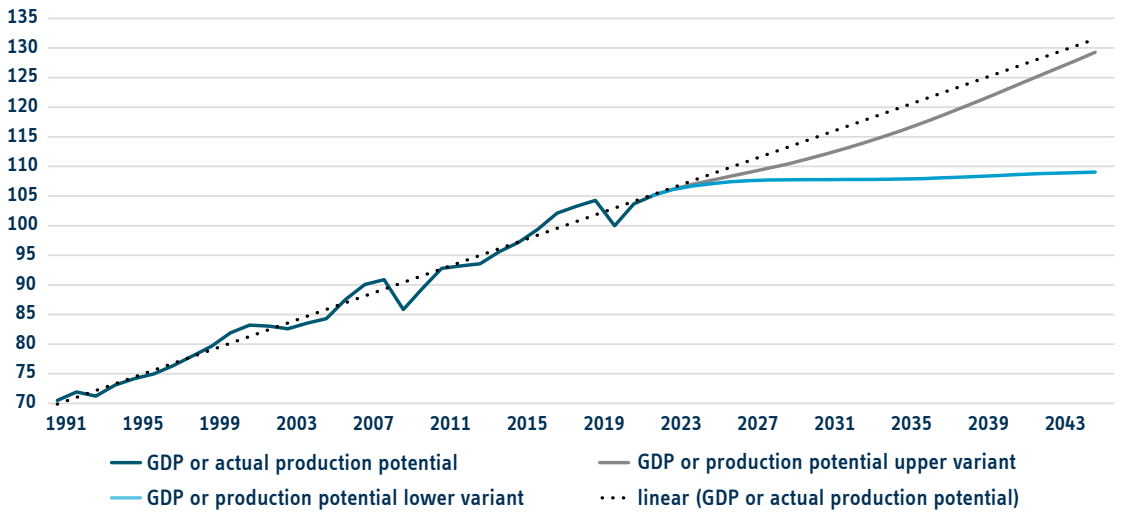
The German economy will continue to rely heavily on domestically sourced primary raw materials in 2045. This is the key finding of this study.

High infrastructure investments, the demand for additional living space and the transformation of the economy to achieve climate neutrality will ensure that the required quantity of raw materials is going to remain high. The study provides an estimate of the quantities of raw materials required in future and indicates how the supply of these raw materials can be secured.

The demand for non-metallic minerals is largely determined by the overall economic development (Fig. 1) and the associated change in the economic sectors that demand raw materials.

While gross domestic product (GDP) growth from 2022 to 2045 averages 0.9% p.a. in the upper variant, it is only 0.1% p.a. in the lower variant. The iron and steel industry hardly grows at all, even in the upper variant, while the construction volume records an above-average increase compared to the overall economic development with average growth of 1.2% p.a.

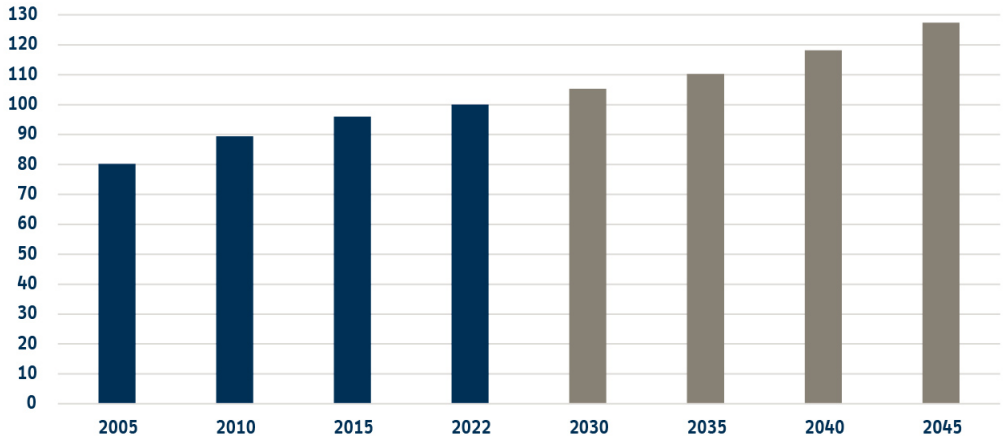
Fig. 1: Development of GDP



Source: Own presentation based on Destatis data; own calculations from 2024 onwards.

