SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

CONSULTATION DRAFT

CHEMICALS SECTOR GUIDANCE

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NOTE ON CONSULTATION DRAFT

This document has been prepared for the purpose of publication for the public's consultation. The content, format and/or design of the document may be subject to significant changes due to the outcomes of the public consultation, new data, and potential changes in the SBTi's format for sector-specific resources.

ABOUT SBTi

The Science Based Targets initiative (SBTi) is a corporate climate action organization that enables companies and financial institutions worldwide to play their part in combating the climate crisis.

We develop standards, tools and guidance which allow companies to set greenhouse gas (GHG) emissions reductions targets in line with what is needed to keep global heating below catastrophic levels and reach net-zero by 2050 at the latest.

The SBTi is incorporated as a charity, with a subsidiary which will host our target validation services. Our partners are CDP, the United Nations Global Compact, the We Mean Business Coalition, the World Resources Institute (WRI), and the World Wide Fund for Nature (WWF).

DISCLAIMER

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"Science Based Targets initiative" and "SBTi" refer to the Science Based Targets initiative, a private company registered in England number 14960097 and registered as a UK Charity number 1205768.

CHEMICALS SECTOR GUIDANCE

Effective date

This guidance is effective for targets submitted on or after TBD date.

Responsibility

This guidance is issued by the SBTi. Any feedback on the SBTi resources can be submitted to info@sciencebasedtargets.org for consideration of the SBTi.

VERSION HISTORY

Version	Change/update description	Release date	Effective dates
Version 1.0	• Publication of the initial version of the guidance	TBD	TBD

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INTRODUCTION

Purpose and system of SBTi Standards and Guidance

Purpose of this Guidance

The latest climate science sends a clear warning that we must dramatically curb temperature rise to avoid the catastrophic impacts of climate change. The SBTi develops resources that show companies and financial institutions how much and how quickly they must reduce their greenhouse gas (GHG) emissions to prevent the worst effects of climate change.

The Chemicals Sector Guidance aims to support GHG emissions reduction by providing a sector-specific set of criteria for companies with activities related to the chemicals sector to use to set science-aligned emissions reduction targets.

System of SBTi Standards

SBTi Standards and Guidance are organized in a modular framework that includes a foundational Standard, the Corporate Net-Zero Standard, and several sector-specific resources with additional requirements specific to each sector. Financial institutions are expected to use the Financial Institutions Net-Zero Standard (once published) to set targets on their investment portfolio, and the Corporate Net-Zero Standard to set targets on their scopes 1, 2 and 3 categories 1-14 emissions.

For terms and definitions used in this guidance and in the SBTi framework, please refer to the SBTi Glossary. Additional definitions of terms specific to this guidance are included in Annex 1.

Use of terms “shall”, “must”, “should” and “may”

Within this guidance, the terms “shall”, “must”, “should” and “may” are used as follows:

- “Shall” and “must” indicate criteria that are required for the applicable activities.
- “Should” indicates a recommendation. Recommendations are important for transparency and best practices but are not required.
- “May” indicates an optional criterion that is permissible, but not required. However, an optional criterion, if chosen, must be adhered to fully. A company may not selectively follow parts of the optional element.

Applicability of the Chemicals Sector Guidance

Users that shall adhere to this guidance

Companies that manufacture any products that fall within the boundary of the chemicals sector, as defined below, shall adhere to the applicable criteria in this guidance when setting targets on emissions from their value chains as part of an entity-wide science-based target. This guidance addresses emissions from the value chain of these chemicals only; however, companies may also have activities within their value chain that fall outside the chemicals sector. For such activities, companies shall review and follow any other applicable sector-specific guidance or standards from the SBTi. Sources of emissions that are not addressed via sector-specific criteria shall be set using the SBTi's Corporate Net-Zero Standard and/or the Corporate Near-Term Criteria.

Due to the extremely diverse and heterogeneous nature of the chemicals sector, certain criteria have been established in this guidance that apply only to specific products, or product groups, in order to most effectively address the climate target setting needs of the emissions associated with these products. Other criteria apply to the production of all products encompassed within the chemicals sector. The organization of the sector at the product level, including why certain products have (or have not) been singled out for criteria, is discussed in greater detail in the section below titled "How has the chemicals value chain been disaggregated for the target setting purposes?"

This guidance contains chemicals sector-specific criteria for setting scope 1, 2 and/or 3 targets. As described in greater detail below, when developing their targets, companies with activities in the chemicals sector should carefully identify which criteria apply to them. Not all criteria will apply to all companies. Further, any products or sources of emissions that are not explicitly addressed by criteria in this guidance shall be covered via the methods and criteria in the SBTi's Corporate Net-Zero Standard and the Corporate Near-Term Criteria.

The guidance shall be applied at the product level. This means that criteria within this guidance may apply even if a company as a whole is not classified as a chemical company under widely used industry classification frameworks[1].

For the purposes of this guidance, companies are considered to manufacture chemical products if these manufacturing activities fall within the company's operational boundary that is used to calculate its scope 1 and scope 2 corporate GHG inventory, as outlined in the GHG Protocol's Corporate Accounting and Reporting Standard (GHG Protocol, 2004).

For the purposes of this guidance, the "sectoral boundary of the chemicals sector" includes the following activities. Each activity is defined in Annex 1 of this guidance.

- The production of primary chemicals.
- The production of other base chemicals.
- The production of intermediate chemicals.

[1] E.g. Global Industry Classification System (GICS), Industrial Classification Benchmark (ICB), North American Industry Classification System (NAICS), etc.

- The production of specialty chemicals.
- The production of pharmaceuticals.
- The production of consumer chemicals.
- Chemical recycling activities.

Treatment of emissions from the use of nitrogen fertilizers

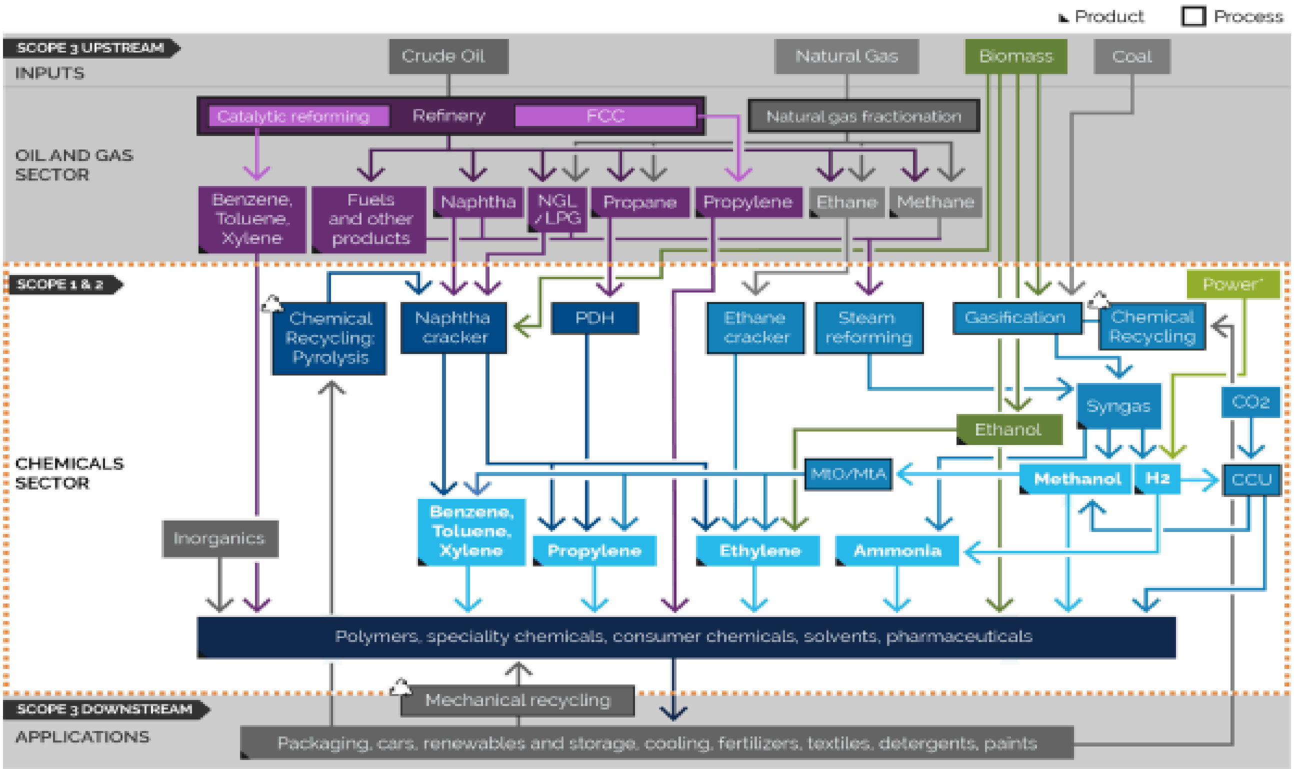
The SBTi has published guidance for companies with emissions from the forestry, land and agriculture (FLAG) sector (SBTi, 2022). This guidance requires companies without direct operations in the FLAG sector to set targets on FLAG related emissions in line with SBTi's FLAG Guidance if these emissions constitute 20% or more of total emissions across scopes 1, 2 and 3. Chemical companies that manufacture nitrogen fertilizers can have significant emissions of N_2O (in scope 3 category 11) due to the agricultural use of sold nitrogen fertilizers. As discussed in more detail below, this Chemicals Sector Guidance includes criteria for manufacturers of fertilizers on setting targets on scope 3 category 11 emissions of N_2O from the land sector. Companies with emissions of N_2O in scope 3 category 11 from the use of sold nitrogen fertilizers shall follow this guidance rather than the SBTi FLAG Guidance for setting targets on this source of emissions. Further, emissions of N_2O in scope 3 category 11 from the use of sold nitrogen fertilizers shall not count towards the calculation of the 20% applicability threshold for the SBTi FLAG Guidance. If companies have other FLAG related emissions these shall be considered towards the 20% applicability threshold. Also, companies shall follow the FLAG Guidance if they meet any other direct applicability criteria in the FLAG Guidance.

Exclusions from the Guidance: The scope of this guidance does not include:

1. The production of final products that may be manufactured using the chemicals listed above, such as plastic packaging, cosmetics, textiles, detergents, paints, or inks.
2. Mechanical recycling activities.
3. Production of biofuels.
4. Production of chemicals in refineries.

A visualization of the sectoral boundary is shown in Figure 1 below.

Figure 1. Chemicals sector boundary (SBTi, 2020)[2]



Notes: CCU = Carbon capture and utilization; FCC = Fluidized catalytic cracking; H_2 = Hydrogen; NGL = Natural gas liquids; LPG = Liquified Petroleum Gas; MtO = Methanol to olefins; MtA = Methanol to aromatics; PDH = Propane dehydrogenation. *Power denotes selected electricity use. Note discussion below on classification of chemical recycling.
Source: SBTi.

Where applicable, the criteria in this document supplement criteria outlined in the SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria.

Other users for which this guidance may be relevant

Companies that do not have operations within the sectoral boundary shall follow the criteria in the SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria[3], and may use elements of this guidance where specified in the document. For example, a company that purchases primary chemicals only may choose to adhere to the criteria for setting targets on primary chemical production emissions to set targets on the purchased chemicals in their scope 3 inventory, even if the company itself does not have operations within the chemicals sectoral boundary.

How to use this guidance

This guidance is a supplement to the SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria. Companies shall adhere to the criteria in the SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria, except where explicitly superseded in this guidance. Applicability of specific criteria in this guidance to products, product groups, or certain sources of emissions is specified in each criterion; therefore, not all criteria are applicable to all chemical companies.

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[2] This figure is not intended to visualize the boundary of SDA pathways defined below.
[3] The SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria contain the necessary guidance and criteria for companies to set net-zero and near-term targets.

Criteria are mandatory for all chemical companies fitting the applicability conditions specified in each criterion. Companies should carefully read the applicability statements in each criterion, as some criteria include options for companies to choose.

Key definitions and additional background information on the derivation of selected components of this guidance are provided in the Annexes:

- Annex 1 – Definitions.
- Annex 2 – Additional information on scope 3 accounting.
- Annex 3 – Background on emissions scenario selection for setting primary chemical SDA pathways.
- Annex 4 – Background on target-setting for N_2O from fertilizer use.
- Annex 5 – Background on target-setting metrics for nitric acid production.
- Annex 6 – Background on target-setting metrics for alternative feedstocks.

Companies should follow these steps when using this guidance:

1. Determine whether there are operations within your organizational boundary that are within the scope of the chemicals sector as defined above.
2. Determine which of the criteria in this document are not applicable or optional to your operations. The applicability of certain criteria depends on whether a company chooses to adhere to it. In these cases, a company may choose to set targets on the relevant emission sources using other methods, such as the SBTi Corporate Net-Zero Standard and/or Corporate Near-Term Criteria[4].
3. Follow all applicable criteria and their guidelines to set a target on the relevant operations or emissions when developing a company-wide target.
4. Set a target using the SBTi Corporate Net-Zero Standard and/or Corporate Near-Term Criteria on any remaining emissions necessary to meet the minimum cumulative target coverage requirements in the SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria (reiterated in this guidance).

The guidance development process

The SBTi developed this guidance with support from Guidehouse. The development of this guidance began prior to the adoption of the Standard Operating Procedures (SOP) for the Development of SBTi Standards. Despite beginning prior to the current SOP's adoption, the project has been developed following the principles of a transparent multi-stakeholder development process that is central to all SBTi's technical development. The project was partially funded via generous donations from the organizations noted in the acknowledgements section of this guidance. Funding does not confer any special status in drafting the content of this document.

[4] For example, a company that purchases ammonia may choose to adhere to the criterion for setting an emissions intensity target on scope 3 emissions from the production of purchased ammonia, or, they may choose to use other scope 3 target-setting methods from the SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria.

The project team was advised by an Expert Advisory Group (EAG) composed of 19 organizations from industry, civil society and academia to provide detailed input during the development of this guidance. EAG members were selected and invited to join the group based on their expertise, position within the sectoral value chain, and geographic location. Member organizations of the EAG are listed in the acknowledgements section of this guidance. The SBTi is grateful for the engagement and input from EAG members. The EAG's role was advisory, and decision on the content included within this document is exclusively within the remit of SBTi. Therefore, criteria and recommendations in this document do not represent the views of individual EAG members.

Introduction to the chemicals sector

The chemicals industry has one of the most complex and diverse value chains of all industrial sectors. Products from the chemicals sector are critical to nearly every aspect of modern life. These products vary from bulk industrial chemicals to highly specialized pharmaceuticals and laboratory reagents. The health care, agriculture, construction, packaging, manufacturing, and transport industries all rely heavily on chemical products. What's more, demand for chemicals is expected to continue to grow in the decades to come (IEA, 2023c).

Much of the chemicals value chain is based on the building blocks of carbon and hydrogen. Today, the sector relies heavily on direct fossil-based hydrocarbon feedstocks (e.g. coal, natural gas, natural gas liquids) or feedstocks that are products of crude oil refineries (e.g. naphtha) for the source of these building blocks. For this reason, the chemicals industry is the largest industrial consumer of energy in the world when both feedstocks and fuel consumption are considered (IEA, 2021b).

