Environmental Impact Testing Laboratories

Optimize resources and test conditions to improve environmental impact, carbon footprint and sustainability

Leif Madsen

Eurolab Denmark

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- 1973-2021
  - ElektronikCentralen, DELTA, FORCE Technology
    - Senior Specialist, Quality & Environment (1975- 2021)
    - Accredited Testing, Calibration and Certifying
      - Microelectronics, Electronics and electrical product
      - EMC, Aviation, Space, Weighing, Medical, Automotive, CPR
    - Design and Supply chain of microelectronics
    - Notified Body CPR, EMCR, REDR
    - Member of national fora on exchange of experience
- 2010 – 2019
  - On behalf of Danish Standards
    - Chair of DS Committee S335 (conformity assessment)
    - Technical expert ISO CASCO WG 29 (ISO 17025)
    - Technical expert ISO CASCO WG 32 (ISO 17065)
- 2012 -
    - Chair of Eurolab Denmark
- 2021-
    - Compliance Consultanty by LM
    - Board member Eurolab a.i.s.b.l.

To-days subjects

- Green House Gases (IPCC)
- Sustainable Development Goals (UN)
- Business continuity (ISO)
- Best Practice Planning for laboratories
  - Goals
  - Scope(s)
  - Calculation of emission
  - Reporting
  - Improving

2009: Wake up call !

- Dear Leif,
  - Please, could provide your data regarding Green House Gases emission for your service?
    Best Regards ….
- Yes, yes
  - My GHG impact ? hm
- External Consultant
  - Training courses
- 10 months later
  - Dear Customer, We are pleased to provide the requested data.
- First time encounter with IPCC

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change

GHG History - Sustainability Brundtland Report

- 1983: Gro Harlem Brundtland was invited by the UN to establish and chair the World Commission on Environment and Development, known as the Brundtland Commission.
- 1987: The political concept of sustainable development was developed. The UN report Our Common Future, provided the momentum for the Rio Summit
- 1992: Sustainable development was first institutionalized with the Rio Process initiated at the Earth Summit in Rio de Janeiro. UNCED
- 1997: The Kyoto Protocol on The Green House Gasses
- 2015: UN General Assembly adopted the17 Sustainable Development Goals (**SDGs**) (2015 - 2030) They addresses the global challenges, including poverty, inequality, climate change, environmental degradation, peace, and justice.

SUSTAINABLE DEVELOPMENT GOALS

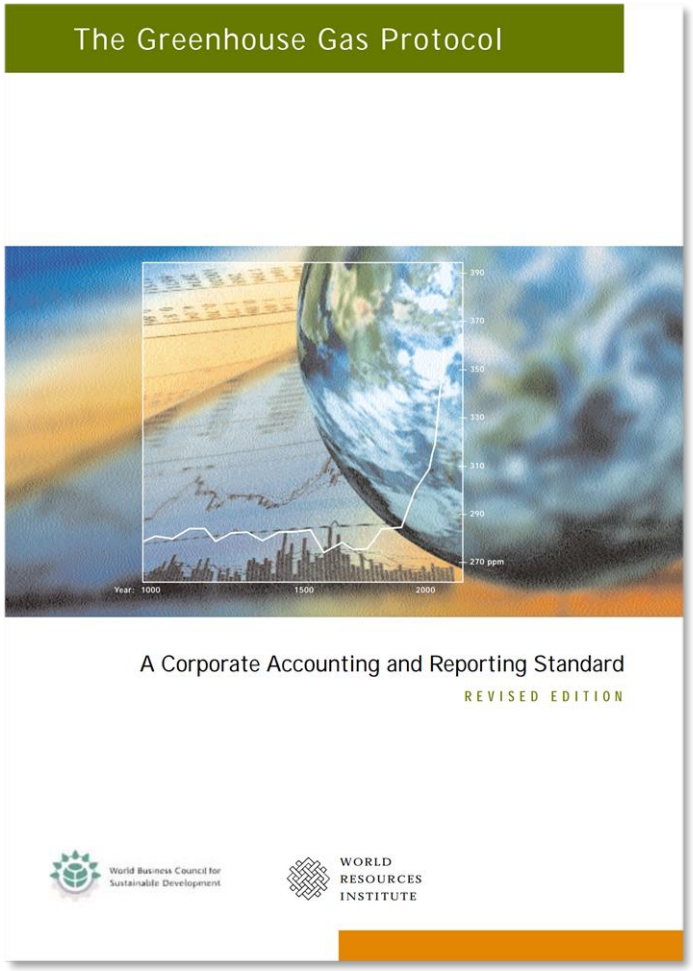
Challenges

- Today’s businesses are dealing with a complex brew of
  - social, environmental, market and technological trends.
- International Standards can help businesses thrive and grow while simultaneously solving
  - some of the **world’s biggest challenges SDG**, making a real difference to our planet.

