TEXTE
101/2022

Ukraine war and sustainability policy

Staying on course in a crisis - accelerating progress forward towards industrial decarbonisation!

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Abstract: Staying on course in a crisis - accelerating progress forward towards industrial decarbonisation!

Germany is an industrialised country with a strong production and export sector in the heart of Europe. However, German industry is dependent to varying degrees on imports of energy sources, raw materials and semi-finished products. Russia's war of aggression against Ukraine is having many consequences - from the break-up and rebuilding of previous supply chains to possible and already implemented sanctions by the EU against Russia as well as reductions in supply volumes up to a supply boycott by Russia, which are having an impact on German industry. This paper shows how operators of industrial plants, licensing authorities and the federal legislator can meet the challenges of maintaining production while reducing energy and raw material consumption. This also supports industry on its transformation pathway towards decarbonisation.

Kurzbeschreibung: Kurs halten in der Krise - schneller auf den Pfad zur industriellen Dekarbonisierung!

Deutschland ist ein produktions- und exportstarker Industriestaat im Herzen Europas. Doch ist die deutsche Industrie dabei in unterschiedlichem Maße auf Importe von Energieträgern, Rohstoffen und Halbzeugen angewiesen. Der Angriffskrieg Russlands gegen die Ukraine zeigt viele Konsequenzen – vom Wegbrechen und Neuaufbau bisheriger Lieferketten bis hin zu möglichen und bereits umgesetzten Sanktionen der EU gegenüber Russland sowie Reduzierungen der Liefermengen bis hin zu einem Lieferboykott durch Russland, die auf die deutsche Industrie zurückfallen. Dieses Papier beschreibt die aktuelle Situation (Redaktionsstand: Anfang Juli 2022), gibt Hinweise, wie Betreiberinnen und Betreiber von Industrieanlagen, Genehmigungsbehörden und der Bundesgesetzgeber den sich für die Aufrechterhaltung der Produktion stellenden Herausforderungen begegnen können und Energie- und sonstige Rohstoffverbräuche einsparen. Dies unterstützt zudem die Industrie auf ihrem Transformationsweg zur Dekarbonisierung.

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List of Abbreviations

ABl.	Official Journal of the European Union
AGEB	Working Group on Energy Balances
BAFA	Federal Office for Economic Affairs and Export Control
BGR	Federal Institute for Geosciences and Natural Resources
BMUV	Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
BMWK	Federal Ministry for Economic Affairs and Climate Action
BNetzA	Federal Network Agency
BAT	Best available techniques
CCfD	Carbon Contracts for Difference, also climate protection contracts or contracts for difference
CCU	Carbon Capture and Use
CO_2	Carbon dioxide
EnEffV	Energy Efficiency Directive
EnSiG	Energy Security Act
EU	European Union
CIS	Commonwealth of Independent States, the merging of various successor states of the former Soviet Union
IED	Industrial Emissions Directive
COM	European Commission
MBA	Mechanical-biological waste treatment plant
Mio.	Millions
OECD	Organization for Economic Cooperation and Development
PJ	Petajoule
StBA	Federal Statistical Office of Germany
t	Tonne(s)
UBA	German Environment Agency

1 German industry: Staying on course towards decarbonisation - despite and due to the war in Ukraine

Germany is an industrialised country with a strong production and export sector. Industry is dependent on imports and exports in varying degrees: Imports of energy sources, raw materials and semi-finished products, exporting goods and commodities in the middle and at the end of the value chains. Resulting interference and changes to delivery and value chains, as well as sales markets, are the outcome during times of crisis. Industry sectors must react to these respectively.

The Federal Republic of Germany has set the aim of becoming carbon neutral by 2045 with the passing of the Federal Climate Protection Act. Alongside new business models, enormous reconstruction measures are required on production facilities within the industrial sector. To some extent, there is also a need for research and development of completely new production methods that should be implemented as a matter of course.

The Russian attack on Ukraine, which contravenes international law, had a substantial impact in the German, European, and also the worldwide political arena. Federal Chancellor Scholz described the attack as a turning point in his government statement on 27 February, 2022. The EU responded by levying several different packages of sanctions designed to attack the Russian economy. In their announcement on 8 March, 2022[1] the EU Commission laid out a strategy for ending the EU's dependence on fossil fuels from Russia, and the fifth package of sanctions[2] was the beginning of its implementation. As an example, EU institutions agreed on 8 April, 2022 on an import ban for all types of Russian coal as well as on timber and cement as well as an export ban of semiconductors and chemicals to Russia. Agreement on the sixth package of sanctions on 3 June, 2022 showed that EU institutions are continuing on this path, particularly regarding the import of Russian crude oil and crude oil products by sea.[3] In response, Russia restricted gas supplies via the Nord Stream 1 pipeline so that gas deliveries to Germany via this route from 14 June, 2022 were reduced initially to 40 %[4], then to just 20 % of the capacity of the Nord Stream 1 pipeline from 27 July, 2022[5] and the risk remains that these will be cut off completely. In response to the first restriction on 23 June, 2022, the Federal Ministry for Economic Affairs and Climate Action raised the alarm and declared that it had reached the second stage of the emergency plan for gas.[6]

After the coronavirus pandemic hit Germany, German society, politics, and the economy, a new crisis with a wide range of effects has struck. Energy supplies become insecure, supply chains break, markets become unclear, prices increase. The number of crises increased and merged with other ever-worsening crises, such as advancing climate change and the loss of biodiversity with all the resulting uncertainty and need for action accompanying these.

In such cases, the industrial sector cannot fully react promptly to such changing circumstances: Changes to facilities or the business model often require substantial investments. Such investments usually require a great deal of time and effort due to internal and subsequent official planning, permits, and commissioning of the facilities. Furthermore, this situation in Germany is compounded by a skills shortage, a lack of (micro)chips and semiconductors, as well

[1] COM (2022a).
[2] EU (2022).
[3] COM (2022b).
[4] BMWK (2022c).
[5] BNetzA (2022).
[6] BMWK (2022b). Minister Robert Habeck: "From now on, gas is a scarce resource".

as volatile prices for raw materials, energy and construction materials like steel. All of these cause uncertainty and curb the willingness to invest. On the other hand, many measures must be taken now to help get the industrial sector out of this crisis situation.

