

PAS 2050-1:2012

Assessment of life cycle greenhouse gas emissions from horticultural products

Supplementary requirements for the cradle to gate stages of GHG assessments of horticultural products undertaken in accordance with PAS 2050



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Foreword

The development of this Publicly Available Specification (PAS) has been facilitated by BSI Standards Limited and published under licence from The British Standards Institution. It came into effect on 21st March 2012.

This PAS has been prepared by a group of experts from several countries, with experience in the assessment of the greenhouse gas (GHG) emissions from horticultural products, with the objective of providing supplementary requirements that when used in conjunction with PAS 2050 (*Specification for the assessment of the lifecycle greenhouse gas emissions from goods and services*) will enhance the effectiveness of the assessment of GHG emissions from any horticultural product.

The development of PAS 2050-1 was co-sponsored by the Dutch Product Board for Horticulture (Productschap Tuinbouw) and the Dutch ministry of Economic Affairs, Agriculture and Innovations (Ministry of EL&I).

Acknowledgement is given to the significant contribution by Hans Blonk as Technical Author for this project and to the following organizations and individuals that assisted with the development of this specification:

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Comments from other parties were also sought by BSI. The expert contributions from all the organizations and individuals consulted in the development of this PAS are gratefully acknowledged.

Use of this document

It has been assumed in the preparation of this horticultural PAS that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

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This PAS is not to be regarded as a British Standard, European Standard or International Standard. In the event that this PAS is put forward to form the basis of a full British Standard, European Standard or International Standard, it will be withdrawn.

Presentational conventions

The provisions of this PAS are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall". Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material (e.g. NOTES) is presented in italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with this PAS does not in itself confer immunity from legal obligations.



Introduction

This Publicly Available Specification (PAS) contains requirements supplementary to PAS 2050 for the assessment of greenhouse gas (GHG) emissions from the life-cycle of horticultural products.

The purpose of these supplementary requirements is to aid consistent application of the PAS 2050 to the horticulture sector by providing:

- a horticultural focus for aspects of the PAS 2050 assessment where options are permitted;
- rules or assessment requirements that are directly relevant to the main sources of emissions from horticulture; and
- clarity on how to apply specific elements of the PAS 2050 assessment within the horticultural sector.

PAS 2050-1 is provided for use in conjunction with PAS 2050 to provide an homologous method for the reliable, repeatable assessment of GHG emissions from the whole life cycle of horticultural products. However, the supplementary requirements provided in PAS 2050-1 relate only to the cradle-to-gate stages of the life cycle and for all subsequent stages (i.e. retail, use and end-of-life) the requirements of PAS 2050 apply. For this reason PAS 2050-1 adopts the same content sequence and structure as PAS 2050 and within that sequence, some clauses do no more than defer to the equivalent clause in PAS 2050.

PAS 2050 sets out generic requirements for undertaking a GHG emissions assessment, such as transport, energy use, data quality rules etc whilst PAS 2050-1 provides supplementary requirements and additional guidance on those elements that have been found to present particular difficulties in an horticultural context such as land use change and allocation. Although, hitherto, it has been possible for those experienced in the use of PAS 2050 to achieve acceptable assessment outcomes using PAS 2050 alone, for new or less experienced users the use of PAS 2050-1 in conjunction with PAS 2050 in an assessment of the GHG emissions from an horticultural product, can be expected to ensure greater accuracy and uniformity of application.

Because of the global nature of trade in horticultural products it is essential that the supplementary requirements provided in PAS 2050-1 are applicable wherever assessment of emissions from horticultural products is to be made. The development of PAS 2050-1 has therefore been undertaken with participation by experts from different countries with the intention of providing a set of supplementary requirements that can be beneficially applied wherever horticultural products are grown.

During the final stages of the development of this PAS, application trials have been conducted for a number of different horticultural products and the experience gained has been used to improve the focus and application of the supplementary requirements presented here. Further information on these trials will be made available following the publication of PAS 2050-1.