Business Continuity

- *Driving parameters for laboratories*
  - *Comply with market demand from*
    - *customers*
    - *authorities*
  - *Compliance with the SDGs*
    - *deal with action for the goals*
  - *Economics in balance*
  - *Optimize the use of resources*
  - *Provide Information*
    - *on extend of compliance*

Green House Gas Protocol



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WORLD RESOURCES INSTITUTE

Issued by:

World Business Council for Sustainable Development and

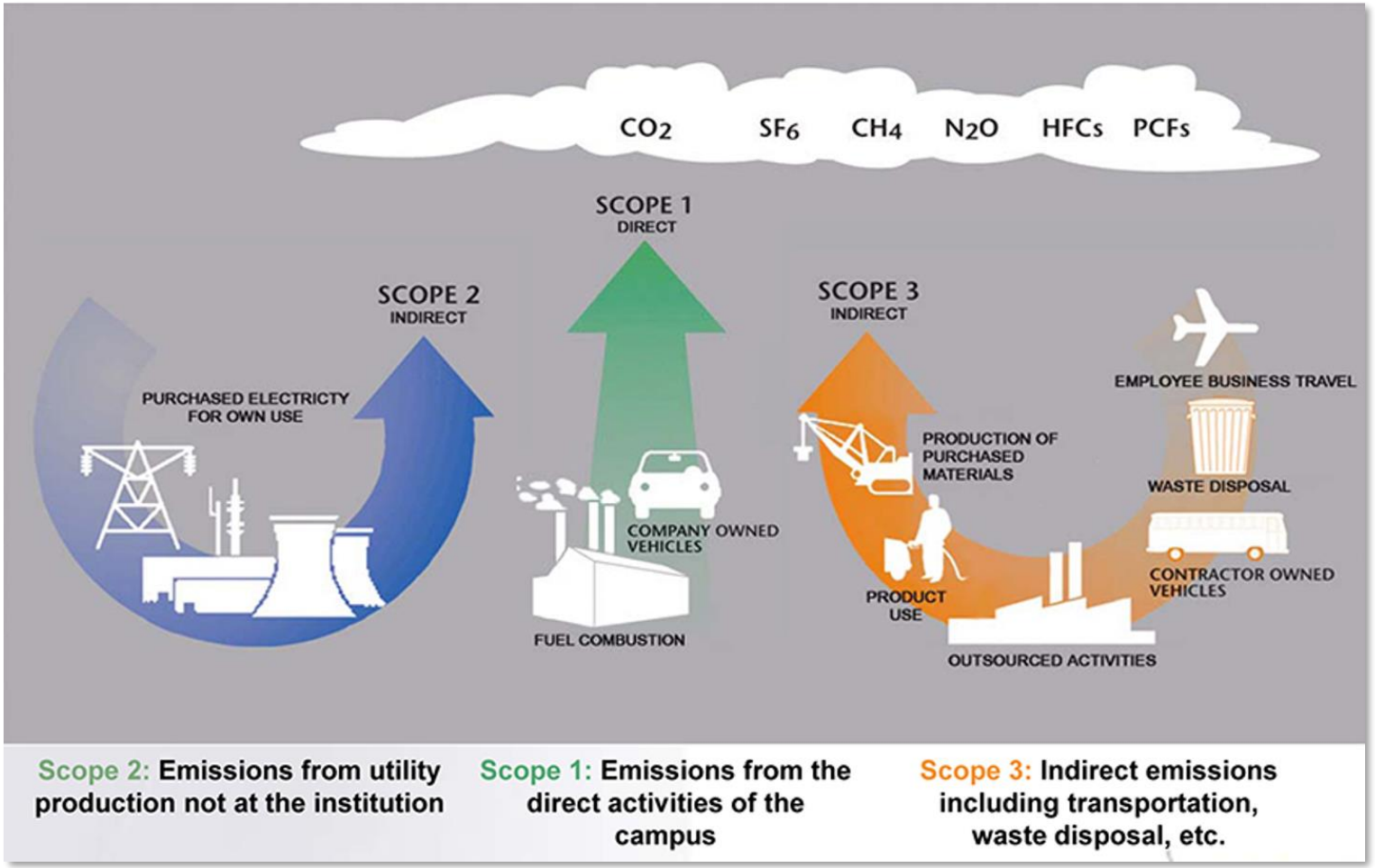
World Resource Institute

ghg-protocol-revised.pdf (ghgprotocol.org)

Guidelines, Principles, and Requirements

Simplified types of GHG Emission Scopes

The Greenhouse Gas Protocol



Adopted from NZBCSD, 2002

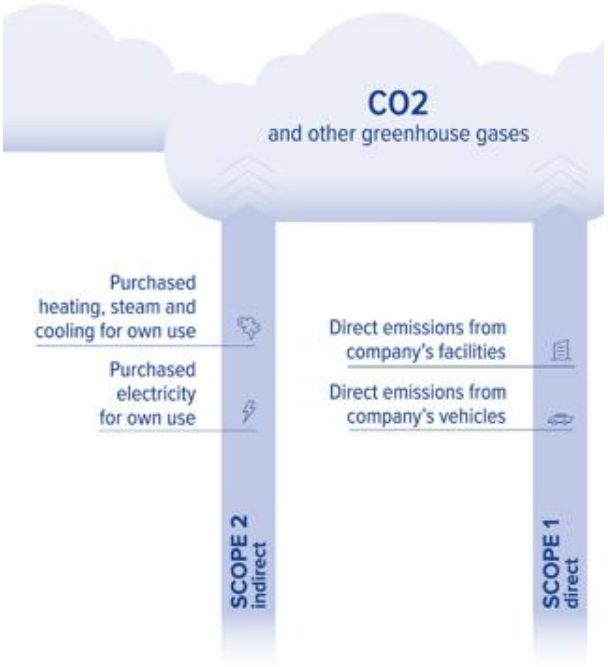
GHG Global warming potential

Greenhouse gas	Chemical formula	100-year Global warming potentials (2007 estimates, for 2013-2020 comparisons)
Carbon dioxide	CO_2	1
Methane	CH_4	25
Nitrous oxide	N_2O	298
Hydrofluorocarbons (HFCs)		
HFC-23	CHF_3	14800
Difluoromethane HFC-32	CH_2F_2	675
Fluoromethane HFC-41	CH_3F	92
HFC-43-10	$CF_3CHFCHFCF_2CF_3$	1640
Pentafluoroethane HFC-125	C_2HF_5	3500
HFC-134	$C_2H_2F_4$ (CHF_2CHF_2)	1100
1,1,1,2-Tetrafluoroethane HFC-134a	$C_2H_2F_4$ (CH_2FCF_3)	1430

Scope 1: Direct GHG emissions

Direct GHG emissions from sources that are owned or controlled by the laboratory, i.e.,

- direct emissions from own facilities
  - testing equipment,
  - temperature chambers,
  - boilers, furnaces,
- direct emissions from own vehicles
  - fuel, electricity
- emissions from chemical production in owned or controlled process equipment
  - evaporation
  - leakage.