Value chain (scope 3) emissions of the chemicals industry are substantial. The fate of the carbon embedded in chemical products must be considered down the value chain, where GHG emissions can occur either during the use phase or at the end-of-life via incineration or decomposition. Additionally, N_2O emissions generated from N-fertilizer application in the field presents a particular challenge for companies producing such fertilizer products. The upstream emissions associated with the extraction and production of the fossil-based feedstocks and fuels, and their alternatives (including land-related and production emissions to obtain biomaterials, emissions from waste recycling processes, and to obtain CO_2 via Carbon Capture & Utilization processes), are just as critical.

In this guidance, the SBTi outlines criteria for chemical companies to set credible, ambitious, science-aligned climate targets. By following these criteria, chemical companies will demonstrate their commitment to the forward-thinking goal of achieving net-zero emissions by no later than 2050 on a 1.5°C-aligned trajectory by setting both ambitious near-term and long-term targets.

Rationale for development of the SBTi Chemicals Sector Guidance

The chemicals sector is responsible for the third highest emissions of GHGs in the global industrial sector, behind steel and cement production, contributing 1,330 megatons (Mt) of

CO_2 emissions in 2022 (IEA, 2023c). Emissions from any unabated combustion of hydrocarbons at the end of their life adds to these emissions.

Much of the chemicals value chain starts with the production of ammonia, methanol, ethylene, propylene, benzene, toluene and mixed xylenes (the latter five known as high value chemicals, or HVCs). These seven building blocks will be referred to as "primary chemicals" for the purposes of this guidance, consistent with the International Energy Agency's (IEA) modelling of individual chemicals (IEA, 2021b).

Primary chemical production accounted for approximately two-thirds of all direct (scope 1) CO_2 emissions from the industry in 2020 (IEA, 2021b):

- Production of primary chemicals involve energy-intensive processes, requiring large amounts of heat currently produced primarily through the combustion of fossil fuels.
- In addition to the emissions from the combustion of these fuels, process emissions are generated from carbon contained in the feedstock.

Emissions reduction options for primary chemical production are reliant on innovative technologies (IEA, 2023a). Therefore, the rate at which the sector can reduce its emissions from these chemicals in the short term may differ from the overall rate of decarbonization possible by the broader economy, as reflected by multiple pathways available in the literature [(IEA, 2021b), (Kremer, et. al 2022)]. For these reasons, dedicated pathways are justified to allow companies to set targets on emissions related to primary chemical production.

Further challenges exist in the impacts throughout the chemicals value chain. The chemicals value chain is not linear in nature, with many overlapping and intersecting material paths. Further, the downstream emissions impacts of many chemical products are difficult to accurately quantify, due to uncertainty in the circumstances of their use, as with emissions from the application of fertilizers, or due to a lack of data about the fate of chemical products at their end-of-life. Thus, in this guidance, the SBTi has included sector-specific target-setting pathways and informative guidance for several issues related to scope 3 emissions from the chemicals sector.

How has the chemicals value chain been disaggregated for target setting purposes?

Primary chemicals

The SBTi's Sectoral Decarbonization Approach (SDA) method is applicable to sectors that produce a relatively homogenous product, since the method relies on a single physical activity metric to establish a representative emissions intensity pathway for the sector (SBTi, 2015). Additionally, the SBTi relies on published emissions scenarios that include data at the sectoral level consistent with an overall carbon budget that aligns with a 1.5°C trajectory, which can be paired with projections of the relatively homogenous physical activity to establish new intensity-based SDA pathways. The chemicals sector as a whole is not a good candidate for a single SDA pathway, because the large number and variation in the products that are manufactured would make the establishment of a single intensity pathway for the sector impractical.

The SBTi instead has focused on the establishment of SDA pathways for each of the primary chemicals because each of these chemicals represents a homogenous product for which a physical intensity metric that is comparable across companies may be developed, and there are published 1.5°C-aligned integrated emission scenarios that include emissions and production levels until 2050 for each primary chemical.

Chemicals produced in refineries

A significant quantity of chemicals are currently produced within oil refineries as co-products to the primary fuel products from the refinery. Specifically, propylene is co-produced within fluid catalytic cracking (FCC) units, and benzene, toluene, and xylenes are outputs from catalytic reforming processes.

The SBTi is not including chemicals produced from refineries within the sectoral scope of this guidance. As co-products of refinery processes, allocating emissions from production of these chemicals between the oil and gas sector and the chemicals sector would be very difficult for the purposes of setting targets. Additionally, many emissions scenarios that include sectoral-level modelling, such as the International Energy Agency's (IEA's) NZE scenario do not consider emissions from chemicals produced within refineries as part of the chemicals sector (IEA, 2023d). Emissions associated with chemical production in refineries will be considered as part of the scoping for the SBTi oil and gas sector standard.

Hydrogen

Hydrogen plays a crucial role in the chemicals sector as a vital feedstock for ammonia and methanol production. However, its production is currently very emissions intensive, resulting in large quantities of CO_2 as a by-product from traditional hydrogen production routes. Hydrogen is also promising as a carbon-free source of energy that could directly replace fossil fuels in many applications, thus mitigating the CO_2 emissions at the point of combustion. The condition for achieving this environmental benefit in the energy sector hinges on producing hydrogen through zero or low-carbon methods. Many 1.5°C-aligned emissions scenarios include a rapid and substantial increase in the use of hydrogen in new markets, as a direct energy source or as part of products that bypass the need for fossil-based hydrocarbon feedstocks (e.g. synthetic methane).

It is therefore critical that the SBTi address the production of hydrogen in its methods. Current hydrogen demands are primarily for feedstocks to produce primary chemicals (ammonia and methanol), direct reduced iron (DRI) production, and crude oil refining (IEA, 2022)[5].

While smaller volumes are used in industries like electronics and glassmaking (IEA, 2022), nearly all current hydrogen demand stems from the above applications where it is typically

[5] See Figure 2.19 and Table 3.3 in the cited source.

produced onsite. Presently, hydrogen production is dominated by fossil fuel-based routes in which CO_2 is also generated, or as a by-product from fossil-based processes within refineries (IEA, 2022). However, technologies[6] to produce low-emission hydrogen exist, and transitioning to these technologies is one of the primary routes to achieving a net-zero trajectory for the chemicals sector while meeting existing hydrogen demand.

The SBTi addresses the emissions associated with current hydrogen production as follows:

- Hydrogen for ammonia and methanol are included within the boundary of the ammonia and methanol SDA pathways described in this guidance, with ammonia and methanol production as the activity metric used to determine emissions intensity.
- Hydrogen for DRI is included within the boundary of the existing iron and steel sector SDA pathway, with steel production as the activity metric used to determine emissions intensity.
- Hydrogen in refineries is considered within the boundary of the oil and gas sector.

The SDA pathways for ammonia, methanol, and iron and steel are based on the IEA's NZE scenario, which maps a transition from traditional to low-emission production methods to meet demand for these existing markets.

While negligible in the current hydrogen demand profile, new markets for hydrogen, primarily as a source of energy, are expected to increase in the coming decades (IEA, 2023c). The IEA's NZE scenario projects hydrogen and hydrogen-based fuels to contribute significantly to the transport and power sectors especially. This new demand for hydrogen will require an increase in the trade of merchant hydrogen. In the NZE scenario, hydrogen and hydrogen-based fuels are modelled as low-emissions fuels. Thus, new markets for hydrogen are met solely by low-emissions hydrogen in the model, as demonstrated by Figure 3.21 in the IEA's *Net Zero Roadmap: A Global Pathway to keep the 1.5°C Goal in Reach* (IEA, 2023c).

The SDA pathways described above provide a method for companies to set targets on emissions from the vast majority of existing hydrogen production using projections of demand for each product (e.g. ammonia, methanol, steel), while taking into account the transition of such production to low-emissions methods. Other existing markets within the chemicals sector and broader industry represent a very small portion of hydrogen production today and do not warrant separate individualized pathways[7]. However, as new markets emerge, it is crucial that merchant hydrogen producers within the chemicals sector adopt low-emission production methods from the outset so that the climate benefits of hydrogen and hydrogen-based fuels can truly be realized. Consequently, the SBTi has not developed a separate SDA pathway for hydrogen production beyond the existing markets of ammonia, methanol and iron and steel. Emissions from such production are subject to the SBTi's Corporate Net-Zero Standard and Corporate Near-Term Criteria.

[6] Low carbon emission technologies include hydrogen produced from electrolysis of water using renewable electricity and steam methane reforming from natural gas with CCUS.
[7] Not mentioned are existing SDA pathways for cement, and potential future pathways for other industrial sectors. Hydrogen production for use in other applications will be considered as part of the SDA pathway boundary for that sector.

Nitric acid

During the production of nitric acid, N_2O is formed and – when not abated – emitted. N_2O has a Global Warming Potential (GWP-100) of 265 (GHG Protocol, 2023), thus the relatively small quantities of N_2O still contribute significant CO_2e emissions[8]. N_2O emitted from nitric acid production can be abated to a large extent at very limited costs (NACAG, 2023). Criteria on target setting for nitric acid production are outlined in this guidance. The SBTi has established specific target-setting requirements on these emissions to:

- Ensure that companies who have not yet taken steps to abate a significant portion of their N_2O emissions from nitric acid production will be incentivized to do so, while simultaneously addressing other sources of emissions within their value chain(s); and
- Acknowledge that companies who have already abated this portion of their N_2O emissions from nitric acid production may consider remaining N_2O emissions from nitric acid production as part of their company-wide target(s) and will thus not be expected to address them separately.

Nitrogen fertilizers

In the 2020 Chemicals Scoping Paper (SBTi, 2020), and the 2023 Chemicals Sector Status Report (SBTi, 2023), the SBTi identified emissions of N_2O from fertilizers used in the land sector as a significant and impactful portion of the scope 3 inventories for chemical companies that manufacture nitrogen fertilizers. These use-phase emissions have been estimated at 50-80% of the total GHG emissions of the fertilizer value chain (Systemiq, 2022). This source of emissions also presents unique challenges in modelling and realizing emissions reductions. Emissions from fertilizer use are directly linked to food demand, given that synthetic nitrogen fertilizers play a crucial role in achieving high crop yields (IEA, 2021a). Further, while the SBTi has published guidance for the FLAG sector (SBTi, 2022), the FLAG Guidance is intended for companies with value chain activities that encompass broad land-related emissions (e.g. agriculture companies or companies purchasing crops or livestock products). This Chemicals Sector Guidance addresses the emissions of N_2O, that occur specifically in the land sector as relevant scope 3 emissions from the perspective of the companies that produce the fertilizers and fertilizer precursors. Companies shall set targets on emissions of N_2O in scope 3 category 11 from the use of sold nitrogen fertilizers using this guidance rather than the SBTi FLAG Guidance.

All other chemicals

The applicability of each criterion in this guidance is defined in the criterion itself, therefore, companies should carefully review this guidance to determine what is and is not applicable to their operations.

This guidance contains chemicals sector specific criteria for setting scope 1, 2 and/or 3 targets on emissions from certain production sources. Targets on emissions from chemicals

[8] An approximate estimate of emissions from for nitric acid production is at least 16 Mt CO_2eq / year (derived from data obtained from (Nieto, 2023) and (AmericanChemistryCouncil, 2022)) or >35 Mt CO_2eq / year (Joerss, 2023) for industrialized countries.

or processes other than those explicitly included in this guidance shall be set in accordance with the SBTi's Corporate Net-Zero Standard and Corporate Near-Term Criteria. The SBTi's evaluation of existing emissions scenarios did not result in the development of additional sector-specific target-setting methods beyond those included in this guidance. The SBTi reviewed the IEA's NZE scenario, which was used as the basis to develop the SDA pathways for primary chemicals described above. The NZE scenario reports emissions from non-primary chemicals as well; however, non-primary chemicals are not modelled using the same technology-rich integrated model that is used for primary chemicals (IEA, 2023b). Additionally, there is a vast diversity in how non-primary chemical products are produced, which introduces a risk in applying a single emissions pathway to these products. Therefore, the SBTi has chosen not to utilize this data to establish a sector-specific target-setting method for non-primary chemicals.

As part of the review and revision procedures for this guidance, the SBTi will consider whether additional methods would further the goals of the SBTi to reduce the climate impact of the chemicals sector on a 1.5°C-aligned trajectory.

CRITERIA

This section includes sector-specific requirements that are complimentary to the SBTi's Corporate Net-Zero Standard and Corporate Near-Term Criteria. The Corporate Net-Zero Standard and Corporate Near-Term Criteria shall be followed except for cases explicitly described in criteria in this guidance.

Target setting for primary chemicals

This section includes sector-specific criteria for chemical companies to set emissions reduction targets on certain emissions sources. The applicability of each requirement is defined in the criteria themselves.

Criteria CHEM-C1 through CHEM-C3 are applicable only if companies choose to utilize the respective SDA target-setting methods for ammonia, methanol and HVC related to each criterion. Companies choosing not to utilize these methods shall follow the target-setting requirements of the SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria.

SDA target setting for ammonia production

CRITERION CHEM-C1	AMMONIA PRODUCTION SDA METHOD
Applicability	Companies that: 1. Have ammonia production activities within their value chain which represent at least 5% of the sum of their total scope 1, 2 and 3 GHG emissions; and 2. Choose to use the ammonia production SDA method.
CHEM-C1 Criterion language	Companies that choose to utilize the ammonia production SDA method shall set a near-term target only, and may set an additional long-term target (as part of a net-zero target) on GHG emissions from ammonia production on the basis of tonnes (t) of CO_2e per t of ammonia produced using the SDA method pathway for ammonia production. Companies shall use the Chemicals Sector Target-Setting Tool as described in the guidelines to this criterion to establish the minimum level of ambition for their target(s).

CRITERION CHEM-C1	AMMONIA PRODUCTION SDA METHOD
CHEM-C1.1 **Baseline and target year data**	Companies shall determine the following for the purposes of setting a target using the ammonia production SDA: ● Emissions in their chosen baseline year from all processes that fall within the minimum target boundary as described in this criterion, regardless of whether these processes fall within the company's scope 1, 2 or 3 GHG inventory. ● Activity output (e.g. t of ammonia produced) in the chosen baseline year. ● The target year. ● Projected activity output in the chosen target year.
CHEM-C1.2 **Target boundary**	Companies shall include in their target boundary for both near-term and long-term targets, at a minimum, emissions from the production of hydrogen, the production of nitrogen, and the synthesis of ammonia from these two components. Companies shall include emissions from all sources within this boundary of the ammonia SDA pathway and include them within the SDA target, regardless of whether these emissions occur within scope 1, 2 or 3.
CHEM-C1.3 **Target boundary exclusions**	Companies shall not use the ammonia production SDA to set targets on emissions from production of ammonia that is produced for use as an energy carrier. Emissions from such production shall be covered using the SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria. Companies shall not include upstream emissions associated with feedstocks or fuels (e.g. CH_4 emissions from natural gas production and transport) within the SDA target boundary.
Reference to relevant resources	● The SBTi Corporate Net-Zero Standard. ● The SBTi Corporate Near-Term Criteria. ● The SBTi Chemicals Sector Target-Setting Tool.

Guidelines for criterion CHEM-C1

Ammonia production SDA target boundary

The minimum target boundary has been set to ensure consistency with the underlying emissions scenario upon which the ammonia production SDA pathway has been based and to ensure comparability of targets between companies.