1 Scope

PAS 2050-1 specifies supplementary requirements for use in conjunction with PAS 2050 for the cradle-to-gate assessment of the GHG emissions from the cultivation stages of horticultural products.

PAS 2050-1 is appropriate for use by organizations operating in the horticultural sector, intending to undertake a programme of GHG emission reduction of their product lifecycle or those needing to provide information on the GHG emissions from their products to downstream business partners.

PAS 2050-1, which has been developed in accordance with the principles set out in clause 4.3 of PAS 2050, follows the structure and form of that PAS. It clearly identifies where PAS 2050 requirements are to be applied without supplement and provides sector-specific requirements that are supplementary to PAS 2050 requirements, where permitted by that PAS.

As with PAS 2050, PAS 2050-1 addresses the single impact category of global warming potential. It does not assess other potential social, economic and environmental impacts arising from the provision of horticultural products, such as non-greenhouse gas emissions, acidification, eutrophication, toxicity, biodiversity, labour standards or other social, economic and environmental impacts that may be associated with the life cycle of such products.

An assessment of the GHG emissions of horticultural products using PAS 2050-1 in conjunction with PAS 2050, does not provide an indicator of the overall environmental impact of these products, such as may result from other types of life cycle assessment.

In line with the principle adopted for PAS 2050, PAS 2050-1 does not specify requirements for communication of assessment outcomes but both directly and by reference to PAS 2050, does include specific requirements relating to how information on GHG emissions arising during the cradle-to-gate stages of horticultural products, is to be conveyed to downstream business partners.

The GHG emissions related to the inputs (upstream) and the output (the horticultural product) downstream are defined by PAS 2050 2011 which establishes the overall framework for conducting the GHG assessment.

***Note** Global warming potential through GHG emissions is only one of many environmental impacts of processes and activities in the lifecycle of horticultural products. In many horticultural products' lifecycles, water depletion and water pollution could have a larger impact on the environment and society. The lifecycle GHG emissions of horticultural products although important, are emphatically not the only indicator for environmental impacts of horticultural products.*



2 Normative references

The following referenced documents are indispensable for the application 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.

PAS 2050: 2011 *Specification for the assessment of life cycle GHG emissions from goods and services.*



3 Terms and definitions

For the purposes of PAS 2050-1 the terms and definitions provided in PAS 2050 together with the following, apply:

3.1 cultivation

activities related to the propagation, growing and harvesting of plants including activities to create favourable conditions for their growth.

3.2 horticulture

cultivation, storage and marketing of fruit, vegetables (see 3.7) and flowering or ornamental plants (see 3.6).

3.3 (horticulture) cradle-to-gate assessment

assessment of GHG emissions arising from activity associated with an horticultural product from initial preparation for cultivation through to the point at which the product leaves the organization undertaking the assessment.

Note This mostly involves multiple cultivation production phases, such as the production of planting material and seeds and all their material inputs and outputs being relevant to and included in, the GHG assessment. See also system boundaries.

3.4 horticultural product

crop or plant together with all associated containers, growing medium, packaging and labelling employed during propagation and growth and to effect a successful transfer of the crop or plant to the intended purchaser

Note The product 'pot plant' includes the plant, the pot, the growing medium, packaging material and label.

3.5 methane slip

unburned methane emitted during the combustion of a methane-containing fuel mix in an engine.

Terms relating to plants and crops

3.6 flowering or ornamental plant

plant produced primarily for decorative or landscaping purposes including, bedding plants; bulbs, corms and

tubers; hardy nursery stock; grown flowers; grown foliage; pot plants; shrubs and trees

Note The above principles are adapted from Global Gap, annex 1.2. version 2.

3.7 fruit or vegetable plant

plant produced primarily to provide food for human or animal consumption in fresh, cooked or processed form, including fruit", "vegetables", "edible roots", "bulbs", "tubers", "nuts", "spices" or "herbs" (see list provided in Annex A)

Note The above definition is adapted from Global Gap, annex 1.2. version 2.

