Boverket

Myndigheten för samhällsplanering, byggande och boende

REPORT 2023:24

Limit values for climate impact from buildings

and an expanded climate declaration

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Foreword

In February 2022, the government commissioned the Swedish National Board of Housing, Building and Planning (Boverket) to submit proposals on how to accelerate the introduction of limit values for climate impact from buildings and expand the application of climate declarations. This report is an English translation of the report sent to the government in May 2023.

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Karlskrona July 2023

Anders Sjelvgren
Director-General

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Terminology

BBR = Boverkets byggregler, or Boverket's building regulations – mandatory provisions and general recommendations, BFS 2011:6.

Building element = A specific part of a building, such as the frame or roof.

Building type = an umbrella term for those buildings that have a specific application, such as "multi-dwelling block" or "education excluding preschools".

Construction product = Product or kit which are produced and placed on the market for incorporation in a permanent manner in construction works or parts thereof and the performance of which has an effect on the performance of the construction works with respect to the basic requirements for construction works. (Definition pursuant to the European Construction Products Regulation.)

Data gap = A data gap is a resource (such as a construction product) that has not been linked to any climate impact, either because it is not quantified in the bill of resources, or because the resource has not been linked to any climate data.

EKS = Boverket's mandatory provisions and general recommendations on the application of European design standards (Eurocodes), BFS 2011:10.

EN 15804:A1 = SS-EN 15804:2012+A1:2013

EN 15804:A2 = SS-EN 15804:2012+A2:2019

Generic climate data = Average climate data for resources that are representative of Swedish conditions. Note that Boverket's climate database contains both "conservative" generic climate data and generic climate data (also referred to in this report as "typical data").

GWP = Global Warming Potential. All emissions are multiplied by what is known as a Global Warming Potential (GWP) in order to compare different greenhouse gases on the basis of a 100-year value (GWP100). This factor differs for the various greenhouse gases, and the GWP indicates the total contribution to global warming of the gas in question. The values are converted to carbon dioxide equivalents using the GWP of the gases. For instance, methane contributes 28 times more to the greenhouse effect than carbon dioxide per tonne of gas emitted, so 1 tonne of methane emission is equivalent to 28 tonnes of carbon dioxide equivalents.

Climate data = Greenhouse gas emissions expressed in kilograms of carbon dioxide equivalents per unit of resource.

Groundworks and ground improvement = soil stabilisation measures, capillary breaking layers and drainage on the site where the building is to be erected up to insulation under the foundation, including measures two metres outside the building's façade. Measures that relate to connection of media up to insulation on the ground are not included.

PBF = Plan- och byggförordningen, the Planning and Building Ordinance (2011:338).

PBL = Plan- och bygglagen, the Planning and Building Act (2010:900)

Reference value = A value of the climate impact of a building that is representative of current construction and is used to determine the limit value for the climate impact of buildings in this report.

Resource = Material and energy.

Coverage ratio = Indicates how much of a building's climate impact that has been calculated. The coverage ratio is calculated by dividing the total cost of all construction products that could be quantified, and where climate data is available, by the cost of all construction products. Alternatively, the cost can be exchanged for weight. The ratio of these two figures corresponds to the coverage ratio of the bill of resources.

Verification = A document, such as a delivery note or similar, verifying that the information in a climate declaration is consistent with what was actually incorporated into the building. Verification may include information on quantities of different construction products and Environmental Product Declarations (EPDs) or equivalent if product-specific climate data has been used for the calculation.

Summary

Boverket, the Swedish National Board of Housing, Building and Planning, has been commissioned by the government to submit a legislative proposal for a next step in the regulations on climate declarations for buildings, including a requirement for limit values for the climate impact of buildings to be introduced before 2027. Boverket's proposal in the report from 2020 entitled "Regulation on climate declarations for buildings" provides key starting points for the assignment. Another key report is "Referensvärden för klimatpåverkan vid uppförande av byggnader" [Reference values for climate impact for the erection of buildings], compiled by the KTH Royal Institute of Technology on behalf of Boverket. The study has produced climate impact values which are representative of today's construction of single-family houses, multi-dwelling blocks, offices, schools and preschools. The KTH report was updated by KTH on behalf of Boverket in 2023. Proposed limit values for the climate impact of buildings are based on the updated report from KTH.

Limit values may be introduced by 2025 at the earliest

Limit values may be introduced on 1 July 2025 at the earliest, in the regulations on climate declarations for buildings, on a maximum climate impact for modules A1–A5 in kilograms of carbon dioxide equivalents per square metre of gross floor area (kg CO_2e per m^2 GFA) of the buildings that are erected and are subject to regulations on climate declarations for buildings. The major need to quickly reduce climate impact is the primary reason for bringing forward in time the introduction of limit values for the climate impact of buildings. Regulations on climate declarations for buildings, which came into force in January 2022, have already had a significant impact on all major stakeholders in the sector. The benefits of including other life cycle stages beyond the construction stage in the limit value are still viewed as limited when it comes to reducing the climate impact of the buildings erected. However, there may be reason to review the system boundary if methods are introduced for better visualisation of the choice of design solutions that last a long time and are easy to repair. However, other policy instruments are likely to be more appropriate for steering towards greater energy efficiency and solutions that favour future reuse, flexibility and suchlike.

It is proposed that the limit value should cover all building elements, from the foundation and its insulation, excluding solar cells and fixed equipment. The climate impact for solar cells integrated in construction products or surface-mounted solar cells must be reported in the climate declaration. It is proposed that limit values for the buildings covered by the climate declaration should be dealt with in two groups.

- Group 1: Relatively homogeneous building types where there are robust reference values. This group includes single-family houses, multi-dwelling blocks, office buildings, education excluding preschools, preschools and special housing. A limit value corresponding to the median level of the building type reference value is proposed for this group (excluding single-family houses). For single-family houses, a limit value corresponding to the 75th percentile of the building type reference value is proposed instead.
- Group 2: Other buildings where there are no robust reference values. A common limit value is introduced for this group, corresponding to the 75th percentile of the reference value for multi-dwelling blocks. Technical equipment and fixed interior design intended for the activity are not included in the climate declaration or limit value.

	Building type	**Limit value (kg CO_2e per m^2 GFA)**
Group 1	Multi-dwelling blocks	375
	Offices	385
	Education excluding preschools	380
	Preschool	330
	Single-family houses	180
	Special housing	385
Group 2	Other buildings	460

Mixed-use buildings are assigned weighted limit values. It is proposed that the exemption from the requirement for a climate declaration should continue to apply to the same buildings and building types that are already exempt.

An expanded climate declaration from 2027

A climate declaration covering the *entire life cycle of the building* is proposed from 1 January 2027. The modules from the building life cycle that are proposed for inclusion in the climate declaration are modules A1–A3 product stage, A4–A5 construction process stage, B2 maintenance, B4 replacement, B6 operational energy use, and C1–C4 end-of-life stage. The climate impact of *groundworks and ground improvement* must also be reported in a climate declaration. Boverket is not submitting a legislative proposal for a separate report on the amount of sequestered renewable biogenic carbon in long-lived construction products incorporated into the building, even though construction sector stakeholders have a great deal of interest in the issue. There is yet no consensus on the environmental valuation of biogenic carbon sequestration in buildings. The work within the EU involving investigation of how biogenic materials are to be dealt with in life cycle analyses of products should be followed, and adjustment may be possible when better knowledge is available. No

requirement regarding the reporting of net exports of locally produced electricity is proposed.

Introducing an expanded climate declaration later than the limit values for the climate impact of buildings will make it possible to make adjustments to similar future regulations from the EU. The European Commission submitted a proposal in December 2021 concerning the revision of the Energy Performance of Buildings Directive (EPBD). The revised Directive will be adopted after a report on this assignment has been submitted. A new type of requirement which did not exist before and is directly linked to the climate declaration framework is introduced in the Directive. The European Commission's proposal includes a requirement to calculate the climate impact of new buildings over their life cycle and disclose this in the energy declarations for all new buildings over 2000 square metres as of 1 January 2027. The European Commission's proposal contains no requirements for determining limit values, and no requirements covering renovation.

Climate declaration for refurbishment from 2027 onwards

Climate declaration requirements are also proposed for certain *alterations* to existing buildings from 1 January 2027. This requirement is not applicable to all alterations, it is limited to two measures that require building permits. This requirement is applicable if the alteration means that the building is fully or partially occupied for, or is fitted out for, a substantially different purpose. The requirement is also applicable if an additional dwelling, or additional non-residential premises for commerce, skilled trades or industry are fitted out in the building. The climate declaration must cover the construction products included in the alteration that is subject to a climate declaration requirement and must be reported in kg CO_2e per m^2 GFA for modules A1–A4 + A5 construction product waste.

Boverket proposes that *extensions* shall not be subject to climate declaration requirements.

The proposals concerning the calculation methodology

Regulations to enhance the quality of climate declarations are proposed. A coverage ratio of 80 per cent is proposed, along with the fact that 75 per cent of a building's climate impact shall be verifiable in terms of the products used and their quantities.

Boverket's climate database shall continue to contain conservative generic climate data that is to be used in a climate declaration if generic climate data is used. Potential use of default values for additional building

elements is proposed. Specific climate data may be used for construction products, as in the current regulatory framework.

Proposal for limit values from 2030 onwards

Reducing limit values every five years is proposed. Reducing the limit value by 25 per cent by 2030, compared to the 2025 level (except for single-family houses) is proposed. For single-family houses, a small reduction of between 0 and 15 per cent in 2030 compared to the 2025 level is proposed. An evaluation of the application and impact of the regulations on climate declaration and the limit values for the climate impact of buildings is proposed two to three years before the limit value is reduced.

Proposed measures for the development of regulations

Boverket proposes several measures for the development of regulations on climate declarations for buildings. Boverket should be commissioned to facilitate the introduction of regulations on limit values for the climate impact of buildings from 2025 and an expanded climate declaration from 2027. This assignment should include resources for the development of Boverket's climate database, climate declaration register, supervision and information and guidance.

New requirements for Boverket's supervision

Boverket's supervision ensuring that limit values for the climate impact of new buildings are not exceeded places more specific requirements on Boverket's performance. A legally certain procedure is based on performing similar assessments using methods based on recognised standards. Any such procedure can only be achieved with a high degree of digitalisation and automation. The regulatory framework on which building elements are covered by the limit value also needs to be clear to developers and contractors to ensure that the supervision is legally certain, efficient and robust.

Boverket proposes that the developer shall enclose a *calculation base* when the climate declaration is registered. This calculation base must be submitted digitally, in a format and structure decided by Boverket.

Boverket sees the need of that reporting of the climate impact of building elements should follow the same structure as the CoClass classification system, according to a classification and level that is publicly available and does not require a licence. Boverket should be commissioned to investigate whether a more detailed level of classification in CoClass – which is currently subject to a licensing requirement – is required for climate declarations and, if so, with also proposing a solution that limits increased administrative costs for developers. It is also proposed that Boverket should be commissioned to investigate whether the State should

take over ownership and management responsibility for the CoClass classification system. There is a general need in the construction industry for a classification system that supports digital management of construction product information, which may improve communication between stakeholders in the urban planning sector. The system can be used throughout the life cycle of construction works, and for any built environment. CoClass allows everyone to access standardised classes, as well as terms and concepts in all software and all information deliverables. Government grants to fund the classification of buildings are widely available to the countries in our immediate vicinity.

Checking the calculation base does not indicate whether the construction products used in the climate calculation have also been used in the building. Verification needs to be requested for any such check to be possible. The verification must show that the construction product has been delivered to the construction site, and it must be possible to link it to the calculation base. Boverket requests verifications when a supervision case is initiated. Besides verification of construction products, verification of climate data is also requested if product-specific climate data was used in the climate calculation. Verifications must be submitted digitally, in a format and with a structure decided by Boverket.

Boverket may levy a sanction fee if the developer has provided incorrect information in the climate declaration or provided incorrect documentation and should reasonably have realised this, or if the declared value of the climate impact of the building exceeds the limit value. The developer must be given the opportunity to give an opinion before Boverket decides to levy a sanction fee.

Development of new information and guidance

There is a major need for information on forthcoming and adopted regulations, as well as developing a clear regulatory framework. There is also a need to issue guidance on the application of the new regulations once they have been adopted. Besides the proposal to commission Boverket to develop information and guidance, it is proposed that the National Agency for Public Procurement be tasked with devising procurement criteria that can be used in the procurement of contractors or consultants in order to achieve limit values for the climate impact of buildings.

Evaluation of the regulations on climate declaration

As Boverket proposes reducing limit values every five years, it is proposed that Boverket be commissioned to conduct an evaluation of the regulations on climate declarations three years before any planned reduction of the limit values (2030). It is also proposed that Boverket be commissioned to conduct a supplementary reference value study in 2027, ahead of planned reduction of the limit values in 2030. It is proposed that

Boverket be commissioned to devise reduced limit values on the basis of the evaluation and the supplementary reference value study.

Impact of the proposals

All regulatory changes are expected to give rise to administrative costs. It is thought that the administrative costs will be incurred initially by developers and contractors, including small and medium-sized enterprises. The cost of extra work that primarily distinguishes a limit value from a climate declaration involves the cost of conducting climate calculations that follow the construction project from the drawing board to a finished building. The proposals mainly affect the developer.

The State, through Boverket, is the stakeholder expected to incur the greatest administrative costs. However, the development costs of adapting to an expanded climate declaration are what make up by far the largest share of government costs in the period 2024–2027. There may be an increase in the ongoing procedure. That said, the costs of running and maintaining the climate declaration register and climate database are also expected to increase. Costs for training initiatives are also expected to be incurred when regulations with limit values and an expanded climate declaration are introduced. Costs for supervision can be expected to increase the running costs of managing climate declarations. Government costs are expected to be affected by both the limit value and the expansion of the climate declaration.

Municipalities will be affected by information costs, as more people will need to be informed about the requirements for climate declarations. This also means that more confirmations of registered climate declarations will be submitted to municipalities for final clearance. This is likely to result in increased handling costs for municipalities, but the changes are not expected to be significant compared to the current legislation on climate declarations.

Design stage to become more important

For developers, the design stage will be more important than before: this is deemed to be a consequence of the limit value. There will be more opportunities at the design stage to make choices that will optimise the climate impact of a building. Project planning costs may increase as a consequence. However, this does not necessarily mean that construction costs will increase, provided that the building and the use of materials are optimised.

Costs for building materials are expected to increase due to the higher cost of climate-improving materials. The cost of producing these materials and the cost of EPDs will be incurred. However, the costs per product are not expected to be significant. The developers and contractors who will have to pay slightly more for materials will be directly affected.

Construction product manufacturers will mainly be affected indirectly by the cost of producing EPDs and incur development costs.

New construction methods have been referred to in several of the interviews conducted as a way of reducing climate impact. Adapting to a new way of construction primarily affects contractors. This includes learning new construction methods such as building with wood instead of concrete, for instance, or optimising the use of concrete.

One possible consequence of limit values is that developers will receive fewer tenders and subcontractor availability will be reduced. This in turn may increase the prices tendered. There are concerns of a decline in subcontractor availability, as building contractors may choose to work on construction projects for private individuals rather than construction projects regulated by limit values.

Skills enhancement in the sector

Upskilling is deemed relevant for all stakeholders in the construction process in order to understand how structures and material choices affect emissions (developers, contractors, construction product manufacturers, small and medium-sized enterprises and project designers). Upskilling is possible by means of training programmes initiated by the industry, or by ensuring that construction stakeholders follow training programmes devised by the public sector. It may be challenging for small businesses to find the time and resources needed to enhance their knowledge, which means that there will be a need for a new kind of simple, practical training programmes.

How construction will be affected

Moderate cost increases can be expected for most construction stakeholders. The cost increase can be estimated to be in the order of 1 to 5 per cent of the production cost, excluding land costs, for any projects that take action by changing their choice of materials. Empirical evidence in this regard is limited, but the results of a simulation study can be used to relate to a cost increase corresponding to the higher value in the range. This shows that with a 5 per cent increase in construction costs, construction will fall by 1.2 per cent and rents will rise by 2.4 per cent.

There is no significant evidence to suggest that the limit value could affect the designed living environment by altering the choice of building type and/or façade materials.

Boverket has been unable to identify any stakeholder that builds single-family houses with classic concrete framing as a business activity. In that case, these would be subject to the requirement for limit values for single-family houses. At present, a single-family house with concrete framing will not meet the limit value proposed in the report. Climate-

improved concrete may make it possible to meet the limit value for single-family houses with lightweight concrete façades. It is also noted that a single-family house with a brick façade will probably fail to meet the limit value, but the limit value can still be met by replacing the brick with climate-improved brick, for example.

Discussion and conclusions

One of the starting points for the development of the proposals presented in this report has been to minimise the complexity of extending the regulatory framework. It is assessed that introducing limit values for modules A1–A5 only is a well-balanced choice. This covers the vast majority of climate impacts from a life cycle perspective, while also placing focus on steering towards the reduction of climate impact that is taking place today when new buildings are erected, and that can be measured and verified, and that is not regulated in any other way by means of regulations on erection, for instance.

The collective proposals in the report represent a major expansion of the regulatory framework. It is assessed that this is possible for users, and the construction sector is already working actively on a number of the issues proposed for inclusion in the regulatory framework. The regulations on limit values should be given priority, if there is any need to prioritise between policy instruments. There are examples of cost-effective new construction concepts that are already significantly lower than the proposed limit value levels even now. There has been rapid advance in the development of tools, implementation and learning about climate calculations. There is deemed to be major potential for new markets. Continued digitalisation and interlinking of digital systems is key to minimising the administrative burden on project stakeholders when preparing climate declarations.

Legislative proposal

Proposal for an act amending the Act on climate declaration for buildings (2021:787)

Step 1 Entry into force 1 July 2025

issued on...

It is hereby prescribed with regard to the Act on climate declaration for buildings (2021:787)

that 17, 18 and 19 §§ shall be worded as follows,

that three new Sections, 16 a, 18 a and 18 b §§, shall be inserted in the Act, worded as follows,

that a new Section, 9 a §, shall be inserted in the Act and that a new heading worded as follows shall be inserted immediately before 9 a §.

Current wording	Proposed wording
	Limit value *9 a §* *Buildings erected may not exceed the limit value for the climate impact of buildings.* *The government may issue further regulations on the limit value.*
	16 a § The supervising authority may conclude a contract with an individual to perform supervisory assignments. However, assignments that involve the exercise of authority when Boverket performs an assessment and makes a decision on the matter may not be delegated.

Current wording	Proposed wording
17 § If the supervising authority calculates a value for the climate impact of the building pursuant to 7 § 4 that deviates significantly from the recorded value, the authority shall provide the developer with an opportunity to submit an explanation for the deviation within a certain period. The authority shall amend the recorded value to the value calculated by the authority unless the developer has made a prima facie case that the deviation pursuant to the first paragraph is acceptable.	17 § *If the supervising authority assesses during its supervision that the recorded value of the climate impact of the building pursuant to 7 § 4 deviates from a value that is reasonable in the assessment of the authority, the authority shall give the developer an opportunity to correct the deviation within a certain period of time.*
18 § The supervising authority may levy a sanction fee if 1. the developer has provided incorrect information in the climate declaration and should reasonably have realised this, and 2. the declared value of the climate impact of the building pursuant to 7 § 4 deviates significantly from the supervising authority's calculated value in a manner that is unacceptable. The government may issue further regulations regarding the sanction fee.	18 § The supervising authority may levy a sanction fee if 1. the developer has provided incorrect information in the climate declaration *or provided incorrect documentation* and should reasonably have realised this, *or* 2. the declared value of the climate impact of the building pursuant to 7 § 4 *exceeds the limit value pursuant to 9 a §*. *The developer shall be given the opportunity to give an opinion before the supervising authority decides to levy a sanction fee.* *A sanction fee may not be levied pursuant to paragraph 1, item 1 if a sanction fee is levied pursuant to paragraph 1, item 2. The fee may not exceed twenty price base amounts.* The government may issue further regulations regarding the sanction fee.

Current wording	Proposed wording
	18 a § The sanction fee may be reduced in an individual case if the fee is not in reasonable proportion to the contravention. Particular consideration shall be given to whether the infringement was not committed intentionally or negligently, whether the infringement may be considered less serious for other reasons or whether the fee imposes a disproportionate burden on the developer. *The fee need not be levied if it is unreasonable in view of* *1. the fact that the developer has provided incorrect information or inaccurate documentation due to a circumstance that the developer could not or should not have foreseen or been able to influence, or* *2. the fact that the limit value was exceeded due to a circumstance that the developer could not or should not have foreseen or been able to influence, or* *3. what the developer has done to avoid an infringement occurring.*
	18 b § A supervising authority may issue the injunctions necessary to fulfil the obligations arising from this Act or from regulations issued in connection with the Act. Any such injunction may be accompanied by a contingent fine. *No sanction fee shall be levied if the infringement has resulted in the imposition of a contingent fine.*
19 § Decisions pursuant to 17 §, paragraph 2 and 18 §, paragraph 1 may be appealed to a general administrative court. Other decisions pursuant to this Act may not be appealed. Leave to appeal is required for appeal to the Administrative Court of Appeal.	19 § Decisions pursuant to *18 §, paragraph 1 and 18 b §* may be appealed to a general administrative court. Other decisions pursuant to this Act may not be appealed. Leave to appeal is required for appeal to the Administrative Court of Appeal.

1. This Act will enter into force on 1 July 2025.

2. Older provisions still apply to buildings for which an application for a building permit has been submitted to the building committee before the Act enters into force.

Proposal for an ordinance amending the Ordinance on climate declaration for buildings (2021:789)

Step 1 Entry into force 1 July 2025

issued on...

It is hereby prescribed with regard to the Ordinance on climate declaration for buildings (2021:789)

that 3, 5, 7, 12 and 13 §§ shall be worded as follows,

that a new Section, 12 a §, shall be inserted in the Ordinance, worded as follows,

that a new Section, 7 a §, shall be inserted in the Ordinance and that a new heading worded as follows shall be inserted immediately before 7 a §.

Current wording	Proposed wording
3 § The climate declaration shall be submitted to Boverket. Boverket may issue regulations on how the declaration is to be submitted.	3 § The climate declaration shall be submitted to Boverket. *The calculation base that verifies the information stated in the climate declaration shall be submitted to Boverket at the same time as the climate declaration. The calculation base shall be submitted in a format established digitally by Boverket.* Boverket may issue regulations on - how the declaration *and the calculation base* are to be submitted, *and* - *electronic transmission of climate declarations and calculation bases.*

Current wording	Proposed wording
5 § The climate declaration shall cover the building envelope for the entire building and all the building's load-bearing structures and interior walls. A building envelope is a building element comprising one or more layers that isolates the interior of a building from the outside world in terms of factors such as temperature, noise and humidity. Load-bearing structures are defined as parts of the building's structure which bear loads of various kinds in addition to their own weight. Interior walls are defined as walls inside the building envelope that are not load-bearing.	5 § The climate declaration shall cover *all parts of the building from the foundation and its insulation.* *The coverage ratio of the building's constituent construction products shall be reported and be at least 80 per cent. If the coverage ratio is less than 100 per cent, the reported climate impact of the construction products in the building shall be calculated so that it corresponds to all of the building's construction products.* *Coverage ratio refers to the proportion of the building's construction products for which it has been possible to calculate the climate impact. The coverage ratio shall be determined by means of calculation on the basis of the cost or weight of the construction products in the building in question.*
7 § Boverket may issue regulations on - What information shall be included in a climate declaration, - What data shall be used when calculating climate impact, and - Exemptions from parts of the requirements defined for the content and scope of the climate declaration.	7 § Boverket may issue *more detailed* regulations on - What information shall be included in a climate declaration, - What data shall be used *and how* the climate impact is calculated, - *Determination of the coverage ratio*, and - Exemptions from parts of the requirements defined for the content and scope of the climate declaration.

Current wording	Proposed wording
	Limit value *7 a § Buildings that are erected may have a climate impact with the following maximum values in kilograms of carbon dioxide equivalents per square metre of gross floor area* *1. Multi-dwelling blocks 375* *2. Single-family houses 180* *3. Office 385* *4. Preschools 330* *5. Education excluding preschools 380* *6. Special housing 385* *7. Other buildings 460* *When calculating the building's climate impact covered by the limit value solar cells shall not be included.* *If a building is to have a number of uses, the limit value is weighted on the basis of the area of the various use in the building.* *Special housing refers to buildings intended for the elderly, students, young people or people with disabilities.*
12 § The developer shall ensure that the documentation verifying the information stated in the climate declaration is retained for five years after the climate declaration has been submitted.	12 § The developer shall ensure that the documentation verifying the information stated in the climate declaration is retained for five years after the climate declaration has been submitted. *Boverket may issue regulations on how the information and documents referred to in 16 § of the Act on climate declarations for buildings (2021:787) are to be submitted to Boverket.*

Current wording	Proposed wording
	12 a § *At the request of Boverket, the developer shall present digital documentation that verifies the information provided in the climate declaration.* *Documentation verifying the information provided in the climate declaration shall include* 1. *verification of the construction products purchased and supplied, with quantities used in the building.* 2. *verification of product-specific and supplier-specific climate data, where applicable.* *Verification of construction products purchased shall be available for construction products covering at least 75 per cent of the total climate impact of the building.* *Verification of product-specific and supplier-specific climate data shall be available for all construction products where specific climate data has been used to calculate climate impact.*
13 § A sanction fee pursuant to 18 § of the Act on climate declarations for buildings (2021:787) is determined by applying the price base amount applicable for the year in which the decision on the fee is made. The sanction fee is one price base amount plus 0.001 price base amount per square metre of the total gross floor area of the building. The fee may not exceed ten price base amounts.	13 § A sanction fee pursuant to 18 § of the Act on climate declarations for buildings (2021:787) is determined by applying the price base amount applicable for the year in which the decision on the fee is made. The sanction fee *relating to 18 §, paragraph 1, item 1 of the Act on climate declarations for buildings (2021:787)* is one price base amount plus 0.001 price base amount per square metre of the total gross floor area of the building. *The sanction fee relating to 18 §, paragraph 1, item 2 of the Act on climate declarations for buildings (2021:787) is one price base amount plus 0.002 price base amount per square metre of the total gross floor area of the building.*

1. This Ordinance will enter into force on 1 July 2025.

2. Older provisions still apply to buildings for which an application for a building permit has been submitted to the building committee before the Act enters into force.

Proposal for an act amending the Planning and Building Act (2010:900)

Step 1 Entry into force 1 July 2025

issued on...

It is hereby prescribed with regard to the Planning and Building Act (2010:900)

that Chapter 10, Section 19 shall be worded as follows.

Current wording	***Proposed wording***
Chapter 10. Implementation of construction, demolition and land measures	
Section 19 The following shall be reviewed during the technical consultation 1. planning and organisation of the work, 2. the developer's proposal for an inspection plan and the other documents submitted by the developer, 3. how waste and reusable construction products have been identified, 4. the need for site visits or other supervisory measures by the building committee, 5. the need for completion protection, 6. the need for staking out, 7. the building committee's need for further documents for a decision on an inspection plan or starting clearance, and 8. the need for additional meetings.	Section 19 The following shall be reviewed during the technical consultation 1. planning and organisation of the work, 2. the developer's proposal for an inspection plan and the other documents submitted by the developer, 3. how waste and reusable construction products have been identified, 4. the need for site visits or other supervisory measures by the building committee, 5. the need for completion protection, *6. the need for climate declaration pursuant to the Act on climate declaration for buildings (2021:787),* 7. the need for staking out, 8. the building committee's need for further documents for a decision on an inspection plan or starting clearance, and 9. the need for additional meetings.

This Act will enter into force on 1 July 2025.

Proposal for an act amending the Act on climate declaration for buildings (2021:787)

Step 2 Entry into force 1 January 2027

issued on...

It is hereby prescribed with regard to the Act on climate declaration for buildings (2021:787)

that 2, 5, 6, 8 and 9 §§ shall be worded as follows,

that a new Section, 8 a §, shall be inserted in the Act, worded as follows.

Current wording	***Proposed wording***
2 § The Act shall apply when new buildings are erected, unless otherwise stated in 5 or 6 §§.	2 § The Act shall apply when new buildings are erected. *The Act shall also apply to the alteration of buildings other than extension if the alteration* - *requires a building permit pursuant to Chapter 9, Section 2 item 3 a of the Planning and Building Act (2010:900), or* - *requires a building permit pursuant to Chapter 9, Section 2 item 3 b of the Planning and Building Act (2010:900) and is not exempt from the requirement for a building permit pursuant to Chapter 9, Section 4 c.* *The Act shall not be applied if otherwise stated in Sections 5 or 6.*

Current wording	***Proposed wording***
5 § The obligation to prepare and submit a climate declaration does not include 1. buildings with temporary building permits intended for use for a maximum of two years, 2. buildings that do not require a building permit pursuant to Chapter 9, Section 6, 7 or 9 of the Planning and Building Act (2010:900), 3. buildings for industrial or workshop purposes, 4. economy buildings for farming, forestry or similar enterprises, 5. buildings with a gross floor area not exceeding 100.0 square metres, and 6. buildings intended for the total defence and buildings of importance for the security of Sweden. If a developer who erects buildings that are exempt from the obligation to submit a climate declaration pursuant to the first paragraph, item 6 also erects other buildings, the government may issue regulations on such exemption for these other buildings as well.	5 § The obligation to prepare and submit a climate declaration does not include 1. buildings with temporary building permits intended for use for a maximum of two years, 2. buildings that do not require a building permit pursuant to Chapter 9, Section 6, 7 or 9 of the Planning and Building Act (2010:900), 3. buildings for industrial or workshop purposes, 4. economy buildings for farming, forestry or similar enterprises, 5. buildings with a gross floor area not exceeding 100.0 square metres, and 6. buildings intended for the total defence and buildings of importance for the security of Sweden. If a developer who erects *or alter* buildings that are exempt from the obligation to submit a climate declaration pursuant to the first paragraph, item 6 also erects *or alter* other buildings, the government may issue regulations on such exemption for these other buildings as well.
6 § A developer who is a natural person and who erects a building other than in the course of business activity is not obliged to prepare or submit a climate declaration.	6 § A developer who is a natural person and who erects *or alter* a building other than in the course of business activity is not obliged to prepare or submit a climate declaration.

Current wording	***Proposed wording***
8 § The information on the climate impact of the building shall include 1. raw material supply at the product stage, 2. transport at the product stage, 3. manufacturing at the product stage, 4. transport at the construction stage, and 5. the construction and installation process at the construction stage.	8 § *When a building is erected,* the information on the climate impact of the building shall include 1. raw material supply at the product stage, 2. transport at the product stage, 3. manufacturing at the product stage, 4. transport at the construction stage, 5. the construction and installation process at the construction stage, *6. maintenance at the use stage,* *7. replacement at the use stage,* *8. operational energy at the use stage,* *9. dismantling, demolition at the end-of-life stage,* *10. transport at the end-of-life stage,* *11. waste processing at the end-of-life stage, and* *12. disposal at the end-of-life stage.*
	8 a § In the case of alteration to a building other than extension, the information on the climate impact of the building shall include additional construction products included in the alteration that are subject to climate declaration requirements in respect of *1. raw material supply at the product stage,* *2. transport at the product stage,* *3. manufacturing at the product stage,* *4. transport at the construction stage, and* *5. the construction and installation process at the construction stage.*

Current wording	*Proposed wording*
9 § The government or the authority designated by the government may issue further regulations on which information is to be included in a climate declaration. The government or the authority designated by the government may also issue regulations on 1. the data to be used to calculate the climate impact, 2. which parts of the building are to be covered by the climate declaration, and 3. exemptions from parts of the requirements defined for the content and scope of the climate declaration.	9 § The government or the authority designated by the government may issue further regulations on which information is to be included in a climate declaration. The government or the authority designated by the government may also issue regulations on 1. the data to be used to calculate the climate impact, 2. which parts of the building *and measures related to the building* are to be covered by the climate declaration, and 3. exemptions from parts of the requirements defined for the content and scope of the climate declaration.

1. This Act will enter into force on 1 January 2027.

2. Older provisions still apply to buildings for which an application for a building permit has been submitted to the building committee before the Act enters into force.

Proposal for an ordinance amending the Ordinance on climate declaration for buildings (2021:789)

Step 2 Entry into force 1 January 2027

issued on...

It is hereby prescribed with regard to the Ordinance on climate declaration for buildings (2021:789)

that 4 and 7 a § shall be worded as follows,

that a new Section, 5 a §, shall be inserted in the Act, worded as follows.

Current wording	Proposed wording
4 §: If Affärsverket svenska kraftnät, the Swedish Fortifications Agency (Fortifikationsverket), the National Property Board of Sweden (Statens fastighetsverk), the Swedish Transport Administration (Trafikverket) or Specialfastigheter Sverige AB is a developer and erects buildings that are exempt from the obligation to submit a climate declaration pursuant to 5 §, paragraph 1, item 6 of the Act on climate declarations for buildings (2021:787) and also erects other buildings, these other buildings are not subject to the obligation to prepare and submit a climate declaration pursuant to 4 § of the same Act.	4 §: If Affärsverket svenska kraftnät, the Swedish Fortifications Agency (Fortifikationsverket), the National Property Board of Sweden (Statens fastighetsverk), the (Trafikverket) or Specialfastigheter Sverige AB is a developer and erects *or alter* buildings that are exempt from the obligation to submit a climate declaration pursuant to 5 §, paragraph 1, item 6 of the Act on climate declarations for buildings (2021:787) and also erects other buildings, these other buildings are not subject to the obligation to prepare and submit a climate declaration pursuant to 4 § of the same Act.
	5 a § When erecting a building, the climate declaration shall also include the climate impact of groundworks and ground improvements. *The term "groundworks and ground improvements" refers to soil stabilisation measures, capillary breaking layers and drainage on the site where the building is to be erected up to insulation under the foundation, including measures two metres outside the building's façade. Measures that relate to connection of media up to insulation on the ground are not included.* *Groundworks and ground improvements shall be reported separately in the climate declaration.*

Current wording	Proposed wording
	Limit value 7 a § Buildings that are erected may have a climate impact with the following maximum values in kilograms of carbon dioxide equivalents per square metre of gross floor area *with regard to 8 § item 1–5 of the Act on climate declaration for buildings (2021:787)*, 1. Multi-dwelling blocks 375 2. Single-family houses 180 3. Office 385 4. Preschools 330 5. Education excluding preschools 380 6. Special housing 385 7. Other buildings 460 When calculating the building's climate impact covered by the limit value solar cells, *groundworks and ground improvements* shall not be included. If a building is to have a number of uses, the limit value is weighted on the basis of the area of the various use in the building. Special housing refers to buildings intended for the elderly, students, young people or people with disabilities.