Companies should use primary data when calculating emissions within the ammonia SDA boundary; however, secondary sources or average data may be used in the absence of primary data for calculating scope 3 emissions within the boundary[9].

The following processes are examples of sources within the boundary of the ammonia production SDA.

- Production of hydrogen used to produce ammonia. Example production types include, but are not limited to:
    - Steam methane reforming (SMR) of natural gas.
    - Electrified SMR of natural gas.
    - Oil partial oxidation.
    - Coal gasification.
    - Biomass gasification.
    - Methane pyrolysis.
    - Water electrolysis.
- Production of nitrogen used to produce ammonia (e.g. air separation).
- Production of ammonia (e.g. via the Haber Bosch process).

The following type of emissions related to ammonia production processes are within the boundary of the ammonia production SDA:

- CO_2 process emissions.
- CO_2 emissions from combustion to supply heat to the process, regardless of whether this heat is produced by the company itself or is imported.
- CO_2 emissions from the production of electricity used in the process, regardless of whether this electricity is produced by the company itself (scope 1) or is imported (scope 2).

In alignment with the IEA model on which this target-setting method is based, CO_2 generated during ammonia production that is then utilized to produce urea is not considered as a scope 1 emission. Nor are CO_2 emissions that are captured and sold as a product to other industries. Therefore, these emissions are not considered within the SDA target boundary. This is in line with the guidance in the section of this guidance "Accounting for Emissions from Carbon Capture and Utilization within a Company's Value Chain". Emissions of CO_2 from the use of urea-containing products (e.g. fertilizers) are considered within a company's scope 3 emissions inventory per the GHG Protocol.

Companies may include emissions within the SDA target boundary from additional related sources which are expected to be minor relative to total production emissions, such as emissions from fuel pre-heaters, supplemental heaters, etc., but these are not mandatory.

[9] Primary data is data from specific activities within a company's value chain (e.g. data provided by suppliers related to their specific activities). Secondary data is data that is not from specific activities within a company's value chain (e.g. industry averages, proxy data, etc.) (GHG Protocol, 2011).

Setting a target using the ammonia production SDA method

Companies shall use the SBTi's Chemicals Sector Target-Setting Tool to calculate targets using the ammonia production SDA method. Detailed instructions for using the Chemicals Sector Target-Setting Tool are provided within the tool. Companies shall calculate the required inputs to the tool using the following steps:

1. **Calculate base year emissions within the SDA target boundary:** Companies shall calculate the CO_2 emissions from each of the processes within the SDA boundary that fall within their value chain in their chosen base year and include these emissions within their ammonia production SDA target boundary, regardless of where they occur within the value chain. For example, a company operating only the Haber Bosch process that chooses to set a target using the ammonia production SDA must include the emissions from the production of the hydrogen and nitrogen they purchase. This measure is necessary to ensure alignment of targets with the underlying emissions scenario and to provide a level playing field between companies with operations covering the entire SDA boundary and companies that operate in only part of the process. An example is outlined in Table 1.

   Table 1. Emissions scope summary for a company operating Haber Bosch process only (thus purchasing hydrogen and nitrogen)

PROCESS	SCOPE AND CATEGORY	NOTES
Hydrogen production	Scope 3 category 1	Within ammonia production SDA boundary
Nitrogen production	Scope 3 category 1	Within ammonia production SDA boundary
Haber Bosch process	Scopes 1 and 2	Within ammonia production SDA boundary

   The Chemicals Sector Target-Setting Tool requires scope 1 and 2 emissions within the SDA target boundary in the base year to be reported separately. Companies shall follow the following guidelines when calculating and reporting scope 1 and 2 emissions:

   - Emissions from purchased electricity and heat shall be included within scope 2 and reported as scope 2 in the SDA Chemicals Sector Target-Setting Tool.
   - Emissions from self-generated electricity and heat shall be included within scope 1 and reported as scope 1 in the SDA Chemicals Sector Target-Setting Tool.

2. **Calculate base year production:** Companies shall calculate the total production of ammonia in their value chain in their chosen base year.

3. **Calculate target year production:** Companies shall project the production of ammonia in their chosen target year. This projection shall be based on the company's best estimates of future production. If a company concludes after its target has been set, but before the mandatory 5-year review that the projection is inaccurate, it shall revise its target using the updated projection estimate.

The company's minimum target emissions intensity for ammonia production will be calculated as an output from the chemicals sector target-setting tool.

SDA target setting for methanol production

CRITERION CHEM-C2	METHANOL PRODUCTION SDA METHOD
Applicability	Companies that: 1. Have methanol production activities within their value chain which represent at least 5% of the sum of their total scope 1, 2 and 3 GHG emissions; and 2. Choose to use the methanol production SDA method.
CHEM-C2 **Criterion language**	Companies that choose to utilize the methanol production SDA method shall set a near-term target only, and may set an additional long-term target (as part of a net-zero target) on GHG emissions from methanol production on the basis of tonnes (t) of CO_2e per t of methanol produced using the SDA method pathway for methanol production. Companies shall use the Chemicals Sector Target-Setting Tool as described in the guidelines to this criterion to establish the minimum level of ambition for their target(s).
CHEM-C2.1 **Baseline and target year data**	Companies shall determine the following for the purposes of setting a target using the methanol production SDA: ● Emissions in their chosen baseline year from all processes that fall within the minimum target boundary as described in this criterion, regardless of whether these processes fall within the company's scope 1, 2 or 3 GHG inventory. ● Activity output (e.g. t methanol produced) in the chosen baseline year. ● The target year. ● Projected activity output in the chosen target year.
CHEM-C2.2 **Target boundary**	Companies shall include in their target boundary for both near-term and long-term targets, at a minimum, emissions from the production of hydrogen and/or syngas, and the synthesis of methanol. If a supplemental source of CO_2 is used to synthesize methanol, companies shall include emissions associated with the production or capture of the CO_2. Companies shall calculate emissions from all sources within this boundary of the methanol SDA and include them within the SDA target, regardless of whether these emissions occur within scope 1, 2 or 3.

CRITERION CHEM-C2	METHANOL PRODUCTION SDA METHOD
CHEM-C2.3 Target boundary exclusions	Companies shall not use the methanol production SDA to set targets on emissions from production of methanol that is produced for direct energy supply purposes, for example as a fuel[10]. Emissions from such production shall be covered using the SBTi's cross-sectoral criteria in the SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria. Companies shall not include upstream emissions associated with feedstocks or fuels (e.g. CH_4 emissions from natural gas production and transport) within the SDA target boundary.
Reference to relevant resources	● The SBTi Corporate Net-Zero Standard. ● The SBTi Corporate Near-Term Criteria. ● The SBTi Chemicals Sector Target-Setting Tool.

Guidelines for Criterion CHEM-C2

Methanol production SDA target boundary

The minimum target boundary has been set to ensure consistency with the underlying emissions scenario upon which the methanol production SDA pathway has been based and to ensure comparability of targets between companies.

Companies should use primary data when calculating emissions within the methanol SDA boundary; however, secondary sources or average data may be used in the absence of primary data for calculating scope 3 emissions within the boundary.

The following processes are examples of sources within the boundary of the methanol production SDA.

- Production of hydrogen/syngas used to produce methanol. Example production types include, but are not limited to:
    1. Steam methane reforming (SMR) of natural gas.
    2. Oil partial oxidation.
    3. Coke oven gas (COG) reforming.
    4. Electrified SMR of natural gas.
    5. Gas heated reforming (GHR).
    6. Coal gasification.
    7. Biomass gasification.
    8. Water electrolysis (requires separate source of CO_2).
- Direct air capture of CO_2 to be used as feedstock.
- Methanol synthesis.

[10] Methanol converted to fuel additives, such as MTBE, does fall within the scope of this criterion, in line with the SBTi's understanding of IEA's modelling boundaries.

The following emissions sources related to methanol production processes are within the boundary of the methanol production SDA:

- CO_2 process emissions.
- CO_2 emissions from combustion to supply heat to the process, regardless of whether this heat is produced by the company itself or is imported.
- CO_2 emissions from the production of electricity used in the process, regardless of whether this electricity is produced by the company itself (scope 1) or is imported (scope 2).

Companies may include emissions within the SDA target boundary from additional related sources which are expected to be minor relative to total production emissions, such as emissions from fuel pre-heaters, supplemental heaters, etc., but these are not mandatory.

Setting a target using the methanol production SDA method

Companies shall use the SBTi's Chemicals Sector Target-Setting Tool to calculate targets using the methanol production SDA method. Detailed instructions are provided within the tool. Companies shall calculate the required inputs to the tool using the following steps:

1. **Calculate base year emissions within the SDA target boundary:** Companies shall calculate the CO_2 emissions from each of the processes within the SDA boundary that fall within their value chain in their chosen base year and include these emissions within their methanol production SDA target boundary, regardless of where they occur within the value chain. For example, a company operating only the hydrogen production process that chooses to set a target using the methanol production SDA must include the emissions from the production of the methanol produced from the hydrogen they sell. This measure is necessary to ensure alignment of targets with the underlying emissions scenario and to provide a level playing field between companies with operations covering the entire SDA boundary with companies that operate in only part of the process. An example is outlined in Table 2.

   Table 2. Emissions scope summary for company operating the hydrogen production process only

PROCESS	SCOPE AND CATEGORY	NOTES
Hydrogen production	Scope 1 and 2	Within methanol production SDA boundary
Methanol synthesis	Scope 3 category 10	Within methanol production SDA boundary

   The Chemicals Sector Target-Setting Tool requires scope 1 and 2 emissions within the SDA target boundary in the base year to be reported separately. Companies shall follow these guidelines when calculating and reporting scope 1 and 2 emissions:

- Emissions from purchased electricity and heat shall be included within scope 2 and reported as scope 2 in the Chemicals Sector Target-Setting Tool.
- Emissions from self-generated electricity and heat shall be included within scope 1 and reported as scope 1 in the Chemicals Sector Target-Setting Tool.

2. **Calculate base year production:** Companies shall calculate the total production of methanol in their value chain in their chosen base year.

3. **Calculate target year production:** Companies shall project production of methanol in their chosen target year. This projection shall be based on the company's best estimates of future production. If a company concludes after its target has been set, but before the mandatory 5-year review that the projection is inaccurate, it shall revise its target using the updated projection estimate.

SDA target setting for high value chemicals (HVCs) production

CRITERION CHEM-C3	HVC PRODUCTION SDA METHOD
Applicability	Companies that: 1. Have HVC production activities within their value chain which represent at least 5% of the sum of their total scope 1, 2 and 3 GHG emissions; and 2. Choose to use the HVC production SDA method.
CHEM-C3 Criterion language	Companies that choose to utilize the HVC production SDA method shall set a near-term target only, and may set an additional long-term target (as part of a net-zero target) on GHG emissions from HVC production on the basis of tonnes (t) of CO_2e per t of HVC produced using the SDA method pathway for HVC production. Companies shall use the Chemicals Sector Target-Setting Tool as described in the guidelines to this criterion to establish the minimum level of ambition for their target(s).
CHEM-C3.1 Baseline and target year data	Companies shall determine the following for the purposes of setting a target using the HVC production SDA: ● Emissions in their chosen baseline year from all processes that fall within the minimum target boundary as described in this criterion, regardless of whether these processes fall within the company's scope 1, 2 or 3 GHG inventory. ● Activity output (e.g. t HVC produced) in the chosen baseline year. ● The target year. ● Projected activity output in the chosen target year.

CRITERION CHEM-C3	HVC PRODUCTION SDA METHOD
CHEM-C3.2 Target boundary	Companies shall include in their target boundary for both near-term and long-term targets, at a minimum, emissions from the direct production of HVCs. Companies shall include emissions from all sources within this boundary of the HVC SDA pathway and include them within the SDA target, regardless of whether these emissions occur within scope 1, 2 or 3.
CHEM-C3.3 Target boundary exclusions	Companies shall not include upstream emissions associated with feedstocks or fuels (e.g. emissions from refining of crude oil into naphtha) within the SDA target boundary.
Reference to relevant resources	● The SBTi Corporate Net-Zero Standard. ● The SBTi Corporate Near-Term Criteria. ● The SBTi Chemicals Sector Target-Setting Tool.

<u>Guidelines for criterion CHEM-C3</u>

HVC production SDA target boundary

The HVC production SDA shall not be used to set targets on emissions from production of HVCs that occur within refineries. Emissions from such production shall be covered using other available target-setting methods. Companies that choose to use the HVC production SDA method shall include total production of all HVCs within their target boundary. This shall be done regardless of whether the individual chemicals are co-produced within the same processes or produced separately.

The minimum target boundary has been set to ensure consistency with the underlying emissions scenario upon which the HVC production SDA pathway has been based and to ensure comparability of targets between companies. In the case of HVCs produced via the methanol-to-olefins or methanol-to-aromatics production routes, only the final HVC production step is within the HVC production SDA boundary.

Companies should use primary data when calculating emissions within the HVC SDA boundary; however, secondary sources or average data may be used in the absence of primary data for calculating scope 3 emissions within the boundary.

The following processes are examples of sources within the boundary of the HVC production SDA:

- Steam cracking of naphtha (traditional and electric cracking).
- Steam cracking of ethane (traditional and electric cracking).
- Pyrolysis oil steam cracking (traditional and electric cracking).
- LPG steam cracking.
- Catalytic cracking of naphtha.
- Ethanol dehydration.

- Bioethanol dehydration.
- Propane dehydrogenation.
- Methanol-to-Olefins (MTO).
- Methanol-to-Aromatics (MTA).

The following emissions sources related to HVC production processes are within the boundary of the HVC production SDA:

- CO_2 process emissions.
- GHG emissions from combustion to supply heat to the process, regardless of whether this heat is produced by the company itself or is imported.
- CO_2 emissions from the production of electricity used in the process, regardless of whether this electricity is produced by the company itself or is imported.

Companies may include emissions within the SDA target boundary from additional related sources, such as emissions from fuel pre-heaters, supplemental heaters, etc., but these are not mandatory.

Some processes for producing HVCs, such as steam crackers, also produce co-products such as butadiene that are not considered HVCs for the purpose of this guidance. The boundary of the HVC production SDA includes all emissions from the HVC production process, even if that process produces non-HVC co-products. No emissions allocation shall be done between HVC products and co-products. When calculating the production of HVCs, only the volume of HVCs should be included.

Setting a target using the HVC production SDA method

Companies shall use the SBTi's Chemicals Sector Target-Setting Tool to calculate targets using the HVC production SDA method. Detailed instructions are provided within the tool. Companies shall calculate the required inputs to the tool using the following steps:

1. **Calculate base year emissions within the SDA target boundary:** Companies shall calculate the CO_2 emissions from each of the processes used to produce any HVCs within the SDA boundary that fall within their value chain in their chosen base year and include these emissions within their HVC production SDA target boundary, regardless of where they occur within the value chain. This measure is necessary to ensure alignment of targets with the underlying emissions scenario and to provide a level playing field between companies with operations covering the entire SDA boundary with companies that operate in only part of the process.

   The Chemicals Sector Target-Setting Tool requires scope 1 and 2 emissions within the SDA target boundary in the base year to be reported separately. Companies shall follow these guidelines when calculating and reporting scope 1 and 2 emissions:

   - Emissions from purchased electricity and heat shall be included within scope 2 and reported as scope 2 in the Chemicals Sector Target-Setting Tool.