What is clear: German industry has started on the path to a transformation, even if it is still very much in the early stages in some parts. We must continue on the path towards low-carbon production. A crisis can also represent an opportunity, as: If the EU impedes imports on certain fossil and mineral raw materials from Russia, or puts delivery quotas on Russia, then renewable energy sources and (secondary) raw materials become increasingly important. These receive a boost and thus can accelerate progress towards a low-carbon industrial sector.

At the same time, there is a risk that the lack of fuel and raw materials and the associated high prices act as a brake on investment or even that production is moved abroad to where it is less dependent on Russian imports.

The current situation represents a major challenge. With this paper, the German Environment Agency is taking stock of the current situation (as per: start of July 2022) and shows several courses of action for the new situation. The recommendations of the German Environment Agency are aimed at various stakeholders and may have short-term, medium-term and long-term effects. They can help ensure that the industrial sector remains on course regarding transformation and decarbonisation.

Key recommendations to operators of industrial facilities and product manufacturers at a glance

Short-term

- When switching over from Russian coal to coal from other countries, it is necessary to adapt exhaust purification to better reflect the different content of pollutants. (see Section 2.1.1.2)
- Check if energy savings can be achieved by operating the industrial plant in a different way (partial-load operation, temporal flexibility, occasional shutdowns), particularly in the case of natural gas (see Sections 2.1.2.1, 2.1.2.2)
- Identification and development of present potential for greater energy efficiency (see Section 2.2) and an accelerated transition to renewable energies (see Section 2)
- Together with the relevant licensing authorities, simulate and train shutting down the industrial plant in good time to avoid fires, accidents and malfunctions (see Section 2.3)
- Use secondary raw materials and recycled materials (see Section 3.2)
- Improvement of consumer information for separated collection of waste (see Section 3.2)
- Voluntarily implement recyclable product designs, such as those with a “high proportion” of recyclable materials, those that are simple to disassemble, separate, repair, and also forgo the use of critical contents that render recycling more difficult (see Section 3.2)
- Disclosure of product content information to consumers as well as recycling companies (see Section 3.2)
- Implementation of the ideas behind sustainable chemistry (see Section 3.3)
- Medium-term

- Application for approving extended operating hours of available peak load boilers, or an application to recommission plants made to the relevant authorities (see Section 2.1.2.2)
- Inclusion of the requirements of amended systems due to differing qualities of crude oil in potentially upcoming cases of plant downtime (see Section 2.1.3)
- Introduction of an energy or environment management system or energy audits (see Section 2.2)

Key recommendations to licensing authorities of industrial facilities at a glance

Short-term

- Preparation for issuing approval for recommissioning and changing the operations of plants (see Sections 2.1.2.2, 2.3), all whilst taking German Environment Agency criteria into account (see Section 3.4)
- Taking facility safety concerns into account, such as the use of other oil pipelines to supply refineries in Eastern Germany (see Section 2.1.3)
- Together with the affected operators, simulate and train shutting down the industrial plant in good time to avoid fires, accidents and malfunctions (see Section 2.3)
- Temporary and conditional use of such leeway if the operator of the industrial plant is unable to comply with emissions limits regarding suspension of approval requirements in individual cases; in this case a focus is required, for example, on the upper range of the conclusions drawn from BAT and setting up further monitoring (see Section 3.4)

Key recommendations for the federal legislature at a glance

Short-term

- Enactment of an Energy Efficiency Directive (see Section 2.2)
- Increased recycling rates for materials (see Section 3.2)
- Introduction of a manufacturer-financed premium fund to support the obligation towards separate collections (see Section 3.2)
- Ascertaining the circumstances in which compliance with threshold values for air pollutants can be waived (see Section 3.4)
- Legal stipulation of the need for special arrangements in specific sectors within industrial production/energy conversion regarding compliance with air pollutant limits; ascertaining the regulations for standardised application of such regulations by the licensing authorities at a federal level (see Section 3.4)

Medium-term

- Introduction of qualitative recycling requirements to extend quantitative recycling rates (see Section 3.2)
- Improving the competitiveness of recycled materials relative to primary raw materials via economic instruments (see Section 3.2)

- Specification of the recyclable nature of the product in terms of product design, such as those with a “high proportion” of recyclable materials, those that are simple to disassemble, separate and repair (see Section 3.2)

Key recommendations to the Federal Government, particularly the BMWK and BMUV, at a glance

Short-term

- Extend promotion of decarbonising industry including carbon contracts for difference (CCfD) as additional measures (see Section 2).
- Acceptance of temporarily increased emissions of greenhouse gases and air pollutants due to changes in fuels without putting climate-related targets into question (see Section 2.1.2.2)
- a clearly defined end to exceptions for observing threshold values on emissions of air pollutants, regular evaluation so that the exception does not become a rule, and that increased emissions do not threaten reduction targets in the medium term (see Section 2.1.2.2)
- ongoing observation and evaluation of developed shutdown, load and distribution scenarios, together with energy-intensive industrial sectors (see Section 2.3)
- appropriate consideration of complex material flows and dependencies between the various sectors in all decisions expected when the supply situation is strained (see Section 2.1.3, 3.1.1)
- Choice of new primary raw material suppliers based on the sustainability criteria developed by the German Environment Agency (see Section 3.1)
- Increasing public awareness through publicity work for products with recyclable content (see Section 3.2)
- Issuing certifications for products with recyclable content (see Section 3.2)
- Standing up relative to the EU regarding recyclable product design, such as those with a “high proportion” of recyclable materials, those that are simple to disassemble, separate and repair (see Section 3.2)

Medium-term

- A clear statement continuing this transformation in the steel industry, even when natural gas is to be used as a link in said transformation until green hydrogen becomes available, and setting constraints for the implementation thereof (see Section 2.1.2.1)
- Taking facility safety concerns into account, such as the use of other oil pipelines to supply refineries in Eastern Germany (see Section 2.1.3)
- Financing expansion of waste sorting and recycling capacity (see Section 3.2)
- Supporting promotion programs for the development and expansion of detection and sorting technologies, such as for sorting plastic and paper along with alloy-specific sorting of metal scrap; digitalisation can help at this point (see Section 3.2)

Long-term

- Selection of new states with mining sites for (primary) raw materials based on sustainability criteria drawn up by the German Environment Agency (see Section 3.1

2 Energy

German industry is on its way to a transformation. Passing the Federal Climate Protection Act means Germany has set the aim of being carbon neutral by 2045. This means that industry is expected to replace fossil resources and that production should be switched to renewable electricity without fuels where possible. The state should look to expand support options to help progress decarbonisation within industry to a much greater degree than is currently the case - such as with the "Decarbonisation in Industry" funding program. One example could be the introduction of climate protection contracts (carbon contracts for difference, CCfD). This requires a conversion so that no more fossil fuels are used, increasing energy efficiency, changing energy sources and energy savings. The war in Ukraine is now causing unintended changes in energy input (sanctions from the EU on the one hand, restrictions on energy, particularly gas deliveries from Russia on the other) that the industry must react to. Foregoing Russian fossil fuels, a trend which has already started and is likely to continue into the future, means a change in the quality and presumably also quantity of fossil fuels as a bare minimum. The industrial sector, licensing authorities and federal legislature must react to this.

