DENEFF
DEUTSCHE
UNTERNEHMENSINITIATIVE
ENERGIEEFFIZIENZ

GUTcert
AFNOR Group

ÖKOTEC
ENERGIEMANAGEMENT GMBH

Guide

FROM ENERGY MANAGEMENT TO CLIMATE MANAGEMENT

THROUGH 5 STAGES – IN 14 STEPS

Version 3
Status: March 2021

This guide refers to the ISO 50001 energy management standard, the ISO greenhouse gas standard series (ISO 14064, 14065, 14067), the Greenhouse Gas Protocol, and BSI specifications PAS 2050 and 2060. A precise list of standards can be found in the appendix of this guide.

The guide is not intended to replace the aforementioned standards and does not claim to be exhaustive.
It is available online at www.gut-cert.de, www.deneff.org and www.oekotec.de

In this guide, personal terms and personal nouns are used in the masculine form for reasons of linguistic simplification. In principle, all genders are addressed.

Suggestions for improvements or hints for errors are explicitly welcome!
Please send these to info@gut-cert.de.

Text: GUTcert and ÖKOTEC

The GUTcert team:
Prof. Dr.-Ing. Jan Uwe Lieback, Jochen Buser, Yulia Felker, David Kroll, Frank Blume

The team of ÖKOTEC:
Mareike Hoffmann, Dr. Kirsten Kubin

Publishers:

German Business Initiative for Energy Efficiency e.V. (DENEFF)
Kirchstraße 21
D-10557 Berlin-Tiergarten

Phone: +49 (0)30 36 40 97 01
Fax: +49 (0)30 36 40 97 42
E-Mail: info@deneff.org

GUT Certification Company
for Management Systems mbH
Environmental Verifiers
Eichenstraße 3b
D- 12435 Berlin

Phone: +49 (0)30 233 20 21-0
E-Mail: info@gut-cert.de

GUTcert is a member of

afnor GROUPE

11, rue Francis de Pressensé
F-93571 La Plaine Saint-Denis Cedex, France

ÖKOTEC Energy Management Ltd.
EUREF-Campus, House 13
Torgauer Straße 12-15
D-10829 Berlin

Phone: +49 (0)30 53 63 97-0
Fax: +49 (0)30 53 63 97-90
E-Mail: energie@oekotec.de

PREAMBLE

DEAR READER,

climate neutrality by 2050 is the European goal. Germany has already pre-drawn its goal to 2045. Achieving it will require a social and economic transformation, which harbours many challenges but also many new opportunities.

With change ahead of us, corporate responsibility is also altering. Companies now can and must contribute an important part in reducing greenhouse gases. In the months coming, EU and federal policy will be adapting directives and laws and will also be looking at the economy. What climate neutrality for each individual company will look like will probably not be regulated down to the smallest detail – and will inevitably require a very individual approach. However, clearly the model "business as usual" has had its day. It is also clear that doing nothing will be expensive in the long run. A sustainable corporate strategy is no longer imaginable without climate strategy. This makes the climate topic a top company priority.

A guideline is needed: What way is it on the road to climate neutrality? What are actual opportunities and accordingly the concrete, individual contribution for each company? All those who are already strategically addressing energy-topics with an energy or environmental management system in accordance with ISO standards are in a good starting position. Then, the step to a climate management system is not too far and can be taken efficiently without expensive detours. Many existing structures and instruments can be resorted to throughout all stages from climate accounting to certified climate neutrality.

As members of DENEFF, the management-, norm- and CO_2-experts of GUTcert and ÖKOTEC have committed themselves to the task of supporting companies implementing a climate management system (CliMS). In 14 steps, the guide "From Energy Management to Climate Management" provides orientation for all companies to be able to set out on the road now.

Christian Noll
Managing Director DENEFF

Prof. Dr.-Ing. Jan Uwe Lieback
Managing Director GUTcert

Dr. Christoph Zschocke
Managing Director ÖKOTEC

DENEFF
DEUTSCHE UNTERNEHMENSINITIATIVE ENERGIEEFFIZIENZ

GUTcert
AFNOR Group

ÖKOTEC
ENERGIEMANAGEMENT GMBH

EDITOR

DENEFF
The German Business Initiative for Energy Efficiency (DENEFF) is the strong voice of energy efficiency and the first independent, cross-sector network of over 180 pioneering companies to advocate for an ambitious and effective energy efficiency policy. The membership structure ranges from young, agile start-ups and innovative medium-sized businesses to major international corporations.
www.deneff.org

GUTcert
GUTcert is a certification body for integrated management systems with a focus on quality, environmental, energy and occupational safety management. In addition, GUTcert verifies greenhouse gas emissions according to recognised standards and certifies sector-specific sustainability requirements. The GUTcert Academy hosts practice-oriented seminars for qualification of auditors and technical experts in various subject areas. As a member of the AFNOR Group network, GUTcert provides its certification services internationally, through 28 cooperation partners worldwide, with 1,800 auditors and 20,000 experts who serve more than 100,000 clients in over 90 countries.
www.gut-cert.de

ÖKOTEC
For 20 years, ÖKOTEC has been standing for intelligent solutions to reduce energy and resource consumption – since 2016 also with our main shareholder Veolia. Depending on objectives and project framework, ÖKOTEC provides companies with competent and experienced support in the form of technical and organisational services and an innovative software for energy efficiency controlling (EnEffCo®). ÖKOTEC has carried out over 2,000 projects with industrial and commercial companies nationally and abroad.
www.oekotec.de

CONTACT

DENEFF
Christian Noll
Managing Director

+49 (0)30 39 88 76 01
christian.noll@deneff.org

GUTcert
David Kroll
Division Manager Product Development, Team Leader Emissions Trading and Guarantees of origin

+49 (0)30 233 20 21-63
david.kroll@gut-cert.de

ÖKOTEC
Dr. Kirsten Kubin
Head of Energy Efficiency (EnEff)

+49 (0)30 53 63 97-33
k.kubin@oekotec.de

TABLE OF CONTENTS

Abbreviations

BMWI ..... Federal Ministry for Economic Affairs and Energy
CAP ..... Corrective Action Plan
CCF ..... Corporate Carbon Footprint
CH_4 ..... Methane
CHP ..... Combined heat and power unit
CLiMO ..... Climate Management Officer
CLiMS ..... Climate management system
CO_2 ..... Carbon dioxide
CO_{2eq} ..... CO_2 equivalent
COP21 ..... United Nations Framework Convention on Climate Change, 21st Conference of the Parties
DEHST ..... German Emissions Trading Authority (German: Deutsche Emissionshandelsstelle)
EDL-G ..... Energy Services Act (German: Energiedienstleistungsgesetz)
EEG ..... Renewable Energy Sources Act (German: Erneuerbare-Energien-Gesetz)
EES ..... Energy Efficiency Strategy
EF ..... Emission Factors
EMAS ..... Eco-Management and Audit Scheme
EnM ..... Environmental management
EnMS ..... Energy Management System
EnWG ..... German Energy Industry Act
ESO ..... Energy Saving Ordinance
EU ETS ..... European Emissions Trading System
EU-COM ..... European Commission
FETA ..... Fuel Emissions Trading Act
FME ..... Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
GHG ..... Greenhouse Gas
GHG Protocol .... Greenhouse Gas Protocol
GWP ..... Global Warming Potential
HFC ..... Hydrofluorocarbons
H-HFC ..... Halogenated fluorocarbons
HLS ..... High Level Structure, basic structure of management systems
IPCC ..... Intergovernmental Panel on Climate Change
ISO ..... International Organisation for Standardisation
KPI ..... Key Performance Indicator
MS ..... Management system
NF_3 ..... Nitrogen trifluoride
Nm^3 ..... Standard cubic metre
N_20 ..... Nitrous Oxide
PAS ..... Publicly Available Specification, British standard for climate balances
PCF ..... Product carbon footprint
PCR ..... Product Category Rules
PDCA ..... Plan-Do-Check-Act
PFCs ..... Perfluorinated Hydrocarbons
QM ..... Quality Management
SBTI ..... Science Based Targets Initiative
SEU ..... Significant Energy Use
SF_6 ..... Sulfur hexafluoride
SpaEfV ..... Top Tax Compensation (German Spitzensteuerausgleich)
SpeES ..... Special equalisation scheme EEG surcharge

INTRODUCTION

Climate change is already altering the business environment of many companies. With the Paris Agreement to limit global warming (2°C target) concluded at the 21st World Climate Conference (COP21), climate protection is becoming a central strategic challenge for the future. This is also made clear by ambitious goals and measures of the energy and climate policy of the "Green Deal" of the EU Commission (EU-COM) or the climate package of the German government: First concrete national measures, such as the Fuel Emissions Trading Act, are currently being legally implemented.

Rising temperature averages and steadily increasing sea levels are just two of many impacts of climate change. It also leads to a change in climate variability – such as strong short-term climate fluctuations and more frequent extreme weather events such as heavy rainfall or hot summers.

"We can and must succeed in making Europe the first climate-neutral continent by 2050" – quote EU Commission President Ursula von der Leyen

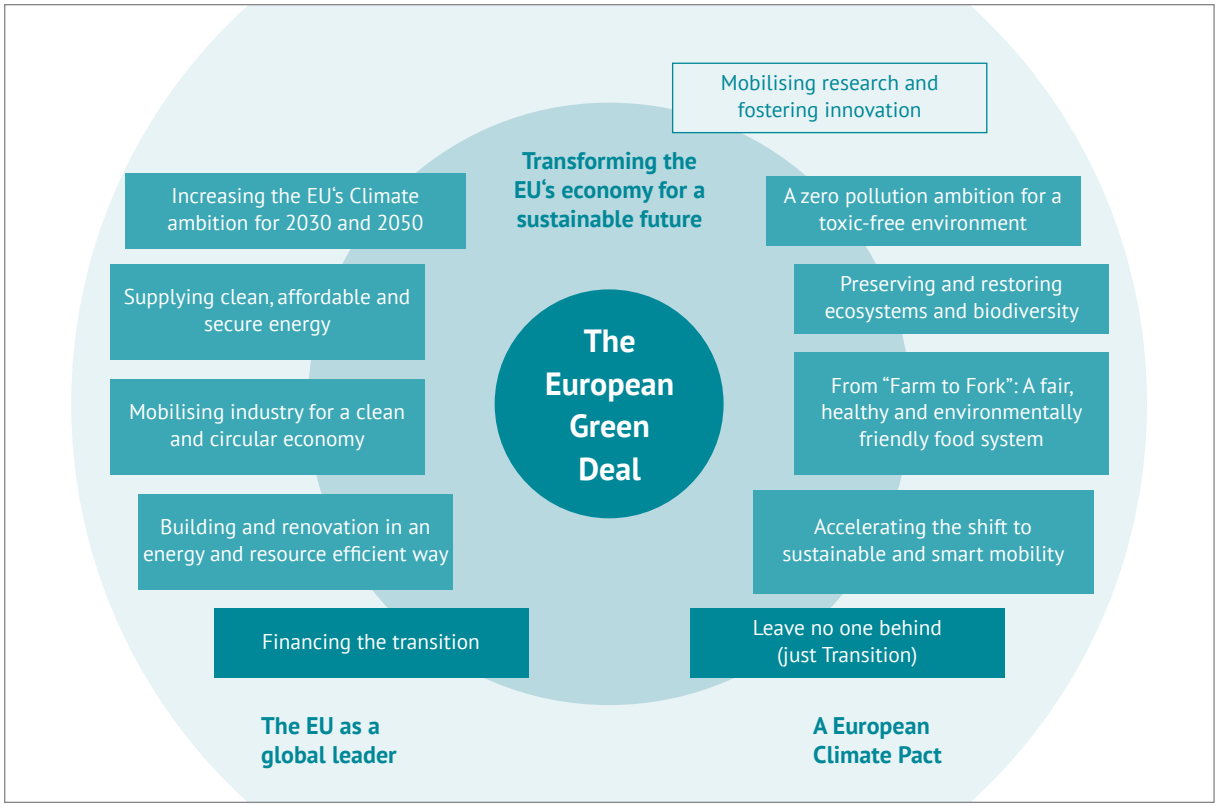


Figure 1: The European Green Deal, Source: EU Commission

With the European Union's climate and energy goals for 2020, there are already concrete targets for greenhouse gas emissions, renewable energy, and energy efficiency.

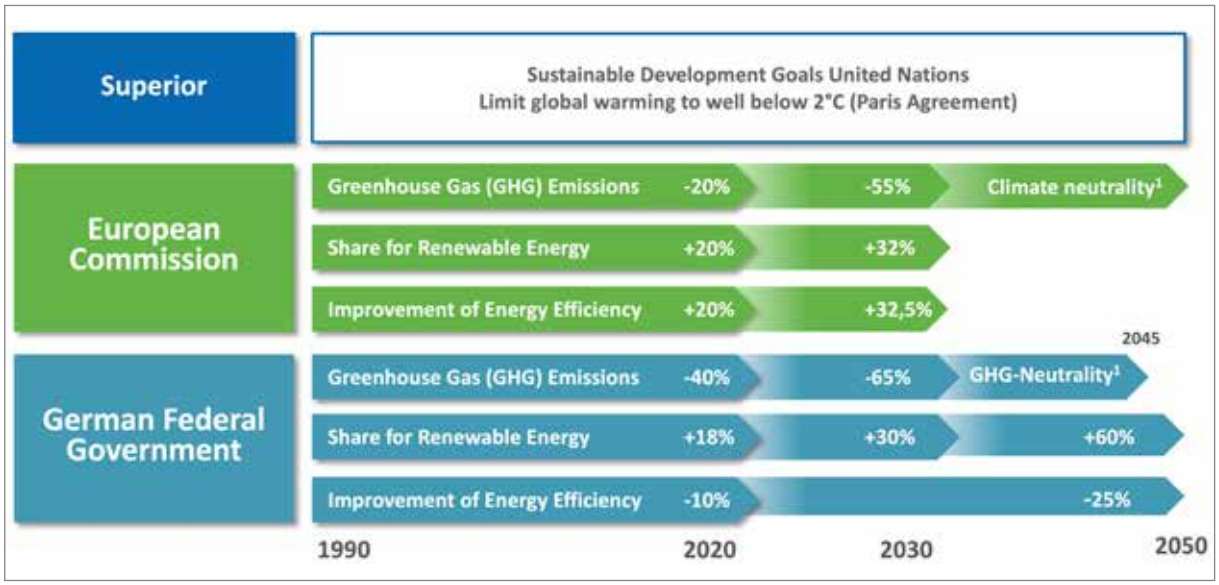


Figure 2: Climate & energy targets in Europe until 2050

In addition, the German government is pursuing the goal of making German economy the most energy-efficient economy globally and halving primary energy consumption by 2050 compared to 2008 with the Energy Efficiency Strategy 2050 (EES).

In consequence, reducing greenhouse gases (GHG) and improving energy efficiency will play a central role in future company development: For companies that want to develop sustainably, it will become a must to deal with the issue more extensively. Irrespective of whether management systems (MS) are in operation or not, companies must react to external influences of politics, associations, and others. In the meantime, the company's own employees, owners or its management are also pushing to put more climate friendliness on the agenda. The concept of strategic planning (context analysis), which is common in ISO standards, usually also includes the topic of climate management since the consequences of climate change also mean opportunities and risks for almost all organisations and sectors.

Emission-intensive sectors such as energy production or heavy industry (steel, aluminium, etc.) naturally play a unique role in climate management. For this reason, concrete measures have already been defined in the climate package. The focus is also on companies whose products are delivered directly to end consumers (B2C), e.g. food or car manufacturers and public sector.

Food industry and retail in particular are taking an increasingly proactive approach to the issue of greenhouse gas accounting and climate neutrality: In the B2B sector, it is playing an increasingly important role in contract awarding; in the B2C sector, too, as it can influence corporate image, sales figures and thus market shares.

1 Note: The EU-COM uses climate neutral, greenhouse gas neutral and "zero net emissions" synonymously (as of 12/2020). The German Federal Government refers to the long-term goal of GHG neutrality without compensation in its targets. For a more in-depth discussion of the topic of climate neutrality vs. GHG neutrality we recommend the article by Hans-Jochen Luhmann and Wolfgang Obergassel (Wuppertal Institute) in GAIA magazine. Further background information can also be found at www.klimaneutralitaet.de. Note: Targets shown in the chart (as of 12/2020) are under discussion nationally and internationally and are subject to change.

The Institute for Energy Efficiency in Production (EEP) at the University of Stuttgart collects data on balance sheet carbon neutrality every six months. The figures of the 2019/2020 winter survey highlight a trend: Six out of ten companies aim to make their company balance sheet climate neutral in the future.

Corporate climate management aims to record and avoid emissions, to reduce relevant emission sources at the location and from upstream and downstream activities along the value chain.

Do you plan to make your company carbon neutral on your balance sheet? (n=852)

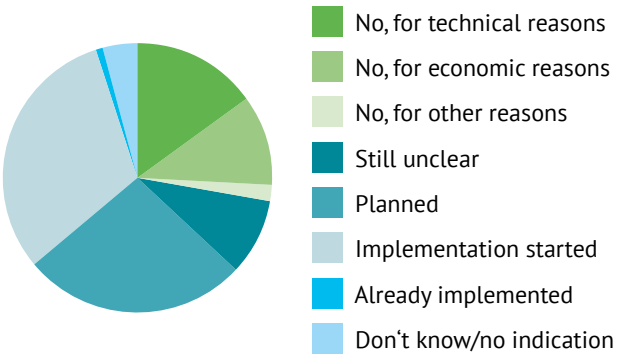


Figure 3: Survey on the motivation "climate-neutral company", Source: EEP of the University of Stuttgart

How can new challenges be met in a reasonable and efficient way?