- Emissions from self-generated electricity and heat shall be included within scope 1 and reported as scope 1 in the SDA Chemicals Sector Target-Setting Tool.

2. **Calculate base year production:** Companies shall calculate the total production of any HVCs in their value chain in their chosen base year. The production of individual HVCs shall be combined to determine a single value for total HVC production.

3. **Calculate target year production:** Companies shall calculate the projected production of any HVCs in their chosen target year. The production of individual HVCs shall be combined to determine a single value for total HVC production. This projection shall be based on the company's best estimates of future production. If a company concludes after its target has been set, but before the mandatory 5-year review that the projection is inaccurate, it shall revise its target using the updated projection estimate.

Scope 1 N_2O emissions target setting for nitric acid production

CRITERION CHEM-C4	SCOPE 1 N_2O EMISSIONS TARGET SETTING FOR NITRIC ACID PRODUCTION
Applicability	Companies that produce nitric acid within their operational boundary.
CHEM-C4 **Criterion language**	Chemical companies that have N_2O emissions from nitric acid production within their base year scope 1 emissions inventory shall set targets on these scope 1 N_2O emissions using the Chemicals Sector Target-Setting Tool as described in the guidelines to this criterion.
CHEM-C4.1 **Baseline and target year data**	Companies may choose a different base year from their other targets for the purpose of setting this target. Companies shall determine the following for the purpose of setting a target as described in this criterion: ● The total N_2O emissions and average N_2O emissions intensity in units of kg N_2O / t nitric acid across all their operations from the production of nitric acid in the base year. ● Estimated nitric acid production in the year 5 years from the chosen base year, if their base year emissions intensity is greater than 0.5 kg N_2O / t nitric acid.
CHEM-C4.2 **Target boundary**	Companies shall include all scope 1 emissions of N_2O from the production of nitric acid within the boundary of the target calculated using this criterion.
CHEM-C4.3 **Target boundary exclusions**	Companies shall not include scope 2 emissions associated with the production of nitric acid within the boundary of the target calculated using this criterion.

CRITERION CHEM-C4	SCOPE 1 N_2O EMISSIONS TARGET SETTING FOR NITRIC ACID PRODUCTION
Reference to relevant resources	• The SBTi Corporate Net-Zero Standard. • The SBTi Corporate Near-Term Criteria. • The SBTi Chemicals Sector Target-Setting Tool.

Guidelines for Criterion CHEM-C4

Setting a target on N_2O emissions from nitric acid production

Companies producing nitric acid shall calculate the average N_2O emissions intensity in units of kg N_2O / t of nitric acid, across all their operations in their base year. Using the following formula:

Average N_2O Emissions Intensity (kg N_2O / t Nitric Acid) = Company-wide N_2O emissions from Nitric Acid production (kg) / Company-wide Nitric Acid Production (t)

1. For companies producing nitric acid with an average annual emissions intensity **below 0.5 kg N_2O / t nitric acid** (see further background in Annex 5) in the base year, no specific target is required under this criterion.
2. Companies producing nitric acid with an average annual emissions intensity **at or above 0.5 kg N_2O / t nitric acid** in the base year shall set a target as follows:
    a. Estimate projected nitric acid production in a target year that is 5 years from the base year and calculate the estimated absolute N_2O emissions in this year based on an average emissions intensity of 0.5 kg N_2O / t nitric acid using the following formula:

    Absolute N_2O Emissions (kg N_2O) = 0.5 kg N_2O / t Nitric Acid x Projected Nitric Acid Production (t Nitric Acid)

    b. Calculate the absolute N_2O emissions in the target year based on a minimum ambition of 4.2% annual reduction that is consistent with a 1.5°C level of ambition for the same target year[11].
    c. If the absolute N_2O emissions in the target year calculated in steps 2.a are lower than the emissions calculated in step 2.b, the company shall set a target to reduce their average N_2O emissions intensity from nitric acid production to **0.5 kg N_2O / t nitric acid or less** within 5 years of their base year.
    d. If the absolute N_2O emissions in the target year calculated in steps 2.a are higher than the emissions calculated in step 2.b, no specific target is required under this criterion.

[11] The minimum ambition consistent with a 1.5°C goal may vary based on the chosen base year, and shall be calculated based on the SBTi's Criteria Assessment Indicators.

Sample calculations for a target on N_2O emissions from nitric acid production

Two example calculations have been provided below. These calculations will be performed by the Chemicals Target-Setting Tool but have been provided here for reference.

EXAMPLE 1. COMPANY A	
Base Year	2021
Target Year	2026
N_2O emissions from nitric acid production in base year	12,000 kg
Nitric acid production in base year	15,000 t
Emissions intensity in base year	0.8 kg N_2O / t nitric acid
Projected nitric acid production in target year	17,000 t

Calculated N_2O emissions in target year based on emissions intensity of 0.5 kg N_2O / t nitric acid (step 2.a above):

0.5 kg N_2O / tonne nitric acid x 17,000 t nitric acid = ***8,500 kg N_2O***

Calculated emissions reduction consistent with a 1.5°C level of ambition for a 2026 target year (step 2.b above):

*4.2% * (2026 – 2020) =* ***25.2% emissions reduction***

Calculated N_2O emissions in target year consistent with a 1.5°C level of ambition:

12,000 kg N_2O x (1 – 25.2%) = ***9,000 kg N_2O***

Since the projected emissions calculated under step 2.a are lower than those calculated under step 2.b, Company A must set a target to reduce their average N_2O emissions intensity from nitric acid production to **0.5 kg N_2O / t nitric acid or less** by 2026.

Sample language for Company A's target set using this criterion is as follows:

Company A will reduce the average scope 1 N_2O emissions intensity from its own nitric acid production to a value of 0.5 kg N_2O / t nitric acid or less by no later than 2026.

EXAMPLE 2: COMPANY B	
Base Year	2021
Target Year	2026

EXAMPLE 2: COMPANY B	
N_2O emissions from nitric acid production in base year	12,000 kg
Nitric acid production in base year	15,000 t
Emissions intensity in base year	0.8 kg N_2O / t nitric acid
Projected nitric acid production in target year	20,000 t

Calculated N_2O emissions in target year based on emissions intensity of 0.5 kg N_2O / t nitric acid (step 2.a above):

0.5 kg N_2O / tonne nitric acid x 20,000 t nitric acid = ***10,000 kg N_2O***

Calculated emissions reduction consistent with a 1.5°C level of ambition for a 2026 target year (step 2.b above):

*4.2% * (2026 – 2020) =* ***25.2% emissions reduction***

Calculated N_2O emissions in target year consistent with a 1.5°C level of ambition:

12,000 kg N_2O x (1 – 25.2%) = ***9,000 kg N_2O***

Since the projected emissions calculated under step 2.a are higher than those calculated under step 2.b, **no separate target on N_2O emissions from nitric acid production is required.**

Revision of targets once emissions intensity target is achieved

Once a company's average emissions intensity for N_2O emissions from nitric acid production has reached the target emissions intensity, a separate emissions intensity target on these emissions is no longer required. This may occur either before or at the target year. Once the target emissions intensity has been reached, companies shall revise their corporate targets to remove this specific N_2O emissions intensity target and shall ensure their remaining corporate target(s) are aligned with all applicable criteria.

Scope 1 and 2 target setting for non-primary chemicals and other emission sources

CRITERION CHEM-C5	SCOPE 1 AND 2 TARGET SETTING FOR OTHER EMISSIONS
Applicability	Chemical companies.

CRITERION CHEM-C5	SCOPE 1 AND 2 TARGET SETTING FOR OTHER EMISSIONS
CHEM-C5 Criterion language	Companies shall use the SBTi's Corporate Net-Zero Standard and SBTi Corporate Near-Teram Criteria to set near-term and/or net-zero targets on any remaining scope 1 and 2 emissions that are not covered by a chemicals sector-specific target. At least 95% of total scope 1 and 2 emissions shall be covered by a target.
CHEM-C5.1 Baseline and target year data	Companies shall determine the target coverage on their scope 1 and 2 emissions of their base year inventory to ensure that at least 95% of scope 1 and 2 emissions are covered by a target.
Reference to relevant resources	● The SBTi Corporate Net-Zero Standard. ● The SBTi Corporate Near-Term Criteria.

Guidelines for criterion CHEM-C5

Companies that choose to set one or more SDA targets on applicable emissions sources following criteria CHEM-C1 through CHEM-C3 shall calculate the percentage of their scope 1 and 2 inventory that these targets represent. Additional targets shall be set, as needed, using the SBTi's Corporate Net-Zero Standard to ensure that total scope 1 and 2 coverage is at least 95%. An example of target coverage is demonstrated in Table 3.

Table 3. Example of scope 1 and 2 emissions target coverage

EMISSIONS SOURCES	TOTAL BASE YEAR GHG EMISSIONS (MT CO_2e)	TARGET TYPE	% OF EMISSIONS COVERED BY TARGET
Methanol production	50	Methanol Production SDA	31.3%
Ethylene production	80	HVC Production SDA	50%
Other scope 1 and 2 emission sources	30	Scope 1+2 ACA	13.7 - 18.7%
		Total:	95 - 100%

Target setting for scope 3 emissions

Target scope 3 boundary requirements for the chemicals sector

Criterion CHEM-C6 is intended to discourage the possibility of "scope leakage", in which the production of primary chemicals may be outsourced from scope 1 into scope 3 category 1 emissions from purchased goods and services.

CRITERION CHEM-C6	SCOPE 3 CATEGORY 1 EMISSIONS FROM PURCHASED PRIMARY CHEMICALS
Applicability	Companies that directly purchase primary chemicals[12].
CHEM-C6 **Criterion language**	Chemical companies that directly purchase primary chemicals shall set a target on all scope 3 category 1 emissions from purchased primary chemicals using any applicable method in the SBTi's Corporate Net-Zero Standard. This criterion shall apply regardless of whether a company's scope 3 emissions contribute 40% or more towards their total scope 1, 2 and 3 inventory[13].
CHEM-C6.1 **Baseline and target year data**	Companies shall calculate the emissions in scope 3 category 1 from purchased primary chemicals in their base year.
CHEM-C6.2 **Target coverage**	Companies shall count emissions from scope 3 category 1 from purchased primary chemicals towards the minimum 67% and 90% scope 3 inventory coverage for near-term targets and long-term targets, respectively, required by the SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria.
Reference to relevant resources	• The SBTi Corporate Net-Zero Standard. • The SBTi Corporate Near-Term Criteria. • The SBTi Chemicals Sector Target-Setting Tool. • The GHG Protocol Standards.

[12] Directly purchasing primary chemicals means either purchasing a primary chemical directly from the producer, or purchasing primary chemicals from a third-party supplier.

[13] The SBTi requires companies to set scope 3 targets only if scope 3 emissions are 40% or more of total scope 1, 2 and 3 emissions. Setting a target on the emissions noted in this criterion is required regardless of whether this 40% threshold is met by a company.

CRITERION CHEM-C7	SCOPE 3 CATEGORY 11 EMISSIONS FROM UREA-BASED FERTILIZERS
Applicability	Companies that produce and sell urea that is used in N-fertilizers or produce and sell urea-based fertilizers.
CHEM-C7 **Criterion language**	Chemical companies that produce and sell urea that is used in N-fertilizers or produce and sell urea-based fertilizers shall set a target on all scope 3 category 11 CO_2 emissions from sold urea using any applicable method in the SBTi's Corporate Net-Zero Standard. This criterion shall apply regardless of whether a company's scope 3 emissions contribute 40% or more towards their total scope 1, 2 and 3 inventory[14]. These emissions shall count towards the minimum 67% and 90% scope 3 inventory coverage required by the SBTi Corporate Net-Zero Standard for near-and long-term targets, respectively.
CHEM-C7.1 **Baseline and target year data**	Companies shall calculate the CO_2 emissions in scope 3 category 11 from the use of sold urea or urea-based fertilizers in their base year.
CHEM-C7.2 **Target coverage**	Companies shall count CO_2 emissions from scope 3 category 11 from the use of urea-based fertilizers in their base year towards the minimum 67% and 90% scope 3 inventory coverage for near-and long-term targets, respectively, required by the SBTi Corporate Net-Zero Standard and Corporate Near-Term Criteria.
Reference to relevant resources	• The SBTi Corporate Net-Zero Standard. • The SBTi Corporate Near-Term Criteria. • The GHG Protocol Standards.

Nitrogen fertilizer use-phase N_2O emissions

CRITERION CHEM-C8	SCOPE 3 CATEGORY 11 NEAR-TERM TARGET SETTING FOR FERTILIZER USE PHASE N_2O EMISSIONS
Applicability	Companies that: 1. Have N_2O emissions from the use-phase of nitrogen fertilizers in their scope 3 category 11 inventory; and 2. Choose to use this criterion to set a near-term target on these emissions.

[14] The SBTi requires companies to set scope 3 targets only if scope 3 emissions are 40% or more of total scope 1, 2 and 3 emissions. Setting a target on the emissions noted in this criterion is required regardless of whether this 40% threshold is met by a company.

CRITERION CHEM-C8	SCOPE 3 CATEGORY 11 NEAR-TERM TARGET SETTING FOR FERTILIZER USE PHASE N_2O EMISSIONS
CHEM-C8 **Criterion language**	Companies shall set near-term targets on N_2O emissions from the use of sold nitrogen fertilizers in scope 3 category 11 using the following level of ambition: ● For base years after or equal to 2020, the minimum value for absolute contraction target = 2.6% x (Target year - 2020). ● For base years between 2015 and 2019 (inclusive), the minimum value for absolute contraction target = 2.6% x (Target year - Base year). Targets set using this criterion are considered to align with a 1.5°C level of ambition; however, the SBTi does not currently classify scope 3 targets based on temperature alignment.
CHEM-C8.1 **Baseline and target year data**	Companies shall calculate emissions of N_2O in scope 3 category 11 associated with the use of sold synthetic nitrogen fertilizers in their base year. Companies should use a quantification methodology based on the Intergovernmental Panel on Climate Change (IPCC) Tier 2 or Tier 3 approach to calculate base year and annual emissions. A Tier 1 approach may also be used in the absence of more detailed data (IPCC, 2006).
Reference to relevant resources	● The SBTi Corporate Net-Zero Standard. ● The SBTi Corporate Near-Term Criteria. ● The SBTi Chemicals Sector Target-Setting Tool. ● The GHG Protocol Standards.

Guidelines for Criteria CHEM-C8

Criterion CHEM-C8 presents an absolute reduction scope 3 target-setting method that is available for companies to use in setting targets on scope 3 category 11 emissions of N_2O from the use of sold synthetic nitrogen fertilizers that can be considered aligned with the chemical sector's 1.5°C-aligned transition pathway to a net-zero state. Companies may choose instead to set targets on these emissions using other available scope 3 target-setting methods, such as engagement targets or emissions intensity targets, in line with the SBTi Corporate Net-Zero Standard and SBTi Corporate Near-Term Criteria.

Applicable products

This criterion applies to companies that produce any synthetic fertilizer that supplies nitrogen, and thus contributes to N_2O emissions upon application in the use phase. Examples of these products include, but are not limited to:

- Ammonia (sold for use as a fertilizer).

- Ammonium nitrate.
- Ammonium phosphate.
- Ammonium sulfate.
- Calcium ammonium nitrate.
- Nitrogen potassium.
- Nitrogen phosphorus potassium.
- Nitrogen phosphorus.
- Urea.