The industrial sector must focus on this limited range of energy sources and amend their production methods accordingly. When lowering dependency on Russian energy, other environmental objectives must be kept in mind, particularly federal climate protection goals and air pollution control.

2.1 Energy supply

German industry still uses fossil fuels: both for energy supply and as a raw material, particularly in the chemical industry. German industry has, and will continue to obtain differing types and quantities of fossil fuels from Russia in this regard.

2.1.1 Coal

The share of Russian coal amongst coal imports and therefore overall coal consumption in Germany was around 50% in 2021.[7] At the beginning of April 2022 the EU decided to impose an import ban on Russian coal with a transition period of four months.[8] This will cause considerable restructuring on the world market. Coal is transported with trains and ships. Regarding imports, it is therefore generally possible to quickly diversify the countries of origin. Operators of public sector power plants and major users of coal, especially operators within the steel industry, already started on the adjustment of delivery contracts and on reducing their usage of Russian coal back in March 2022.[9] As a result of the looming bottlenecks in delivery capacity from Russia in the final quarter of 2021, coal importers began to diversify and look for other countries as a source.

In Germany, coal and its by-products are substantially used in the energy industry along with the iron and steel sectors.

2.1.1.1 Use of coal in the steel industry (coking plants, blast furnaces)

The steel industry uses coal to produce coke in coking plants as well as in the form of finely ground pulverised coal in blast furnaces. It is not possible to forego the use of coke when producing primary steel via the blast furnace production route

[7] AGEB (2022a), p. 24.
[8] EU (2022).
[9] BMWK (2022a), p. 5.

Replacement of coal obtained from Russia in coking plants is not a problem from a technical perspective as mixtures of different coals are generally used in coke batteries. This is necessary to ensure the properties of coke (gas permeability, compressive strength, fragmentation) required for operating blast furnaces.

Suitability for pulverised coal injection is predominantly due to its grindability and ease of transport. An adjustment to coal from other production areas or other carbon carriers represents only a minor technical challenge in the light of these criteria.

2.1.1.2 Coal in industrial energy conversion plants

If the coal used has a different area of origin then - even with commonly used mixtures of coal types - there is always a change in their material properties. This influences air pollutant emissions.

On the one hand, this has an effect on the calorific value. In this regard, Russian coal was a solid, middle-of-the-road option. Russian coal was also average compared to all coals imported to Germany in terms of CO_2 emission factors.

The fluctuation in the mercury content is considerably higher than is the case with CO_2 and can be up to 4 times the level in the coal that was previously used. The sulphur content does not vary so much, but is significantly higher. The Russian coal used in Germany up until this point had low sulphur content on average.

Plant operators must make corresponding adjustments to exhaust purification if the type of coal used in ongoing operations is changed. A lower level of pollutants can lead to reduced material consumption. If there are higher levels of pollutants in the coal, then the plant operator must align the air purification technology with the requirements of the new fuel in order to safely comply with threshold values once again.

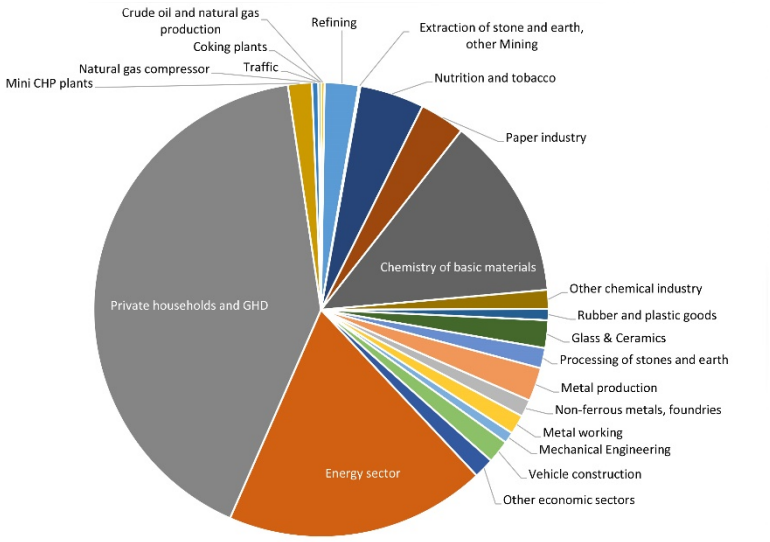
2.1.2 Natural gas

According to the most recent figures in 2021, net imports of natural gas were 2938 PJ, corresponding to approx. 89% of natural gas consumed in Germany.[10] Russian natural gas is imported to Germany via the Yamal-Europe pipeline and the Nord Stream 1 pipeline. Furthermore, Germany is linked for transit with all surrounding countries.

Approximately half of all natural gas consumed in Germany came from Russia until the start of 2022. Households, then the commercial, retail, and services sectors use the largest proportions of natural gas. The industrial sector and the energy industry come after them. In the energy industry, most natural gas is used in cogeneration units. The district heat generated in this manner is predominantly used by households and other smaller consumers. There are also so-called mini cogeneration plants that generate electricity for private consumption or feed it into the mains network whilst covering their heating requirements at the same time.

[10] StBA (2022).