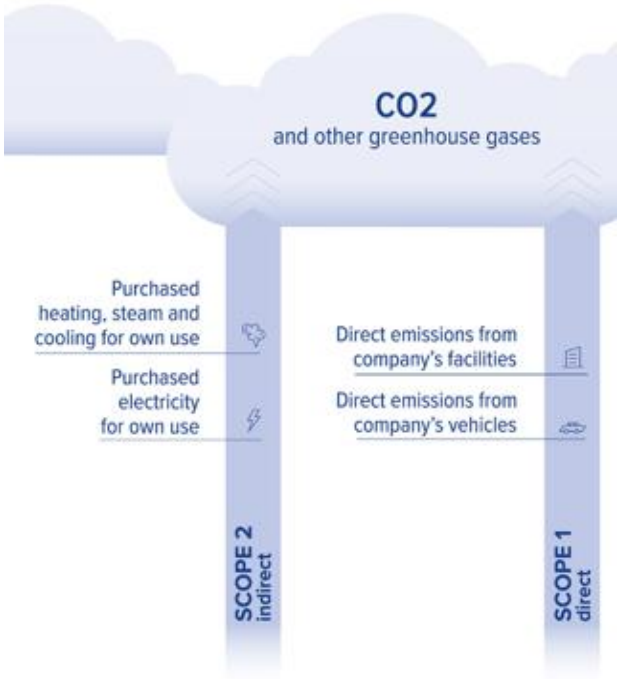


Scope 2: Indirect GHG emissions

GHG emissions from the generation of purchased such as

- Heating
- Cooling
- Water
- Compressed air
- Steam
- Electricity (consumed in the lab.)
- Consumables (e.g. paper etc.)

Scope 2 emissions occur physically (indirectly) at the facility where generated.



Scope 3: Other indirect GHG emissions

Scope 3 is an optional reporting category.

Such emissions are a consequence of the laboratory activities but occurring indirectly at facilities not owned or controlled by the laboratory.

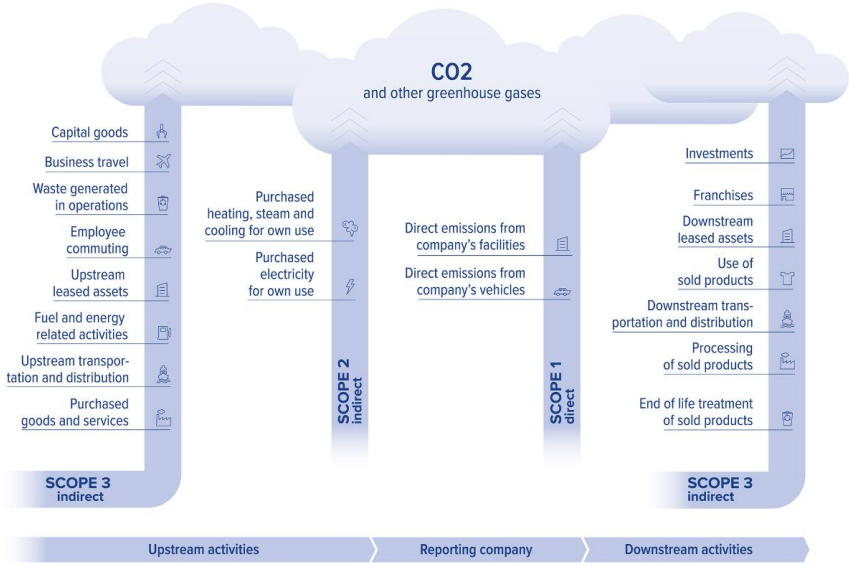
Some examples of scope 3

Upstream activities:

- extraction and production of purchased goods and materials; i.e., reference materials, test jigs, equipment
- transportation of purchased goods;
- Commuting

Downstream activities:

- use of sold products and services
- End of life of sold products



Scope 1, 2 and 3 emissions according to the GHG protocol.

Risk Assessment / Concerns of relevance

The Greenhouse Gas Protocol

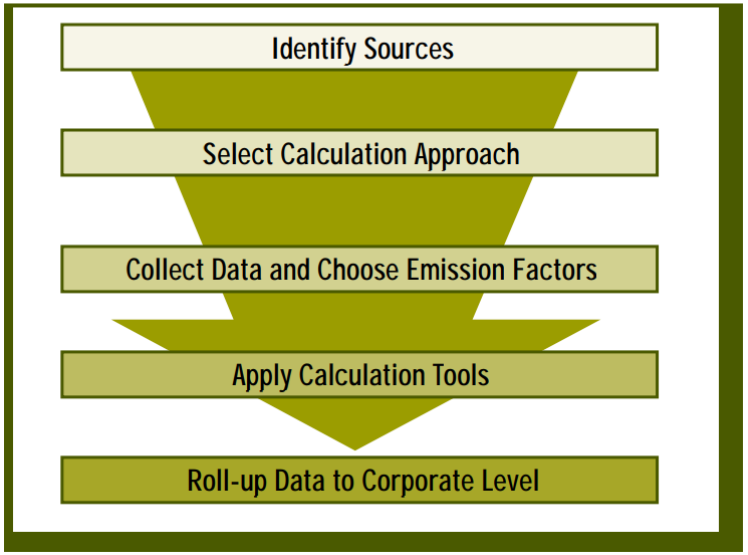
- Sector boundaries
  - Scope of the laboratory
- Regulations
  - Local / National / Regional (EU) / Global
- Client's request and/or internal policy
  - Data for $CO_{2\text{-eq}}$ per service / unit / laboratory
- Laboratory – **LCA study**
  - Scope 1 Own emissions - data per service or units
  - Scope 2 Upstream impacts – data from supplier
  - Scope 3 Up / Downstream impact - data from customer / users
- **Decision** to establish and define a Carbon Footprint Calculation Tool in order to systematically provide $CO_{2\text{-eq}}$ data to authorities and customers.

