International Standard

ISO 19870-1

First edition
2026-04

Hydrogen technologies — Methodology for determining the greenhouse gas emissions associated with the hydrogen supply chain —

Part 1: Emissions associated with the production of hydrogen up to the production gate

Technologies de l'hydrogène — Méthodologie pour déterminer les émissions de gaz à effet de serre associées à la chaîne d'approvisionnement en hydrogène —

Partie 1: Émissions associées à la production d'hydrogène jusqu'au point de production

Reference number
ISO 19870-1:2026(en)

© ISO 2026



COPYRIGHT PROTECTED DOCUMENT

© ISO 2026

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ... **iv**

Introduction ... **v**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms, definitions and abbreviated terms ... **2**
3.1 Terms related to quantification of the carbon footprint of a product ... 2
3.2 Terms related to products, product systems and processes ... 4
3.3 Terms related to life cycle assessment ... 7
3.4 Terms related to organizations ... 10
3.5 Terms related to data and data quality ... 10
3.6 Abbreviated Terms ... 11

4 Evaluation methods for GHG emissions ... **12**
4.1 Evaluation basis ... 12
4.1.1 General principles ... 12
4.1.2 Attributional approach ... 12
4.1.3 Consequential approach ... 12
4.2 Product reporting ... 13
4.2.1 Product system boundary ... 13
4.2.2 Selected cut-off criteria ... 14
4.2.3 Evaluation elements ... 14
4.2.4 Evaluation cycle ... 15
4.3 Quantification of GHG emissions ... 16
4.3.1 Process description and data quality ... 16
4.3.2 Emissions inventory ... 16
4.3.3 Emissions allocation ... 20
4.3.4 CFP calculation ... 24
4.4 CFP study report ... 24

5 Critical review ... **24**

Annex A (Normative) **Hydrogen Purity** ... **25**

Annex B (Informative) **Consequential Approach—Examples for Hydrogen Production** ... **29**

Annex C (Normative) **Feedstocks for hydrogen production** ... **33**

Annex D (Normative) **Hydrogen Production Pathway – Methane Reforming with or without Carbon Capture and Storage** ... **42**

Annex E (Normative) **Hydrogen production pathway – water electrolysis** ... **60**

Annex F (Normative) **Hydrogen production pathway — Chlor-alkali** ... **66**

Annex G (Normative) **Hydrogen production pathway — steam cracking** ... **74**

Annex H (Normative) **Hydrogen production pathway — gasification with or without carbon capture** ... **81**

Annex I (Normative) **Hydrogen production pathway – methane pyrolysis** ... **90**

Annex J (Normative) **Hydrogen production pathway — chemical looping water splitting with or without carbon capture** ... **98**

Annex K (Normative) **Hydrogen production pathway — geologic hydrogen production** ... **107**

Annex L (Normative) **Hydrogen Production Pathway — Catalytic Naphtha Reforming** ... **118**

Bibliography ... **125**

© ISO 2026 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 197, *Hydrogen technologies*, Subcommittee SC 1, *Hydrogen at scale and horizontal energy systems*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/CLC/JTC 6, *Hydrogen in energy systems,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 19870-1 cancels and replaces ISO/TS 19870:2023, which has been technically revised.

A list of all parts in the ISO 19870 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO 2026 – All rights reserved