Figure 1: Natural gas usage in Germany in 2020 (Data from AGEB 2022)



2.1.2.1 Natural gas within the industry

The chemicals sector is the largest industrial consumer of natural gas, and around 1/3 of the quantity consumed is in material terms. The food industry comes next (food and tobacco). After that, the main consumers are the paper industry, refineries and the metals industry. Relevant quantities of natural gas are used in all other industrial sectors. The extent to which an industry is affected by possible restrictions to gas supply does not just depend on the proportion of total energy that is consumed, but also depends on upstream manufacturing processes in product chains or also on the proportion of natural gas consumption relative to total energy consumption within a specific industry. As an example, the proportion of natural gas compared to all fuels was 97% of all fuels used in the production of glass and ceramics in 2020.[11]

In the steel industry, natural gas is used for the generation of process heat, and – in relatively low quantities for non-energy purposes, namely in the as of yet only direct reduction plant in Hamburg. Several new direct reduction plants are expected to be built in the next few years, in order to decarbonise the steel production. These new plants will be operated with green hydrogen in the long term, but in the meantime, they will still require natural gas . As a result of the current uncertainties in the gas market, the Federal Government is requested to set out a reliable set of framework conditions for the decarbonisation of the steel industry using hydrogen and - ahead of time - natural gas. In parallel, it should create new incentives for the necessary remodelling of the steel industry. Otherwise it could be delayed for decisive years. As an example, decarbonisation projects of the industry that have already been promised should be further encouraged, and the relevant funding programs should be continued.

Plant operators are unable to replace natural gas with other energy sources at short notice.[12] However, they can check to see if savings are possible by changing plant operation modes, such as partial-load operation, temporal flexibility in discontinued processes or occasional shutdowns of the plant. In some cases, such as in the glass industry, a temporary fuel switch to fuel oil would be technically feasible as well as expedient, despite the cross-media effects that arise.

[11] AGEB (2022b).
[12] BDEW (2022).

2.1.2.2 Natural gas in industrial energy conversion plants

To a certain degree, natural gas can be substituted by other fuels or even omitted altogether in the event of a reduction or complete discontinuation in the supply of Russian natural gas. Substitution can either be via a change in fuel or also be via separate plant components, e.g. additional peak load boilers. An increase in the number of operating hours for the peak load boiler raises legal questions regarding approval, which must be clarified in advance with the licensing authorities.

Replacement of natural gas with coal or heating oil is only possible to a limited extent with these plants. It is fundamentally possible to increase the capacity of existing plants and to therefore replace natural gas in energy conversion plants. This is already in the implementation phase. Plants that are kept operational can be, in purely technical terms, quickly brought back into regular operation. The relevant technical state of the plants that are kept operational determines the effort required to bring them back into operation.

In the case of plants that were already fully closed down (such as coal-fired boilers in various industrial sectors) then renewed commissioning may, depending on the state, be linked with substantial outlays both in terms of time and technology. Recommissioning is based on the condition that it is approved under emission control law; it is probable that some of these plants may not be fully able to comply with current thresholds.

Regulatory solutions must be found for all these aspects if required. Ultimately, this also has an impact on the quantity of air pollutants emitted every year. Germany's CO_2 emissions will also rise if coal is burned instead of natural gas. The climate objectives in accordance with the Climate Change Act are not to be cast into question. Essentially, Germany must not attempt to resolve the current energy crisis with short-term measures, but also substantially contribute to the climate crisis in the process. The requirement must be clearly defined and be for a limited period only so that the exceptions do not lead to deadweight effects.

The German Environment Agency recommends, as part of the framework described below, (see Section 3.4), that legally binding specifications are set.

2.1.3 Crude oil

Crude oil is only used in refineries. In 2021 around 33% of all crude oil used in Germany (approx. 84 million tonnes) came from Russia.[13] However, Russian crude oil has a very different relevance within German regions. An import ban on Russian crude oil would especially affect the refineries in Schwedt and Leuna. These are currently supplied directly with Russian crude oil via pipelines.[14,15]

The parent company of TotalEnergies Raffinerie Mitteldeutschland GmbH has already announced in March 2022 the expiration of contracts for the delivery of Russian crude oilby end of 2022 at latest.[16] The supply could be partially, i.e. with reduced capacity, covered via the harbours in Rostock and Gdansk and existing pipelines to the refineries. Supplementary supply with products can take place from other refineries with correspondingly challenging logistics.[17] From the perspective of the German Environment Agency, there must be no compromises on

[13] BAFA (2022).
[14] Martin.
[15] En2x (2021).
[16] Total (2022).
[17] En2x (2022).

safety with the pipelines, although the start of construction should be approved and accelerated where possible.

In the case of Schwedt, due to ownership interests as a majority holding of it is with the Russian state-owned company Rosneft, this is more difficult.. Supplementary supply with mineral oil products can take place from other refineries if production capacities are limited.[18]

Refinery plants are set up relatively specifically for processing a certain quality of incoming crude oil. This applies to the composition, e.g. the distribution of various boiling cuts and molecule sizes, viscosity and the removal of impurities, e.g. sulphur.[19] A switch to other qualities of crude oil is therefore not possible without considerable short-term capacity reductions, but would also require modifications to the plant, some of them structural. If using crude oil that has a high sulphur content, for example, then there should be sufficient desulphurisation plants available to ensure the high quality of the products. Further impacts are also expected on other peripheral plants, such as waste water treatment, if the qualities of crude oil change.

Technical and structural changes to the plants take some time, also planning and permitting processes can rarely be implemented in the short-term (e.g. period of 6-12 months). In general, major maintenance is usually carried out every 3-6 years on the plants with corresponding long-term preparation and planning so that all work can be carried out promptly and quickly during downtime. Even in case of a massively accelerated investment decision, planning and permitting process, usual delivery times for plant parts and limited capacities of plant construction companies still makes short-term implementation of far-reaching measures very unlikely.

2.2 Energy efficiency within industry

Efficient use of energy lowers consumption and not only reduces the dependency on Russian energy sources, but also saves money and lowers greenhouse gas emissions. Potential for efficient use of energy have not yet been fully identified and developed in all sectors to their fullest extent. The extremely high energy prices at the moment support quicker implementation of efficiency measures.

Due to the rapid introduction of an Energy Efficiency Directive (EnEffV), the federal legislature can use regulatory law to ensure that operators of plants requiring approval implement cost-effective energy efficiency measures in line with the current state of the art for economical, efficient use of energy. This also implements the energy efficiency requirements as set out in emission control laws.

An EnEffV means in the future that all operators of plants requiring approval can analyse their plants via certified energy management systems or energy audits to search for energy losses and potential energy savings. It can be used to identify appropriate measures for your plant and implement cost-effective energy efficiency measures that exploit existing high levels of potential in terms of energy. This reduces energy costs, saves resources, and lowers emissions. In this case, the operator must prepare their own implementation plans for cost-effective measures. These take the individual aspects of each plant into account, ascertain and implement customised technical solutions, and take the corporate situation as well as strategic corporate developments into account when scheduling said implementations. At the same time, the EnEffV ensures legal and planning security within Germany as well as equal competitive opportunities for all operators of plants that require approval.