1. This Ordinance will enter into force on 1 January 2027.

2. Older provisions still apply to buildings for which an application for a building permit has been submitted to the building committee before the Act enters into force.

Introduction

The regulations on climate declarations for buildings[1], which entered into force on 1 January 2022, are a first step in regulating the climate impact of construction and do not contain any limit values. This created the conditions for setting minimum requirements for the climate impact of a building from a life cycle perspective.

In a previous government assignment, Boverket has presented a plan for the continued development of the regulations on climate declarations for buildings (Boverket's report 2020:13 "Regulation on climate declarations for buildings"). Boverket has proposed that from 2027, the climate declaration shall be expanded to cover the entire life cycle of the building, and essentially all building elements. The limit values for the climate impact of buildings were also proposed for inclusion in the regulations on climate declarations.

The new government assignment involves an investigation by Boverket of some of the issues and proposals dealt with in the report that relate to the development of the rules. In addition, Boverket will submit proposals for legislation. The study on reference values is an important basis for the task of developing limit values, which KTH Royal Institute of Technology has carried out in 2020–21 on behalf of Boverket. The report entitled "Referensvärden för klimatpåverkan vid uppförande av byggnader" [Reference values for climate impact for the erection of buildings] by KTH was revised in March 2023 on behalf of Boverket. Updated default values for technical equipment, fixed interior design and interior finishes have been produced.

In its work, Boverket need to take account to the ambition of the Nordic Council of Ministers to achieve Nordic harmonisation of climate regulations for buildings. The Ministry of the Environment in Finland is running a special Nordic project named "Work package Nordic Harmonisation of Life Cycle Assessment"[2] for the 2021–24 period. Its aim is to promote Nordic harmonisation of building regulations in respect of climate. Boverket is involved in the project together with other Nordic building authorities.

Delimitations

The key starting points for the assignment have been Boverket's proposal for development of regulations on climate declaration for buildings

[1] Law (2021:787) on climate declaration for buildings.
[2] https://nordicsustainableconstruction.com/work-packages/nordic-harmonisation-of-life-cycle-assessment.

(report 2020:13), and KTH Royal Institute of Technology's report on reference values for climate impact when erecting buildings (which was revised in March 2023).

The proposals developed shall otherwise harmonise as extensively as possible with the regulations being developed in the Nordic countries on climate requirements for buildings from a life cycle perspective. Where possible, the proposals shall be compatible with the European Commission's framework for sustainable buildings, Level(s), for relevant parts.

Implementation

A working group at Boverket consisting of civil engineers, lawyers, economists, experts and investigators has conducted the assignment.

Boverket commissioned KTH Royal Institute of Technology, together with the consultancy firm WSP and the research institute IVL Swedish Environmental Research Institute, to produce a proposal for limit values and an expanded climate declaration. [3] KTH Royal Institute of Technology's basis is based on discussions with a number of stakeholders in the construction sector, workshops, literature searches and summaries. A major hearing, at which KTH Royal Institute of Technology presented proposals that were discussed with stakeholders from the construction sector and various government authorities, was held on 31 August 2022. The hearing was held digitally, and a questionnaire was used to gather written comments on the proposals. The hearing was attended by 159 people.

Consultancy firm WSP was commissioned by Boverket to conduct a socio-economic analysis of a proposal for limit values for greenhouse gas emissions from construction, and an expanded climate declaration for the climate impact of buildings.[4] WSP's analysis is based on a survey of the current situation, about ten semi-structured interviews, as well as the questionnaire [Questionnaire for the Boverket hearing on 31 August 2022]) and the group discussions held at the Boverket hearing on 31 August 2022.

RISE Research Institutes of Sweden was commissioned to produce a proposal on how Boverket can perform quality assurance of the supervision of climate declarations and limit values for the climate impact of buildings.[5] RISE was also commissioned to provide information for the additional elements for reporting climate impact in the climate declaration.[6]

[3] Malmqvist et al., 2023b.
[4] Pädam et al., 2022.
[5] Carlsson et al., 2023.
[6] Ylmén et al., 2022.

Boverket has also held discussions with a number of different stakeholders, including the Swedish Environmental Protection Agency (Naturvårdsverket), the Swedish National Heritage Board (Riksantikvarieämbetet), the Swedish Energy Agency (Statens Energimyndighet), the Swedish Transport Administration (Trafikverket), the Swedish Geotechnical Institute (Statens geotekniska institut), the National Agency for Public Procurement (Upphandlingsmyndigheten), Swedenergy (Energiföretagen), the association for Swedish construction materials enterprises (Byggmaterialindustrierna), the building materials trade, the BIM Alliance, and Sustainable Innovation. A discussion has also been held with representatives from the Nordic building authorities in Denmark, Finland and Norway, who are working on developing corresponding regulations in these countries.

How to read this report

This is a fairly comprehensive report, so there is quite a long summary. Most of this report is made up of proposals for further development of the regulatory framework. A two-step approach is proposed, with limit values introduced from 2025, and an expanded climate declaration from 2027. The report is structured accordingly. Each proposal section also includes a brief account of the responses to the questionnaire sent out in connection with the Boverket **hearing** on 31 August 2022, as well as how the other **Nordic countries** are currently dealing with their respective regulations or are working on developing them.

Background

The development of the construction sector's climate impact is presented in this chapter. The consultation responses to Boverket's report "Regulation on climate declarations for buildings" is also presented in general terms, alongside a follow-up of the regulations on climate declarations for buildings that entered into force in January 2022.

Boverket's previous proposal for a next step in the regulations

The need for the sector to reduce its climate impact was the reason for introducing regulation on climate declaration for new buildings in January 2022. In 2020, the construction and real estate sector in Sweden accounted for domestic greenhouse gas emissions of approximately 9.8 million tonnes of carbon dioxide equivalent, corresponding to 21 per cent of Sweden's total greenhouse gas emissions. The sector also contributes to significant emissions abroad on account of imported goods. These emissions amounted to around 6.1 million tonnes of carbon dioxide equivalent. Total greenhouse gas emissions amounted to 15.9 million tonnes of carbon dioxide equivalent.

Greenhouse gas emissions from the construction and real estate sector (domestic + imported)

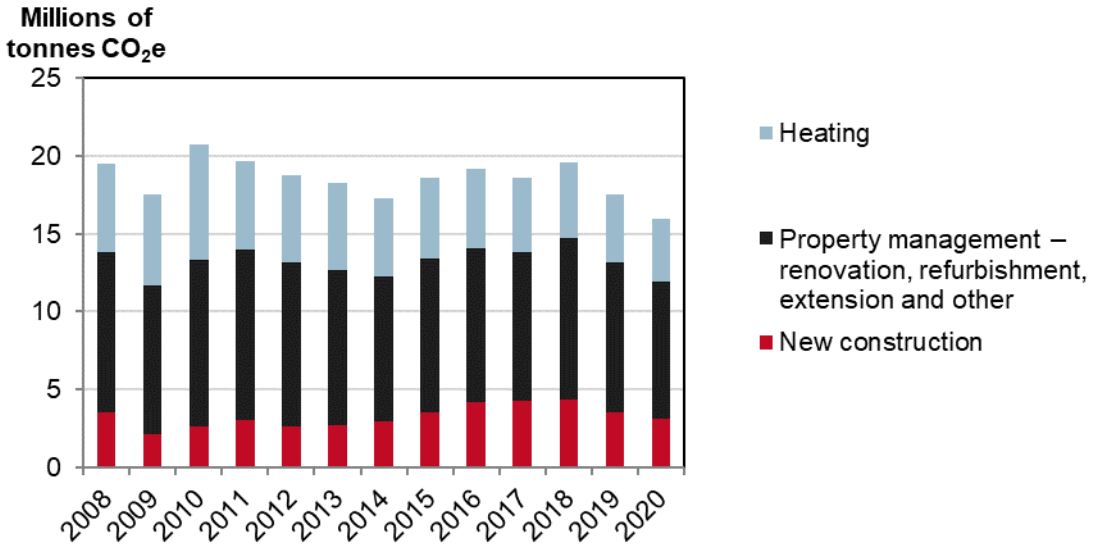

Figure 1. The development of climate impact from the construction and real estate sector for the period 2008–2020. Source: Boverket/Statistics Sweden.

Total greenhouse gas emissions (domestic and imported) from the construction and real estate sector in 2020 are distributed as shown in Figure 1; with just under 20 per cent from new construction, 25 per cent from

heating and 55 per cent from property management (including renovation, refurbishment, extension, and other property management).

Cost-effective measures to reduce the climate impact of the buildings erected will be facilitated by increasing knowledge in the sector of the climate impact of buildings. The regulations on climate declarations that were introduced in 2022 also lay the foundation for the subsequent development of the regulatory framework. There is reason to introduce limit values unless the sector reduces its emissions quickly enough to meet the climate targets. The construction sector is keen on long-term rules and planning conditions, which is why Boverket was commissioned by the government to develop a clear plan. Boverket submitted a proposal for such a plan to the government in June 2020, stating that limit values could be introduced in 2027, and also expanding the climate declaration in the report entitled “Regulation on climate declarations for buildings”.

A summary of the consultation responses for the next step of the regulations

This section presents a summary of the consultation responses to Boverket’s report “Regulation on climate declarations for buildings”, which the government sent out for consultation. The emphasis is on the relevant opinions for the development of the proposals in this report, as well as the element that problematises whether or not the limit values should include the entire life cycle.

The Ministry of Finance sent the report for comments to 136 consultation bodies on 1 March 2021, and their responses were due for submission by 2 June 2021. In particular, the government sought views on the proposed schedule for introducing the limit values and an expanded climate declaration. 67 consultation bodies responded to the draft for comment.

Many of the consultation bodies emphasise the importance of introducing limit values before 2027. Two thirds of respondents want to introduce limit values earlier or are in favour of Boverket’s proposal. A number of stakeholders want limit values to be based on the entire life cycle. This group represents 18 per cent of respondents. A number of consultation bodies expressed concerns about additional costs when introducing limit values and an expanded climate declaration. These views are specifically reported below.

About additional costs on account of limit values and an expanded climate declaration

The Swedish Association of Local Authorities and Regions (Sveriges Kommuner och Regioner) deems it important for the proposal not to exclude small stakeholders in the construction market. There is an appreciable risk of this, although the fact that the costs for climate calculations are expected to be lower than before is positive.

Bostadsrätterna is of the opinion that the starting point should be that only information that is clearly justified and necessary should be included in the declaration, given the fact that all information in the climate declaration involved work and costs for the developer.

The Swedish Energy Agency (Energimyndigheten) is of the opinion that the proposals in the report may promote opportunities to reduce greenhouse gas emissions in line with the national climate ambitions and targets, and provide socio-economic benefits that far exceed the costs of introducing climate declarations and guideline values.

The Swedish Geotechnical Institute (Statens Geotekniska Institut) emphasises that the costs of foundation work, excavation and filling can be reduced by taking ground conditions into account, while also improving the climate performance of the planned built environment.

No analysis of housing costs

According to the Swedish Union of Tenants (Hyresgästföreningen), it is very important for the regular evaluations prior to a reduction of the limit values to also include a review of how this will affect people's housing costs. Further increases in construction costs must be countered with other measures so that the right to housing for all is not jeopardised by the climate declarations. The City of Stockholm (Stockhoms Stad) is of the opinion that reliable calculation data must be available, as well as clear evaluations for future changes of regulations so that housing construction is not affected by unnecessary additional costs. Public Housing Sweden (Sveriges Allmännytta) is of the opinion that the demands made of developers are very extensive at present, and that the impact of the new requirements will be particularly severe in those housing projects that may encounter major problems with bearing additional costs. The City of Gothenburg (Göteborgs Stad) is of the opinion that solutions are available that are probably more cost-effective than the climate declaration as a way of reducing the climate impact of new construction. Developers may change the ways in which they build and purchase materials, according to the City of Stockholm. This may be assumed to involve increased costs initially. Construction product manufacturers need to provide more information about their products and alter their production to meet developers' demands. Increased costs will be reflected in the price of buildings, or in the cost of renting. According to Fastighetsägarna Sverige, introducing limit values will affect the market supply and price of construction products. Products that are transported a long way are likely to struggle to compete with products and materials produced locally. The impact assessment is lacking an outline of the impact on construction costs and, ultimately, the housing costs resulting from the proposal. In the opinion of Wallenstam, it is important for the government to go on including the costs of the effects of climate declarations in its evaluations. It is important for people to be able to afford to live in the housing

needed. The analyses presented to date merely consider the administrative costs of producing the climate declaration. That part is negligible compared to the costs that will be involved in additional investments for reducing emissions when we build.

Only administrative costs have been investigated

HSB is of the opinion that the costs and benefits in the impact assessment have not been properly investigated or reported. How costs and benefits are affected in production has not been investigated. Only the administrative costs have been investigated. This information needs to be supplemented if we are to gain a full view. Riksbyggen is also of the opinion that the costs have not been fully investigated or reported in the impact assessment. The impact on production costs has not been investigated, yet these ought to be the major costs. Only the administrative costs have been investigated.

Increased investment costs

Region Stockholm assumes that introducing limit values for the climate impact of buildings in the future will probably involve additional costs for Region Stockholm's investment projects. However, in the longer term these policy instruments may can steer project design towards more structures with more efficient use of materials. This could potentially involve certain cost savings. Locum is of the opinion that there will be increased investment costs if the proposals presented in Boverket's report "Regulation on climate declarations for buildings" are decided and enter into force as a legal requirement from 2027. These costs are due partly to additional data to be included in the climate declaration, but mainly to the need to implement measures to reduce climate change in construction projects.

EPDs often involve considerable cost

Requiring each element to have a specific EPD, and also requiring EPDs to be prepared for unique products, requires a great deal of effort and will therefore be unreasonably expensive, according to Svensk Ventilation. Of course, this will ultimately affect construction projects and end users on account of increased construction costs. That is why it is necessary to develop automated solutions for producing EPDs. Each EPD represents a significant cost that could – in a worst-case scenario – be excessive if required on everything produced, according to the Swedish association for manufacturers of heating, plumbing, sanitation and metering products and equipment (VVS-Fabrikanternas Råd). A solution to this problem is needed in order to maintain an innovative industry with space for stakeholders of all sizes. EPD documentation takes time to produce and is costly, according to Swedisol. The Confederation of Swedish enterprises within sheet metal and ventilation (Plåt & Ventföretagen) emphasises that the information in module D is mandatory in all EPDs for construction products, and cannot be considered costly. The Swedish steel producers'

Association (Jernkontoret) is also of the opinion that a mandatory module D is not costly, as relevant data for module D must be available in all EPDs by 2027.

Construction products risk becoming more expensive

Construction products are at risk becoming generally more expensive, according to the Board of Swedish Industry and Commerce for Better Regulation (Näringslivets Regelnämnd), as products manufactured locally are favoured when the climate impact of transport is taken into account in the calculation. Competition and price pressure in the construction products market is affected when products manufactured further away become more expensive. This is a socio-economic cost that needs to be specified in greater detail in the impact assessment. According to Skanska Sweden (Skanska Sverige), several of the additional building elements vary greatly depending on adaptations for tenants. Default values that can be utilised if necessary are required, so that the expansion does not become costly. According to the Association of Swedish Building Materials Merchants (Byggmaterialhandlarna), the trade has to fend off costs for construction products that are at risk of becoming more expensive.

The need to develop digital tools

Svenska Bostäder has carried out a number of climate calculations. This work is deemed to be resource-intensive and cumbersome, and the company is of the opinion that both the process and the digital tools need to be developed and simplified. An evaluation of the direct costs associated with the LCA calculations in the projects is ongoing, and these calculations are resulting in increased costs at present. Region Kalmar län is of the opinion that the cost can be limited to a reasonable level for a climate declaration via access to common input data for the industry.

The risk of suboptimisation

According to Svensk Betong, the choice not to include the entire life cycle with all modules and the proposed calculation period of 50 years risks leading to suboptimisation, unhealthy competition, increased costs, reduced innovation and limited development of new materials and solutions. According to Cementa, the lack of the entire life cycle perspective provides incentives for suboptimisation, with enormous impact on the environment and costs.

Follow-up of the regulations on climate declarations

Since January 2022, Boverket has been responsible for follow-up and analysing the application of the Act on climate declarations for buildings (2021:787), according to Boverket's instructions.[7] According to its instructions, Boverket shall also follow-up the development of issues

[7] Pursuant to Section 7(5) of the Ordinance with instructions for Boverket (2022:208).

within its area of activity and, if necessary, propose measures to achieve the purpose of the regulations and other policy instruments.[8]

This section describes the climate declarations that have been registered with Boverket to date, as well as a follow-up of the building committees' management of the requirement in the permit and construction process. There is also a description of the activities that Boverket intends to implement going forward as part of the regular follow-up of the regulations.

Follow-up of climate declarations received

The number of climate declarations submitted to Boverket has increased month by month since the Act on climate declarations for buildings entered into force on 1 January 2022. This increase has taken place as developers apply for final clearance in cases requiring climate declarations. The first climate declaration was submitted to Boverket in April 2022. A total of 139 climate declarations have been submitted to Boverket up to the end of March 2023: see Figure 2.

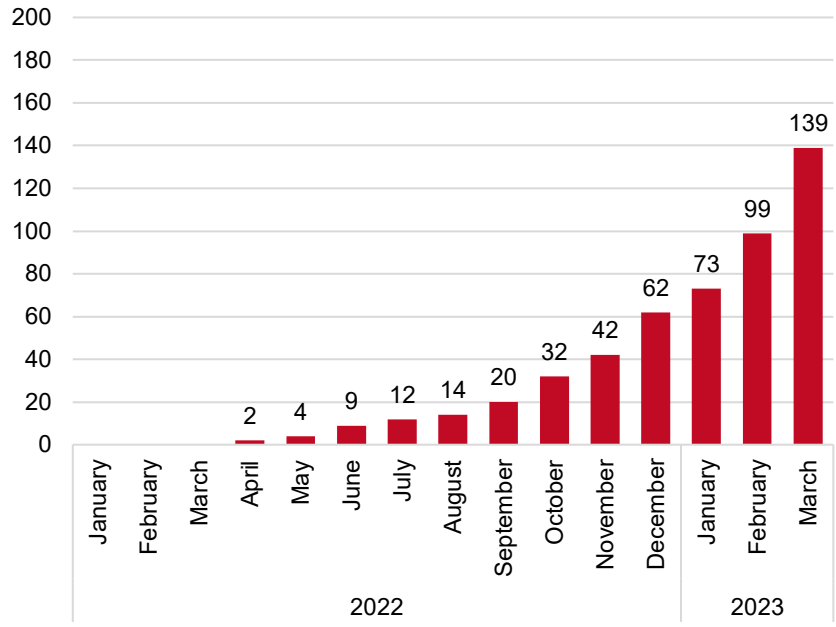

Figure 2. The total number of climate declarations in Boverket's register. Source: Boverket.

The climate declarations registered relate to different types of buildings, and are distributed as follows: single-family house (100), other (14), primary and lower secondary school (9), office (5), multi-dwelling block (4), preschool (3), retail (2) and upper secondary school (2).

In summary, the number of climate declarations submitted to Boverket has increased as new buildings have been completed. The climate declarations that have been submitted are mostly for the single-family house

[8] Section 4 of the Ordinance with instructions for Boverket (2022:208).

building type, which is assumed to take less time to complete than other building types. The total number of climate declarations is deemed too small to allow any conclusions to be drawn.

Follow-up on the management of climate declaration regulations by building committees

During the municipality's permit and construction process it is necessary to clarify whether a new building being erected is subject to the climate declaration requirement. Building committees have an important role to play in this regard. That is why Boverket has produced guidance and provided information to municipalities on which buildings are covered by the requirement and how the requirement is to be managed in the permit and construction process. Since the requirement was introduced, Boverket has regularly followed up how the municipalities are working with the issue of climate declarations in the permit and construction process.

Link to the Planning and Building Act

The Act on climate declarations for buildings states that the Planning and Building Act (PBL) contains provisions stating that in certain cases, a climate declaration is a requirement for obtaining final clearance. [9]

The PBL currently refers to climate declarations in only one section; in Chapter 10, Section 34, which regulates what is required for the building committee to be able to issue final clearance. According to that provision, the developer must have shown that it has submitted a climate declaration or made a prima facie case that there is no obligation to submit a climate declaration for the building committee to be able to issue a final clearance.[10]

Management of the requirement in the permit and construction process

The developer is responsible for preparing a climate declaration and submitting it to Boverket. The climate declaration shall not be submitted to the building committee: the committee shall merely receive confirmation that the climate declaration has been submitted to Boverket. The building committee's management of this requirement is very important, as this confirmation is now a prerequisite for obtaining final clearance.

In early advice situations (before applying for a building permit, for instance), the municipality can provide information about the requirement within the framework of its service obligation in cases where it is obvious that the requirement applies. Boverket has identified five situations in the permit and construction process when the requirement can or has to be

[9] Section 4 of the Act on climate declaration for buildings (2021:787).
[10] Chapter 10, Section 34 of the Planning and Building Act (2011:900).

raised by the building committee: in the building permit, technical consultation, starting clearance, final consultation and final clearance.

It is important for this requirement to be dealt with at an early stage, and so it is also useful if the building committee decides early on whether a building is covered by the requirement for a climate declaration. This is easy to determine in some instances and it can be done when the building permit is processed, either when contacting the applicant or as a disclosure in the decision to grant a building permit.

Once the building permit is granted, a technical consultation shall be held and issues such as the need for staking out and completion protection are addressed. The need for a climate declaration should be addressed in the technical consultation in a similar way to these issues. In cases where it is difficult to determine whether a building is covered by the requirement, the technical consultation is a good opportunity to discuss this and clarify any issues. A record shall be kept of the technical consultation, and it is appropriate for this record to state whether or not a climate declaration is required.

The building committee shall state in the starting clearance which documents are to be submitted to the committee prior to the decision on final clearance. Confirmation that a climate declaration has been submitted is a document required for final clearance in situations where a climate declaration is required. Boverket assess that the starting clearance must state that a confirmation of a climate declaration is a document that must be submitted to the building committee prior to final clearance, in situations where a climate declaration is required. This also clarifies the building committee's view on whether the requirement applies to the building in question in a decision made pursuant to the PBL before the final clearance is reviewed.

The question of whether a climate declaration is required should be addressed during the final consultation. For final clearance to be issued, the developer must show that a climate declaration has been created for the building or have made a prima facie case that there is no obligation to submit a climate declaration. The building committee shall issue final clearance if the confirmation has been submitted to the building committee and the other conditions for issuing final clearance are met.

If a climate declaration is required but no confirmation has been submitted to the building committee and the other conditions for issuing final clearance are met, the committee may issue an interim final clearance pending the submission of the confirmation by the developer. It is appropriate for this decision to specify how much time the developer has to submit the confirmation. Boverket assess that six months may be an appropriate maximum time limit for submitting the confirmation.

Boverket's guidance to municipalities

Boverket shall promote enhanced knowledge among municipalities, regions, state authorities and other stakeholders within its area of activity.[11]

Guidance regarding which buildings the requirement applies to was published on boverket.se in July 2021. A digital handbook on climate declarations entitled "Klimatdeklaration – en handbok" [Climate declaration – a handbook] was published on boverket.se in September 2021. The guidance on which buildings are covered by the requirement was moved to the handbook at that time.

Guidance to municipalities on how the requirement can be handled in the permit and construction process was published in the digital handbook entitled "PBL kunskapsbanken" [The PBL knowledge base] on boverket.se when the Act came into force on 1 January 2022.

Specific information initiatives in the form of digital newsletters and webinars have also been conducted.

Boverket's follow-up of municipalities' work with climate declarations

In 2022–2023, Boverket has followed up on how the municipalities are working with the climate declaration in the permit and construction process. This follow-up has mainly involved regular focus group meetings with a number of municipalities. The municipalities included in the focus group are Stockholm, Malmö, Umeå, Östersund and Sollentuna.

Boverket has also participated in two municipal meetings organised by the Jönköping County Administrative Board and attended by a number of municipalities. Boverket provided information on the regulations at these meetings, and found out in practice how the climate declaration has worked to date in the permit and construction processes.

Besides this, Boverket also intends to follow up the building committees' management of the requirement through its own annual work on following up the PBL. This will allow Boverket to contribute information and statistics that may form the basis for future follow-ups, analyses and evaluations.

Based on the follow-up conducted with the municipalities in 2022 and 2023, Boverket concludes that:

- All municipalities are of the opinion that the climate declaration should be managed as early as possible in the permit and construction process and not only in connection with final clearance, because it is too late by then.

[11] Section 3 of the Ordinance with instructions for Boverket (2022:208).

- The municipalities have had slightly differing views on whether the need for a climate declaration should be addressed for all cases in the technical consultation, or only for those cases where a declaration is required. It would have been useful to clarify this in the PBL.
- The municipalities have internally raised the requirement to incorporate the requirement into their processes and templates; at working meetings, for instance. They have benefited from Boverket's guidance.
- Some of the municipalities have information about the requirement on their websites.
- Very few cases have been covered by the requirement in the municipalities included in the reference group.
- There has been little discussion with developers as to whether or not the requirement applies.
- Most developers have been aware of the requirement. However, there have been cases in which the developers in some of the municipalities were unaware of the requirement. In onecase, this was only realised at the time of final clearance.
- In most cases, the cases that have been subject to requirements have not progressed beyond the municipality's decision on the starting clearance.
- The number of applications for building permits for major construction projects increased sharply at the end of 2021. This is probably one of the reasons why there have been few cases requiring climate declaration in 2022.
- The number of new construction cases has declined in most municipalities in 2022 compared to previous years, and the decrease is significant in some municipalities. Housing construction in particular has declined.[12] The reduced number of cases is probably one reason why the municipalities have had few cases requiring climate declaration.

Exemptions from the climate declaration requirement

Focus group meetings and municipal meetings, and emails and telephone queries received by Boverket have raised a number of questions about which buildings are covered by the exemptions from the climate declaration requirement. These questions have related mainly to the exemptions

[12] Housing construction peaked in the full year 2021, when around 71,000 dwellings were granted starting clearance, including net additions through refurbishment. The twelve-month rate has slowed down slightly since then, reaching 66,000 at the end of the third quarter of 2022, the same number as one year previously. See also Boverket's indicators, no. 2, December 2022 (Boverket, 2022b).

for private individuals and industrial buildings. There have also been questions about how to deal with multi-use buildings.

There have also been questions about the exemption that applies to buildings intended for national defence and buildings of importance to Sweden's security. These questions have included matters such as whether hospitals and wastewater treatment plants – for example – are covered by the exemption.

The exemption for climate declarations for national defence buildings was initially intended to be similar to the exemption for energy declarations. This means that "Buildings intended for national defence and which are of a secret nature because of their design or the activities carried out there" would be exempted. However, following consultation responses from the Swedish Armed Forces and the Swedish Fortifications Agency, the wording was changed and the exemption was instead worded as "Buildings intended for national defence and buildings of importance to Sweden's security". The preparatory work states that buildings of importance to Sweden's security include buildings with an enhanced protection function, for example.[13]

National defence involves military activities (military defence) and civilian activities (civil defence). Military defence refers to the activities conducted by the Swedish Armed Forces with the support of defence authorities, parts of the voluntary defence organisations and parts of the defence industry and other relevant parts of the business community, in order to prevent war and prepare Sweden for war. Civil defence refers to the civilian activities undertaken by government authorities, municipalities, regions, individuals, enterprises, voluntary defence organisations and civil society, among others, to prepare Sweden for war. According to Swedish Civil Contingencies Agency (MSB), the following constructions are examples of civil defence constructions:

- Contingency stocks, stocks that are not part of current logistics or seasonal storage (but may be co-located with such stocks).
- Technical equipment for energy production or distribution.
- Hospitals, health centres, infection control facilities.
- Technical equipment for the preparation of foods.
- Traffic management centres, transport infrastructure, depots, logistics centres.
- Shelters.

What buildings are referred to by "intended for national defence" is not clear from the preparatory work. Questions have therefore arisen as to whether buildings used for civil defence, such as hospitals, are covered

[13] Government Bill 2020/21:144 p. 80.

by the exemption. The question is whether all buildings that are part of national defence are exempt from the requirement, or whether only buildings intended "solely" for national defence are exempt? After all, hospitals are not only intended for national defence but are also used as hospitals in peacetime.
The intention of the amendment following the consultation responses appears to be that military buildings should be exempt from the requirement regardless of whether they are of a secret nature. However, the way the exemption is worded it could mean that all buildings intended for national defence are covered by the exemption; that is to say, buildings for both military and civilian activities. This is not clear from the preparatory work, and there is yet no case law providing guidance. The legislator likely did not intend for hospitals, health centres, traffic management centres or energy plants, for instance, to be exempt from the requirement for climate declarations. This may have transpired, however, depending on the interpretation of "intended for national defence". Boverket intends to try to compile guidance on how this exemption is to be interpreted in order to facilitate the application of the legislation. Amendment to the exemption provision may also be necessary in order to ensure that not too many buildings are covered by the exemption. However, the climate declaration system needs to be operational for a little while longer to make it possible to recognise the scale of the problem and work out more precisely which buildings are problematic.

Following up the regulations over time

Boverket's instruction focuses on regular follow-up and the regulatory framework in force at a given time. This follow-up should cover the impact, application and consequences of the regulatory framework. Table 1 provides examples of activities that Boverket plans to carry out going forward as part of its regular follow-up of the regulations.

Activity	Purpose
Extraction of statistics from Boverket's climate declaration register. Summary, analysis and publication on boverket.se.	Evaluate the impact of the policy instrument.
Summary and analysis of information from Boverket's supervision.	Evaluate the application with a view to - improving compliance with the regulations. - making supervision more effective. - developing regulations.

Activity	Purpose
Follow-up, mainly of the application, to develop the handbook on climate declaration issued by Boverket; for example by means of industry and municipal surveys.	Facilitate application.

Table 1. Examples of activities that Boverket intends to implement as part of the regular follow-up of the regulatory framework on climate declarations for buildings.

See the section entitled “Evaluation of the regulations on climate declaration” for further information on proposals on evaluation.

Conclusions

It is not possible to draw any conclusions regarding the follow-up of the climate declarations submitted to Boverket as there are too few of them. Most of the climate declarations submitted are for the “single-family houses” building type.

Municipalities have encountered few cases where climate declarations have been required since the Act entered into force. The guidance produced by Boverket is deemed to have helped increase the chances of building committees being able to incorporate the requirement for a climate declaration in their case management. This has also been confirmed in the follow-up work carried out by Boverket. Boverket sees a need to amend the PBL in order make the regulations on technical consultation clearer. Proposals for amendments to the PBL are set out in the legislative proposals and are also expected to help improve conditions for developers to consider the requirement, and hence the purpose of the Climate Declaration Act, at an early stage. It is too early to draw any conclusions about whether the municipalities are applying the regulations in the Climate Declaration Act and the PBL correctly.

Current situation regarding the climate impact of buildings

Limit values to be set need to be based on a knowledge base of the climate impact of the construction stage for different building types, as they are built today. Such reference levels are largely dependent on the building techniques and materials used by the market. In practice, this means that relatively homogeneous building techniques will result in a more uniform climate impact, unlike those building types that vary in terms of the number of storeys and the framing materials used. A limit value will have a greater impact on the latter building types as regards choosing not to use materials and technical solutions that result in greater climate impact.

This chapter presents the status of the reference values linked to the regulations on climate declarations in Sweden today. Similar studies and work have also been conducted in other countries. A selection of these is shown in Chapter 3 of (Malmqvist et al., 2023), and also in a study by (Röck et al., 2022).

A study on reference values for the climate impact of buildings

Boverket's report entitled "Regulation on climate declarations for buildings" proposed that the starting level for limit values in 2027 should be "20–30 per cent lower than a reference value obtained through a study of climate calculations for buildings". Such a study was carried out in 2020–21, calculating the climate impact of 68 new buildings. That study was updated by KTH Royal Institute of Technology on behalf of Boverket in 2023 (Malmqvist et al., 2023). As a result, there is now an increased knowledge base on the climate impact for the construction stage (modules A1–A5) for a number of building types. The climate impact in the project was calculated according to the proposed system boundary in Boverket (2020), and primarily from Boverket's climate database with typical, generic climate impact data. These reference values are based on newer buildings, focusing on typical buildings of each type:

- Single-family houses – 11
- Multi-dwelling blocks – 19
- Preschools – 14
- Schools (Education excluding preschools) – 10
- Offices – 11

Figure 3 shows the results for the climate impact of different building types and its distribution within each building type from the reference value study (Malmqvist et al., 2023). Table 2 shows the highest, lowest, mean and median values for each building type.