Recently, several guides[2] have already been published on this. However, each of them has its own focus, and a comprehensive set of rules does not yet exist.

With this guide, DNEFF, GUTcert and ÖKOTEC primarily aim to explain the transition from conventional ISO management system to climate management and to pave the way for those responsible for MS. The partners draw on years of expertise in the field of management systems and the verification of greenhouse gas emissions, both within the framework of the European emissions trading system (EU ETS) as well as in the voluntary market.

Series of standards regarding greenhouse gas accounting and existing links

The ISO 14064 series[3] addresses the challenges of climate change and provides organisations with important tools for implementing scientific knowledge related to organising, balancing, and reducing GHG emissions.

In addition to the ISO 14064 series, there are other standard series, such as the British PAS or the Greenhouse Gas Protocol, which also deal with areas of climate management.

There is a spotlight on PAS 2060, which will be transferred into ISO 14068 and which specifies existing additional requirements for achieving and demonstrating climate neutrality. It should be emphasised that offsetting GHG emissions through compensation is not sufficient: Additional GHG reduction strategies and concrete GHG savings must be in place before climate neutrality can be declared.

2 E.g. Guideline Introduction Climate Management by Global Compact Network Germany and Sustainable AG, 2017; Climate Risk Management. 2050 – Developing an Operational Climate Risk Strategy Step-by-Step by CO_2ncept plus; Guidebook From Emissions Report to Climate Strategy by WWF. Germany and CDP (Carbon Disclosure Project); etc.

3 An overview of other standards in the 14064 series can be found in the appendix.

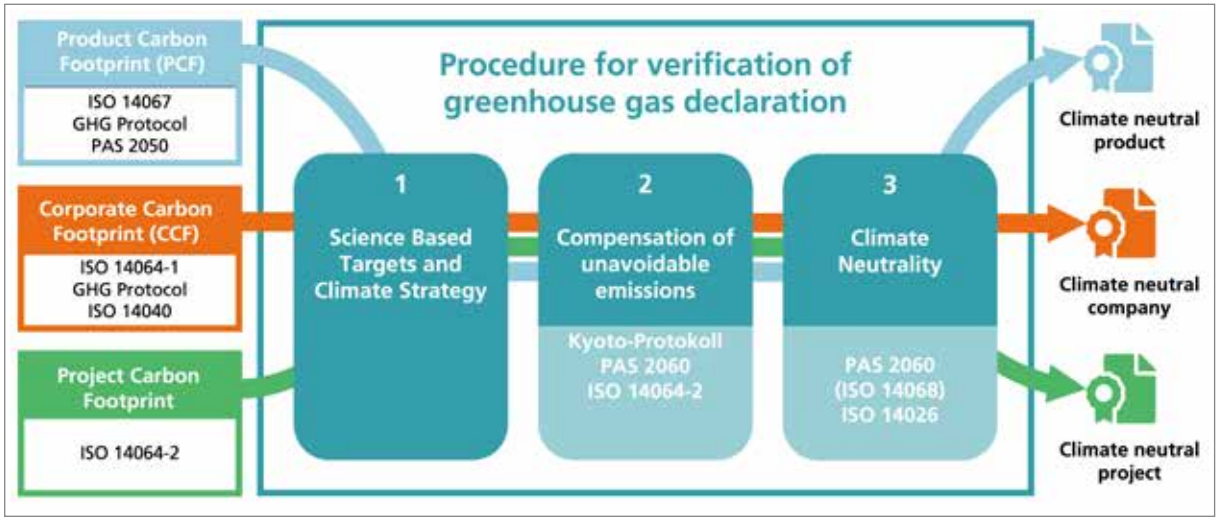


Figure 4: From carbon footprint to verified climate neutrality, source: GUTcert

The "DIN EN ISO 14064-1:2019-06: Greenhouse gases-Part 1: Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals", which is relevant for this guide's purpose, is more of a technical standard and is not structured accordingly to HLS (High Level Structure, basic structure of all MS standards) of ISO management systems.

Nevertheless, this standard not only provides concrete requirements for credible and sound GHG accounting, but also introduces a simplified management approach that enables companies to:

- define the boundaries of the GHG balance as well as the model calculations (quantification) of GHG (5, 6)
- define climate-relevant targets (7.3)
- plan and implement initiatives to reduce GHG emissions (7.1)
- derive appropriate measures (7.2)
- ensure their implementation and the quality management of GHG balances (8, 9)

At this point it is important to understand that an ISO-standard for introduction and maintenance of climate management does not yet exist in the conventional ISO-version.

The ISO 14064 series defines requirements for determining and reporting GHG emissions and their removal on organisational or project level, as well as for their validation and verification. The aim is to produce a consistent GHG statement that is in line with the needs of intended users (stakeholders).

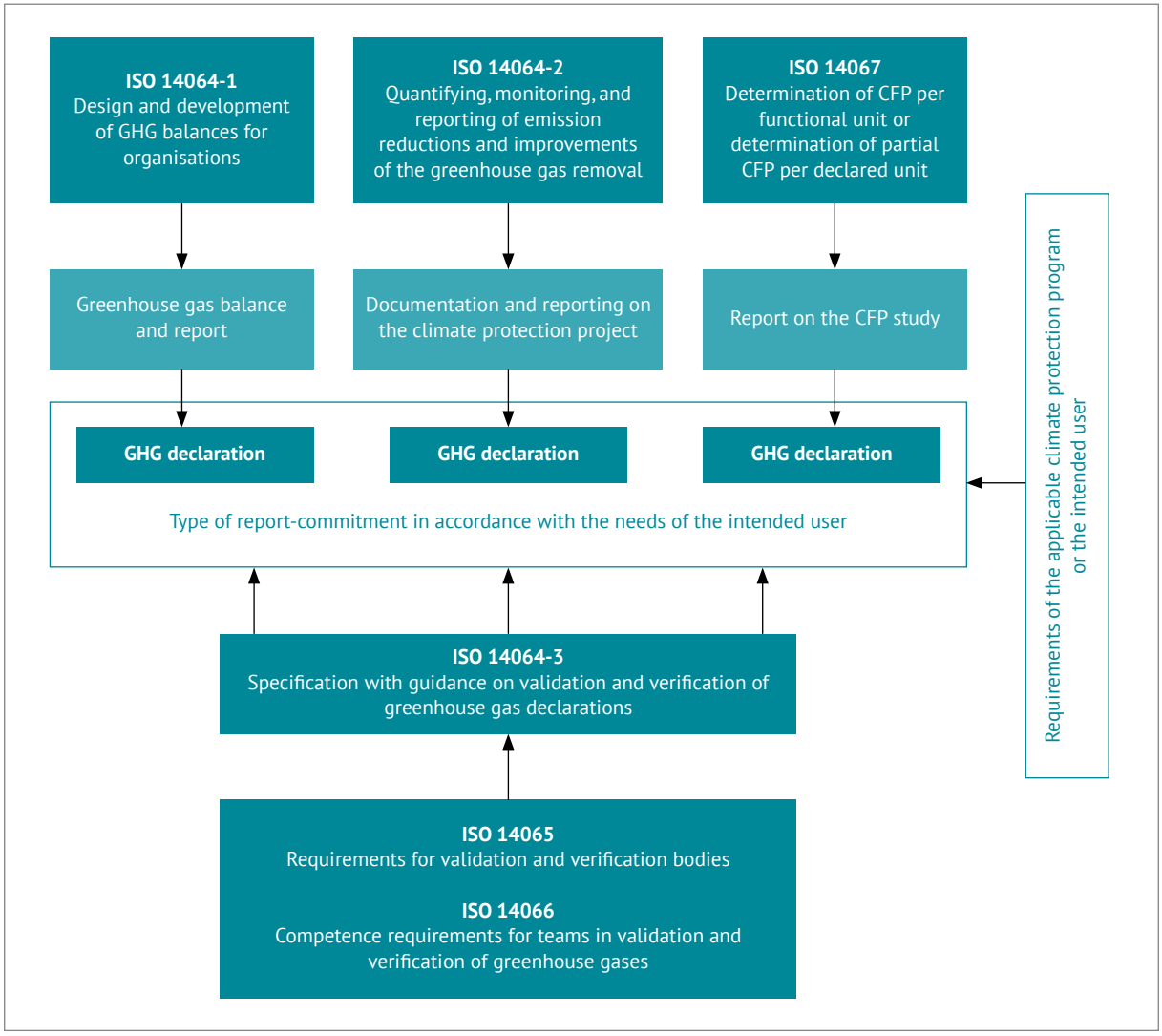


Figure 5: Overview of relevant ISO standards in the verification process of a carbon footprint, source: based on ISO 14064-1, p. 11

FROM ENERGY MANAGEMENT SYSTEM (ENMS) TO CLIMATE MANAGEMENT SYSTEM (CLIMS)

When the strategic decision to introduce climate management is made in a company, the first question is about what of the existing pool of data, figures, facts, and structures can be directly applied and which gaps may still need to be closed.

Experience shows that companies with a functioning EnMS in accordance with "DIN EN ISO 50001:2018-12 Energy management systems – Requirements with guidance for use" have a clear advantage in the transition to CliMS. There is a large overlap, because climate management is also about energy sources and energy consumption, the efficiency of energy use and classic management. In the following, we will take a closer look at precisely these overlaps and provide guidance on how to exploit synergy effects when introducing climate management.

Every management system is based on a continuous improvement process – the PDCA cycle (PLAN, DO, CHECK, ACT). ISO 14064-1 is not a typical management system standard in this respect; it lacks the reflection of top management (decision-making level). Therefore, we have added chapters 9 and 10 of the HLS to the requirements of ISO 14064-1 to picture a complete classical management system.

To ensure sustainable corporate development, climate protection goals should in any case be in line with the overall company strategy, which makes the integration of these topics into strategic planning and subsequently into process control indispensable.

Applying familiar MS systematics and tackling new climate challenges with help of classic principles and instruments suggests itself. Should a GHG report be prepared within the framework of a CliMS and in accordance with the requirements of ISO 16064-1, its conformity may be externally audited and certified.

ISO 14064-1 speaks about the voluntary nature of GHG emission reduction initiatives exclusively and leaves room for their implementation. We have structured our guide[4] traditionally like a staircase, with steps and stages, bringing together various implementation phases and corporate intentions.

I. Establishment of balance sheet framework and initial inventory (steps 1-3)
II. Creation of greenhouse gas model and initial management assessment (steps 4-7)
III. Establishment of a climate strategy and data management (steps 8-10)
IV. Integration of climate management into existing company energy management processes (steps 11-12)
V. Verification and communication (steps 13-14)

The comparison (see following graphic) illustrates essential overlaps between energy management (blue circle) and climate management (green circle) and gives an initial overview of the main fields of action in the transition from energy management to climate management. This is taken up again in detail in the individual steps within the guide.

4 GUTcert energy management guide

We recommend building the CliMS on the foundation of an EnMS. However, the following should be pointed out in advance:

- A significant and accurate GHG accounting is a first step for further strategic decisions in terms of increasing climate friendliness. This task can be accomplished much more easily with help of the EnMS data collection (at least for Scopes 1 and 2).
- Existing organisational, communication and control structures within the EnMS will also help those responsible with establishing systematic structures and a sustainable communication culture.
- Furthermore, the solid measurement-proven knowledge of one's own energy-specific facilities and processes in the EnMS will help with the management of new tasks. Special attention is paid to these facilities in environmental management systems.

In the following chapters we will explain how exactly this path may be taken.

By the way: The box in the margin of some paragraphs indicates which chapters and sections of the ISO 14064-1 standard are relevant for the respective topic.

3.4.4
3.4.6

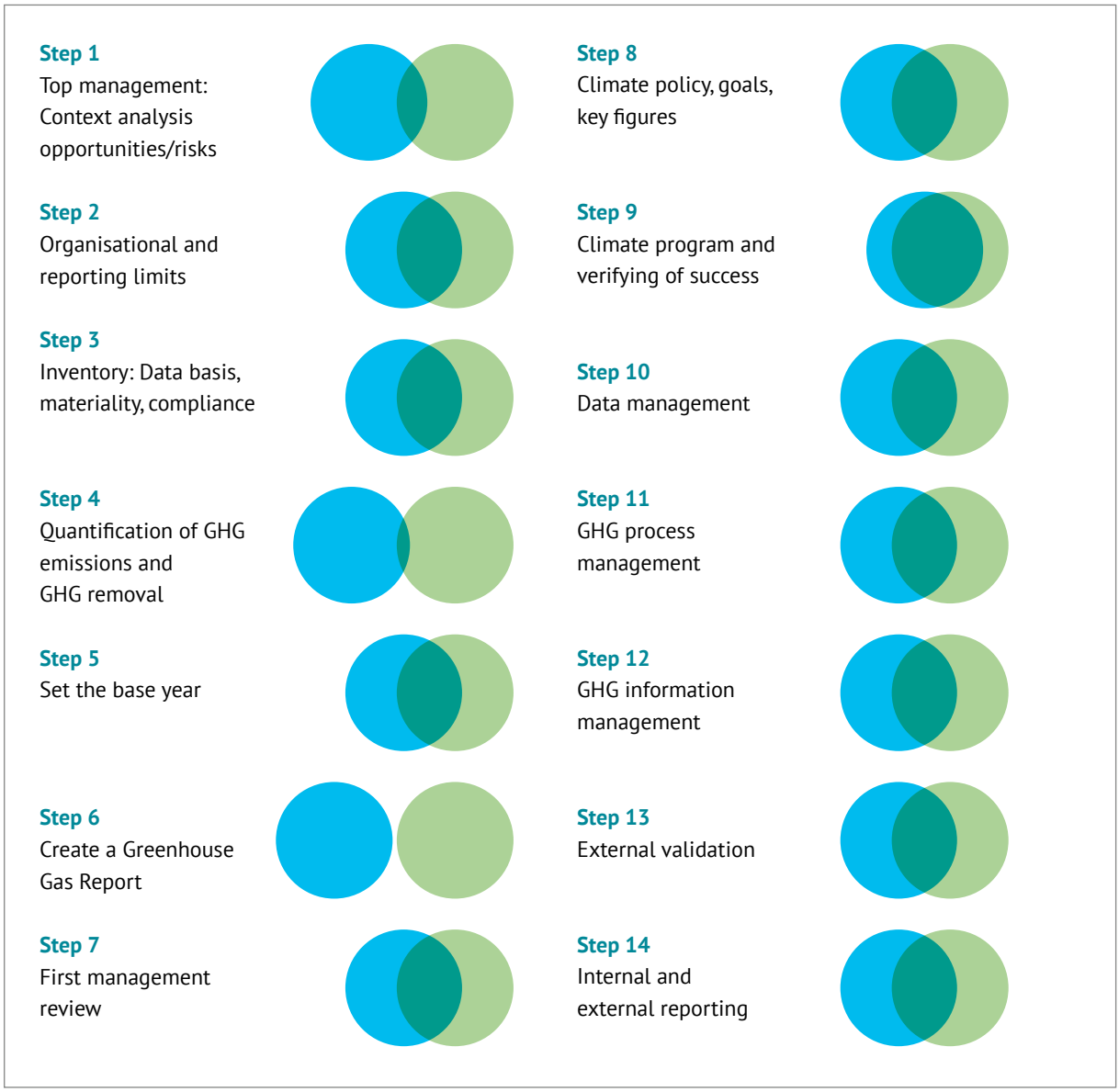


Figure 6: Overlaps in energy and climate management, source: GUTcert

STAGE I – INVENTORY

The decision of top management to introduce a climate management system based on GHG balancing according to DIN EN ISO 14064-1 starts the process: The entire company is informed. Thus, the first milestone is set right at the beginning.

Once top management has positioned itself, it makes sense to draw up a project plan in which responsible and involved people, time schedule and the goal or interim goals are defined. Already at this stage, the first analysis of the business context is necessary to determine risks and opportunities: These are essential for further planning. To delimit the project, it is necessary to define balance sheet boundaries as precisely as possible, before the first extensive task of data collection is undertaken. Result evaluation by top management and the decision on how to proceed, which may initiate the second stage, mark the conclusion of the first stage.

1ST STEP: TOP MANAGEMENT COMMITMENT, APPOINTING PROJECT LEADERSHIP, CONTEXT ANALYSIS

Along the lines of the EnMS, the organisation's top management must make a clear commitment to the CliMS at the beginning: To capture the current situation in terms of GHG accounting and to reduce emissions. And of course the necessary resources must also be made available for this.

Top management must ensure that responsibilities and authorities are assigned to relevant roles and communicated within the organisation. Therefore, it makes sense to appoint a project manager or, in other words, a climate management officer (CLiMO) in the role of "person of action" (as with the EnMS).

In case of the company's energy, sustainability or environmental management officer or somebody else taking over this role, this person should have sufficient capacities and expertise to do so. The established energy management team can also work as a climate team and, if necessary, may be expanded to include new members (see step 11).

Context analysis as planning basis

When it comes to strategic business planning, context analysis is a MUST: In- and external issues that define scope and strategic direction through interested parties (stakeholders) must be identified.

This is of particular importance as requirements of intended users can directly influence further consideration of organisational or balance boundary, e.g. inclusion of indirect emissions (Scope 3). But experience shows that these are often not clearly identified by companies! The GHG balance should therefore ALWAYS be prepared from the perspective of intended use and interested parties.

