Annex II
Mapping of sustainable sourcing practices

Annex II Mapping of sustainable sourcing practices

II.1 Background and methodology

This standalone document provides a non-comprehensive inventory and mapping of sustainable sourcing practices applicable to a set of selected raw materials.

According to the selected raw materials considered as relevant for EU consumption, a literature review as well as contacts with relevant European associations were initiated, for identifying sustainable sourcing practices respectively to be adopted by actors of aluminium (section 0), copper (section 0), iron (section 0), gold (section 0), limestone and gypsum (section 0), timber (section 0), chemicals and fertilisers minerals (section 0) as well as salt (section 0) supply chains. With the objective to further estimate their GHG emission reduction potential, practices were categorised based on the position of the possible **adopter(s) of the practice** in the product's value chain, and on the **type of instrument(s)** employed. It is indeed clear that most instruments are not exclusive to a single value chain actor or stage, and practices can combine several instruments. Similarly, practices can target several supply chain actors and not be specific to only one adopter. Also, the environmental benefits resulting from the adoption of a practice can be realized by different actors on the value chain and does not, therefore, necessarily target (only) direct climate mitigation impacts realized by the immediately preceding value chain actor. The following indexation matrix was created to facilitate the mapping of identified practices, see II.2.

Table II.1: Indexation matrix for sustainable practices categorisation, according to employed instrument(s) and practice adopter(s) on the value chain

Type of instrument/Supplier of raw materials, intermediate products or finished goods	Requirements addressing raw material producers	Requirements addressing raw material processors or manufacturers	Requirements addressing raw material traders
Regulations	MR	PR	TR
Standards and certification	MS	PS	TS
National, regional, international & sectoral networks & commitments	MN	PN	TN
Sectoral performance benchmarking, as in BAT Reference Documents (BREFs)	MB	PB	TB
Technology innovations	MT	PT	TT
Economic instruments	ME	PE	TE
Awareness raising	MA	PA	TA

Once categorised and indexed accordingly, individual identified practices were elaborated and referenced following the same template. In case readily available

Kongens Nytorv 6
1050 Copenhagen K
Denmark
Tel.: +45 3336 7100
Fax: +45 3336 7199
eea.europa.eu

were found, this template includes a section for describing the climate mitigation potential of the specific practice. In view of estimating the climate mitigation potential of identified practices, information on the relevance of the specific raw material for European consumption is systematically reminded, together with information on sources of greenhouse gas emissions (GHG) along each raw material supply chain. The final section provides an overview of all identified and categorised (mapping) practices (section **Error! Reference source not found.**).

II.2 Bauxite and Aluminium

Practice number: A1	
Practice category: PT	
Practice adopter	Raw material processors
Instruments used	Technological innovations
Relevance to EU consumption	Size of direct imports of bauxite ore and other aluminium, and of the aluminium footprint of imported products
Description	
Procuring alumina from plants using material efficient technologies During the refinement of bauxite into alumina using the Bayer Process, red mud or bauxite residue is generated as an industrial waste. Currently, only a very small segment of this industrial waste is re-used as raw material for clinker cement. However, in theory a lot more raw materials could be extracted from this bauxite residue, including more alumina, pig iron and a viscous slag suitable for industrial mineral wool production [1-2]. Efficient reprocessing of this bauxite residue could potentially increase the domestic EU iron ore production by 18% [1]. A novel Electric Arc Furnace (EAF) technology can smelt bauxite residues without any pre-treatment. This new process for bauxite refinement could increase the efficiency of the Bayer Process from 3% to 9-13%, thereby increasing the yield of extracted alumina [1]. In addition, this novel technology allows for the production of pig iron and viscous slag suitable for industrial mineral wool. Therefore, this technology not only improves the existing alumina extraction from bauxite by the RM processor, but also converts a hazardous waste into viable co-products, and preventing accidental discharge into the environment [1-2].	
Mitigation potential	
This novel process could increase the amount of aluminium produced from the same amount of bauxite compared to traditional technologies as this novel technology increases the efficiency of the Bayer Process from 3% to 9-13% [1]. Therefore, the for the same amount of aluminium less mined bauxite will be required. Consequently, this will reduce the greenhouse gas emissions associated with the mining of bauxite for the same amount of produced aluminium. In addition, viable co-products are produced with this novel technology, generating extra raw materials that could not be recovered from bauxite residue before. Therefore, additional greenhouse gas emission from the mining of these raw materials could potentially be reduced.	
Reference(s)	1. (Wyns and Khandekar, 2020) 2. (Advanced Mineral Recovery Technologies Ltd., 2015)

Practice number: A2	
Practice category: PT	
Practice adopter	Raw material processors
Instruments used	Technological innovations
Relevance to EU consumption	Size of direct imports of bauxite ore and other aluminium, and of the aluminium footprint of imported products
Description	

Procuring aluminium from processing plants using energy efficient technologies

A raw material processor has developed a new generation of electrolysis technology for aluminium production. By using its experience in aluminium production and modelling tools, the RM processor was able to develop these performance electrolytic cell components and methods to reduce process variability. This new technology changes the electrolytic cell technology for aluminium production by reducing cell resistance, enhance heat conservation and further improvement of standard operational procedures. This results in lower energy consumption, higher current density, lower CAPEX and lower greenhouse gas emissions for electrolysis technology using carbon anodes [1-2,4].

In the conventional process of primary aluminium production (Hall-Héroult process), the energy efficiency improvement is limited to the corrosive and harsh environment of the electrolytic cell. The physical modification of the electrode design can allow for improvements in energy efficiency of the Hall-Héroult cells and could reduce direct emissions from the carbon anodes which are gradually consumed during the aluminium production process [1-3]:

- Sloped and perforated anodes make electrolysis more efficient by allowing better circulation within the electrolyte bath, while vertical electrode cells save energy by reducing heat loss and improving electrical conductivity. This new design of anodes will however also require a different type of cathode [1,3].
- Inert (non-carbon) anodes will eliminate the direct emissions during the electrochemical process and reduce energy consumption compared to the energy-intensive carbon anode production method. These anodes are ideally combined with wetted cathodes to have truly “green” aluminium primary production. Wetted cathodes improve the electrical contact between the molten aluminium and the cathode, which will allow for reduced energy consumption of approximately 20% compared to conventional carbon cathodes. The development of inert anodes will also allow for the further development of multipolar cells which have the potential to reduce energy consumption by 40% through lower operating temperatures and higher current densities [1-2,5].

However, the electrode technologies have not yet fully reached the demonstration stage and are still being developed. A partnership between two aluminium producers, has successfully demonstrated the application of inert anode technology and has already produced aluminium using inert anodes. Currently, they are continuing their research by exploring scale-up possibilities. The goal is to demonstrate the technology at commercial scale by 2024 [1-2].

Mitigation potential

This new electrolysis technology will use 15% less energy for aluminium production than the global average (14.1 kWh/kg), providing the lowest CO_2 footprint in the world. The RM

processor's pilot plant aims to set a new benchmark for emissions, reducing direct CO_2 emissions to 1.40-1.45kg CO_2-eq/kg aluminium or 0.8kg/kg aluminium below the current world average [1-4]. Depending on which new type of anodes and cells used in electrolysis technology, different levels of environmental benefits can be achieved. • Sloped and perforated cells would reduce energy use by 2 to 2.5 kWh per kg of produced aluminium [3,5]. • The inert anode technology would reduce direct emissions from aluminium production by more than 20%. Furthermore, most inert anode technologies will ensure a reduction in energy consumption, in particular lower electricity consumption. This will further reduce greenhouse gas emissions [1]. • Wetted cathodes would reduce energy consumption by approximately 20% compared to conventional carbon cathodes [5]. • Multipolar cells would reduce energy consumption by 40%, due to lower operating temperatures and higher current densities [1,5].	
Reference(s)	1. (Wyns and Khandekar, 2020) 2. (European Aluminium, 2019) 3. (Gautam et al., 2018) 4. (Segatz et al., 2016) 5. (Wyns et al., 2018b)

Practice number: A3	
Practice category: PT	
Practice adopter	Raw material processors
Instruments used	Technological innovations
Relevance to EU consumption	Size of direct imports of bauxite ore and other aluminium, and of the aluminium footprint of imported products
Description	

Procuring aluminium from processing plants that have an increased electrification level and that implement energy demand response systems

Modern primary aluminium producers are currently increasing the level of electrification of their production processes. Their future power supply will depend on various types of energy sources including renewable sources. Therefore, these industries can benefit from having a system for programmable variation in energy demand. Such a system enables them to increase or decrease their energy consumption for a certain period of time. This creates a 'virtual battery' which could accommodate for energy supply variations [1-3].

Currently, a primary aluminium producer is operating an industrial scale pilot with demand and response technology in its smelter's furnaces with the aim to reduce CO_2 emissions. The concept relies on installing adjustable heat exchangers that can maintain the energy balance in each electrolysis cell during shifts in power input. The total virtual storage capacity of the pilot plant is 1 120 MWh with a 95% efficiency level [1,4]. This demand and response system enables the smelter to increase or decrease its electricity consumption by 25% for up to several hours without adverse effects on the production process and product quality [1-3]. This would be further beneficial for the smelter if it would increase the power consumption when demand and electricity prices are low, allowing them to 'store' energy in molten aluminium so that energy consumption can be reduced at times of high demand and high electricity prices. This would help with managing supply and demand variability in the power sector, which will become increasingly important when the fraction of variable renewable energy sources in the grid increases [1].

The non-ferrous metal production sector has a significant potential to offer higher levels of demand response to the European power market. This is in particular the case for primary aluminium, zinc and copper production. If all energy intensive industries in the EU would apply an industrial demand and response system with a variation in demand by 5-10%, it would equal a virtual power generation capacity of 3.3-6.6 GWe in the EU. Sufficiently large demand and response capacity in the EU could reduce investments costs in back-up power generation and storage [1].

Mitigation potential

Under normal operating conditions the furnaces installed with the demand and response technology outperformed the regular furnaces with 0.25 DCkWh/kg aluminium lower energy consumption and 0.4% higher current efficiency [3]. Overall this will reduce the energy consumption by the RM processor and consequently will lead to reduced greenhouse gas emissions.

Reference(s)	
	1. (Wyns et al., 2018a) 2. (Wyns and Khandekar, 2020) 3. (Djukanovic, 2017) 4. (Wyns et al., 2018b)

Practice number: A4	
Practice category: MT	
Practice adopter	Secondary raw material producers (aluminium recyclers)
Instruments used	Technological innovations
Relevance to EU consumption	Size of direct imports of bauxite ore and other aluminium, and of the aluminium footprint of imported products

Description

Procuring aluminium scrap from recovery plants implementing sorting efficient technologies increasing scrap quality

An aluminium secondary raw material producer that uses metal scrap to obtain secondary aluminium can decrease its energy consumption, indirect greenhouse gas emissions and increase its raw materials' yield by separating non-metallic constituents and metals other than aluminium by using one or a combination of the following techniques:

- magnetic separation (separate aluminium from ferrous metal components);
- eddy current separation (separate aluminium from non-metallic constituents);
- relative density separation (separation of aluminium from other non-ferrous metals).