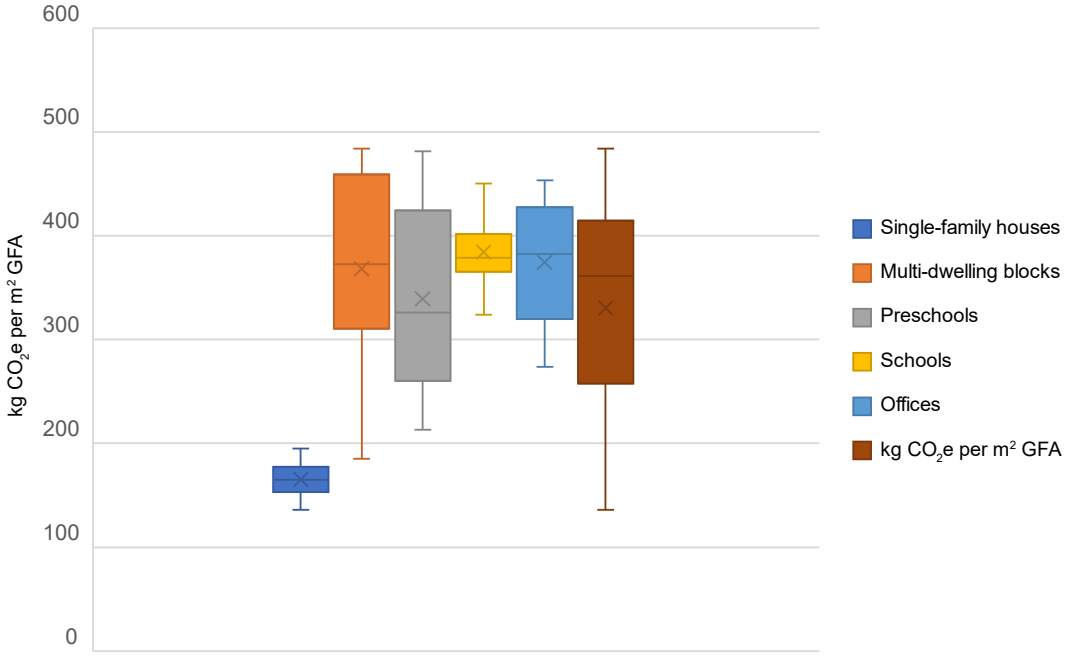

Figure 3. Climate impact and its distribution for modules A1–A5 from the buildings included in the reference value study (Malmqvist et al., 2023). The building elements included are the entire building; that is, according to the proposed delimitation for the development of climate declaration regulations (Boverket, 2020). Note that Boverket uses the term “education excluding preschools” in the legislative proposal and throughout the report instead of the term “schools” used in the reference value study.

kg CO_2e per GFA	Lower quartile	Median	Mean	Upper quartile
All	258	361	330	415
Multi-dwelling blocks	311	373	368	459
Single-family houses	153	165	165	177
Offices	320	383	374	427
Schools (Education excluding preschools)	365	379	384	402
Preschools	260	326	339	424

Table 2. Climate impact values for different building types in the reference value study (Malmqvist et al., 2023). The building elements included are the entire building; that is, according to the proposed delimitation for the development of climate declaration regulations (Boverket, 2020). When the concrete quality is not specified, the calculations use climate data from the “Byggsektorns Miljöberäkningsverktyg” an environmental calculation tool with the value 0.141 kg CO_2e per kg of ready-mixed concrete. Mean data from Boverket’s climate database has been used in other respects. This is the same data as illustrated in Figure 3. Note that Boverket uses the term “education excluding preschools” in the legislative proposal and throughout the report instead of the term “schools” used in the reference value study.

Note that the sample in the reference value study – which is used as a starting point in this assignment to define different requirement levels – is the largest in Sweden, but still too small to be statistically significant. The aim of the reference value study was to include typical buildings in the data. The sample should also reflect the new construction of each building type in terms of dominant materials in the frame, a characteristic that has been demonstrated to have a major impact, which means that the sample is deemed to represent new construction of buildings in Sweden relatively accurately.

Supplementary reference values on the climate impact of buildings

A number of developers and contractors were contacted within the framework of this investigation to find out whether they had performed climate calculations for the building types that were not included in the reference value study (Malmqvist et al., 2023), and were also asked whether they could share the results.

Figure 4 presents the results of the climate calculations obtained, adjusted to the same system boundary for building elements and life cycle modules as in the reference value study, and the number of calculations obtained for each building type (n). Table 3 shows the highest, lowest, mean and median values for each building type.

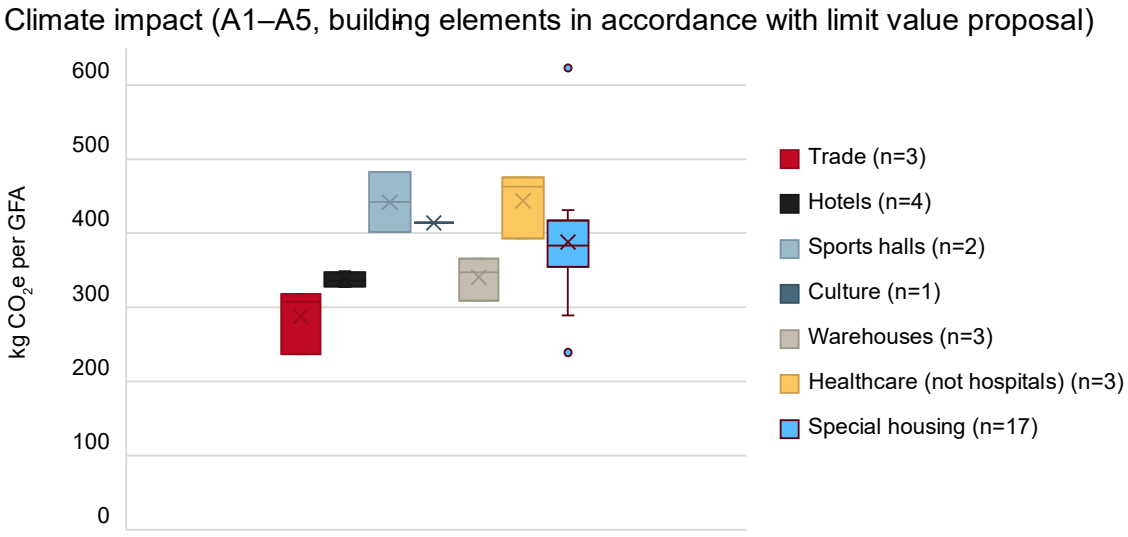

Figure 4. Presentation of the climate impact for the buildings reported by the interviewees. X is the mean, and the line in the centre marks the median. The upper and lower edges of the box mark the upper and lower quartiles. The lines mark the highest and lowest values, provided that these are within 1.5 times the distance between the quartile and the median. Otherwise, the value is marked as an point, an outlier.

The number of calculations for all building types except special housing is very low, as shown in the figure. However, the values do not differ

significantly from the calculations performed for the building types included in the reference value study.

	Trade (n=3)	Hotels (n=4)	Sports halls (n=2)	Culture (n=1)	Warehouses (n=3)	Healthcare (not hospitals) (n=3)	Specialist housing (n=17)
Lower quartile	237	328			309	393	355
Median	308	337			347	463	383
Medium	287	337	442	414	341	444	388
Upper quartile	318	347			366	475	418

Table 3. Climate impact values for the supplementary calculations within the scope of the assignment. Values updated in March 2023. This table is based on the same data as in Figure 4.

Current situation on the climate impact of refurbishment

The increase in attention being paid to the climate impact of new buildings means that there is also greater interest in learning more about the climate impact associated with renovation measures. A number of projects are currently in progress on developing the climate calculations specifically for renovation projects; partly within the framework of LFM 30 and partly for another renovation project led by IVL Swedish Environmental Research Institute. This forms part of a newly launched E2B2 project to gather knowledge about the climate impact of various renovation measures in a Swedish context, in a similar way as was done for Boverket in the reference value study (Malmqvist et al., 2023).

Previous research has frequently focused on whether there is an optimum in the context of refurbishment or the broader concept of renovation. This relates to the climate impact associated with major energy efficiency measures, compared to future climate savings resulting from energy efficiency. Or, more generally, this relates to how much energy efficiency measures in particular cost in terms of embodied climate impact, and how strategies can be adopted that together lead to the lowest possible climate impact over the life cycle (Brown et al., 2013, 2014, EASAC, 2021, Olsson et al., 2016). The conclusion from optimisation studies for energy renovations generally shows that implementing extensive energy saving measures in existing buildings does not increase the climate impact of a life cycle perspective, but that the climate payback period is longer for larger interventions and when more new construction products are added. For instance, Ramírez-Villegas et al. (2019) calculated different types of energy saving packages for a typical Million Programme buildings in Sweden. All options paid off over a 50-year perspective, in climate terms. Brown et al. (2014) calculated the climate impact of the production of materials for the cost-optimised renovation measures that should be

implemented throughout the entire building stock to achieve the energy savings of 50 per cent that Boverket and the Swedish Energy Agency produced a number of years ago. It emerged here, too, that the renovation represented a certain additional climate impact to begin with, but that implementing the energy efficiency operations was still clearly climate efficient. Naturally, automatic control and regulation measures have the lowest climate impact (0–2 g CO_2e per kWh saved) compared to individual measures. The measures that involve major alterations to the building envelope have the highest climate impact (up to 15–30 g CO_2e per kWh saved). Ventilation measures, including FTX technical equipment and window replacements, both have a relatively high climate impact per kWh saved. These measures also accounted for more than 80 per cent of the climate impact, viewed at stock level, if all the proposed renovation measures were to be implemented (N. W. O. Brown et al., 2014). A case study involving a major renovation of a multi-dwelling block in Denmark dating back to the 1960s can also be provided as an example. This included replacement of windows, additional insulation and replacement of the ventilation system. The combined climate impact of the measures amounted to 90 kg CO_2e per m^2 (Rasmussen & Birgisdóttir, 2016).

Otherwise, there are few studies to date that have studied the embodied climate impact of different types of renovation measures in more detail, but there are a few examples. Berglund et al. (2018) compared the climate impact of a life cycle perspective, with a traditional pipe replacement compared to relining. From a life cycle perspective, the climate impact of relining was almost 50 per cent lower than for traditional pipe replacement, and the actual input into the embodied climate impact was in the order of 3–7 kg CO_2e per m^2 net heated area. The lower figure was for relining, and the higher figure was for traditional pipe replacement (Berglund et al., 2018). The climate impact can be considerable when it comes to upgrading the standard of renovations, such as renewing the furnishings and finishes in kitchens and bathrooms. According to Akademiska hus (2020), the construction of kitchens and bathrooms accounts for around 175 kg CO_2e per m^2 GFA, compared to around 30 kg CO_2e per m^2 GFA for the construction of a standard bedroom. Large quantities of materials and components are often removed even though they have not reached the end of their service life, even in the case of what are known as tenant adaptations of offices, which commonly occur when changing tenants or renegotiating rents for offices. Liljenström & Malmqvist (2016) performed quite accurate calculations for an office building in Stockholm. It was found that five major tenant adaptations (including the removal and replacement of certain interior walls) represent about the same climate impact as building a new structure. Such tenant adaptations once a decade are not uncommon, according to the real property owner whose building was studied.

Refurbishment may involve a wide variety of measures

Refurbishment may involve a wide variety of measures, and what is meant by the term is rarely defined in different contexts. The term is often used as an umbrella term for a large number of types of measures for existing buildings. The term "renovation" is also used in a similar way in the field of climate and energy; as an umbrella term covering many different measures.

The PBL clearly defines what refurbishment is, as well as other types of alterations such as extensions. It is important to be able to relate the measures assessed pursuant to the PBL legislation to the various changes defined by the law, as this affects the extent to which design and technical functional requirements are to be met. That is why it is beneficial for measures to be traceable to the terms used in building legislation. It is also natural for the development of the regulations on climate declarations for buildings to take into account how various measures are defined in the PBL, As the Climate Declarations Act is currently linked to the permit and construction process pursuant to the PBL.

Climate impact of groundworks and ground improvements

The climate impact associated with groundworks, and in particular with ground stabilising measures (ground improvements), has begun to be discussed more widely. The municipalities of Gothenburg and Stockholm are working with to start calculating the climate impact of detailed development plans, which includes the issue of ground improvement measures. To date, there are only a few case studies in Sweden where calculations have been performed under the conditions prevailing at the construction site in question. However, there is no comprehensive overview in Sweden of the climate impact associated with different land measures or ground conditions. However, it is difficult in many cases to compare the reported climate impact of ground improvement works in different case studies, due to differences in delimitation and choice of climate data. The Swedish Geotechnical Institute (Statens geotekniska institut, SGI) is carrying out work within the framework of the project entitled "Klimatdata för grundläggningsmetoder" (Climate data for foundation methods)[14], which will run until 2023. The aim is to start developing generic data for ground improvements. That said, no useful public figures have been produced by the project to date. However, it is widely recognised that ground improvements – which involves driving long piles – comes at a high cost in terms of climate impact.

[14] https://swedgeo.diva-portal.org/smash/record.jsf?pid=diva2%3A1756945&dswid=-5092. Downloaded on 8 June 2023.

It was included calculations of the groundwork in the case study of the cross-laminated timber building known as Strandparken, and also of the ground improvements using tubular steel piles and a retaining wall, as the building was constructed on a steep slope down to Lake Mälaren. This part accounted for 24 kg CO_2e per m^2 net heated area in the project, of which 30 per cent involved use of diesel for the groundworks. The rest of the climate impact was linked to the production of materials for the ground improvements (Larsson et al., 2016). IVL's instructions on calculation (Thrysin et al., 2020) include default values that have been set conservatively with a 25 per cent supplement; that is, with 30 kg CO_2e per m^2 net heated area. There was a case study as part of the project entitled "Klimatdata för grundläggningsmetoder" (Climate data for foundation methods), with a simplified climate calculation for the foundation and groundworks of a 36-storey office building in Gothenburg. The case study showed – on the basis of generic climate data (typical values) developed in the project – that the climate impact of the driven concrete piles and tubular steel piles (modules A1–A5) was approximately 90 kg CO_2e per m^2 GFA (there was also an additional climate impact of excavation and the use of temporary steel sheet piling, for example).[15] Röck et al. (2022) show that foundation work accounts for 50 kg CO_2e per m^2 on average, based on case studies in a number of European countries (not Sweden). However, this figure is based on studies in which the boundaries may vary slightly for what is considered as part of the foundation. This particular building element has a big variation of values in the study. The climate impact of handling different masses is described in greater detail in (Liljenström & Björklund, 2022), on behalf of the Swedish Transport Administration. The climate impact of different types of piling in Sweden has also been studied in more detail in a number of degree projects.

Municipalities have also begun to focus more attention on construction works for public spaces and outdoor environments around buildings, given the urgency of the climate issue. Besides the climate impact of added resources and construction works, it is relevant to ask how the existing carbon stocks are affected by the works. We also need to consider how carbon removal can be stimulated in the soil and planted vegetation when implementing construction projects. More and more approaches and methods have thus started to emerge as a way of estimating the climate impact of landscape projects, carbon removal in urban nature, and carbon storage in soils and vegetation. See (Erlandsson et al., 2022, Lind, 2020, Sällberg, 2020), for example, for the Swedish context.

[15] https://grundlaggningsdagen.se/onewebmedia/2023/3A-3_Abstract_Klimatdata%20grundl%C3%A4ggningsmetoder.pdf.

Current state of regulatory developments outside Sweden

Countries such as France, Belgium and the Netherlands have already introduced requirements for climate or environmental declarations, ahead of us in Sweden. Regulations on climate declarations and limit values have been or are being introduced in the neighbouring Nordic countries.

Norway has demanded climate declarations for public construction projects run by the Norwegian Directorate of Public Construction and Property (Statsbygg) for a long time, but work is now in progress on introducing a more comprehensive regulatory framework. A study was conducted in 2022 on proposals for a mandatory climate declaration for new buildings. This requirement was introduced for multi-dwelling blocks and commercial buildings on 1 July 2022 with a one-year transition period, and is imposed via the Norwegian regulations on technical requirements for construction works (Byggteknisk forskrift).[16] Exempt buildings include single-family houses and terraced houses.

In Denmark, regulations on mandatory climate declaration and limit values for new buildings came into force in January 2023 for buildings more than 1000 square metres in area. Limit values will apply to all new buildings from 2025. The entire regulatory framework is being developed, which involves reviewing both limit values and the implementation of the framework from 2025. Denmark has a calculation tool, LCAByg, which is available to all stakeholders to use free of charge.

Development for the regulatory framework that is expected to enter into force in 2025 is also in full swing in Finland. This involves specifying more details of the outline method already published in 2019 (Finnish Ministry of the Environment, 2019). A legislative proposal has been circulated for comment, and work is now in progress on producing the regulation. More details on the Nordic countries' choice of methodology can be found in a separate item under each proposal.

Current situation on digital climate calculations and verifications

Digitalisation of the construction sector is a prerequisite for production of high-quality climate declarations in a resource-efficient manner. Moreover, the rapid pace of digital development is largely due to regulatory requirements. It is still the stakeholders in the front line who have the knowledge and drive the digital development. Small and medium-sized

[16] Fleire tiltak for å auke ombruk og redusere klimautslepp frå byggenæringa - regjeringen.no. Downloaded on 2 May 2023.

enterprises may need support to help them adapt in terms of resources and knowledge.

Initiatives to increase digitalisation in the construction sector

A number of initiatives are in progress to accelerate, streamline and facilitate digital management of the information needed to produce climate declarations for buildings.

Lantmäteriet and Boverket[17] are working to introduce and provide guidance on national basic data for buildings and other relevant basic data.[18] This is linked mainly to implementation of the use of basic data, supported by the National Geodata Platform (Nationella Geodataplattformen).[19] The use of national basic data is making an enormous contribution to facilitating information processing according to "the once only principle" (TOOP).[20]

Digital verifications are being developed for digital business solutions in the construction sector. A digital delivery note can provide information about the construction products purchased and supplied, with the quantities used in the building. One initiative is BEAst[21], Byggbranschens Elektroniska Affärsstandard (the Swedish Construction Industry's Electronic Business Standard). This is a system for initiatives such as digital delivery notes and follows the European standard Peppol[22], with specifications developed by the market in Sweden. BEAst streamlines and automates digital communication between suppliers and contractors through measures such as an information standard for climate declarations.

Miljödata NU! (Environmental data NOW!) is run by the Swedish Construction Federation, and is a collaboration between the building materials trade and building contractors via the BEAst Supply 4.0 project. The first stage of the project focuses on Boverket's climate declarations. A digital platform with digital delivery notes is expected to be implemented throughout the value chain, from material manufacturers to developers, by 2025.

Another digitalisation initiative is the Smart Built Environment project entitled "Öppen nationell databas för redovisning och visualisering av

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[17] Uppdrag om fler lösningar som främjar en enhetlig tillämpning av plan- och bygglagen (2010:900) i en digital miljö, Report 2023:3, Swedish National Board of Housing, Building and Planning, 2023.
[18] https://www.digg.se/ledning-och-samordning/ena---sveriges-digitala-infrastruktur/nationella-grunddata Downloaded on 27 February 2023
[19] https://www.lantmateriet.se/sv/nationella-geodataplattformen/ Downloaded on 27 February 2023
[20] https://www.toop.eu/ Downloaded on 27 February 2023
[21] Byggbranschens elektroniska affärsstandard, https://beast.se. Downloaded on 2 May 2023.
[22] https://www.digg.se/digitala-tjanster/peppol. Downloaded on 27 February 2023.

bygg- & anläggningssektorns klimatdata" (Open national database for accounting and visualisation of climate data in the construction sector). [23] This is being funded by Vinnova and the Development Fund of the Swedish Construction Industry (SBUF), and run by LFM30[24] and Byggsektorns Resurshubb (the Construction Sector Resource Hub)[25], which is an open digital EPD hub that provides the environmental performance of products free of charge.

[23] https://www.smartbuilt.se/projekt/informationsinfrastruktur/nationell-databas/. Downloaded on 10 January 2023.
[24] Lokal färdplan Malmö (LFM30) https://lfm30.se. Downloaded on 1 March 2023.
[25] Erlandsson et al.: Digital produktinformation baserat på datamallar. Koncepttest av implementering av miljövarudeklarationer (EPD) och prestandadeklarationer (DoP) i kommersiella webbtjänster. Smart Built Environment, SBUF, IVL, January 2023.

An EU perspective

There is a lot going on in the EU that may influence efforts on climate declarations. This chapter provides a general overview of key EU policy instruments and initiatives.

The Green Deal is an overall EU priority to become the world's first climate-neutral region. The toolbox to achieve this ranges from the development of direct legislative acts, to guideline strategies and initiatives in areas where the EU has no legislative right. The Green Deal was presented in December 2019 and means that the EU is now working towards climate neutrality by 2050. One target is to reduce emissions by at least 55 per cent by 2030, compared to 1990.

EU regulations are direct legislative acts. This means that they become directly applicable in the Member States without the Member States themselves enacting them in their national legislation. Examples in this section include the Taxonomy Regulation, the Construction Products Regulation and the Ecodesign for Sustainable Products Regulation.

EU Directives are legislative acts that are to be implemented in the Member States by being incorporated into national legislation. The Energy Performance of Buildings Directive is one example in this section.

EU standards are common methods for assessment, description and calculation, ensuring that we all speak the same technical language and are able to compare results between ourselves. Standards for the sustainability of buildings and construction products are examples in this section.

Guidelines are a way for the EU to influence and accelerate the development of Member States in certain areas where the EU has not been granted the right to issue regulations. Examples in this section include Level(s), and Digital Building Logbook.

EU standards for the sustainability of buildings and construction products

European standards EN 15978 and EN 15804 have been and remain key starting points in the regulations on climate declaration for buildings, in order to describe the methodology for the sustainability of buildings and construction products respectively. CEN[26] proposes that both standards should become reference calculation methods for environmental declarations when the Construction Products Regulation is revised: see the

[26] European Committee for Standardization.

section entitled “Construction Products Regulation” below for more information.

Standard EN 15804

Specific climate data for construction products used in a climate declaration of a building and registered at Boverket must comply with the calculation regulations for EPDs according to the EN 15804[27] standard and be third party verified or equivalent. EN 15804 is the basic standard for calculating what are known as EPDs, which are third party verified declarations that quantitatively describe the environmental impact of a product during its life cycle. EN 15804 has been adjusted twice since the standard was first published: amendment A1 in 2013, and A2 in 2019.

Standard EN 15978

According to European standard EN 15978, the life cycle of a building is divided into: a product stage, a construction stage, a use stage and an end-of-life stage.[28] The various stages of the life cycle are in turn divided into what is known as information modules, which describe the processes during the life cycle: see Figure 5. The division into modules allows the climate impact to be reported uniformly, which facilitates the interpretation of results.

<table>
<tr><th colspan="5">Life cycle information, building</th></tr>
<tr><th colspan="2">A1–5 Construction stage</th><th rowspan="2">B1–7
Use stage</th><th rowspan="2">C1–4
End-of-life stage</th><th rowspan="2">D
Benefits and loads beyond the system boundary</th></tr>
<tr><th>A1–3
Product stage</th><th>A4–5 Construction process stage</th></tr>
<tr><td>A1 Raw material supply</td><td rowspan="2">A4 Transport</td><td>B1 Use</td><td rowspan="2">C1 De-construction, demolition</td><td rowspan="8"></td></tr>
<tr><td>A2 Transport</td><td rowspan="3">A5 construction, installation process</td><td>B2 Maintenance</td></tr>
<tr><td rowspan="2">A3 Manu-facturing</td><td>B3 Repair</td><td>C2 Transport</td></tr>
<tr><td>B4 Replacement</td><td rowspan="2">C3 Waste processing</td></tr>
<tr><td></td><td>B5 Refurbishment</td></tr>
<tr><td></td><td></td><td>B6 Operational energy use</td><td>C4 Disposal</td></tr>
<tr><td></td><td></td><td>B7 Operational water use</td><td></td></tr>
</table>

Figure 5. The various stages of a building’s life cycle are labelled with different letter designations according to the European standard EN 15978 Sustainability of construction works – Assessment of environmental performance of buildings. Parts marked green are included in the climate declaration from January 2022. Illustration: Boverket.

[27] This standard is available as Swedish standard SS-EN 15804:2012+A2:2019 Hållbarhet hos byggnadsverk – Miljödeklarationer – Produktspecifika regler (Sustainability of construction works – Environmental declarations – Core rules for the product category of construction products).

[28] This standard is available as Swedish standard SS-EN 15978:2011 Hållbarhet hos byggnadsverk – Värdering av byggnaders miljöprestanda – beräkningsmetod (Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method).

The standard provides rules for calculating and assessing the environmental performance of new and existing buildings. Among other things, it provides guidance on

- the choice of LCA purpose and scope
- delimitations within a system investigated
- data and collection and analysis of data
- indicators to be included, and how these are calculated
- how the results are to be reported.

EN 15978 is currently being revised by CEN/TC 350/WG 1[29], and the next step in the standardisation process is expected to take place in April 2023. The revision of the standard has resulted in a decision to split EN 15978. The version that is soon to be published is prEN 15978-1 "Sustainability of construction works – Methodology for the assessment of performance of buildings – Part 1: Environmental Performance".

EU framework for sustainable buildings – Level(s)

The European Commission's framework for sustainable buildings is called Level(s).[30] This is a voluntary reporting system to improve the sustainability of buildings. Level(s) is based on existing European standards, including EN 15978 and EN 15804, and will provide a common language within the EU for assessing the sustainability performance of buildings. Level(s) uses what are known as core sustainability indicators to measure materials, water, health, comfort and climate change impact through the entire life cycle of the building. Level(s) has been developed in broad cooperation between EU Member States and professionals working with sustainable construction.

The European Commission refers to Level(s) in its work on various EU regulations, such as the taxonomy and revision of the EPBD. One of the Level(s) indicators, the GWP indicator, is closely linked to the regulations on climate declarations. The Level(s) GWP indicator covers significantly more of the climate impact of buildings than the Swedish regulations on climate declarations for buildings from 2022. The climate impact to be reported pursuant to this report will be more consistent with Level(s).

[29] CEN/TC 350 /WG 1 "Environmental performance of buildings".
[30] Information on Level(s) can be found on the European Commission website: https://environment.ec.europa.eu/topics/circular-economy/levels_en. Downloaded on 2 May 2023.

A roadmap for reducing carbon emissions throughout the life cycle of a building

The European Commission is developing a roadmap for the reduction of whole life carbon of buildings by 2050. This roadmap will provide information for policies, strategies and targets, and support market initiatives, research and data collection. The European Commission has initiated a study to support the development of the roadmap.[31] The roadmap is expected to be adopted by the end of 2023. The first step is to demand a calculation and a report on the climate impact of buildings. The aim of this is to increase knowledge and understanding and reduce the climate impact of a building's entire life cycle. This has already been introduced – or is in the process of being introduced – in various EU regulations; on sustainable finance, EPBD and EED, for instance. The idea in the next step is to introduce reference values, targets or limit values.

Taxonomy Regulation

There is a link between the climate declarations and the EU Taxonomy Regulation[32] regarding the extension/expansion of the climate declaration modules. This is partly because it applies to new buildings, and partly because it applies to the entire life cycle.

The Taxonomy Regulation was created to provide EU-wide criteria to demonstrate the extent to which investments are environmentally sustainable. From 2023 onwards, the entire life cycle of new buildings with a usable floor area of more than 5,000 m^2 must be reported, with a GWP indicator for each stage, in order to meet the criteria of the delegated regulation[33] concerning the erection of buildings in the Taxonomy Regulation. The GWP value, which is provided to investors and customers upon request, is a numerical indicator for each stage of the life cycle, expressed as kilograms of carbon dioxide equivalent per square metre (of usable indoor floor area), averaged over one year of the 50-year reference study period. The Taxonomy Regulation refers to a methodology according to Level(s), and the European standardisation calculation regulations for buildings EN 15978.

There is no requirement for LCA and GWP indicator in the case of refurbishment work. At present, there are no limit values to relate to in the

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[31] https://c.ramboll.com/whole-life-carbon-reduction. Downloaded on 2 May 2023.
[32] Taxonomiförordningen https://eur-lex.europa.eu/legal-content/SV/TXT/PDF/?uri=CELEX:32020R0852&from=EN. Downloaded on 2 May 2023.
[33] Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives.

taxonomy in respect of GWP indicators, as there are for energy use in new buildings, which must be slightly better than the new construction requirement.

Energy Performance of Buildings Directive (EPBD)

The European Commission set out a proposal on 15 December 2021 to revise the Energy Performance of Buildings Directive (EPBD).[34] Negotiations are currently in progress within the EU. The revised Directive will be adopted after a report on this assignment has been submitted, possibly towards the end of 2023.

The EPBD will influence how the regulatory framework for climate declarations will need to be formulated in the future. This is an important reason for Boverket's proposal in this report; that the expanded climate declaration should not be introduced until 2027 (that is, at a later stage than the introduction of the limit values). The rationale for this is described in greater detail below.

The forthcoming requirements for calculation of climate impact

The EPBD has a significant impact on Member States' energy requirements, for both new and existing buildings. The purpose of the Directive is to promote the improvement of energy performance in the building stock. It focuses on operational energy use. The proposal for a revised Directive includes relatively extensive amendments in this respect. A new type of requirement which did not exist before and is directly linked to the regulation for climate declarations will be introduced in the Directive at the same time.

The European Commission's proposal includes a requirement for calculating the life-cycle climate impact[35] of new buildings, which shall be disclosed through the energy performance certificate of the building:

a) as of 1 January 2027, for all new buildings with a useful floor area larger than 2000 square meters; and

b) as of 1 January 2030, for all new buildings.

The proposal also includes requirements for the methodology to be used to calculate the climate impact. Data selection, scenario definition and calculations shall be carried out in accordance with EN 15978.[36] The

[34] Proposal for a Directive of the European parliament and of the Council on the energy performance of buildings (recast). Brussels, 15 December 2021 COM(2021) 802 final. EUR-Lex – 52021PC0802 – EN – EUR-Lex (europa.eu). Downloaded on 2 May 2023.
[35] Global Warming Potential (GWP).
[36] EN 15978:2011: Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method.

building elements and technical equipment defined in the Level(s) common EU framework for indicator 1.2 are to be included.[37]

The European Commission's proposal contains no requirements for determining limit values, and no requirements covering renovation.

An expanded climate declaration from 2027 at the earliest

In practice, the climate calculation will be performed by the developer in accordance with the regulatory framework for climate declarations, although the proposal requires the climate impact to be reported in the energy performance certificate issued by a certified energy expert. This means that the Swedish regulatory framework needs to be formulated so that it is consistent with the regulations for calculating climate impact in the forthcoming EU Directive. Thus the certified energy expert will retrieve climate impact data from the climate declaration, if the proposal is implemented.

The impact of the Directive on the regulations for climate declarations needs to be investigated once it has been adopted. The proposals set out in this report on how the climate declaration should be expanded going forward may need to be adapted: see the section entitled "Climate declaration of a building's entire life cycle from 2027". This may include which buildings, life cycle modules and building elements (construction products) are to be included, and how these are to be handled in a climate impact calculation.

As this may have an impact on the drafting of the regulations and the need for measures before the regulations enter into force, for example development of scenarios and guidance, the expansion of the scope of the climate declaration with more life cycle stages should be coordinated with the EPBD (that is, not introduced until 2027).

Energy Efficiency Directive (EED)

The proposal for the revision of the Energy Efficiency Directive, which was originally set out in July 2021, highlights climate impact of a life cycle perspective as regards requirements relating to public bodies as role models, and requirements for public procurement procedures. Reporting climate impact data is not mandatory as regards public procurement: that said, the contracting authority is provided with the option of requiring submission of data on the global warming potential of the building over its life cycle when implementing a public procurement procedure for a new building. Requiring this data is voluntary for the contracting authority. A description is also provided to indicate that it is possible to publish

[37] Level(s) indicator 1.2: Life cycle Global Warming Potential (GWP).

the data, particularly for buildings with a usable floor area in excess of 2000 square metres.

The EED was created to reduce energy use in the EU by improving efficiency in all sectors, and also to help implement a sustainable energy system.

Construction Products Regulation (CPR)

The conditions for implementing limit values pursuant to the applicable Construction Products Regulation were examined in Boverket's 2020 report "Regulation on climate declarations for buildings", which presented a roadmap for the introduction of regulations and limit values. It was found that developed case law limits the information on construction products that public sector stakeholders can request. It was also found that the harmonised standards for construction products needed to be updated with references to the Environmental Product Declaration (EPD) standard in order for this standard to become part of the harmonised system. These conditions still apply.

A revised Construction Products Regulation

The European Commission presented a proposal for a revised Construction Products Regulation in 2022. This proposal involves expansion of the scope of the legislative act. The revised regulation will not only promote the free movement of construction products in the internal market, as it does at present: it will also be used as a tool for achieving the objectives of the Green Deal. At the same time, the European Commission presented a proposal for an Ecodesign for Sustainable Products Regulation for sustainable products. Corresponding sustainability requirements for construction products have been woven directly into the proposal for a revised Construction Products Regulation.

This is a very comprehensive proposal, but it does not impose direct product requirements. However, it is proposed that the Commission may supplement the regulation by defining product requirements in delegated acts in relation to product safety and sustainability aspects in particular. A greater degree of control over the manufacturing process, closer involvement of third party bodies and increased market surveillance are also proposed. The implementation period is related to the ongoing development of the CPR Acquis.

The European Commission's proposal is currently being negotiated by the European Parliament and the European Council, and will then be negotiated in what are known as trilogues. The final regulation and its impact can be assessed when it is available. Support for the Swedish

approach to the negotiations was secured by the Government Offices of Sweden with the Swedish Parliament in May 2022.[38]

CPR Acquis

The Construction Products Regulation defines requirements on how information on the performance of the essential characteristics of construction products is to accompany the products from manufacturer to user. Harmonised standards define which characteristics are essential for a given product group, and indicate how these are to be verified and reported. Use of the harmonised standards for construction products are mandatory for manufacturers. The system of harmonised standards is older than the legislative act itself, and began to be developed when the earlier Construction Products Directive was adopted in 1989. The test methods referred to in the standards are not technically up to date in many cases, or else there are no test methods at all. It has proven difficult to make the necessary amendments to the standards as new information needs have arisen. By way of example, several Member States have recently recognised the need for environmental product declarations for construction products.

That is why the European Commission has initiated work under the working title CPR Acquis. The aim is to conduct a systematic review of the harmonised system of standards, product group by product group. This will be based on an inventory of the product information needs in each country's building regulations. The Swedish climate declarations are a typical example of the need for environmental product declarations for construction products. The inventory should result in renewed mandates for standardisation, and hence new harmonised standards. The review will provide an opportunity for incorporation of product characteristics that are not included in the current harmonised system of standards. A horizontal expert group on environmental sustainability has been created in order to support the product-specific working groups within the CPR Acquis with knowledge in the field of sustainability. The European Commission refers to this work in the case of enquiries into environmental product declarations, rather than the CPR revision.

The need for product-specific climate data when introducing limit values

There will be an increasing need for specific climate data for construction products when limit values are introduced. It is important for this climate data to be of sufficiently high quality when it is used to calculate the climate impact of a building. Boverket has no intention of defining national criteria for this, but is actively involved in the implementation at European level by means of input to the CPR acquis. The possibilities to

[38] https://www.riksdagen.se/sv/dokument-lagar/dokument/fakta-pm-om-eu-forslag/revidering-av-byggproduktforordningen_H906FPM82. Downloaded on 2 May 2023.

access specific climate data are gradually expanding as work on the CPR Acquis progresses.