In all common management system standards with HLS-structure, relevant interested parties and their requirements must be identified (e.g. GHG initiatives, such as the Carbon Disclosure Project or Science Based Targets). In this context, organisations determine what outputs they need to provide to these relevant interested parties.[5]

Governmental and standards organisations, authorities, associations, utilities, consultants, auditors, competitors, suppliers, landlords, insurers, and financiers are external stakeholders. Management, employees, supervisory boards, if applicable, works council, etc. act as internal parties.

5 HLS definitions are published in ISO 9000. The term "interested parties" can be found there under 2.2.4.

Usually, stakeholders relevant for the GHG balance are

Internal:
- Management
- Employees
- Labour market (potential applicants)

External:
- Customers
- Investors
- Competitors
- Suppliers
- Regulators (authorities)
- NGOs

The following external and internal topics may be relevant in CliMS-related context regarding global climate change and associated corporate risks[6]:

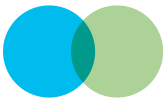
External:
- Risks related to legal regulations, e.g. EU target: 40% Reduction of GHG emissions by 2020 and further possible tightening of regulatory requirements
- Financial risks/opportunities in emissions trading when certificates become more expensive or through the Fuel Emissions Trading Act for fossil fuels
- Appraisement of climate strategy by investors, local authorities, regulators, clients, analysts, media and/or society at large
- Standards and requirements in supply chain
- Risks to the company's reputation and business opportunities (e.g. new market, new business model)
- Image in society
- Government GHG programmes such as early action credits, agreements, or national and local reporting programmes

Internal:
- Initiatives such as voluntary participation in the GHG register or sustainability reporting initiatives
- High effort for data collection, e.g. due to
  - Database searches
  - Ensuring transparency
  - Preparation for specific departments
- Inaccuracy of results with current collection method
- No real-time method, which makes monitoring and evaluation difficult
- No possibility to carry out dynamic evaluations
- Expectations of own staff

A context analysis includes the evaluation of risks and opportunities as determined by stakeholders. An already defined and documented methodology for risks and opportunity analysis can be adopted from the existing MS. Results may be expanded to include climate-relevant issues and should be defined as part of the planning process and documented in a comprehensible way to allow for continuous updates.

6 Evaluation of risks of climate change in detail in the CO_2ncept plus guideline

Step 1
Top management:
Context analysis,
opportunities/risks



Need for action in energy management
Often, in the organisational context, the same actors as in the EnMS are active regarding the CliMS. However, in relation to implementing climate strategy, these may bring additional topics with them – at international, national, and sectoral level or that of a department and specific company. Individual interests and needs should be analysed in great detail and integrated into further decision-making. Assessments for corporate global climate change risks should, if necessary, be established and integrated into the overall company risk-opportunity analysis. The context analysis according to ISO 50001:2018 practised in the company must therefore be supplemented and expanded to include further topics.

2ND STEP: DEFINING ORGANISATIONAL AND REPORTING BOUNDARIES

Accompanying project planning, it is first necessary to precisely define the scope of the study and its subsequent application. This definition is made regarding organisational boundaries and GHG emissions, which are to be determined (reporting boundary).

Organisational boundaries

For defining organisational boundaries, a choice can be made between the control approach and the equity share. It is important to have a uniform and justifiable approach so that choosing accounting boundaries does not differ with location or company shareholding. In individual cases, other aggregation approaches can also be applied, if it is required in the use of the GHG balance sheet, such as in the case of special GHG programmes or targets.

5.1

Within the control-based approach, an organisation accounts for 100% of GHG emissions or removals from its controlled processes. A distinction between financial and operational control is made:

- Under **financial control**, a company contributes 100% of GHG emissions over which it has financial control. This does not include GHG emissions from operations in which the company has an interest but no financial control. This is usually the case when the majority of ownership of operating assets, associated risks, and rewards is held, or the operation is accounted for in the financial accounts as a group company or subsidiary.
- Under **operational control**, a company contributes 100% of GHG emissions over which it has operational control. This approach does not consider GHG emissions from operations in which the company has an interest but over which it does not have operational control. This means that introduction and implementation of operations is the responsibility of the originator of the GHG balance.

Through the **equity share approach**, a company accounts for GHG emissions from operations according to its share of the company's equity. This approach reflects economic interest, as it is based on the extent to which the company has the chance to influence risks and opportunities.

If a company chooses this approach, emissions from any asset (e.g. a facility) that the company partially or fully owns must be included in its GHG balance. Emissions from assets that the company controls but does not own (e.g. a leased asset) are excluded.

In complete ownership / joint operations of Climate industry	Legal structure and partners	Shareholdings of Climate Industries	Operational control at	Financial accounting at Climate Industries	Emissions covered and reported by Climate Industries	
					Equity Share approach	Control approach
Climate Germany	Ltd.	100%	Climate Industry	Subsidiary in full ownership	100%	100% operational 100% financial
Climate Austria	Ltd.	80%	Climate Industry	Subsidiary	80%	100% operational 100% financial
Luftikus	Joint venture with moderate financial control, other Partner ABC	50%	ABC	From Climate Austria	40% (80% * 50%)	0% operational 50% financial
Good Air	Subsidiary of Climate Austria	75% from Climate Austria	Climate Austria	From Climate Austria	60% (80% * 75%)	100% operational 100% financial
ClimFix	Unregistered joint venture, three partners with 1/3 financial control each	33%	Climate Industry	Quota-consolidated Joint venture	33%	100% operational 33.3% financial
ClimateFox	Integrated joint venture with partner DEF	40%	Climate Industry	Subsidiary	40%	100% operational 100% financial
Good Climate	Integrated joint venture with partner GHI	60%	Good Climate	Associated company	60%	0% operational 0% financial
GHG	Company, subsidiary of XYZ	1%	XYZ	Investments in fixed assets	0%	0% operating 0% financial

Figure 7: Organisational structure and accounting of GHG emissions, source: GUTcert, own illustration based on GHG Protocol

Practical tip

In the field of EnMS, many energy efficiency systems (ISO 50001, alternative systems according to SpaEfV) were introduced in Germany to obtain reductions. This is the case especially within the range of SpaEfV for the reimbursement of the electricity tax and for the SpeES for reclaiming the EEG apportionment. The balance sheet limits of the applicant organisation (legal entity) were checked intensively and can be seen in the certificates or attestations. These balance limits can also be used for the GHG balance, as long as they include all relevant GHG sources.

Note

Experience shows that many organisations find it difficult to decide on the right approach for organisational boundary (consolidation approach). Here, the intended application and requirements of the stakeholders (e.g. consumer) should always be taken into account. There is no right or wrong here: However, the decisions made must be justified in a transparent and comprehensible way for all users.

Reporting boundaries

- In addition to organisational boundaries, also boundaries of GHG reporting must be defined and documented. This includes identifying direct and indirect GHG emissions and withdrawn GHG quantities associated with the organisation's processes and grouping them into scopes.

5.2
5.2.2
5.2.3

Released emissions are grouped into categories[7]:

- Direct GHG emission: GHG emission from GHG sources owned or controlled by an organisation. These emissions are considered as Scope 1.

3.1.9

- Indirect GHG emission: GHG emission resulting from corporate operations and activities from GHG sources not owned or controlled by the organisation. These emissions are further subdivided into:
  - Indirect emissions from purchase of grid-based energy. These emissions are considered as Scope 2.
  - Indirect emissions from upstream and/or downstream corporate activities. These emissions are considered as Scope 3.

3.1.11

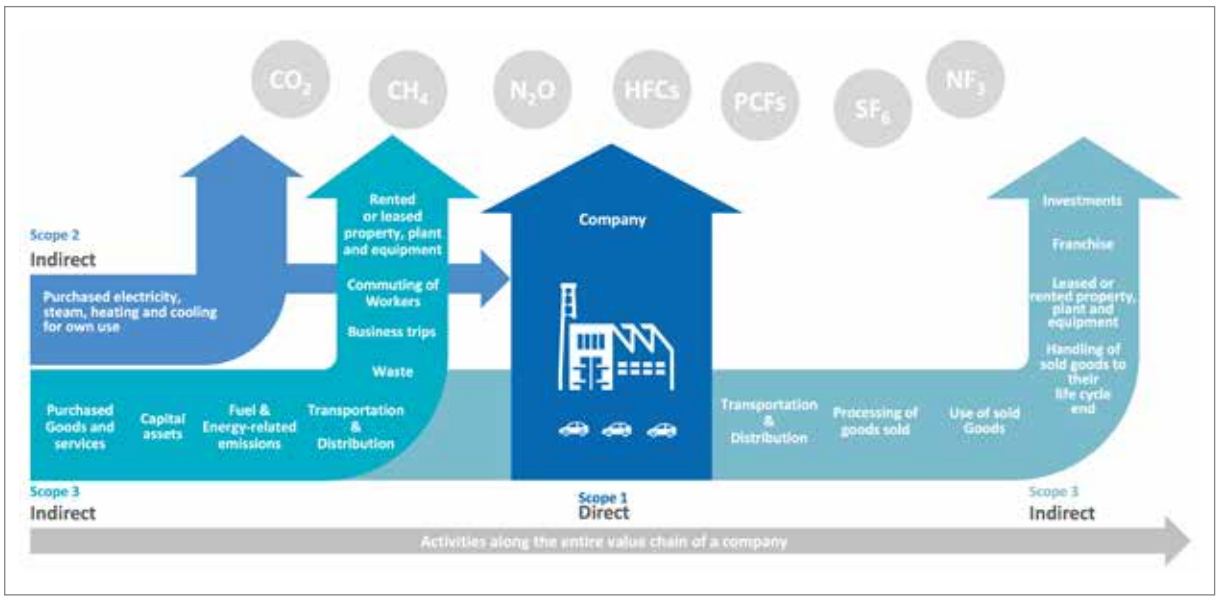


Figure 8: Scopes according to GHG Protocol, source: own representation based on GHG Protocol

The choice of balance limit influences which activities in the company's value chain are categorised as direct emissions and which are categorised as indirect emissions. Thus, indirect emissions would have to be considered for purchased electricity if there is no (equity) participation in the power and heat supply station.

If, on the other hand, the operational control approach is chosen and the organisation has a say in the operation of the power plant, direct emissions may have to be included.

7 In each category, non-biogenic emissions, biogenic anthropogenic emissions and, if quantified and reported, biogenic non-anthropogenic emissions must be separated.

Step 2
Organisational and reporting limits

Need for action in energy management
Often the organisational boundary for the GHG balance overlaps with the scope of the EnMS according to ISO 50001, whereby the consolidation approaches (control or participation approach) should be evaluated again with reference to benefits and stakeholder analysis.
For the reporting boundary, all direct emissions as well as indirect emissions from purchased external energies should already have been systematically recorded and evaluated. All other potential GHG sources that could be indirectly related to the company's activities must be analysed and listed for climate management firstly without emission factors.

3RD STEP: INVENTORY

The next step – systematic recording of the current state – consists of assigning actual input quantities from the relevant period of the baseline to identified GHG sources.

This GHG baseline is an essential foundation of CliMS, as all further planning and objectives are based on it. It is the reference point for future comparisons. The baseline always refers to a fixed time period (usually one year, possibly subdivided into months).

What GHG emissions are actually relevant for climate management?

For identified emission sources, the preparer of the GHG balance must record and document the so-called global warming potential (GWP) for each GHG separately in carbon dioxide equivalents (CO_{2eq}). Relevant GHG include all gases regulated by the Kyoto Protocol whose GWP were last updated in the fifth Assessment Report (AR5) of IPCC (Intergovernmental Panel on Climate Change):

- Carbon dioxide (CO_2) has a GWP of 1 and is released in all fossil fuel combustion processes, deforestation, and slash-and-burn agriculture.
- Methane (CH_4) has a GWP of 28 and is thus 28-times more harmful to the climate than carbon dioxide. Methane is emitted, for example, from animal husbandry, rice cultivation, leakage and as landfill gas in waste management.
- Nitrous oxide (N_2O), also known as laughing gas, has 265-times the GWP of carbon dioxide and is produced, for example, during conversion of nitrogen fertiliser.
- Perfluorinated hydrocarbons (PFCs) have a GWP of up to 12,200 and are often used in aluminium smelters for surface cleaning and as refrigerants.
- The GWP of hydrofluorocarbons (HFCs/H-HFCs) is up to 14,800. These GHG (e.g. ethane and propane) are mainly used as refrigerants.
- Nitrogen trifluoride (NF_3) is used in semiconductor industry and in very large quantities in liquid crystal display and solar industries and has a GWP of 16,100.
- Sulphur hexafluoride (SF_6) has a GWP of about 23,500 and is used mainly in high-voltage power lines and as a filler gas.

Due to the very different GWPs, even small amounts of e.g. SF_6 or coolants can lead to significantly higher CO_{2eq} and should be included taking into account materiality criteria. For example, emissions of 1 t SF_6 could lead to 23,500 t CO_{2eq}. If individual GHG are not taken into consideration, this must be explained and documented in detail.

Practical tip
Usually, CO_{2eq} is already given in the common databases of the Federal Environment Agency, such as Probas or GEMIS. If data sources only take CO_2 into account, a conservative estimate based on further literature sources from comparable GHG sources is recommended.

Collection of basic data

3.2.1

ISO 14064-1 describes GHG-related activities as a quantitative measure for an activity that results in a direct or indirect GHG emission or removal. It is, for example, the amount of energy, fuel or electricity consumed, material produced, services provided, or land area affected. For classic MS, this means keeping track of all operational processes on the one hand and all supporting processes on the other.

For this purpose, experience has shown that it is advisable to carry out an initial analysis of potential GHG sources along the entire value chain of organisational activities and products and, to subdivide them into direct and indirect emissions in a first step[8]. The analysis' result should be listed in a brief overview by GHG source and indicated with corresponding data sources (see table).

For indirect emissions (Scope 3) outside the company's sphere of influence, data are usually only rudimentary or have to be estimated – we will discuss this in the following.

	Scope 1	Scope 2	Scope 3
Description	Direct emissions from own combustion processes	Indirect emissions from procurement of grid-bound energy	Other indirect emissions from upstream and downstream corporate activities
Categories	• Stationary equipment • Mobile assets • Chemical processes • Direct emissions	• Electricity • Steam • Heating • Cooling • Compressed air	• Purchased goods/services • Transport and distribution • Business trips, employee travel • (11 other categories)
Emission sources	• Natural gas heating • Company car • Forklift truck	• Machine 1,2 • Refrigeration unit • Production site	• Upstream processes • Car, plane, train • Purchased services
Data sources	• Financial accounting • HR • Operating records • Fuel cards etc.	• Billings • Remote readings meter • Operating records	• Databases with emission factors • Estimates • Financial accounting • Information from employees

Figure 9: Distribution of major GHG sources by scopes, source: GUTcert

8 GHG sources are all processes that cause a release of GHG into the atmosphere (3.1.2). GHG sinks are all processes that remove a GHG from the atmosphere (3.1.1).

Direct emissions

a) From stationary combustion of any fuel type (fossil or biogenic) in (stationary) plants such as heaters, gas turbines, boilers, etc. In most cases, this produces heat, mechanical work, and steam.

b) From mobile combustion of fuels in transport equipment in the company's own fleet, such as motor vehicles, trucks, ships, aircraft, locomotives, forklift trucks, etc. Emissions from travel in vehicles outside the organisation's boundaries should be classified and reported as "indirect emissions" due to business travel, commuting, travel to and from customers or visitors, upstream rental facilities, etc.

c) Direct emissions and direct removal from industrial processes: Industrial processes that result in direct process emissions include cement and lime production, chemical production, manufacturing, oil and gas refining, and non-combustion processes including abatement, replacement, destruction, decomposition, or mitigation of industrial GHG emissions (e.g. N_2O) and cleaning processes associated with carbon capture and storage (e.g. collection systems in mining).

d) Through discharges of fugitive GHG in anthropogenic systems, such as leakage from air conditioning units, SF_6 from switchgear or CH_4 from biogas plants.

e) Direct emissions and direct removal from land uses, land use change and forestry.

Indirect emissions

To keep track of the often very complex totality of indirect emissions from Scope 3, it is advisable to use the 15 categories of the GHG Protocol Corporate Value Chain (Scope 3). Scope 3 emissions can be divided into upstream and downstream emissions.

Upstream or downstream	Scope 3 category
Upstream scope 3 emissions	1. Purchased goods and services 2. Capital goods 3. Fuel- and energy-related activities (not included in scope 1 or scope 2) 4. Upstream transportation and distribution 5. Waste generated in operations 6. Business travel 7. Employee commuting 8. Upstream leased assets
Downstream scope 3 emissions	9. Downstream transportation and distribution 10. Processing of sold products 11. Use of sold products 12. End-of-life treatment of sold products 13. Downstream leased assets 14. Franchises 15. Investments

Figure 10: Scope 3 categories according to GHG Protocol, source: based on GHG Protocol, page 32

- *For more information on individual Scope 3 emission categories, please visit https://ghgprotocol.org/standards/scope-3-standard*
- *For more information, see the CDP & WWF guide "From emissions reporting to climate strategy" http://klimareporting.de/wp-content/uploads/2014/02/Klimareporting_Vom_Emissionsbericht_zur_Klimastrategie_2014_02_20.pdf*

Experience shows that for many organisations the bulk of activity-related emissions is in Scope 3, which is why a detailed analysis taking into account consideration of materiality is essential here.