By applying these techniques, a larger variety of scraps are eligible to be used for secondary raw material production and the quality of raw material is increased [1-2]. In addition to the existing technologies mentioned above, new techniques for physical sorting scrap metal include colour sorting and laser induced breakdown spectroscopy (LIBS), which could further increase the variety of scraps that can be used and to increase the quality of raw material. Currently, LIBS appears to be the most promising high volume/high speed process [2].

Mitigation potential

The application of improved separation techniques realises an improved selection of feed raw materials for the melting process. This in turn will result in reduced energy use in secondary aluminium production. It is estimated that this increased quality of raw material results in a reduction of 12% in energy use relative to current methods of secondary production [3].

In addition, these separation techniques increase the recovery of other raw materials (metals) that can be used or traded as a secondary raw material. Therefore, additional greenhouse gas emissions from the mining of these raw materials could potentially be reduced [1-2].

Reference(s)	
	1. (EIPPCB, 2001) 2. (Wyns and Khandekar, 2020) 3. (Wyns et al., 2018b)

Practice number: A5	
Practice category: MS, PS, TS	
Practice adopter	Raw material producers, processors and traders
Instruments used	Standards and certification
Relevance to EU consumption	Size of direct imports of bauxite ore and other aluminium, and of the aluminium footprint of imported products
Description	
Procuring bauxite and aluminium from third-party certified actors complying with specific industry standards A non-profit, multi-stakeholder organisation within the aluminium industry administers an independent third-party certification program for the whole aluminium value chain. The goal of this organisation and its certification program is to provide independent assurance of responsible production, sourcing and stewardship of aluminium [1-3]. The standard imposed by the organisation on its certified members defines environmental, social and governance principles and criteria which their members have to adhere to, with the aim to address sustainability issues within the aluminium value chain [2]. In addition, the organisation also provides a voluntary standard which their members can choose to adhere to. This standard sets out requirements for the creation of a chain of custody for aluminium, which is produced and processed through the value chain into diverse downstream sectors [3]. Several principles within these standards are related to sustainable sourcing and environmental impact. The members should be committed to sound management of its environmental, social and governance processes. The members should also be committed to take a life cycle perspective and to promote resource efficiency, collection and recycling of aluminium within its operations as well as within the value chain. Lastly, the members should recognise the ultimate objective established under the UN Framework Convention on Climate Change, and they are committed to reducing its greenhouse gas emissions from a lifecycle perspective to mitigate its impact on the global climate [1-3].	
Mitigation potential	
All members of the value chain can be a member of this non-profit organisation. Therefore, adhering to these principles in the imposed standards allows for reduction of greenhouse gas emissions and environmental impact throughout the complete value chain. For aluminium smelting in particular the standard dictates that the member should demonstrate that the Scope 1 and Scope 2 greenhouse gas emissions from the production of aluminium (up to and including 2020) is at a level below 8 tons CO_2-eq /ton aluminium by 2030. Aluminium smelters starting production after 2020, should demonstrate that the Scope 1 and Scope 2 GHG emissions from the production of aluminium are currently at a level below 8 tons CO_2-eq/ton aluminium [2].	
Reference(s)	1. (Aluminium Stewardship Initiative, 2017c) 2. (Aluminium Stewardship Initiative, 2017b) 3. (Aluminium Stewardship Initiative, 2017a)

Practice number: A6	
Practice category: MN, PN, TN	
Practice adopter	Raw material producers, processors and traders
Instruments used	National, regional, international & sectoral networks & commitments
Relevance to EU consumption	Size of direct imports of bauxite ore and other aluminium, and of the aluminium footprint of imported products
Description	
Procuring bauxite and aluminium from actors adhering to voluntary sustainability targets defined by industry association roadmaps or other voluntary initiatives An aluminium industry association has drafted a sustainability roadmap that takes a holistic approach in positioning the aluminium industry to contribute to a transition to a competitive, sustainable economy. In this roadmap the industry association has determined a set of voluntary sustainability targets that their members are committed to achieve by 2025 on several aspects of the value chain, including adoption of sourcing and traceability standards, other responsible sourcing practices, energy consumption reduction targets, greenhouse gas emission reduction targets, encourage research on several topics and recycling targets [1-2]	
Mitigation potential	
The goal of the aluminium industry is to reduce energy consumption by 10%, per ton of aluminium produced or transformed throughout the whole value chain by 2025 [1-2]. The efforts of the aluminium industry to reduce its direct emissions (-70% in absolute terms), combined with the European Commission's scenario on reductions of emissions from European power generation (-92%), have the potential to deliver a total of 79% reduction in the sector's direct and indirect emissions throughout the whole value chain by 2050 [3].	
Reference(s)	1. (European Aluminium, 2015a) 2. (European Aluminium, 2015b) 3. (European Aluminium, 2019)

Practice number: A7	
Practice category: PS	
Practice adopter	Secondary aluminium producer
Instruments used	Standards and certification
Relevance to EU consumption	Size of direct imports of bauxite ore and other aluminium, and of the aluminium footprint of imported products
Description	
Aluminium manufacturers procuring from production plants certifying a minimum aluminium post-consumer recycled content An aluminium product manufacturer has developed a new aluminium alloy with a fixed minimum content of post-consumer recycled aluminium used in a series of products. Through using recycled content, they reduce energy consumption drastically compared to primary production. The percentage of scrap can vary depending on specifications from the client, but they will guarantee a CO_2 footprint below 2.3 kg CO_2 per 1 kg aluminium produced [1-3]. The production process is fully traceable, and the product is certified by an independent third party (DNV GL: ISO 14064) with details of CO_2 footprint and fully traceability of the materials [4].	
Mitigation potential	
The aluminium alloy has a carbon footprint of below 2.3 kg CO_2 per kg aluminium produced. The reduction in greenhouse gas emissions will mainly be achieved at level of bauxite mining, refining and primary aluminium production as a specific fraction of secondary aluminium is incorporated in the product [1-2]. Aluminium recycling requires 95% percent less energy and emits approximately 95% less greenhouse gases compared to primary production of aluminium [3].	
Reference(s)	1. (Hydro, 2019) 2. (Wyns and Khandekar, 2020) 3. (European Aluminium, 2015b) 4. (Hydro, 2020a)

Practice number: A8	
Practice category: PS	
Practice adopter	Aluminium producer
Instruments used	Standards and certification
Relevance to EU consumption	Size of direct imports of bauxite ore and other aluminium, and of the aluminium footprint of imported products
Description	
Aluminium manufacturers procuring from production plants certifying the use of renewable energy in their activities An aluminium product manufacturer has developed a new brand of low-carbon, sustainably produced aluminium. It is produced using renewable energy from water (hydro power), wind and/or solar. It allows the manufacturer to produce aluminium that reduces the carbon footprint per kg of aluminium to 25% of the global average. This results in a maximum carbon footprint of 4.0 kg CO_2 per kg aluminium [1-3]. The products of this brand can be verified according to ISO 14064 by DNV GL, covering all carbon emissions from bauxite mining and alumina refining to the production of aluminium in electrolysis and casting [1-2]. It is also possible to provide certificates of origin by Environmental Product Declaration (EPD) in accordance with ISO 14025 and verified by a third party [3].	
Mitigation potential	
The aluminium products have a maximum carbon footprint of 4.0 kg CO_2 per kg aluminium covering all carbon emissions from bauxite mining and alumina refining to the production of aluminium in electrolysis and casting [1-3]. Main reductions in emissions are achieved by using renewable energy sources for the power supply of the aluminium production process.	
Reference(s)	1. (Hydro, 2020b) 2. (Hydro, 2019) 3. (Alcoa, 2020)

Practice number: A9	
Practice category: MR, PR, TR	
Practice adopter	Secondary raw material producers, processors and traders
Instruments used	Regulation
Relevance to EU consumption	Size of direct imports of bauxite ore and other aluminium, and of the aluminium footprint of imported products
Description	
Procuring aluminium and scrap from companies complying with Member States transpositions of the Waste Framework Directive and participating to extended producer responsibility national and/or regional schemes A non-profit association within the aluminium industry aims to support the disposal or treatment of components and building profiles of windows, doors and curtain walling of aluminium for the purpose of material reuse (recycling). Another objective of the association is the promotion of the collection profile offcuts and tension remains originating from the production process of aluminium and their recycling and reusing as secondary raw materials. The aim is an environmentally friendly and resource-saving material cycle of aluminium. The members take care of disassembling the aluminium parts, while the association itself provides a nationwide network of collection points to which members can return their used aluminium and production waste which is supplied to the collection partners. In return the members receive payment based on the current market price. After classifying, breaking up, separating and analysing the aluminium scrap by certified recycling partners, the aluminium can be melted down, casted and remanufactured into new aluminium products. The members can be suppliers and manufacturers of aluminium building profiles for windows, doors and curtain walling, metalworkers, components distributors, recyclers and companies interested in the topic of closed material cycle for aluminium. With targeted educational work the association wants to promote the inclusion of aluminium into construction. In corresponding agreements the product responsibility, redemption and return obligations of the parties are clearly defined. The active participation is confirmed by a certificate which is reviewed annually [1-2].	
Mitigation potential	
Aluminium recycling requires 95% less energy and emits approximately 95% less greenhouse gasses compared to primary production of aluminium (the electricity use per ton secondary aluminium produced is 0.12-0.34 MWh/t compared to around 14-16 MWh for primary [3-4]), resulting in greenhouse gas emissions of 0.5 tons CO_2 eq/ton recycled aluminium [3]. Given this, recycling aluminium provides an opportunity to decrease greenhouse gases by replacing the import of primary aluminium with the use of secondary aluminium. Therefore, emissions at the mining and refining stage are avoided.	
Reference(s)	1. (AUF, 2017) 2. (European Aluminium, 2015b) 3. (Wyns and Khandekar, 2020)