The fact that it must not be costly to produce product-specific data is an important issue to consider/follow-up. There must be ways of declaring a product so that its quality can be deemed equivalent to an EPD reviewed individually by a third party.

How a GWP indicator will be reported pursuant to EN 15804 is another important question. It will no longer be possible to create new EPDs pursuant to EN 15804:A after November 2022. However, there will be valid EPDs pursuant to EN 15804 version A1 until 2027, as these are generally valid for five years. The Commission has expressed a desire to amend some of the methods used to calculate the contribution to various environmental impact categories. This also includes climate impact (GWP). For Swedish legislation, it is important for the GWP indicator to be reported so that it is possible to exclude biogenic carbon from the construction product so that GWP-GHG is reported as the limit value is limited to modules A1–A5.

Ecodesign Directive

The initial purpose of the current Ecodesign Directive[39] was to implement energy savings by promoting the development of technology towards more energy-efficient products on the market. This methodology is based on regulation, banning the least energy efficient products within a product category while allowing the more energy efficient products to remain on the market.

Other product aspects besides energy use have gradually come to be regulated through ecodesign. In the European Commission's opinion, this is a successful way to drive product development. That is why the Commission presented a proposal for an EU regulation on ecodesign for sustainable products in March 2022. The proposal for a regulation on ecodesign for sustainable products covers all products with the exemption of food, feed, pharmaceuticals, live animals and plants. Nor does it cover the products covered by specialised legislation containing the same sustainability criteria as the Ecodesign for Sustainable Products Regulation. The proposal for a renewed Construction Products Regulation, which was published at the same time as the proposal for the Ecodesign for Sustainable Products Regulation in the same legislative package, is one such example. So in theory, construction products that are not harmonised within

[39] Regeringens promemoria om ekodesignförordningen https://www.regeringen.se/faktapromemoria/2022/05/202122fpm84/. Downloaded on 2 May 2023.

the scope of the Construction Products Regulation could be regulated via the Ecodesign for Sustainable Products Regulation.

This proposal is currently under negotiation, and the final regulation and its impact will have to be assessed once it has been finalised and adopted. Support for the Swedish approach to the negotiations was secured by the Government Offices of Sweden with the Swedish Parliament in May 2022.

Logbook for the erection of new buildings

Boverket has previously received a number of assignments from the government in order to investigate the regulations that are to apply to the documentation of construction products in new buildings and construction works and that are to be collected in a logbook. This logbook shall make it possible to trace construction products used in construction works throughout their life cycle. The latest assignment was reported to the Government Offices of Sweden in June 2018.

In the assignment it was concluded that the requirement for a logbook can be introduced into Swedish legislation, but that this was only possible with limited benefit at that time in relation to the desired scope. The construction industry was generally in favour of the legal regulation of a logbook. However, it would be desirable for the logbook to be capable of including all information about the chemical content of construction products (and not just hazardous substances). However, such a requirement was not compatible with the EU Construction Products Regulation (CPR).

Boverket submitted a proposal to the Government Offices of Sweden, which essentially involves three different options:

1. A requirement for a logbook is to be introduced immediately in order to create a system where it will be possible to include expanded requirements from the Swedish Chemicals Agency on construction products in the future. Sweden is also pushing for changes to the EU Construction Products Regulation which will require the chemical content of construction products to be reported.
2. The government is initially pursuing the issue with the European Commission to ensure that the EU Construction Products Regulation requires disclosure of the chemical content of construction products and will then introduce national regulations when it can be assessed with reasonable certainty that this will be the case.
3. Sweden is awaiting and will introduce more comprehensive legislation when the EU Construction Products Regulation allows for this.

The government chose not to work actively on the issue at EU level, and no legal requirement for a logbook has been introduced in Sweden.

The European Commission had paused the work on a logbook at the time of the study. This work has resumed, and the European Commission is preparing a framework for Member States which have introduced or are about to introduce a legal requirement or voluntary systems to use. It is thought that this work will be completed by the end of 2023. The Government Offices of Sweden and Boverket are following the ongoing efforts regarding the framework and any next steps towards regulation.

Limit values may be introduced in 2025

In its report on the development of regulations for climate declarations (Boverket, 2020), Boverket proposes that limit values for the climate impact of buildings and an expanded climate declaration could be introduced in 2027. Earlier introduction of the limit values was considered in the report. However, there was still major uncertainty about the opportunities to perform calculations of sufficient quality for more or less all of the developers in Sweden, as the regulations had not yet entered into force.

Proposal for 2025

1. Limit values to be introduced in 2025 for the climate impact of buildings for modules A1–A5 in kg CO_2e per m^2 GFA, for those buildings that are erected and subject to regulations on climate declarations for buildings.
2. This requirement states that the climate impact may not exceed the limit value for the building to be erected, where an application for a building permit is submitted to the building committee after the regulations enter into force. It is proposed that the regulations should enter into force on 1 July 2025.

Rationale

The major need to reduce climate impact quickly is the main reason for bringing forward the introduction of limit values for the climate impact of buildings, compared with Boverket's proposal in its report "Regulation on climate declarations for buildings" (Boverket, 2020). There is also a strong demand for this from the industry. Many referral bodies pointed out the importance of introducing limit values earlier than 2027 in the consultation on Boverket's report "Regulation on climate declarations for buildings". It has already had a major impact on all major stakeholders in the industry, performing climate calculations and identifying improvement measures. Moreover, various tools for making climate declarations and reducing climate impact are emerging rapidly. This was difficult to predict at the time when the data was produced for Boverket's report "Regulation on climate declarations for buildings". Digitalisation is in full swing, enabling more efficient calculations and management of verifications in line with existing legislation, although smaller stakeholders are less mature as things stand at present.

Many industry stakeholders have already developed an internal target regarding maximum climate impact of new construction (see the section

entitled “Proposed levels for limit values in 2025”). Most of the calculation methods and climate data are in place for the system boundary covered by the limit values, in that the regulatory framework for climate declarations has been operational since 2022. There are also robust reference values for the climate impact of new buildings in Sweden (Malmqvist et al., 2023) on which the limit values can be based.

All respondents to the Boverket survey are in favour of introducing limit values in 2025, with a few exceptions. Some respondents would like limit values to be introduced earlier. A number of stakeholders have commented that they would like limit values to be based on the entire life cycle. See the section entitled “Proposed levels for limit values in 2025” for further discussion on this. See the chapter entitled “Impact assessment” for more information on Boverket’s considerations.

Developments in the Nordic countries

Denmark introduced limit values from 2023 for buildings over 1000 m^2, and this requirement will apply from 2025 for all buildings. Climate declarations must be submitted for all new buildings from 2023.

Finland intends to introduce both a climate declaration and a limit value in 2025 for all buildings where an energy declaration is required. Buildings are divided into three different groups:

1. Buildings subject to requirements for a climate declaration and limit values.
2. Buildings that need a climate declaration only.
3. Buildings exempted from climate declaration requirements.

Norway introduced mandatory climate declaration in 2022, but it is unclear when any limit values will be introduced.

Levels for limit values in 2025

This chapter presents proposals relating to system boundaries and levels in respect of limit values for the climate impact of buildings.

The system boundary for limit values

The system boundary in respect of limit values for the climate impact of buildings involves considering which life cycle stages and modules are included, as well as looking at which building elements are included. The former have not been the subject of this investigation: instead, they follow the system boundaries already proposed in Boverket's report "Regulation on climate declarations for buildings" (Boverket, 2020).

Proposal for 2025

- Limit values will be introduced in 2025 for the climate impact of buildings for modules A1–A5 in kg CO_2e per m^2 GFA, for those buildings that are erected and subject to regulations on climate declarations for buildings.
- The building elements covered by the limit values are all elements of the building from the foundation and its insulation, except for solar cells and fixed equipment.
- The climate impact for solar cells integrated in construction products or surface-mounted solar cells shall be reported in the climate declaration.
- Technical equipment and fixed interior design intended for the activity are not included in climate declarations or the limit value for Group 2 buildings.

Rationale

When limit values are introduced, all parts of the building from the foundation and its insulation must be included in the limit value, except for solar cells and fixed equipment. This proposal is similar to Boverket's report "Regulation on climate declarations for buildings" (2020). Boverket sees no reason to alter this, but emphasises the importance of being able to use default values for the additional parts of a building compared to the 2022 regulations on climate declarations. This is particularly true when bringing forward the introduction of limit values is proposed. That is why the timing of the introduction of the limit values does not rely on an anticipated trend towards more climate data and increased digitalisation, as is required in order to obtain quality-assured climate calculations for additional building elements as well. It also makes it easier for smaller stakeholders to perform cost-effective calculations. Not allowing the use

of default values for additional parts could be considered. However, it is debatable whether it would be appropriate to include these building elements in the limit value if the rationale is to drive climate improvements. The effect of the policy instrument risks being diminished when default values are allowed as an alternative to project-specific calculations. This is because default values merely signal that climate impact may be significant, but they do not require the developer to take mitigation measures. See the section entitled “Default values for additional building elements may be used” for further information.

The main reason for adding more building elements is that the climate calculation better reflects the climate impact of an entire building, and because it enhances the comparability of climate declarations from different buildings and different building element classifications. This is important when introducing limit values.

Furthermore, there is a trend towards an increasing share of technical equipment in newly constructed buildings, and thus an associated climate impact. There is also a demand from suppliers of technical equipment that technical equipment should be included in the regulatory framework in order to increase the demand for EPDs. The reference value study highlighted the fact that the building elements, finishes and fixed interior design, may also account for a relatively large part of the climate impact (Malmqvist et al., 2023). Boverket’s previous report (Boverket, 2020) also provides additional reasons for including these building elements.

Boverket has also reviewed whether fixed equipment (cookers, refrigerators, dishwashers, washing machines, etc.) should be included in the limit value. Neither Finland nor Denmark has included fixed equipment in the adopted or forthcoming regulations on climate declarations, in order to make things easier for stakeholders (reduce costs). Boverket has also checked this issue with stakeholders in the Swedish construction industry; and Boverket’s proposal is to not include these products as they do not perceive any problem with exempting them. This will also reduce costs for Boverket when the climate database is updated.

Technical equipment and fixed interior design intended for the activity are not included in climate declarations and the limit value for Group 2 buildings as there are no robust reference values for this building category. For hospitals, for instance, this may mean major climate impact of technical equipment and fixed interior design intended for the activity. A study with climate calculations for Group 2 buildings representative of typical construction in Sweden today is needed before these building elements are introduced to the limit value.

Exclusion of both surface-mounted and integrated solar cells from the limit value is a deviation from the previous proposals in Boverket’s report “Regulation on climate declarations for buildings”. It was revealed

in the reference value study (Malmqvist et al., 2023), that there is a large distribution in climate impact depending on the number of solar cells, as well as the number of floors in a building. This could mean that limit values with a system boundary that includes the climate impact of the production of materials for solar cells steers away from installation of solar cells on new buildings. A further argument, then, is that the climate savings in the operational stage of solar cells cannot be included in the calculation since the limit value covers modules A1–A5. To summarise, the installation of solar cells could be disadvantaged, which is not desirable. The proposal presented at Boverket's hearing was to include only integrated solar cells, as these are construction products that also form part of the building envelope and are therefore included in the current system boundary for climate declarations. However, clear criticism was expressed at the hearing with regard to failure to treat all forms of solar cells equally. Therefore, excluding integrated solar cells from the limit value is the final proposal here.

Considerations

Integrated solar cells form part of the building envelope. On average, the entire building envelope accounts for 15 to 20 per cent of the climate impact of all building types (excluding single-family houses), according to the reference value study (Malmqvist et al., 2023). For single-family houses, the building envelope accounts for almost half of the climate impact for modules A1–A5, on average. Integrated solar cells have been used very sparingly in new construction thus far. Excluding such solar cells – that is, not including the climate impact of the part of the building envelope that they represent in the calculation – should therefore lead to very limited additional emissions from the construction sector overall. Despite this, Boverket assess that the parts of the building envelope that are "exempted" should be replaced when integrated solar cells are used. Such an approach is deemed to be in line with the purpose of the law. It also reduces the risk of the regulatory framework steering towards façade systems with integrated solar cells that are costly in terms of climate. Technical equipment are building elements that is still far from being a climate calculation practice in a construction project. This is an important reason as to why the current regulatory framework does not require declaration for this part, besides the fact that it may be more complicated to manage. However, more and more climate data is becoming available, and consultants are developing better methods for performing quantification and climate calculations for this building element.

The vast majority of respondents to the Boverket survey support the proposal on constituent building elements. Respondents who commented on the matter of building elements have commented on how solar cells are dealt with in the proposal. It was suggested at the hearing that integrated solar cells should be included in the limit value as they form part of the

building envelope. Several respondents stated that this could place solar cells at a disadvantage. Therefore, the proposal here is to no longer include these in the limit value.

Rationale for a limit value limited to modules A1–A5

A limit value for climate impact must cover a defined and verifiable part of the life cycle for the erection of buildings (modules A1–A5) when it is introduced to the regulatory framework. This is the starting point for this investigation. At the same time, some stakeholders are pushing for inclusion of the climate impact of the entire life cycle of the building in the limit value. This emerges both in the consultation responses to Boverket's report "Regulation on climate declarations for buildings" (Boverket, 2020), and in the hearing held on 31 August 2022 within the framework of this assignment. This section provides a general description of the rationale for the delimitation. See also the annex entitled "Concerns about not to include the whole building life cycle in the limit value". This problematises the rationale for restricting the limit value to modules A1–A5. This makes it possible to discuss the benefits of the limit value potentially covering the entire life cycle in the future.

Initially, it is useful to clarify what the climate impact of the various life cycle modules represents according to the EN 15978 standard, and what the status is of the methodology and practice for calculating these modules at present. Modules A1–A5 describe emissions that occur today, linked to the erection of a building. Use stage B describes emissions and removal during a reference study period to be determined. Boverket (2020) suggests setting this to 50 years, which is currently the case in Level(s) (Dodd et al., 2021), and is the most common reference study period in similar calculation methodologies on an international level (Lützkendorf & Balouktsi, n.d.). End-of-life stage C describes emissions linked with dismantling and handling building elements and residual products in 50 years' time.

The arguments in favour of introducing limit values with a limited system boundary were described in Boverket's report "Regulation on climate declarations for buildings" (Boverket, 2020), and there is nothing to suggest that these arguments do not still holds. The rationale can be summarised in the following points:

- Focus on the construction stage involves a more focused steering towards reduction of the greenhouse gas emissions that occur today, i.e. modules A1–A5 (raw material supply in the product stage, transport in the product stage, manufacturing in the product stage, transport in the construction stage, the construction and installation process in the construction stage).

- It is also possible to verify these emissions, unlike estimates of future emissions or removal of greenhouse gases.
- Thus the emphasis is on reducing today's emissions and not considering these as equivalent to potential emissions decades in the future that are more difficult to evaluate.
- The construction stage accounts for a high proportion of emissions with climate impact over the life cycle of a building. The trend can be expected to move towards increased electrification, with the commitments of the Paris Agreement, the Climate Act etc., based on renewable energy sources, phasing out fossil fuels and production methods with low greenhouse gas emissions. This means that the construction stage's share of actual climate impact over the life cycle of a building will in turn be even greater than shown by current life cycle analyses (which are based on static climate data for future emissions).
- The calculation becomes more "diluted" as more parts of the life cycle are included in the calculation. That is why a limit value for an entire life cycle provides less incentive to reduce current emissions.
- Although the fact that decisions on building design and construction choices are made solely on the basis of climate impact for a limited part of the life cycle can intuitively be viewed as presenting a risk of suboptimisation, this risk is not necessarily particularly great. Firstly, standardised and regulated scenarios need to be defined for the modules in the B and C stages. This means that the potential climate-improving project design choices made will not necessarily be clearly apparent in the calculation. These stages (as described above) will account for relatively limited climate impact, and thus will not necessarily be affected all that much by changes in product choice.

The benefits of including other life cycle stages beyond the construction stage in the limit value are still viewed as limited when it comes to reducing the climate impact of the buildings erected.

There may be reason to review the system boundary if methods are introduced for better visualisation of the choice of design solutions that last a long time and are easy to repair. However, other policy instruments are likely to be more appropriate for steering towards greater energy efficiency and solutions that favour future reuse, flexibility and suchlike.

Developments in the Nordic countries

Denmark, which includes ground improvements in its declaration, is considering weighted limit values in some form, depending on ground conditions. Finland has no intention of including groundworks and ground improvement in the limit value. Norway has produced a report assessing the

inclusion of groundworks. The report recommends not including groundworks in the limit value as this will result in major differences depending on ground conditions, but groundworks should be included in the climate declaration.

Both Finland and Denmark include more or less the same system boundary as proposed here for building elements. Norway appears to have the same building elements as in the regulations on technical requirements for construction works (Byggteknisk forskrift). They have investigated whether technical equipment should be included, but the study states that they have chosen not to include it on account of a lack of reliable climate data.

The Danish limit value covers modules A1–A3, B4, B6 and C3–C4. The Finnish limit value covers the entire life cycle (excluding module D). A more limited life cycle may be included in the limit value in Norway, at least A1–A3, probably also A4 and A5 construction product waste, and module B2 and B4, but this is not definite. Norway has analysed limit values for A1–A5, B4 and C1–C4 in a report.

Different limit values for different building types

Boverket proposes setting different limit values for single-family houses, multi-dwelling blocks and non-residential premises in its report containing proposals on the development of regulations for climate declarations (Boverket, 2020). There is a need for further differentiation for non-residential premises, as non-residential premises consist of many different types. There has been limited data to date on the level of climate impact for the less common building types. It must be possible to clearly link the different methods and levels for the limit values to the different building categories described in Boverket's Purpose Catalogue (Ändamålskatalogen) tool.[40]

Proposal for 2025

- The limit values are set differently for different building types, defining the building types according to Boverket's Purpose Catalogue tool.
- The limit values are not adjusted due to different characteristics of buildings, such as storeys below ground level, balconies, energy performance and the shape of the building.
- Buildings are divided into two main groups. The two groups are:

[40] Ändamålskatalogen – PBL kunskapsbanken – Boverket. Downloaded on 2 May 2023.

1. Relatively homogeneous building types where robust reference values are available when the limit values are introduced – single-family houses, multi-dwelling blocks, office buildings, preschools, education excluding preschools, and special housing.

2. Other building types where robust reference values are not yet available when the limit values are introduced.

Robust reference values for different building types above refer to reference values for climate impact for the erection of buildings, according to the study from KTH Royal Institute of Technology (Malmqvist et al., 2023). Values for special housing have been developed within the framework of this investigation. See the section entitled “Supplementary reference values on the climate impact of buildings” and Annex 3. Special housing refers to housing for the elderly, students, young people or people with disabilities.

Rationale

The proposal means that building types are listed on the basis of the purposes for buildings according to the Boverket’s Purpose Catalogue tool and that limit values are specified for these. Many of these will initially have the same limit value, as it´s deemed to be no significant difference in terms of climate impact from the construction of them.

This approach means that flexibility is built into the regulatory framework in order to define relevant and differentiated limit value levels for different building types from the outset. The requirements for different building types may change over time. It may also be easier to optimise some building types than others; in relation to progressively more stringent limit values, for example. The proposed design involves building in flexibility in order to deal with this development by allowing an independent assessment to be made for future updates on an appropriate limit value level for each building type.

Two different approaches are used to define limit values as the development of robust reference values currently varies for Swedish conditions, depending on building types. For single-family houses, multi-dwelling blocks, office buildings, preschools and education excluding preschools, the reference values developed in the reference value study (Malmqvist et al., 2023), which are described in brief, are deemed to be robust as a starting point for the definition of limit values in the section entitled “A study on reference values for the climate impact of buildings”. Moreover, this investigation has collected recent calculations performed for the special housing group. This is considered to provide a sufficiently robust foundation for placing special housing in Group 1.

A strong desire to “capture” as many as possible of the erected buildings in a system of limit values was expressed in a workshop involving

construction stakeholders and architects that was held in April 2022. Many felt that it would be possible to define limit values for most building types, in the form of a maximum climate impact in kg CO_2e per m^2 GFA. Group 1 buildings, as above, correspond to approximately 65 per cent of the building permits granted in Sweden in 2019 (Statistics Sweden, 2020). According to general input from the workshop, it is appropriate to prioritise building types that are widely built and also those that have a high climate impact. Widely built building types today include industries, warehouses, multi-dwelling blocks, offices, buildings linked to transport and communications, special housing and – until recently – single-family houses (in terms of the number of building permits granted) and commercial buildings.[41] The Swedish Association of Local Authorities and Regions (SALAR) has made a forecast showing that the need for special housing (in terms of number of buildings) is in the same order of magnitude as the need for schools and preschools. The number of sports halls needed is about half the number of schools, although this figure is not divided into sports halls, ice rinks and swimming pools (Malmqvist et al., 2023).

Relatively few buildings are expected to fall into Group 2, which includes other buildings and building types, as several buildings are exempted from the requirement for a climate declaration. Industries and warehouses account for a relatively high proportion of building types that do not fall into Group 1. However, buildings for industrial purposes are exempt from the requirement for a climate declaration, and the same rule on exemption is also proposed to apply when limit values are introduced. Other examples of buildings that are exempt from the requirement for a climate declaration are buildings where the Swedish Transport Administration is the developer, i.e. buildings with a link to transport and communications. Buildings where the developer is Specialfastigheter Sverige AB are further examples of exemptions. This developer constructs buildings such as prisons and detention centres, which are specialised buildings that may need to include structures that greatly drive climate change. Other examples of exemptions are buildings intended for national defence and buildings of importance for Sweden's security. Profile buildings may be included in Group 2. However, based on signals from industry, it is reasonable for these to be subject to a requirement for a limit value. A Group 2, where the limit value is set with a higher margin until further notice, is deemed to be needed, as profile buildings are more unique. However, this

[41] Demand for new tenant-owned apartments and single-family houses has fallen sharply after mid-2022. Boverket is therefore expecting a rapid decline in the start of construction for tenant-owned apartments, especially for housing developers with a weak financial position. The construction of single-family houses will decrease in particular after mid-2023. See also Boverket's indicators, no. 2, December 2022 (Boverket, 2022b).

means that all buildings can be included in the same method for limit values. This creates clarity and simplicity in the system.

Finally, not introducing any kind of weighted limit values for different characteristics (which may drive climate change) of buildings is proposed. No clear differences have emerged to date in the level of climate impact, which appears to be due to different characteristics of buildings (Erlandsson, 2014, Malmqvist et al., 2023). This can include features such as storeys below ground level, balconies, energy performance and the shape of the building. Any differences based on building characteristics should be investigated in greater detail when the limit values are eventually lowered, as their percentage impact increases with lower overall value.

Considerations

The method(s) for defining limit values also need to assume opportunities to update values over time. The quality of the data and the calculations on which the declarations are based today can be expected to vary widely, as knowledge of how climate calculations are carried out is still relatively low. The number of buildings will be much larger than is possible to obtain today, even if data from the climate declaration register at Boverket contains significantly greater uncertainties than the data used in the reference value study (Malmqvist et al., 2023). Data from the climate declaration register should therefore be good enough to allow developments to be followed-up. One advantage is that the climate declarations produced will follow a much more uniform calculation method on account of the regulations on climate declarations and the guidance from Boverket. If a calculation base is requested in a standardised format in the supervision work, the data from Boverket's supervision of buildings from submitted climate declarations, will be able to form a good foundation for the future development of reference values.

One issue that was widely discussed during the study was the matter of whether slightly stricter limit values could lead to undesirable consequences in terms of the design of buildings. This was discussed at the workshops held with industry stakeholders in April 2022, but it did not emerge as a major issue in any particular respect.

The proposal made here for a limit value for the climate impact of the construction stage allows for flexibility going forward. It is also clear, for instance, that the current climate impact of building single-family houses per square metre of GFA is significantly lower than for other building types. Similarly, building types that typically have one or two storeys should not be lumped together with building types that typically have more storeys, as this is an aspect that affects the option of reducing climate impact per GFA (or net heated area, for that matter) (Malmqvist et al., 2023).

Some other options have been considered in order to deal with building types for which robust reference values are not yet available in Sweden, as well as for special unique buildings. Having a different approach to limit values that would instead result in project-specific limit values was considered in particular. This follows the management of defining reduction requirements applied by the Swedish Transport Administration in procurement procedures for infrastructure projects and the management of common certification systems such as the Swedish Miljöbyggnad and LEED. The advantage may be that this can be done regardless of the type of building, thereby avoiding the need to develop new reference values for more unusual building types. Ultimately, this principle was abandoned as it was regarded as awkward in the regulatory system and difficult for developers (and other stakeholders) to understand how to deal with having two different limit value systems. Moreover, the perception is that these unusual building types and buildings are not particularly numerous, and, furthermore, several of them may fall within one of the exemptions from providing climate declarations that already exist in the regulatory framework, so the climate benefits can be assumed to be limited. A further argument in favour of having one limit value for all building types is that this facilitates the management of mixed-use buildings.

The respondents (with a few exemptions) to the Boverket survey in connection with the hearing are in favour of the division into groups 1 and 2. Three quarters are in favour of not adjusting the limit values according to building characteristics. The concerns raised about not making adjustments for building characteristics often involve recognising that this could become a major issue with stricter limit values; that it may be difficult to achieve the limit values when there is a need for storeys below ground level and shelters for various reasons, for instance. Commercial premises – which account for a large proportion of construction – are also expected to be able to meet the proposed limit values for other building types relatively easily. These were therefore also highlighted as a priority group for which more stringent limit values should be defined.

Developments in the Nordic countries

Denmark is introducing a limit value for all buildings over 1000 m^2 in 2023, regardless of building type. It will apply to all buildings by 2025. There appears to be no discussion at the moment about differentiation by building type. Instead, it is envisaged that it will be possible to add a supplement to the limit value if a building type with certain building elements is a driver of climate change. Norway is working on developing reference values related mainly to three different types of dwellings and offices. The idea is to differentiate the limit values for different building types.

Limit value for mixed-use buildings

There needs to be a method for defining limit values for multi-purpose buildings when differentiating the limit values for different building types according to the previous section.

Proposal for 2025

- In the case of mixed-use buildings, the level of limit values is weighted per square metre GFA of the area of different features in the building.

Rationale

Many buildings have more than one function. A weighted limit value needs to be developed in order to define a limit value for these buildings. Using the area of each function for weighting means that all buildings can be covered by the limit value.

Proposed levels for limit values in 2025

In its report "Regulation on climate declarations for buildings", Boverket proposes that the limit values to apply from 2027 should be introduced at a level that is "20–30 per cent lower than a reference value obtained through a study of climate calculations for buildings". The idea was that some form of climate-improving measures would be required in order to meet the requirements. Such a study was carried out in 2020–21, calculating the climate impact of 68 new buildings. That study was updated on behalf of Boverket in 2023 (Malmqvist et al., 2023). That study is referred to below as the reference value study.

Figure 6 shows the calculated climate impact in kg CO_2e per m^2 GFA for all buildings in the reference value study, according to the proposed system boundary for limit values. The calculations are performed using typical climate data (not conservative climate data) from Boverket's climate database. A number of different reference levels are plotted in the figure for each building type in the study. Black corresponds to the 75th percentile, below which 75 per cent of the buildings studied can be found within each building type. Boverket assess that this value should be the "reference value" referred to in the report "Regulation on climate declarations for buildings" (Boverket, 2020). Red represents the median value. This is the value of the building with the middle value within each building type. Dark blue represents 20 per cent and light blue represents 30 per cent better than the 75th percentile. That is to say, 20 and 30 per cent better than the reference value plot referred to by Boverket in the report "Regulation on climate declarations for buildings". The approximate level for limit values would thus be somewhere between the dark blue and light blue levels in 2027, according to Boverket's report "Regulation on climate declarations for buildings".

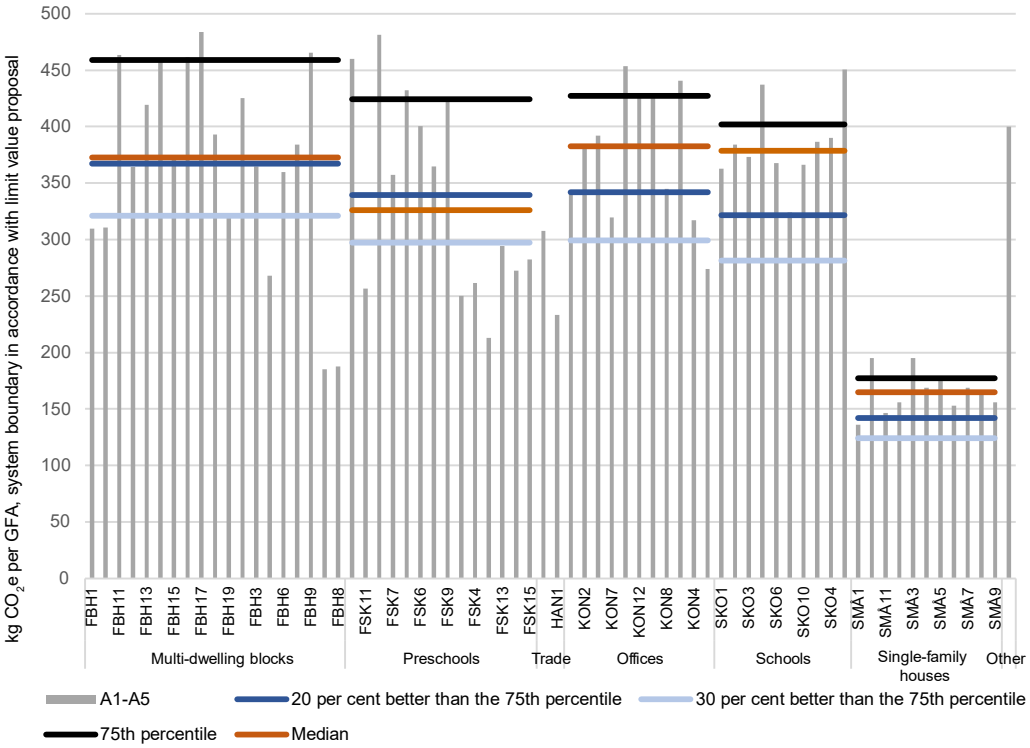

Figure 6. Different reference levels based on the reference value study (Malmqvist et al., 2023), according to the system boundary proposed for limit values and calculated using typical generic climate data.

Proposal for 2025

Limit values will be introduced in 2025 as follows:

Group 1: Relatively homogeneous building types where robust reference values exist. This group includes single-family houses, multi-dwelling blocks, office buildings, education excluding preschools, preschools and special housing. A limit value corresponding to the median level of the building type reference value will be introduced for this group (excluding single-family houses). For single-family houses, a limit value corresponding to the 75th percentile of the building type reference value in the reference value study (Malmqvist et al., 2023) will be introduced instead.

Group 2: Other buildings where no robust reference values are available. A common limit value will be introduced for this group, corresponding to the 75th percentile of the reference value for multi-dwelling blocks in the reference value study.

Levels for limit values, rounded to the nearest five, result in the levels shown in Table 4.

Table 4. Limit values, rounded to the nearest five, for the climate impact of buildings for different building types as proposed above.

	Building type	Limit value (kg CO_2e per m^2 GFA)
Group 1	Multi-dwelling blocks	375
	Offices	385
	Education excluding preschools	380
	Preschool	330
	Single-family houses	180
	Special housing	385
Group 2	Other buildings	460

Rationale

In its report “Regulation on climate declarations for buildings” (Boverket, 2020), Boverket proposes that when limit values are introduced, measures will be required to have been implemented in order to achieve the limit value. Admittedly, introduction of limit values two years earlier than in the Boverket report is proposed here. However, the introduction level proposed here involves a gentler level than the level in Boverket’s report in Figure 5 for all building types except preschools. The reference values produced are based on quantities and products from actual new construction projects built around 2020, and on climate data reflecting what was used in Sweden around 2020. A limit value that reflects the median within the building type would mean in theory that half of the new construction projects would need to implement measures to reduce their climate impact if there are no developments in construction technology

and the climate impact of materials for other reasons. This is far from being the case, however, as discussed below.

We were able to perceive relatively rapid development back in 2022 in terms of the climate impact of construction products and project design and production for a reduced climate impact. That is why it is likely that even without limit values in 2025, a significantly larger proportion of construction projects will have a climate impact that is lower than the proposed limit values. Therefore, the proposed level of ambition cannot be assumed to contribute to a major climate reduction, but is dependent on reduction relatively soon. Hence it is deemed better for the industry to have an initial level that does not require excessive reduction measures, but where the direction for the next reduction is clear. This will then give the industry plenty of time to develop working methods for the use of climate calculations at an early stage so as to ensure that the limit value can be achieved, and also to drive learning about how reduction measures can be implemented for different building systems. This will also ensure a market for products with a lower climate impact.

Various interim studies have been carried out in order to provide a sound basis for the proposal for limit values for 2025. Five main issues have been analysed in detail:

- What is the likely evolution of climate impact for some key construction products, according to manufacturers?
- What climate impact trends can we expect across the construction industry, based on actions across the value chain?
- What potential is there in individual construction projects to reduce climate impact?
- What climate targets do construction enterprises have?
- What level of limit values can the most cost-sensitive stakeholders in the construction industry tolerate?

The following sections present the findings and conclusions of the interim studies.

What is the likely evolution of climate impact for some key construction products, according to manufacturers?

A number of industry organisations and major construction product manufacturers were asked in May 2022, via the association for Swedish construction materials enterprises (Byggmaterialindustrierna), what they think about the evolution of construction products with climate reductions, and what uncertainties there were. The estimates made are summarised in Figure 7.