Figure 11: Distribution of main GHG sources according to scopes, source: GUTcert

Practical tip
To determine relevant data, existing data management systems such as financial accounting, business management or process control systems and their evaluation systems or operational records should be used. Invoices are particularly reliable as they are verified by two parties.
Furthermore, internal operational data can be used – however, the leading primary data source should be documented and explained, as experience has shown that external reviews or personnel changes can lead to long discussions and time-consuming searches.

Consideration of materiality for climate impacting GHG

5.2.3

In climate management, just as in other management systems, consideration of materiality plays a major role. The principle that, due to limited resources, investments should always be made where the greatest effect or the highest risk can be expected, applies. Also the famous Pareto principle comes into play here. Even if the strategic decisions on measures to reduce emissions are made later (step 8), it is essential to carry out the best possible GHG materiality analysis already in this step. This applies in particular to Scope 3 emissions and their significance for the company's climate strategy.

On principle, in certain cases, the same emissions of scope categories can be attributed to two or more companies. For example, Scope 1 emissions of an electricity producer are the Scope 2 emissions of an electrical appliance user, which in turn are the Scope 3 emissions of both the appliance manufacturer and the appliance retailer. Each of these four companies has different and often mutually exclusive ways to reduce emissions. For example, the electricity generator can produce energy from lower GHG sources. The appliance users can use the appliance efficiently, while the appliance manufacturer can increase appliance efficiency and the appliance retailer can offer a choice of energy-efficient products.

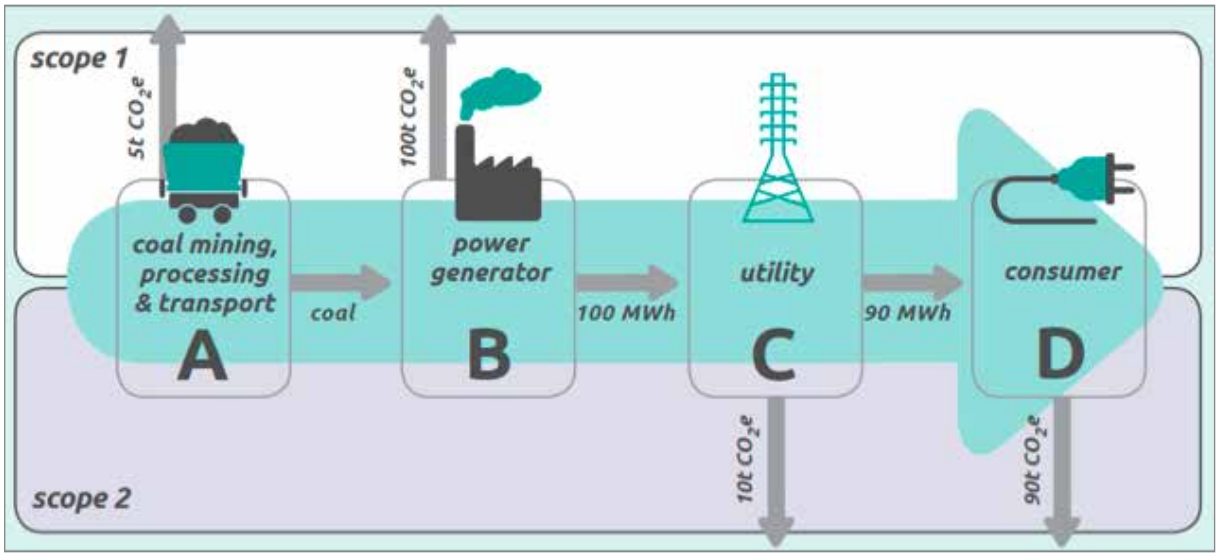


Figure 12: Emissions along the value chain of electricity production, source: GHG Protocol, page 42

As can be seen in Figure 13, the main GHG emissions are located in varying sectors and areas.

- Manufacturing sector: Extraction of raw materials, production of intermediate products, emissions from use of products, whereas the focus – materiality of impact – can be on operational Scope 1 and 2 emissions (cement manufacturers) or in the use phase (Scope 3 of a chip manufacturer).
- Service sector: Purchased energy – Scope 2; office supplies, business travel, conferences, employee commuting, product impacts – Scope 3.

We will go into a more in-depth analysis in step 8. However, an initial evaluation for this will be completed during basic data collection.

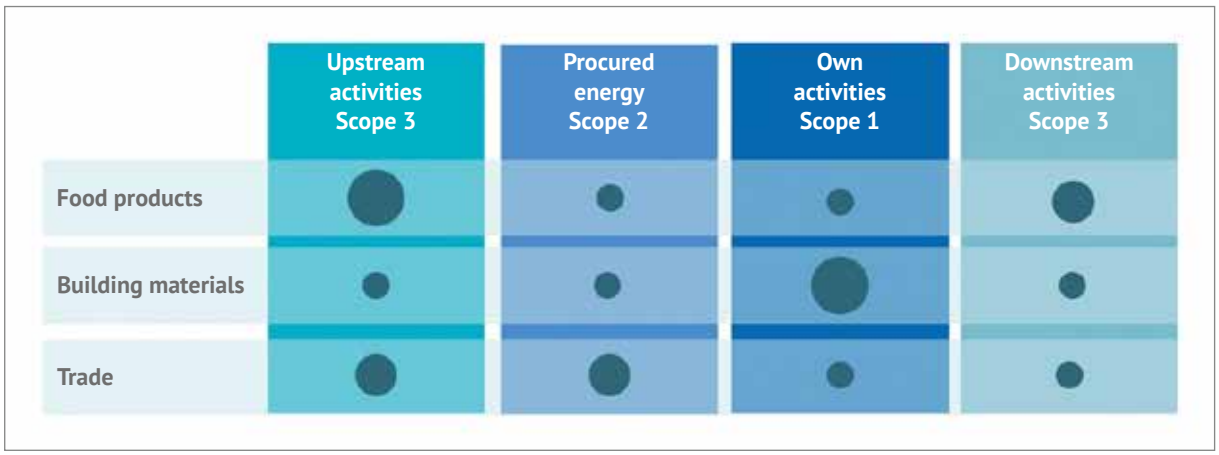


Figure 13: Emission core areas within the value chain (generic)

To address the issue of Scope 3 inclusion in a consistent manner, ISO 14064-1, as it is common in other ISO procedures, requires organisations to develop and apply a process by defining traceable materiality criteria, taking intended use into account. These materiality criteria MUST be used by the organisation to assess which Scope 3 emissions are included and which are excluded.

Important: Regardless of intended use, these criteria should not be used to exclude significant amounts of indirect emissions. Exclusions of significant indirect emissions must be justified.

Practical tip

The criteria for assessing materiality may take following aspects into account:

- Dimension/volume of emissions
- Degree of influence on sources/sinks
- Access to information and accuracy of attributed data (complexity of organisation and monitoring)
- Regulation, standards, sector-specific guidance/industry standards
- Corporate strategy, political relevance
- Employee motivation
- Approaches to reduce and influence GHG emissions
- Reputation
- Risks or opportunities (e.g. climate-related risks such as financial risks, risks related to legal regularities, supply chain, product and customer risks, litigation, image risks)
- Organisational business opportunities (e.g. new market, new business model)
- Relevance and interests of internal and external stakeholders
- New technologies

Identifying legal obligations and other requirements

The requirement for legal compliance is not part of ISO 14064-1 as it has a different focus – the quality of the GHG report. However, part of any good governance and management system (QM, UM, occupational safety, EnM, etc.) is to ensure that laws and other relevant requirements that an organisation has committed to are complied with. Checking organisational practices against laws applicable to CliMS and other relevant requirements of interested parties is therefore an essential task in baseline data collection.

This commitment, which is essential for sustainable corporate development, should be made in CliMS: GHG-relevant legislation is increasing in force at all levels and has a general tendency to become more stringent, which has a direct impact on corporate actions.

The introduction of a certificate disposal on all fossil fuels through the Fuel Emissions Trading Act (FETA) will make detailed assessment of GHG emissions and their consideration in future innovation decisions a must.

Many German companies are already affected by regulations of the Energy Saving Ordinance (ESO) or the energy audit obligation under the Energy Services Act (EDL-G), but the European Emissions Trading Directive (EHRL) is also already having an impact on energy suppliers and manufacturing companies in certain sectors. Other regulatory instruments may include:

- Efficiency standards
- Emission trading schemes (European Emissions Trading, Fuel Emissions Trading Act)
- Mandatory GHG reporting
- Conditions for subsidies
- Regulatory law
- Communication requirements for products or services

To be able to systematically overview further developments, it is necessary to create a comprehensive collection (legal cadastre): Relevant laws, municipal regulations, voluntary commitments, energy-relevant licensing requirements, technical regulations for plants, processes and other relevant requirements, regulations, and restrictions. The cadastre should be created as part of baseline survey and then checked for relevance at regular intervals and updated if necessary. However, it should only contain those regulations that apply or could apply to the organisation, otherwise overview will quickly be lost.

Step 3
Inventory:
Data basis,
materiality, compliance

Need for action in energy management

For the GHG balance, overlaps between existing data structure of data management systems and evaluations regarding energy management according to ISO 50001 should be analysed. If operational energy use and consumption provide a solid basis for logging Scope 1 and Scope 2 emissions, GHG emissions for Scope 3 remain out of focus for the conventional EnMS according to ISO 50001.

Traceable materiality criteria should be established for Scope 3 emissions and reconciled with the initial analysis of reporting boundary. Exclusions for Scope 3 should be referenced with the stakeholder analysis and application of GHG balance and submitted to management for approval. The EnMS systematics of the legal cadastre can be retained. Its content should be supplemented with requirements regarding CliMS. Updates at: e.g. umwelt-online, information from associations, certifiers, etc.

STAGE II – DEVELOPING GREENHOUSE GAS MODEL

Once all potential GHG sources and consumption quantities have been recorded, the resulting GHG emissions must now be determined or quantified. The collected data in kWh, Nm^3 or kg must be converted into CO_{2eq} via measurement (analysis) or model application (fixed emission factors from valid databases or estimates). For MS managers, this means on the one hand working with usual operational data collection systems and on the other hand searching for appropriate and accepted secondary data (emission factors) needed to calculate GHG emissions.

4TH STEP: QUANTIFICATION OF GHG EMISSIONS AND GHG REMOVAL

ISO 14064-1 refers to the choice or development of a GHG quantification model that includes the entire data flow from data collection to GHG model to GHG calculation:

6.1 – 6.3

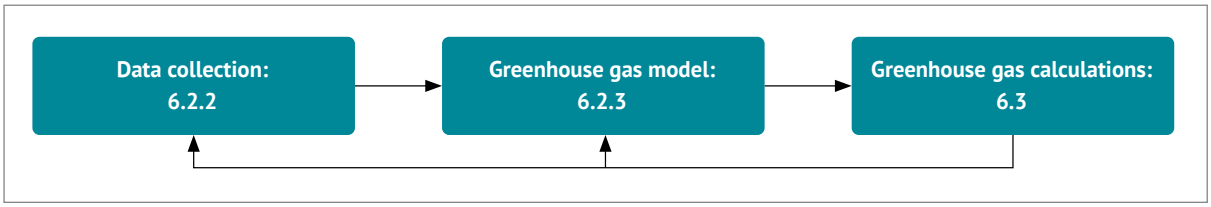


Figure 14: Steps of quantification approaches, source: based on ISO 14064-1

Quantification methodologies must be selected and applied in such a way that uncertainties are minimised, and accurate, consistent, and reproducible results are obtained. They must be plausible and documented accordingly. In particular, the following aspects of the model should be considered:

- Accurately reflection of emissions and removal
- Application limits
- Uncertainties and accuracy
- Reproducibility of results
- Appropriateness
- Origin and degree of its recognition

	Activities	Example for calculation: CO_{2eq} emissions = ...
Accuracy	Emissions (greenhouse gases other than CO_2)	GHG emissions [t] * Global warming potential of this gas [Global Warming Potential]
	Primary energy consumption	Diesel consumption [l] * Emission factor for diesel [t CO_{2eq}/l diesel]
	Secondary energy consumption	*Electricity consumption [MWh] Emission factor for electricity consumption [t CO_{2eq}/MWh]
	Other operational data (physical units)	Distance/kilometres driven [km] Emission factors per distance [t CO_{2eq}/km]
	Financial data	Total flight costs [EUR] / average cost of airline ticket [EUR/flight] Emission factor per flight [t CO_{2eq}/flight]
	Structural data (extrapolation)	Sales area [m^2] * Emission factor per sales floor [t CO_{2eq} /m^2]

Figure 15: Calculation logics for activity data, source: based on WWF & CDP, p. 58

Selection of emission factors

When selecting emission factors, in addition to the aspects mentioned for quantification methodologies, information provided by energy suppliers (own supplier for electricity, heating, steam and cooling) and existing recognised databases should be used above all. Databases usually contain literature values of recognised institutes (ifeu Institute, Öko Institut or IPCC as an intergovernmental committee) and scientific publications on specific topics. Generally, the more specific the emission factors, the more extensive the research.

When selecting emission factors and databases, it should be noted that some factors include upstream chains and thus the production process (extraction, processing and transport, sometimes even including construction of conveyor systems on a pro rata basis).[9] Others only take direct substance combustion into account. Some common databases are listed below:

- GEMIS (free of charge, values for energy, material, and transport systems)
- ecoinvent (fee-based, one of the best-known services)
- ProBas (free of charge, with life cycle data, from UBA and Öko-Institut)
- Gabi
- Tremod
- EcoTransIT
- EFDB (fee-based, English, contains emission factors from the Intergovernmental Panel on Climate Change (IPCC))
- Emissionfactors (free of charge, English, various sources)
- Greenhouse Gas Protocol (free of charge, English)
- Life Cycle Database (partly free of charge, English)
- DEBEIS – formerly DEFRA (free of charge, English, some data UK-specific)
- German Association of the Automotive Industry (VDA)
- Database for the European electricity mix – AIB

Note: Even when selecting emission factors from databases, appropriateness of model assumptions and origin, and degree of acceptance of the underlying model should also always be assessed.

Various calculation tools can also be used as a supplement:

- EnergyAgency NRW
- KlimAktiv
- ecocockpit
- FutureCamp / KlimaManufaktur

Practical tip: Emission factors
The UK Department for Business, Energy & Industrial Strategy (DEBEIS, see list of databases) publishes an annual Excel spreadsheet with a comprehensive and cost-free collection of emission factors for Scope 1-3. The list also includes CO_{2eq}. Please note that the corresponding electricity mix was also used as basis for the UK emission factors, so there may be differences for individual emission factors that should be assessed.
Emission factors should be taken from the reported emission year (if available) or otherwise the latest available year and should best characterise the network in question, meaning that local, regional, or national circumstances should be considered. It should be noted that other indirect emissions from generation such as transmission and distribution losses (T&D losses) or well-to-tank (WTT) from Scope 3 should also be considered.

9 Emission factors used to calculate carbon footprint are available without and, in the best case, with "upstream chains". With upstream chains means that they include emissions from upstream and downstream processes. For example, the emission factor for diesel without upstream chain only includes direct emissions from its combustion. The emission factor with upstream chain additionally includes emissions that occur during extraction of raw material, refining, and through supply.

An emission factor for electricity is intended to reflect emissions of electricity consumption. Balanced emissions of consumed electricity usually differ from those generated during production. Upstream and downstream emissions are not included in the production mix. There are various approaches for obtaining realistic emissions:

- According to §42 EnWG, every electricity supplier has a so-called electricity labelling obligation, according to which environmental impact must also be shown in g CO_2/kWh.
- To also include emissions from line losses, imported and exported electricity in the balance, the residual mix should be used. Guarantees of origin are also taken into account here. Further information on the residual mix can be found at the association of issuing bodies (AIB, see list of databases). Specific regulations on electricity accounting can also be found in the GHG Protocol Scope 2 Guidance at https://ghgprotocol.org/sites/default/files/Scope2_ExecSum_Final.pdf.

Step 4
Quantification of GHG emissions and GHG removal

Need for action in energy management
For converting used energy, resilient emission factors (EF) must be used for the GHG model. It must be assessed whether these EFs are fundamentally reliable and also include upstream chains and CO_{2eq}. To research EF, databases, tools, publications, or studies that fit the corporate circumstances should be used. A detailed assessment is indispensable!
The emission factor for purchased electricity, due to its usually great significance, should be differentiated and justified according to grid-average emission factors (location-based approach) or to information provided by the electricity supplier (market-based approach).

5TH STEP: SELECTING AND DEFINING THE BASE YEAR

6.4.1
6.4.2

For GHG accounting, it is assumed that the organisation establishes a historical base year against which further climate targets can be measured and concrete measures and their implementation can be assessed. A robust target setting and climate policy requires a balanced decision on the reference year, which is why all significant internal and external influences and developments should be taken into account when selecting the historical period (base year, seasonality or other justifiable periods).

If no sufficient information on historical data is available, the first GHG balance may also be used as base year.

The following criteria (among other) should be considered for decision-making:

- Use and message of GHG balance, e.g. what message does the company want to communicate and how it should be formulated on the certificate
- External requirements regarding the GHG balance, e.g. are there specific requirements from industry, international agreements (Paris Agreement), initiatives (Science Based Targets), or specific stakeholder interests
- Internal requirements for GHG balance, e.g. is there a specific year of particular importance for employees, internal reporting periods (financial years), or specific strategic management decisions
- Technical or organisational changes, e.g. have there been relevant changes in recent years, such as a merger, takeover or dissolution, or substation of fuels

Above all, attention should be paid to ensure that the selected baseline period is representative for the organisation's current reporting boundary and that a robust data basis is available. The selection must be explained in the GHG statement.