Practice number: A10	
Practice category: ME	
Practice adopter	Secondary raw material producers (aluminium recyclers)
Instruments used	Economic instrument
Relevance to EU consumption	Size of direct imports of bauxite ore and other aluminium, and of the aluminium footprint of imported products
Description	
Aluminium recyclers procuring post-consumer scrap collected through a Deposit Return System In a Deposit Return System (DRS) consumers are charged a small deposit when buying single-use beverage containers (metal, glass, plastic). This deposit is returned to the costumer when the container is returned to a collection point. This collection point enables the sorted recollection of beverage containers such as aluminium cans, which allows them to be easily processed and recycled [1-2]. A DRS system has been applied in several countries and has proven to be particularly successful in most cases. The recycling rates of these beverage containers usually exceeds 80%, but in the case of some well-performers, they even exceed 90%. In comparison, countries which depend on the kerbside collection of beverage containers have a recycling rate that is significantly lower, around 70%. Therefore, a DRS has been shown to increase the collected and eventually recycled amount of beverage containers, including aluminium cans. This results in a higher recovery of aluminium that is placed on the market, ensuring a higher amount of recycled aluminium that can be used as secondary raw material. This allows the companies to demonstrate through Extended Producer Responsibility Schemes (EPRS) that the effort of consumers to return and recycle aluminum cans is translated into new use and applications [3-4]. A country can motivate beverage manufacturers and importers to be part of a DRS by providing an exemption for beverage packaging tax when they are a member of a DRS. Typically the DRS is managed by one or a few national companies that organise the DRS. The recycling objectives of DRSs and the minimum values of different beverage package deposits can be laid down in regulations and decrees [1-3].	
Mitigation potential	
It is estimated that aluminium can recycling saves the annual equivalent of approximately 3 million tons of greenhouse gas emissions [4]. Aluminium recycling requires 95% percent less energy and emits approximately 95% less greenhouse gasses compared to primary production of aluminium (the electricity use per tonne secondary aluminium produced is 0.12-0.34 MWh/t compared to around 14-16 MWh for primary) [4-6]. Given this, recycling aluminium provides an opportunity to decrease greenhouse gases by replacing the import of primary aluminium with the use of secondary aluminium. Therefore, emissions at the mining and refining stage are avoided.	
Reference(s)	1. (Poole, 2019) 2. (Palpa, 2015) 3. (SITRA, 2017) 4. (Euractiv, 2019) 5. (European Aluminium, 2015b) 6. (Wyns and Khandekar, 2020)

II.3 Copper

Practice number: C1	
Practice category: MS	
Practice adopter	Raw material producers
Instruments used	Standards and certification
Relevance to EU consumption	The demand for copper is expected to grow and the environmental impacts of copper production are significant. Thus, significant reductions in the emissions of copper production is essential.
Description	
Procuring copper from third-party certified producers voluntarily monitoring and reducing GHG emissions Raw material processors and manufacturers can apply the practice of requiring their suppliers to comply with sustainability standards, such as evaluation of the climate impact during annual environmental sustainability reviews in compliance with the requirements of the ISO 14001 and OHSAS 18001 standards [1].	
Mitigation potential	
The sourcing requirements of processors and manufacturers will impact the performance of upstream actors and reduce the climate impacts of them.	
Reference(s)	1. (Boliden, 2020a)

Practice number: C2	
Practice category: PB	
Practice adopter	Processing company
Instruments used	Best Available Techniques (BAT) and BAT Reference Documents (BREFs)
Relevance to EU consumption	The demand for copper is expected to grow and the environmental impacts of copper production are significant. Thus, significant reductions in the emissions of copper production is essential.
Description	
Manufacturer of copper semi-fabricated products procuring from processing plants applying Best Available Techniques (BAT) Manufacturer of copper semi-fabricated products can apply the practice of requiring their suppliers to use BAT techniques in processing, aiming to reduce climate impacts, to enhance resource and energy efficiency, as well as to facilitate the use of copper scrap in the processes [1].	
Mitigation potential	
The sourcing requirements of processors and manufacturers will impact the performance of upstream actors and reduce the climate impacts of them.	
Reference(s)	1. (Boliden, 2020a) 2. (European Commission. Joint Research Centre., 2017)

<table>
<tr><td colspan="2">Practice number: C3</td></tr>
<tr><td colspan="2">Practice category: MS, PS</td></tr>
<tr><td>Practice adopter</td><td>Raw material producers, processors and manufacturers</td></tr>
<tr><td>Instruments used</td><td>Standards and certification</td></tr>
<tr><td>Relevance to EU consumption</td><td>The demand for copper is expected to grow and the environmental impacts of copper production are significant. Thus, significant reductions in the emissions of copper production is essential.</td></tr>
<tr><td colspan="2">Description</td></tr>
<tr><td colspan="2">Procuring ores and copper from certified actors complying with specific standards defined in business partner code of conducts
A big mining and processing company uses a Business Partner Code of Conduct initiative that requires compliance with ISO 14001 standards and follows the OECD Due Diligence Guidance for responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas. In order to control risks involving business partners and to achieve continual improvements throughout the business chain, the company carries out evaluations of the performance of business partners from a corporate social responsibility perspective. The evaluations are made according to criteria based on the UN Global Compact, 10 Principles and ILO- and ISO-standards, and the company's Code of Conduct, addressing among other issues, systematic environmental and sustainability work. Audits of business partners are carried out [1].

In the interest of their brands, market leading ICT producers must hold their suppliers to the highest standards using a Supplier Code of Conduct. Assessing and closely partnering with suppliers to ensure that requirements are being met from sourcing of materials to the recycling of products at every point in the supply chain. so that they can assess and manage the environmental impact that may occur in the value chain of their components; for the raw materials and the manufacturing process.

In 2019 one ICT company performed 1142 supplier assessments in 49 countries [2].

Another ICT producer works solely with Eco Partner-certified suppliers and have a third-party auditing system for the suppliers. Key Evaluation Items of the Supplier Registration Program include [3]:
Environment and Safety requirements request suppliers to satisfy the criteria set in 22 articles, spanning occupational safety, fire prevention equipment, occupational health, hazardous substances, and environmental facility.
Eco-Partner certificate is acquired by compliance with product environmental policy, education & training and the use of hazardous substances.</td></tr>
<tr><td colspan="2">Mitigation potential</td></tr>
<tr><td colspan="2">The sourcing requirements will impact the performance of upstream actors and reduce the climate impacts of them.</td></tr>
<tr><td>Reference(s)</td><td>(Boliden, 2020b)
(Apple, in press)
(Samsung, 2020)</td></tr>
</table>

Practice number: C4	
Practice category: PT	
Practice adopter	Processing companies
Instruments used	Technology innovation
Relevance to EU consumption	The demand for copper is expected to grow and the environmental impacts of copper production are significant. Thus, significant reductions in the emissions of copper production is essential.
Description	
Procuring from primary copper production plants implementing renewable energy systems for the smelting process Environmentally sustainable sourcing activities are related to sourcing of electricity, where replacing fossil fuels with wind power is the main sourcing activity for climate change mitigation. Agreements with wind power developers and building wind farms close to the smelting operations can secure long-term supply of renewable energy [1].	
Mitigation potential	
A large private mining and processing company has set targets for a decrease in carbon dioxide intensity by 40 % by 2030 (base year 2012). The climate impacts of primary copper production from ore are significant. Currently in Europe, 50 % of material feed is covered by scrap, but for this actor, which has mining activities, only 13 % is from scrap (Processing of ores constitutes for only 20 % of the emissions related to copper cathode production, why there is a marginal reduction from the 13 % scrap utilisation on the total emissions). By reducing the emissions of primary copper production by 40 %, the vast emissions of copper production of 5059 kg CO2eq/t can be significantly reduced, resulting in a major impact on the climate impacts of the European economy. Numerical mitigation estimate: EU-28 uses approx. 3000 kt of copper cathode annually, by saving 40 % of the (5059 kg CO2eq/t) emissions, ~2000 kg CO_2eq/t can be saved, which would be a total of 6000 kt CO_2eq annually. Since the use of copper is expected to grow, the savings would grow similarly. Since the average content of scrap copper is 50 %, the savings would be smaller. Approx. 20 % of emissions relate to mining processes, and the these are halved for the European average copper. A saving of 30 % for the European average would still indicate significant savings.	
Reference(s)	1. (Boliden, 2020b)

Practice number: C5	
Practice category: MN, PN	
Practice adopter	Raw material producers, processors and manufacturers
Instruments used	National, regional, international & sectoral networks & commitments
Description	
Procuring ores and copper from actors adhering to voluntary sustainability targets defined by industry association roadmaps or other voluntary initiatives Actors of the copper industry can unite their efforts in a sectoral commitment to develop guidelines and agreements to operate in a more sustainable manner. Producers in a network generating approx. 40 – 50 percent of global annual copper ore production, are using a set of Sustainable Development Indicators and have developed a set of methodological guidelines for reporting. The network represents a majority of global copper production and include many of the largest copper and copper-alloy fabricators [1]. The aim is for all partners to reach 100 percent renewable energy on site and finding ways to reduce fuel and energy use through innovative technology. 54 % of the total CO_2 emissions originate from electricity, and another 25 % from fuels and other direct sources. Meaning that in theory, moving towards 100 % renewable energy could cut CO_2-emissions down to 21 % [1].	
Mitigation potential	
The amount of refined copper represented by these sustainable development indicators in 2017 was 8.6 million tonnes. In 2017 the average CO_2 emissions per tonne of the network members were 4.2 tCO_2/t, giving an estimated mitigation potential of almost 30 million tonnes CO_2 on a global scale.	
Reference(s)	1. (International Copper Alliance, in press)

II.4 Iron and steel

Practice number: I1	
Practice category: MT, PT	
Practice adopter	Raw material producer, processors and manufacturers
Instruments used	Technology innovation
Relevance to EU consumption	Iron ore is one of the most imported raw materials, has a significant material footprint, is mined in the EU-27 in high volumes, and steel is recycled to be used as a secondary raw material to meet almost a fourth of the demand

Description

Procuring steel produced from low carbon energy sources during processing and mining operations

A mining company, a steelmaker and an energy producer collaborated in the setup of an initiative that aims to replace coking coal, traditionally needed for ore-based steel making, by hydrogen, and substitute fossil energy with renewable energy. The objective is to achieve fossil-free steel-making technology, with virtually no carbon footprint [1].

A high share of renewable energy in a country's energy mix is expected to contribute to the success of such practice, as the mining company applies environmentally sustainable sourcing practices related to energy consumption, where replacing fossil fuels with renewables is a main contributor to climate change mitigation [1].

A steelmaking company has environmentally sustainable sourcing practices that are related to energy consumption, where replacing fossil fuels with renewables is a main contributor to climate change mitigation [2].

A steelmaking company created a roadmap aiming to achieve carbon neutral steelmaking by 2050 and cutting up to 80% of carbon emissions by 2035 [3]:

- aim to reduce CO_2 emissions with carbon capture, storage and utilisation (CCSU)
    - utilisation by converting waste gases into hydrogen, methanol, or naphtha
- aim for direct avoidance of CO_2 emissions by introducing hydrogen as a fuel source

other technology innovations for fossil free steelmaking

Mitigation potential

Fossil-free steel; the current climate impacts are 1674 kg CO_2eq per tonne of steel produced.