Note to 3.6 & 3.7, Plants can constitute a crop in themselves (e.g. cabbages, leeks) or can yield a crop and remain in growth for subsequent cropping (e.g. raspberries, cut flowers)

3.8 annual [crop] plant

crop yielding plant that is sown or planted and harvested during one production season.

Note This period may fall across two calendar years, e.g. sowing of 'Brussel sprouts' in August and harvesting in March the following year. In this situation, all activities of growing the crop are allocated to the year of harvest; see section 8.2.2 on co-production in crop rotation.

3.9 perennial [crop] plant

plant from which parts can be harvested over several productive seasons (e.g. sugar cane, asparagus, chicory, fruits, nuts), or which can be harvested entirely after growing for more than two seasons (e.g. trees, shrubs, potted plants)

3.10 open field cropping

growing of annual or perennial [crop] plants, in the open field in soil and without protection from the climate

3.11 protected cropping

growing of annual or perennial [crop] plants under some form of protection from the climate, e.g. in greenhouses or under polythene sheeting, or from the soil, e.g. substrates to favor growing conditions

3.12 crop rotation

growing of crops in a pre-determined seasonal sequence

Note Crop rotation is usually introduced to prevent diseases, maintain soil conditions and optimize yields.

3.13 crop rotation plan

the plan of a grower that provides for the planting of [crop] plants in a pre-determined cycle

Note A grower that applies a crop rotation plan often has multiple plots supporting different crops at the same time. Such plans are mostly applied to open field annual crop cultivation, where the grower produces multiple crops per production season

3.14 multiple cropping

planting and harvesting two or more species of [crop] plant in succession from the same growing area in the same year

3.15 inter cropping

mingling two or more species of [crop] plant at the same time in the same growing area in the same year

3.16 multiple crop production system

production system that yields multiple crops in a year that can be the result of crop rotation, multiple cropping or inter cropping in both open field and protected cropping systems



4 Principles and implementation

4.0 Overview

This PAS focuses on how the assessment of GHG emissions from the cradle-to-gate stages of horticultural production is to be undertaken (Figure 1).

The primary objective of this PAS is to provide greater clarity as to how the inputs of goods, land, materials and energy carriers and related GHG emissions can best be attributed consistently to the quantity and quality of the horticultural product that is being assessed.

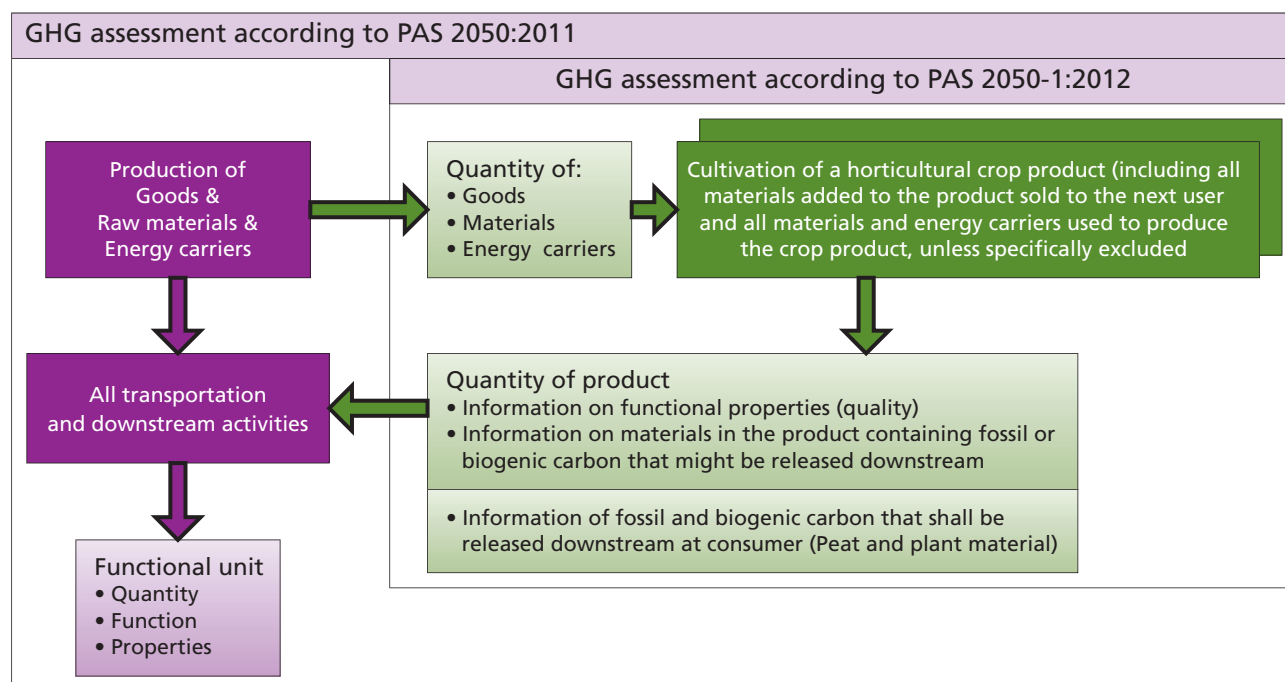
The following concepts are important for the proper use and understanding of this PAS.