Estimating N_2O emissions in scope 3 category 11

This criterion only applies to the N_2O emissions resulting from the use phase of synthetic fertilizers on land. These emissions fall under the GHG Protocol's scope 3 category 11: use of sold products (GHG Protocol, 2011). Targets set using this criterion would count towards the 67% minimum near-term target coverage of scope 3 emissions required by the SBTi Corporate Net-Zero Standard.

The metric for this criterion is absolute N_2O emissions from fertilizer use. In order to accurately estimate base year emissions and emissions reductions, the use-phase N_2O emissions should be calculated using a methodology based on the IPCC Tier system to calculate N_2O emissions from managed soils (IPCC, 2006):

- A Tier 1 approach provides a generic methodology that is solely based on the volume of fertilizers sold regardless of location. It therefore is widely applicable but low in level of detail. The only reduction measure that can be accounted for via this approach is a reduction in volume of sold fertilizer.
- A Tier 2 approach is location-specific and allows for a disaggregation of the emission factor used in combination with the amount of synthetic fertilizer sold so that various emission reduction measures undertaken by fertilizer companies can be accounted for when calculating emission reductions, as well as other factors influencing the quantity of N_2O emissions. These other factors should include at least climate type, crop type, soil type and fertilizer type used.

A methodology based on the IPCC's Tier 3 approach may also be used. This method provides the most detail as it involves the integration of dynamic models and/or on-site experimental measurements.

Setting a target using this criterion

Chemical companies that choose to set a scope 3 category 11 N_2O target in adherence with this criterion shall do so using the following steps:

1. Calculate base year scope 3 N_2O emissions in category 11 from all synthetic N-fertilizer products.
2. Establish the target year. The target year shall be the same target year used to set targets on other emissions sources, excluding targets set on scope 1 N_2O emissions from nitric acid production as described in Criteria CHEM-C4.

3. Calculate the required reduction in scope 3 category 11 N_2O emissions based on a minimum level of ambition aligned with a 26% reduction between 2020 and 2030 in N_2O emissions per year using the below formulas.

   For base years after or equal to 2020:
   Minimum value for absolute reduction in N_2O emissions = 2.6% x (Target year - 2020)

   For base years before 2020:
   Minimum value for absolute reduction in N_2O emissions = 2.6% x (Target year – Base year)

Companies may not set a target that has already been achieved as of the company's most recent annual GHG inventory.

Sample language for a target set using this criterion is as follows:

Company A will reduce emissions of N_2O from the use of sold synthetic nitrogen fertilizers in scope 3 category 11 18% by 2027 from a base year of 2022.

CRITERION CHEM-C9	SCOPE 3 CATEGORY 11 LONG-TERM TARGET SETTING FOR FERTILIZER USE PHASE N_2O EMISSIONS
Applicability	Companies that: 1. Have N_2O emissions from the use-phase of nitrogen fertilizers in their scope 3 category 11 inventory; and 2. Choose to use this criterion to set a net-zero target on these emissions.
CHEM-C9 **Criterion language**	Companies shall set a long-term target on N_2O emissions from the use of sold nitrogen fertilizers in scope 3 category 11 using the SBTi's FLAG Agriculture pathway in the SBTi Corporate Net-Zero Tool. Companies do not need to follow the FLAG Guidance in full.
CHEM-C9.1 **Baseline and target year data**	Companies shall calculate emissions of N_2O in scope 3 category 11 associated with the use of sold synthetic nitrogen fertilizers. Companies should use a quantification methodology based on the IPCC Tier 2 or Tier 3 approach to calculate base year and annual emissions. A Tier 1 approach may also be used in the absence of more detailed data (IPCC, 2006).
Reference to relevant resources	• The SBTi Corporate Net-Zero Standard. • The SBTi Corporate Near-Term Criteria. • The SBTi Chemicals Sector Target-Setting Tool. • The GHG Protocol Standards.

Guidelines for criterion CHEM-C9

Chemical companies may set a net-zero target covering absolute N_2O emissions from synthetic fertilizer use in scope 3 category 11 that aligns with the minimum ambition level of a 72% reduction in absolute emissions from the base year by no later than 2050. This level of ambition is aligned with the SBTi's FLAG Guidance; however, companies do not need to follow the FLAG Guidance for setting targets on N_2O emissions from the use-phase of nitrogen fertilizers. Annex 2 of this document provides additional background on the status of development of specific target-setting methods for N_2O emissions from synthetic N-fertilizer use.

Other scope 3 emissions sources

CRITERION CHEM-C10	SCOPE 3 TARGET SETTING FOR OTHER EMISSIONS
Applicability	Chemical companies.
CHEM-C10 **Criterion Language**	Companies shall use the SBTi's Corporate Net-Zero Standard and SBTi Corporate Near-Term Criteria to set near-term and/or net-zero targets on any remaining scope 3 emissions that are not covered by a chemicals sector-specific target.
CHEM-C10.1 **Baseline and target year data**	Companies shall determine the target coverage on their scope 3 emissions of their base year inventory to ensure that at least 67% of scope 3 emissions are covered by a near-term target and 90% of scope 3 emissions are covered by a net-zero target (if applicable).
Reference to relevant resources	• The SBTi Corporate Net-Zero Standard. • The SBTi Corporate Near-Term Criteria.

Guidelines for criterion CHEM-C10

Companies that set a scope 3 target following criteria in this guidance shall calculate the percentage of their inventory that these targets represent. Additional targets shall be set, as needed, using the SBTi's Corporate Net-Zero Standard and Corporate Near-Term Criteria to ensure that total scope 3 coverage is at least 67% for near-term targets and 90% for long-term targets.

Additional target-setting requirements

Alternative feedstock targets

CRITERION CHEM-C11	NEAR-TERM ALTERNATIVE FEEDSTOCK TARGETS
Applicability	Companies that purchase and use carbon-containing materials as feedstocks for the manufacture of products to which the guidance is applicable.
CHEM-C11 Criterion language	Companies shall set a near-term alternative feedstock target based on feedstock purchased for use within their operational boundary, expressed in percentage by weight (wt. %) carbon content. The near-term target shall be calculated using the Chemicals Sector Target-Setting Tool as described in the guidelines to this criterion.
CHEM-C11.1 Baseline and target year data	Companies shall calculate the share, as a wt. %, of fossil and alternative feedstocks from all sources within the boundary of this target in their chosen base year. This share shall be calculated based on the total carbon utilized as feedstock in the company's operational boundary. Companies shall provide in their target submission a description for their strategy to achieve the target percentage of alternative feedstock and shall substantiate any target value below the recommended value.
CHEM-C11.2 Target boundary	Companies shall set a target on the total company-wide share of alternative carbon-based feedstocks they utilize to make products.
CHEM-C11.3 Target boundary exclusions	Companies may exclude the feedstocks used for production of ammonia for other purposes than conversion to urea from the scope of this target[15].
Reference to relevant resources	• The SBTi Corporate Net-Zero Standard. • The SBTi Corporate Near-Term Criteria.

CRITERION CHEM-C12	LONG-TERM ALTERNATIVE FEEDSTOCK TARGETS
Applicability	Companies that: 1. Purchase and use carbon-containing materials as feedstocks for manufacture of products to which the guidance is applicable, and 2. Choose to set a net-zero target.

[15] The reason for this option to exclude ammonia is that there are low-emissions routes for ammonia production that do not involve any carbon feedstock, such as electrolysis using renewable electricity, also known as green ammonia. Companies pursuing green ammonia technologies will not be required, under this criterion, to also set a target on increasing the share of alternative feedstocks used in non-electrolysis based production routes.

CRITERION CHEM-C12	LONG-TERM ALTERNATIVE FEEDSTOCK TARGETS
CHEM-C12 **Criterion Language**	Companies shall set a long-term alternative feedstock target based on feedstock purchased for use within their operational boundary, expressed in percentage by weight (wt. %) carbon content. The long-term target shall be calculated using the chemicals sector target-setting tool as described in the guidelines to this criterion with a target year no later than 2050. If a company sets a long-term alternative feedstock target, it shall also set a near-term alternative feedstock target using the requirements in CHEM-C11.
CHEM-C12.1 **Baseline and target year data**	Companies shall calculate the share, as a wt. %, of fossil and alternative feedstocks from all sources within the boundary of this target in their chosen base year. This share shall be calculated based on the total carbon utilized as feedstock in the company's operational boundary. Companies shall provide in their target submission a description for their strategy to achieve the target percentage of alternative feedstock and shall substantiate any target value below the recommended value.
CHEM-C12.2 **Target boundary**	Companies shall set a target on the total company-wide share of alternative carbon-based feedstocks they utilize to make products.
CHEM-C12.3 **Target boundary exclusions**	Companies may exclude the feedstocks used for production of ammonia for other purposes than conversion to urea from the scope of this target.
Reference to relevant resources	● The SBTi Corporate Net-Zero Standard. ● The SBTi Chemicals Sector Target Setting Tool.

Guidelines for criteria CHEM-C11 and CHEM-C12

The alternative feedstock targets shall accompany, not replace, emissions reductions targets. This target is not intended to be specifically aligned with emission reduction goals, but this non-emission metric lays a foundation for a feedstock transition through a minimum requirement (by setting a floor), and a recommended requirement to recognize forward-looking strategies. Alternative feedstock targets shall be set on a company-wide basis and do not count towards the minimum target coverage for scopes 1, 2 or 3.

Applicable products produced from alternative feedstocks

These criteria apply to the production of chemicals that originate from feedstocks containing carbon molecules. Examples of these include, but are not limited to:

- Methanol.

- HVCs.
- Intermediate chemicals (e.g. polyethylene, styrene, propylene oxide).
- Specialty chemicals and pharmaceuticals.
- Ammonia (when based on SMR).
- Urea.

The percentage of alternative feedstock shall be calculated based on the share of alternative-based carbon content, by weight of carbon. As the metric is based on carbon content (C-content), this share does not include hydrogen produced via the electrolysis of water. For the production of hydrogen used in ammonia, methanol or urea, the share of alternative feedstock shall be calculated based on the mass of carbon in the alternative sources of hydrocarbons (e.g. biomethane) within the total mass of carbon of all hydrocarbons used.

Definition of alternative feedstock

The types of alternative feedstocks that apply towards the target are the following:

- Bio-based (e.g. bio-oils, bioethanol, dry biomass, wet biomass).
- Feedstocks from chemical recycling (e.g. pyrolysis oil).
- CO_2 from Carbon Capture and Utilization (CCU) sources (point-source captured CO_2), regardless of whether the CO_2 has a fossil or a bio-origin, provided the CO_2 originates from a process that is itself producing a separate product or supplying energy (e.g. captured CO_2 from a boiler or electricity production plant, or CO_2 from a cement plant)[16].
- Direct air capture (DAC) CO_2.

Companies should use primary data when calculating share of feedstocks within the target boundary; however, secondary sources or average data may be used in the absence of primary data.

These criteria do not apply to feedstocks that do not contain carbon, such as hydrogen, nitrogen, and others. Re-use or recovery (for example solvent recovery[17]) does not qualify as (alternative) feedstock as, while the pursued extension of the useful life is to be encouraged, this does not lead to the production of new chemical products – existing products are just used longer. Mechanical recycling does not qualify as alternative feedstock as this is primarily executed outside the boundary of the chemical sector[18].

[16] This implies that cases such as ammonia produced from fossil feedstocks delivering the CO_2 and ammonia for conversion to urea within the same plant, do not qualify as “alternative feedstock”. Similarly, CO_2 that is produced explicitly for use as a feedstock, and not captured as emissions, is not considered an alternative feedstock source.
[17] For example, purifying solvents by distilling them periodically to remove heavy impurities that would build up over time.
[18] Furthermore, mechanical recycling options are available for only some chemical products (such as plastics).

Setting an alternative feedstock target

Chemical companies should set an alternative feedstock target through the following steps:

1. Calculate the total mass and percentage, by weight, of fossil-based carbon and alternative-based carbon in feedstocks used in production within their operational boundary in their chosen base year, expressed as wt. % C. This may require a conversion from mass of feedstock to the equivalent mass of C. An example of this calculation for ethane feedstock is provided below.

   Mass C-content Feedstock (Mt C) = Mass Ethane Feedstock (Mt C_2H_6) x (24 g/mol C)/ (30.1 g/mol C_2H_6)

   The wt % of alternative feedstock shall be calculated as follows:

   Wt. % Alternative Feedstock = (Sum of Mass of C-content of All Alternative Feedstocks (Mt)) / (Sum of Mass of C-content of All Alternative Feedstocks (Mt) + Sum of Mass of C-content of All Fossil-based feedstocks (Mt))

2. Establish the target year for the near-term and/or long-term target. The long-term target, if chosen, shall be achieved by no later than 2050.
3. Calculate the minimum target percentage of alternative feedstock, in wt. % carbon, in the target year(s) using the SBTi Chemicals Sector Target-Setting Tool. The target shall be set at or above the minimum value for the chosen target year. Companies are recommended to set a target at least at the level of the recommended value in the tool and may set a target up to 100% of alternative feedstock.
4. The target will be set based on the following considerations:
   a. If the company's percentage of alternative feedstock in the base year is lower than the minimum percentage required in the chosen target year, the minimum target percentage shall be the minimum value of the alternative feedstock range in the target year in the tool.
   b. If the company's percentage of alternative feedstock in the base year is higher than the minimum percentage required in the chosen target year, the company shall, at a minimum, establish a maintenance target to maintain their base year share of alternative feedstock. Companies are recommended to set a target to increase their share of alternative feedstocks in the target year.
   c. Companies may count alternative feedstocks that are partially used as fuel in their processes due to the inherent process dynamics of the chemical process towards the alternative feedstock target[19].

Sample language for a target set using this criterion is as follows:

[19] For example, when using naphtha as feedstock in steam crackers, part of the feedstock is typically collected as process gases and used as fuel to provide heat for the process. A company can thus choose to consider all naphtha input to the cracker as feedstock under this criterion.

Company A will increase its share of purchased feedstocks that are composed of alternative non-fossil sources from 10% by weight of carbon to 23% by weight of carbon by 2030 from a base year of 2022.

ANNEX 1 – DEFINITIONS

Alternative feedstock – Carbon-based feedstocks to chemical processes that are of the following origin:

- Bio-based (e.g. bio-oils, bioethanol, dry biomass, wet biomass).
- Feedstocks from chemical recycling (e.g. pyrolysis oil).
- CO_2 from Carbon Capture and Utilization (CCU) sources (point-source captured CO_2), regardless of whether the CO_2 has a fossil or a bio-origin, provided the CO_2 originates from a process that is itself producing a product or supplying energy (e.g. captured CO_2 from a boiler or electricity production plant, or CO_2 from a cement plant)[20].
- Direct air capture (DAC) CO_2.

Ammonia as an energy carrier – Ammonia that is produced for the purpose of being used as a low-emissions fuel, fuel additive, or for energy storage as a hydrogen carrier. For example, ammonia used as maritime fuel or as a long-distance energy carrier for hydrogen.

Carbon dioxide capture and utilization / Carbon capture and utilization / Carbon capture and use (CCU) – A process in which CO_2 is captured and then used to produce a new product. CCU is sometimes referred to as carbon dioxide capture and use[21]. CCU differs from carbon dioxide capture and storage (CCS) in that CCU does not aim nor result in permanent geological storage of carbon dioxide. Instead, CCU aims to convert the captured CO_2 into more valuable substances or products, where CO_2 could be sequestered short-term (such as in fuels) or long-term (for example in building materials).