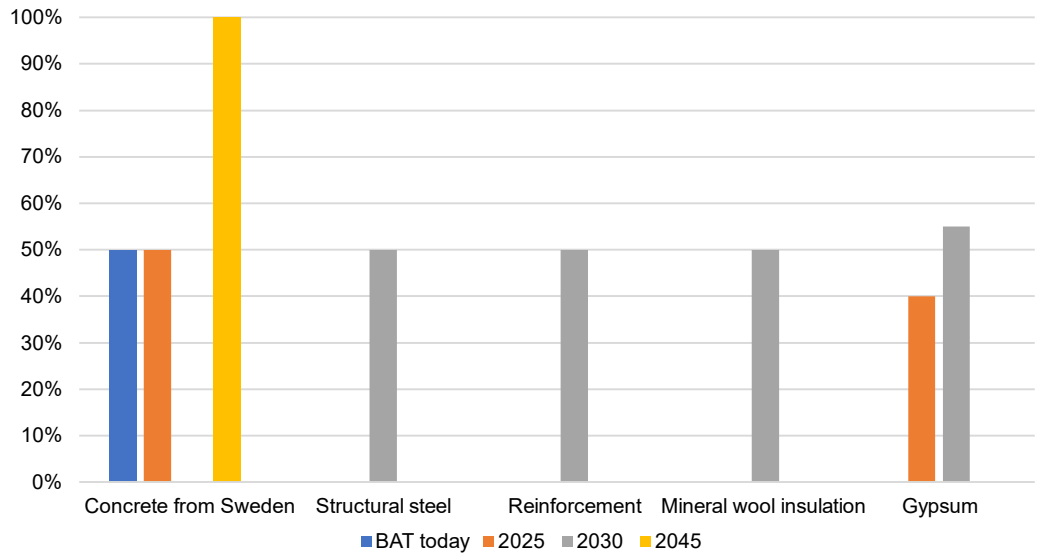

Figure 7. Manufacturers' estimates of the potential reduction for key materials in the value chain. BAT = Best Available Technology.

To summarise, most are of the opinion that it is possible to reduce the climate impact of their products by around 50 per cent by 2030 by means of better production processes and better optimisation of materials in individual construction projects. The figure shows that halving of the climate impact of these materials is expected by 2030. See Annex 4 for more details.

What climate impact trends can we expect across the construction industry, based on actions across the value chain?

Potential emission reductions have been studied for various sectors, including the construction sector, as part of the major ongoing research programme known as Mistra Carbon Exit. KTH Royal Institute of Technology[42] has developed slightly adapted and updated scenarios of relevance to the initial level of the limit values in discussion with doctoral student Ida Karlsson at Chalmers University of Technology (see Annex 4). The most likely one of a number of scenarios for the climate impact of the construction sector has been selected. This scenario shows the reduction in climate impact of all new construction of buildings in Sweden for different years compared to the 2020 level. Two alternative scenarios have been devised for 2030; one where CCS is assumed to have been introduced for cement, and one without CCS. Figure 8 shows the scenario without CCS (given that there are still uncertainties concerning its development), where the potential reduction is estimated at just below 50 per cent by 2030, compared to 2020 levels. This potential includes measures

[42] As part of the assignment from Boverket to provide data for the government assignment on limit values for buildings in 2022.

across the entire value chain, from the project design of buildings and the manufacture of construction products, to construction. Total construction emissions are the sum of emissions from building materials, and emissions from transport and construction equipment/material transport.

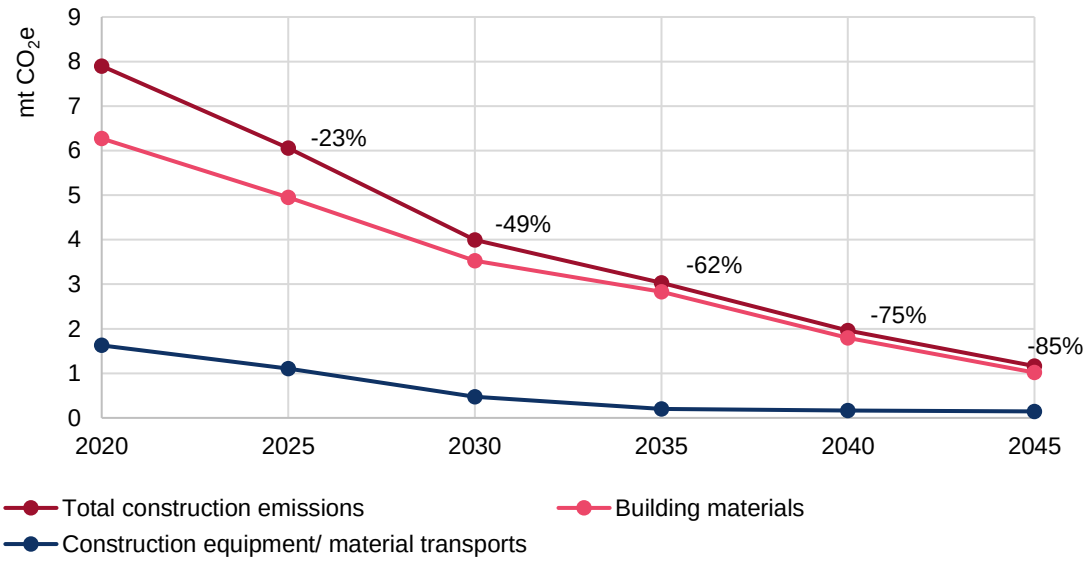

Figure 8. The anticipated evolution of climate impact of construction in Sweden. Scenario without CCS for cement. Source: Ida Karlsson, Chalmers University of Technology and (Karlsson et al., 2020).

What potential is there in individual construction projects to reduce climate impact?

An estimate has been made of the potential for climate impact reduction for individual building projects, based on a building system with a concrete frame cast in situ and lightweight curtain walls (see Annex 4 for more details). The best available technology (BAT) in 2020 is estimated to be 40 per cent lower than the reference level for this type of building system applied to multi-dwelling blocks, and 52 per cent lower by 2025. It is estimated that this type of building can be built with 77 per cent lower emissions for 2030 (in the scenario with CCS for cement), and 56 per cent lower (in the scenario without CCS), compared to 2020 levels.

The aim of introducing limit values is to force construction projects with high climate impact to take action to meet the requirements. This involves purchasing climate-improved concrete, for example. The feasibility of this measure requires sufficient availability of climate-improved concrete. That is why it is interesting to look at both the national scenarios and the potential of the individual project in order to analyse what will be possible to achieve for the share of construction projects that are forced to take action. This is particularly interesting when it comes to measures linked to the purchase of climate-improved materials. Measures such as lean design solutions, for example, are not reliant on a sufficient quantity of climate-improved products.

What climate targets do construction enterprises have?

In April 2022, 30 stakeholders in the construction sector were asked (of which 17 responded) about their organisations' climate impact targets for new construction of buildings. Figure 9 below shows climate targets for stakeholders building multi-dwelling blocks. This figure shows how the proposed limit value level for 2025 is higher than the climate targets defined by the various organisations to apply from 2025. That said, these are merely objectives, and the organisations were selected because of their previous known work in the climate field. This means there is likely to be bias in the selection of organisations with high climate ambitions. However, the organisations selected are large in many instances, and they can be assumed to represent a significant proportion of new construction in Sweden. Many of them are also publicly owned. Public housing enterprises are one example currently representing typical new construction in Sweden. The levels are adjusted so that they are comparable to the proposals in Table 4 for a limit value for 2025.

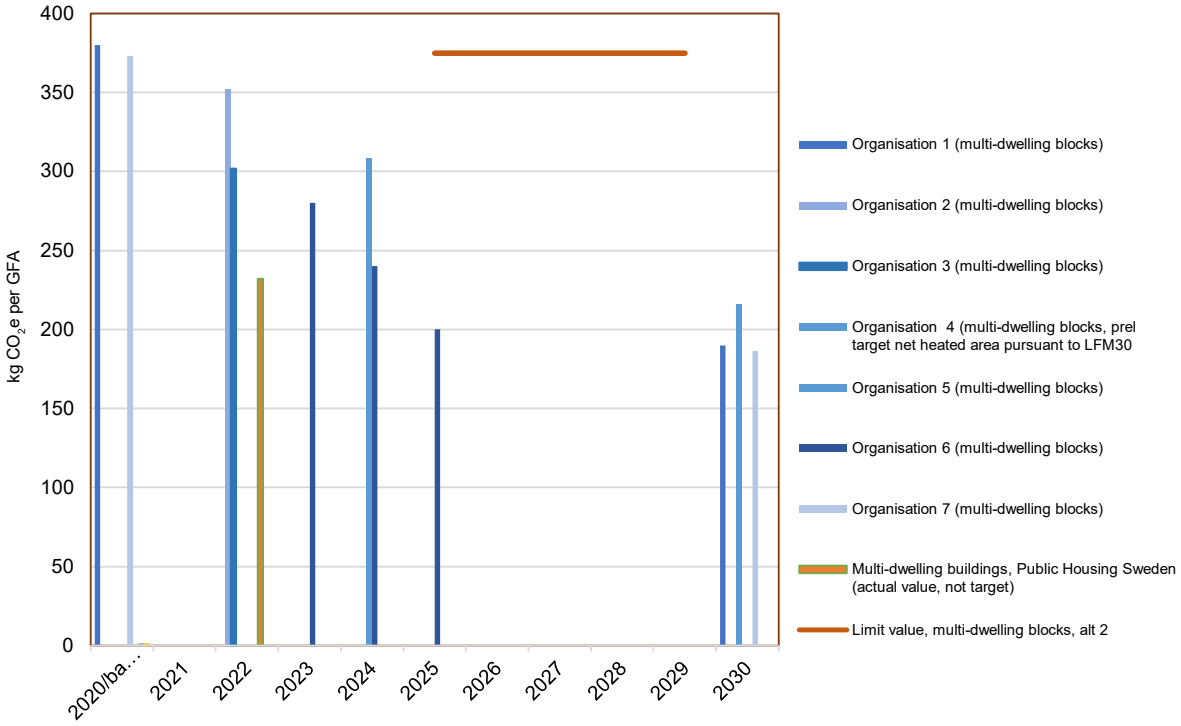

Figure 9. Examples of climate targets for new construction among developers of building multi-dwelling blocks today. 2020 is the baseline year.

Only five of the organisations that have adopted a climate target have performed any kind of economic analysis of it, several of which are very comprehensive. Several respondents point out that it is difficult to identify the potential additional costs of meeting climate targets, as the fluctuation in material prices is much greater in the prevailing market situation. Two organisations point out that there may be additional costs for project redesign if the issue is introduced late on in the process. One organisation is of the opinion that a 10–15 per cent reduction will not involve

significant additional costs compared to how they build at present, but that things may be more expensive later on. One organisation is of the opinion that there may be an initial reduction in costs due to reduced waste, but that costs may increase with larger reductions. One organisation has analysed the fact that the materials with low climate impact are likely to decrease in price, while the price may increase for those with greater climate impact.

The organisations that responded include those that want to be market leaders. However, a climate requirement is also imposed by enterprises in the public housing sector, which are often under financial pressure, and whose assignments often include building as cheaply as possible so that everyone can afford to have a place to live. Therefore, the parties that define climate targets do not expect buildings with lower climate impact to be costly, but rather a way of securing the future value of the property. There are climate criteria in some of the sustainability certifications on the Swedish market. These are formulated in different ways, but the trend is clear. It involves moving from information requirements, to requirements to include climate performance targets as an improvement within the individual project. Many sustainability requirements are defined via sustainability certifications. The Sweden Green Building Council (SGBC), which administers most of the certifications, provides statistics on the number of certified new construction projects. There were about 500 per year (both preliminary certifications and verifications), the majority of which were multi-dwelling blocks with Miljöbyggnad certification.[43] Compare this to the number of building permits granted; just under 10.000 in 2021.[44]

What level of limit values can the most cost-sensitive stakeholders in the construction industry tolerate?

The developers that are part of the public housing sector are often highlighted by developers as being the most cost-sensitive stakeholders. Public Housing Sweden (Sveriges Allmännytta) (Ulaner, 2022) was therefore asked how the organisation's members – primarily municipally owned enterprises that rent out housing – would be affected by a limit value in respect of climate impact. The most cost-effective multi-dwelling blocks are Allmännyttan kombohus,[45] i.e framework-procured multi-dwelling blocks. There are framework agreements for up to 25,000 new homes in a new generation of Kombohus (multi-dwelling buildings), tower blocks and slab blocks from three different suppliers. These buildings can be

[43] https://www.sgbc.se/statistik/. Downloaded on 2 May 2023.
[44] Boende, byggande och bebyggelse (scb.se). Downloaded on 2 May 2023.
[45] https://www.sverigesallmannytta.se/nyproduktion/allmannyttans-kombohus/. Downloaded on 2 May 2023.

constructed flexibly, with a wide range of looks in terms of height, width, colour and shape.

Figure 8 (above) shows the climate impact of the Kombohus blocks in orange, from the supplier who builds using concrete frames. It can be concluded that these meet the proposed level for a limit value for 2025 by a good margin. It can therefore be concluded that it is possible to build cost-effectively even now, with a significantly lower climate impact than the proposed limit value. Note also that the level in Figure 8 relates to whether the building is constructed today. There will also be developments up to 2025.

Small businesses are another group deemed to be cost-sensitive. It is not thought that the levels proposed here as limit values for 2025 will be difficult for smaller developers and contractors to achieve. Rather, the additional administration that the regulations entail may present an obstacle for this group. They are already affected by most of this, on account of the regulatory framework as it stands from 2022 onwards.

Consequences of limit values with typical data, and a climate declaration with conservative data

The limit value level for 2025 is based on the reference value study (Malmqvist et al., 2023) where typical climate data from Boverket's climate database was used for the calculation. It will be slightly more difficult to achieve the limit value in 2025 if a developer chooses to base the climate declaration solely on generic (conservative) climate data, when Boverket intends to go on demanding the use of such climate data in the climate declaration. An illustration of what this involves is shown by recalculating the buildings in the reference value study using only generic, conservative climate data and comparing them to the proposed limit value levels (see Figure 10).

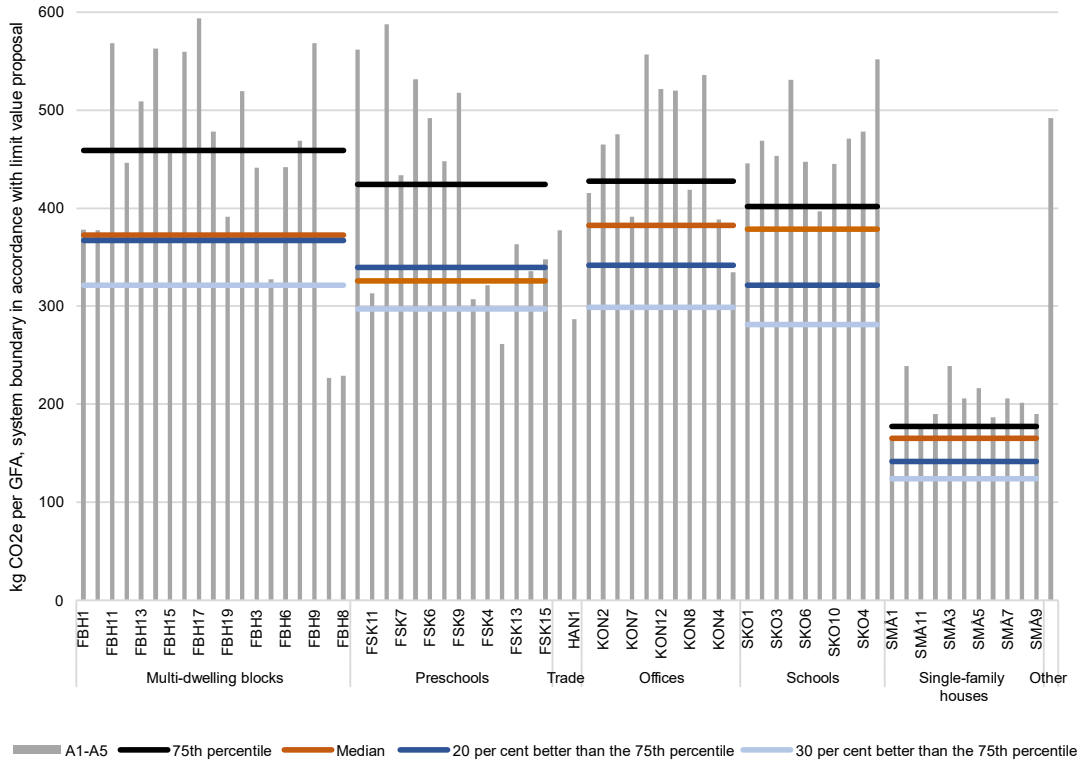

Figure 10. Different reference levels based on the reference value study (Malmqvist et al., 2023), according to the system boundary proposed for limit values. The climate impact is calculated using only conservative generic data.

Figure 10 shows that fewer buildings in the reference value study would have met the limit value level when they were erected if the developers had chosen to base their climate calculations solely on generic (conservative) data. The buildings that would have met the limit value are mainly – but not exclusively – those where timber is the dominant frame material. For instance, some multi-dwelling blocks with concrete frames would also have met the limit values, even if they had only used conservative climate data in the climate calculation. These buildings are constructed using concrete cast in situ. However, it is reported that at least one of these has been optimised slightly in terms of concrete use. So this involves fairly lean structures and the right concrete in the right place, not the use of what is known as climate-improved concrete.

The starting point in the study has always been that some form of measures must be required in buildings with high climate impact, as limit values are introduced in order to steer towards reduced climate impact. Two examples of measures are provided below, which involve switching to better products from a climate standpoint. Note, however, that improvements are also expected throughout the value chain in general, and that other measures are also available. This may involve changing building materials or aiming for a leaner structure, as already referred to above.

Figure 11 shows that simply replacing data with EPD data is not sufficient for most of the buildings in their climate calculation as regards the major material groups of concrete, structural steel, insulation and gypsum.

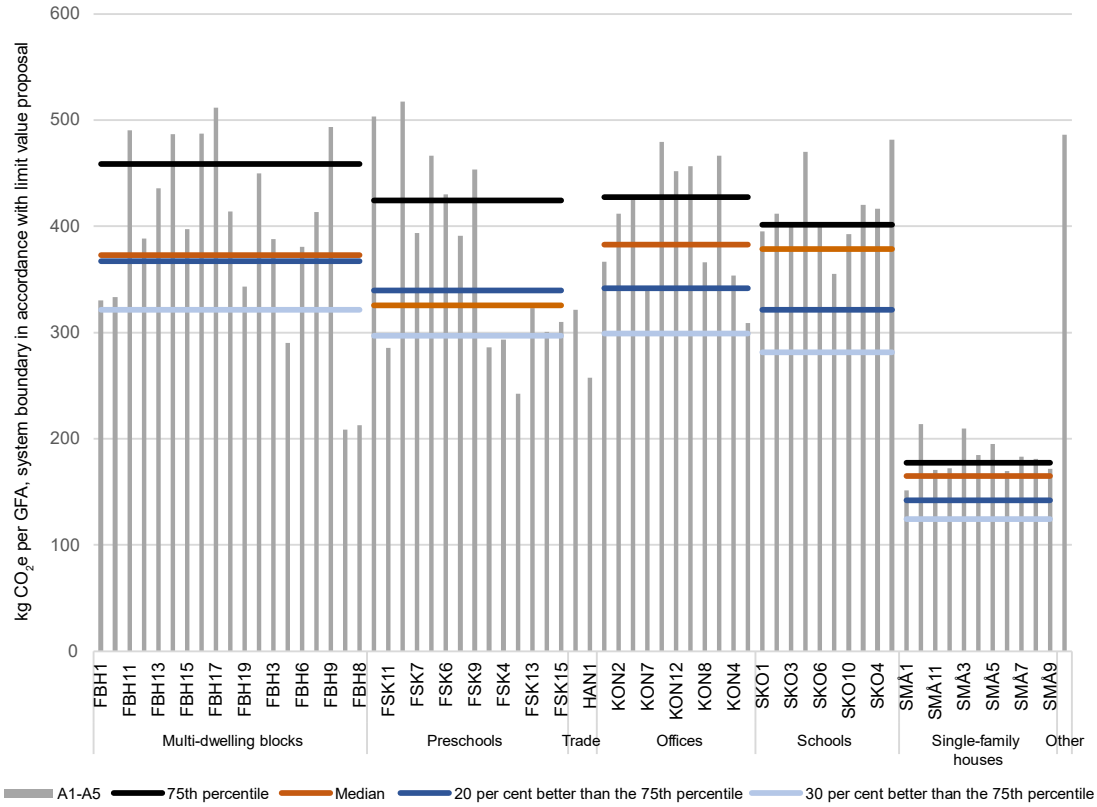

Figure 11. Climate impact for the buildings in the reference value study (Malmqvist et al., 2023), calculated using conservative generic data. Concrete, structural steel, reinforcement, insulation and gypsum are excluded. For these, typical data is used instead (to represent a switch to specific EPD data). The orange line shows the proposed limit value for each building type (except for single-family houses). The black line indicates the proposed limit value for single-family houses for 2025.

Figure 12 reflects the same calculation as Figure 11. Here, however, the calculations have also used climate-improved concrete. Figure 11 thus reflects both an important measure for buildings with a high proportion of concrete (switching to climate-improved concrete) and the outcome if manufacturers of single-family houses use specific data for materials with high climate impact for this building type in their calculation (i.e. insulation and gypsum). The calculation then reveals that a high proportion of buildings (regardless of building type) can reach the limit values with this one measure.

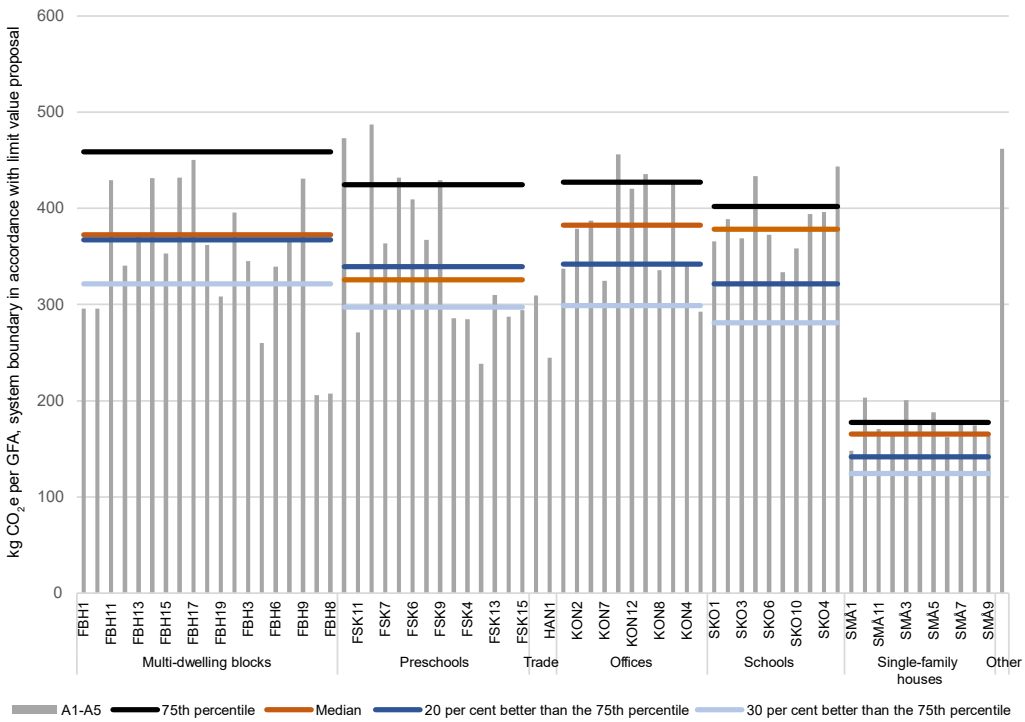

Figure 12. Climate impact for the buildings in the reference value study (Malmqvist et al., 2023), calculated using conservative data; but not for concrete where climate-improved concrete has been used. And typical data has been used for structural steel, gypsum and insulation (to represent the replacement of generic data with specific EPD data). The orange line shows the proposed limit value for each building type (except for single-family houses). The black line indicates the proposed limit value for single-family houses for 2025.

In summary, Boverket's approach (Boverket, 2020) was to hold off with limit values. However, action would be required when they were introduced. However, introducing a limit value two years earlier than the one in the report is proposed here. That said, the review above shows the rapid development, the fact that it is possible to achieve limit values with existing construction products on the market.

The building types included in Group 1 are expected to represent a large proportion of new construction in Sweden going forward. At Boverket's hearing held with the construction industry in August 2022, half of the respondents to the Boverket survey said they would have liked to see stricter requirements than the proposed levels for limit values. It can be noted that many calculations result in a significantly lower level of climate impact even now (such as Kombohus buildings), compared to the proposed limit value levels. There are fewer remaining buildings. This investigation has not seen any indication that the types of buildings that are not already exempt from the requirement for a climate declaration would have a significantly higher climate impact (see the section entitled "Supplementary reference values on the climate impact of buildings"). However, as things stand at present, it is reasonable to add a "safety margin" in the absence of robust reference values, until better knowledge is

available. The proposal to select the 75th percentile of the reference value study's multi-dwelling blocks is reasonable, therefore, as this is the building type in the study with the highest 75th percentile. Finally, the reference value study shows that single-family houses are already climate-optimised, to some extent. For this reason, setting the 75th percentile as a limit value from 2025 for this building type instead is proposed.

Considerations

The easiest way to meet the limit value level is probably to demand climate-improved construction products, particularly in the case of concrete. Whether there will be sufficient quantities of climate-improved concrete if the market begins to demand it in order to meet the limit values to a greater extent is an important question. Such construction products are already available, but it is unclear how much demand there is. However, this is not the only measure for reducing climate impact, as highlighted earlier in this section. Developers at the forefront have already started to better optimise and streamline structures, which is resulting in significant climate savings. This involves using customised concrete recipes depending on the location in the structure where the product is to be used, and also economising on the amount of materials used. There is currently a clear and predictable market for products with less climate impact. Moreover, the industry stakeholders consulted are perceiving a likely rapid transition, as discussed earlier in this section (see also Annex 4).

Another important question is whether the climate-improved construction products on the market have EPDs which the developer can use to verify whether climate-improved construction products have indeed been used. Boverket assess that conservative data in Boverket's climate database has helped to ensure that more construction product manufacturers have produced EPDs for their products. The proposed limit value levels for 2025 are defined so that they will be able to stimulate the continued development of EPDs. This is true for the major material groups, at least. Concrete manufacturers can produce specific climate data relatively cost-effectively using the EPD tool developed by Svensk Betong, among other options. 50 per cent of a building's climate impact can already be based on specific climate data, according to an assessment performed as part of this assignment.

Defining different limit values for single-family houses than for other Group 1 building types is proposed. This means that the 75th percentile will be set as an initial level. After consideration, the median level for single-family houses was deemed to be too strict for a limit value; not least because Boverket intends to go on requiring the use of conservative generic climate data in climate declarations unless specific climate data is used. Moreover, single-family houses are already more climate-optimised than other building types. At present, single-family houses are usually built as one or two-storey buildings. Furthermore, it is generally easier to

reach the limit value for a two-storey building as the foundation slab (which usually drives climate impact in single-family houses) can be spread over twice the gross floor area of a two-storey building compared to a one-storey building. The proposed level of limit values for 2025 corresponds to a single-storey building in the reference value study. This proposal means that more measures to reduce climate impact will be required if a developer wishes to build single-family houses in concrete or brick. However, these are few buildings. There were 45 building permits granted for stone buildings in Sweden in the first half of 2022 (out of about 1800 single-family houses in total).[46] Some of these are likely to be exempt from a climate declaration due to the fact that the developers are private individuals.

Some level of comment on the limit value level for preschools is also made. Preschools were the building type in the reference value study that demonstrated the greatest variation in dominant framing materials. The overall selection of buildings in this group also effectively represents the group of preschools in current construction in Sweden, in relation to a dominant frame type (Byggfakta, 2020). The proposed limit value for this group is halfway between the level for preschools with a timber frame type, and those with a steel and concrete frame type. Hence there are many examples of preschools that are already being built to meet the limit value by a good margin, as well as examples of preschools built from concrete and steel that would currently need to implement a few more measures. Again, this may also be particularly true of preschools built as single-storey buildings.

A limit value limited to modules A1–A5 has been a starting point in the study. Calculating the entire life cycle is often used as an argument against suboptimisation and solutions that will cost more in terms of climate impact in the later part of the life cycle. Developments in Sweden in recent years, with regulations on climate declarations, have culminated in greater insight into the difficulties with defining limit values for the entire life cycle that cannot be verified. Stages B and C (and D) need to be based on fixed scenarios, which means that smart solutions are not evident in the calculation. Annex 2 discusses concerns about conflicting objectives when defining limit values only for modules A1–A5 in more detail.

A number of different options for the starting level have been discussed as part of the study; at the workshops that took place in April 2022, for example. This emphasised that simple measures can be implemented to reduce these levels. According to the discussions, rapid introduction of limit values was the most important aspect.

[46] TMF market statistics, based on data from Byggfakta. September 2022.

Finally, it is worth noting that more and more stakeholders that constructing multi-dwelling blocks have started to define climate performance targets and perform climate calculations during the course of this assignment in 2022. It can be noted that many calculations result in a significantly lower level of climate impact even now (such as Kombohus buildings), compared to the proposed levels for limit values. This, too, was an issue specifically raised at the August 2022 hearing. About half of the respondents to Boverket's survey believe that the limit values should be stricter than the limit values proposed. A slightly lower percentage feel that the proposed levels are reasonable, while just under a tenth think the levels are too strict. Several respondents emphasise the need for a clear roadmap going forward, even after 2025.

Developments in the Nordic countries

In 2023, Denmark introduced a limit value of 12 kg CO_2e per m^2 per year for buildings more than 1000 m^2 in area. This limit value is defined so that it is 10 per cent better than the building with the greatest climate impact in their reference value study (Zimmermann et al., 2020). Denmark also has a voluntary "sustainability class" set at 8 kg CO_2e per m^2 per year. At the time of the next change in the regulations in 2025, all buildings are expected to be subject to a limit value which will be lower than the 12 kg CO_2e per m^2 per year. There are no proposals as yet for levels for limit values in Finland and Norway.

It is still difficult to compare reference values between countries as the system boundaries differ. The Danish limit value covers several parts of the life cycle, and is in the order of half the value attributable to modules A1–A3. In that case, this would not diverge all that much from the Swedish proposal for a value for 2025 when modules A4 and A5 are added, which are not included in Denmark's system boundary. The comparison is further complicated by the fact that the reference values also have different area units. Attempts are being made in Denmark, Finland and Sweden to compare reference values (Nygaard Rasmussen et al., n.d.), and Sweden's values are generally slightly higher than those of the other two countries. It is not clear why.

Climate declaration of a building's entire life cycle from 2027

In its 2020 report (Boverket, 2020), Boverket proposes expansion of the climate declaration itself to include additional information modules, as well as introducing limit values. That is why there are proposals for an "expanded climate declaration" in this report to cover the entire life cycle.

System boundary for the expanded climate declaration

Boverket's report containing proposals on the development of regulations for climate declarations (Boverket, 2020) proposes expansion of the reporting of climate impact in a life cycle perspective by 2027, to include the following life cycle modules: maintenance (B2) replacement (B4) and operational energy at the **use stage** (B6) and de-construction, demolition (C1) transport (C2) waste processing (C3) and disposal (C4) at the **end-of-life stage**.

Proposal for 2027

- The climate declaration for buildings at the time of their erection is expanded from 2027 to include the entire life cycle pursuant to EN15978, with a reference study period of 50 years.
- Modules A1–A5, B2, B4, B6 and C1–C4 are proposed for inclusion in the climate declaration. However, the final formulation of the regulations needs to be aligned with regulations adopted by the EU. This applies mainly to the revised Energy Performance of Buildings Directive (EPBD), which had not been adopted at the time of the reporting of this assignment by Boverket.
- The building elements to be included in the expanded climate declaration from 2027 are the same as those included in the proposed regulations for 2025 in this report.
- Groundworks and ground improvements must be described in a climate declaration. Default values for climate impact may be used for these elements.

Rationale

The starting point in this investigation was that Boverket's previous proposal from 2020 for an expanded climate declaration should be retained, as these modules are viewed as most relevant for inclusion. It is deemed appropriate to introduce the expanded climate declaration at a later date

than the limit value, due to the ongoing development of regulations in the EU on reporting the climate impact of buildings through revision of the Energy Performance of Buildings Directive (EPBD). The aim of this is to potentially adapt the regulations on the expanded climate declaration to the EU regulations adopted. Otherwise, there is a risk that the regulations will have to be amended again shortly after they come into force. Introducing the regulations is proposed for 2027, the same year in which entry into force of the revised Energy Performance of Buildings Directive is proposed. More information on this can be found in the section entitled "Energy Performance of Buildings Directive (EPBD)".

For the time being, additional modules can be handled using simple default values developed by Boverket. The main reason for requiring a declaration of more life cycle modules and life cycle stages is that this will provide greater harmonisation with the ongoing Nordic and European initiatives, along with the fact that several referral bodies for Boverket's report "Regulation on climate declarations for buildings" perceived this as important. This will require further development of skills among those performing calculations. However, some stakeholders have already addressed the issue through the use of various certification systems that already require declaration of more parts of the life cycle. It should be relatively easy to integrate these elements into the calculation tools used in Sweden, as the proposal is that Boverket should provide scenario data for stages B and C. Stages B and C are always scenario-based, and hence can never be verified. One way to steer the scenario assumptions that need to be made is that they should follow the same basic principles and provide default values, energy scenarios, material recycling scenarios, etc.

It can be noted that there is an increased willingness to simplify the regulations in work on the regulations on climate declarations both in Sweden and abroad, as the LCA methodology is to be incorporated into national regulations. There is also a desire to steer towards reducing current emissions. This is in line with the Swedish regulations. However, adaptation may be necessary in view of the ongoing revision of the Energy Performance of Buildings Directive (EPBD); that is to say, which life cycle modules and construction products are to be included in the declaration, and how these are to be handled in the calculation of climate impact on the basis of EU regulations. The proposal for a 50-year calculation period may need to be adjusted in a similar manner. However, 50 years is the currently applicable period in Level(s), and this is the most common reference study period used in a similar calculation methodology on an international level (Lützkendorf & Balouktsi, n.d.).

Addition of groundworks and ground improvements is proposed when introducing an expanded climate declaration, in addition to the building elements that are already to be calculated from 2025. It is thought that there is now considerable support for adding this in an expanded climate

declaration (but not to the limit value), as interest in climate calculations is growing and their development has been rapid. A number of studies show that the climate impact of this element can be significant, particularly in the case of ground conditions requiring soil stabilisation such as piling. Incentives could be created for implementation of reduction measures by defining requirements for the climate declaration for this part. See also the section entitled “Climate declaration of groundworks and ground improvement” for more detailed reasoning and handling of the climate declaration of groundworks and ground improvements.