- it is necessary that the specific quantity and quality of products being assessed be determined as part of the scope of an overall assessment in accordance with PAS 2050:2011. So, the functional unit as such, can only be determined within the scope of such an assessment, in relation to the use and intended purpose of the horticultural product being assessed. Therefore this horticultural PAS only addresses the definition of a functional unit and provides some guidance on its determination in relation to specific situations (see 5.2.4).

- The horticultural crop as a 'product' is assessed including all associated containers, growing medium, packaging and labeling employed during propagation and growth and to effect a successful transfer of the crop or plant to the intended purchaser, in addition to the actual crop or plant.
- The processes to be assessed therefore include all activities related to the propagation, growing, harvesting and marketing of plants including activity to create favorable conditions for growing. There are multiple cultivation steps possible within a GHG assessment of a horticultural product.

To facilitate an assessment of GHG emissions fully in accordance with PAS 2050, this horticultural PAS provides information as to the treatment of fossil and biogenic carbon in horticultural products that are likely to be transferred to users downstream. This is relevant for non-food, non-feed biogenic carbon and for fossil carbon containing materials.

Figure 1 Relationship between PAS 2050-1:2012 & PAS 2050:2011



The potential GHG emissions likely to arise from these materials after the cradle-to-gate stages of production, are to be assessed in accordance with the requirements of PAS 2050:2011. However, in the case of peat that is passed on to the consumer, this horticultural specification sets out specific requirements on how to calculate GHG emissions (8.2.3.2). This is particularly relevant for ornamental plants and trees.

Notwithstanding its focus on the cradle-to-gate stages of the horticultural product lifecycle, this PAS can be used in conjunction with PAS 2050 for the proper undertaking of a GHG assessment in accordance with PAS2050: 2011, for both of the situations described in 1 and 2, below:

- 1) A practitioner intends to undertake an assessment in response to or in anticipation of a request for GHG emission information from the cradle-to-gate stages to support an assessment being performed further on in the production chain, such as by a retailer or processor.
- 2) A practitioner intends to conduct a whole lifecycle assessment up to and including the disposal stage.

In situation 1 however, where an assessment is being done to provide information to support assessments undertaken at subsequent stages of the supply chain, particular care will be required to ensure that the functional unit used in the cradle-to-gate stages of the assessment is made known as part of the information provided, so as to facilitate the use of a common functional unit throughout (see also 6.2.3).



4.1 Primary requirements

Assessment of the GHG emissions and GHG removals from horticultural production systems, claimed to be in conformance with PAS 2050-1, shall be carried out using the principles and methods specified in PAS 2050 supplemented by the provisions made in this horticultural PAS in respect of the cradle-to-gate stages of those products.