Note: For an independent laboratory the scope 3 is controlled by the client and/or user. I.e., the laboratory is one part in a supply chain

Best Practice GHG emissions

The first of the five steps in identifying and calculating a laboratory's emissions as outlined in is to categorize the GHG sources within that company's boundaries.

FIGURE 9.
Steps in identifying and calculating GHG emissions



Step 1: Identify GHG emissions sources

The Greenhouse Gas Protocol

Identify Sources

The first step in identifying and calculating a company's emissions to categorize the **GHG sources** within that company's boundaries.

GHG emissions typically occur from the following source categories:

- **Stationary combustion (Lab or Field testing)**
  - combustion of fuels in stationary equipment such as **boilers, furnaces, burners, heaters,** engines, flares, **test equipment** etc.
- **Mobile combustion (Transportation)**:
  - combustion of fuels in transportation devices such as automobiles, trucks, buses, trains, airplanes, boats, ships, etc.
- **Process emissions**:
  - emissions from **physical or chemical processes** such as $CO_{2\text{-}eq}$ from the calcination step in cement manufacturing, $CO_{2\text{--}eq}$ from catalytic cracking in petrochemical processing, PFC emissions from aluminum smelting, etc.
- **Fugitive (volatile) emissions**:
  - intentional and unintentional releases such as **equipment leaks from joints, seals, packing, gaskets,** as well as fugitive emissions from coal piles, wastewater treatment, pits, **cooling towers**, gas processing facilities, etc.

Notes:
Almost all businesses generate indirect emissions due to the purchase of electricity for use in processes or services.

Process emissions are usually only relevant to industry sectors like oil and gas, aluminum, cement, etc.

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Identifying Emissions

Step 2: IDENTIFY SCOPE 1 EMISSIONS

The laboratory should undertake an exercise to identify its direct emission sources (scope 1) in each of the four source categories, where relevant.

Step 3: IDENTIFY SCOPE 2 EMISSIONS

Identifying indirect emission sources from the consumption of purchased electricity, heat, compressedair, steam, and paper.

Step 4: IDENTIFY SCOPE 3 EMISSIONS

This **optional** step involves identification of other indirect emissions from a company's upstream and downstream activities as well as emissions associated with outsourced/contract manufacturing, leases, or franchises not included in scope 1 or scope 2

Step 5: Select Calculation Approach

Direct measurement of GHG emissions by monitoring concentration and flow rate is NOT common. More often,

- emissions may be calculated based on a mass balance or
- basis specific to a facility or process.

Most common approach for calculating GHG emissions is through the application of documented emission factors.

These factors are calculated ratios relating GHG emissions to a proxy measure of activity at

an emissions source. The IPCC guidelines (IPCC, 1996) refer to a hierarchy of calculation approaches and techniques ranging from the application of generic emission factors to direct monitoring

Greenhouse Gas Protocol calculation tools:

- http://www.ghgprotocol.org/calculation-tools

GHG Calculation Tools

The Greenhouse Gas Protocol

Select Calculation Approach

Apply Calculation Tools

Free GHG Protocol calculation tools:

- GHG Procotol Tools (MS Excel sheets)
  - **Cross-sector tools:** Applicable to many industries and businesses regardless of sector.
  - **Country-specific tools:** Customized for particular developing countries.
  - **Sector-specific tools:** Principally designed for the specific sector or industry listed, though they may be applicable to other situations.
  - **Tools for countries and cities:** These tools help countries and cities track progress toward their climate goal