[18] BMWK (2022a), p. 5.
[19] Martin; Barthe, et al.

2.3 Adaptation options if crude oil and natural gas supplies are interrupted – changing energy sources and energy savings

If necessary, a short-term switch from crude oil or natural gas to other fuels is possible in some plants within various industries. The requirement for such a short-term amendment is that the plants are already equipped with suitable firing technology or that plants that are currently shut down can be quickly recommissioned and that corresponding approval has been issued. If approval has not been issued, then the authorities should enable quick recommissioning of these plants on site with special temporary permits. Cross-media impacts should be weighed up and monitored accordingly. The Federal Government should exercise their responsibility set out in § 1 paragraph 1 clause 1 number 5 EnSiG and urgently specify temporary deviations or exceptions for the operation of plants (see Section 3.4).

The plant operator must check the extent to which the following measures were possible in plants that do not allow fuel changes at short notice for procedural reasons:

- partial-load operation,
- temporal flexibility in discontinuous processes, or
- shutting down the plant.

However, abruptly shutting down high-temperature facilities leads to complete failure of the facility in many cases. A corresponding schedule must be taken into account if a complete shutdown of plants is requested by the authorities. Furthermore, it should be borne in mind that a complete shutdown will lead to a total failure regardless of the lead time with some plants (e.g. glass furnaces).

The German Environment Agency also indicates from an industrial safety perspective that the plant operator, together with the licensing authorities, should simulate and train shutting down their plants in good time as a precautionary measure to avoid fires, accidents and malfunctions. Operators and the authorities should actively observe and manage the facilities even when these are shut down.

In addition to changes in energy sources, energy savings are required. Energy savings may be achieved, if necessary, via partial-load operations of plants that cannot be adjusted in the short-term (even if specific energy requirements and emissions are expected to increase) or via digitalisation of production and manufacturing. These options may be relevant for continuing the production of system-relevant products if the available quantities of gas and oil are not sufficient for maintaining the whole range of products. The German Environment Agency recommends that the BMWK, together with the energy-intensive industries in question, observe and evaluate the shutdown, load and distribution scenarios for the short term. Supply disruption and contractual penalties that may arise due to a fall in production - if they do take place, as the war could be seen as a force majeure event - should be compensated by the state where necessary. The authorities should therefore lead by example and also be prepared to find ways to save energy too.

3 Raw materials and supply chains

The effects of the war in Ukraine as well as sanctions on Russia and Belarus have, alongside the impacts on fossil resources stated above, both direct and indirect effects on the supply of raw materials for the production sector in Europe and Germany with mineral raw materials (metals, industrial minerals). Russian metals and minerals are not remotely as relevant in economic terms for the EU as Russian gas and oil. Some industries and companies are highly dependent on imports of raw materials or processed products such as steel. A complete ban on imports from Russia will nevertheless lead to shortages and increased prices in the short-term, and these increases will only drop back over the medium or long-term due to expansion of production into other countries according to experts. If, for example, Ukraine completely shut down exports of iron ore products, then it would lead to shortages and higher prices that would affect "green steel production" in particular.

In May 2022, 56.6 % of construction companies in the structural engineering sector reported shortages of construction materials.[20] At the moment, examples of such shortages include parquet and construction timber, crude-oil based construction films and insulating materials, bitumen, steel mats, steel girders, sheet metal or steel bars.[21] Approx. 40 to 50% of steel imports into Europe and 30% of structural steel used in Germany comes from CIS states. Furthermore, Spanish and Italian tile manufacturers are heavily dependent on kaolin supplies from the Ukrainian region of Donbass. A few native clay quarries, such as those in the Westerwald region, have already sold their annual production to Spain and Italy.

Shortages are continuing to occur on important raw materials for the energy transition and electric mobility. This is currently leading to record prices for aluminium or nickel on the London Metal Exchange. Nickel trading was temporarily suspended as prices became disconnected from reality.[22] Also, 40% of all globally traded palladium comes from Russia, as does around 23% of vanadium and 4.5% of tungsten. This affects the production of catalytic converters, batteries/accumulators for electric mobility, etc. This becomes even more relevant as battery production predominantly took place outside Germany/Europe, but it has been observed that major battery production sites are also being readied in Germany.

Shortages of imported raw materials and associated price increases, along with occasional price surges, mean that recycling of secondary materials, particularly waste raw materials that are already found in Germany is an attractive prospect. Increasing prices for primary raw materials represent an opportunity to seriously address the notion of circularity, particularly with construction waste. Legislators, funding agencies, and also companies are called upon to set out the framework conditions to move towards circularity (see Section 3.2).

Until this point, shortages and associated increases in cost will continue to curb the willingness of the industrial sector to make investments for this transformation to take place (see Section 1). There are a few levers for companies and for federal politicians, described below, that can effectively counter shortages.

3.1 Diversification of primary raw material sources

Diversification of raw material sources is imperative as neither increased substitution of metallic components, nor rapidly increased recycling of metallic secondary raw materials will cover the total need for metals either today or in the short term. However, sustainability aspects must be taken into account. The examples of rare earths acquired from China, as well as cobalt

[20] Ifo (2022).
[21] Ifo (2022).
[22] Handelsblatt (2022a).

and coltan from Congo, show that these may go hand-in-hand with considerable environmental destruction, health risks, or human rights infringements. Supply stability can also be fragile here; one example is that China enforced an export ban on rare earths from Japan for a prolonged period due to ideological reasons.

Russia, Belarus, and Ukraine were also important producer countries of raw materials in the fertiliser industry, such as phosphate ores. Morocco comes into question as a major exporter of phosphate ore of a suitable quality (low in cadmium)[23], however, it is mined in areas that are part of Western Sahara, which was annexed by Morocco in a way that was illegal under international law, so such imports would finance armed conflict.

The Federal Government should select the states with large mineral endowments which could become partners for a secure raw material supply of the German economy not just on the basis of geological, geopolitical and economic criteria, but also very substantially based on environmental, social and governance (ESG) criteria. Only then can Germany safely and sustainably ensure the necessary diversification of long-term raw material supplies for German industry without having to look for new solutions once again in the medium-term.