The aim of the mining company is to reduce carbon emissions by at least 12 percent and reduce energy intensity (kWh)) by at least 17 percent per tonne of finished product by 2021 compared with 2015. At the same time also reduce e.g. emissions of nitrogen (NOx) and particulates to air. The targets are [2]:

2015: 27.2 kg CO2/tonne. 166 kWh/tonne.
2019: 25.8 CO2/tonne. 158 kWh/tonne.

Calculated target 2021:

23.9 kg CO_2/tonne – savings 3.3 kg CO_2/tonne. 137 kWh/tonne The target of the Steelmaker is to offer fossil-free steel to the market in 2026 and to eliminate all CO_2 emissions by 2045. The company's annual steel production capacity is approximately 8.8 million tonnes [2] Savings: Interim targets for 2020: Lasting reduction of 300,000 tonnes in CO2 emissions Lasting reduction of 400 GWh in purchased energy Lasting improvement of 50,000 tonnes in residuals utilization (Base year 2014) Outcome in 2019 296,000 tonnes or 99% of the target 463 GWh or 116% of the target 51,000 tonnes or 102% of the target		
Reference(s)	1. (HYBRIT, in press) 2. (SSAB, 2020a) 3. (Tata Steel, 2020)	

Practice number: I2	
Practice category: MS, PS	
Practice adopter	Raw material producer, processors and manufacturers
Instruments used	Standards and certification
Relevance to EU consumption	Iron ore is one of the most imported raw materials, has a significant material footprint, is mined in the EU-27 in high volumes, and steel is recycled to be used as a secondary raw material to meet almost a fourth of the demand
Description	
Procuring ores, iron and steel from certified actors complying with specific standards defined in business partner code of conducts The input materials needed to make iron and steel account for the most significant sourcing activities. This one producer has approximately 20,000 suppliers globally. Suppliers must comply both with the company's own standards and with international social and environmental guidelines in order to remain qualified suppliers. The Supplier Sustainability Policy of this company based on the UN Global Compact principles to which the company is a signatory. In the company's Supplier Sustainability Policy, in the theme for environment it is stated that: *Suppliers shall work in a systematic, goal-oriented and proactive manner to reduce the impact to the environment including pollution prevention and waste minimization. The business must be run in such a way that serious discharges and emissions to the ground, water and air are systematically prevented* [1].	
Mitigation potential	
-	

Reference(s)	1. (SSAB, 2020b)

Practice number: I3	
Practice category: PS	
Practice adopter	Steelmakers
Instruments used	Standards and certification
Relevance to EU consumption	Iron ore is one of the most imported raw materials, has a significant material footprint, is mined in the EU-27 in high volumes, and steel is recycled to be used as a secondary raw material to meet almost a fourth of the demand
Description	
Procuring steel from processing and manufacturing plants voluntary third-party certified monitoring and reducing GHG emissions Several steelmaking companies have established their own Environment, Health, Safety and Quality policy. Management systems and work routines implement these policies at each production site. Production sites employ certified ISO 9001 Quality Management Systems and ISO 14001 Environmental Management Systems. Typically, energy efficiency is integrated into environmental management systems, although several sites have also achieved ISO 50001 certification for energy efficiency. The functioning of these systems is monitored using both internal and external audits [1,2].	
Mitigation potential	
N:a	
Link	1. (Outokumpu, 2020) 2. (SSAB, 2020a)

Practice number: I4	
Practice category: PS	
Practice adopter	Steel manufacturer
Instruments used	Standards and certification
Relevance to EU consumption	Iron ore is one of the most imported raw materials, has a significant material footprint, is mined in the EU-27 in high volumes, and steel is recycled to be used as a secondary raw material to meet almost a fourth of the demand
Description	
Construction industry procuring steel from BES 6001 certified producers Responsible sourcing is identified as a critical issue for the construction sector and its wider sustainability agenda, the clients in the construction sector need to be confident that their sustainable approach is supported by the construction products provided by the producer. This company has acquired the BRE responsible sourcing standard BES 6001 certification for all UK manufactured steel construction products [1]. The Standard BES 6001 specifies requirements for organisational management, supply chain management and management of sustainability issues in order to allow organisations to demonstrate an on-going commitment to the principles of responsible sourcing in relation to the provision of a specific product. For the principles of sustainable sourcing, BES 6001 states the following [2]: • *Supply chain management: Communicate and work constructively with the supply chain to deliver sustainable policies and practices.* • *Climate change and energy: Use energy efficiently in the production of materials and products and minimise the emission of greenhouse gases associated with these processes. Reduce fossil fuel consumption and utilise renewable sources of energy.* • *Resource use: Recognise the need to use all materials in the most appropriate and sustainable manner.*	
Mitigation potential	
By 2030 cutting 30 % by 2035 cutting 80 % Fossil free steel by 2050 [1] Mitigation potential in relation to the current climate impacts of 1674 kg CO_2eq per tonne of steel produced.	
Reference(s)	1. (Tata Steel, 2020) 2. (BRE Global Ltd., 2016)

Practice number: I5	
Practice category: MS, PS, TS	
Practice adopter	Raw material producer, processors and manufacturers
Instruments used	Standards and certification
Relevance to EU consumption	Iron ore is one of the most imported raw materials, has a significant material footprint, is mined in the EU-27 in high volumes, and steel is recycled to be used as a secondary raw material to meet almost a fourth of the demand
Description	
Procuring ores, iron and steel from third-party certified actors complying with specific industry standards This Australia-based non-profit organisation aims at providing the steel industry with a first global multi-stakeholder standard and certification initiative ensuring responsible sourcing and production throughout the value chain of steel. The standard aims to benefit people and the environment, but also producers are offered a business advantage in a market that is subject to increased scrutiny. GHG related requirements of the standard are such as commitment to the Paris agreement and to reduce greenhouse gases. All certification bodies that have been approved and may carry out audits for this non-profit organisation are located in Europe [1,2].	
Mitigation potential	
The certification initiative aims at targeting sourcing activities of manufacturers in order to impact the performance of upstream actors and reduce the climate impacts of them.	
Reference(s)	1. (ResponsibleSteel, 2019) 2. (Responsible Steel, 2020)

II.5 Gold

<table>
<tr><td colspan="2">Practice number: G1</td></tr>
<tr><td colspan="2">Practice category: MT</td></tr>
<tr><td>Practice adopter</td><td>Mining companies</td></tr>
<tr><td>Instruments used</td><td>Technological innovations</td></tr>
<tr><td>Relevance to EU consumption</td><td>Demand for materials extraction and associated environmental impact from gold production are extremely important</td></tr>
<tr><td colspan="2">Description</td></tr>
<tr><td colspan="2">Procuring from mining companies decarbonising the power supply of gold mines
One of the primary methods to reduce greenhouse gas emissions from gold mining is the transition of the mine’s energy source for power generation to more sustainable sources. The reduction in greenhouse gas emissions is achieved by either switching to an energy source that emits relatively less greenhouse gasses (e.g. switch from diesel to natural gas) or by deploying renewable energy sources such as solar and/or wind to generate a fraction of the power demand thereby reducing the need for fossil fuels [1].

Several gold mining companies have applied this sustainable practice by for example installing natural gas plants at the mine location to switch from a diesel fuel powered mine to a natural gas powered mine. In other examples gold mining companies have installed an electricity microgrid combining wind, solar, gas energy sources and battery storage to supply power to the mine’s operations [1-5].</td></tr>
<tr><td colspan="2">Mitigation potential</td></tr>
<tr><td colspan="2">A gold mine that installed two gas power plants (a total of 62 MW) which was previously powered by diesel fuel, reduced its greenhouse gas emissions by 20% (35 400 tons CO_2-eq) [1,2].
A gold mine that installed an 8 MW solar panel installation and a 2 MW backup battery to support the mine’s existing gas engines to supply electricity for the underground gold mine, processing plant, camp and other facilities, reduced its greenhouse gas emissions by 10% (9 500 tons CO_2-eq) [1,3].
A gold mine that intents to install a new 56 MW hybrid energy microgrid combining wind, solar, gas energy sources and battery storage to supply power to the mine’s operations intents to reduce greenhouse gas emissions by 50% (40 700 tons CO_2-eq) [1,3-4]
A gold mine that installed a solar power plant and a 6 MW backup battery reduced its greenhouse gas emissions with 12 959 tons CO_2-eq [5].</td></tr>
<tr><td>Reference(s)</td><td>(Ulrich et al., 2020)
(Newmont, 2017)
(Ovens, 2019)
(Gold Industry Group, 2020)
(Sandfire Resources NL, 2018)</td></tr>
</table>

Practice number: G2	
Practice category: MT	
Practice adopter	Mining company
Instruments used	Technological innovations
Relevance to EU consumption	Demand for materials extraction and associated environmental impact from gold production are extremely important
Description	
Procuring from mining companies electrifying their vehicle feet and using energy-efficient systems and ventilation Another large source of greenhouse gas emissions besides the mine's power supply is the emissions by the vehicle fleet operating on and in the mine. A possible solution to reduce greenhouse gas emissions is replacing all or part of the diesel-operated vehicles with battery-electric vehicles (BEVs) (electrifying vehicle fleet). Furthermore, automated mining technologies and processes to optimise operations can further reduce energy consumption and consequently greenhouse gas emissions. For example, BEVs that are deployed in an underground mine do not generate any diesel particulate matter, which is beneficial for the workers' health. This also reduces the need for ventilation during mining activities to about 50% compared to a baseline diesel-operated, underground mine. The fact that electric engines are generally three times more efficient than diesel engines in combination with the reduced need for ventilation will further reduce energy consumption [1-2].	
Mitigation potential	
It is estimated that a gold mine that replaced all its diesel-operated vehicles in the mine fleet with BEVs, will reduce its greenhouse gas emissions with 6 600 tons CO_2-eq. It is estimated that consumption of 2 million litres of diesel and 1 million litres of propane will be saved in that mine. Furthermore, due to more efficient electric engines and reduced need for ventilation it is estimated that the energy consumption will be reduced by 330 000 MWh annually [2].	
Reference(s)	1. (Mining Technology, 2020) 2. (Energy and Mines, 2020)