The organisation may change its base year. However, it must justify any changes in this respect. If structural changes, changes in calculation methods, organisational boundaries, or errors are subsequently identified, these effects on the GHG balance must also be applied retroactively for the base period.

Step 5
Setting the base year

Need for action in energy management

When selecting the baseline period, various internal and external criteria should be considered. A close connection of the baseline period for the climate targets to the existing reporting periods and targets of the energy management system is recommended. The target strategy "avoid – reduce – compensate" should also be recognised here.

ISO 50001:2018 is an excellent tool for this, especially for the "Reduce" sub-aspect. For example, the standard immediately points out that its implementation already leads to organisations supporting general climate protection goals by reducing their energy-related greenhouse gas emissions. It is therefore important to also disclose EnMS energy efficiency targets in terms of their GHG savings potential.

As part of EnMS contextual analysis, external topics such as impacts of weather, of climate change and of the amount of GHG emissions generated should be analysed. This environmental perspective of strategic decisions in EnMS should simplify the strategic orientation towards climate protection. Conflicts regarding energy efficiency versus environmental improvement or climate protection may thus be avoided.

6TH STEP: PREPARING A GREENHOUSE GAS REPORT

In general, it is always advisable to document methodology and data sources used in a GHG report so that they can be tracked by all parties involved at any time.[10] There is a good reason for this – only what is written down (documented) can be improved. Experience shows: If there are only verbal agreements, people often act very differently, believing in good faith that everything is done according to agreement.

9.2
9.3
App. F

A management report such as a GHG report provides a TARGET with what an ACTUAL may be compared. Therefore, documentation in context of management systems is not a "meaningless mandatory task" but entails continuous improvement. However, the documentation system should be appropriate for the system's purpose and the organisation's size.

GHG documentation can be in paper, electronic, or other form. Handling of all relevant information must be defined and documented in a procedure regarding document storage and record maintenance.

According to ISO 14064-1, a GHG report only needs to be prepared if a public GHG declaration is made, or if the GHG balance is to be verified by a third party. In our experience, a management system is necessarily linked to a document system.

There is no obligation to publish the GHG report, as it is the case with environmental declarations (EMAS), for example. In the case of verification, the declaration of conformity (certificate) serves as proof. Regardless of this, GUTcert always recommends transparent and open external communication.

10 If confidential information is not included in a GHG report, this must be justified.

The following principles are basic requirements for the GHG report:

- Relevance: All data and information are to be selected according to the needs of the intended user
- Completeness: All relevant GHG emissions and removals should be included
- Consistency: Meaningful comparisons of GHG-related information should be allowed for
- Correctness: Systematic deviations/uncertainties should be reduced (as far as possible)
- Transparency: Appropriate GHG-related information should be disclosed to enable users to make decisions with sufficient certainty

Practical tip
As with any important document, it is essential to determine who is responsible for the GHG report (document management) and who will be involved in document approval in addition to the main person responsible (e.g. management, quality management officer, etc.). Furthermore, it should be clarified in advance how often the GHG report should be issued and which information from the GHG model (usually Excel calculations) it should contain. A list of revisions should also be included.

According to ISO 14064-1, the following structure is recommended for the GHG report:

1. General description of organisational and balance sheet objectives
   a. Base period
   b. Climate objectives and climate strategy (including intended use and stakeholder analysis)
   c. Responsibilities

2. Organisational boundaries

3. Reporting boundaries

4. GHG model
   a. Data sources
   b. Assumptions and calculation methodologies
   c. Emission factors
   d. Scope 3 materiality consideration
   e. Uncertainty assessment

5. GHG reduction initiative and internal performance monitoring

Scope 1	(t)	(%)
Energy from own generation	3.300	11%
Refrigerant	220	1,7%
Vehicle fleet	1.280	3,3%
Total	**5.020**	**16%**
Scope 2	**(t)**	**(%)**
Electricity	1.200	4%
Total	**1.200**	**4%**
Scope 3	**(t)**	**(%)**
Raw materials & packaging	21.000	70%
Employee transit & business travel	900	3%
Water & waste disposal	30	0%
Office supplies and printing	30	0%
Logistics (inbound/outbound)	2.100	7%
Total	**24.060**	**80%**
Total	**30.280**	**100%**

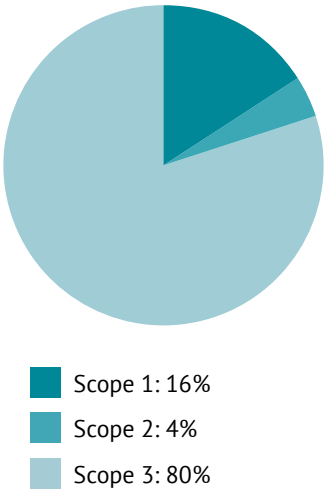


Figure 16: Example of GHG balance according to GHG Protocol

Note
Another example template of a GHG report can be found at the Carbon Disclosure Project (CDP) at:
http://klimareporting.de/wp-content/uploads/2014/02/Klimareporting_Vorlagenheft_Klimabericht_2014_02_20.pdf

Step 6
Creating a Greenhouse Gas Report

Need for action in energy management
The documentation in the GHG report should be appropriate for the purpose of the GHG balance and the organisation's size. Main decisions and methodologies should be comprehensibly included. This concerns especially the objectives and boundaries of the organisation, and of the balance. In particular, Scope 3 is usually not included in the EnMS balance sheet.
While planning and creating, the intended use and the stakeholders' interest should always be kept in mind. It is advisable to use existing structures of energy management to keep the effort as low as possible. In particular, the collected data of energy assessment (6.3) and planning of energy data collection (6.6.) should be expanded regarding GHG data.

7TH STEP: AN INITIAL MANAGEMENT REVIEW

8.1

With the data collected and the GHG report, top management and, if possible, all positions and people who have a significant influence on GHG emissions conduct a (first) management review. Here, results of data collection and the first GHG balance are presented, explained, and discussed.

Afterwards, it is important to:

- Review responsibilities and authorities
- Identify required competencies and training for the people concerned
- Validate organisational and balance targets for timeliness
- Rate organisational boundaries
- Review application of materiality criteria
- Contemplate first concrete targets
- Prepare a list of possible actions for reducing GHG
- Design a monitoring system to track measures (planning of internal audits)

Subsequently, decisions must be made by top management:

- Context determination and prioritising of internal and external issues relevant to GHG planning
- Determination of risks and opportunities in relation to CliMS
- Drafting the organisation's initial climate strategy
- Confirming of compliance and adherence to all climate-related legislation or formulating of measures to ensure compliance in the future
- Determination/confirmation of GHG balance, main GHG sources and sinks, and importance of scopes in relation to the strategic direction
- Confirmation or derivation of climate targets and actions for the next period
- Deciding next steps (putting the system on a formally more stable footing and moving on to stage III, or simply annually updating the basics and staying at stage II for the time being)
- Establishment of a suitable organisational structure for processing goals, collecting data, regular communication and, if necessary, further development of CliMS in the next stage: Embedding in the existing management structures

If not before, results of the first review should be communicated in a suitable form at this point at the latest to inform, involve and motivate all staff. Extensive information has potential to involve all employees in saving efforts.

Step 7
First management review

Need for action in energy management

The decisive course for furthering the climate strategy and methodology of the GHG balance should be set in the first management assessment. Experience shows that a valid basis is needed to make sound decisions. Therefore, steps 1-6 should be implemented in advance to the management review. Especially the discussions on organisational boundary and materiality considerations from Scope 3 should be carefully prepared and already documented in the GHG report.

STAGE III – CLIMATE STRATEGY: AVOID, REDUCE, COMPENSATE

Within the first steps, important foundations for establishing a CliMS have been set. The analysis of GHG sources that has been carried out already makes it possible to identify and implement potentials for CO_2 avoidance and reduction. For some companies, this may already be enough to get started. They can simply continue the annual recording and management assessment with updated target settings.

However, many will want to tackle the next steps up to external verification because of the transparency already created and the successes achieved. On the one hand, it is a matter of achieving the set reduction target and, on the other hand, a matter of effectively and efficiently integrating necessary steps and stages into the company's organisation to benefit from the effects of the continuous improvement process within the framework of a management system.

In steps 8 to 12, existing management system structures are thus expanded to include climate topics, and the necessary aids and tools are provided. Dovetailing with the existing EnMS organisation is continued. Only where necessary should additional responsible people be appointed and new processes initiated. The following steps therefore describe further important elements that will increase effectiveness of the CliMS in all areas of an organisation.

8TH STEP: CLIMATE POLICY, TARGETS, KEY FIGURES

The initial inventory of GHG sources and the consideration of materiality provide an important strategic basis for decision-making in context of the aspired CliMS. Details of which parts or products of the organisation are to be covered by the CliMS and which balances are to be aimed for must be determined. The carbon footprint offers a suitable methodology in this regard, as it can be determined at company level (CCF) on the one hand and at product level (PCF) on the other.

Corporate Carbon Footprint (CCF)

The Corporate Carbon Footprint (CCF) includes direct and indirect GHG emissions released by activities of a company or organisation. These emissions can be divided into three scopes:

- Direct GHG emissions, known as Scope 1 emissions, which occur at a site or part of a company, e.g. emissions deriving from use of the company's own power plant
- Indirect GHG emissions, so-called Scope 2 emissions, which arise from external energy supply of a company
- Indirect GHG emissions, so-called Scope 3 emissions, which arise along the value chain (e.g. business travel, manufacture of supplied products)

To determine the CCF, GHG sources need to be identified and their materiality assessed. By drawing up a GHG balance sheet, the company then identifies its GHG hotspots, determines CO_2 savings potentials, and can evaluate whether existing energy-saving measures are target-oriented. Disclosing the CCF is an effective tool for a company to make its environmental impacts transparent, to demonstrate environmental commitment and to meet stakeholder wishes.

When verifying the Corporate Carbon Footprint, an accredited verification body checks the calculations against the requirements of ISO 14064-1, ISO 14040, or the Corporate Standard of the GHG Protocol. Verification according to international standards enables credible communication of the CCF and the company's climate strategy.

Product Carbon Footprint (PCF)

The calculation of the Product Carbon Footprint (PCF) enables the assessment of the carbon footprint of a specific product. The GHG that occur during the entire product life cycle are calculated according to the principle "from cradle to grave". The PCF considers climate-damaging emissions that are released through:

- Raw materials and their procurement
- Transport
- Production
- Packaging
- Distribution/trade
- Utilisation phase
- Product disposal

To calculate a PCF, a GHG balance (see stage II) must first be drawn up by identifying comparable key figures and assessing their materiality. With this inventory, courses of action and potential CO_2 savings along the value chain can be identified. With a PCF, the company can develop a strategy to save GHG emissions along the value chain and reduce the product's environmental impact.

Subsequently, calculation methodology, savings strategy and collected data can be verified by an accredited certification body. The regulatory framework for verification of the PCF is ISO 14067, the Product Lifecycle and Reporting Standard of the GHG Protocol and PAS 2050, while the Carbon Footprint can be verified at project level according to ISO 14064-2. In the verification process, detailed remarks are provided regarding the efficiency of savings measures and on process and product optimisation. If the PCF meets the applicable standards, the Product Carbon Footprint can be verified by a certificate and communicated without hesitation.

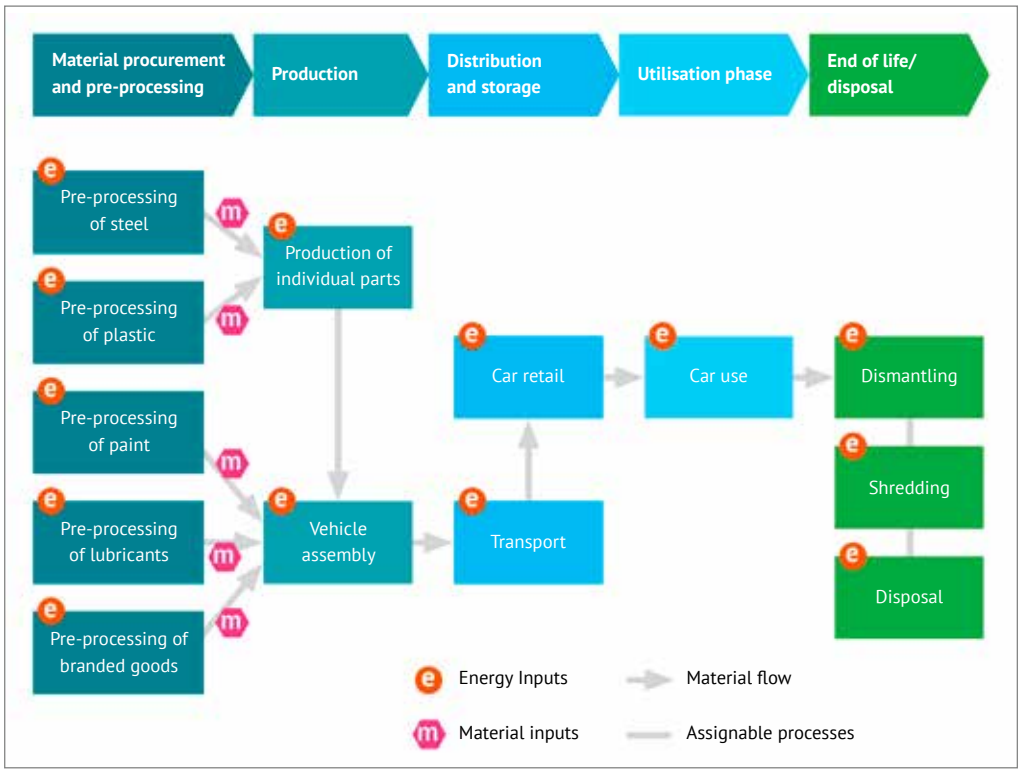


Figure 17: GHG chain of value for a car, source: based on GHG Protocol Product Life Cycle Accounting and Reporting Standard

Once the appropriate decisions on the strategic approach of CliMS have been made, a climate strategy can be formulated. As part of the introduction of the energy management system, management has drawn up the higher-ranking strategy in relation to the company's context. With this, the company commits, among other things, to ensure the continuous improvement of energy-related performance, to implement measures, acquire energy-efficient products and services, and implement measures for efficient operation.

ISO 14064-1 does not explicitly require a climate policy, only climate targets. However, for a successful integration of the CliMS into existing management systems, we recommend to first formulate a climate policy: As in other management systems, this provides the working framework and strategic goals of the CliMS. The ISO principle of continuous improvement of (climate-relevant) performance and the management system itself should also not be missing from the climate policy.

All measures should be oriented towards the hierarchy of climate neutrality:

Figure 18: The basic principle for achieving climate neutrality

- Avoid – Usage of renewable energies and abandonment of climate-damaging technologies
- Reduce – Reduction of energy consumption and other GHG sources
- Neutralise – A strategy for unavoidable emission remainders

Top management hereby determines the importance of the CliMS and how the strategic course is set for the triplet "avoid-reduce-neutralise".

- "Avoid-Reduce": In addition to general commitment to corporate climate protection, the focus of strategic orientation should be communicated here. This means a top management commitment to take a comprehensive look at GHG emissions along the value chain (Scope 1-3) as a basis for corporate action.
- "Neutralise": Another strategic consideration is to compensate for unavoidable GHG emissions.

Climate targets

The company sets a framework for further action and internal and external communication based on its energy and climate policy. An absolute climate target refers to an absolute GHG emission reduction. Alternatively, a relative climate target may be set with reference to GHG intensity, although this does not necessarily lead to a GHG emission reduction per se and is therefore not considered as ambitious as an absolute climate target.

Within target setting, companies should differentiate between covered activities (e.g. for a site, a product or a project) and covered GHG (CO_2 or also other GHG), such as CO_2 neutrality for the company site by 2025 and net zero emissions in supply chain by 2030, etc.

Note: Climate neutrality
Climate or carbon neutrality describes the balance between emission and absorption of carbon from the atmosphere into sinks. The European climate targets refer to "net greenhouse gas emissions" (EU Green Deal) or "net zero emissions" (FME Climate Protection Plan 2050), e.g. a state in which no greenhouse gases are emitted exceeding those that can naturally be absorbed.

Regardless of all efficiency and CO_2 reduction measures, not all emissions can usually be reduced or avoided by companies on their own. Remaining CO_2 emissions may be counterbalanced, for example, by investing in recognised climate protection projects (e.g. Gold Standard, Verified Carbon Standard). Internationally, the ISO 14068 standard is being developed to create binding definitions. Up to now, climate neutrality is usually assessed based on PAS 2060.

EnMS distinguishes between goals and energy targets. While "target" generally refers to the result, that is to be achieved and is oriented towards the above-mentioned guidelines, the "energy or CO_2 target" is always a quantifiable goal for improving energy-related performance. A CO_2 or energy target should always have a concrete verifiable value, giving policy and strategy related to CliMS a structure and a concrete roadmap.

"Reducing GHG emissions from heat generation" or "increasing the share of renewable energy" are strategic targets and belong in the climate policy and the overall climate strategy. Targets should still be specific, measurable, ambitious, realistic, and timed ("S.M.A.R.T."). They are in line with the climate policy and are key instruments of any management system. Targets that are not measurable e.g. whose pursuit cannot be monitored and whose implementation cannot be proven, are irrelevant for the system.