3.1.1 The chemical industry as an example

The chemical industry does not just use crude oil and natural gas for energy, but also for materials. Many chemicals - including polymers - contain carbon and/or hydrogen from these fossil sources. A great deal of methane is required to produce hydrogen and synthesis gas, which are required for products such as ammonia and methanol. Back in autumn 2021, some producers in Germany lowered the ammonia production temporarily due to high natural gas prices.[24] Since the middle of March 2022, some plants have lowered production again due to high natural gas prices.[25]

Basic chemicals are used to produce many other substances that are required in other industrial sectors, including for example important products for the energy transition, but also plastics, pharmaceuticals, construction chemicals, paper chemicals etc. . Chemicals are often produced in a tight combination of the plants[26]. For this reason, when suspending the production of a single chemical, other chemicals also may no longer be produced or major modification measures are required .

Plants for producing basic chemicals occasionally run for 5 years without interruption until a scheduled shutdown, which then makes major amendments to the plant possible. In order to become carbon-neutral, the chemical industry strives not just to switch over to renewable energy (e.g. electrification of process heat generation) but also change their raw material base to renewable sources (defossilisation). A proportion of chemicals can therefore be produced from biomass. Due to the availability of these biogenic raw materials or biogas, expansion is only possible to a limited degree. Chemical recycling of plastics that cannot be mechanically recycled has not shown itself to have ecological advantages relative to energy recovery.[27] In the long term, hydrogen can be produced by electrolysis of water and CO_2 can be used as a source of carbon. For the production of hydrogen, e.g. for ammonia synthesis, a great deal of renewable electricity is required, also large electrolysers and in many cases renewed transport infrastructure. To ensure that the hydrogen economy takes off, the German Bundestag approved

[23] German Environment Agency (2019), p. 297.
[24] Handelsblatt (2021).
[25] Handelsblatt (2022b).
[26] German: Verbundstandorte
[27] German Environment Agency (2020), p. 10.

a package of laws on 7 June 2022 to ensure both the expansion of renewable energies as well as hydrogen production that supports energy systems. A terminal in Brunsbüttel is planned for importing ammonia with the aim to start operations in 2026. The EU Commission is also increasingly relying on ammonia imports (as a provider of green hydrogen).[28] Ammonia imports may be more cost-effective in some cases compared to producing it in Germany.

Alongside the use of renewable energies and raw materials, raw material cycles should be closed where possible (see Section 3.2) and consumption must be lowered (see Section 3.3). Companies should work on collaboration with the aid of Chemistry 4.0, with enhanced knowledge, and with the use of relevant data along the value creation chain. Chemical leasing and the capacity for recycling the chemicals used can also play a part here (see Section 3.3). An important prerequisite for transforming the chemical industry (e.g. use of CO_2 and green hydrogen instead of hydrogen from fossil resources using methane as a raw material) is sufficient availability of renewable energy at competitive prices. As many chemical plants run 24 hours a day, seven days a week, there should be corresponding opportunities to make electricity procurement flexible in line with the electricity supply. Base chemicals, particularly CCU products, based on renewable electricity are certainly becoming more competitive as natural gas prices continue to rise, but are still more expensive than fossil-based chemicals.

It appears expedient to clarify how many chemical/pharmaceutical products should be produced here in Germany (or the EU) for strategic reasons such as supply security or group matters, and what can possibly be produced in geographically more favourable locations, in what quantities, without serious disadvantages to Germany as a whole. A major reason for energy-intensive ammonia synthesis is the production of mineral nitrogen fertilisers for agricultural purposes. However, an adapted agricultural and nutrition system could substantially reduce the dependency of food production on mineral nitrogen fertilisers and therefore also the need for ammonia synthesis.[29]

3.1.2 Refineries as an example

Alongside products from refineries used as an energy source in the heating and fuel sectors (such as heating oils, diesel and petrol), some products are also used as a material source. In particular, this pertains to naphtha as a raw material for organic basic chemistry (steam crackers, olefins), but also applies to sulphur that is removed from the crude oil or products and then processed further in sulphur chemistry, or the use of bitumen e.g. in road building. Furthermore, there are additional material links in supply chains, such as gases and aromatic compounds. The changes to the product spectrum of refineries after switching from Russian crude oil quality to crude oil from other countries, and the impacts these would have on further production chains, remain unclear.

3.2 Reduced dependency on sources of primary raw materials through recycling

The recycling and reuse of fabrics and materials (such as scrap metals, glass, textiles, plastics and paper) is, after reduction of raw material consumption (see Section 3.3), a prerequisite for conserving primary raw materials. Recycling plays a part in reducing dependency on raw

[28] COM (2022c) stated potential short, medium and long-term measures to counter dependency on Russian gas with quantitative goals until 2030. This includes the import of ammonia.
[29] German Environment Agency paper on Ukraine “Ernährungssicherheit und landwirtschaftlicher Umweltschutz in Krisenzeiten – Gegner oder Alliierte?“ (Food security and agri-environmental measures during times of crisis - opponent or ally?)

material imports, such as those from Russia and there should be greater focus on it from all relevant actors - companies, consumers and legislators: This applies to mineral raw materials such as nickel and copper, which are also obtained from Russia in noticeable proportions, as well as to biogenic raw materials such as timber and fossil resources for producing plastics.

Recycling simultaneously reduces the need for fossil resources/fuels, as the extraction of secondary raw materials is generally linked to lower energy input. As an example, aluminium production from scrap only requires approx. 11% of the input of primary raw materials and energy required for primary aluminium production from bauxite smelting. Other positive environmental and climatic effects are also generally linked to recycling. As an example, recycling paper saves up to 70% of water and 15% of CO_2 relative to paper production from virgin fibres, whilst material recycling of plastics (polyolefins, PET, polystyrene) saves up to 70-80% of CO_2 relative to producing virgin plastics.

There is a great deal of potential in Germany that has not yet been exploited, particularly in quality recycled materials that replace new goods from identical materials. Only this kind of recycling actually allows to reduce the need for primary raw materials, whilst also enabling (multiple) cases of recycling in the medium and long-term.