Another important factor for the demand for raw materials is the development of raw material productivity (Fig. 2). The trend of rising raw material productivity, which has been observed for over two decades, continues in both scenarios as a result of innovations, investments and quality improvements. This is considered in the projection model used by sectorally differentiated adjustment factors in order to be able to convert real monetary production development into physical raw material demand.

Fig. 2: Raw material productivity of non-metallic minerals (2022 = 100; upper variant)

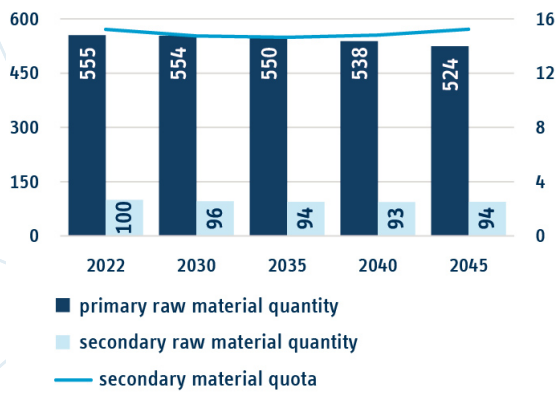


Source: Own presentation up to 2022 according to Destatis data; from 2030: projection results.

In the upper variant, the primary extraction of non-metallic minerals will be 524 million tons in 2045, 5.8% below the level of the base year 2022, while the volume of secondary raw materials will be 5.4% below the 2022 level at 94 million tons, meaning that the secondary material quota in 2045 will remain at the 2022 level of 15.2% (Fig. 3).

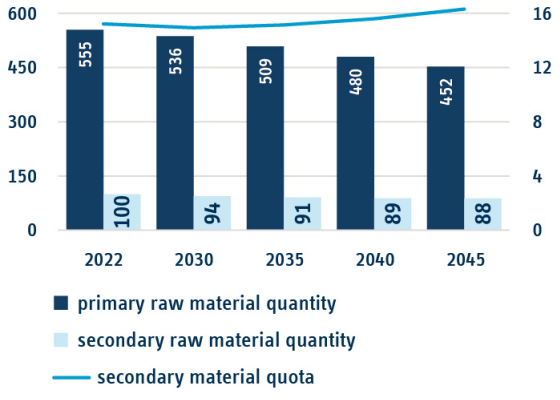
Assuming a less favorable overall economic development in the lower variant, primary extraction falls to 452 million tons (-18.5% compared to 2022) and the volume of secondary raw materials to 88 million tons (-11.5% compared to 2022). The secondary material quota thus rises from 15.2% in the base year 2022 to 16.3% in 2045 (Fig. 4).

Fig. 3: Raw material quantities in million tons and secondary material quota in % - upper variant



Source: Own presentation and calculations.

Fig. 4: Raw material quantities in million tons and secondary material quota in % - lower variant



Source: Own presentation and calculations.

Gravel, sand and natural stone represent the largest proportion of the primary raw materials considered. Their share of primary raw materials is 82.8% (2022). Compared to the base year, production declines up to 2045: in the upper variant, production of gravel and sand by 7.1% and production of natural stone by 5.2%, in the lower variant by 19.7% and 19.0% respectively. The largest fraction of secondary raw materials are recycled building materials with a share of 75.6%. Compared to 2022, they will increase by 7.0% in the upper variant and by 0.3% in the lower variant.

The share of total raw material demand covered by secondary raw materials remains unchanged in the upper variant. The slight decline in the volume of secondary raw materials is due in particular to the end of coal-fired power generation, as FGD gypsum and hard coal fly ash are no longer available. In addition, the volume of pig iron slag will decrease as a result of the discontinuation of the blast furnace route in steel production. As the volume of secondary raw materials is independent of the demand for raw materials, supply deficits for individual raw materials can only be offset by increasing the extraction of primary raw materials.