4.2 Supplementary requirements – implementing PAS 2050-1

In accordance with PAS 2050: 2011:

- the assessment of cradle-to-gate GHG emissions and removals arising from horticultural products shall include the GHG emissions and removals (including all upstream emissions) arising up to the point at which the horticultural product leaves the grower for transfer to another party;
- the assessment shall include the emissions and removals from materials classified as waste from the cradle to gate phases;
- in addition, the potential impact of actions taken during the cradle-to-gate stages that could result in emissions arising during and after transfer of the product to another party shall be assessed and recorded separately (5.2.2).

Note 1 This does not preclude organizations undertaking a cradle-to-grave assessment for horticultural products for which PAS 2050 provides requirements for the other life cycle stages.

Note 2 Choices made at the cultivation stage can affect emissions at subsequent stages of the product life cycle. This may result from the choice of a growing medium (peat based or alternatives), pots, containers and packaging. Pots made out of different materials for example, will have different emissions at the disposal phase. Although this PAS only accounts for the cradle-to-gate phases of the product life-cycle, information recorded separately about subsequent emissions at use and disposal is intended to drive choices towards reducing emissions across the product life.

5 Emission and removals

5.1 Primary requirement

The requirements of PAS 2050 clause 5 shall be applied, supplemented by 5.2.1 to 5.2.3 of this PAS.

5.2 Supplementary requirements implementing PAS 2050-1

5.2.1 Included sources of GHG emissions

In relation to 5.1 of PAS 2050, the cradle-to-gate assessment of horticultural products shall include GHG emissions and removals arising from all processes, inputs and outputs in the cradle-to-gate stages of a horticultural product, including:

- emissions and removals of biogenic carbon (e.g. in burning biomass for fuel) where that biogenic carbon does not become part of the horticultural product;
- CO₂ emissions arising from fossil carbon sources (e.g. fossil fuel, peat and peat based compost, limestone);
- CH₄ (methane) emissions arising from manure used as fertiliser and other agricultural processes;
- N₂O (nitrous oxide) emissions arising from soils and agricultural processes.

CO₂ emissions and removals related to biogenic carbon captured in a horticultural product intended for human or animal consumption (food and feed) may be excluded in accordance with PAS 2050:2011.

The carbon content of dry organic matter of horticulture products is usually between 0.45 and 0.5. IPCC 2006 gives a default of 0.47 for trees. The carbon content of the horticultural product shall be calculated by multiplying the carbon content of dry organic matter by the dry matter mass of the product.

5.2.2 Delayed emissions resulting from actions taken during cradle-to-gate stages

In relation to 5.2 of PAS 2050, where carbon containing materials are added to the horticultural process during the cradle-to-gate stage that are likely to give rise to emissions during the use or end of life stages and within the 100 year assessment period, the potential emissions from those sources shall be assessed as if released at the beginning of the assessment period. A record of that assessment shall be made and retained separately from the overall cradle-to-gate assessment (see also 6.2.3).

5.2.3 Inclusion and treatment of land use change

5.2.3.1 Limited traceability of products

The following hierarchy shall apply when determining the GHG emissions and removals arising from land use change occurring not more than 20 years or a single harvest period, prior to making the assessment (whichever is the longer):

- a) where the country of production is known and the previous land use is known, the GHG emissions and removals arising from land use change shall be those resulting from the change in land use from the previous land use to the current land use in that country; *in this case, the requirements of clause 5.2.3.2 shall be applied;*
- b) where the country of production is known, but the former land use is not known, the GHG emissions arising from land use change shall be the estimate of average emissions from the land use change for that crop in that country; *in this case, the requirements of clause 5.2.3.3 shall be applied;*
- c) where neither the country of production nor the former land use is known, the GHG emissions arising from land use change shall be the weighted average of the average land use change emissions of that commodity in the countries in which it is grown.