The German Environment Agency recommends the following support measures, which are interlinked, to exploit this as yet unexploited potential:

- Domestic potential: It is better to exploit domestic potential for secondary raw materials from anthropogenic storage. As an example, Germany is a net exporter of scrap and used plastics. These are still often exported to countries with lower environmental standards such as India, Pakistan, Malaysia and Indonesia. Further high-quality recycling of this waste within Germany or the EU would, alongside the matter of supply security, also have positive effects on the environment. The Federal Government should make consumers aware of these circumstances via publicity work and certifications so that they can make a more informed decision when purchasing such products. If necessary, the federal legislature can counter higher prices for secondary raw materials resulting from collection and handling of the materials, amongst other things, by setting out legally binding recycling quotas.

- Separate collection of separate waste fractions that are as clean as possible. There is still potential with the implementation of legal duties to collect waste separately (§ 9 Recycling Management Act (KrWG), particularly in the construction sector (incl. introduction of a separate waste code for specific waste plastic fractions) and in the collection rates for waste electrical and electronic equipment(from 45% at the moment to the legally required figure of 65%). Improvement of the collection system and also of information given to consumers, alongside financial incentives for separate collection in the form of a premium fund collectively financed by manufacturers could increase the quantity and quality of waste gained from private end consumers to recover more valuable materials.

- Recycling: Supporting expansion of sorting and recycling capacity, including digitalisation processes, - through finance from the EU, the government and federal states alongside national legislation introduced in the form of qualitative recycling requirements to expand on quantitative recycling rates – that ensure (single origin), high-quality cycles free of pollutants and impurities in order to avoid downcycling. The established and innovative detection and sorting technologies that are available, such as for sorting plastics and paper along with alloy-specific sorting of metal scrap, should be supported by funding programs so that the large-scale implementation of such technologies becomes feasible. Stringent material-specific recycling requirements may, for example, reduce the dependency on raw

material imports from Russia for materials including iron, copper, aluminium, plastics and nickel.

- Use of recycled materials: Encouraging the use of recycled material via new federal legislation stating quotas and quality of the use of recycled materials, along with using economic instruments to improve the ability of recycled materials to compete relative to primary raw materials. As examples that could apply to other waste streams, specifications for using recycled materials in PET drinks bottles (25% from 2025 onwards) and batteries, as well as in the basic principles behind the Blue Engel award for recycled papers and plastics. As an example, the legislature can transfer the insights gained from this to technical plastics or rare earth magnets.
- Recyclable product design: As a supplementary addition to recycling specifications, both the EU and the federal legislature should ascertain and make existing product requirements both binding and clear in terms of product design, such as "high-quality" recyclability, being simple to disassemble, separate, repair, and so on. Product manufacturers should therefore forego critical content in production and processing that ultimately hinders recycling.
- Provision of information about the product lifecycle: Information for consumers as well as, amongst others, recycling companies is required, such as a product passport showing the contents of the products to help consumers make an informed choice. This also applies to controlling recycling flows so that it is possible to forgo complex sorting techniques.

Producers and manufacturers must take on more responsibility as key actors to ensure the success of a circular economy, as their decisions have an impact on all stages of the life cycle. Ultimately, it is in their own interests of resource security that they should not just see waste and used products as a cost factor, but as tomorrow's source of raw materials. They can start on this right now.

Some of the stated measures and instruments are implemented at a national level (e.g. economic instruments for promoting recyclability and the use of recycled materials, stipulation of recycled material quotas for product groups that have not been harmonised in line with union law). In the case of regulations applying across the EU, the Federal Government should participate in the negotiations regarding current or expected revisions of the following EU legislative acts for ambitious anchoring of the stated measures, instruments, and extended responsibility on the part of the manufacturer at EU level: Battery Regulation (COM draft from December 2020, trialogue ongoing), Sustainable Products Initiative (COM draft from March 2022), Industrial Emissions Directive (COM draft from April 2022), Packaging Directive (COM draft in July 2022), ELV Directive (COM draft in 1st quarter of 2023) and the WEEE Directive (preparations for 2023, COM draft expected to be in 2024). Companies and associations can support these by corresponding statements and data provision in these processes as well as in ancillary standardisation activities.

3.3 Reducing consumption of raw materials

Recycling and the use of recycled materials alone cannot cover the current need for raw materials: The need for raw materials within industry for production and processing into products far exceeds the quantities of qualitative and quantitatively available waste and recycled materials. The demand for raw materials must therefore be substantially reduced, not just from an environmental perspective, but also to reduce dependency on imports. Extending the durability and lifecycle of products, reusability, repairability and avoiding waste are the key words which should be implemented.

Anchoring of binding targets for waste streams or product group-specific targets in federal law for

- waste prevention and
- preparation for recycling

force all parties in the value chain to focus more closely on these initial two stages of the waste hierarchy via measures and initiatives. The largest proportion of residential waste is packaging, which amounts to around 37%, and there is an urgent need for avoidance measures as the volume of packaging has increased by around 18% since 2010. Provision of multi-use systems, design of packaging that uses material efficiently and optimising supply chains to provide more items without packaging such as fruit and vegetables, are major starting points.

The design of all products should focus on the use of recycled materials, reusing products/components/materials, improved recyclability as well as avoiding hazardous materials. The durability of products or components and the ability to repair them also help decouple economic activities from resource consumption whilst also reducing resource consumption in absolute terms.

The Sustainable Product Initiative from the European Commission aims to replace the notion of a throw-away society with a circular economy model via the "Ökodesign-Verordnung für nachhaltige Produkte" (Eco-design for Sustainable Products Regulation) framework. By expanding the scope from "products relevant in terms of energy consumption" to practically all physical products (except food and feed, medical products as well as living plants and animals) and expanding the provisions of law, this creates an instrument that could spell out a circular economy at a product level even with statutory requirements whilst also increasing the potential for such with the manufacturers.

Chemicals play a central role in practically all aspects of life and the economy, which is why the chemical industry has such a wide-reaching role, as: The use of chemicals usually has effects on the environment and the climate. High gas consumption in material use for basic chemicals and products is also an aspect that comes into focus with the war in Ukraine. Previous efforts to change products/manufacturing (substitution of products or even sufficiency) and the ideas behind a more sustainable form of chemistry must start gathering momentum: Chemicals as a Service (CaaS), particularly chemical leasing, recycling capacity, improving durability of a product, sustainable design, choice of components, use of resources and raw materials, the smallest possible ecological footprint and foregoing the use of hazardous materials as far as possible. The company must now take advantage of available opportunities.