About three quarters of respondents to Boverket’s survey are of the opinion that the additional life cycle modules are appropriate. Several respondents emphasise a desire to include the entire life cycle, including module D. Some highlight the risk of always choosing to use default values for this building element when ground conditions are difficult.

Figure 13 summarises the proposed system boundary for the expanded climate declaration from 2027, and how it relates to the system boundary for the limit value.

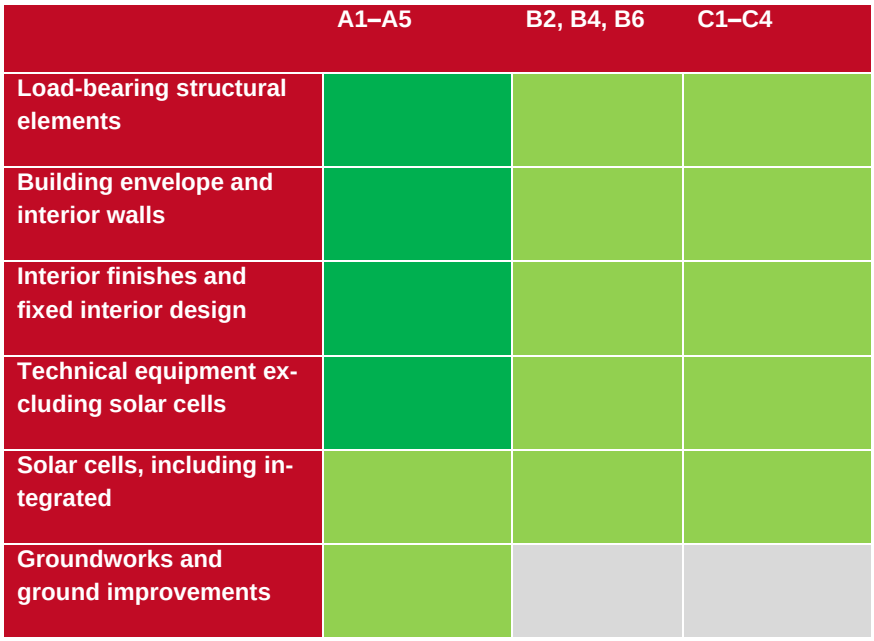

Figure 13. System boundary for an expanded climate declaration from 2027 and how it differs from the system boundary for the limit value. The climate declaration includes the climate impact of all green fields. The limit value includes the climate impact from the dark green fields.

Considerations

This involves increased complexity of the regulatory framework, with an expanded climate declaration as proposed above. One issue that may be difficult to communicate is that the calculation of climate impact for modules A1–A5 needs to be split. This is because groundworks, ground improvements and solar cells have to be included in the declaration, but not in the limit value. The alternative would be to exclude these elements from the expanded climate declaration in order to facilitate understanding

and to reduce the complexity of the regulatory framework. This was put forward as a proposal at Boverket's hearing in August 2022, to entirely exclude construction products for local energy production from the declaration. One argument in favour of this would be to focus on the climate impact of a building in the regulatory framework, and not its energy system. However, many stakeholders at the hearing expressed a desire for the climate declaration to include this, and that all types of solar cells (i.e. both loose and integrated) should be treated equally in the climate declaration. This has therefore been included in the final proposal.

Developments in the Nordic countries

Both Finland and Denmark include roughly the same system boundary as that proposed here for building elements in general, while Norway is investigating in greater detail whether or not to include technical equipment. Denmark and Finland have the same system boundary for limit values as climate declaration. Finland and Denmark also include module D in the declaration. Finland's declaration covers the most life cycle modules: A1–A5, B3–B4 and C1–C4. In Norway, calculation of modules A1–A4, A5 construction product waste, B2 and B4 is required for the building elements pile foundation, slab foundation, load-bearing structural elements, exterior walls, interior walls, claddings and roofs, while technical equipment and fittings are not included. Fossil fuel heating of new buildings has been banned in Norway since 2016, and the use of fossil oil for heating existing buildings has been prohibited since 2020. The use of fossil oil for heating and drying on construction sites was also banned in 2022.

Climate declaration of groundworks and ground improvement

This issue has been investigated by Boverket on a number of occasions (Boverket, 2018, 2020), considering whether groundworks and materials for ground improvement should be included in a climate declaration. In its latest study, Boverket recommended further investigation of the issue in order to determine whether a reduction in climate impact of groundworks would be managed best in the planning process or the construction process.

The municipality's comprehensive plan should already include the basic principles concerning the intended use of land and water areas. The binding regulation of land and water use and the built environment is implemented by means of detailed development plans where the suitability of the land for development is assessed. The planning process must take into account environmental and climate aspects in accordance with the PBL, as well as intermunicipal and regional conditions, and it must promote long-term efficient management of land, water, energy and raw materials

and good environmental conditions in general[47]. This means that the built environment structure has to be developed within the framework of society's environmental and climate aspects. Starting points are provided during the planning process to discuss matters such as how buildings are to be sited, or how undeveloped areas can be developed to help make future reductions in greenhouse gas emissions. This is why decisions made during the planning process have a major impact on the climate impact of groundworks and ground improvement measures when buildings are erected, for instance. It is also important to take into account existing values beyond those stated in the PBL, such as existing carbon storage on land in trees and green areas.

In its project planning, the developer needs to relate to and make decisions on the basis of criteria such as the conditions that apply according to the detailed development plan in terms of the choice of products, materials and foundation methods, as well as other project planning choices that may involve more or less climate impact in respect of groundworks and ground improvement measures. To some extent, the developer can make a difference in the climate impact of factors such as ground improvement by actively choosing a geotechnical structure with less climate impact, for example.

Proposal for 2027

- A requirement will be introduced in 2027 for a climate declaration for groundworks and ground improvement in connection with the erection of buildings. This will then become part of the expanded climate declaration.
- The climate impact of groundworks and ground improvement is reported separately in the climate declaration.
- Default values from Boverket's climate database or project-specific data may be used to calculate the climate impact of groundworks and ground improvement.
- The term "groundworks and ground improvement" refers to soil stabilisation measures, capillary breaking layers and drainage on the site where the building is to be erected up to insulation under the foundation, including measures two metres outside the building's façade. Measures that relate to connection of media up to insulation on the ground are not included. Inclusion of all resources (energy and materials) within this system boundary is proposed.

[47] Chapter 2, Section 3 of the Planning and Building Act (2010:900).

- Activities that may be performed during groundworks and ground improvements are: basic excavation, subgrade preparation with crushed rock, piling, soil stabilisation, sheet piling, remediation measures and removal of contaminated soil (not off-site remediation), grading, paved surfaces, blasting and felling of trees.

Rationale

It is deemed possible to introduce requirements from 2027 that also involve inclusion of the climate impact of groundworks and ground improvement in the climate declaration. It has been pointed out in a number of consultation responses to Boverket's report, "Regulation on climate declarations for buildings" (Boverket, 2020) that this part should also be included in the regulations on climate declarations for buildings, as there is potential for improvements that are not insignificant from a climate standpoint. Requiring submission of a climate declaration for this part as well will allow knowledge about improvement work to begin to be built up among stakeholders in the construction sector other than those currently affected by the regulatory framework. This applies to land developers, for example. There are situations in which the climate impact of groundworks and ground improvement measures is significant, as referred to in the section entitled "Climate impact of groundworks and ground improvement activities". It is therefore deemed important to also include this element in the regulations on climate declarations for buildings so as to accelerate development in the industry.

However, no requirement for a limit value that includes groundworks and ground improvement is proposed. This is because the climate impact of these parts may vary greatly depending on ground conditions. This may mean that weighted limit values need to be devised for different ground conditions, or that it may be difficult to erect a building for certain ground conditions without exceeding the limit values. Furthermore, the follow-up of the limit values may be too complicated, taking into account the different conditions that may exist in individual cases. The actual declaration for groundworks and ground improvement activities needs to be reported separately from the other building elements, as these components are merely declared and not included in the limit value. However, a separate report may be a better way of highlighting the climate impact of these elements, thereby initiating discussions on potential improvements.

A declaration of the climate impact of groundworks is submitted at the same time, prior to final clearance, and in the same declaration as other parts of the building. According to the assessment, the easiest way to do this is to communicate that "groundworks and ground improvements" are to be reported separately from other building elements. The climate impact associated with stages B and C are less relevant for this building

element. This is why stages B and C are set to zero, which facilitates the declaration.

According to Boverket's proposal, the system boundary for groundworks and ground improvements must be two metres outside the building's façade. Inclusion of all resources (energy and materials) for the building's foundation and drainage within this system boundary is proposed, except for media connections such as district heating, water and sewage, electricity and data: see Figure 14 below. The activities that may be performed during groundworks and ground improvements are: basic excavation, subgrade preparation with crushed rock, piling, soil stabilisation, sheet piling, remediation measures and removal of contaminated soil (not off-site remediation), grading, paved surfaces, planting of vegetation, blasting and felling of trees. All resource flows with climate impact are included in the boundary, from the start of soil preparation for a construction project. This system boundary lays the foundation for a potential future limit value.

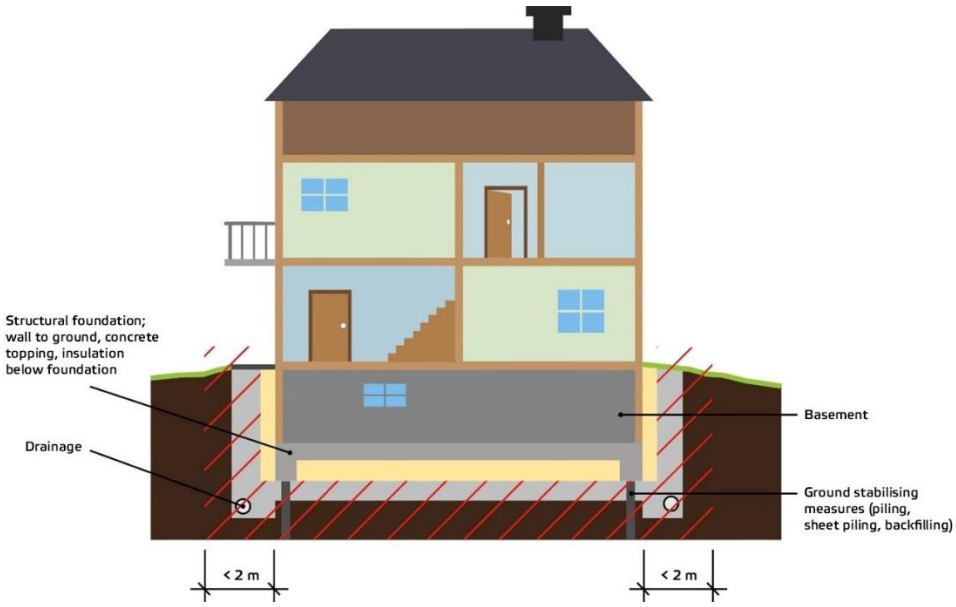

Figure 14. The term **groundworks and ground improvements** refers to soil stabilisation measures, capillary breaking layers and drainage on the site where the building is to be erected up to insulation under the foundation, including measures two metres outside the building's façade. The red dashed area marks this boundary. Measures that relate to connection of media up to insulation on the ground are not included.

More and more similar initiatives are being implemented in municipalities and various groups, where it is sometimes argued that the regulatory framework for climate declarations is currently too narrowly defined. All but one of the respondents to Boverket's survey are of the opinion that the proposal is reasonable regarding the introduction of climate declarations for groundworks and ground improvements. Approximately two thirds consider it reasonable to use default values for this part, but many believe that default values should eventually be removed. The option of using default values for this part is highlighted as an important tool to

allow commencement of calculation of certain parts with specific data at an early stage if the aim is to implement improvements. It is also pointed out that climate impact should be reported separately, as this is a highly variable item. Land contractors are a new group that will be affected by the legislation, so training programmes are requested for them.

Considerations

The complexity increases slightly when groundworks and ground improvements are included in the regulatory framework for climate declarations, as there is an additional element to deal with. This is because of the system boundary in the first instance, as this part should be included not in the limit value, but in a climate declaration. Communicating this may present something of a challenge. The actual implementation of the calculation can be facilitated for the developer, as default values are permitted for this part. It is important for default values to be formulated and selected in a manner that reflects the specific conditions for a project, so that the use of default values does not result in losing sight of the purpose if a climate declaration is submitted for this part. Automatic gathering of quantification results for energy and material resources for groundworks and ground improvements will be possible if the digital platform on which the industry is working is available in 2025.

It is relevant to ask what benefit a climate declaration has, as groundworks and ground improvements are not to be included in the limit value. It is deemed unreasonable to define requirements at a different point in the permit and construction process than existing requirements, when the rest of the climate declaration has to be submitted at the time of final clearance. In terms of benefits, a requirement may increase the incentives to implement reduction measures in the soil preparation work. A separate report on the climate impact of this part of construction is also expected to increase knowledge in the field, which in turn will pave the way for better products, methods and measures to be chosen from a climate perspective.

Different options have been considered in order to address this part of the regulations on climate declarations for buildings. A more ambitious option would have been to propose inclusion of this part in the limit value for the climate impact of buildings, and that it would then require more action to reduce the climate impact of the rest of a building. The benefit – besides providing more guidance – would also involve facilitating communication; that is to say, the fact that the proposal above means that all building elements are treated in the same way in the regulations on limit values for the climate impact of buildings, and in the regulations on climate declarations for buildings.

As regards the system boundary, including the demolition of an existing building in this part has also been considered. From a climate

perspective, it is desirable for existing buildings which still have a long technical service life to be supplemented or reconstructed more extensively rather than being demolished. However, it is not considered crucial for a real property owner to include demolition in the system boundary for this part, in its choice between demolition and reconstructing, as greater weight is often attached to other factors in a trade-off of this kind.

Developments in the Nordic countries

Finland will include groundwork in the climate declaration, but keep this part outside the limit values as a way of addressing the major differences in ground conditions. Finland is also looking into including a calculation of the "carbon handprint" of planted stands of trees, if the construction site is in an area subject to a detailed development plan.

In Denmark, a climate impact is already included in the calculation methodology and the proposed limit values for building materials, non-energy-intensive works, foundation work and ground improvements. This is not perceived to be a problem, as the limit values from 2023 are very generous. However, the impact of ground conditions on levels has emerged as a difficulty, as the idea is to reduce the limit values from 2025. Possible ways of dealing with difficult ground conditions are currently being explored, such as some form of supplement that a developer can apply for if it can demonstrate special circumstances.

Norway has included pile foundation and slab foundation in the climate declaration.

No description of biogenic carbon sequestration of long-lived products

In its report on the development of the regulations for climate declarations (Boverket, 2020), Boverket proposes making separate declaration of biogenic carbon sequestration in long-lived wood-based products incorporated into the building mandatory. However, this must be outside the limit value.

Proposal for 2027

- There is no proposal for separate disclosure of the amount of sequestered renewable biogenic carbon in long-lived construction products incorporated into the building.

Rationale

This proposal is not included even though there is a great deal of interest in the issue from stakeholders in the construction sector, as there is no consensus as yet on how biogenic carbon sequestration in buildings should be valued on an environmental level. However, most respondents to Boverket's survey are in favour of separate reporting of sequestered

carbon in bio-based products. Separate reporting of biogenic carbon sequestration in the climate declaration involves an additional area for the developer to report, although this can essentially be done "automatically" if Boverket provides data for this linked to bio-based construction products. Declaring this as well will be more demanding for developers. Work is being initiated in the EU to investigate how this should be handled in life cycle analyses of products (within PEF). This work should be followed, and potential adjustment can take place when better knowledge is available.

Developments in the Nordic countries

Biogenic carbon sequestration in construction products and planted trees is included as part of the "carbon handprint" in the Finnish methodology. There is no equivalent in Denmark, but the climate data includes CO_2 removal in modules A1–A3 and emissions in modules C3–4. Biogenic carbon sequestration is not included in Norway.

No report on net exports of locally produced electricity

In its report on the development of regulations for climate declarations (Boverket, 2020), Boverket proposes that net exports of locally produced electricity should be reported in order to highlight the positive side of solar cells in the climate declaration.

Proposal

- There is no requirement to report net exports of locally produced electricity, where applicable.

Rationale

In Boverket's report (Boverket, 2020), the reasoning was that this additional information could compensate to an extent for the fact that the climate impact of the production of solar cells was included in the calculation for modules A1–A5, which would also be subject to a limit value. This additional information is no longer considered to be as important, as the new proposal is not to include the climate impact of the production of solar cells in the limit value, along with the fact that it should only be reported separately in the expanded climate declaration. This will make it easier for developers to produce climate declarations. Moreover, the quantification in a declaration for the net export of electricity could only have been based on a calculation, and not on actual production when the solar cells are in operation on the site, as the declaration has to be submitted in connection with final clearance.

Almost three quarters of respondents to Boverket's survey are in favour of excluding climate impact for the net export of local energy production.

Considerations

Revision of EN 15978, which sets out LCA-based calculation rules for buildings, is in progress. This contains proposals for how the export of the energy generated on your own property can be reported in what is known as module D2. That is to say, the societal benefit generated by any net export from a building can be provided as separate information in module D.

One argument in favour of including the reporting of exports of locally produced electricity is that this then provides a complete picture of the climate impact from the entire life cycle A–D.

Developments in the Nordic countries

Finland appears to be adhering to its “carbon handprint” concept, where net exports of locally produced electricity or other types of energy would be recognised in some form.

Climate declaration for refurbishment and extension, 2027

This chapter presents the proposal for a climate declaration requirement when certain alterations are made to buildings, as well as the reasons for not proposing regulations for extensions.

Proposal on climate declaration for certain alterations

The issue of a climate declaration in the case of refurbishment was briefly examined by Boverket in 2020 in its report "Regulation on climate declarations for buildings". Boverket did not submit a final proposal, but instead suggested that the issue should be investigated further. This government assignment states that "Boverket shall investigate and propose how the requirement for a climate declaration in connection with refurbishment can be introduced". Boverket has assumed that the proposed regulation does not need to adhere to the definition of refurbishment in the PBL, as this is a concept that is difficult to interpret. Further, relatively few measures would be covered by a climate declaration in the application of refurbishment pursuant to the PBL. Instead, Boverket has concluded that it is better to define requirements for climate declarations for certain alterations to buildings.

Proposal for 2027

- Requirement for a climate declaration for alterations to an existing building other than extension, if the alteration requires a building permit pursuant to Chapter 9, Section 2 (3a)) or (3b)) and is not exempt from the requirement for a building permit pursuant to Chapter 9, Section 4c of the PBL. The climate impact should include construction products that form part of the alteration covered by the requirement for a climate declaration, and be reported in kg CO_2e per m^2 GFA for modules A1–A4 + A5 construction product waste.

Rationale for requiring a climate declaration for certain alterations

Total greenhouse gas emissions from the construction and real estate sector amounted to 15.9 million tonnes of carbon dioxide equivalent in 2020, if emissions from imported products were included according to Boverket's environmental indicators.[48] Property management including renovation, refurbishment and extension, as well as other property management,

[48] https://www.boverket.se/sv/byggande/hallbart-byggande-och-forvaltning/miljoindikatorer---aktuell-status/vaxthusgaser/. Downloaded on 16 January 2023.

accounts for 55 per cent of total emissions (domestic and imported) from the construction and real estate sector, i.e. a significant climate impact.

Extensive renovation of an existing building has a significant climate impact, and in some cases is equivalent to the production of new buildings. However, initiatives have been implemented in the construction sector in recent years to increase knowledge of climate calculations in renovation projects; within the Local Roadmap Malmö (LFM30) initiative, for example.

Performing a climate calculation should not be too difficult, if the methodology for climate declaration for certain alterations to buildings broadly follows the regulatory framework for climate declarations from 2022. A statutory methodology facilitates comparisons by providing a common understanding of how calculations are to be performed for stakeholders in the construction sector working on renovation and refurbishment projects.

Boverket's report "Regulation on climate declarations for buildings" (Boverket, 2020) states that the regulatory framework for climate declarations for new buildings can also automatically drive the development of construction products with lower climate impact that are used in connection with refurbishment initiatives. However, when erecting buildings, the emphasis will – at least initially – be on reducing the climate impact of the material resources in the load-bearing structures. A mandatory climate declaration for a particular type of alteration could help accelerate product and material development for product groups that are often used in renovation and refurbishment projects (such as technical equipment and fixed interior design). It could be argued that learning about climate calculations and improvement measures in new construction is more or less automatically transferred to renovation projects as well. However, the transfer of knowledge between them has historically been generally poor (Olsson et al., 2015), which is why a climate declaration for some alterations could create greater incentives.

The issue of whether refurbishment work should be covered by climate declarations has been raised both in the hearing held in January 2020 within the framework of Boverket's report "Regulation on climate declarations for buildings" (Boverket, 2020) and within the framework of this investigation. A slight majority of respondents to the hearing referred to first wanted climate declarations to be introduced for refurbishment work as well. Instead, an overwhelming majority called for a mandatory climate declaration for refurbishment work in the hearing held in August 2022.

Rationale for which buildings are to be covered in the event of alterations

The following starting points have been important in defining the type of alterations that should be covered by the requirement for climate declarations for existing buildings. Boverket sees that terms already defined in the Planning and Building Act should be used. The Act on climate declarations for buildings is linked to the Planning and Building Act, and the assessment of whether climate declarations are required is made in the individual construction projects. Another starting point is that the regulations must provide as much climate benefit as possible. That is to say, measures with high climate impact must be covered and measures involving demolition of construction products despite having a long technical service life remaining must be limited. It has also been important to ensure that the introduction of regulations for changes to existing buildings is as simple as possible to apply and serves the same purpose as the introduction of the requirement for new buildings. This means that climate declaration regulations must mainly help to raise awareness and increase knowledge about climate impact, so that action can be taken to reduce climate impact.

Inclusion of the following types of changes in the regulation was identified as desirable, in terms of realising a climate benefit:

1. Measures involving high climate impact such as replacement of windows, renewal of technical equipment and major interventions in exterior walls and load-bearing structures for energy reasons. It is desirable for the regulatory framework to guide both product choices and solutions with low climate impact. However, this is also true of the renovation of windows, installation of energy glass instead of replacing entire windows and replacement of parts instead of entire installation systems, if the difference in energy performance is not significant.

2. Measures involving a change from offices to apartments, for example, where relatively large amounts of material are removed and replaced.

3. Tenant adaptations in office buildings where major material resources are removed and replaced prematurely. It would be desirable for the regulatory framework to limit the frequency of such renovations.

4. Extensive implementation of “measures to improve standards” in the renovation of multi-dwelling blocks, where major material resources are removed and replaced prematurely. It is desirable for the regulatory framework to encourage careful renovation instead.

There was discussion on which of the above measures could fall under the existing definitions in the PBL legislation. Firstly, whether the concept of refurbishment pursuant to the PBL could be used was considered:

"alteration of a building, which means that the entire building or a significant and definable portion of the building is substantially renewed"

However, this term is difficult to interpret and was under review as recently as 2021.[49] The assessment is that relatively few measures that are linked to climate benefits would be covered by climate declarations in the event of refurbishment if the definition pursuant to the PBL were to be used. Introducing a specific definition of refurbishment in the regulations for climate declarations is not appropriate.

More measures that may "cost" a fairly large amount of climate impact are deemed to be covered by the requirement for a climate declaration if the requirement is linked instead to certain changes that require a building permit, other than extensions. Structuring the regulations on climate declaration when buildings are altered is proposed in the same way as for the erection of buildings.

Alteration of a building is defined in Chapter 1, Section 4 of the PBL as one or more measures that modify a building's design, function, use, appearance, or cultural-historical value. As indicated in current regulations, it is appropriate for only changes requiring a building permit to be subject to climate declaration requirements. The changes that require a building permit relate to extensions, changes of use, additional dwellings or non-residential premises and façade changes. The buildings that should be subject to climate declaration when changes are made are the same as those indicated in the current regulations. This means that the exemptions pursuant to Section 5 and 6 of the Act on climate declarations for buildings and Section 4 of the Ordinance on climate declarations for buildings shall also apply when a building is altered. Boverket assess that a climate declaration must be required for two of the changes requiring a building permit; that is, change of use and additional dwellings or non-residential premises.

Pursuant to Chapter 9, Section 2, item 3 of the PBL, requires a building permit for "alterations to a building other than extensions, if the alteration entails

a) that the building in whole or in part is used or equipped for a significantly different purpose other than the one for which the building was last used or for which it has been adopted,

[49] "Översyn av ombyggnad i PBL", report 2021:19, Boverket (2021).

according to the latest building permit granted, without the intended use having come about,

b) alterations to the building that provide any additional dwellings or any additional non-residential premises for retail, trade or industry; or

c) changing the colour, facing, or roofing material of the building or the buildings' external appearance is substantially changed in any other way

The first paragraph, item 3c applies only if the building is situated in an area covered by a detailed development plan."

Item 3a) applies if, for example, an office building is changed into a multi-dwelling block. All measures included in the change are subject to the requirement for a climate declaration. Many measures that are common in the event of a change of use are covered in this way, such as replacement of windows, new fixed interior design, kitchens and wet rooms, renewal of technical equipment, new interior walls and major interventions in load-bearing structures.

Measures such as tenant adaptations and extensive "measures to improve standards" that are implemented without the building being occupied or converted to a substantially different purpose are not usually subject to building permits and will therefore not require a climate declaration.

For example, item 3b) covers situations where new residential apartments are created in an attic or a larger apartment is converted into several smaller ones. Larger non-residential commercial premises may also be converted into several smaller non-residential premises. These are changes that have been identified as desirable to include in the regulation. Measures that are commonly used in the event of such changes are new windows, doors, roof domes, interior walls, fixed interior design, kitchens, wet rooms, renewal of technical equipment and major interventions in load-bearing structures.

There is an exemption from the statutory requirement to furnish an additional dwelling in a single-family house in Chapter 9, Section 4c of the PBL. If such a measure is implemented in a single-family house with a gross floor area of more than 100 square metres, by a developer that is a legal entity (such as a housing association or a property company), the measure requires a building permit in accordance with the main rule in Chapter 9, Section 2(3b), but is then exempt from the statutory requirement in Chapter 9, Section 4c. The starting points for which alteration measures are to be covered by the climate declaration requirement include the fact that the measure must require a building permit and have a high climate impact. As this measure does not fulfil both of these starting points, the requirement is formulated so that if an additional dwelling is

exempt from the statutory obligation pursuant to Chapter 9, Section 4c, it is not subject to the requirement for a climate declaration.

As regards additional non-residential premises for trade or industry that require a building permit pursuant to Chapter 9, Section 2(3b), most of these measures will be covered by the existing exemption for buildings for industrial or workshop purposes in the current Climate Declarations Act. Boverket assess that this is applicable even now in connection with the development of the regulations.

Chapter 9, Section 2 of the PBL also includes item 3c), which relates to changes that involve changing the colour, facing, or roofing material of the building or substantially changing the building's external appearance in any other way; what are known as façade changes. This obligation includes – for instance – changing the façade material from timber to brick, or the roofing material from clay tiles to sheet metal. Such a measure on a larger building could justify a climate declaration requirement. However, the fact that a requirement for a climate declaration should apply to measures pursuant to this item is not considered justified, taking into account other changes that are also covered by the item and which are often of a smaller scale and thus have limited climate impact. Examples of other changes covered by the section include changing the colour, additional insulation, putting up a wall on a carport, putting up a new door or window or substantially changing existing ones, and installing solar cell panels on the outside of a building's facing or roofing material. Moreover, this is consistent with the choice of the system boundary for the calculation of alteration measures; that is to say, not impeding maintenance measures or energy efficiency measures by imposing a climate declaration requirement.

The proposal that involves some – but not all – changes requiring a building permit being covered by the requirement will mean that some minor measures that would have been desirable to capture from a climate impact perspective will not be covered by the requirement.

In its review of which measures are to be subject to climate declaration requirements, Boverket has also considered including measures that are subject to reporting pursuant to the Planning and Building Ordinance, so as to include some of these measures as well. However, Boverket assess that the regulations would be unpredictable and difficult to interpret for both building committees and developers if changes subject to reporting were to be included. Therefore, the requirement will only cover those measures that form part of the designated measures requiring a building permit.

Rationale for the choice of system boundary for the calculation

The starting point for the proposed system boundary is to capture a large proportion of the climate impact associated with alteration measures, and to make this as simple as possible.

Previous life cycle analyses of refurbishment projects show that the product stage (modules A1–A3) of new construction products accounts for a significant part of the climate impact: see the section entitled “Current situation on the climate impact of refurbishment”. The proposal means that the calculation follows the same system boundary as for the erection of buildings, as proposed for the limit value from 2025, except for the fact that module A5 energy is excluded. Making the system boundaries for erection and alteration basically the same makes things easier in terms of communication. Excluding A5 energy may be reasonable, as the climate benefit may be considered small compared to the effort required to collect data for this part.

Alteration to a building is equated with new construction in respect of methodology (A1–A5) according to the European calculation standard for buildings EN 15978. The building elements that remain after the alteration are “free” for the new investment period for the building. This can be said to favour circularity, as careful renovation will generate significantly lower climate impact than if many construction products are removed and replaced.

It would have been relevant to include module B6 operational energy to support the implementation of energy efficiency measures in connection with changes. However, there are other regulations that govern this. Focus on modules A1–A5 in the climate declaration therefore primarily targets reducing the climate impact linked to the construction products used in connection with the change.

It is deemed relevant to include demolition work and waste disposal when changing the system boundary as this “belongs” to the project activities, so to speak. However, it is reasonable to exclude this in order to reduce the administrative burden, as this element generally accounts for a very small part of the climate impact compared to that of producing new construction products. However, this could be considered for inclusion if there is a desire to steer the regulations more towards the reuse of existing construction products.

It is not deemed reasonable to introduce limit values as things stand at present, based on some form of reference values for change. Changing a building can involve a wide variety of measures; and it may be important to implement different measures depending on the maintenance status, even if it involves further climate impact on account of replacement of materials. It is important for the legislation not to discourage important

energy efficiency measures and promote good maintenance to maximise the service life of buildings.

Many contractors work solely with renovation; and it can be assumed that more small and medium-sized enterprises are found in this group, compared to the erection of buildings. It can therefore be assumed that many of them have not come into contact with the climate declaration regulations to date, or have only done so to a small extent. Bearing this in mind, it may be relevant to also introduce the regulatory framework gradually for stakeholders of this kind in the same way as for the erection of buildings, and not to introduce it with too complexity from the outset. That said, the regulatory framework has already led to the infrastructure being built for climate calculations by 2025. It will then also be available for use by stakeholders who work with renovation.

Other system boundaries considered

Another system boundary investigated involves considering a change as a new life cycle for the building, thereby treating it in the same way as the expanded climate declaration for the erection of buildings. The common interpretation of the European standard EN 15978 is that a renovation or refurbishment project must be treated as a new life cycle, where both the climate impact of disposal of removed parts and the production of new parts are allocated to modules A1–A5. For these, other life cycle modules are then calculated for the remaining estimated service life. By performing the calculation for an entire life cycle, it will also be possible to highlight module B6 operational energy with potential energy efficiency measures in the renovation project (by means of lower climate impact per year than before the renovation due to lower energy demand). This interpretation has been used in calculations for renovation projects in various countries, such as Germany, Switzerland, the United Kingdom, France and the Netherlands (Lützkendorf & Balouktsi, n.d.). Finland also appears to be choosing to move forward with its regulatory framework. This could be another option to consider if harmonisation with other Nordic countries and the EU is viewed as a primary goal. However, apart from highlighting module B6 operational energy, this option is not expected to provide greater climate benefits than the proposed system boundary.

Other considerations

Module A4 transport and A5 construction product waste could also have been excluded from the climate declaration of changes to buildings in terms of system boundaries for the declaration, as these account for a lower percentage of emissions. However, the calculation of these elements should not be viewed as particularly demanding, as Boverket's climate database provides generic climate data for these elements. A majority of people at the August 2022 hearing preferred the A1–A5 system boundary.

Requiring submission of the climate declaration in connection with building permits is another option that has been investigated. This could increase the chances of early identification of reduction measures in the event of changes. However, Boverket deems it difficult to impose a requirement to submit a declaration at a time other than that which applies to the climate declaration pursuant to the regulations on climate declarations from 2022 (i.e. before final clearance). One risk with the proposal to only declare climate impact in connection with final clearance is that this will be a paper product with no guidance towards measures to reduce climate change.

It is worth mentioning that several stakeholders at the hearing in August 2022 highlighted the fact that it would be desirable for a climate declaration for refurbishments to also be able to encourage the reuse of construction products and avoid premature demolition of buildings. In principle, it can be said that if limit values were to be introduced for alterations and set at the same level as for the erection of buildings, it would become apparent in the majority of cases that renovating and "reusing" existing building frames costs less in terms of climate impact than demolition and new construction. This is because an existing building frame in such a calculation becomes "free" from a climate standpoint, and in that case it will probably never be difficult to meet a limit value. However, the steering effect towards the reuse of building frames would be very dubious as long as the limit values are not particularly costly to meet in new construction work. The system boundary would need to be expanded for climate declarations on erection of buildings in order to include demolition and waste disposal for an existing building on the site where a new one is erected, in order to steer more in this direction. Alternatively, other policy instruments should be sought in order to support the utilisation of the bank of resources that society has in existing buildings.

Finally, it should be noted that it is still very important to encourage implementation of energy saving measures in the existing built environment. That is why it is important to ensure that any introduction of a climate declaration when alterations are made to buildings does not negate this ambition.

Developments in the Nordic countries

The other Nordic countries are also currently investigating the introduction of a climate declaration for refurbishments. Finland intends to apply the same requirements to refurbishment projects, such as the requirements for declarations for the entire life cycle and the erection of buildings; and this applies to buildings that are to be made more energy efficient. The idea is to link the definition of the projects to be covered strictly, in more detail, to the definition in the EPBD. Discussions are taking place in Finland on policy instruments to encourage renovation

instead of demolition and new construction. That said, Finland does not intend to have a limit value for refurbishment projects.