Sector specific GHG calculation tools:

-GHG emissions from the production of **aluminum**

-CO2 emissions from the production of **iron and steel**

-N2O emissions from the production of **nitric acid**

-CO2 emissions from the production of **ammonia**

-N2O emissions from the production of **adipic acid**

-CO2 emissions from the production of **cement**

-CO2 emissions from the production of **lime**

-GHG emissions from **pulp and paper mills**

-HFC-23 emissions from the production of **HCFC-22**

-PFC emissions from the production of **semiconductor wafers**

Methodology for data capture

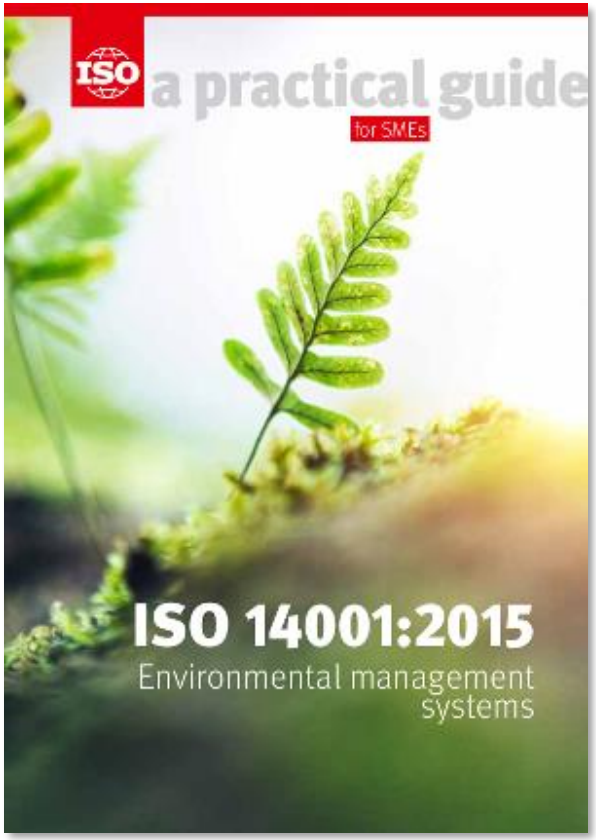
- Databases
  - General information, i.e. key figures, are gathered from the following sources:
    - Ecoinvent database, www.ecoinvent.ch
    - GaBi4 databases
    - EU Regulation 1005/2009 16. sept 2009 (consolidated 0605/2017) Substances that deplete the OZON-layer
    - EU Commission – European platform on Life Cycle Asessment European Commission Service Site (europa.eu)
    - www.world-airport-codes.com
    - National Energy Agency
    - Climatiq data explorer Climatiq Data Explorer - Search Global Carbon Emission Factors
- Material composition of product
    - Declaration of Material Composition is derived from requirements given in the product specification and the joined intermediates.
    - The material composition of integrated circuits are highly depended on decisions and choices of the design phase.
    - The decision of resulting product specification is in general managed by our customers.

Methodology for data capture

- ***$CO_{2\text{-}eq}$ Footprint***
  - Impact of emission to environment is stated as CO_2-equivalent ($CO_{2\text{-}eq}$) values.
  - The calculations of $CO_{2\text{-}eq}$
    - include all Green House Gases (CO_2, CH_4, N_2O, etc.)
    - methodology described by GHG protocol
  - A Life Cycle Assessment LCA study with focus on emissions to the environment

Lots of ways of saying…

- LCA study
  - ISO 14044:2006 Environmental management — Life cycle assessment
  - LCA focussed on Emission of Green House Gasses to the Ozon layer
  - Process LCA is a popular method for conducting LCA assessment and is often referred to as the SETAC-EPA method because of the role played by SETAC and EPA in this method's development.
  - Tools exist on the market to assist researchers in conducting process LCA (such as GaBi, Ecoinvent, and Umberto). These tools contain data from previous LCAs for the environmental impact of chemicals, materials, products, and processes.