Practice number: G3	
Practice category: PB, PS, PR	
Practice adopter	Raw materials processors
Instruments used	BATs and BREFs Standards and certification Regulation
Relevance to EU consumption	Demand for materials extraction and associated environmental impact from gold production are extremely important
Description	
Procuring gold from processing plants applying Best Available Techniques (BAT), certified monitoring and reducing GHG emissions, and complying with the Emissions Trading System (ETS) Directive All Best Available Techniques (BAT) Reference Documents (BREFs), including the BREF for the Non-Ferrous Metals Industries (BREF NFM), indicate that it is BAT to adhere to an environmental management system (EMS) in order to improve the overall environmental performance. This indicates that the EMS is BAT for all sectors that fall under the Industrial Emission Directive (IED). EMSs should incorporate a wide range of features that are clearly outlined in the BREFs, but essentially it should establish objectives, set targets and communicate instructions and results to improve the overall environmental performance. Typically, an EMS incorporates the concept of continuous improvement, meaning that environmental management is an ongoing process, not a project which eventually comes to an end. In practice, this generally translates to a plan-do-check-act cycle, but EMSs systems such as ISO 14001 and EMAS, management systems for occupational health and safety such as OHSAS 18001, or a quality management system such as ISO 9000 can assist by formalising the system [1]. This environmental performance is interpreted in a broad sense, but also indirectly includes greenhouse gas emissions. In the EMS/BREFs these emissions are typically indirectly addressed by regulating energy consumption. In the EMS, all significant consumption (including energy) and emissions are managed in a coordinated manner by the operator for the short, medium and long term, in conjunction with financial planning and investment cycles [1]. In addition to this, there is also a horizontal BREF on energy efficiency (ENE) that applies to all sectors that fall under the IED. The goal of this BREF is to cover the energy efficiency issues under the IED. This document contains generic guidance on what is considered to be BAT for energy efficiency and on how to approach, assess, implement and deal with energy efficiency related issues along with corresponding permit and supervising procedures. Furthermore, the former IPPC Directive was amended by council directive 2003/87/EC establishing a scheme for greenhouse gas emissions allowance trading within the community (ETS Directive). Therefore, member states may choose not to impose requirements relating to energy efficiency in respect of combustion units or other units emitting carbon dioxide for activities listed in the Annex I of the IED [2].	
Mitigation potential	
An EMS promotes and supports the continuous improvement of the environmental performance of a processor's plant. If the processor's plant already has a good overall environmental performance, an EMS helps the processor to maintain the high performance	

level. This includes optimising energy consumption with associated reductions in greenhouse gas emissions [1].	
Reference(s)	1. (EIPPCB, 2001) 2. (EIPPCB, 2009)

Practice number: G4	
Practice category: MS, PS, TS	
Practice adopter	Raw material producers, processors and traders
Instruments used	Standards and certification
Relevance to EU consumption	Demand for materials extraction and associated environmental impact from gold production are extremely important
Description	
Procuring gold from third-party certified actors complying with specific industry standards A non-profit, standard-setting and certification organisation imposes a code of practices on their certified members within the jewellery and watch industry. This code of practices defines the responsible ethical, human rights, social and environmental practices that all certified members must comply to. Moreover, all members must be certified within a relatively short period of time to maintain membership in this organisation. The code of practices that are imposed on all certified members build on international standards and development goals. It defines the requirements for establishing responsible business practices throughout the whole supply chain, from mine to retail. All participants of the supply chain from miners, to processors, manufactures and traders can be certified members of such a non-profit organisation. All members receive a common standard for responsible business practices that is audited by a third party [1]. An example of such a code of practice can be: 'Apply the principles of reduce, reuse, recycle and recover to minimise environmental impact where applicable, including reducing greenhouse gas emissions and increasing energy efficiency' [1].	
Mitigation potential	
All participants of the supply chain from miners, to processors, manufactures and traders can be certified members of such a non-profit organisation. Therefore, adhering to the imposed code of practices will oblige all the certified members throughout the supply chain to apply a wide range of practices including certain sustainable sourcing practices and practices related to environmental impact [1].	
Reference(s)	1. (Responsible Jewellery Council, 2019)

Practice number: G5	
Practice category: PS	
Practice adopter	Precious metals processors
Instruments used	National, regional, international & sectoral networks & commitments Certification
Relevance to EU consumption	Demand for materials extraction and associated environmental impact from gold production are extremely important
Description	
Refiner and manufacturers of precious metals procuring from processing plants certifying a minimum post-consumer gold recycled content A refiner and manufacturer of precious metals and precious metal jewellery products offers a brand of jewellery that is manufactured of 100% recycled precious metals. These precious metals, including gold are made from non-mined, recycled sources such as recollected jewellery, silverware, coins, precious metals and dental scrap. In cases where they might require additional recycled metals from other sources, they buy metal from other responsible, earth-friendly refineries that exclusively use recycled metal. They require these secondary refineries to provide full disclosure of their metal sources in writing. To verify and confirm the use of 100% recycled precious metals, they are audited every year by a globally-recognized independent third-party certifier and sustainability expert. They supply the private company with a certification that verifies that all the used metals in this brand are 100% recycled. In this way they can commit to their customers demand of raw materials that are ethically sourced with minimal environmental impact [1]. A computer manufacturer partnered up with a jewellery manufacturer to create a new collection of gold jewellery made mostly from recycled gold recovered from the computer manufacturer's various recycling programs. The goal is to create a lifestyle brand focused on sustainable, ethical fashion and production within jewellery. It focuses on sustainable production, conscious sourcing and supporting local artisans. With this partnership the computer manufacturer intents to bring greater visibility to the value within technology, encourage people to recycle responsibly and promote a more circular economy where gold recycled from e-waste can be repurposed in high value items [3-4].	
Mitigation potential	
This practice that is applied by the manufacturer does not necessarily directly reduce greenhouse gas emissions at the manufacturer's plant, but it reduces the need for primary, mined gold. Therefore, the reductions in greenhouse gas emissions are achieved at the mining and ore processing stage, as there is less demand for primary, mined gold. For the same type of product produced, the total environmental impact will be less as it is estimated that use of recycled gold has 99% less environmental impact compared to the use of primary, mined gold [2].	
Reference(s)	1. (Hoover and Strong, 2020) 2. (Werner et al., 2017) 3. (Dell, 2020) 4. (Bayou, 2020)

II.6 Limestone and gypsum

Practice number: L1	
Practice category: MT, MR	
Practice adopter	Limestone producers, raw material producers
Instruments used	Technology innovation Regulation
Relevance to EU consumption	Domestic extraction of gypsum is highly relevant; the contribution of recycled limestone to meet the raw materials demand results in the highest recycling input rate; the limestone and gypsum footprint of imported products is significant.
Description	

Procuring limestone-based products from plants implementing energy-efficient and low emissions technologies, and complying with the Emissions Trading System (ETS) Directive

<u>Corporate commitment to invest in energy-efficient and better environmental technologies</u>

Providers of limestone, crushed and ground limestone, concentrated calcite, quicklime and hydrated lime have included sustainability at the very core of their company strategies. An example of such strategy promises the company to:

1. actively develop new products and solutions that support our customers in their sustainability efforts, i.e. focus on limestone-based solutions that help their customers reduce their environmental impact;
2. increase the engagement in circular solutions and strive for total utilisation of all extracted material with a 100% material efficiency target,
3. focus on reducing the carbon emissions and the other harmful impacts of the operations.

Proposed solutions for lowering emissions to air include:

- improving energy efficiency and monitoring the completed energy efficiency actions against an annual target;
- taking decisive steps towards fossil-free operations;
- investing a minimum of 10% of their investment budget into better environmental technologies and increasing the automated monitoring of emissions;
- choosing low-emission alternatives for logistics: transport by sea or rail, where possible, aiming for a higher payload and alternative fuels in truck transport;
- approving one new carbon reduction action each quarter.

Rotary kilns are generally equipped with heat recovery set-ups. Recovered heat is either used on-site or delivered to district heating networks [1].

<u>Compliance with the ETS Directive</u>

Lime kilns are covered by the EU Emission Trading System, which ensures that the CO_2 emissions are monitored rigorously [1].

Mitigation potential

Annual specific CO_2 emissions for kiln processes have been in the level of 1.1 tonne/ tonne quicklime. Goal is to decrease CO_2 emissions in the long term.

Reference	1. (Nordkalk, in press)

Practice number: L2	
Practice category: MT	
Practice adopter	Limestone producers
Instruments used	Technological innovations
Relevance to EU consumption	Domestic extraction of gypsum is highly relevant; the contribution of recycled limestone to meet the raw materials demand results in the highest recycling input rate; the limestone and gypsum footprint of imported products is significant.
Description	
Procuring limestone-based products from plants implementing carbon capture technologies Several research and development projects are ongoing, which target to CO_2 capture from lime kiln and further concentration, storage or utilisation (CCS and CCU). New process concepts and technologies are needed for CO_2 separation and concentration. These technologies include especially indirect heating of limestone e.g. by electrification of lime kiln and oxycombustion. Possible utilisation options for separated CO_2 can be: sellable liquid CO_2 as purified and compressed, use in paper filler production, conversion to sellable CO, synthesis to SNG or synthesis to Fischer-Tropsch products [1,2].	
Mitigation potential	
The total direct CO_2 emissions of the European lime industry are around 26 Mtonne of CO_2. Nearly 70% of the emissions are formed in decarbonation process and can't be avoided. The only way to control these emissions are CCS and CCU technologies.	
Reference(s)	1. (LEILAC, 2020) 2. (Decarbonate, 2020)

II.7 Timber

Practice number: T1	
Practice category: MS	
Practice adopter	Forest owner, raw material producer
Instruments used	Standards and certification
Relevance to EU consumption	Significant domestic production and direct imports
Description	

Procuring wood from third-party certified actors complying with specific industry standards

Forest certification is a voluntary process whereby an independent third party assess the quality of forest management and production against a set of requirements predetermined by a public or private certification organization. Forest certification is a way of informing consumers about the sustainability of forests from which wood and forest products were produced. There are two main certification systems in the world: PEFC™ (The Programme for the Endorsement of Forest Certification) certificate, which is supported by forest owners and forest industry and FSC® (Forest Stewardship Council) certificate, which originates in environmental protection and nature saving organisations [1].

There are two types of forest certification:

1. Certification of forest management and 2. Certification of the chain of custody, which verifies that certified material is identified or kept separate from non-certified or non-controlled material through the production process, from the forest to the final consumer. To label an end-product as certified, both forest management certification and chain-of-custody certification are required.