Introduction

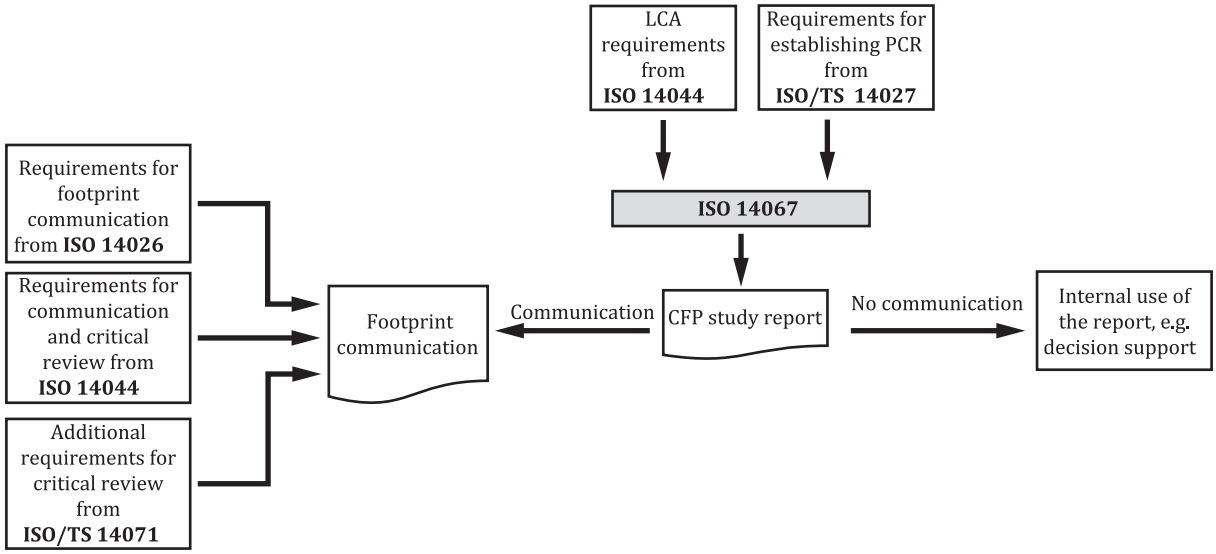
The Paris Agreement was adopted at the UN Climate Change conference (COP21) with the aims of strengthening the global response to the threat of climate change, restricting global temperature rise to below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1,5 °C above pre-industrial levels. To meet these goals, greenhouse gas (GHG) emissions need to be reduced by about 45 % from 2010 levels by 2030, reaching net zero in 2050 (IPCC, 2018; UNFCCC, 2021).

Initiatives on GHG mitigation rely on the quantification, monitoring, reporting and verification of GHG emissions and/or removals. International Standards that support the transfer of scientific knowledge into tools can help in reaching the targets of the Paris Agreement to address climate change.

ISO 14044 defines the requirements and guidelines identified in existing International Standards on life cycle assessment (LCA). The ISO 14060 series provides clarity and consistency for quantifying, monitoring, reporting and validating or verifying GHG emissions and removals to support sustainable development through a low-carbon economy. It also benefits organizations, project proponents and stakeholders worldwide by providing clarity and consistency on quantifying, monitoring, reporting and validating or verifying GHG emissions and removals.

ISO 14067 is based on the requirements and guidelines on LCA identified in ISO 14044 and aims to set specific requirements for the quantification of a carbon footprint (CFP) and a partial CFP. ISO 14067 defines the principles, requirements and guidelines for the quantification of the carbon footprint of products. Its aim is to quantify GHG emissions associated with the lifecycle stages of a product, beginning with resource extraction and raw material sourcing and extending through the production, use and end-of-life stages of the product.

Figure 1 illustrates the relationship between ISO 14067 and other ISO documents on LCA.



Key

PCR Product category rule

Figure 1 — Relationship between standards beyond the GHG management family of standards (source ISO 14067)

Hydrogen can be produced from diverse sources including renewables, nuclear and fossil fuels, with or without carbon capture, utilization and storage (CCUS). Hydrogen can be used to decarbonize numerous sectors.