***Note** Countries in which a crop is grown can be determined from import statistics, and a cut-off threshold of not less than 90% of the weight of imports may be applied.*

5.2.3.2 Assessment of GHG emissions from land use change when the previous land use is known

The GHG emissions from land use change consist of GHG emissions and removals from vegetation and soil carbon stocks changes. Both vegetation and soil carbon stocks of the previous land use and the current land use shall be assessed in accordance to the relevant sections of the IPCC Guidelines for National GHG Inventories. In accordance with PAS 2050, the carbon stock change shall be linearly amortised during a period of 20 years. All GHG emissions from land use change shall be attributed to crop production.

***Note 1** An Excel tool is available in which the specific situation (when the previous land use is known) can be selected and the GHG emissions are calculated automatically.*

Note 2 The capture of CO₂ in the crop and delayed emissions from harvested and consumed products, burning and decay of biomass, is implicitly included in the land use change calculations and shall not be reported in another part of the GHG assessment, because this will result in double-counting.

5.2.3.3 Assessment of average GHG emissions from land use change when the previous land use is not known

For assessment of the average GHG emissions from land use change when only the crop and country are known, four previous land use categories in the 20 years prior to the assessment shall be considered and the highest GHG emission value shall be taken from two estimates of average land use change:

- 1) The value calculated by using the average of land use change from either:
 - forest (1/3), grassland (1/3) and perennial (1/3) cropland to annual cropland, or
 - forest (1/3), grassland (1/3) and annual cropland (1/3) to perennial cropland
- 2) The value calculated by deriving a (weighted) country average of transformation of land use categories in the country to perennial or annual cropland.

Note An excel tool is provided to support the calculation of these averages.

For the assessment of the (weighted) average, the rate of expansion shall be determined on the basis of the share of area expansion during 20 years prior to the assessment and at the time of the assessment, using data from the United Nations Food and Agriculture Organization (FAO) (faostat.fao.org), starting with the most recent available year in this database. For the evaluation of the trend in land use change of the crop, the average crop area in the most recent three years shall be compared with the three years average of 20 years previously ago.

If there is no expansion, no land use change shall be attributed to the crop. If expansion has taken place, the share of area expansion in relation to total current area of the assessed crop (REC) shall be assessed as follows:

$$REC = \frac{\text{expanded area of assessed crop (ha)}}{\text{current area of assessed crop (ha)}}$$

The remaining (1 – REC) shall be assumed to be not related to any land use change.

The expanded area of the assessed crop consists of (at maximum) four shares:

- 1) Share of area expansion at the expense of forest land (SEF)
- 2) Share of area expansion at the expense of grassland (SEG)
- 3) Share of area expansion at the expense of perennial tree cropland (SEP)
- 4) Share of area expansion at the expense of annual cropland (SEA)

These shares shall be based on three year rolling averages of area expansion and contraction data of all crops in the country (from FAO statistics) during the 20 years prior to the three most recent years for which data is available.

The share of area expansion for annual or perennial crops at the expense of forest, grassland and annual or perennial crop land, shall be calculated in two steps.

Step 1 First the combined decline in forest and grassland (SEF&G) shall be calculated from area expansion and contraction for all individual crops in the country (annual and perennial crops) as follows:

$$SEF\&G = 1 - \frac{\text{the sum of all crop area contractions (ha)}}{\text{the sum of all crop area expansions (ha)}}$$

When the result is negative, the value of either the decline of forest or grassland shall be set to zero. In this case, only the conversion of perennial to annual or vice versa needs to be calculated.

Step 1.1 (Only to be included if SEF&G > 0)

The share of area expansion at the expense of forest land shall be equal to:

$$SEF = SEF\&G * \frac{\text{contraction forest (ha)}}{\text{contraction forest and grassland (ha)}}$$

If the sum of contractions of forest and grassland area equals zero (due to the lack of specific data), SEF shall equal SEF&G * 1, and SEG shall equal 0.

Note: The total forest land or grassland area contraction is not equal to the total land use change in a country. It is not possible to directly determine the share of area expansion at the expense of forest land or grassland from FAO data.