The PEFC's criteria for SFM standards

- Criterion 1: Maintenance and appropriate enhancement of forest resources and their contribution to the global carbon cycle
- Criterion 2: Maintenance of forest ecosystem health and vitality
- Criterion 3: Maintenance and encouragement of productive functions of forests (wood and non-wood)
- Criterion 4: Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems
- Criterion 5: Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water)
- Criterion 6: Maintenance of other socioeconomic functions and conditions
- Criterion 7: Compliance with legal requirements [3]

The FSC principles

- Principle 1: Compliance with laws
- Principle 2: Workers' rights and employment conditions
- Principle 3: Indigenous peoples' rights
- Principle 4: Community relations
- Principle 5: Benefits from the forest
- Principle 6: Environmental values and impacts

• Principle 7: Management planning • Principle 8: Monitoring and assessment • Principle 9: High conservation values • Principle 10: Implementation of management activities [2]		
Mitigation potential		
PEFC standard requires that climate positive practises in management operations, such as greenhouse gas emission reductions and efficient use of resources shall be encouraged. It also requires that the capacity of the forest to store and sequester carbon shall be safeguarded in the medium and long term by balancing harvesting and growth rates, using appropriate silvicultural measures and preferring techniques that minimise adverse impacts on forest resources [3].		
Reference(s)	1. (FAO, 2020) 2. (FSC, 2020) 3. (PEFC, 2020)	

Practice number: T2	
Practice category: MS, PS	
Practice adopter	Raw material producers, processors
Instruments used	Standards and certification
Relevance to EU consumption	Significant domestic production and direct imports
Description	

Furniture producer procuring wood from actors complying with their own defined standards

All the wood used in products of a large furniture company are sourced in compliance with their own standardised method, which sets out the minimum environmental and social standards expected from their suppliers, including compliance with laws. Sustainable sources include FSC-certified forests and recycled sources. The adoption of sustainable forestry methods is actively promoted also beyond their own value chain and they are working with global partners including WWF and Forest Stewardship Council (FSC®). The 'transport section' of this standard is also requesting suppliers to implement a CO_2 emissions reduction programme including goals and an action plan covering the fleet used for supplying this furniture producer [1].

The company has goal to be climate positive by 2030 meaning that they will reduce more greenhouse gas emissions than their value chain emits while growing the business.

Radical reductions to greenhouse gas emissions are needed from all parts of the value chain to achieve the climate positive target. Identified means include:

- Striving towards 100% renewable energy and phase-out of fossil fuels
- Improving energy efficiency
- Using more sustainable materials, ambition to use only renewable or recycled materials by 2030
- Ensuring that carbon remains stored in products longer through circular economy
- Collaborating with customers, suppliers and partners to reduce their total GHG emissions.
- Supporting and partnering with home furnishing suppliers to reduce the total footprint of their factories.

Mitigation potential

The current climate footprint of a company has been estimated to be 24.9 million tons CO_2 eq – accounting for 0.1% of the world's greenhouse gas (GHG) emissions. The largest portion of the footprint (42%) comes from raw materials extraction and processing from which, the share of boards & solid wood was 24% although these materials composed 70w-% of materials used. Future goal is to be climate positive [2].

Reference(s)	1. (IKEA, 2020)a 2. (IKEA, 2020)b

Practice number: T3	
Practice category: PE	
Practice adopter	Construction industry
Instruments used	Economic instrument: green public procurement
Relevance to EU consumption	Significant domestic production and direct imports
Description	
Construction industry procuring wood for public buildings for complying with public authority requirements A national Wood Building Programme was identified, as a joint government undertaking aimed at increasing the use of wood in urban development, public buildings as well as large constructions such as bridges and halls. Using wood reduces the carbon footprint of the construction industry when evaluating the entire life-cycle of wood from the raw-material through manufacturing, use and recycling. The carbon bound by trees is retained in structures and furnishings for a long time and affects the overall environmental impact of the construction industry positively. Increasing the amount of wood used in construction is also an efficient way of attaining the energy and climate targets laid down to reduce carbon footprint by 2030. Concrete actions of the programme for promoting the use of wood in public buildings include procurement guidelines for public building projects, electronic contracting tools, testing measurement and assessment tools to establish the carbon storage and carbon footprint in wood building projects, and a report on the carbon storage in wood products. The outcomes of the programme will be evaluated on the following indicators: • the increase in the number of timber-framed blocks of flats • the proportion of industrial wood construction of all wood construction • the increase in the exports of wood-based construction products • the amount of carbon bound by buildings • the increase in the number of non-profit developers active in wood construction • the programme will undergo an annual impact assessment	
Mitigation potential	
Construction and buildings have estimated to produce approximately one third of greenhouse gas emissions of a country. The share of wood buildings from all new public buildings is targeted to be 31% in 2022 and 45% in 2025.	
Reference	1. (Ministry of the Environment in Finland, 2020)

II.8 Chemical and Fertiliser Minerals

Practice number: F1	
Practice category: MT	
Practice adopter	Mining company, raw material producers

Instruments used	Technology innovation
Relevance to EU consumption	Chemical and fertiliser minerals represent a significant share of EU raw materials imports; potash is also mined in EU-27.
Description	
Procuring from mining companies using energy and fuel-efficient ore loaders and haulage systems and ventilation in potash mines Energy-efficient loaders and haulage systems In one of the world's largest potash mines, located in Europe, the loaders use an energy-saving hydraulic system that is fitted with variable displacement pumps with Load Sensing control which adjusts the pump capacity to the load. This innovation allows the truck's capacity to increase and a reduction in thermal emission which is a benefit when working at temperatures as high as 52ºC underground [2]. Another, non-European, relevant innovation was identified in a potash greenfield project which, during the mine planning phase, assessed the utilization of truck hauling versus overland conveyor for the transport of the ore [3]. Truck haulage is responsible for significant diesel consumption in the mining environment [4]. It was demonstrated that the transportation of the ore using trucks results in higher CO_2 emissions relative to the use of conveyor belts [3,4]. Energy-savings in mines ventilation A different potash underground mine, in Belarus, opted to implement automated ventilation control (AVC) systems and design its ventilation systems on the basis of ventilation-on-demand (VOD) principle. The basis of AVC and VOC is energy-efficiency of mine ventilation systems under the condition that there is sufficient ventilation of all working areas. These systems use sensors to monitor real-time air quality, vehicle use, and personnel to ventilate only specific areas of the mine instead of ventilating the whole mine all the time [5].	
Mitigation potential	
By using a belt transport system instead of truck haulage, the above-mentioned feasibility study estimated that CO_2 emissions are reduced by factors in the range 1.2–1.4 kg/t.km, resulting in a potential saving of about 300 000 tonnes per year [3]. In order to improve energy efficiency of ventilation in underground, the use of the AVC system including controlled recirculation and dynamic operation mode results in the reduction of time-average energy consumption from 2200 kW to 1400 kW, saving about 36% [5]. In general (not only applicable to potash mines) it is estimated that loading and hauling operations account for 17% of the energy use across the mineral mining industry [1]. The maximum cumulative GHG reduction achievable in the Canadian potash mining sector considering technological innovations (new alternative haul truck powertrain technologies, haul truck operating mode improvement, advanced haul truck thermal management system, ventilation on demand, steam generation and product drying efficiency improvements) that can concurrently be implemented results in 3Mt of CO_{2eq}, 2% of sectors emissions.	
Link	1. (Kumar Katta et al., 2020) 2. (Moore, 2020) 3. (Kluge et al., 2017) 4. (Soofastaei et al., 2018) 5. (Semin and Levin, 2017)

Practice number: F2	
Practice category: PT	
Practice adopter	Ammonia producer
Instruments used	Technology Innovation
Relevance to EU consumption	Chemical and fertiliser minerals represent a significant share of EU raw materials imports; nitrogen-based fertilizers are the most commonly used straight fertilisers in Europe.
Description	
Fertilizer producers procuring ammonia from plants implementing carbon capture technologies	
Carbon capture, transportation and utilisation (CCU)	
Fertilizer producers, such as urea producers, use a portion of CO_2 generated from the production of ammonia as a feedstock for their chemical production processes often taking place on site [3]. One of the largest ammonia producers, having a plant located in Norway, produces a high purity CO_2 for sale for use in other industrial applications. A water wash process to clean the CO_2 rich process gases from ammonia production is used. By the action of absorption in water, the CO_2 is removed from the process gas. The pressurized wash water (saturated with CO_2) is depressurized in a two-step process to release CO_2. This CO_2 gas is divided into two roughly equal parts with one part going for liquefication to produce high purity CO_2 while the other portion is vented to the atmosphere through a stack. After the CO_2 is liquefied, it is stored in intermediate storage tanks and loaded on to ships for transport to the industrial consumer [1].	
Carbon capture, transportation, utilisation and storage (CCUS)	
Another non-European nitrogen fertilizer producer has also implemented carbon capture and utilisation technologies at its own ammonia production sites for reducing GHG emissions. Similarly, this involves compressing the CO_2 into a near-liquid state and injecting into a pipeline to be sold and transported to an oilfield for enhanced oil recovery (EOR). In 2019, one of its ammonia facilities has also started capturing previously vented CO_2. The carbon injection technique helps to maximize recovery and prolong the life of oil reservoirs. After EOR and in this case, the CO_2 remains in permanent storage in an underground geological formation [2].	
Mitigation potential	
Non-European nitrogen fertilizer producer mentioned above reported that captured and sold CO_2 diverted more than 1.2 Mt of CO_2 from the atmosphere in 2019 [2]. They also claim that this additional project involving permanent CO_2 storage will capture 250 000 tonnes of CO_2 each year.	
Reference(s)	1. (Haugen et al., 2017) 2. (Nutrien Ltd, 2020) 3. (Cuéllar-Franca and Azapagic, 2015)

Practice number: F3	
Practice category: PT	
Practice adopter	Ammonia producer
Instruments used	Technology Innovation
Relevance to EU consumption	Chemical and fertiliser minerals represent a significant share of EU raw materials imports; nitrogen-based fertilizers are the most commonly used straight fertilisers in Europe.
Description	
Fertilizer producers procuring ammonia from plants valorising CO_2 through industrial symbiosis Residual heat and CO_2 from gas burners from ammonia production operations can be valorised and supplied to adjacent facilities, subsequently representing a promising option to reduce energy costs of e.g. greenhouses horticulture [1]. A practice was identified of a fertilizer company that created a symbiotic connection of heat and CO_2 between its facility and local greenhouses. This type of industrial symbiosis can be achieved by using a pipeline network. This is an example of industrial symbiosis on a large scale that implements benefits to the environment, horticulture, and the fertilizer industry [1]	
Mitigation potential	
60 kilotons of CO_2 are now used annually in horticulture through this practice whereas the use of the residual heat avoids the emission of another 135 kilotons of CO_2 annually.	
Reference(s)	1. (Yara's WARMCO2: Spearheading Industrial-Horticultural Symbiosis, in press)

Practice number: F4	
Practice category: MT	
Practice adopter	Raw material producers
Instruments used	Technological innovation
Relevance to EU consumption	Chemical and fertiliser minerals represent a significant share of EU raw materials imports; nitrogen-based fertilizers are the most commonly used straight fertilisers in Europe.
Description	

Ammonia producers procuring hydrogen with a lower carbon footprint

As described above, today's ammonia production is mainly consisting of steam methane reforming of natural gas combined with Haber-Bosch ammonia synthesis. As part of the MIDDEN project several hydrogen sourcing practices are proposed for decarbonising the Dutch fertiliser industry [1]. It is described that ammonia producers can produce on-site hydrogen with a lower carbon footprint or source it from external sources:

External sourcing of hydrogen enabled by the development of an open distribution infrastructure

Several fertilizer producers consider that the promotion of regional open network for hydrogen infrastructure could facilitate the reduction of GHG emissions and in the long term, also reduce the dependency on carbon capture and storage. Three companies have realised a hydrogen infrastructure between themselves. Hydrogen that is generated as a by-product from processes in one company is transported by pipeline to a serve as a feedstock for the production processes for the two other companies. The first phase of the project promises a hydrogen supply of 4.5 kt/year.