Examples

- Target-setting for absolute GHG emissions
- Performance indicator: Tonnes CO_{2eq} achieved, or percentage reduction compared to the reference year
- 20% reduction in absolute emissions, equivalent to a reduction of 1 million tonnes CO_{2eq} by 2025 compared to the same period in 2019
- Target for energy efficiency in percent, for example: Improvement of 3.2% by 2025 compared to the reference year 2019 for production area XY
- Target: Increasing share of renewable energies by, for example, 15% by 2025 compared to the reference year 2019

Examples of energy targets related to overarching goals

Scope 1
- Reduction of compressed air leakages in paint-spray lines by 10% of the previous year's value by 31.12.2020
- Reduction of waste heat losses from process steam by 15% by 30.09.2020
- 100% Substitution of equipment with climate-damaging refrigerants for cooling and air conditioning in retail branches with more environmentally friendly refrigerants by 31.12.2022

Scope 3
- Reducing CO_2 emissions from employee commuting by 15% by 31.12.2020 by offering e-bikes and car-pooling
- Reduce emissions from transport activities by 20% through driver training and introduction and use of telematics systems for efficient route planning by 31.12.2020

Building on this, companies may decide to include further criteria in their climate targets. An approach such as Science Based Targets can be helpful in integrating scientific knowledge on climate change.

Science Based Targets
SBTs refer to reduction targets for relevant greenhouse gas emissions that are calculated on a scientific basis. Science Based Targets were created in mid-2015 by the Science Based Targets Initiative as a result of a merger of the organisations CDP (Carbon Disclosure Project), WRI (World Resources Institute), WWF (World Wide Fund for Nature), and UNGC (United Nations Global Compact).

SBTs refer to a target in line with the <2°C target of the 2015 Paris Climate Agreement. Over 950 companies have joined the initiative (as of 09/2020). Regardless of joining, it is possible to form a climate target based on this methodology. Website: https://sciencebasedtargets.org/

Measures

With an EnMS, you have already established a strong organisational framework and lever to make GHG emissions transparent and to implement measures for CO_2 avoidance and reduction. Analogous to energy assessment in EnMS, the aim of a CliMS is to identify relevant CO_2 emitters, to derive potentials and to develop corresponding goals and measures. The balance sheet shows where emissions occur – now they need to be avoided or reduced.

The company commits itself, for example, to only use resources that are actually needed or to exclude technologies that are harmful to the climate ("avoid"). In order to reduce consumption of resources, the company can rely on best available technologies, measures to increase efficiency and/or substitution of alternative materials or increase the share of renewable energies in the used electricity mix.

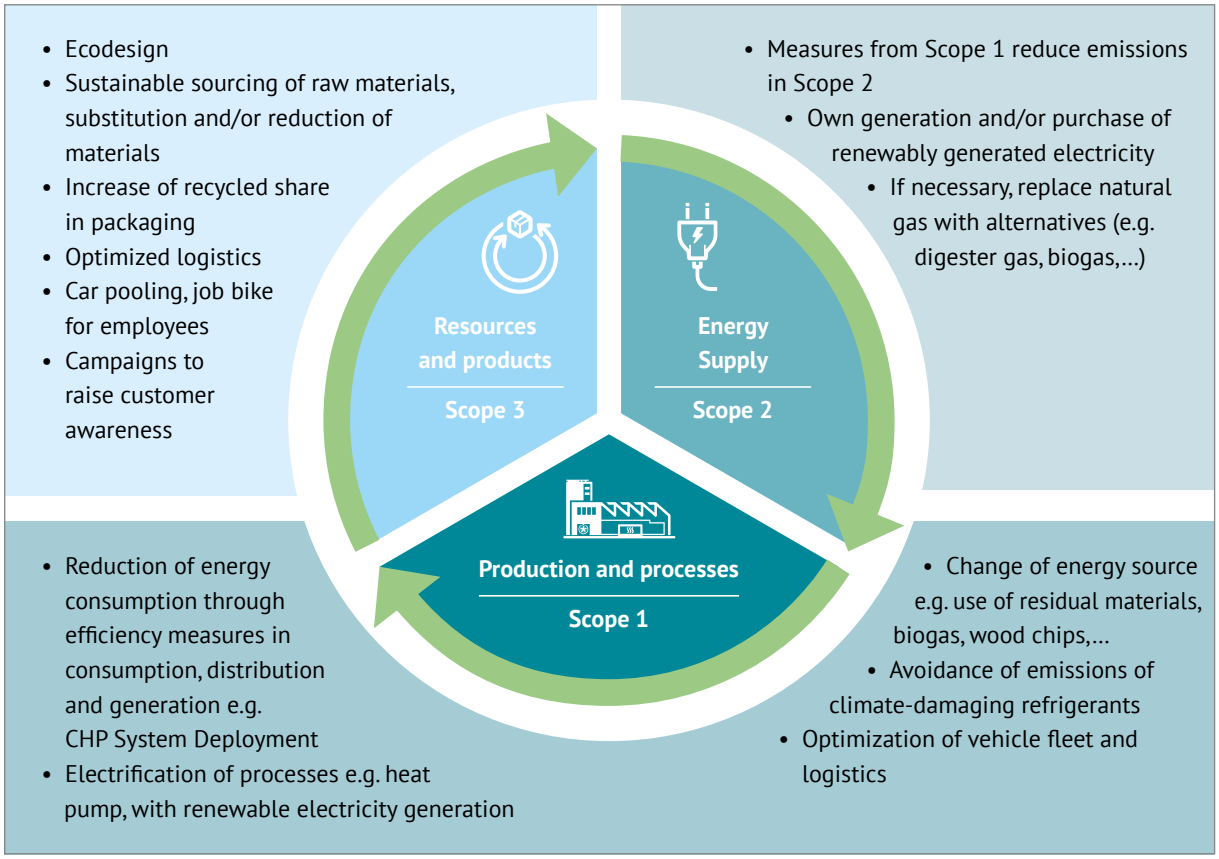


Figure 19: Levers for avoiding and reducing emissions (example food industry), source: ÖKOTEC

Depending on sector or stage in the value chain, the ability to influence upstream and downstream Scope 3 activities is challenging or not possible for various reasons. Within the Science Based Targets Initiative, companies are asked to perform a Scope 3 screening to determine whether GHG emissions from upstream and downstream activities account for more than 40% of total emissions (Scope 1-3). If this threshold is exceeded, a Scope 3 target is mandatory.
If climate neutrality according to the British standard PAS 2060 is the goal, all Scope 3 categories that account for more than 1% of the total carbon footprint must be accounted for.

According to the objective target, measures are to be evaluated and prioritised. For this purpose, the already existing technical-economic perspective for the assessment of measures must be expanded to include socio-political and ecological parameters. Furthermore, dynamics or uncertainties must be considered, for example the price development of fuels according to the Fuel Emissions Trading Act and the availability of CO_2-neutral fuels.

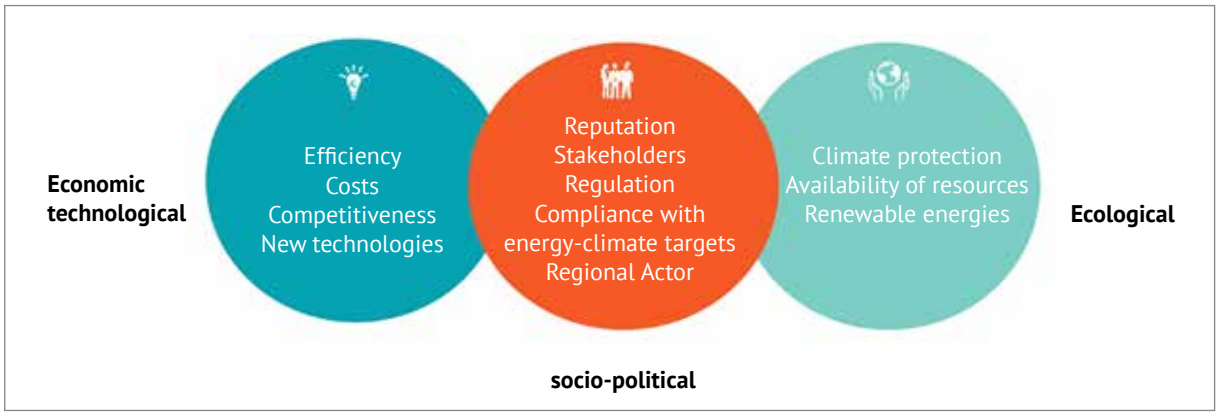


Figure 20: Examples of materiality criteria for evaluating measures

When evaluating emission categories, it is still relevant to consider their influenceability. Therefore, many companies begin with measures within scopes 1 and 2, as responsible parties have direct influence within these scopes (see also step 3).

Practical tip
For consideration of measures and a roadmap, the following questions might be helpful:

- Which energy media should become CO_2 neutral? What is the dimension?
- Which alternatives for CO_2-neutral energy supply are available by 2030 and how will prices develop (electricity, biogas, H_2)?
- Which energy efficiency measures and (waste) heat utilisation are economically feasible in this time frame and with which (alternating) effects?
- Can flexible storage or hybrid solutions as well as individual solutions for on-site generation be used economically?

Ideas for GHG reduction and corrective measures must be prioritised in a further step. Prioritisation can be derived, for example, from whether legal concerns are affected (highest priority), whether a fast, inexpensive implementation is possible, whether the savings volume is particularly high, etc. The prioritisation is, for example, based on results of the in-depth materiality assessment of climate-impacting emissions.

Depending on the complexity of the examination, a scenario assessment may be useful to support the decision-making process. The aim is developing a climate context roadmap for conversion of energy media (incl. retrofitting of plants, if necessary), which also considers the fulfilment of regulatory framework conditions within the extent of this roadmap or scenario.

Measures and project-ideas to avoid and reduce GHG

1.) Fuel self-sufficient factory, technology company
As part of a savings project, it was determined that systematic heat recovery from compressed air and cooling is possible. Furthermore, efficiency measures such as optimising air-injection in halls, adjusting control technology and optimising the peak load could be identified. After implementing these measures, an almost fuel-free operation in a winter period was confirmed, with an annual saving of 2,000 t CO_2.

2.) Tip Project idea: Conversion of climate-damaging refrigerants in combination with an optimisation of a refrigeration supply system
On 1st of January 2020, the new stage of F-Gases Regulation – VO(EG) 517/2014 – came into force to reduce emissions of fluorinated greenhouse gases (F-gases). This affects more than 2 million refrigeration- and air conditioning-systems in industry and commerce. The conversion of a refrigeration supply system to a different refrigerant – e.g. due to the requirements of the F-Gas Regulation – poses a significant change within which questioning existing concepts, making requirement-adjustments, and raising efficiency-potentials is worthwhile.

In conventional refrigeration systems, heat energy extracted from process plus drive energy converted into heat is released at great expense into the environment as waste heat. This not only pollutes the environment but is also a waste of energy. Often, heat at a temperature level of 60°C to 90°C is also required. Heat pumps can be used to generate cold and heat at the same time. Modern storage solutions also offer the possibility of compensating for use-specific, temporal- or capacitive-differences. High-temperature heat pumps can also generate temperatures of > 100°C.

Practical tip
Energy performance indicators can easily be used or adjusted to monitor CO_2 savings, if appropriate emission factors are adopted to evaluate the amount of used energy.

Practical tip: Funding opportunities through BMWi and FME
When making investment decisions on implementing measures, funding opportunities should be considered. There is a broad range of funds available on various levels (federal, state, local) and target groups – they are worth researching!
The BMWi offers attractive funding opportunities for measures to increase energy efficiency and the usage of renewable energies for process heat. The funding package "Federal Funding for Energy Efficiency in the Private Sector" offers plenty of tolerance for implementing a suitable solution. There is a choice between a grant and a loan with partial debt relief (repayment allowance). Another funding option with higher funding rates is offered by the programme "Federal Funding for Energy Efficiency in the Economy – Funding Competition".
Current information on this can be found at deutschland-machts-effizient.de.
In 2019, the amended Refrigeration and Air Conditioning Directive also came into force as part of the National Climate Initiative (NKI) of the Federal Ministry for Environment. The new funding conditions make it possible to switch to sustainable systems that protect the climate in the long term. Among other things, funding is available for refrigeration generators, associated components, and systems as well as thermal storage units. More about FME funding may be found on the BAFA website (section energy/energy efficiency/refrigeration and air conditioning systems).

Key figures

For the success of the CliMS, key figures or performance indicators should be selected that are in line with the strategy and its processes and can accordingly well support evaluation and the decision-making processes. Key figures are indispensable for the effectiveness of efficiency- and CO_2-measures, the improvement-progress and optimised facility-management.

Key figures should be edited and normed comprehensible, meaningful, and informative. The aim is to use the indicator to show a verifiable positive change compared to the baseline and to check whether implemented measures are effective or need to be readjusted. According to DIN EN ISO 50001, it is necessary to provide evidence of an improvement using appropriate energy performance indicators that correspond to a documented methodology.

FME /ÖKOTEC Indicator methodology for Scope 1
The indicator methodology of ÖKOTEC and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (FME) may be used to map out benefits and costs of facilities to determine overall efficiency.
Key figures are systematically established with a uniform scale (benefit per effort) for all concerted and relevant areas (process and supply plants as well as buildings). Extensive energy data can be summarised in meaningful parameters by usage of indicators and offer the user a variety of benefits.
The key figure methodology offers reports in various units, depending on the target group or user inside the company: For energy managers in "MWh", controller-evaluations in "Euro" or "Euro per unit", for sustainability officers on the other hand rather in the unit "tons of CO_2". Download from FME: Brochures, praxis guidelines, and key figure catalogue for cross-sectional technologies >https://www.bmu.de/meldung/enpi-connect-energiekennzahlen-in-der-praxis/

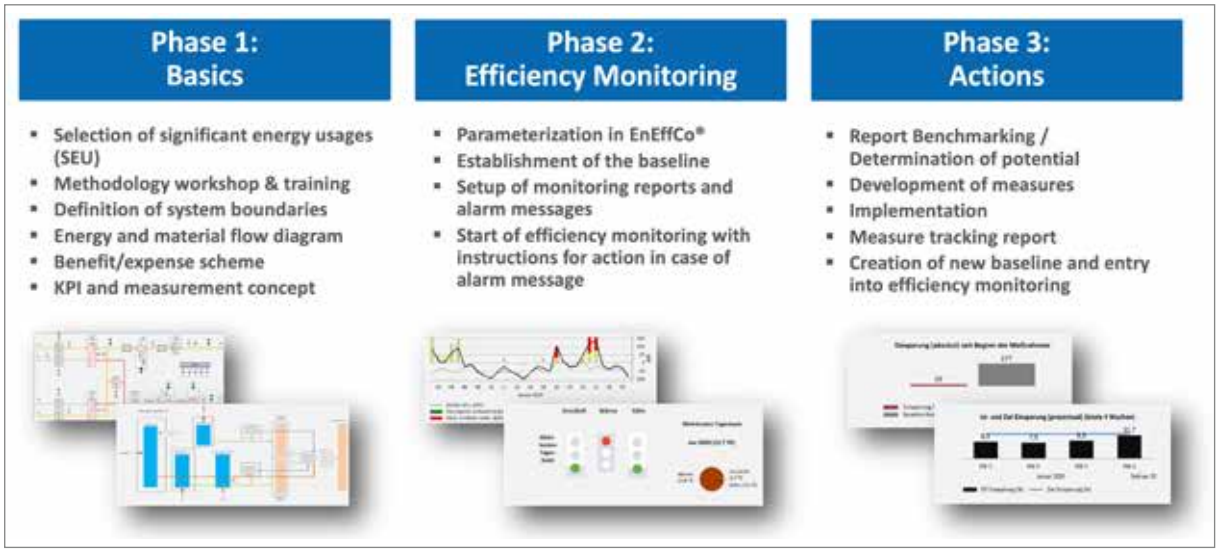


Figure 21: Systematic approach to efficiency improvement for a technology (SEU) based on the key figure methodology, source: ÖKOTEC

Step 8
Climate policy, objectives, key figures

Need for action in energy management
Within the first management review, deciding steps regarding climate strategy and GHG balance methodology should be taken. Experience shows the need of a valid basis to enable sound decision making. Therefore steps 1-6 should be concluded before the management review. Especially discussing organisational boundaries and assessment of materiality from scope 3 should be well prepared and documented in the GHG report.
Expand energy targets with goals regarding GHG lowering. These should always focus on reducing GHG emissions absolutely and reference the representative base year. Define target settings for specific time periods, e.g. from 2025 to 2030. Define key indicators with relevant parameters to monitor target effectivity.
Alternating courses of action for GHG reduction and avoidance need to be revived, prioritised, and a concrete target deducted. For calculation basis of variable costs, prices of energy fuels or media, that are also CO_2-neutral need to be used.
For amortisation calculation e.g. costs for emission-free energy, biogas, or green petroleum gas, need to be called upon. It needs to be considered, that these energy media may be subject to dynamic pricing due to future availability and demand. This contemplation is needed for specific efficiency actions and for choosing the suitable supply mix to be set up future-proof and sustainable.

9TH STEP: CLIMATE PROGRAM AND VERIFICATION OF SUCCESS

According to the extensive review in the previous step, an energy saving programme can be developed on a solid basis. In the climate programme or action plans, you define target measures and determine how implementation is organised operationally. KPIs, responsibilities, resources, and a deadline for each measure must be defined.

This must be agreed and decided upon with top management as part of the assessment and target setting process. Only then can climate strategy and action plans be processed with desired success. The climate programme summarises all savings targets and is the basis for success verification.