Scope of Reporting

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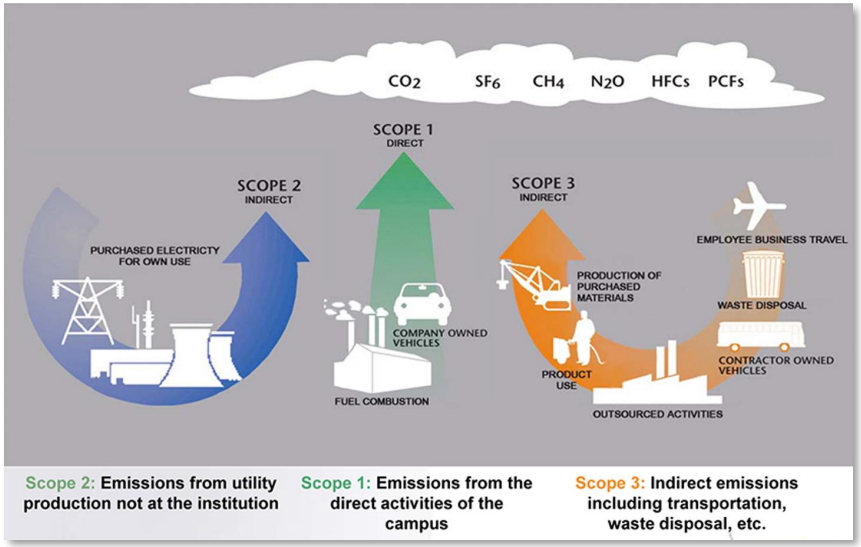
Roll-up Data to Corporate Level

- The scope of the calculations
  - “cradle-to-customer gate” (LCA) study
  - distinction between four elements in the supply chain
    - extraction of raw materials,
    - production of intermediates and components,
    - and testing in the laboratory,
    - transportation.
- Data is provision
  - Scope 1
    - Emission data to water and air - omitted
  - Scope 2
    - Consumption of electricity
    - Consumption of heating
    - Reference Materials
    - Chemicals etc.
  - Scope 3
    - Actual material composition
    - Subcontractors
      - Consumption of electricity
      - Consumption of heating / cooling
    - Transportation
    - Omitted customer use and disposal

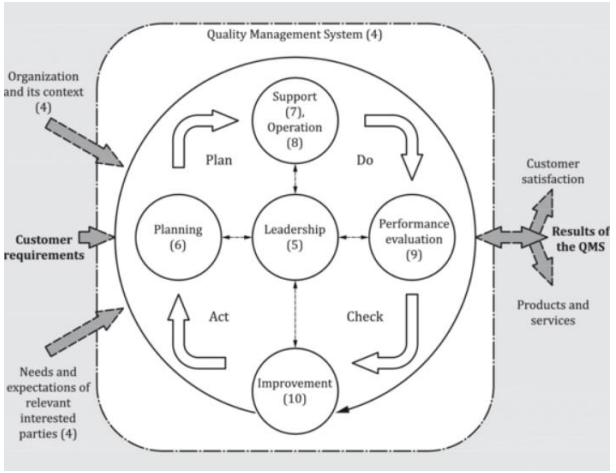


GHG “Final” Reporting

The Greenhouse Gas Protocol

Roll-up Data to Corporate Level

- ***Roll-up***
- ***Plan-Do-Check-Act cycle PDCA***
  - Report to Management
    - Review - Check
    - Conclude - Plan
    - Improve - Act
  - Report to interested parties
    - Customer
    - Authority as appropriate
    - Certification body