Green hydrogen produced from electrolysis of water

The hydrogen required for the Haber-Bosch process for producing ammonia could be produced by electrolysis of water. Electrolysers pass an electrical current between an anode and a cathode through an electrolyte which results in the splitting of water into hydrogen and oxygen.

Blue hydrogen produced from natural gas with carbon capture and storage

Blue hydrogen is produced from natural gas, typically through steam-reforming, with carbon capture and storage.

Hydrogen from biomass gasification

The gasification of (ligno-)cellulose from wood can result in the production of a syngas, being a mixture of hydrogen, carbon monoxide and carbon dioxide. This gas could be used as a feedstock in the ammonia production process.

Other hydrogen production processes

Other processes could be used to produce hydrogen, however they still have rather low TRL levels.

- Methane pyrolysis (thermal decomposition of methane) can result in reduced energy demand and could potentially be based on renewable methane. Solid carbon and hydrogen result from this process (TRL 4–5).
- Thermochemical processes in which high-temperature heat could be used to split water. The heat could be supplied by solar heat or waste heat (TRL 4).
- Photocatalytic processes (TRL 2–3).

Mitigation potential

Most of suggested hydrogen sourcing practices are not being implemented yet. Technological innovations have not been implemented at large scale yet. Climate mitigation potential of above-mentioned hydrogen distribution infrastructure is estimated to be approximately 10 kt CO_2 per year.

A feasibility study indicates that in a second project phase the climate mitigation potential could reach 20–40 kt CO_2 per year. While no plants using electrolysis to produce ammonia are currently operational (still at a pilot level in EU) and is dependent on the intensity of GHG emissions of electricity generation, its climate mitigation potential could reach more than 80%. When hydrogen is made with electrolysis, other sources of CO_2 are required to produce urea or supply CO_2 for other purposes as the CO_2 is no longer made available by the conventional ammonia process [1,2].	
Reference(s)	1. (Batool and Wetzels, 2019) 2. (Wyns et al., 2018a)

Practice number: F5	
Practice category: PB	
Practice adopter	Producers of intermediate products: Ammonia producers, Nitric acid producers, Sulphuric acid producers
Instruments used	Best Available Techniques (BAT) Reference Document (BREF) for the Manufacture of Large Volume Inorganic Chemicals - Ammonia, Acids and Fertilisers
Relevance to EU consumption	Chemical and fertiliser minerals represent a significant share of EU raw materials imports; nitrogen-based fertilizers are the most commonly used straight fertilisers in Europe.
Description	

Fertilizer producers procuring intermediate products from plants applying Best Available Techniques (BAT)

BAT applied to ammonia production for

- mitigating NO_x concentrations in ammonia production
  - use a low NO_x burner in the primary converter;
  - as in the selective non-catalytic reduction technique;
  - for the removal of ammonia from flue gas and waste gases
  - alternatively, an auto-thermal heat exchanger for low-temperature desulphurization should be applied
- reducing energy consumption and mitigating energy loss
  - involves increasing the preheating time for the raw material, preheating of the combustion air, and modifying the process equipment.
  - other options involve removal of excessive CO_2, removal of SO_2 at low temperatures, use of small catalyst particles in the ammonia converter, use of a catalyst in low-pressure ammonia synthesis, liquid nitrogen washing for the removal of synthesis gases, indirect cooling of the ammonia synthesis reactor, hydrogen recovery from the liquidated gas in ammonia synthesis, or application of a well-developed process control system [1,2]

BAT applied to nitric acid production for

- reducing N_2O levels in nitric acid production
  - Optimized conditions for raw material preparation
  - Optimal mixing of raw materials
  - Optimal gas distribution on the catalyst surface
  - Monitoring catalyst performance
  - Optimization of NH_3/air ratio
  - Optimization of pressure and temperature for oxidation
  - N_2O separation by expansion of the reactor in new facilities
  - Reduction of NO_x and N_2O in tail gases
- decreasing NO_x emissions levels for nitric acid production
  - Optimization of HNO_2 absorption by water during nitric acid production
  - Decreasing NO_x and N_2O concentrations in tail gases
  - Addition of H_2O_2 to water to achieve 100% HNO_2 absorption [1,2]

BAT applied to sulfuric acid production for

- determining SO_2 emission levels and conversion rate
- reducing SO_3/H_2SO_4 emission levels
  - mitigating the impurity content of the raw materials;

○ using low sulfur concentrations (during sulfur burning); ○ and drying of the gas entrance tubes; ○ use of a large area of the reactor for concentration processing; ○ use of high acid distribution and circulation rates; ○ application of a high- performance filter after SO_2 absorption in sulfuric acid production; ○ and monitoring of absorber acid concentration and temperature [1,2]	
Mitigation potential	
Mitigation potential is specific to techniques and example plants used in the BREF Document. As an example, the revamp of an ammonia plant led to the following environmental benefits: • Reduced NO_x emissions <200 mg/Nm^3 due to low oxygen surplus • Energy consumption reduction (before and after the revamp) from 36.0 to 31.1 GJ/tonne (fuel + feed) • Net energy consumption after revamp: 30.6 GJ/tonne [1]. A European producer of Ammonium nitrate (AN), concluded that procuring ammonia and nitric acid from plants using BAT resulted in total emissions 3,6 kg CO_2eq/kg of AN produced. The implementation of such abatement technology for N_2O emissions led to a reduction of emissions of around 50% (compared to a similar plant not having implemented this technology) [3].	
Reference(s)	1. (European Commission, 2007) 2. (Gezerman, 2016) 3. (Fertilizer life cycle perspective | Yara International, 2018)

Practice number: F6	
Practice category: PR	
Practice adopter	Ammonia, nitric acid, sulphuric (intermediate product) producers
Instruments used	EU Directive, market-based instrument
Relevance to EU consumption	Chemical and fertiliser minerals represent a significant share of EU raw materials imports; potash is also mined in EU-27
Description	
Fertilizers producers procuring intermediate products from plants complying with EU Emissions Trading System (ETS) Ammonia, nitric acid and sulphuric acid facilities are covered by the EU ETS Directive, that need to be transposed and implemented by Member States. The EU ETS is based on the 'cap and trade' principle. A cap is established which limits the total amount of certain greenhouse gases that can be emitted by e.g. ammonia, nitric acid and sulphuric producers (as responsible for CO_2 and NO_2 emissions). This cap is reduced over time so that emissions can also decrease. Within the cap, companies receive or purchase emission allowances, which they can trade between themselves. They can also buy limited amounts of international credits from emission-saving projects around the world. The limit on the total number of allowances available ensures that they have a value [1,2]. After each year, a company must prove that it has obtained enough allowances to cover all its emissions or else heavy fines are imposed. In case a company was able to reduce its emissions, it can keep the spare allowances to cover its future needs or sell them to another company that is in need of allowances. According to the EC, trading brings flexibility that ensures emissions are cut in a cost-effective manner and a robust carbon price also promotes investment in clean and low-carbon technologies [1].	
Mitigation potential	
The linear reduction factor of the amount of emission licences was set in line with the EU-wide climate action targets for 2020 - the overall 20% emissions reduction target and the EU ETS sector-specific 21% emissions reduction target relative to 2005. In phase 4 (2021-2030), the cap on emissions will be subject to an annual linear reduction factor of 2.2% [2]	
Reference(s)	1. (EC, 2019) 2. (Fertilizers Europe, 2018)

Practice number: F7	
Practice category: PS, TS	
Practice adopter	Traders and Fertilizers producers
Instruments used	Standards and certification
Relevance to EU consumption	Chemical and fertiliser minerals represent a significant share of EU raw materials imports
Description	

Fertilizers traders and producers procuring certified products and intermediate products

Voluntary product stewardship performance assessment and certification scheme

An international fertilizers association had created a product stewardship standard for fertilizers, and members of its association. This standard covers specific quality, environmental, health and safety aspects of the ISO 9001 and 14001, as well as the OHSAS 18001 certifications. Six areas are examined: management system, product development and planning, sourcing and contractor management, manufacturing techniques, supply chain to customer, as well as marketing, sales and application. This certification programme presents a practical framework for implementing product stewardship practices, while providing the necessary reference material and the tools to aid implementation and to measure the progress achieved. In 2020, 59 companies in 58 countries were certified [1].

Compulsory product stewardship program

In line with the above-mentioned international voluntary certification scheme, a European fertilizers association has established and, in this case, imposes a product stewardship programme to its member companies. The program specifies best practice operations for management of safety, health, environment and security in sourcing of fertilizer materials, fertilizer production and storage, and in the supply chain to the farmer. It covers mineral fertilizers, their raw materials and intermediate products. Implementation is verified by third party audits organised by this association. A certificate is issued to those companies that pass the audit without any non-conformity [2].

Mitigation potential

The mandatory program provides a structure for establishing a product stewardship program in a company with reference to best practice guidelines that have been issued by the industry association. Direct climate mitigation potential associated with these practices have not been reported, however those schemes guide and promote the adoption of energy efficient and abatement (CO_2 and NO_2 emissions) techniques for certified producers, as well as the compliance with regulations such as REACh (Registration, Evaluation, Authorisation and Restriction of Chemicals) [2].