A particular challenge is that identical hydrogen molecules can be produced and combined from sources that have different GHG intensities. Similarly, hydrogen-based fuels and derivatives will be indistinguishable and can be produced from hydrogen combined with a range of fossil and non-fossil inputs. Indeed, some of

© ISO 2026 – All rights reserved

the products made from hydrogen (e.g. electricity) can themselves be used in the production of hydrogen. Accounting standards for different sources of hydrogen along the supply chain (see Figure 2) is important for creating a market for low-carbon hydrogen, and these standards need to be agreed upon internationally. Additionally, there is the possibility that consumption gates are not located in proximity to hydrogen production gates, requiring hydrogen transport. ISO 14083[2] gives guidelines for the quantification and reporting of GHG emissions arising from transport chain operations.

A mutually recognized international framework that is robust, and that avoids miscounting or double counting of environmental impacts is needed. Such a framework will provide a mutually agreed upon approach to “guarantees" or “certificates” of origin, and will cover greenhouse gas inputs used for hydrogen production, conditioning, conversion and transport.

The ISO 19870 series aims at establishing methodologies that should be applied, in line with ISO 14067, to the specific case of the hydrogen supply chain, covering different production processes and other parts of the supply chain, such as conditioning hydrogen in different physical states, conversion of hydrogen into different hydrogen carriers and the subsequent transport up to the consumption gate.

The ISO 19870 series consists of the following parts:

— ISO 19870-1 on emissions associated with the production of hydrogen to production gate;

— ISO 19870-2 on emissions associated with the conditioning and transport of gaseous and liquid hydrogen up to consumption gate;

— ISO 19870-3 on emissions associated with the production, storage and transport of ammonia up to delivery gate and the conversion of ammonia into hydrogen;

— ISO 19870-4 on emissions associated with the storage and transport of hydrogen via LOHC.

This document considers the steps up to the production gate.

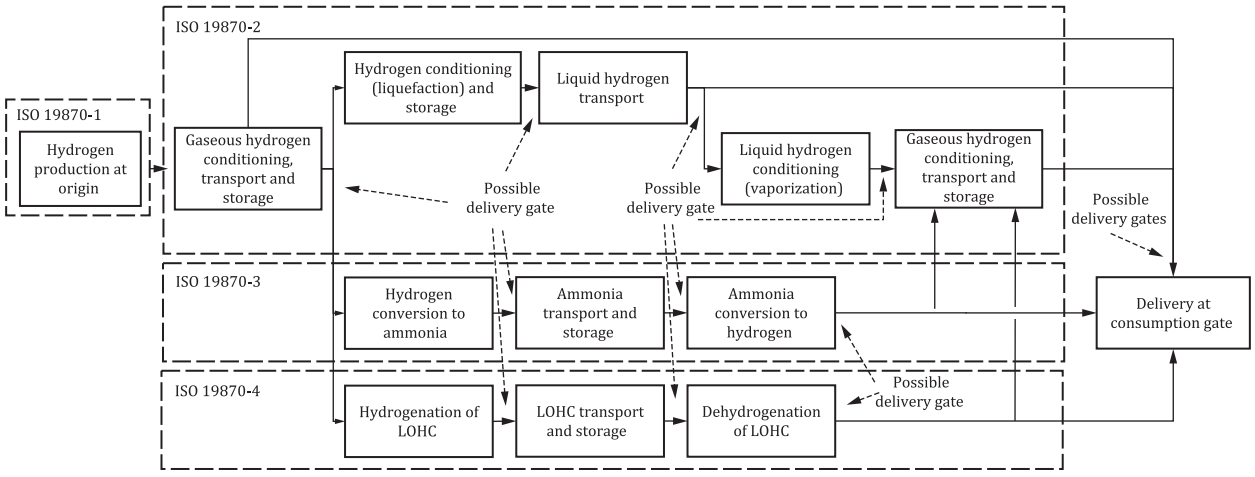


Figure 2 — Examples of the hydrogen supply chain and coverage of ISO 19870 series with the possible delivery gates

© ISO 2026 – All rights reserved

Hydrogen technologies — Methodology for determining the greenhouse gas emissions associated with the hydrogen supply chain —

Part 1: Emissions associated with the production of hydrogen up to the production gate

1 Scope

There are numerous pathways to produce hydrogen. This document specifies a methodology for different hydrogen production pathways for determining the greenhouse gases (GHG) emissions associated with the hydrogen supply chain from the raw material extraction up to the production gate.