Regular controlling should be used to check processing status and effectiveness of implemented measures. Success is usually reflected in the GHG balance but can also lead to differences in GHG emissions or removal outside the GHG balance related limits.

Practical tip
Already at the start of climate strategy and survey of GHG balance (figures, organisation, legal environment), potential for improvement may become apparent. Note these down in a list of measures. Record all potentials, regardless of whether they currently appear feasible or not. Based on these listed potentials, initial climate goals can be set and summarised in a climate program and furtherly developed.

Measure		
No.	1	2
Location	Berlin	Berlin
Target allocation	CO_2 reduction/quantification	CO_2 reduction/quantification
Concerns	refrigeration	compressed air
Measure	Centralization of refrigeration and use of a highly effective refrigeration system	Installation of a higher-level control system
Measure		
Responsibility	EnM	EnM
Start	Sep 20	Jun 20
Implementation until	Mar 21	Aug 20
Status	In progress	Completed
Status comment	Delivery of new refrigeration plant CW43	–
Control		
Detection method	Metrological	Metrological
Electricity savings	127,800 kWh/a	14,200 kWh/a
Gas savings	–	–
Cost savings	19,170 Euro/a	2,130 Euro/a
Investment costs	320,000 Euro	13,600 Euro
Amortization	16.7	6.1
Verification comment	As new SEU integration in the EnMS	Already recorded and measured in EnMS

Figure 22: Explementary action plan for measures in manufacturing area

Verification of success

To verify an emission improvement, as already mentioned, establishing a baseline period is necessary. Furthermore, it is helpful to carry out the verification based on individual indicators regarding identified significant consumers or areas. In this way, an improvement or impairment in the respective area can be verified (bottom-up). Several indicators may need to be assessed to demonstrate an improvement in various areas. Accordingly, also a suitable reference period is necessary for each indicator.

When using key figures to verify savings, corresponding influencing variables (relevant variables) must be considered. In addition to savings verification after measure implementation, it is also advisable to verify ongoing compliance of this improvement. Accordingly, the system on which the measure was implemented should be subject to continuous monitoring.

Continuously measured data is important for verification. Estimates or selective measurements are not advisable, as they do not take sufficient account of influencing variables.

Step 9
Climate program and success verification

Need for action in energy management
Individual savings projects aiming to improve climate impact must be worked out from assessment results and subordinated to the respective goals of the action plan. Necessary resources, such as investments and personnel deployment, must be approved by top management. When implementing measures, GHG emissions or removal must be marked and quantified through implementation of GHG reduction initiatives. If a quantification and report is carried out, GHG reduction initiatives and associated differences in GHG emissions or GHG removal need to be documented separately.

IMPORTANT: If the organisation includes purchased or developed carbon credits in reports, these must be listed separately from GHG reduction initiatives. In addition to the general survey (climate programme), action plans should include a performance review and, if applicable, a calculation of economic viability for the savings project (e.g. taken from project cost controlling).

10TH STEP: DATA MANAGEMENT

The organisation shall, in terms of the standard, manage its GHG information according to an established and documented procedure.

The following objectives shall be pursued:

- Ensure accuracy and completeness of GHG balance with respect to GHG per se but also to the organisational limits
- Identify and address errors and omissions
- Consistency of GHG balance and selected GHG reporting format
- Compliance with standard-requirements

The data management process is about measuring GHG sources and sinks within the defined boundaries, and determining and documenting methods of monitoring, measuring, conversion, analysis, and assessment.

Data management procedure defines metrological specifications as well as measurement frequency, responsibilities, competences of the people responsible, limitations and used measuring instruments (if applicable). Care should be taken to ensure that all emitted quantities can be allocated to specific processes or units at the end of the measurement period.

Continuous monitoring of climate-relevant processes is a basis for maintaining and increasing efficiency. Similarly, for the goal of long-term reduction of GHG emissions continuous monitoring is also necessary. At the same time, proving effectiveness of implemented measures is important and, even better, maintaining long-term effectiveness of measures. For both goals – GHG reduction and efficiency maintaining – it is fundamental that data collection takes place at an appropriate time interval so that all operating states as well as weather-related, or seasonal fluctuations of influencing variables are recorded.

Practical tip
In practical implementation, we recommend creating a concept for key indicators and measurements (see 8th step) to decide which systems and associated influencing variables are to be measured. The selection of systems to be measured is based on the consideration of materiality (see 3rd step). Firstly, the focus should be on essential areas to achieve initial improvements there. The systems can then be successively expanded.

To save and evaluate measured data, a suitable energy controlling system is required to store all data in a central location and to be able to evaluate it accordingly.

In transition from energy management to CliMS, it cannot be assumed that all necessary data will initially be recorded using measurement technology. Experience shows that reporting is refined over the years and relevant processes are recorded more and more precisely and meaningfully. This also increases the informative value of the report over time.

Thus, data-basis will be a combination of continuously measured (live-) data and additional supplementary data. Supplementary data must be checked regularly to ensure that they are up to date. For example, emission factors must be regularly checked and adjusted. In the long term, continuous measurements should be set up for all essential areas.

If a data management system is set up flexibly, data maintenance and additions can be implemented easily and with little effort. Traceability and transparency of data are essential. All conversion factors must be documented and explained. When collecting data, it is also recommended to assess it‘s quality, as this also allows the significance of the results to be evaluated. Checking accuracy takes on a particular position here.

It is advisable to start with data collection for essential areas in a first step and then successively expanding them. Areas in which measures are planned and are to be implemented should also be equipped with necessary measurements, if possible, to be able to prove their success.

Furthermore, uncertainty associated with quantification approaches (e.g. for the quantification and models of used data) shall be assessed using a described methodology. If a quantitative estimate of uncertainty is not possible or costly, this must be justified, and a qualitative assessment must be carried out.

Also, a conversion methodology – also an essential part of the quantification approach – must be defined and documented to ensure consistency across multiple organisational areas. Furthermore, as in all ISO procedures, rhythm, and rules for checking data quality should be defined. This includes both surveys of technical facilities and systemic audits, as well as a regular review of opportunities to improve the information management process (see 12th step).

Praxis example: Product-specific footprint for companies with batch-processes

CO_2realtime offers the possibility of simplified and efficient data management. The aim of ÖKOTEC‘s project was to combine energy management software, real-time measurement, and methodology in a way that GHG emissions can be measured and reported in real time. The Software captures and manages all material, energy, and emission flows to enable continuous monitoring, benchmarking, or reporting. The global aluminium manufacturer Hydro was the application partner. At Hydro‘s plant in Grevenbroich, aluminium strips are rolled and thus prepared for packaging for e.g. food or medicines. Hydro saw itself increasingly confronted by customers with enquiries about specific product carbon footprints.

Enquiries were related to many and various product types that have individual energy expenditure levels, production routes and that require distinct manufacturing specifications depending on the customer. With CO_2realtime, it is possible to automatically pass on so-called CO_2-backpacks for each process step up to the final product. This transfer is mapped out through the plants-networking functionality in the EnEffCo® software system. A specific PCF can be shown for each individual product and may be 'labelled' accordingly.

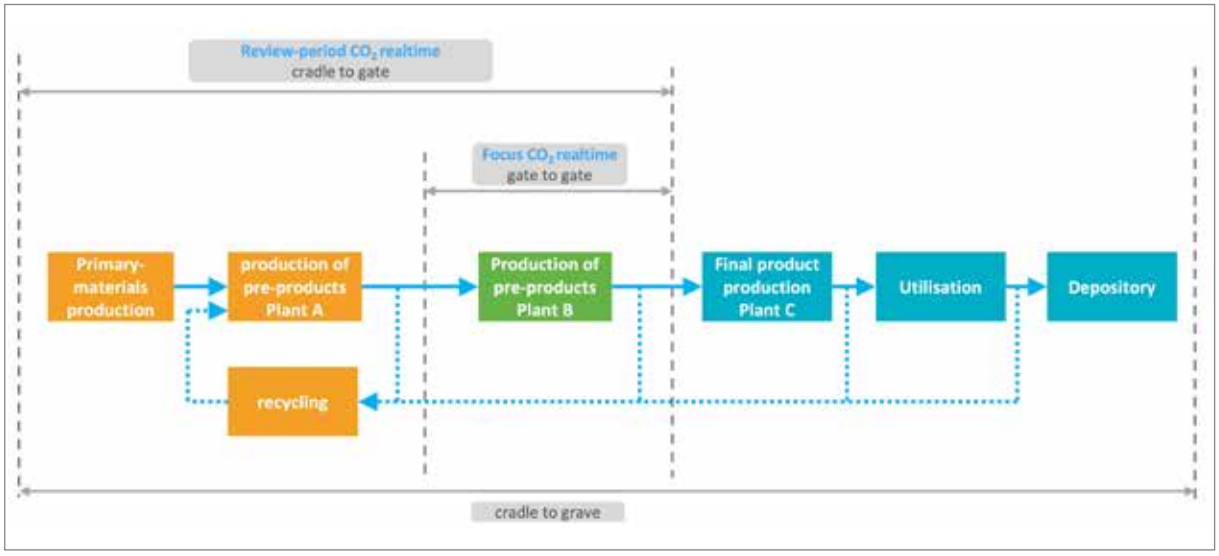


Figure 23: Balance sheet framework and systematic allocation of GHG emissions, source: ÖKOTEC

Step 10
Data management

Need for action in energy management

The energy data collection plan must be expanded to include GHG balancing issues. The existing register of all measuring devices ("list of measuring devices") may also be supplemented and help to keep track of whether measuring devices, that are subjected to testing have expired, weather devices indicate incorrect measurements, and if accuracy is sufficient for meaningful target setting.

STAGE IV – INTEGRATING CLIMS IN CORPORATE PROCESSES

8.1

The systematic data collection, that is explained in the first stages should help to find out whether there is "something to get" in terms of climate impacting GHG. To realise possible saving potentials and to keep an eye on the intended use with the defined climate goals, the CliMS should be integrated in regulated company processes. Experience has shown that particular attention should be paid to employee involvement and establishment of an iterative quality and improvement management system.

ISO 14064-1 is not a classic management standard as it essentially refers to processes and procedures for regular verification of correct calculation of GHG emissions in the GHG model. Therefore, ISO 14064-1 primarily defines systemic basic requirements for quality management, which processes should already be known through energy management in the organisation.

GHG process management:

- Integration into existing processes of EnMS (process control, organisational structure)
- Competence analysis (responsibilities, raising awareness, training, and skills)

GHG information management:

- Risk analysis on timeliness and application of envisaged GHG balance methodology (internal audit, uncertainty assessment)
- Management review focusing on completeness and consistency of GHG balance with intended use and stakeholder interests (management review)
- Continuous improvement process (PDCA, CAP)

For a first PDCA cycle (Plan, Do, Check, Act), a comprehensive assessment should therefore be carried out at least every 12 months. The cycle can be based on the calendar or the business year but should not exceed 12 months.
For the assessment, all facts and figures of the GHG report should have been updated and the internal audit for control of methodical implementation should have been carried out. Finally, based on results of the previous year, a review with top management is held to decide on future strategy and goals to be achieved before routine processes for implementing goals and improvements finally start again.

11TH STEP: GHG PROCESS MANAGEMENT

Managing the course of action

8.1.1

In addition to determining organisational procedures and system-relevant processes, those activities that have a significant influence on climate impacts must be described and planned in more detail. Operational planning and control shall be designed in such a way that activities associated with significant emissions are planned and executed so that they result in the lowest possible impacts but with the highest possible efficiency.

For Scope 1 & Scope 2: Control of energy consumption in technical facilities (e.g. heating cycles, system operation, maintenance, and repairs) and in fleet operations (e.g. route planning, fleet status), purchase of energy and other GHG-relevant raw materials and equipment, building management, etc.

For up- and downstream processes from Scope 3 (see step 3), the organisation's options for influencing main GHG sources should be assessed and clear specifications for procurement or investments should be made as "best practice". The specifications may be very diverse, such as:

- Only electric mobility for own fleet or leased vehicles
- Purchase of raw materials only with short delivery routes or, if applicable, already compensated GHG emissions
- Transport of raw materials only without usage of heavy oil or only liquefied natural gas (LNG)
- Air travel is always compensated (currently a requirement of public authorities)
- Mandatory requirements for reutilisation of produced products, such as recycling quotas, recycling type (thermal recycling, landfilling, etc.)

It is important to have a well-founded discussion of respective climate impacts as well as a constructive exchange with suppliers.

Note
Even if ISO 14064-1 does not explicitly require it, savings potentials in electricity procurement or GHG-relevant raw materials should be included in procurement guidelines so that the climate impact can be considered in purchasing decisions.

Organisational structure

If the organisational analysis has revealed deficits in earlier steps, it is essential to create a systematic and organisational framework for the CliMS, if this has not already been done in the previous steps. As for every process, it is also imperative to appoint one or more individuals to the CliMS who are responsible for creating the GHG statement and providing supporting GHG information. This appointment should also be accompanied by valid planning of capacities and financials so that the climate officer has appropriate resources. Within the organisational structure, the climate officer should be closely linked to management to be able to delegate appropriate decisions and measures. Experience has shown that a close link to financial accounting, H&R and operational data controlling is indispensable, as a lot of information comes together in CliMS.

Practical tip
Experience has shown that CliMS requires cross-departmental cooperation. Therefore, as many people as possible should be involved in regular assessment of reporting boundaries or balance sheet framework. Overall, this results in the following functions within the individual departments:

- **Climate coordinator:** Coordination of company-wide communication in coordination with the person responsible for operational control (climate management officer)
- **Climate management officer:** Operationally responsible person who ensures compliance with the defined time and process plan
- **Climate site manager:** Implementing climate management at the respective sites, providing of site-specific data, and checking plausibility
- **Data manager:** Collecting and providing basic data for the GHG model

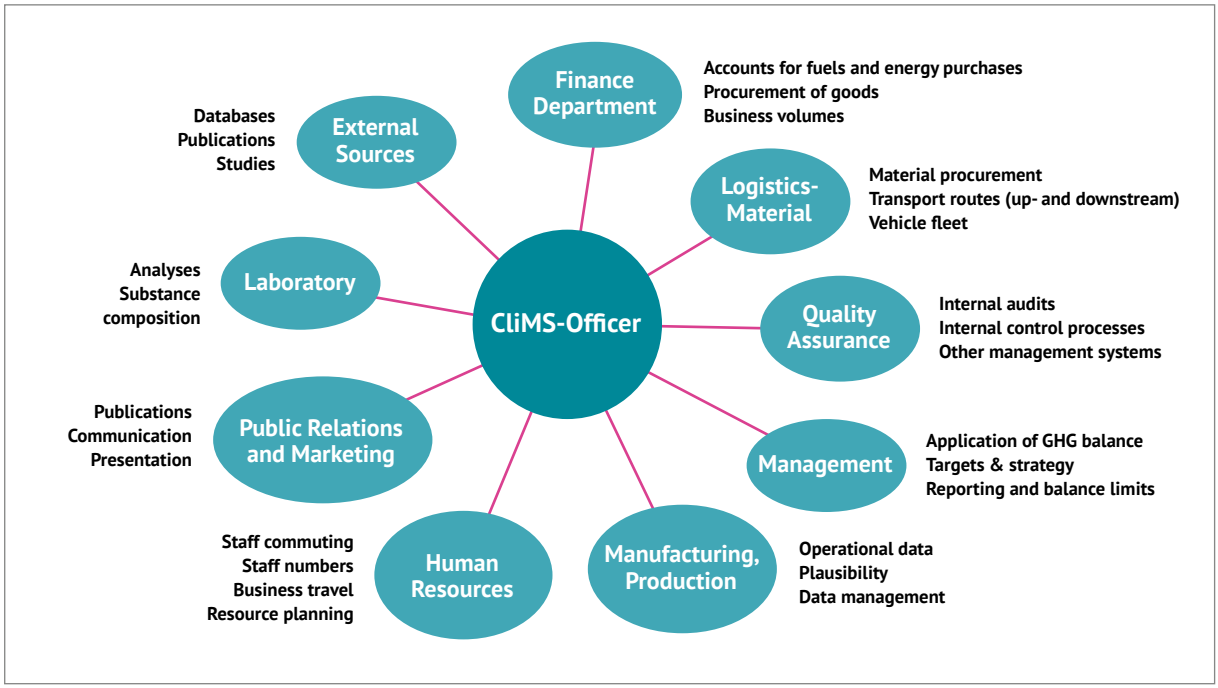


Figure 24: Links of CliMS-Officer, Source: GUTcert

Raising awareness, training, and skills

It simply does not work without employee involvement. No management system works without the commitment of employees who consistently "live" established procedures. CliMS is about the employees' knowledge of the impact of their operational activities on the climate on the one hand and the sensitisation for certain climate-friendly process changes, e.g. in travel or meeting organisation, on the other hand.

Training topics related to CliMS can come from general surveys regarding training needs, cross-checking against a training matrix, or experience of the officer who keeps up to date with developments within the organisation, sector, and market. Training and briefing of all staff on CliMS will be integrated into the existing training plan.

- Management should be trained and briefed on the current GHG situation on an ongoing basis, including regulatory changes, development of expectations of interested parties, and technological know-how, to involve them in strategic and operational goal setting and to promote their implementation in all areas.
- If the specific departments show little activity in this regard, important topics (e.g. new processes and techniques, energy-efficient design, etc.) should always be stimulated by the CliMS officer and his market knowledge.
- Employees of service providers or other people acting on behalf of the company should be trained from a climate perspective in facilities and processes that affect them, to promote their participation in CliMS and their understanding of energy-relevant processes and to encourage them to think and act.