In Denmark, work is in progress on proposing how refurbishment projects should be dealt with in the regulatory framework from 2025. Alternative ways of trying to define limit values of some kind for renovation projects are being investigated. Studies have been produced with different approaches in terms of calculation methodology and system boundaries and how this affects the level of climate impact for refurbishment projects. A study is in progress on how refurbishment is to be defined in the regulations.

In Norway, climate declarations are required for major refurbishment of multi-dwelling blocks and commercial buildings.

No climate declaration proposed for extensions

The assignment included investigating whether regulations on climate declarations can be introduced for extensions. To date the regulations have only covered the erection of buildings, and not extensions. An extension is defined as an alteration to a building that involves an increase in the volume of the building, according to Chapter 1, Section 4 of the Planning and Building Act.

The starting point of this investigation was to treat extension in the same way as building erection; that is to say, with an associated limit value, and limit value levels defined according to the purpose of the extension. An extension would have the same limit value as the erection of a building. It would probably have been easier to meet applicable limit values for extensions than for new buildings, as extensions generally have fewer exterior walls; and extensions do not have a substructure. Only the additional materials and works for the extension element itself would be covered by the declaration. The larger extensions would be subject to the regulatory framework for climate declarations in the same way as erection of buildings.

Considerations

More construction projects would be subject to climate declaration regulations, which would have provided additional potential for reducing emissions. However, it was difficult to estimate the extent of anticipated emission reductions as there was a lack of data on the number of square metres of extension. Boverket's proposal – that the legislative proposal be introduced at two different times – has affected Boverket's assessment that it is inappropriate to define requirements for limit values and climate declarations for extensions. Striving for simplicity in the development of the regulations has provided an important starting point. This involved introducing limit values as a first step, which was deemed to be a more important policy instrument for reducing climate impact than an expanded

climate declaration. It was important not to extend the regulations from 2022 more than necessary. The option was to add more building elements. An extension may have been introduced at the next step, when the climate declaration was expanded in 2027. For the sake of simplicity, Boverket again deemed it inappropriate to introduce limit values for extensions. In that case, it would only be a climate declaration for extensions. Boverket reckons that the costs would exceed the benefits, based on a socio-economic impact analysis. More stakeholders in the construction industry would be covered by the regulations, while the climate impact of extensions was deemed to be relatively small compared to that of new buildings. The following paragraphs contain more information on the consequences for various stakeholders.

Consequences for construction stakeholders

94 per cent of respondents to Boverket's survey [conducted in connection with Boverket's hearing (a total of 33 stakeholders)] thought that the proposal for a climate declaration and a limit value for extensions is reasonable.[50] However, 57 per cent of stakeholders said that meeting the limit value could be a problem, as extension work has to take into account the existing building material and existing solutions. Most of the respondents who said this could be a problem were consultants and developers. It is also possible that many respondents misunderstood the proposal, believing that climate calculations should be performed and the limit value met even for the materials in an existing building.

Consequences for developers

It is clear from the interviews conducted as part of this assignment that a number of stakeholders believe that the proposal will not lead to any consequences. For instance, a developer that mainly builds multi-dwelling blocks said that they are unlikely to be affected by the proposal. Hence no additional activities or costs are anticipated. Another developer organisation (which also manages buildings) said that the consequences may depend on the nature of the extension.[51]

Extension work is often carried out by smaller building contractors, who are generally less aware of climate declarations and limit values. For instance, one of the developers recognises that finding contractors for extensions may present more of a challenge than finding contractors for new construction.[52] They go on to say that it is difficult to predict how costs will be affected, but believe that the contractors they procure will add a mark-up to the cost.

[50] Questionnaire for the Boverket hearing, 31 August 2022.
[51] Interviewee, Riksbyggen, 2022.
[52] Interviewee, Riksbyggen, 2022.

Consequences for building contractors

Building contractors are the group most likely to be affected by the proposal, particularly the smaller stakeholders specialising in extensions. The consequences expected from the proposal are largely dependent on the type of extension.[53] Work on major extensions is often performed in the same way as for new buildings. Smaller extension tasks are often performed by smaller stakeholders, and these stakeholders may specialise in extensions. There is likely to be a need for major upskilling among small stakeholders.

As with the impact on new construction, there is deemed to be no impact from a limit value and a climate declaration in terms of the impact on the designed living environment through the choice of building form and materials.

Consequences for construction product manufacturers

Stakeholders in the building materials industry state that the proposal will not make a significant difference, and that the costs and parties involved are roughly the same as for new buildings and extensions.

Consequences for small and medium-sized enterprises

According to what has emerged from interviews as part of this investigation, the stakeholders who will be particularly affected by the proposal on climate declarations and limit values for extensions are the small and medium-sized building contractors who largely work solely with extensions. For instance, one developer states that the small and medium-sized contractors will need to assimilate knowledge if they are to be able to produce data for climate declarations and limit values for extensions.[54] Smaller contractors may also need to bring in consultants as they do not have the expertise in-house.

Some small construction enterprises state that they will be affected in the same way as for new construction, with the difference that they will need to submit climate declarations and calculate limit values for more construction projects.[55] This is likely to increase administrative costs initially for small construction enterprises. However, there may be opportunities for further efficiency gains as this is the same approach.

Consequences for the State

More climate declarations will be entered in the climate declaration register on account of the introduction of a climate declaration and a limit value for extensions. The State, through Boverket, will therefore have to increase its supervision of climate declarations and limit values, which

[53] Interviewee, Swedish Construction Federation (Byggföretagen), 2022
[54] Interviewee, Riksbyggen, 2022.
[55] Interviewee, SJB, 2022.

will lead to increased administrative costs. Several stakeholders emphasise the fact that small building contractors will need to assimilate knowledge if they are to develop documentation for climate declarations and limit values for extensions. Boverket may therefore need to implement training programmes aimed at small and medium-sized building contractors on climate declarations and limit values for extensions. There have also been requests in the interviews to clarify what constitutes an extension project.

Consequences for municipalities

Municipalities will need to provide information on the requirement to submit a climate declaration in connection with an extension. There will be a slight increase in administration as more projects will be required to submit a climate declaration.

Effects on costs

According to the assessment, the effects on costs will not differ significantly compared to new construction, but the training programmes may need to be more extensive as a larger proportion of small and medium-sized enterprises will be involved. One possible difference, compared to new construction, is that it may be easier to meet the limit value because there are fewer exterior walls (wing extension). Alternatively, there is no need for a foundation (single-storey extension), which can be expected to have a minor impact on material costs.

Low emissions from extensions

In terms of magnitude, the reduction in greenhouse gas emissions from extensions is small in relation to the estimated reduction in emissions from the limit value for new buildings. The magnitude is estimated to be just 2.5 per cent of the emission reduction from the introduction of the same limit value as for new buildings, which may be an argument in favour of not introducing a limit value for extensions. Furthermore, extension projects are often implemented by small or medium-sized building contractors, who are much less used to working with sustainability issues. That said, there may be arguments in favour of imposing a limit value on extensions. The risk of suboptimisation is one argument. This may occur if developers build an extension (such as a new wing of a multi-dwelling block or non-residential premises) rather than building a new standalone building in order to avoid the limit value for erection of a building. The need to reduce emissions to net zero may be another argument in favour of imposing a limit value on extensions. This means that all emissions must be reduced.

Proposal concerning the calculation methodology

The basic calculation methodology is common to all subsequent parts; that is to say, both for the limit values, and for the expanded climate declaration for the erection of buildings and alteration of buildings. Minor adjustments are described under each part in the following sections.

Choice of the type of generic climate data

Boverket's climate database currently contains generic climate data that is both conservative and typical. Conservative generic climate data for construction products must be used in the declaration unless specific climate data is used, according to current regulations on climate declarations for buildings. Specific climate data (EPDs) may be used, if available for the embedded construction products. Conservative generic climate data (25 per cent supplement on typical data) in Boverket's climate database was introduced in order to create an incentive for developers to demand and purchase products with lower climate impact. This in turn would create incentives for manufacturers to produce product-specific climate data (EPDs) for more construction products. The use of conservative climate data is thus a tool for increasing the use and production of EPDs, and Boverket sees that that this has worked well to date. This development has led to increased learning in the building materials industry, and more and more EPDs have gradually been produced.

Proposal for 2025

- Generic climate data will continue to have a conservative value in Boverket's climate database when limit values are introduced; that is to say, a general supplement will be applied to the typical value.
- Climate-improved construction products will be removed from Boverket's climate database.

Rationale for the continued use of conservative data

The main argument in favour of using conservative generic climate data is that it drives the use of product-specific climate data. It is possible for a developer to use 100 per cent generic climate data in the climate declaration, provided that it is not possible to require the declaration to be based on a certain proportion of specific climate data. Boverket assess that this will not be possible in 2025 due to EU law. Using conservative data reduces the risk of favouring manufacturers with a higher climate impact than average data. This risk will also be mitigated with a stricter limit value.

The continued use of conservative data was advocated by many construction product manufacturers at the Boverket hearing, while contractors and developers preferred the use of typical data. Boverket intends to continue using conservative generic climate data in the climate declaration. However, it should eventually be changed to typical climate data, when EU law makes it possible to demand product-specific climate data in a climate declaration.

The level for the conservative data supplement is debatable. When developing Boverket's climate database, there was an ambition to set a conservative value based on the worst 25 per cent percentile calculated. It proved difficult to obtain such an adequate basis. Instead, the same factor was used for all construction products. The factor 1.25 was used as average data to define a conservative value for the construction product. Sweden has chosen a 25 per cent supplement, and Finland a 20 per cent supplement. An obvious disadvantage of this simplified procedure is that the factor is too low in some cases. The lower the factor used, the more likely it is to underestimate an intended 25th percentile for the worst products. 25 per cent is slightly too low but still reasonable for those products for which it has been possible to compile full market documentation (such as gypsum and mineral wool). Climate impact can vary considerably more than this within the same product group, which is why there is reason to evaluate the appropriate level to use for conservative climate data going forward.

Developers are automatically encouraged to use product-specific climate data for more of a climate declaration if the limit value is set reasonably strictly when it is introduced. There is a greater incentive to do this with conservative data, than if typical generic data is used.

Considerations regarding switching to typical data

Many users have difficulty understanding the significance of the climate improvements that are actually being made. Replacing conservative climate data for a construction product with specific climate data in their calculation can be perceived as making a climate improvement. However, in reality a genuine improvement compared to the average has only been made when the specific construction product has more than 25 per cent lower climate impact compared to conservative climate data in Boverket's climate database. The use of typical climate data at an early stage may better reflect the actual outcome if a significant proportion of specific climate data is used in a climate declaration (provided that the construction products are incorporated into the building). Early calculations will be required when limit values are introduced so that developers can feel confident of meeting the limit value. Thus it would be easier to work with the same type of generic data throughout the project.

Climate data for energy and transportation of construction products is not defined conservatively in the current Boverket database. This use of typical and conservative climate data may cause confusion.

Other considerations

Boverket has considered whether the "climate-improved construction products" found in Boverket's climate database for certain products should continue to be included in the database. If Boverket's climate database is to continue to contain climate-improved construction products, there is a risk unless requirements are defined for verification of product-specific climate data for these construction products. Developers can choose to use this data from the climate database in their calculations without actually using climate-improved products in their buildings. The idea was that this type of data could be used at an early stage to give an indication of what climate improvements might be possible. It is also a way of making it easier for users to produce a climate declaration, while also highlighting the fact that they have chosen to use construction products with a lower climate impact than generic climate data in a product group. This is particularly true for product groups with a wide range of climate impacts for individual products used on the market. However, a verification requirement needs to be introduced if this data is used in the climate declaration, so as to reduce the risk of a developer using climate-improved data from the climate database in the calculation in order to meet a limit value without incorporating such products in practice. This incentivises developers not to cheat. In practice, this means that the value of making climate-improved data available in the database lies primarily in facilitating the developer's early calculations, with the aim of obtaining a good indication that the limit value is achievable. The alternative is to remove the climate-improved construction products from Boverket's climate database. This means removing climate-improved concrete for all concrete grades. At the request of Boverket, the developer has to present a verification of product-specific climate data if data from Boverket's climate database has not been used. Boverket sees that this option is preferable because it makes the regulations clearer and easier to follow.

The type of generic data still used has an impact on the quantitative level at which limit values should be set. Adjustment of the proposed levels for 2025 limit values are not proposed, depending on whether typical or conservative climate data is chosen for the climate declaration after 2025.

Among those who responded to Boverket's survey, a small majority are in favour of using conservative generic climate data. The main reason for using conservative data is to avoid the risk of favouring manufacturers of construction products with poorer climate performance by using generic climate data in a climate declaration. The main reason for using typical climate data is that it simplifies the work. This is partly because the same data can be used throughout the process, and partly because it avoids the

current confusion surrounding the use of conservative data. Most believe that the current level of a 25 per cent supplement is reasonable, if conservative generic climate data is to be used. A large majority are also in favour of including climate-improved options in the generic climate data.

Developments in the Nordic countries

Finland also applies conservative values for generic data in the climate database, with a supplement of 20 per cent. In Denmark, generic climate data is available from 2023, when their regulatory framework came into force (the GenDK database). This consists mainly of data from the German database Ökobaudat, which has a supplement of 10–30 per cent. Proposals for data including GWP values were included in the documentation for the hearing[56] held in Denmark in the spring of 2022. Development of Danish generic climate data is ongoing for the most important construction products, and this is leaning towards the methodology of the climate databases in Sweden and Finland.

Use of product-specific climate data

Proposal

- At least 75 per cent of the climate impact of the construction products for modules A1–A5 must be based on specific climate data, when possible according to EU law.
- Boverket needs to ensure that this is possible with the environmental declaration that may be introduced in the future, so that a material-neutral indicator can be used in applications that are not made for an entire life cycle.

Rationale for using at least 75 per cent specific climate data

This proposal is based on the revision of the EU Construction Products Regulation, which requires construction product manufacturers to declare a GWP-GHG indicator for their construction products. There are examples of introducing a climate impact indicator known as “GWP total” in the European Commission’s proposal for a work plan for the revision of the EU Construction Products Regulation; that is, an indicator that includes biogenic carbon sequestered in the product. There is no problem with using GWP totals if a limit value is set for the entire life cycle of a building, as the removal and emission of biogenic carbon is then automatically reset to zero. However, this will be a problem in Sweden as the proposed limit value covers only the construction stage, not an entire life cycle. The GWP total is thus an inappropriate indicator, unless an entire life cycle is analysed and is what is to be evaluated. Note also that

[56] Microsoft Word – datagrundlag.docx (windows.net). Downloaded on 2 May 2023.

comparability between different material types and stages A, B, and C is eliminated completely when only GWP totals are used. That is why it is important for Sweden to emphasise the need for an indicator that includes all emissions with climate impact except for biogenic carbon dioxide.

Technical equipment are not covered by the Construction Products Regulation, even after extending the definition as proposed by the European Commission. That said, this type of product is covered by the Ecodesign for Sustainable Products Regulation (ESPR) and is already regulated under the Ecodesign Directive. The proposal for a new Ecodesign for Sustainable Products Regulation is applicable to most product groups except for food and feed, pharmaceuticals and living organisms. The proposal contains several elements to ensure the sustainability of products, including the possibility for the European Commission to use delegated acts to define performance and information requirements for products with regard to a large number of different product parameters, including climate impact.

Once European legislation is in place, the regulations on climate declarations should be updated with requirements for the minimum proportion of specific climate data for construction products in modules A1–A5 to be used in the climate declaration. A level of 75 per cent is proposed here as a suggested minimum level for specific data in the calculation. However, what is an appropriate and reasonable level should be assessed, as this option may be possible to implement pursuant to EU law. As things stand at present, it can be concluded that 75 per cent is a reasonable level that would require relatively little specific data in the calculation. To achieve at least 75 per cent specific data (GWP-GHG and A1–A5), it can be stated in simplified terms that EPDs are normally required for fewer than ten product groups. In other words, there are not many product groups contributing most to climate impact.

It is important to use an indicator that does not include emissions and removal of biogenic carbon dioxide (i.e. GWP-GHG) in order to make a climate declaration for the construction stage, as the limit value does not cover an entire life cycle. Boverket needs to ensure that this is also possible with the environmental declaration that may be introduced in the future, so that a material-neutral indicator can be used in applications that are not made for an entire life cycle (buildings).

More stringent quality requirements for the climate calculation

Boverket must assess whether a building's climate impact meets a limit value: see also the section entitled "New requirements for Boverket's supervision". To do this, Boverket needs access to calculation bases and verification indicating that the construction products on which the climate

calculation is based have also been used in the building. It is necessary for the calculation base to be of high quality in order for a climate declaration to match the actual climate impact. Making a climate calculation still presents a challenge for many people today, although there is increasing experience with similar calculations, and various types of tools are being developed. The current calculation methodology for climate declarations in respect of buildings will generally work well even when limit values are introduced. However, some regulatory changes are proposed to ensure that climate calculations are of high quality so that they can be assessed against a limit value.

Proposal for 2025

- The climate declaration's underlying calculation base must include information that reports the calculation of the climate impact of all resources according to the regulations on climate declarations.
- The coverage ratio must be at least 80 per cent. This means that the construction products that have undergone climate calculation must account for at least 80 per cent of the building's total climate impact. An increase to 100 per cent is made in the same way as today.
- At least 75 per cent of a building's total climate impact must be verifiable during Boverket's supevision in terms of construction products and their quantities.
- The minimum level for verification and coverage ratio proposed above may be reduced further, depending on the state of the market in 2025.
- Boverket's supervision is being tightened up, so it is not deemed necessary to introduce a system involving personal certification in order to make a climate declaration or a system involving third party review of a climate declaration.

Rationale

There is no requirement for a minimum coverage ratio in the climate declaration regulations for buildings that are applicable from January 2022. The coverage ratio shows the proportion of all construction products in a building that have undergone climate calculation. The higher the coverage ratio, the better the calculation reflects the actual climate impact of a building, which will be important when limit values are introduced. The 80 per cent level was discussed with industry stakeholders when compiling Boverket's handbook for climate declarations in 2021, and it was deemed reasonable at that time. IVL's calculation instructions (version dated 1 February 2022) have a requirement for a coverage ratio of at least 80 per cent, while LFM30 requires a coverage ratio of at least 85 per

cent. When using the default value for entire additional building elements, the coverage ratio is assumed to be 100 per cent for those specific building elements. The figure on the left in Figure 15 highlights how the coverage ratio includes both resources linked to climate data and any default values.

The coverage ratio allows climate calculations that do not cover the entire building to be assessed against a limit value. It is used to adjust an estimated climate impact to include the entire climate impact of the building when the coverage ratio is not 100 per cent. This adjustment is already made today and will continue to apply.

Similarly, a requirement is proposed for a minimum level for what proportion of climate impact can be verified in a spot check, in terms of which construction product has been incorporated and in what quantity. The fact that the calculation reflects the actual building is ensured by ensuring that verification is available in the form of documentation (delivery notes or similar, for example) from the supplier of construction products for the quantities and products actually incorporated in a building. Many changes are made during the construction stage, and this must be taken into account in the climate calculation. The fact that this has been done is reflected in the verifications. There is already a requirement for the developer to save documentation in order to be able to verify which type of construction product and which quantity of each construction product accounts for most of the climate impact. Defining a quantitative level for what “most of the climate impact” means is the difference with the current regulatory framework. It is thought that it will be possible to define a requirement of at least 75 per cent verification in 2025, and it will be possible to check later whether this value can be increased. A high percentage has the advantage of allowing the climate declarations can be steered towards greater representation of actual quantities purchased/supplied. This is important for credibility when limit values are introduced. When Boverket’s handbook for climate declarations was developed, discussions were held with industry stakeholders on how much of the climate impact it was reasonable to require verification for. The proposed level is in line with these discussions. This would mean significant quality assurance, while the administrative burden is deemed to be limited. As shown in Figure 15, this refers to 75 per cent of the climate impact linked to data.

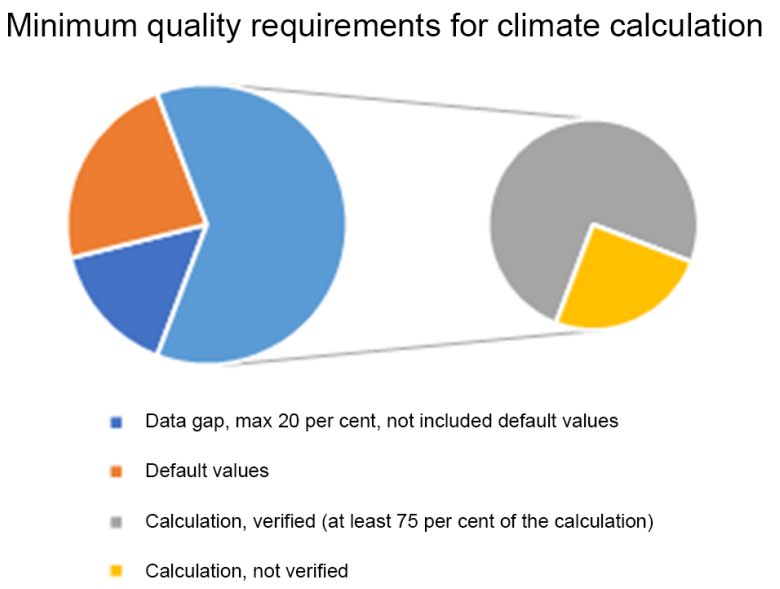

Figure 15. An illustration of what the percentages represent in the proposed quality requirements for coverage ratio and verification. Light blue represents the part of the climate impact that corresponds to the resources that could be linked to climate data.

Finally, we come to the issue of whether verification may have an additional purpose – that is, be able to verify that the limit value is met – when the limit value is introduced. If the market develops a digital system of delivery notes, it would be possible in principle to define requirements for verifications of 95 per cent. This would further increase comparability on a level playing field. However, the lower percentage of 75 per cent is deemed necessary as there is no guarantee that such a system will be in place by 2025 and, moreover, as not all developers will be able to access it.

Considerations

The minimum level for verifications has been considered. A comprehensive requirement has the advantage that it will reflect the erected building in a more quality-assured way, and capture changes compared to the designed building. A less extensive requirement will reduce the administrative burden. Figure 16 shows the proportion of climate impact of various product groups in relation to the climate impact of the entire building for the buildings in the reference value study (Malmqvist et al., 2023). If 75 per cent of the climate impact is to be verified, this covers many construction products regardless of the type of building. However, it is thought that there are probably fewer than ten different product groups as long as technical equipment, interior finishes and fixed interior design are calculated using default values. By way of comparison, 50 per cent of the climate impact means that verification would be needed for the following:

- Multi-dwelling blocks: only concrete for concrete frame buildings, also reinforcement, other steel, timber products, insulation and gypsum for timber frame buildings.
- Preschools: concrete, reinforcement and other steel, and in some cases timber products, insulation, gypsum and other building boards.
- Offices: Concrete, reinforcement and other steel, and for timber-framed offices also timber products, insulation, gypsum and other building boards.
- Education excluding preschools: Concrete, reinforcement and other steel. Note that no school with a timber frame is included in the data in the reference value study.
- Single-family houses: concrete, reinforcement, other steel, timber products, insulation and gypsum.

An alternative design of this quality requirement could involve requiring concrete, reinforcement and steel, as well as other metals, to always need a verification. This provides predictability for the person preparing the documentation, but has the disadvantage of reducing the flexibility of the materials for which it is possible to choose to save verifications. Moreover, this increases the burden on the suppliers of these particular product types. Such a requirement is not material-neutral, therefore. A further problem is that many contracts are run as shared contracts with several subcontractors. The easiest thing for a developer to do is to summarise the proportion of subcontractors: as long as these represent less than 25 per cent of the total climate impact, there is no need for a verification for these subcontractors at all.

Figure 16. Proportion of climate impact for different construction products, for the buildings that have undergone climate calculation in the reference value study (Malmqvist et al., 2023).

It is debatable whether the above measures are sufficient to ensure that climate declarations will be of sufficiently high quality going forward. The reason is that limit values, which are linked to sanctions, place much more stringent demands on the comparability and equal treatment in respect of the climate declarations made. For instance, it is possible to consider requiring a certified expert to prepare the climate declaration, or a system of third party review of climate declarations when limit values linked to the regulatory framework are introduced. This also risks increasing the cost of making climate declarations. Moreover, should such a requirement be imposed, there is a need to build up a sufficiently large base of expertise. The regulations on energy declarations impose such a requirement. However, there are no other quality requirements for the declaration itself, and this system has been criticised on occasion. For the climate declaration, therefore, it should be possible to use the quality requirements that already exist, plus those proposed here. Instead, it will be

important to ensure that climate declarations that are registered are also checked and that a random sample of climate declarations is selected for supervision. The quality of climate declarations should be followed-up and evaluated; and if there is a clear need to do so, consideration should be given to introducing competence requirements. Open training programmes for the industry already exist, on how the calculations for the climate declaration must be performed and quality assured.

Respondents to Boverket's survey are positive about the proposed level for the coverage ratio, with a few exemptions. However, several stakeholders point out that the calculation of the coverage ratio per se is difficult, especially if the production calculation cannot be accessed. Some of the respondents indicate that they have not understood the current regulatory framework with regard to this issue.

More than three quarters of respondents consider the proposal to be reasonable, in terms of the proportion of verifications for products and their quantities. If limit values are introduced, almost three quarters of respondents to the survey believe that the quality requirements would also need to be supplemented with some form of competence requirement for the person responsible for producing the climate declaration. Better calculations and easier procurement of the right skills are the positive aspects highlighted. At the same time, it is recognised that this will be costly. Costs and the risk of having too few trained people available are mentioned by those who highlight negative aspects.

However, it is not deemed reasonable to demand a third party review of the climate declarations for buildings. More than half of respondents do not believe that a third party review of a climate declaration should be required. The main concerns raised relate to increased costs and a lack of resources that can perform reviews.

Developments in the Nordic countries

The calculations are based – at least for the time being – on BIM models in Finland and Denmark, although these do not cover the scope of construction products required by the Swedish regulatory framework, through the requirement for coverage ratio and calculation. There are no specific requirements for quality assurance in Norway. However, the climate calculation must be included in the documentation.

Default values for additional building elements may be used

In Boverket's report proposing development of the regulations for climate declarations (Boverket, 2020), Boverket proposes the use of default values for the additional building element, interior finishes and fixed interior design. It is suggested that providing default values for the additional building element technical equipment could be considered. Default

values here refer to typical values in kg CO_2e per m^2, for all or part of a building element.

Proposal for 2025

- Default values may be used for the additional building elements of technical equipment, interior finishes and fixed interior design. The need for default values should be reviewed in a future update of the system.
- It is proposed that default values should have a conservative supplement, in the same way as climate data in Boverket's database.
- Default values must be developed for parts of these building elements so as to make it possible to make the calculation specific to parts of a building element.
- According to the section entitled "More stringent quality requirements for the climate calculation", the part of the climate declaration that is calculated using default values is not included in the calculation of the coverage ratio, as well as in the requirement for a verification.

Rationale

Boverket's report "Regulation on climate declarations for buildings" (Boverket, 2020) predicted that development would continue towards more climate data and increased digitalisation, which would facilitate the inclusion of the building elements interior finishes, fixed interior design and technical equipment. We can now see this happening to some extent. However, this is important for anyone who wishes to be able to use default values for these building elements when bringing forward the introduction of limit values, which means that the timing of the introduction of the limit values is not reliant on an expected development towards more climate data and increased digitalisation. It also helps to reduce the administrative burden for these calculations.

Default values for these building elements were produced in the reference value study and have now been reviewed within the framework of this investigation (Malmqvist et al., 2023).

Default values here refer to typical values in kg CO_2e per m^2, for all or part of the building element. This may involve using an aggregated default value for the entire building element – technical equipment in kg CO_2e per m^2 (GFA or net heated area), or using a standardised value for electrical technical equipment but calculating specifically for the building's other technical equipment. The use of default values in relation to a limit value requirement is not ideal as it provides less incentive for the market to make improvements. That said, it could also send a clear signal

to material suppliers and developers to improve their knowledge of the climate impact of these elements. There are updated standardised subdefault values for different building types in the updated version of the reference value report (Malmqvist et al., 2023). These are based on climate calculation data for a number of different buildings and discussions with specialists in different types of technical equipment in buildings. The main purpose of updating the default values was to make the data for defining levels for limit values more robust. Specific calculations are further encouraged as the default values are defined with a conservative supplement.

Considerations

The aim should be to progressively encourage a shift towards dealing with the additional building elements in the same way as the remaining building elements; that is to say, not using default values. Only then will it be possible to steer more towards reducing the climate impact of these building elements. Boverket has received comments stating that calculations with default values are of no interest.

Almost two thirds of respondents are in favour of the proposal to use default values for additional building elements. Some of the individuals commenting have misunderstood the issue. One person highlights the risk of always choosing to use default values for this building element when ground conditions are difficult.

Developments in the Nordic countries

It has been possible to use default values for technical equipment up to now, at least for early-stage calculations in Finland, according to (Finnish Ministry of the Environment, 2019). Both Finland and Denmark otherwise provide climate data for different types of technical equipment in their respective databases per kg, running metre, item and similar units, but not default values.

Unit for climate declarations and limit values

Proposal for 2025

- The reference unit continues to be per square metre of gross floor area, which is used to measure and compare climate impact in the climate declaration and for limit values.
- The development of Level(s), the taxonomy and the EPBD needs to be followed. The regulatory framework needs to be amended if a different area unit is introduced to the EU regulations.

Rationale

The area unit used plays a part in the level of the result. That is why it is important not to compare the calculated climate impact per gross floor area with per heated area or net heated area, for example, as this will give different results. However, different reference units are used in different countries to calculate the climate impact of buildings, making it difficult to compare results between countries.

The issue of the reference unit has been present throughout the development of the regulatory framework for climate declarations, and is also debated in other countries in which similar development of regulations is in progress. Level(s) is currently using a new area unit, “usable floor area”, which has not been defined previously.

The reference value study (Malmqvist et al., 2023) investigated whether buildings with storeys below ground level generally had a higher climate impact than buildings without. The study showed no clear differences in the climate impact calculated per square metre of gross floor area (GFA). However, there was a tendency for buildings with storeys below ground level to be disadvantaged by using net heated area as a reference unit. The selection of buildings with storeys below ground level was slightly limited but still gave a clear indication that the reference unit GFA appears to work well in relation to the system boundary module A1–A5 (Malmqvist et al., 2023). This means that this area unit is deemed suitable for a limit value covering modules A1–A5. Other countries that include module B6 in their system boundary have chosen to use a heated area or other units, mainly for this reason. However, as stated above, using heated area or net heated area as a reference unit poses difficulties when it comes to handling limit values covering only modules A1–A5, as it may lead to developers avoiding building basements or underground car parks. If net heated area were to be used as the reference unit instead, this would then probably require differentiation of levels for limit values depending on whether or not the building has storeys below ground level.

Developments in the Nordic countries

Norway uses gross floor area as a reference unit, while Finland uses a heated net area for consistency with the energy declaration. Denmark uses gross floor area to calculate embodied climate impact (but heated area for calculation of module B6 in the declaration). For some building elements, such as balconies, external staircases and access galleries, only 25–50 per cent of the gross floor area is included in the total gross floor area by which the embodied climate impact is divided. Norway refers to Norwegian Standard NS 3720:2018 Method for greenhouse gas calculations for buildings.

Limit values from 2030 onwards

In its report on the development of the regulations for climate declarations (Boverket, 2020), Boverket proposes long intervals between updated limit values (every 8 years). There needs to be time to evaluate the introduction of limit values according to the rationale, and the level before that to be reduced. This proposal would also simplify the regulatory framework, making it easier for stakeholders in the construction sector.

Proposal for 2030

- Limit values are reduced every five years.
- The aim is for the limit value for all building types – excluding single-family houses – to be 25 per cent lower in 2030 than the 2025 level. For single-family houses, the limit value is 0–15 per cent lower than the 2025 level, but which level is appropriate needs further investigation.
- The regulations must be evaluated in the interim in order to identify the need for adjustment of levels.

Rationale

The limit value levels for 2030 (based on this proposal) would be as shown in Table 5.

Table 5. Levels for limit values in 2030 rounded to the nearest five, as proposed above.

	Building type	Limit value (kg CO_2e per m^2 GFA)
Group 1	Multi-dwelling blocks	285
	Offices	290
	Education excluding preschools	285
	Preschool	250
	Single-family houses	155–180
	Special housing	290
Group 2	Other buildings	345

Rationale for the reduction interval

It should be possible to update the limit values slightly more frequently than previously proposed, which could also mean making slightly smaller reductions every time. However, the choice of intervals for reductions also has an impact on the level at which limit values will be introduced.

The issue of time intervals between reductions has been widely discussed as part of the assignment. The main argument *in favour of* a more frequent reduction interval is that it facilitates industry transition and allows all parts of the value chain to adapt gradually as supply and demand are subject to changes over more steps. The main argument *against* more frequent reduction intervals is to allow time for evaluations and necessary regulatory amendments. Boverket assess that five years or more to be a reasonable time interval. Frequent reduction intervals may be problematic, according to industry stakeholders, as projects that fall between reductions may face problems if the schedule shifts. They have therefore recommended intervals no more frequent than every three years.

Indicating the direction for the next reduction level at five-year intervals may suffice to give industry stakeholders time to implement changes. Rather, a three-year interval would need to indicate the direction for several subsequent reduction levels.

Rationale for levels for limit values for 2030

As a minimum, the direction for the first reduction of the limit values should be clarified to give the sector's stakeholders a reasonable chance to plan measures. Several stakeholders have emphasised the importance of this predictability. At the same time, evaluations need to be performed that can lead to changes, compared to the proposals submitted by Boverket to the government.

The level of limit values for 2030 is a balance between the need to push for faster emission reductions, while also taking into account small and medium-sized stakeholders with fewer resources. All stakeholders must be able to meet the levels at reasonable costs, be able to buy climate-improved construction products and have time to build up expertise to work on emission reductions in projects.