Future Laboratory improvement

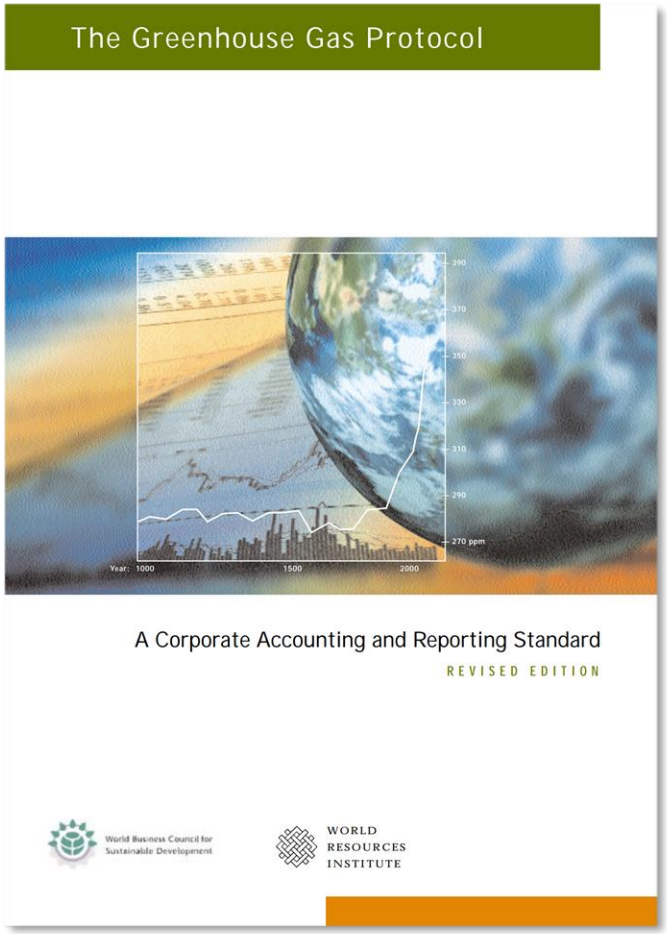
Optimize carbon footprint

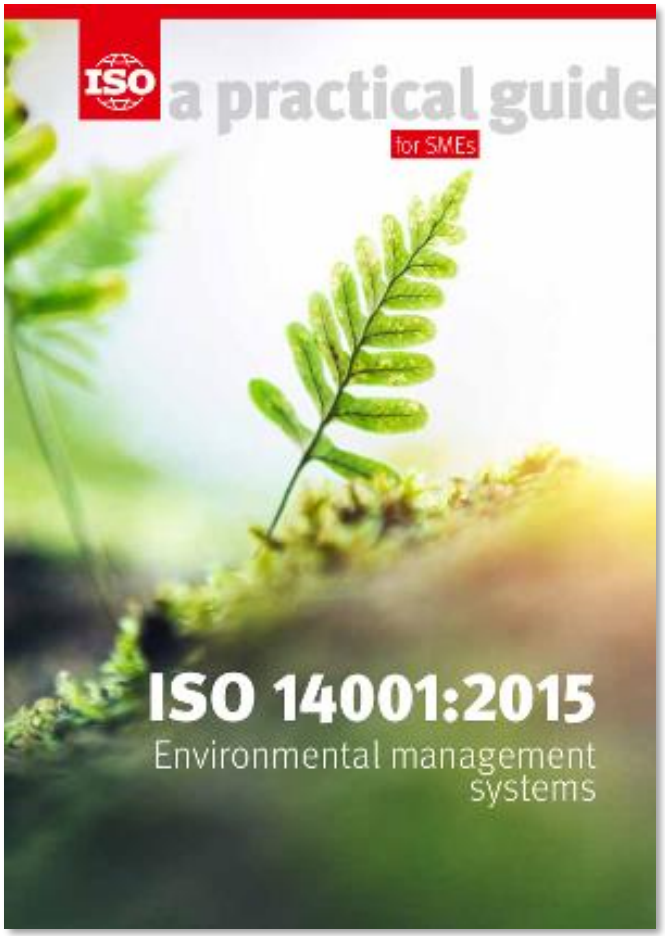
Evaluate own performance / impact

- Apply AI
  - to control environmental conditions of the laboratory
    - Temperature, humidity, pressure
    - energy efficiency
  - to systemize a uniform testing process
  - to capture GHG emission data
  - to simplify calculations
- Understanding and interpretation of testing standards / requirements to achieve optimized testing
- Improve / optimize instrumentation
  - Purchase of energy saving equipment
  - Standby function for ovens light etc.
  - Use of paperless operation
- Reuse / recycle
  - consumables
  - packaging materials

- Externally
  - Keep track of changes to provider's impact and requirements
  - Innovate and improve testing requirement in standardization workgroups
    - Optimize test methodologies
    - Optimize testing requirement

Practical Guides





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[3] ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines

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[1] IPCC The Intergovernmental Panel on Climate https://www.ipcc.ch/

Sustainability - Carbon Footprint

Thank You for your Attention