Consumer chemicals – Chemicals for use in personal care and household purposes such as cleaning products, cosmetics and hygiene products[22].

Direct air capture (DAC) – Chemical process by which CO_2 is captured directly from the ambient air, with or without subsequent storage.

Global warming potential 100 (GWP-100) – A factor describing the radiative forcing impact (degree of harm to the atmosphere) of one unit of a given GHG relative to one unit of CO_2. The GWP values in this guidance are on a 100-year time horizon basis[23].

High value chemicals (HVCs) – The following chemicals are considered HVCs for the purpose of this guidance: ethylene and propylene (together classified as olefins), benzene, toluene, and mixed xylenes (together classified as aromatics).

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[20] This implies that cases such as ammonia produced from fossil feedstocks delivering the CO_2 and ammonia for conversion to urea within the same plant, do not qualify as “alternative feedstock”.
[21] Definition adapted from IPCC, Annex I: Glossary. *In Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change* (2018).
[22] Definitions adapted from CDP’s Activity Classification System (CDP-ACS).
[23] Definition from the GHG Protocol (GHG Protocol, 2004).

Intermediate chemicals – Chemicals that typically utilize primary and other base chemicals as inputs and are often used as inputs to additional products or are sold directly to consumers. Intermediate chemicals include propylene oxide, polymers, styrene, acetone and formaldehyde.

Low-emission hydrogen – Hydrogen produced through water electrolysis with electricity generated from a low-emissions source such as renewables or nuclear, or biomass or from fossil fuels equipped with CCUS technology. Production from fossil fuels with CCUS is included only if upstream emissions are sufficiently low, if capture, at high rates, is applied to all CO_2 streams associated with the production route, and if all CO_2 is permanently stored to prevent its release to the atmosphere[24].

Merchant hydrogen – Hydrogen produced by one company to sell to others[25].

Methanol as an energy carrier – Methanol that is produced for the purpose of being used as a fuel or – as methanol – as fuel additive. Methanol converted to fuel additives, such as MTBE, is not considered an energy carrier in this definition.

Other base chemicals – Base chemicals not included in the definition of primary chemicals, such as acids, bases, alkalis, and industrial gases.

Pharmaceuticals – Operations involved in the discovery, development, and manufacture of drugs and medications.

Primary chemicals – Ammonia, methanol, ethylene, propylene, benzene, toluene, or mixed xylenes (the latter five chemicals collectively known as HVCs).

Process emissions – Emissions of GHGs that originate from the raw materials used to produce chemicals, rather than from the combustion of fuels to produce energy. Process emissions often occur as a byproduct to an industrial process, for example when there is an excess of carbon in the raw materials as compared to the final product, in which case the excess carbon can be emitted as CO_2. Examples of process emissions are CO_2 emissions from steam methane reforming of natural gas to produce hydrogen, or N_2O emissions from nitric acid production.

Specialty chemicals – Chemicals for bespoke purposes not included in other categories, such as chemical used to produce additives, adhesives, solvents, catalysts, dyes, flavourings, ink, lubricants, paints and advanced materials[26].

[24] Definitions from IEA (IEA, 2023c).
[25] Definition adapted from IEA (IEA, 2021b).
[26] Definitions adapted from CDP's Activity Classification System (CDP-ACS).

ANNEX 2 – ADDITIONAL INFORMATION ON SCOPE 3 ACCOUNTING

In this annex we provide information on several key scope 3 accounting issues relevant to the chemicals sector. This information is not intended to replace the GHG Protocol as the standard companies shall use to develop their corporate GHG emission inventories; rather, this is intended to supplement the GHG Protocol by providing chemicals-sector specific guidance on relevant topics.

Accounting for downstream use-phase and end-of-life emissions from products (scope 3 categories 11 and 12)

Accurately tracking scope 3 emissions downstream of a company's operational boundary poses a challenge. Yet, it's essential to meticulously consider the function and ultimate fate of all products, including intermediate ones, generated by chemical companies when estimating downstream emissions impacts.

Chemical products find application in diverse sectors such as foods, pharmaceuticals, hygiene products, plastics and various consumer goods. Emissions occurring during the use phase or at the end-of-life of these products can often be estimated using available guidance. For instance, there are calculation methods specifically designed to estimate emissions from products landfilled at the end of their life, with a focus on consumer items typically used and discarded by end-users. However, estimating downstream emissions for products like pharmaceuticals, food additives and personal hygiene items can be more intricate due to the varied ways they are consumed or disposed of.

Pharmaceuticals and food additives may be either discarded or consumed, potentially entering wastewater systems and contributing to greenhouse gas emissions during treatment processes or being released into the environment. Personal hygiene products are also likely to end up in wastewater systems after use.

To develop a comprehensive scope 3 inventory, chemical companies should make a concerted effort to estimate downstream emissions, including those associated with consumable products. A key recommendation is the detailed mapping of the downstream value chain to ensure accurate estimates. Collaborative initiatives with other companies or experts can further enhance research and data availability, fostering methodological consistency across the sector.

This concerted effort to estimate downstream emissions is relevant for hydrocarbons, but also for N_2O from fertilizer from the field emissions (scope 3 category 11). For this sector and category, developing better methodologies to quantify emissions and emission reductions would help fertilizer companies to quantify improvements.

Accounting for emissions in scope 3 categories 10, 11 and 12

Many chemical companies produce and sell intermediate products that may be further processed into hundreds of additional products. In certain cases, the company selling the intermediate product may not reasonably know all the downstream processing steps, or the exact end use for their intermediate product; therefore, accurately estimating the full downstream GHG profile for their products can be difficult.

As described above, the SBTi expects companies to account for all scope 3 categories including downstream emissions from intermediate products and services, where relevant. The use of primary data is preferred, but secondary data is also acceptable when calculating scope 3 emissions[27]. In the instance that a company faces barriers to calculating emissions from one category of scope 3, the company should demonstrate its best efforts to calculate these emissions, and this shall not preclude them from providing reasonable estimates of emissions in other categories.

For example, if a company faces barriers to calculating emissions from the processing of sold intermediate products (scope 3 category 10) because the uncertainty in potential processing steps is too large, they may be potentially able to justifiably exclude these emissions from their inventory as outlined in the GHG Protocol (GHG Protocol, 2011). However, the company should demonstrate its best efforts to calculate these emissions, and this shall not preclude them from providing an estimate of emissions in other categories (e.g. emissions at end-of-life in scope 3 category 12).

Using the mass balance approach in GHG accounting

New materials from circular, bio-based, and CCU-based origin are expected to increase within the chemicals value chain as alternatives to fossil feedstocks and fuels. The life cycle GHG impacts of these different materials can vary widely, but in many cases the feedstocks or materials produced from these alternatives are chemically indistinguishable from one another. Additionally, different materials can often be integrated into existing production equipment as “drop-in” alternatives. To accurately estimate the GHG emissions impacts associated with these materials, companies must have a way to accurately estimate the proportion of alternative materials in the products they purchase, the products they manufacture, and the products they sell.

The mass balance approach is a chain of custody tracking method by which the attributes of an alternative feedstock can be applied to the resulting products, while ensuring that outputs are balanced with inputs on a mass or energy balance basis[28]. This allocation of attributes is then available to subsequent customers to understand the material origin of the products they purchase, and any subsequent products they produce and sell from these materials. Without such an attribution method, the only way companies could determine the content of

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[27] Primary data comes from specific activities within a company’s own value chain. Secondary data is not specific to a company’s value chain, for example industry or geographic averages.
[28] Conceptually, the mass balance approach intends to connect the allocation of material attributes in outputs to the materials used as inputs. Mass balance mechanisms may utilize characteristics other than only mass to accurately balance inputs and outputs, such as energy content or carbon. This is because alternative materials may be utilized differently within chemical processes, resulting in different transformation efficiencies.

alternative materials in their products would be through certain analytic testing techniques, or through a complete physical and process segregation of these materials, which is impractical and an inefficient use of existing infrastructure.

While the mass balance approach allows for companies to distinguish between materials that are integrated within products, it does not *inherently* assign environmental benefits or burdens to those materials. Companies should utilize best accounting practices when accounting for the value chain emissions associated with alternative materials, such as bio-based and CCU-based materials. Any attributes that include certified characteristics, such as a cradle-to-gate carbon footprint for the material, must be substantiated if used in the GHG inventory calculation.

The GHG Protocol recognizes the utility of using mass balances in collecting data for GHG emissions calculations (GHG Protocol, 2013), but it does not specifically address approaches for allocating material attributes using the mass balance method. The SBTi recognizes that the mass balance approach can be a practical method for differentiating the origin of materials in products, and thus estimating the GHG impacts of those materials. It can also serve to incentivize traceability and accuracy of impacts and reduction claims associated with alternative materials. Until the SBTi or the GHG Protocol publishes additional guidance on the mass balance approach, companies may utilize the mass balance approach in calculating GHG emissions for use in setting and achieving science-based targets, if they adhere to the following guidance. Companies shall:

- Utilize a mechanism, such as a third-party certification, to substantiate the environmental attributes (e.g. percent by weight of bio-based carbon) of the purchased or sold material in the company's value chain.
- Provide justification of the mechanism used and a description of the chain of custody documentation and the allocation methods used in the mechanism.
- Demonstrate how the attributes of the materials have been utilized in GHG emissions inventory calculations (e.g. using differentiated emission factors for each material)
- Follow all applicable GHG accounting requirements for scopes 1, 2 and 3 from the SBTi and GHG Protocol as appropriate for the materials (e.g. accounting for full upstream impacts of bio-based materials, including land sector emissions).

Companies may not, at this time, use credits or certificates that have been generated using the mass balance approach and traded on a marketplace/exchange, or transferred from a different company or product value chain. Companies may only utilize the mass balance approach for attribute allocation on materials produced and sold within the direct value chain of the product[29].

Companies shall adhere to any future guidance or criteria produced by the SBTi or GHG Protocol related to the use of mass balance allocation approaches.

[29] The SBTi recognizes that some available mass balance certification mechanisms allow for the transfer of credits between companies. Use of attributes that have been traded or transferred in this way cannot currently be used to calculate emissions for the purposes of setting or meeting a target with the SBTi. This is subject to change based on updated guidance from the SBTi or GHG Protocol.

Accounting for emissions from bio-based materials within a company's value chain

Feedstocks and fuels derived from biological carbon offer promising alternatives to fossil-based materials. These bio-based materials and biofuels can originate from crops cultivated for this specific purpose or from agricultural and other residual wastes of organic materials. Bio-based materials present potential climate benefits compared to their fossil counterparts because their carbon content originates from the atmosphere. Consequently, the eventual release of CO_2 during a product's use phase or at end-of-life through incineration or decomposition does not lead to a net addition of CO_2 to the atmosphere.

However, the overall impact of these materials throughout their life cycle can be substantial. This impact encompasses environmental burdens and GHG emissions from land use change, land management, and additional non-biogenic emissions generated during the processing of biomass into usable products. Emissions of other GHGs such as CH_4 from the combustion or decomposition of bio-based products must also be accounted for within GHG inventories. Therefore, conducting a robust accounting of life cycle emissions associated with biogenic materials is crucial.

Chemical companies incorporating bio-based products into their value chain should adhere to the current guidance from the GHG Protocol regarding the accounting of GHG emissions in scopes 1, 2 and 3 related to these materials. This guidance necessitates a comprehensive assessment of GHG emissions linked to purchased bio-based materials across all scopes, encompassing both net biogenic emissions and non-biogenic emissions. Specifically, companies must factor in emissions from the land sector attributable to the biogenic material they are acquiring. This includes, but is not limited to, emissions resulting from land use change and net biogenic CO_2 emissions from land management.

Accounting for emissions from carbon capture and utilization within a company's value chain

Carbon capture, utilization and storage (CCUS) refers to the process of removing CO_2 from an industrial emissions point source or directly from the atmosphere and then using it in other processes (e.g. integrated into a product or fuel) or sequestering it in permanent storage (e.g. geologic reservoirs).

However, corporate-level accounting for emissions related to Carbon Capture and Utilization (CCU), where CO_2 is utilized as a carbon source for products, lacks detailed guidance. For example, the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard does not provide specific guidance for the accounting of emissions associated with CCU-based products, as of the publication of this guidance.

To provide clarity, this section offers guidance based on GHG Protocol accounting principles. The GHG Protocol dictates that emissions from sold products should be accounted for in the reporting company's scope 3 inventory. The same principle applies when CO_2, captured and sold as a product, is utilized downstream in the value chain. The captured CO_2 would not be included in the original emitting company's scope 1 emissions as it has not been emitted within the company's operational boundary. However, the downstream scope 3 impacts of the sold CO_2 would need to be included in scope 3 category 11 by the company that sells it. This shift from scope 1 to scope 3 aligns with the GHG Protocol Scope 3 Accounting and Reporting Standard. The emissions associated with the capture of the CO_2 (e.g. from the energy consumed in the capture process) remain part of the capturing companies' scope 1 emissions, while they are accounted for in scope 3 category 1 for the company using the CO_2.

A practical representation of this method is urea-based fertilizer production, in which CO_2 is captured (typically during ammonia production) and utilized subsequently to produce urea but is eventually emitted in the fertilizer's use-phase.

Figure 2 and Table 4 below illustrate a simplified example on how companies would account for fossil-based CCU related emissions. This example, adjusted from the Global CO_2 Initiative, represents hypothetical emissions associated with the production of 1 t of methanol (Michailos, et al., 2018). Company A captures 1.45 t of CO_2 from the emissions from their steam cracker and sells the CO_2 as a product to Company B. Company A's scope 2 emissions associated with the energy used to capture the CO_2 itself are 0.05 t of CO_2, and 0.22 t of CO_2 are not captured and are therefore emitted directly from Company A's process. Company B utilizes the CO_2 from Company A to manufacture methanol and emits 0.08 t of CO_2 within their scope 1 (from process emissions, not emissions from incineration of other fuels*)*. The sold methanol is burned as a fuel downstream the value chain outside the companies' boundaries. Thus, the CO_2 from the fuel combustion is accounted within scope 3 category 11 (emissions from the use of sold products) for both Company A and Company B.