The fight against climate change is one of the best-known issues in society: An open and transparent presentation of corporate contribution promotes awareness-raising and may also increase the attractiveness of the company as a responsible employer.

Step 11
GHG process management

Need for action in energy management

Existing EnMS training and briefings should be supplemented with GHG topics. Topic-specific knowledge should be expanded.

ISO 16064-1 does not define requirements for GHG-related organisational structure of the company. However, from many years of experience in certification and validation of GHG balances, we recommend using familiar ways of internal responsibility structure (climate team led by climate officer). On the one hand, the topic is very complex and needs to be dealt with systematically and from various points of view – this is a team task. On the other hand, many tasks in EnMS and CliMS overlap, so it usually makes sense to assign the existing EnMS team with the new topics.

However, other company divisions not previously represented within the EnMS team can also be helpful in the climate team.

Energy-relevant processes of EnMS should be supplemented with GHG issues. Here, processes with a major impact on energy consumption are already known. A close examination of all organisational processes and those that are energy relevant (possibly already recorded in other management systems such as QM) shows which processes should be described more detailed, at least in an initial approach.

Procurement should also be redefined. Climate friendliness should be added to energy efficiency as a purchasing criteria. This way, GHG-relevant information is not lost when obtaining offers, and procurement thus supports the company's GHG strategy. Depending on scope-materiality, several Scope-3-relevant processes and procedures may have to be redefined.

12TH STEP: GHG INFORMATION MANAGEMENT

Internal audit

8.1

First part of the at least annual self-review (check) in the PDCA cycle is an internal analysis. Ongoing energy and GHG controlling does not replace detailed collection of all relevant data and facts at least once a year and neither updating of (external) information (emission factors, stakeholder requirements, upcoming legal regulations, new economical processes, current characteristic values from benchmarking, etc.). In addition, the assumptions from the GHG model should be assessed for topicality and completeness in particular: Do not forget to also check the intended use of GHG balance as well as stakeholder interests.

Accordingly, the internal audit in CliMS includes both technical and systemic components. The GHG balance and analysis is basis for revision planning for the next period and for the internal audit. It is used in top management review for success monitoring. The significance of areas to be audited for climate impacts should be considered in planning of internal audits. Within a three-year cycle, each area that has an impact on the GHG balance should be internally audited at least once. Less emission-relevant areas may only be considered once every three years.

In preparation for internal energy audits, the auditors should receive up-to-date information (figures, data, facts = FDF) to use as a basis, e.g. to clarify the cause of changes before visiting an area. After the internal audit, the GHG report is corrected or supplemented with current results. In this phase already, data quality, suitability of selected indicators and changes to the baseline should be checked.

The internal audit agenda should primarily include the following aspects:

- Interviews with top management and asset managers on organisational and reporting boundaries
- Review of data flow activities ("path of data"), beginning with primary data source (meter, invoice, process control system) to GHG model for Scope 1-2 and all departments involved
- Interview with plant management about other potential GHG sources within the production site
- Interview with H&R on potential Scope 3 emissions (employee commuting, business travel)
- Further topic-related focus points

Corrective Action Plan (CAP)

Dealing with non-conformities and corrective actions, which is mentioned in all standards, is the essential tool to make an organisation more efficient, better, and safer. Improvement suggestions and identification of shortcomings and risks lead to new ideas for savings, corrective actions, and waste preventing measures. They are the basis of continuous improvement.

Corrective and improvement actions derive from everything that happens in an organisation. Walk-throughs of all kinds, internal and external audits, suggestions from staff, ideas or actions worked out in meetings, etc. always lead to new insights. What can be done better, what is going wrong and needs to be corrected, how can risks be identified? It is important to immediately record constantly incoming suggestions and possibilities for improvement so that no good idea is "lost". For goals to be realistically realisable, they should be incorporated in the improvement action plan in the next step.

Step 12
GHG information management

Need for action in energy management

The existing system for planning and conducting internal audits should be used and expanded to include CliMS aspects. External data sources and used calculation parameters (analyses, emission factors) should be particularly considered.

Existing systems from EnMS for the corrective action plan can also be used here. However, criteria for implementing measures should possibly be re-evaluated, as, for example, there may be a significantly higher risk of reputational losses in CliMS.

STAGE V – VERIFYING AND COMMUNICATING

A carbon footprint serves as a management tool to implement climate and cost reduction plans and to develop a clear climate strategy to help mitigate global warming. External verification of the GHG footprint safeguards reporting, improves reputation, and serves as evidence of credibility regarding climate neutrality in the company.

ISO 14064-3 serves as basis for external verification.

13TH STEP: EXTERNAL VALIDATION

External verification by an independent body increases credibility of GHG balances. Overriding requirement is that the verification is complete, independent and without conflicts of interest, e.g. that the verification body has not participated in any way in preparation of the GHG balance. Accredited certification bodies are regularly inspected by accreditation bodies of the European states. In Germany, this is the Deutsche Akkreditierungsstelle GmbH (DAkkS). Non-accredited certificates should be investigated very critically.

10

The verification programme (procedure, dates, required documents) should be reconciled with the verification body. The verification body then carries out a strategy and risk analysis regarding methodology and framework conditions of the GHG balance.

The verifiers require insight into the determination methodology of the GHG balance, including:

- Organisational & operational reporting boundaries
- Recorded GHG emissions from Scope 1-3
- Emission factors
- Reference values
- Uncertainties

The data provided is subject to verification. An on-site inspection of facilities takes place at selected representative sites – it is important to note that not all locations necessarily have to be inspected on site, but that the verification body can make a representative selection here. This means that it is for example sufficient to visit one location on site, if comparable processes are carried out at various locations.

Verifiers of the verification body then summarise their findings. The result is a verification report with a recapitulation of findings, notes, and recommendations for verification.

Depending on the verification body, additional approval symbols can be acquired for (in- and external) communication. These can for example be placed on vehicles, packaging, documents, advertising material (roll-ups, banners) or the company's website to make the commitment to climate protection directly visible to employees, customers and stakeholders.

Figure 25: Examples of verification symbols of GUTcert

Step 13
External validation

Need for action in energy management
In consultation with top management, the necessary extent to secure the GHG balance through external verification and possible risks for reputation and credibility should be analysed. To make use of potential synergy effects, it is possible to integrate the GHG balance in existing cycles of certification according to ISO 50001 (or ISO 14001) as part of an integrated verification. Due to many overlaps, it makes sense to also assess overall unified organisational structures and processes during review.

14TH STEP: INTERNAL AND EXTERNAL REPORTING

For reporting, the first step should be to consider whether communication should only be for internal use, e.g. as a decision-making tool or for raising staff awareness, or also as a public GHG statement (external communication). There is no obligation to publish the GHG report.

If a public GHG statement is planned for the carried out GHG accounting, a complying GHG report MUST be drawn up accordingly to the requirements of step 6.

Overall, the GHG statement should explain decisions and interpretations in a comprehensible and plausible way so that the potential reader/user can understand them. It should be based on an analysis of possible risks for the current organisational situation (e.g. takeover of companies that are in particular public focus, public criticism of individual activities or product impacts). Attention should also be paid to possible queries from users so that these may be answered in advance.

Note
Often, those responsible for the GHG balance have an ambition to carry out a complete balance across all scopes already in the first year, which means that efforts often come to nothing due to large data volume. Experience has shown that, on the one hand, the most important GHG sources should firstly be considered and, on the other hand, that continuous improvement should take place in an interactive process.

The ISO 14000 standards series, and in particular the ISO 14020 series, provides key rules on how to develop and use environmental information for products and services:

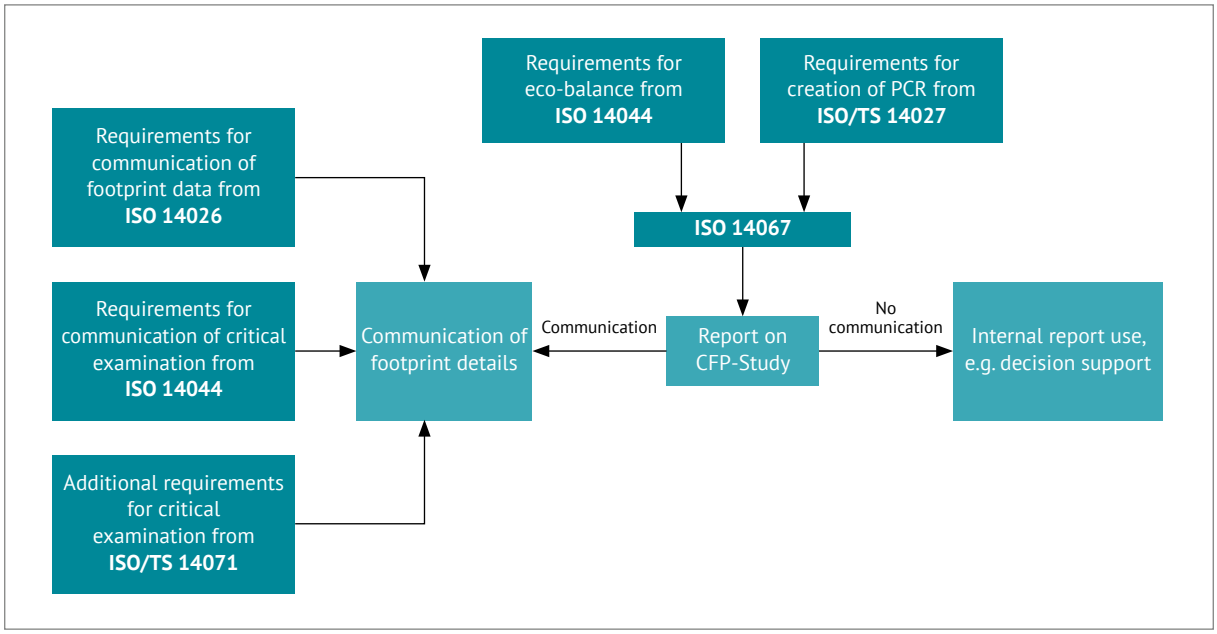


Figure 26: Relationship between ISO 14067 and standards beyond GHG management, source: ISO 14067, p. 14

For environmental labelling of products and services, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (FME) has developed a current guideline with requirements that can be applied to the publication of GHG balances by companies:

> https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/umweltinformationen_produkte_dienstleistungen.pdf

Here, also, among others the following principles apply:

- Statements must be accurate, verifiable, and correct. They must not be formulated in a misleading way or omit explicit statements.
- The used methodology should be based on scientifically verifiable methods and use reliable sources for reference values.
- Essential information on procedures, methods, criteria, and basic assumptions should be available to all users and interested parties.

Step 14
Internal and external reporting

Need for action in energy management

Existing EnMS documentation should be expanded to include the GHG report. For this purpose, the guidelines from step 6 should be considered.

Form, frequency, and depth of external publication should be clarified with internal stakeholders (top management, communication, marketing).

CHECKLIST FOR ENERGY OFFICERS

Step 1 "Commitment and context analysis"

- ☐ Identify interests and needs of in- and external stakeholders
- ☐ Context analysis with evaluation of risks and opportunities
- ☐ Obtain management commitment and engagement

Step 2 "Organisational and reporting boundaries"

- ☐ Establish organisational and reporting boundaries with top- and asset-management (check links with EnMS)

Step 3 "Inventory"

- ☐ Initial analysis of GHG sources for Scope 1-3 (create overview)
- ☐ Define materiality criteria and apply for Scope 3 (justify exclusion)
- ☐ Evaluate further legal requirements for the company's GHG balance sheet (legal register)

Step 4 "Quantification of GHG emissions"

- ☐ Check availability of existing data
- ☐ Determine emission factors and check stableness of data sources
- ☐ Determine emission factors and methodology for electricity
- ☐ Establish GHG model (quantification methodologies for conversion to CO_{2eq})

Step 5 "Base year"

- ☐ Select and justify base period
- ☐ Set climate targets and align with base period

Step 6 "GHG report"

- ☐ Prepare GHG report to document key decisions and methodologies (compare with EnMS documentation)
- ☐ Analysis to provide sufficient justification and explanations for intended use and stakeholder interest

Step 7 "Management review"

- ☐ Conduct management review

Step 8 "Climate policy, targets, indicators"

- ☐ Establish general climate strategy and overarching goals according to the principle of "avoid, reduce, compensate"
- ☐ Set specific reduction targets
- ☐ Formulate measures to achieve reduction targets
- ☐ Select key figures and performance indicators (which targets and measures can be monitored against)

Step 9 "Climate programme and verification of success"

- ☐ Summarise targets and measures in a unified climate programme
- ☐ Establish a monitoring system for success of measures in climate programme

Step 10 "Data management"

- ☐ Elaborate control system through continuous monitoring, measurement, and analysis
- ☐ Establish data management system

Step 11 "GHG process management"

- ☐ Integrate climate management processes and procedures in EnMS structures (process control)
- ☐ Integrate climate officer in organisational structure
- ☐ Carry out competence analysis and define scope for training needs

Step 12 "GHG information management"

- ☐ Conduct internal audit
- ☐ Transfer need for action into corrective action plan (CAP)

Step 13 "External validation"

- ☐ Assess need for external verification
- ☐ Carry out verification by accredited verification body

Step 14 "Internal and external reporting"

- ☐ Decide communication type (in- and/or external), determine scope and content of public GHG report
- ☐ In the case of public communication: Comparison of basic requirements

APPENDIX

NORMS AND STANDARDS IN CLIMATE MANAGEMENT CONTEXT

- ISO 50001: Energy management systems – Requirements with guidance for use
- ISO 14064-1: Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals
- ISO 14064-2: Greenhouse gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements
- ISO 14064-3: Greenhouse gases – Part 3: Specification with guidance for the verification and validation of greenhouse gas statements
- ISO 14065: Greenhouse gases — Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition
- ISO 14067: Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification
- ISO 14040: Environmental management – Life cycle assessment – Principles and frameworks
- The Greenhouse Gas Protocol (GHG) – A Corporate Accounting and Reporting Standard
- Greenhouse Gas Protocol (GHG) – Corporate Value Chain (Scope 3) Accounting and Reporting Standard
- Greenhouse Gas Protocol (GHG) – The GHG Protocol for Project Accounting
- Greenhouse Gas Protocol (GHG) – Product Life Cycle Accounting and Reporting Standard
- BSI: PAS 2050: Specification for the assessment of the life cycle
- BSI: PAS 2060: Specification for the demonstration of carbon neutrality

SUMMARISING TABLE ISO 50001 VS. ISO 14064-1

ISO 50001	ISO 14064-1 (CCF)	notes
§4. Context of the organization	§5. boundaries of GHG balance (organizational & reporting boundaries)	Clear definition & Delineation required
§5. Leadership	./.	Not explicitly mentioned
§6. Planning	§4. Principles §6. Quantification of GHG emissions and GHG removals §7. Reduction activities §8. Quality management of GHG balances §9. GHG reporting	Not transferable 1:1
§7. Support	§8. Quality management of GHG balances	Not transferable on a 1:1 basis
§8. Operation	./.	Not explicitly mentioned
§9. Evaluation of performance	§9. GHG reporting §10. Role of the organisation in verification activities	See also ISO 50015 & ISO 50006
§10. Improvement	./.	Not explicitly mentioned

LIST OF FIGURES

LIST OF SOURCES AND LINKS

German Federal Government
https://www.bundesregierung.de/breg-de/themen/klimaschutz/bundesregierung-klimapolitik-1637146
https://www.bundesregierung.de/breg-de/themen/klimaschutz/climate-change-act-2021-1913970

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, page 22
https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/klimaschutz_zahlen_2020_broschuere_bf.pdf

BMU / ÖKOTEC Fraunhofer ISI, DENEFF: EnPI-Connect: Energy Performance Indicators in Practice, page 42
https://www.bmu.de/meldung/enpi-connect-energiekennzahlen-in-der-praxis/

European Commission
https://ec.europa.eu/clima/policies/strategies_en
https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

Investment plan for a sustainable Europe, page 2
https://ec.europa.eu/commission/presscorner/api/files/attachment/860464/Commission%20Communication%20on%20the%20European%20Green%20Deal%20Investment%20Plan_DE.pdf.pdf

GHG Protocol – A Corporate Accounting and Reporting Standard, page 23
https://ghgprotocol.org/corporate-standard

GHG Protocol – Corporate Value Chain (Scope 3), page 32 and 42
https://ghgprotocol.org/standards/scope-3-standard

GHG Protocol – Product Life Cycle Accounting and Reporting Standard, page 36
https://ghgprotocol.org/sites/default/files/standards/Product-Life-Cycle-Accounting-Reporting-Standard_041613.pdf

ISO 14064-1 – Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals
https://www.iso.org/standard/66453.html

ISO 14067 – Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification, page 14
https://www.iso.org/standard/71206.html

University of Stuttgart: Energy Efficiency Index of the Winter Survey 2019/20, page 9
https://www.uni-stuttgart.de/universitaet/aktuelles/presseinfo/Mehrheit-der-Unternehmen-strebt-Klimaneutralitaet-an

Wuppertal Institute – Climate Neutrality versus Greenhouse Gas Neutrality: Requirements for Cooperation in a Multi-level System in Germany, page 8
https://epub.wupperinst.org/frontdoor/deliver/index/docId/7492/file/7492_Luhmann.pdf

WWF & CDP (publishers): From emissions report to climate strategy, page 58
http://klimareporting.de (only in german language available)