The primary extraction of non-metallic minerals will therefore continue to be of great importance in the coming decades. For reasons of high transport cost sensitivity, transport emissions and security of supply, decentralized extraction and processing should be ensured. As there are some social reservations about the extraction of raw materials, the question arises as to how the future supply of non-metallic raw materials for downstream economic sectors such as construction, industry and agriculture can be secured.

The policy recommendations therefore discuss measures to counteract this trend. They relate to regulation to ensure the sustainable extraction of non-metallic minerals, the promotion of recycling and the use of industrial by-products to close material cycles, as well as increasing acceptance for the extraction of non-metallic minerals and the use of secondary raw materials.

Taken as a whole, the recommended individual measures serve the purpose of securing the long-term supply of non-metallic minerals in terms of sustainable extraction. Among other things, the optimization of planning and approval procedures for the extraction of raw materials and the creation of a balance between hazard prevention and sustainability in secondary raw materials are recommended. The aim has be to ensure the necessary extraction of primary raw materials in harmony with the interests of the public and to make the best possible use of substitution potential, e.g. through the use of secondary raw materials.

The results of the study show that secondary raw materials such as RC construction materials or industrial by-products will significantly contribute to the supply of raw materials in the future. However, they will hardly be able to replace primary raw materials to any greater extent than is already the case today (Table 1).

Table 1: Projection variants for primary and secondary raw material volumes (in million tons)

raw materials		upper variant				lower variant			
	2022	2030	2035	2040	2045	2030	2035	2040	2045
gravel and sand	253,0	252,0	249,5	242,9	235,0	244,2	230,9	217,0	203,2
special gravel/sand	10,5	9,7	9,6	9,6	9,5	9,5	9,1	8,8	8,5
natural stone	210,0	210,4	208,3	204,3	199,0	203,5	191,8	180,9	170,0
ashlar	1,3	1,2	1,2	1,2	1,2	1,2	1,1	1,1	1,0
total limestone	57,1	54,1	51,0	46,9	46,1	52,6	47,7	42,2	39,9
- unfired	10,0	8,8	8,3	7,7	7,6	8,6	7,7	6,9	6,5
- fired	10,2	9,3	8,8	8,4	8,3	9,1	8,4	7,7	7,4
- for cement	36,9	35,9	33,9	30,8	30,1	34,9	31,5	27,6	25,9
special clay, kaolin	5,3	5,0	5,0	5,0	5,0	4,9	4,8	4,6	4,5
brick clay	10,6	9,5	9,4	9,1	8,9	9,2	8,7	8,2	7,7
clay for cement production[1]	1,1	5,0	8,0	9,8	11,0	4,9	7,4	8,8	9,6
gypsum, anhydrite	5,8	6,5	7,6	9,1	8,8	6,2	6,9	8,2	7,7
primary raw materials	**554,7**	**553,6**	**549,7**	**538,0**	**524,5**	**536,3**	**508,6**	**479,8**	**452,1**
RC construction materials	75,3	76,0	78,0	79,4	80,6	74,6	75,0	75,2	75,5
pig iron slags[2]	7,2	5,6	3,6	3,1	2,5	5,5	3,4	2,9	2,2
steel mill slags	4,7	5,1	5,9	6,0	6,1	5,0	5,6	5,5	5,4
hard coal fly ash	2,2	1,1	0,0	0,0	0,0	1,1	0,0	0,0	0,0
other ashes	5,2	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0
FGD gypsum	5,1	2,9	1,7	0,0	0,0	2,9	1,7	0,0	0,0
secondary raw materials	**99,6**	**95,7**	**94,2**	**93,5**	**94,2**	**94,1**	**90,7**	**88,6**	**88,1**
secondary material quota (in %)	15,2	14,7	14,6	14,8	15,2	14,9	15,1	15,6	16,3

Source: Own presentation based on data from bbs, own calculations from 2030 onwards. - [1]Includes calcined clays in particular as a clinker substitute in future. - [2]Slag from blast furnaces and other slags from pig iron production, including from future DRI-based steel production.