Figure 2. Sample of carbon flow for CCU-based applications

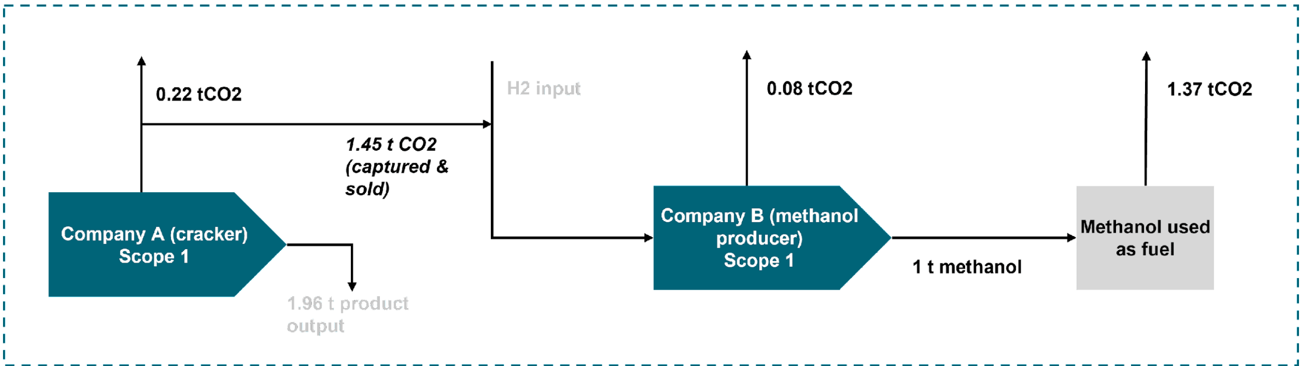

Table 4. Sample of GHG inventory calculations for CCU-based applications

COMPANY	SCOPE 1 & 2 EMISSIONS	SCOPE 3 EMISSIONS		
		CATEGORY 1 - EMISSIONS FROM PURCHASED PRODUCTS	*CATEGORY 10 – PROCESSING OF SOLD PRODUCTS*	*CATEGORY 11 - EMISSIONS FROM SOLD PRODUCTS*
Company A	0.27 t*	--**	0.08 t	1.37 t
Company B	0.08 t	0.05 t**	--	1.37 t

* Includes 0.05 t of scope 2 emissions associated with the carbon capture process.
** Company A and B should also account for any scope 3 category 1 emissions associated with other purchased products; however these emissions are outside the scope of this example.

Captured CO_2 that is integrated into products may also be emitted at the end-of-life of the product, rather than during the use phase. In this case, a similar method as above would apply, with the captured CO_2 instead being accounted for within scope 3 category 12 (emissions from the end-of-life of sold products) for both the emitting and the utilizing companies. Existing requirements and guidance on scope 3 emissions accounting should be used when estimating these emissions.

This guidance on accounting for value chain emissions associated with CCU-based products should be combined with guidance on accounting for bio-based materials if the initial captured CO_2 is of biogenic origin. Requirements from the GHG Protocol on how to account for emissions of biogenic carbon should take precedence, while the scope classification of captured and sold biogenic CO_2 in the value chain should align with this guidance.

Accounting for emissions from recycling processes within a company's value chain

Increasing the circularity of the chemicals value chain holds the potential for environmental benefits. However, accounting for emissions related to recycling processes poses challenges for companies purchasing recycled materials, those producing recyclable products, and those involved in both. Two ways in which recycling can offer emissions advantages include:

- The difference in emissions between extracting and processing virgin material versus preparing recycled material for reuse; and
- A reduction in emissions that would otherwise have occurred if the waste had been sent to a landfill or other waste treatment method (GHG Protocol, 2013).

Accounting methodologies for allocating emissions from recycling processes propose system cuts that allocate the emissions burden appropriately, since recycling extends the usefulness of the material from a linear life cycle to a circular one. This ensures that companies purchasing recycled content and producing recyclable materials do not double-count the emissions associated with multiple use cycles of their products. However, some methodologies may not balance the benefits from recycling between the recycling companies and the companies whose products are recycled, and not all companies are incentivized to pursue circularity based solely on the reduction in scope 3 emissions compared to a linear lifecycle model.

For instance, the recycled content accounting method recommended by the GHG Protocol (GHG Protocol, 2013) allocates emissions from recycling processes to scope 3 category 1 of the company purchasing the recycled material. The company would not account for any emissions in scope 3 category 5 or category 12 from their own products that are recycled. A benefit in overall scope 3 emissions for this company could be seen as compared to a linear fossil alternative if:

- Emissions from the recycling process are lower than the upstream (category 1) emissions associated with the linear alternative; and/or
- There are emissions from the end-of-life processes for non-recycled products, and the company can accurately estimate these emissions; and/or
- The company can accurately estimate the quantity of their products that are recycled at the end-of-life, and thus assume no end-of-life emissions to these products.

In practice, emissions benefits from increased circularity can be difficult to quantify. Companies may be limited by data availability in accurately estimating the end-of-life fate of their own products, especially if they are producing primary or intermediate products that are eventually sold and disposed of across different global regions. Additionally, emissions from end-of-life processes for non-recycled wastes may carry low or no emissions burden, making the alternative circular route less advantageous. For example, in the World Business Council for Sustainable Development (WBCSD) Guidance for Accounting & Reporting Corporate GHG Emissions in the Chemical Sector Value Chain, guidance is given that no emissions should be attributed to products at the end-of-life when a product is landfilled, if the product is known not to degrade within 100 years (WBCSD, 2013). Thus, durable plastic products that are landfilled would be attributed no end-of-life emissions. Further, the GHG Protocol Standards state that companies should not account for emissions from the incineration of wastes for energy recovery (waste-to-energy) in their scope 3 category 5 or category 12 inventory; rather, these emissions are allocated to the users of the energy produced. These challenges contributed to the rationale for requiring companies to set an alternative feedstock target (Criteria CHEM-C11 and C12).

Additional collaboration between interested stakeholders to further develop accounting methodologies that fairly and accurately quantify emissions from recycling of products derived from chemicals may provide an opportunity to further incentivize a move toward a circular chemical value chain.

To fully account for and maximize the positive impacts of recycling, companies should:

- Fully account for emissions from the recycling processes for products in their value chain, without double-counting.
- Source recycled materials that are produced with minimal direct GHG emissions, preferably using renewable electricity as the primary energy source.

- Fully and accurately account for upstream emissions associated with virgin alternatives to recycled materials, to ensure the benefits of circular alternatives are properly captured.
- Increase visibility into the end-of-life fate of products sold for more accurate accounting of end-of-life emissions.
- Collaborate with downstream customers, communities, and governments to increase recycling collection rates and material handling efficiency.
- Maximize the recyclability of the products being sold to boost the likelihood of diversion from waste streams and successful recycling.

ANNEX 3 – BACKGROUND ON EMISSIONS SCENARIO SELECTION FOR SETTING PRIMARY CHEMICAL SDA PATHWAYS

The SBTi has developed 1.5°C-aligned emissions intensity convergence pathways for ammonia, methanol and HVCs, which together constitute approximately 70% of direct emissions from the chemicals sector. Emissions scenarios that are granular at the chemical product level were needed to establish the chemical-specific emissions intensity convergence pathways. Specifically, projections of emissions, electricity consumption, and product demand to 2050 that are consistent with a 1.5°C emissions budget were needed for each chemical group. The SBTi researched many scenarios that include data for the chemicals sector as a part of the larger model framework or as the primary sectoral focus of the model, to assess the availability and suitability of the data for developing pathways.

Based on this research, the SBTi chose to use data from the IEA's Net Zero by 2050 (NZE) report (IEA, 2021b) and other related publications to develop the chemical-specific pathways. This IEA model was chosen for the following primary reasons:

- The IEA's NZE is a scenario produced by the IEA's Global Energy and Climate model, which includes detailed "technology-rich" modelling for primary chemicals, which includes both emissions, electricity consumption, and demand projections to 2050.
- The IEA has published the data from the 2021 version of the NZE scenario in various topic-specific reports, such as the *Global Hydrogen Review*, which provide transparency into the underlying model results.
- The IEA's NZE scenario has been used as the basis for sector-specific emissions intensity convergence pathways in existing SBTi sectoral guidance, including guidance for the cement and iron and steel sectors. This ensures consistency in the modelling approach across sectoral resources.
- The SBTi has established CO_2 emissions budgets to 2050 at the sectoral level, which were published in the paper *Pathways to Net-Zero: SBTi Technical Summary* (SBTi, 2021). These budgets were developed based on the 2021 IEA NZE Report, therefore using this model for chemical-specific emissions intensity pathways ensures consistency with the upper bound of the sectoral CO_2 budget.
- The SBTi has included the IEA NZE as part of the envelope of scenarios that have been used to develop our cross-sector emissions reduction pathway.
- The IEA is an internationally recognized research organization with a high level of credibility within the chemicals sector and broader climate community.

Detailed descriptions of the derivation of the data used for each chemical is included within the Chemicals Sector Target-Setting tool. The tool may be reviewed and revised by the SBTi in the future to reflect new data; therefore, companies should ensure they are using the most up-to-date version of the tool when calculating their targets.

ANNEX 4 – BACKGROUND ON TARGET SETTING FOR N_2O EMISSIONS FROM FERTILIZER USE

The SBTi, with input from members of the project's EAG, explored source-specific emissions scenarios to develop a science-based trajectory that could be used by fertilizer manufacturers to set 1.5°C-aligned emissions reduction targets on emissions of N_2O in the use-phase (scope 3 category 11).

The SBTi used the following qualitative criteria to guide assessment of pathways for this emissions source[30]:

- Provide a realistic representation of the potential reduction in emissions until 2050 resulting from different measures that fertilizer companies can take.
- Be compliant with a scenario that limits global warming to a maximum of 1.5 °C.
- Be based on recent and credible scientific research.
- Provide transparent underlying data and calculations.

Many emissions scenarios for the land sector model N_2O emissions from fertilizer use, such as those summarized by Roe et al. (Roe, et al., 2019); however, these models typically lack the resolution on mitigation options for individual emission source types necessary to be used to establish a pathway on N_2O emissions from fertilizer use only. For this reason, the land sector-wide scenarios reviewed were determined to not meet the SBTi's criteria for ambition when considering N_2O emissions alone. The SBTi also reviewed other emissions scenarios that specifically examine the emissions mitigation potential for fertilizer N_2O emissions from the field, instead of broader land-sector studies. However, none of these individually completely met all our criteria for use as a pathway in setting science-based targets.

Given the lack of a specific emissions scenario on which to model near-term and net-zero targets for N_2O emissions from fertilizer use in scope 3, the SBTi utilized the average projected reductions from three studies which focused in the most detail on the key levers to reduce N_2O emissions from fertilizers from the field (Gao & Serrenho, 2023), Systemiq (Systemiq, 2022), and McKinsey & Co (McKinsey & Co, 2020). The key mitigation levers relevant for N_2O considered in these studies include minimizing the demand and use of N-fertilizers while maintaining crop production sufficient to meet global food demand, and thus ensuring food security. Maximizing the nitrogen use efficiency (NUE) of N-fertilizers[31] is a key strategy to achieve optimized fertilizer application while maintaining adequate and equitable food supply. Increasing NUE can be achieved by:

- Applying the "4R" N management principle (i.e. applying right N source at the right rate, time and place); and

[30] These criteria were established for the specific purpose of evaluating scenarios dealing with emissions of N_2O from fertilizer use in the field. They are not representative of the evaluation of scenarios for other SBTi work, for which more general principles are currently in development.
[31] Nitrogen use efficiency is the fraction of N input that is harvested as product in the crop.

- Use of Enhanced Efficiency Fertilizers (EEFs).

The use of nitrification inhibitors (NIs) is another lever to mitigate N_2O emissions from the field. NIs are chemicals that prevent bacteria from performing the nitrification and denitrification reactions that generate N_2O.

The three studies that primarily informed the N_2O pathway each include consideration in their model that meeting future food demand is a necessity that cannot be compromised by reductions in N_2O emissions from N-fertilizers. Gao & Serrenho (2023) rely on projected crop demand and N-fertilizer demand from the Food and Agriculture Organization of the United Nations (FAO) against which their mitigation levers are measured. McKinsey & Co rely on mitigation scenarios from the IPCC's 2018 report, *Global Warming of 1.5°C* which considers trade-offs and synergies with the sustainable development goals (SDGs).

Gao & Serrenho (Gao & Serrenho, 2023) separately modelled 2020-2030, while we derived the annual emission reduction from the other two models based on their 2020-2050 modelling. The average N_2O emission reduction from this combination over the period of 2020-2030 is 26%, equivalent to an annual reduction of 2.6% per year.

Because these three studies that were deemed most suitable for use in constructing a pathway examine only a single source of emissions within the broader land sector, it is difficult to definitively conclude their alignment with the 1.5°C level of ambition that the SBTi has recognized for the land sector (SBTi, 2022). The McKinsey study claims alignment with the upper end of required reductions and is higher than the interquartile range for emissions reductions from agriculture in the low-overshoot scenarios from the Integrated Assessment Modelling (IAM) Consortium that underpins IPCC's 2018 report Global Warming of 1.5°C (IPCC, 2018). For this reason, the SBTi considers the McKinsey pathway and other, more ambitious pathways, to be consistent with a 1.5°C level of ambition. However, the SBTi currently does not assign a temperature classification to scope 3 targets.

At present, only a near-term source-specific trajectory has been defined due to uncertainties surrounding long-term projections until 2050, and a lack of literature focusing specifically on N_2O emissions from the use of fertilizers. Establishing a near-term (2020-2030) pathway will facilitate fertilizer companies to set immediate near-term targets on N_2O emissions on their scope 3 category 11 inventory. Companies wishing to set a net-zero target that includes N_2O emissions from fertilizers in the land sector in scope 3 may utilize the sectoral pathway in the SBTi's FLAG Guidance to set a target covering only these emissions. This pathway requires a minimum emissions reduction of 72% from the base year, with a target year no later than 2050.

The SBTi recognizes the importance of establishing a specific long-term pathway for setting targets on N_2O emissions from the use of fertilizers in the field. Additional research on mitigation measures for these emissions in the context of equitable food demand scenarios would provide further insight into source-specific climate-aligned pathways. Additionally, improving the availability of primary data from farming practices up the value chain could provide fertilizer manufacturers more visibility and influence on how their products are being used. This could increase the uptake of optimized fertilizer application methods in all regions and thus reduce the N_2O emissions associated with the use of fertilizers and improve quantification of these reductions. In future work, the SBTi may revisit this target-setting method as part of the review and revision process for this guidance to incorporate additional future research.

ANNEX 5 – BACKGROUND ON TARGET-SETTING METRICS FOR NITRIC ACID PRODUCTION

The SBTi has established the target emissions intensity metric of 0.5 kg N_2O / t Nitric Acid based on an assumed unabated emissions intensity of 9.0 kg N_2O / t Nitric Acid [(NACAG, 2023), (Joerss, 2023), (WRI, 2015)] and an assumed annual average abatement percentage of around 95% from the use of tail-gas abatement technologies [(NACAG, 2023), (IPCC, 2007)].

The SBTi has chosen to set a requirement to reach this threshold value rather than to derive an SDA because this ensures that companies who have not taken abatement measures yet will be incentivized to do so, without creating an obligation for companies who have already implemented abatement measures to invest in deeper abatement, while still ensuring that these emissions are covered by a companies' overall emission reduction target.

ANNEX 6 – BACKGROUND ON TARGET-SETTING METRICS FOR ALTERNATIVE FEEDSTOCKS

Scenarios and roadmaps for the chemicals sector's transition towards net-zero consistently include a reduction in reliance on virgin fossil feedstocks, and an increase in the usage of alternative feedstocks. Different literature sources provide different projections for the future feedstock mix as well as the dominance of the various alternative feedstocks (bio-based, recycling and CCU), as is illustrated in table 4.3 of (Kloo, 2023).

To determine the increase in share of alternative feedstocks for this target, the SBTi used the scenarios described in the reports *Planet-compatible pathways for transitioning the chemical industry* (Mang, et al. 2023), and *Planet Positive Chemicals: Pathways for the chemical industry to enable a sustainable global economy* (Kremer, et al. 2022).

These Systemiq studies present planet-compatible pathways toward 2050 employing demand-side and supply-side interventions. These Systemiq pathways were chosen due to the detailed modelling of feedstock types, scope 3 emissions, and availability of data between 2020 and 2050.