Reference(s)	1. (International Fertilizer Association, in press) 2. (Fertilizers Europe, 2016)

Practice number: F8	
Practice category: PA	
Practice adopter	Fertilizer producers
Instruments used	Awareness raising
Relevance to EU consumption	Chemical and fertiliser minerals represent a significant share of EU raw materials imports
Description	
Fertilizers producers procuring intermediate products from recognised good practitioners An international fertilizers association made up of members from 72 countries bestows the Safety, Health and Environment Gold Medal on producers that appraise and address their efforts in four key areas: Employee Safety Performance, Employee Safety Perceptions, Environmental Performance and Energy Efficiency & CO_2 Emissions. This voluntary benchmarking allows members of this association to compare their performance on these four key areas compared to world leaders, identify improvements levers and measure progress over time. According to this international industry association, their Energy Efficient & CO_2 Emissions benchmarking survey became a global reference for ammonia producers for measuring progress and encouraging investment in efficiency improvement (2015 edition saw a participation by 66 plants located in 26 countries) [1].	
Mitigation potential	
The voluntary Energy Efficiency & CO_2 Emissions Benchmark's total performance has improved for each survey since this activity started in 2004 with an average net Energy Efficiency +4% and net CO_2 Emissions -9% [1].	
Reference(s)	1. (International Fertilizer Association, in press)

II.9 Salt

Practice number: S1	
Practice category: MS	
Practice adopter	Salt producers
Instruments used	Standards and certification
Relevance to EU consumption	Salt represents a significant share of EU domestic raw materials extraction
Description	
Procuring salt from certified producers monitoring and optimising energy consumption A German salt producer operates a DIN EN ISO 50001 certified energy-management system and frequently conducts energy audits in accordance with DIN EN ISO 16247. A group-wide concept for energy management is being developed and the introduction of ISO 50001 at sites outside the EU has begun. As they forecast that the use of solution mining as well as the continuing expansion of other underground raw material mining is expected to increase specific demand for primary energy, the company has converted some of their coal-powered operating sites outside Europe to natural gas as a reduced-emissions energy source. This provides a means to significantly reduce CO_2 emissions [1]. Also, by using Combined Heat and Power (CHP) technology, the company is able to generate most of its energy requirements for electricity and heat in its own sites using primary energy sources, making energy conversion more efficient [2]. For achieving its climate mitigation goals, this company investigates the possibility of using renewable energy sources such as sun and/or wind [1]. ISO 50001 provides a framework of requirements for organizations to: • Develop a policy for more efficient use of energy • Fix targets and objectives to meet the policy • Use data to better understand and make decisions about energy use • Measure the results • Review how well the policy works, and • Continually improve energy management.	
Mitigation potential	
In 2019, the carbon footprint for electricity consumed was 297.4 kg CO_2e/MWh (2018: 298.1 kg CO_2e/MWh), a change of -1.7% to the selected base year (2017). The reduction is due to a production-related higher share of CHP own electricity generation in total electricity consumption. This accounts for savings across the entire product line, not just salt [2]. Procuring from certified companies developing an energy management system, provides a framework for continuous improvement and mitigation potential.	
Reference(s)	1. (Energy & climate - K+S Aktiengesellschaft, in press) 2. (K+S Annual Report 2019, 2020) 3. (ISO - ISO 50001 — Energy management, in press)

Practice number: S2	
Practice category: MT	
Practice adopter	Salt producers
Instruments used	Technology innovation
Relevance to EU consumption	Salt represents a significant share of EU domestic raw materials extraction
Description	
Procuring sea salt from energy-efficient production A European sea salt producer makes use of a photovoltaic system and also possesses energy saving resources in the form of infrastructure such as frequency-controlled engines and heat conductors, etc. To dry the salt, a gas-powered dryer that is pre-heated with steam recovered from a neighbouring company is used. The natural gas dryer uses a clean combustion process that ensures negligible emissions of NOx, dust, soot and other components [1].	
Mitigation potential	
The use of a photovoltaic system allows the sea sat producer to satisfy over 60% of their own energy requirements [1].	
Reference(s)	1. (Sustainable salt production & refinery | Zoutman industries, in press)

Practice number: S3	
Practice category: PB	
Practice adopter	Chlor-Alkali producer: salt processors
Instruments used	Best Available Techniques (BAT) Reference Document (BREF) for the Production of Chlor-alkali
Relevance to EU consumption	Salt represents a significant share of EU domestic raw materials extraction

Description

Procuring chlorine and caustic soda from plants applying Best Available Techniques (BAT)

In order to use energy efficiently in the electrolysis process, BAT is to use the combination of the techniques given below:

- High-performance membranes: show low voltage drops and high current efficiencies while ensuring mechanical and chemical stability under the given operating conditions.
- Asbestos-free diaphragms: consist of a fluorocarbon polymer and fillers such as zirconium dioxide. These diaphragms show lower resistance overpotentials than asbestos diaphragms.
- High-performance electrodes and coatings: Electrodes and coatings with improved gas release (low gas bubble overpotential) and low electrode overpotentials.
- High-purity brine: The brine is sufficiently purified to minimise contamination of the electrodes and diaphragms/membranes, which could otherwise increase energy consumption [1].

Mitigation potential

The achieved environmental benefit of using the combination of above-listed techniques is a reduction of energy consumption. High-performance membranes are generally used by membrane cell plants. The conversion to asbestos-free diaphragms at two plants from the same company in France (chlorine capacity of diaphragm cell unit 150 kt/yr and 175 kt/yr) also involved the replacement of anodes and cathodes by expandable anodes and better performing cathodes, resulting in an overall reduction in electricity consumption for electrolysis of 3–4 % [1].

Reference(s)	1. (European Commission. Joint Research Centre. Institute for Prospective Technological Studies., 2014)

Practice number: S4	
Practice category: PB	
Practice adopter	Soda ash producers: salt processors
Instruments used	Best Available Techniques (BAT) Reference Document (BREF) for the Manufacture of Large Volume Inorganic Chemicals – Solids and Others indsutry
Relevance to EU consumption	Salt represents a significant share of EU domestic raw materials extraction
Description	
Procuring soda ash from plants applying Best Available Techniques (BAT) In the Solvay process, sodium chloride brine, limestone, coke and ammonia are the feedstock in a series of reactions which result in the production of soda ash. The following are the process steps involved: • Brine purification • Lime kilns and milk of lime production • Absorption of ammonia • Precipitation of sodium bicarbonate • Separation of sodium bicarbonate from the mother liquor • Sodium bicarbonate calcination • Ammonia recovery For soda ash plants using the Solvay process in the EU-25 (2007), 13 BAT conclusions have been drawn for soda ash plants based on the Solvay to limit energy consumption as well as CO_2 from the process, including for instance: • Total energy consumption in the production of soda ash in the range of 9.7 – 13.6 GJ per tonne of dense soda ash produced (or 8.8 – 12.8 GJ per tonne of light soda ash produced). • Optimised operation of the soda ash plant, to maintain the emissions of CO_2 from the process in the range of 0.2 – 0.4 tonne of 100 % CO_2 per tonne of soda ash produced (integrated production of soda ash with refined sodium bicarbonate at the site can lead to much lower emission levels)	
Mitigation potential	
Mitigation potential is specific to techniques and example plants used in the BREF Document	
Reference(s)	1. (European Commission, 2007)

Practice number: S5	
Practice category: PT	
Practice adopter	Chlor-Alkali and caustic soda producers: salt processors
Instruments used	Technological innovation
Relevance to EU consumption	Salt represents a significant share of EU domestic raw materials extraction
Description	

Procuring chlorine and caustic soda produced with low carbon energy sources

As part of the MIDDEN project several energy sourcing practices are proposed for decarbonising the Dutch chlor-alkali industry. The necessary upscaling of those innovative technologies is also supported a European chlor-alkali industry association [1-2]:

Sustainable heat generation

Several technologies are being developed for a more sustainable generation of heat, including biomass boilers, electric boilers and geothermal heat supply.

Efficiency and electrification

According to the study, the caustic soda vaporisation process may be made more efficient by deploying Mechanical Vapour Recompression (MVR). Due to the higher steam temperature requirements, the MVR technology is estimated to be ready for implementation in caustic soda vaporisation after 2030. Membrane cell designs are refined and optimised continually in the competitive chlor-alkali industry. With the “zero-gap technology” the distance between the anode and cathode is minimised as they are placed very closely to the membrane wall. This technology has become widely adopted since 2010, realising significant energy savings.

Mitigation potential

Based on the research carried out by the Midden project, the small-scale implementation of biomass boilers as well as electric boilers can support three production plants located in the Netherlands (producing roughly 850 kt chlorine/yr, 950 kt of caustic soda/yr, 24 kt of hydrogen per year) to meet the thresholds for direct emission reductions stipulated by the ETS. The necessary investments in electrifying steam generation are relatively minor (EUR 150,000) in electric boilers can already reduce the direct emissions by more than 20 kt of CO_2 per year by 2030 [1].

Although the chlor-alkali’s direct emissions are not lowered by the zero-gap technology, it has a significant influence on its electricity usage, and thus helps to reduce indirect emissions. Since the indirect emissions of the chlor-alkali industry are considerably higher than the direct emissions, this alternate technology seems promising in reducing the net emissions of the Netherlands as a whole. One plant in the Netherlands having implemented this technology reported the energy usage of their chemical processes was said to have been reduced by 10% [1].

Reference(s)	1. (Scherpbier and Eerens, 2020) 2. (Energy, in press)

Practice number: S6	
Practice category: MS, PS, TS	
Practice adopter	Salt producers, processors and traders
Instruments used	Standards and certifications
Relevance to EU consumption	Salt represents a significant share of EU domestic raw materials extraction

Description

Procuring salt from certified producers monitoring and reducing GHG emissions

Certification for monitoring and optimising transport-related CO_2 emissions

A Belgian company specialised in producing and processing sea salt, is using large sea vessels to supply raw materials, subsequently minimising CO_2 emissions per ton transported compared to transport by truck. For this reason, the refining units are located near major and easily accessible waterways. The company is certified ISO 14001: 2015 for storage and transshipment, refining, processing and transport of salt and brine for various applications [1].

Sustainable sea salt certification

A registered non-profit NGO has developed criteria and indicators for sustainable sea salt certification. Companies that fulfil the criteria can use the eco-label for their sea salt products. The criteria that must be met includes social, economic, legal and environmental aspects. The environmental requirements include:

- Air Emissions Management: applicants that seek certification need to prove that they have identified potential sources of GHG emissions and have set reduction targets and strategies to be implemented in order to achieve them.
- Energy Management:
    - The total amount of net energy consumption resulting from the operations is calculated annually by including: direct consumption of external energy (both renewable and non-renewable), internal renewable energy production and consumption, fuels used for transportation and functioning of the equipment of Salt pan, grey energy use and production (e.g. input, packaging, equipment).
    - Applicants must outline their objectives for the reduction of energy resources and the implementation of strategies and assessment methods to achieve these goals.
    - The applicant must determine the energy drawn from renewable energy systems. If not all the energy that is required comes from renewable sources, then the company must purchase "green credits" on the market.

Mitigation potential

This Belgian company is claiming that 10,000 truck journeys are avoided each year [1]. The NGO having developed sustainable sea salt standards and it is in the process of developing standards for sustainable salt from solution mining. Procuring from certified companies developing an environmental management system, provides a framework for continuous improvement and mitigation potential.

Reference(s)	1. (About ZOUTMAN | Zoutman industries, in press) 2. (Sustainable Salt, in press)

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