3.4 Interrupted supply chains

The effects of the war in Ukraine show in part the dependencies on specific supply relationships. Alongside the frequently mentioned cable harnesses that are produced in Ukraine and where the automobile industry is facing shortages, the German Environment Agency is aware of other cases such as the shortage of input materials for lowering emissions in industrial plants.

Ammonia production requires large quantities of natural gas. If this is no longer available, or is only available at prohibitively high prices, then there is also a lack of ammonia water in addition to a lack of ammonia. Several industry sectors, such as the cement industry, thermal waste treatment plants or power plants us this to lower nitrogen oxide emissions. If the measures for reducing nitrogen oxide emissions have to be suspended due to a lack of ammonia water, then it would not be possible to comply with the approved threshold values. The same would also apply

to failures with lime-based products for desulphurisation of exhaust gases and other input materials for reducing emissions. If it is necessary for the Federal Network Agency to establish criteria for shutting plants down as a so-called federal system operator as per § 3 Gaslastverteilungs-Verordnung (Ordinance on the Distribution of Gas Load Sharing) within the industrial sector in the event of a gas shortage, then this should be appropriately taken into account.

From the perspective of the German Environment Agency, an unconditional temporary suspension of industrial emission requirements with no upper limit would also not be displayed for precautionary reasons. Moreover, if it transpires that there are delivery bottlenecks for ammonia water or other input materials required for reducing emissions, the German Environment Agency recommends that the federal legislature and licensing authorities should carry out the following measures:

(1) Legal stipulation of the essential need for special arrangements in specific sectors and under certain conditions at a federal level (establishing the actual shortage in general and taking the relevance of the sector regarding supply security into account)

(2) or suspending approval requirements in individual cases (incl. a time limit)

(3) Capping the emissions in the relevant derogation period that is most closely oriented to the minimum requirements from other legal fields (e.g. upper range of BAT conclusions, minimum requirements in IED attachments, focusing on emission requirements in other industrial sectors)

(4) The operator has a duty to regularly demonstrate the existence of the actual bottleneck for their plant

(5) incl. extended monitoring and reporting duties regarding current emissions in the relevant derogation period.

An adaptation to the environmental requirements may be required in the event of a temporary change in fuel (e.g. from gas to coal). Identical measures must be set out in this case.

3.5 Creating new supply chains

The mineral and metals industry, including the mining sector, is responsible for banning human rights infringements and severe environmental impacts from the supply chain. Handling human rights infringements and conflict-related risks are covered comprehensively by the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas.

The OECD is currently developing a Handbook on Environmental Due Diligence in Mineral and Metal Supply Chains, initiated by the BMUV and supported by the German Environment Agency and the Federal Institute for Geosciences and Natural Resources. This practical instrument aims to support companies in their environmental risk assessment and environmental management whilst also illustrating how environmental risks overlap with human rights-related risks and adverse effects. It enables companies to engage with suppliers and other stakeholders to develop effective measures measures to cease, prevent, mitigate, and in some cases remediate environmental impacts in the upstream part of global mineral supply chains.

4 Safe disposal

Waste treatment plants play an important part in safe disposal and are part of the recycling management; they act as a pollutant sink and also sanitize low-quality waste. The import ban on Russian gas may primarily result in bottlenecks in the supply of natural gas (e.g. for ignition and auxiliary burners) in the thermal and mechanical-biological waste treatment sector (particularly incinerators for residual waste (WtE), hazardous waste and sewage sludge, RDF plants as well as mechanical-biological waste treatment plants (MBA)). Bottlenecks are also possible in the operating and auxiliary materials sector (e.g. urea, burnt lime) as suppliers of these items are also dependent on provision of energy products.

Interruptions in the supply of natural gas and operating resources would be associated with increased emissions and could lead to the plants being decommissioned. Interim storage of waste is only possible to a very limited degree whilst also being problematic for health and safety reasons (especially with hazardous waste and sewage sludge).

MBAs generate substitute fuels for RDF plants and the cement industry from waste. Those fuels can only be substituted to a limited extent by other fuels (such as natural gas). WtE and MBAs were already considered to be system-relevant during the corona pandemic, and recorded by the Federal Office for Information Security as an official KRITIS sector in § 2 para. 10 of the German IT Security Act 2.0.

WtE and MBAs are essential for maintaining safe disposal and ensuring hygienisation of residual and commercial waste. In the opinion of the German Environment Agency, in the event of restrictions in the supply of natural gas and operating materials as part of the war in Ukraine these plants should be preferentially considered when looking at the potential shutdown sequence from the Federal Network Agency (the so-called federal system operator as per § 3 Gaslastverteilungs-Verordnung).

5 Information about distribution of gas if an emergency level is called as part of the gas emergency plan

On 23 June 2022, the Federal Ministry for Economic Affairs and Climate Action raised the alarm for the second stage of the emergency plan for gas. The consequence is that all gas consumers are requested to reduce gas consumption as far as possible. Currently, the market is still able to acquire the necessary quantities of gas, but at higher prices. If the third stage as part of the gas emergency plan comes into force, known as the emergency stage, then the Federal Government can summon the BNetzA as a federal system operator who is responsible for distributing the gas if the situation becomes worse.

The following information, summarised, is from the above explanations for such distribution of gas by the BNetzA as a federal system operator:

- Partial-load operation may provide energy savings in some industry sectors. If not all system-relevant products can be covered with the available quantities of gas and oil, then partial-load operation may allow to cover a wider product range (see Section 2.3).
- Production often takes place - especially in the chemical industry - in conjunction with other companies. Shutting down a plant within a value chain may lead to a breakdown in the whole production chain, preventing the production of urgently required base chemicals for various economic sectors (see Section 3.1.1).
- This dependency becomes clear when looking at value creation in producing ammonia, in which ammonia water is produced to reduce nitrogen oxide emissions in the cement industry, in thermal waste treatment plants and power plants. Limits for air pollutants would no longer be achievable in these plants without ammonia water. The same applies to failures with lime-based products for desulphurisation of exhaust gases (see Section 3.4)
- Waste treatment plants depend on
    - natural gas for ignition and auxiliary firing,
    - urea and burnt lime as operating and auxiliary materials, including desulphurisation of exhaust gases.

  Thermal waste treatment plants are used to ensure safe disposal. For their part, MBA produce substitute fuels for downstream industry sectors such as the cement industry. Both are system-relevant in this regard within the context of § 2 para. 10 of the Act on the Federal Office for Information Security (see Section 4).

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