This document considers the GHG emissions associated with hydrogen production up to the production gate. This document applies to and includes every step within the production process up to the production gate (see Figure 2 in the Introduction).

NOTE Complementary documents in the ISO 19870 series will consider hydrogen conditioning, conversion and transport methods.

ISO 14044 requires the goal and scope of a life cycle assessment (LCA) be clearly defined and be consistent with the intended application. Due to the iterative nature of LCAs, it is possible that the LCA scope needs to be refined during the study. According to ISO 14040:2006, A.2, the goals and scope of LCAs correspond to one of the following two approaches:

a) an approach that assigns elementary flows and potential environmental impacts to a specific product system, typically as an account of the history of the product (see 4.1.2);

b) an approach that studies the environmental consequences of possible (future) changes between alternative product systems (see 4.1.3).

In this document, approach a) is referred to as an attributional approach, while approach b) is referred to as a consequential approach. Complementary information is accessible in the ILCD handbook[4].

A carbon footprint of a product (CFP) (3.1.2) or partial CFP (3.1.3) as defined by ISO 14067 can be estimated using either the attributional or the consequential approach, the latter corresponding to the use of "system expansion via substitution" to avoid allocation when a unit process yields multiple co-products. This document applies to the CFP for hydrogen production.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14067, *Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification*

ISO 14071, *Environmental management — Life cycle assessment — Critical review processes and reviewer competencies*

© ISO 2026 – All rights reserved

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Terms related to quantification of the carbon footprint of a product

3.1.1
allocation
partitioning the *input* (3.2.7) or *output* (3.2.9) flows of a process or a *product system* (3.2.3) between the product system under study and one or more other product systems

[SOURCE: ISO 14040:2006 and ISO 14040:2006/AMD 1:2020]

3.1.2
carbon footprint of a product
CFP
sum of *greenhouse gas emissions* (3.1.12) and *greenhouse gas removals* (3.1.4) in a *product system* (3.2.3), expressed as *CO_2 equivalent* (3.1.10) and based on a *life cycle assessment* (3.3.5) using the single impact category of climate change

Note 1 to entry: A CFP can be disaggregated into a set of figures identifying specific *GHG emissions* (3.1.12) and *removals* (3.1.4). A CFP can also be disaggregated into the stages of the *life cycle* (3.3.4).

Note 2 to entry: The results of the *quantification of CFP* (3.1.8) are documented in the CFP study report expressed in mass of *CO_2e* (3.1.10) per *functional unit* (3.2.13).

[SOURCE: ISO 14067:2018, 3.1.1.1]

3.1.3
partial CFP
sum of *greenhouse gas emissions* (3.1.12) and *greenhouse gas removals* (3.1.4) of one or more selected process(es) in a *product system* (3.2.3) expressed as *CO_2e* (3.1.10) and based on the selected stages or processes within the *life cycle* (3.3.4)

Note 1 to entry: A partial CFP is based on or compiled from data related to (a) specific process(es) or footprint information modules (defined in ISO 14026:2017, 3.1.4), which is (are) part of a *product system* (3.2.3) and can form the basis for quantification of a carbon footprint of a product (CFP). More detailed information on information modules is given in ISO 14025:2006, 5.4.

Note 2 to entry: The results of the quantification of the partial CFP are documented in the CFP study report expressed in mass of *CO_2e* (3.1.10) per declared unit.

Note 3 to entry: In this document, partial CFP of hydrogen extends from raw material extraction up to the production gate.

3.1.4
greenhouse gas removal
GHG removal
withdrawal of a *greenhouse gas* (3.1.9) from the atmosphere

[SOURCE: ISO 14067:2018, 3.1.2.6]

© ISO 2026 – All rights reserved