The low- and high-circularity demand scenarios (LC and HC), and the most economic (ME) and no fossil new build after 2030 (NFAX) supply scenarios were jointly analyzed to model the rate of increase in alternative feedstock consumption by the chemical sector from 2020 to 2050.

Ultimately, the SBTi has decided to use the LC demand scenario as the basis for the minimum target thresholds because it relies to a lesser extent on mechanical recycling and would thus be more robust in case projected mechanical recycling rates would not materialize[32]. The values for the alternative feedstock target thresholds in each year have been determined based on the following 5 step approach. Further details of each step are provided below. Unless otherwise noted, the scenarios analyzed are the LC-ME and LC-NFAX scenarios.

STEP 1: Determine overall use of different feedstocks for production of the chemicals included in the scenarios for each year.

STEP 2: Determine a representative end-of-life emission factor in 2050 based on the modelled end-of-life fates for each hydrocarbon chemical (e.g. incineration with and without CCS, recycling, landfilling, etc.).

STEP 3: Determine the end-of-life emissions in 2050 for all the produced hydrocarbon chemicals (including urea) in each scenario.

STEP 4: Determine the ratio between the LC-ME and the LC-NFAX scenarios that balances the amount of feedstock C of atmospheric origin in 2050 with remaining emissions from step

[32] As a comparison exercise, a combination of the HC-ME and HC-NFAX scenarios was also analyzed, which resulted in comparable values to the LC scenarios for the alternative feedstock target in 2030, 2040 and 2050.

3. This results in shares of alternative feedstocks for the modelled chemicals that are between the modelled shares from the LC-ME and LC-NFAX scenarios.

STEP 5: Add 8% to the obtained alternative feedstock numbers to reflect the additional potential of direct bio-based routes that are not included in the modelled feedstocks in the Systemiq scenarios, and current use of bio-based feedstocks.

A detailed explanation of the method used to determine the alternative feedstock threshold values using these steps is provided below.

STEP 1: The yearly overall use of the various types of feedstocks was determined from:

1. Feedstock use (in Mt feedstock) to produce ethylene, propylene, butadiene, benzene, toluene, xylene, methanol, and urea was taken from Systemiq's global dashboard file[33]:
    - HVCs produced in refineries are not accounted for in the feedstock share. As IEA projects for their NZE scenario that by 2050 around 32% of total fuels will be alternative fuels (based on energy content, rather than C-content) (IEA, 2023d), chemicals originating from refineries were not deemed to present a major deviation for the downstream chemical companies purchasing HVCs for the minimum target. Thus, production of primary chemicals in Systemiq's modelling using the following refinery processes is excluded:
        - Gasoline catalytic reformer.
        - LPG catalytic reformer.
        - Off-gas catalytic reformer[34].
    - Production of "Ammonium Nitrate" and production of "Ammonia (excl. Derivatives)" are excluded; production of ammonia for the conversion to urea (including its subsequent conversion to urea) are included.

2. The feedstock consumption in Mt feedstock from #1 was converted to feedstock consumption in Mt-C by multiplying #1 with the carbon content for each feedstock, which was taken from the global dashboard file as well. The value for naphtha was used as an estimate for pyrolysis oil - rather than the 0 in the dashboard file.

3. Total feedstock use was determined for each of following feedstock categories:
    - Virgin fossil feedstock.
    - Bio-based feedstock.
    - Direct Air Capture CO_2 (considered part of CCU-based feedstock).
    - Point Source CO_2 (considered part of CCU-based feedstock).
        - The SBTi's definition of alternative feedstock excludes traditionally produced urea[35] from the CCU feedstock category. Therefore, to consider point source CO_2 used to produce urea:

[33] The Global Dashboard file is provided as part of the supplementary modeling documentation data for the Systemiq study. It is available at https://github.com/systemiqofficial/Pathways-Chemical-Industry.
[34] This also means the impact of a shift from production of High Value Chemicals in refineries to the chemical sector has not been explored.
[35] Traditionally produced urea involves the production of ammonia from fossil-based sources, in which the ammonia and the CO_2 from this ammonia production is captured explicitly to be used as feedstocks to produce urea.

        - CO_2 from fossil and municipal solid waste (MSW)[36] feedstocks to produce urea doesn't qualify as CCU and thus doesn't contribute to the alternative feedstock target.
        - CO_2 from bio-based feedstocks to produce urea doesn't qualify as CCU but does qualify as bio-based and thus counts towards the alternative feedstock target.
        - Double counting of CO_2 from fossil- or bio-based feedstocks is corrected.
        - Remaining CO_2 feedstock to produce urea is all assumed to originate from another point source (e.g. the cement sector) and thus counts towards the alternative feedstock target as CCU-based feedstock (but doesn't qualify as CO_2 of atmospheric origin – see below).
    - For Point Source CO_2 for methanol:
        - CO_2 feedstock is all assumed to originate from another point source and thus contributes to the alternative feedstock target as CCU-based feedstock (but doesn't qualify as CO_2 of atmospheric origin – see below).
- Chemical Recycling[37]:
    - Includes MSW refuse derived fuel (RDF) and pyrolysis oil.
    - Deviating from Systemiq's approach, the potential for depolymerization and dissolution-recycling (from the demand model supplemental data file, "Recycling LC" worksheets for each chemical) was added to the chemical recycling potential[38] to reflect that this option is available for more producers. The impact of this addition was minor.
- Mechanical recycling was not included as feedstock as this doesn't provide a feedstock for the additional production of modelled chemicals (HVCs / methanol) and is not taken into consideration in the derivation of the alternative feedstock target.
- Methanol is used as one of the feedstocks to produce HVCs in Systemiq's modelling. However, this methanol-as-feedstock is excluded when determining the share of alternative feedstock in Systemiq's model outcomes, because the share of alternative feedstock has already been included in the feedstocks to produce this methanol. Towards later years, the feedstocks going into methanol production seem too high to meet the methanol demand, while the amount of feedstocks is too low for the propylene demand and especially for the xylene demand. We believe a relevant share of the methanol is used for the production of mainly xylene in these years[39].

[36] MSW feedstocks do qualify as chemical recycling. Note the origin of the MSW (bio-based or fossil) would only have been relevant for 2050, in which no MSW feedstock is used to produce urea in any of the assessed 4 scenarios.
[37] The SBTi perceived the values for use of pyrolysis oil and municipal solid waste RDF (chemical recycling) to be relatively low in relation to the amount of waste available for pyrolysis and gasification indicated by Systemiq.
[38] Assuming a carbon-efficiency of 100% for simplicity.
[39] While this is not shown in the numbers for feedstock use for propylene and xylene we used, we are relatively confident about this assumption as we can approximately replicate the Mt Carbon feedstock from figure 2 in (Meng, Wagner, Kremer, & Kanazawa, 2023).

STEP 2: The end-of-life emission factor (t CO_2 / t C) was determined for 2050 for each of the hydrocarbon chemicals considered by Systemiq (ethylene, propylene, butadiene, benzene, xylene, toluene and methanol) as follows:

1. Determining the total amount of each of these chemicals that end up in waste (after increasing re-use and substitution, and after mechanical recycling)[40].
2. Converting these into end-of-life emissions using the following emission factors[41]:
    - Chemical recycling: 0 t CO_2 / t C (from the "Scope 3 Yearly" worksheet in the demand model supplemental data file).
    - Landfilling / Dumpsite: 0 t CO_2 / t C (from the "Scope 3 Yearly" worksheet in the demand model supplemental data file. This is a simplification, assuming durable plastics and ignoring emissions of methane from non-durable waste.
    - Leakage to the environment and to oceans: 0 t CO_2 / t C (from the "Scope 3 Yearly" worksheet in the demand model supplemental data file. This is a simplification which may require further work in the future.
    - Incineration with or without energy recovery without CCS: Stoichiometric conversion (all C becomes CO_2). While this value is higher than assumed by Systemiq, this assumes by 2050 emissions will not be attributed to the energy consumer.
    - Incineration with CCS: 5% of the emissions without CCS, in line with the "Scope 3 Yearly" worksheet in the demand model supplemental data file.
    - Open burning: Stoichiometric conversion (all C becomes CO_2). This value is higher than assumed by Systemiq.

STEP 3: The overall end-of-life emissions (ton CO_2) for the hydrocarbon chemicals and urea were determined for each scenario (LC-ME and LC-NFAX) based on their production in 2050[42] by adding:

1. The product of the production of each of the hydrocarbons with their end-of-life carbon emission factor determined as described in step 2 above.
2. End-of-life carbon emissions from urea, obtained by multiplying its production[43] with the stoichiometric emission factor (44/12) based on the assumption that all urea would be applied as fertilizer and thus emit the embodied CO_2.

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[40] Based on the distribution of waste processing technologies as Systemiq provides for LC-scenarios.
[41] The SBTi is unsure whether the distribution of end-of-life treatment routes is just based on plastics, or also on other products. In the absence of other data, the SBTi has applied the distribution between these routes to all production of the hydrocarbons, adding uncertainty to the approach taken.
[42] This assumes ultimately each produced hydrocarbon reaches – at some point – end-of-life status; its timing was not considered. In line with our understanding of Systemiq's approach total (fossil+biobased) CO_2 emissions are included.
[43] As simplification: To weigh the emission factors of the different feedstocks and products, 100% conversion of C in all feedstocks to product has been assumed; this assumption is not conservative for urea (as the C-conversion efficiency in urea production is likely significantly higher than the C-conversion efficiency in HVC production from naphtha even when considering by-products).

STEP 4: The minimum threshold for the alternative feedstock target in each year in this guidance was based on a combination of the LC-ME and the LC-NFAX scenarios that would ensure the percentage of overall end-of-life carbon (as CO_2) emitted was equal to the percentage of carbon of atmospheric origin in the feedstock[44], by:

1. Determining the percentage of carbon of atmospheric origin in the feedstock as the amount of bio-based carbon + CCU-based carbon from direct air capture[45] for the LC-ME and the LC-NFAX scenarios separately.

2. Establishing a percentage of alternative feedstocks in each year using a weighted average of the alternative feedstocks in each of the two scenarios to achieve a balance between CO_2 emissions at the end-of-life and feedstock carbon of atmospheric origin. In this balanced state, the amount of feedstock C of atmospheric origin = the amount of emitted C at the end-of-life. This was done using the following data and method:

Table 5. Parameters used to determine combined alternative feedstock target values

PARAMETER	VALUE	NOTES
Percentage of C emitted at the end-of-life from total produced hydrocarbon chemicals in the LC-ME scenario in 2050	22 wt.% C	Represents the total C to be balanced by feedstocks of atmospheric origin in the SBTi target threshold calculations
Percentage of feedstocks of atmospheric origin in the LC-ME scenario in 2050	7 wt.% C	Implies there are remaining emissions at the end-of-life in this scenario that are not balanced by feedstocks from atmospheric origin.
Percentage of feedstocks of atmospheric origin in the LC-NFAX scenario in 2050	57 wt.% C	Implies there are greater amounts of feedstocks from atmospheric origin than end-of-life emissions in this scenario.

The SBTi combined the LC-ME and LC-NFAX scenarios by assigning a relative weight to each scenario based on how close each scenario's share of feedstocks of atmospheric origin, as summarized in table 5, is to the 22% of end-of-life CO_2 emissions in the LC-ME scenario. In this case, closer values result in a higher weight:[46]

Weighting for LC-ME scenario = 1- [(22 wt.% C – 7 wt. % C) / (57 wt. % C – 7 wt. % C)] = 70%

[44] This carbon balancing method is described by Systemiq in (Meng, Wagner, Kremer, & Kanazawa, 2023), although the SBTi is unsure whether Systemiq applied this rationale of balanced carbon flows to all scenarios. We have chosen to apply the end-of-life percentages based on *products* to *feedstocks*, thus including the share of feedstock that end up as loss, fuel or by-product would have a similar emission factor as the share of feedstock that ends up as product; this assumption has been made for simplicity and is not based on either an assessment or expert judgement.
[45] This approach just accounts for removal of CO_2 from the atmosphere into bio-based feedstock and through direct air capture into products. It ignores any upstream emissions for the production of biobased feedstock / DAC. It also doesn't account for any upstream emissions savings by replacing the virgin fossil feedstock. It thus is a highly simplified approach that should not be used for Life Cycle Analyses or GHG emissions accounting.
[46] This calculation method includes a simplifying assumption of equivalent volume of production between the LC-ME and LC-NFAX scenarios, as both scenarios use the same demand model. In the actual Systemiq modelling there are minor differences in total production between the scenarios.

Weighting for LC-NFAX scenario = 1- [(57 wt.% C – 22 wt. % C) / (57 wt. % C – 7 wt. % C)] = 30%

The weighted average of the alternative feedstock share from each scenario, using the weighting factors above, was used to determine the minimum alternative feedstock share thresholds in each year, prior to the adjustment described below in step 5.

STEP 5: 8% is added to the total feedstock values calculated as above[47], now and in future years to account for bio-based feedstocks currently used in the sector, mainly to make specific chemicals often with molecule structures resembling the molecule structure of biomass. This percentage is based on the currently estimated percentage (Kaehler, 2023) and is assumed to stay constant in time. The minimum and recommended targets in the table below include the 8% bio-based feedstocks values.

The higher alternative feedstock share target values based on the LC-NFAX scenario remain as an inspirational alternative feedstock target because:

1. The minimum target threshold is based on a highly simplified approach, for example ignoring emissions from non-durable waste from landfilling and upstream emissions from the production of biomass (including indirect land-use change emissions).

2. This approach relies to a high extent on application of CCS on waste incineration and on landfilling, and assumes zero emissions from leakage and landfilling. Thus, higher alternative feedstock shares may be needed.

3. As our understanding of Systemiq's modelling suggests a rather limited potential for chemical recycling, therefore the potential for chemical recycling as a feedstock option may be higher.

4. The current targets ignore the upward potential for growth of direct routes towards bio-based or CCU-based chemicals (without methanol or High Value Chemicals as intermediates)

5. As Systemiq modelled the scenario with a relatively low[48] carbon price[49], the share of alternative feedstocks by 2050 may be higher for scenarios based on a carbon price similar to the carbon price in IEA's NZE scenario.

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[47] 0% in 2020; 1.6% in 2021, 3.2% in 2022; 4.8% in 2023; 6.4% in 2024; 8% in 2025 and later; this 8% is assumed to be additional production (*not* involving the production of primary chemicals), and the total % of alternative feedstocks is thus divided by 1.08.

[48] Carbon price used by Systemiq (132 USD/ton CO_2) is likely lower than the carbon price applied by IEA in their NZE scenario, ranging from 55 to mostly 180-250 USD/ton CO_2 (IEA, 2023c). This infers that the percentages of alternative feedstock projected from Systemiq's Most Economic scenarios would be higher if a higher carbon price was utilized.

[49] Carbon price for Systemiq can be found in the "Prices and Availability" tab in the "Master Template" file in (Systemiq, GitHub repository).

Table 6. Target alternative feedstock shares by 2030, 2040 and 2050

SCENARIO	2030	2040	2050
Minimum target (based on the combination of Systemiq's LC-ME and LC-NFAX scenarios)	14 wt.% C	26 wt.% C	44 wt.% C
Recommended target (based on Systemiq's LC-NFAX scenario)	16 wt.% C	38 wt.% C	83 wt.% C

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