This proposed level for 2030 is lower than the construction sector's "Roadmap to fossil freedom", which calls for a 50 per cent reduction by 2030 compared to the 2015 level. It is also lower than the Mistra Carbon Exit work for all construction in Sweden without CCS (as this is still an uncertainty factor), where 49 per cent reduction in emissions is estimated by 2030 (see Figure 8). What is crucial to understand here is that it is not the "unique construction project" that needs to achieve the entire reduction, but that significant reductions are expected to occur earlier in the value chain (that is, at the material producer level) over the next decade. It can also be pointed out that today's (2020) best possible technology for individual construction projects is already 40 per cent lower than the proposed introductory level for limit values in 2025, according to the work of Mistra Carbon Exit (see Annex 4). It is reasonable to assume that what was best available technology in 2020 will be widely used technology in 2030. The assumptions in that calculation are also considered to be

somewhat conservative, and it is also estimated that some improvements have already been made at producer level since the calculation was performed. This calculation is made for a multi-dwelling block with a concrete frame cast in situ and is reasonably in line with the type of construction solution on which the median building in the reference value study is based. The trade organisations for building material manufacturers themselves also perceive major potential for rapid reductions in emissions.

The reduction for single-family houses has been set lower, as these can already be considered "more optimised" from a climate standpoint. This means that there are fewer opportunities to implement significant reductions compared to the other building types. The proposal here is lower than the level that one single-family house company (interviewed as part of the assignment) had defined as a target for 2025.

Introducing limit values means that early climate calculations will have to be performed so that the developer knows that the building will meet the limit value, unless intelligence from previous projects means that it is certain that the levels will be met. This means that even a project that does not need to take action will need to include this in its work process. This will create the knowledge to allow stricter requirements to be met in future, which will then require action.

Considerations

Greater client expertise will be required to meet the level of limit values when future reductions are made, especially when building using construction systems involving large quantities of materials with a higher climate impact. This will also place more stringent demands on the ability to carry out climate calculations at early stages cost-effectively but with reasonable accuracy so as to ensure that the level can be achieved. Closer discussion is also needed on what is possible to achieve between different competences in construction projects. That said, this also depends on the speed of the transition of the major building materials in Sweden. If CCS is deployed for cement in Sweden, for example, less needs to be done in the specific construction projects. Respondents to Boverket's survey felt that the proposed level is too low, not least because they believe that the proposed limit value for 2025 is not sufficiently strict. In particular, it could be argued that the level for multi-dwelling blocks in 2025 is what should be slightly stricter when limit values are introduced.

Boverket proposes a lower level for limit values for the first reduction than many stakeholders in the construction sector have suggested, taking into account the impact on small and medium-sized enterprises. Clarity now on what will happen in the near future is valuable for all industry stakeholders. That said, it is not possible to predict today how much progress the transition will have made in just a few years. That is why it is important to evaluate whether it is easier or more difficult to achieve

emission reductions for individual building types before reducing the limit values in 2030.

There is deemed to be no apparent risk of buildings with certain characteristics finding it difficult to reach the level for the proposed level of limit values in 2025. However, it will be more important to keep track of any conflicting objectives in construction in the run-up to the 2030 reduction. There was a particular discussion on the risk of conflicting objectives or undesirable consequences of slightly more stringent limit values in the workshops held by KTH Royal Institute of Technology in April 2022 with various construction stakeholders. Table 6 contains a summary of potential conflicting objectives and undesirable consequences that industry stakeholders have raised during the study, as well as comments on the need to evaluate the issue in greater depth before reducing the limit values. (There is deemed to be no risk of similar undesirable consequences for the levels of limit values proposed for 2025.)

Table 6. A summary of the potential conflicting objectives or undesirable consequences of strict limit values.

Question/characteristic	Expressed concern about undesirable consequence	Comment on the need for evaluation and further studies
Apartment size	*Concern:* Could strict limit values make construction of smaller apartments that are more efficient in terms of space less attractive? *Reasoning:* More smaller dwellings means more kitchens, bathrooms and interior walls per square metre, compared to a multi-dwelling block with fewer and larger apartments. This is because kitchens and bathrooms are drivers of climate change.	A need for further studies for the limit value level for 2030. This analysis could not be performed due to a lack of data on the number of apartments in the reference value study (Malmqvist et al., 2023).
Moisture problems	*Concern:* Could strict limit values lead to concrete being eliminated in moisture-prone locations? *Reasoning:* This could have consequences with moisture problems.	It will be useful to evaluate the issue before the limit values are reduced.
Increased costs	*Concern:* Could strict limit values lead to more expensive housing? *Reasoning:* This could lead to an increase in the cost of construction if the implementation of climate-improved concrete leads to longer construction times.	It will be useful to evaluate the issue before the limit values are reduced.
Transport of climate-improved products	*Concern:* Could strict limit values make it more difficult to comply with the limit value in northern Sweden, for example, due to longer transport distances? *Reasoning:* This could lead to an increased climate impact due to longer transport distances if climate-improved products are produced in only one part of the country.	This is not a problem as long as generic data is used in the climate declaration for module A4. Moreover, the increase is generally marginal in terms of the total climate impact for modules A1–A5, even if specific data is used.

Question/characteristic	Expressed concern about undesirable consequence	Comment on the need for evaluation and further studies
Features	*Concern:* Could strict limit values lead to fewer basements and underground car parks being built? *Reasoning:* This could lead to the developers avoiding incorporating such features in buildings, if building basements and underground car parks has a higher climate impact.	The reference unit for the climate declaration is square metres GFA, partly with a view to counteracting this. To date, there are no studies in Sweden that indicate that it would be more difficult for buildings with basements and underground car parks to achieve a limit value than would be the case for buildings without these features.
Room height	*Concern:* Could strict limit values prevent the construction of higher room heights in buildings? *Reasoning:* Essentially, higher room heights mean that the area of the building envelope is greater in relation to the gross floor area of the building, which may therefore lead to a higher climate impact per square metre of gross floor area.	It will be useful to evaluate the issue before the limit values are reduced.
Single-family houses made of brick or concrete	*Concern:* Could strict limit values prevent the erection of single-family houses made of brick or concrete? *Reasoning:* The reference values on which the limit values are based for single-family houses are based only on buildings with timber as the dominant frame material (as the market is dominated by this). The question, then, is whether the limit values can be reached if other materials are used for construction. For instance, a requirement for a brick façade can be set out in a detailed development plan.	To take this into account, the study's proposal has been amended for the final report in order to propose a less stringent limit value for single-family houses from 2025. This is deemed reasonable to achieve. However, some form of climate-improving measures may be required as early as 2025, which is entirely reasonable. If only façade material is involved, it is deemed entirely possible to achieve the limit value as it is a defined building element. A single-family house with a classic concrete frame will not meet the limit value, but Boverket has not seen any businesses erecting such buildings in Sweden.
Form factor	*Concern:* Could strict limit values lead to a premium being put on certain building types, such as tower blocks? *Reasoning:* The smaller the area of the building envelope in relation to the gross floor area, the lower the climate impact for modules A1–A5.	This issue was investigated in the reference value study, and no such impact was found in that sample of buildings. The issue has also been studied previously in (N. Brown, 2013). This showed that there were no significant differences between the options studied.

Question/characteristic	Expressed concern about undesirable consequence	Comment on the need for evaluation and further studies
Climate zone	*Concern:* Could strict limit values make it more difficult to erect buildings that meet limit values in a more northerly climate? *Reasoning:* More insulation material would be required to meet the energy performance requirement in a more northerly climate.	This issue was examined in the reference value study, and no such impact was found. That said, however, there were no climate zone 1 buildings in the sample. The issue has also been studied previously in (Erlandsson & Pettersson, 2015). It was shown that buildings with better insulation than required by BBR make a marginal contribution in relative terms to the climate impact in the construction stage.
The limit value does not include module B6	*Concern:* Could strict limit values lead to less focus on high energy efficiency when constructing new buildings? *Reasoning:* More insulation material would be required to achieve a building with high energy efficiency.	See above. However, the major focus that the new climate declaration regulations bring with them on the climate impact of the construction stage, in combination with the issue of whether increased use of solar cells is supported, risks leading to lower focus on achieving more energy-efficient building envelopes than the BBR requirement demands. This is an issue that may be interesting to evaluate in the future.
New requirements for shelters	*Concern:* Could new requirements for shelters make it difficult to achieve the proposed limit values? *Reasoning:* More heavy materials and space underground would be required.	See above regarding buildings with storeys below ground level. It is also discussed whether shelters are to be viewed as part of national defence, and thus excluded from the climate declaration.

There is discussion on single-family houses and the opportunities for reaching limit values in the section entitled “Proposed levels for limit values in 2025”. A reasonable alternative could be not to implement any reduction of the limit value level for single-family houses in 2030, although participants at the hearing on 31 August 2022 were predominantly in favour of reducing the requirements for single-family houses. An evaluation before 2030 may show whether it is necessary to exempt single-family houses from the reductions.

Two alternatives were proposed at the August 2022 hearing for reducing the limit values in 2030, either 25 or 50 per cent lower than the initial limit values. Significantly more respondents to the survey were in favour of a 50 per cent reduction. The vast majority are in favour of reductions every five years. However, several respondents highlight the fact that they prefer a stricter initial limit value, and more steps with smaller

reductions in each step rather than a relatively generous initial value followed by a single large reduction.

Three quarters of respondents felt that the reduction level of 30 per cent below the median was reasonable for single-family houses by 2030. The risk of meeting the requirements being more difficult for detached houses with brick façades, and the fact that single-storey detached houses will find it more difficult to achieve the levels than two-storey detached houses and terraced houses, is highlighted.

According to respondents, if Boverket could indicate a direction for at least the next level of limit values, this would be valuable. See the chapter entitled “Impact assessment” for more information on Boverket’s considerations.

Proposal for measures for development of the regulations

This chapter presents Boverket's proposals for the measures needed to develop the regulations on climate declarations for buildings.

Proposal for 2024

- Boverket is tasked with facilitating the introduction of regulations on limit values for the climate impact of buildings in 2025, as well as an expanded climate declaration in 2027. This assignment should include resources to develop Boverket's climate database, climate declaration register, supervision, information and guidance.

New requirements for Boverket's supervision

Boverket has been responsible for supervising climate declarations since 2022. Supervision ensuring that limit values for the climate impact of new buildings are not exceeded places more specific requirements on Boverket's achievements. This section describes in greater detail how supervision needs to change.

Proposal for 2025

- A reference value for different building types will be developed within the framework of Boverket's assignment, describing information on design solutions and material choices in accordance with the CoClass classification system. This reference value must coincide with the limit value for the building type.

The following rules apply to all climate declarations entered in Boverket's register:

- Boverket must check that the climate impact registered in the climate declaration does not exceed the limit value.
- The developer must attach a calculation base when the climate declaration is registered. This calculation base must be submitted digitally, in a format and with a structure decided upon by Boverket.
- Boverket must compare the registered climate impact with the reference value for the building type by comparing the calculation base submitted by the developer with the calculation base for the reference building and then perform a reasonability assessment for correct calculation of the climate impact.

- The developer is given an opportunity to rectify any shortcomings in the calculation base.

For some climate declarations entered in Boverket's register:

- A random sample of registered climate declarations is taken for review.
- An review is also carried out if shortcomings are detected in the calculation base and the developer fails to take corrective action.
- An review is carried out by qualified reviewers. Whether a system of accredited verification bodies should be introduced in 2027 should be considered if regulations on an expanded climate declaration are introduced.
- Verifications must be submitted digitally in the event of an review, in a format and with a structure decided upon by Boverket.
- The developer is given an opportunity to remedy any shortcomings detected in an review or verification. Boverket issues a sanction if the matter is not remedied.

Boverket's supervision must be legally certain, effective and robust. Boverket may issue sanctions if a limit value is exceeded. In turn, the developer can appeal against decisions on sanctions. The assessments made in a supervisory case must therefore be able to stand up to critical scrutiny (by a court, for example). A legally certain procedure is based on performing similar assessments using methods based on recognised standards. Any such procedure can only be achieved with a high degree of digitalisation and automation.

The regulatory framework on which building elements are covered by the limit value needs to be clear to developers and contractors so as to ensure that the supervision is legally certain, efficient and robust. There must be no ambiguity in the definition of the system boundary, and how the climate impact of construction products is to be allocated to the various building elements. The current categorisation of building elements for the climate declaration has proven to be too rough and unclear. A number of construction enterprises have also requested that Boverket should use an established building element classification system. Boverket therefore advocates a building element classification similar to CoClass, according to a classification and level that is accessible to the public and does not require a licence.

The review process

A minimum level for checking climate declarations submitted is that the developer can show that a climate calculation forms the basis for the

declared value of the building's climate impact in the climate declaration. Attaching the calculation base to the climate declaration when it is registered at Boverket must therefore be mandatory.

The climate declaration and calculation base will be public documents when the developer has submitted and registered them in Boverket's climate declaration register. According to the principle of public access to documents, public documents held by a government authority are public and can be requested by the general public. However, the right to access public documents may be limited by confidentiality. The data in the calculation base submitted by the developer may contain sensitive information about the company's activities. Boverket assess that this information needs to be protected by confidentiality. It is proposed that Chapter 30, Section 23 of the Public Access to Information and Secrecy Act (2009:400) could be amended to also apply to "registration" in addition to the activities "study, planning, price regulation, permit issuance, supervision or support activities" listed in the section. Furthermore, a corresponding amendment can then be made to Section 9 of the Public Access to Information and Secrecy Ordinance (2009:641) and an addition can be made under item 168 of the annex to the Ordinance, stating that confidentiality must also apply to calculation bases in the climate declaration register.

A large volume of data will thus be submitted to Boverket. A defined data format for the calculation base will be a prerequisite for digital automated control, which in turn is a prerequisite for legally certain and cost-effective supervision. Boverket can verify the calculations that form the basis of the declared climate impact with developed IT support; for example, by checking the climate impact of the various building elements, transport from factories to construction sites, energy used on the construction site and the climate impact of the construction waste generated on the construction site.

In discussions with the construction industry, Boverket intends to determine the digital format in which calculation bases and verifications are to be submitted. Several initiatives are currently in progress, where industry stakeholders are developing solutions with the aim of enabling digital communication of the data needed for a climate declaration, among other things. It is also important for the digital formats adopted to also be adapted for smaller stakeholders.

Boverket will be carrying out checks on the calculation base, which means that the base will be compared with a reference building of the same building type and which has a climate impact that complies with the limit value. The reference buildings are described in relative detail, with construction products divided into building elements with quantities and climate data, typical transport lengths, energy use and construction waste

on site. When a building meets a limit value, this means that a certain proportion of climate-improved construction products have been used. Such checks will be carried out. These checks will make it possible to assess whether the building can reasonably be expected to meet the limit value. For instance, it is reasonable to expect that a building will not meet the limit value unless it is made of materials that have a low climate impact and/or has a significantly higher quantity of materials.

However, checking the calculation base does not indicate whether the construction products used in the climate calculation have also been used in the building. Verification must be requested for any such check to be possible. These verifications must show that the construction product has been delivered to the construction site, and they must include information on the name of the construction product, product ID, weight, climate data and transport data. It must be possible to link the verifications to the calculation base.

A random sample of registered climate declarations will be selected for this review, and a supervisory case will be opened. The climate declarations that have shortcomings in the calculation base, or that are deemed not to meet the limit value in the review of the calculation base, will also be produced for this review.

It is important for the review process to work with an increased volume of climate declarations, that the review can be automated, and that it is clear and transparent.

An review involves studying whether the data and uncertainties can unequivocally rule out the outcome being below the limit value. For this reason, it is of particular importance to have the right competence pursuant to ISO 14066, to have a systematic approach pursuant to ISO 14033, to have standardised verification requirements pursuant to ISO 14064-3, and to clearly follow the framework and requirements pursuant to EN 15804.

Boverket may issue sanctions if a climate declaration is not deemed to meet the limit value, or if the calculation base or verification has such shortcomings that Boverket has requested a correction that the developer has not implemented.

Organisation of review systems

Through its exercise of authority, Boverket has a mandate to take action against developers with regard to the requirement for reported climate declarations to be correct and not exceed limit values.

There are two main alternatives for organising Boverket’s regulatory responsibility for the review system, based on studies of existing requirements for verifiability and similar systems:

- The system is run and executed entirely by Boverket.
- The system is run by Boverket, but the review is outsourced to third party bodies.

The normal procedure in the case of review systems outsourced by government authorities to another party is to indicate that the review is to be conducted by an independent reviewer (usually referred to as a third party) who has no relationship with either the developer or any other stakeholder in the construction project. A third party review is usually deemed to be of sufficient quality to allow the results to be used in a further process by the government authority.

A system run by Boverket, but where the review is outsourced to a third party, can be divided into three further options.

- The review is carried out by an accredited verification body.
- The review is carried out by an accredited inspection body.
- The review is carried out by a certified reviewer (expert).

All options assume that Boverket designates another party (pursuant to regulations) to stand responsible for the review. Moreover, these options rely on the use of the accreditation system to ensure that the party performing the review has the right conditions to do so.

The third party review options make it difficult for Boverket to influence the costs of the actual reviews in advance. Accreditation and certification are also associated with a cost for the actual accreditation or certification. This cost needs to be allocated by the reviewing party to the review assignments carried out, together with the other costs that are to be covered in order to carry out the activity. As regards the critical volume, it is difficult to determine whether it would be interesting for enterprises or individuals to provide their own accreditation or certification.

A system run by, and entirely carried out by Boverket can be divided into two options:

- The review is carried out by qualified in-house reviewers.
- The review is carried out by externally qualified reviewers.

Both options are based on the assumption that Boverket is responsible for ensuring that the reviewer is independent and has the right expertise to carry out the review systematically and correctly.

Both options also allow Boverket to decide in advance how many reviewers will be needed, based on the anticipated volume of climate declarations to be reviewed. This also allows Boverket to determine in advance what the review will cost.

Regardless of the option selected, Boverket needs to develop a system for qualification of reviewers and ensure resources to maintain that system. Essentially, Boverket needs to develop a qualification system that corresponds to what an accredited personal certification body would need to develop in order to offer certification.

Given the above, Boverket proposes that the review be carried out by Boverket using qualified in-house and/or external reviewers.

Building elements by classification system

The current classification of buildings into building elements used for reporting climate impact in a climate declaration is too coarse and unclear. A clearer classification system should be introduced for building elements when limit values are introduced. This will also promote legally certain and cost-effective supervision.

Proposal

- Boverket is commissioned to investigate whether a classification at a more detailed level than the CoClass two-letter level (which does not require a licence) is required for climate declarations.
- Boverket should also be commissioned to investigate whether the State should take over ownership and management responsibility for the CoClass classification system.

Using an existing classification structure would make it easier for the industry to recognise which building elements are referred to, thereby facilitating the inclusion or exclusion of the material resources to be included in a climate declaration. The three classification systems used in Sweden at present are BSAB83/SBEF, BSAB96 and CoClass.

BIM models often use BSAB96, and cost estimates often use BSAB83/SBEF. BSAB96 is gradually being replaced by CoClass.

CoClass is a classification system for the built environment. Moreover, it is designed to manage information in a life cycle perspective where standardised classes, terms and concepts create the conditions for a seamless flow of information through all stages: programme, project planning, production, use, decommissioning and reuse. CoClass can be accessed via various types of web services for use in computerised applications, such as CAD tools, management systems and purchasing and costing systems. CoClass is a system customised for digital flows.

Boverket has sought the views of several major contractors/developers concerning the introduction of a classification system linked to CoClass, and the reactions have been positive. However, the Swedish Construction Federation emphasises that translation tables to CoClass from

BSAB83/SBEF and BSAB96 will be needed for a transitional period. Boverket's assessment is that such tables are best handled by the construction industry.

Use of CoClass at two-letter level is free of charge. However, it has not been sufficiently investigated whether this level is adequate for the needs of climate declarations. Boverket should therefore be commissioned to investigate the matter further.

There is also a general need in the construction industry for a classification system that supports the digital management of construction product information. CoClass can improve communication between stakeholders in the urban development sector.[57] The system can be used throughout the life cycle of construction works, and for any built environment. CoClass allows everyone to access standardised classes, as well as terms and concepts in all software and all information deliverables.[58] Government grants to fund classifications are widely available to the countries in our immediate vicinity. CoClass is jointly owned by BIM Alliance, Svensk Byggtjänst, the Swedish Association of Local Authorities and Regions (SALAR), the Swedish Transport Administration, Region Stockholm, Swedavia, the Swedish Fortifications Agency, the National Property Board of Sweden, Akademiska hus and Specialfastigheter. So CoClass is also funded in Sweden by public funds to a great extent, albeit at organisation level. The State taking over ownership and management responsibility for CoClass is therefore an option that Boverket believes should be investigated.

Development of Boverket's climate database

Boverket provides a climate database in order to calculate the climate impact in the construction stage. If a developer wishes to use generic climate data in its climate declaration, the data must be retrieved from here. Boverket's climate database currently contains over 200 resources with generic climate data for the life cycle modules A1–A5. The information in the climate database can be retrieved via a web interface, and via an application programming interface (API) in Excel, JSON and XML file formats. Boverket's climate database needs to be developed if the proposals made in this report are implemented. A few key elements are summarised below.

Proposal for 2025

Boverket's climate database needs to be developed with the following when limit values for the climate impact of buildings are introduced and

[57] Byggnadsinformationsmodellering – BIM, Report 2023:4, p. 36, Boverket 2023.
[58] https://www.smartbuilt.se/library/3943/slutrapport-grupp-4.pdf , Kapitel 10. Downloaded on 3 March 2023.

the building elements: technical equipment, interior finishes and fixed interior design are added:

- Default values need to be developed and added to the climate database for technical equipment, interior finishes and fixed interior design. But also climate data for construction products contained in these building elements, in kg CO_2e per kg or equivalent.
- Create new categories in Boverket's climate database for the additional building elements: technical equipment, interior finishes and fixed interior design.

Proposal for 2027

Boverket's climate database needs to be developed with the following when the system boundary for a climate declaration is expanded with life cycle modules B2, B4, B6 and C1–C4, as well as groundworks and ground improvements:

- Boverket's climate database needs to be expanded with new generic climate data for life cycle modules B2, B4, B6 and C1–C4.
- New generic climate data for resources used in groundworks and ground improvements.
- Create new categories in Boverket's climate database for the additional elements of groundworks and ground improvements.
- Develop scenarios for technical service lives and maintenance intervals for the resources included in the national climate database, which are needed for calculation of maintenance (module B2) and replacement (module B4).
- Climate data for future greenhouse gas emissions from district heating, electricity, and any other relevant energy carriers needs to be produced for calculation of the climate impact of operational energy (module B6). See the section below entitled "Climate data for fuels, electricity and district heating" for more information.
- Climate data based on scenarios for calculation of dismantling and demolition (module C1) and transport of waste (module C2).
- Climate data based on scenarios for various waste processing methods for modules C3 and C4, and categorisation of the various waste processing methods.
- A study of generic climate data for construction products that are more commonly used in the case of alteration, and addition of the same to Boverket's climate database.

Climate data for fuels, electricity and district heating

Boverket's climate database contains climate data (GWP-GHG) for fuels, electricity and district heating. Climate data for fuels, electricity and district heating is used in a climate declaration for buildings to calculate the climate impact of the transportation of construction products (module A4), and from energy use at the construction site (module A5 energy), according to the current regulations on climate declaration.

Climate data for fuels is taken from the fuel report[59] published annually by the Swedish Energy Agency. **Climate data for the Swedish electricity mix** has been calculated by IVL. [60] This is an average value from 2015 to 2017 and is based on the annual statistics published by Entso-E. **Climate data for district heating** is taken from the publication produced by the Swedish Environmental Protection Agency for the calculation of emission reductions in applications to the Klimatklivet scheme. [61] Climate data is based on Swedenergy's statistics as an average for 2018–2020 and emission factors in Miljöfaktaboken. This publication is updated every two years.

Proposal

- Boverket is developing scenario-based emission factors for electricity and district heating for the purpose of climate declarations.

Rationale

Climate data for electricity and district heating should be produced using a consistent method and published annually in Boverket's climate database. The climate impact of district heating compared to electricity should be considered when selecting a method, as the climate impact of district heating can have a significantly higher climate impact than electricity, which is specific to Sweden in comparison with other EU countries.

Need for scenario-based emission factors for electricity and district heating

The expanded climate declaration proposed for 2027 will include the climate impact of operational energy (module B6).

Operational energy includes the energy used by integrated technical systems during the operation of the building, pursuant to European standard EN 15978. This includes heating, hot water, ventilation, air conditioning,

[59] Drivmedel 2021, ER2022:08, Swedish Energy Agency.
[60] IVL has used the methodology used in the Fuel Quality Directive 98/70/EC and taking into account clarification in a complementary Directive (EC) 2015/652 dealing with the establishment of calculation methods and reporting requirements for fuels, as well as the Renewable Energy Directive (EU) 2018/2001.
[61] Klimatklivet – Vägledning om beräkning av utsläppsminskning, 25 October 2021, Swedish Environmental Protection Agency.

lighting, lifts, escalators, etc. Pursuant to EN 15978, the system boundary for operational energy should be consistent with the Energy Performance of Buildings Directive and its national implementation, which means – among other things – that the system boundary should be consistent with the definitions used in a Member State's energy requirements for construction. See also Annex 2 for more information on the calculation of module B6 operational energy.

When calculating the climate impact of operational energy, the starting point should be purchased energy supplied (unweighted) multiplied by emission factors for the various energy carriers used by the building.

Regarding the choice of methodology for producing climate data for electricity and district heating, it should be noted that Sweden's electricity market is divided into four bidding zones as part of the Nordic Nordpool electricity market. For district heating, the actual energy production is dependent on the local network, which differs between municipalities. However, use of a national average consumption mix (including imports, exports and losses) is proposed for both electricity and district heating. The main reason for this is that it is consistent with national methods in the other Nordic countries, and with the method developed by the EU Joint Research Centre. Another reason is that the climate declaration focuses on the characteristics of the building rather than its location; that is to say, a building is not "penalised" if it is connected to a district heating network with higher emissions or "favoured" if it is connected to a district heating network with lower emissions. Similarly, it is proposed that the declaration also does not address potential benefits from the purchase of "green electricity" or origin-labelled electricity. Using a national consumption mix that accounts for imports, exports and losses is appropriate in order to represent the energy actually supplied to the building. Electricity produced in buildings and exported must be included in the consumption mix.

When it comes to scenarios for the future development of climate impacts for electricity and district heating, it is important to use a future scenario to ensure that the climate data used is consistent with Sweden's climate targets for the development of the energy system. The use of such "dynamic" climate data is also consistent with the methods used for similar regulations in Denmark and Finland, for example.

The Swedish Energy Agency is tasked with producing scenarios for electricity consumption up to 2050. According to the Swedish Energy Agency, scenarios this far into the future are uncertain as they often involve rough estimates. Producing scenarios 50 years ahead is subject to even greater uncertainties, and is also costly. Taking the Swedish Energy Agency's scenarios for 2050 and applying them to 2070 would provide sufficiently good estimates.

It is proposed that Boverket develops scenario-based climate data for electricity and district heating specifically for the purpose of climate declarations.

Development of Boverket's climate declaration register

The climate declaration register will also have to change as the regulations for climate declarations change. An increase in the proportion of building elements will be needed in step 1 (introduction of limit values in 2025). There will also be a need for a flexible way to receive attached calculation bases, as described in the section entitled "New requirements for Boverket's supervision". Step 2 (expansion in 2027) will also involve a change, with more modules and additional building elements being added.

Figure 13 summarises the changes for both step 1 and step 2, showing which building elements are added, which building elements are included in the limit value and which modules are added. There will also be a change in the classification of building elements, as Boverket intends to divide the building into building elements according to the CoClass classification system.

The challenge when developing the climate declaration register is to make it clear to users which elements are included in the limit value, and which are not. The building elements added to the climate declaration and included in the limit value are not all that difficult to integrate into the climate declaration. It is more pedagogically challenging to expand the climate declaration with data that is not included in the limit value. There may therefore be a reason to clear divide the climate impact into those parts that are not included in the limit value and those that are.

Step 1 2025 Limit values introduced

The additional building elements to be reported in the climate declaration and included in the limit value will affect the online service and register. The additional building elements need to be listed separately, just like the current building elements, to make them easier to handle, distinguish and trace. The additional building elements need to be added under the current "Information module" part, which contains A1–A3 the product stage, A4 transport and A5 construction product waste.

It is important for the existing and new building elements to be linked clearly; partly because they are now included in a limit value, and partly because in the future (step 2) they will be clearly delimited from such additional building elements that are not to be included in a limit value.

Boverket needs to review and refine the building types used in the climate declaration register at present according to the Boverket's Purpose Catalogue so as to obtain better documentation for future limit values.

It is also very important to ensure that clear information and guidance are available on the changes in the online service itself (in addition to the guidance in Boverket's handbook on climate declarations) to avoid incorrect entries when registering climate declarations from 2025.

Step 2 2027 Climate declaration expanded

When we come to the proposed changes in step 2, this will again involve changes to the online service and register. It is important for the **additional elements** groundworks and ground improvements to be reported in a similar way to the existing building elements (A1–A5) proposed for inclusion in the 2025 limit value. It should be clearly stated that these are not included in the limit value. A clear method also needs to show that the values are not included in the limit value for the **additional stages**, the use stage and the end-of-life stage.

The modules to be reported for the use stage – B2 maintenance, B4 replacement and B6 operational energy – are reported under a separate section in order to clarify that they are not included in the limit value.

The same applies for the end-of-life stage modules in C as for the B modules: they have to be reported in a separate section so that it is clear that they are not included in the limit value. C1–C4 could be reported as one value for all climate impacts in the four modules for C, which would simplify matters and reduce the administrative burden.

For certain **alterations** that require a building permit, the climate impact must be reported for additional construction products, as stated in the building permit in kg CO_2e per m^2 GFA for modules A1–A4 + A5 construction product waste. There will be a separate access point for registering these climate declarations when climate declaration registration begins in order to distinguish new construction from alterations. One advantage is that identification of the building is easier, as there must always be a registered building for the time of alteration, which is not the case for the time of new construction.

Development of new information and guidance

There is a major need for information initiatives on forthcoming and adopted regulations, as well as developing a clear regulatory framework. There is also a need to issue guidance on the application of the new regulations once they have been adopted. It is therefore proposed at the beginning of this chapter that Boverket be given the task of facilitating the introduction of the regulations pursuant to this report. This assignment

should include resources to develop information and guidance and is described in greater detail in this section.

Proposal for 2025

- Boverket proposes that the National Agency for Public Procurement be tasked with developing procurement criteria that can be used in the procurement of contractors or consultants to achieve limit values for the climate impact of buildings.

Some areas where **information initiatives** are facilitating compliance with regulations for the industry are:

- Targeted outreach initiatives to stakeholders across the entire value chain. More stakeholders will be affected by the regulations when limit values are introduced, compared to the current regulations.
- Targeted initiatives aimed at small and medium-sized enterprises in their various roles.
    - The smaller real property owners who are developers and build infrequently are likely to be largely dependent on external expertise to meet the requirement.
    - A large number of the smaller building contractors work as subcontractors. They must provide relevant information to the building contractors. This task can be facilitated by good information from the building materials trade.
    - It can be difficult to reach out to smaller stakeholders with information, which is why information initiatives should use channels that they are already using (such as the building materials trade).
- Work on early stages and measures to reduce climate impact will be required when limit values are introduced. Therefore, additional emphasis should be placed on these elements.
- Increased knowledge of measures to reduce climate impact is a recurring need (highlighted by the industry).
- There is a demand for customer support. This means supporting the practical performance of the work by producing tender specifications and procurement support (especially for public sector stakeholders), for example. Boverket therefore proposes that the National Agency for Public Procurement be given the task and resources to produce procurement criteria that can be used by developers in their procurement of building contractors and consultants in order to ensure that limit values for the climate impact of buildings are met during the erection of buildings.

- A new area in the climate declaration regulations is the proposal to require a climate declaration for certain alterations of a building. Targeted efforts are therefore needed for stakeholders that are not currently covered by the regulatory framework for climate declarations. This information should assume that people are not familiar with the current regulatory framework.

- Webinars from Boverket with an opportunity for discussion on application of the regulations.

Guidance on the regulations in Boverket's handbook on climate declarations also needs to be developed.

- Updated guidance based on the proposals in this report on limit values and an expanded climate declaration.

- Development of Boverket's online training on climate declarations.

Boverket has held close discussions with stakeholders in the construction sector during its work on facilitating the introduction of regulations on climate declarations. One important starting point has been not to go into details in order to prevent technological development. The State cannot and must not go into detailed descriptions of how a climate calculation is to be performed and what action can be taken to reduce climate impact. That said, it has been important to capture the needs of the construction sector in order to facilitate climate declarations without overly burdensome administration for the sector. There is a need to accelerate assimilation of knowledge of climate calculations among stakeholders in the construction sector that are subject to the regulations, prior to the introduction of limit values for the climate impact of buildings. Limit values for the climate impact of buildings impose completely different demands on the construction sector. A better understanding of measures to reduce climate impact is needed to ensure that the construction sector can be confident that limit values are not being exceeded. Boverket has therefore considered a proposal for the State to fund a national platform ("meeting place") for the dissemination of knowledge in the construction industry on the climate impact of buildings, but after consideration it has concluded that it is difficult to find appropriate forms for this initiative.

The proposal is that the State contributes to dissemination of knowledge by providing information and guidance via Boverket as proposed above. At the same time, there are a number of climate initiatives ongoing in the construction and real estate sector at local, regional and national level in Sweden that are contributing to this dissemination of knowledge, and may suffice entirely. Boverket should follow this development.

Evaluation of the regulations on climate declaration

In this investigation, Boverket proposes that limit values be introduced in 2025, and then reduced every five years. On this basis, Boverket sees a need of an evaluation of the consequences of the regulations, and that this should be carried out two to three years before the planned reductions. Boverket sees a need of a supplementary reference value study to be carried out in 2027, before stricter requirements are introduced 2030.

Proposal for 2027

- Boverket is commissioned to conduct an evaluation of the regulations on climate declarations three years before a planned reduction of the limit values (2030). The State is allocating special funds for Boverket to conduct the evaluation.
- Boverket is commissioned to conduct a supplementary reference value study in 2027 prior to a planned reduction of limit values 2030. The State is allocating special funds for Boverket to conduct the study.
- Boverket is commissioned to develop reduction of the limit values based on the evaluation and the supplementary reference value study.

Table 7 provides examples of what an evaluation should include.

Activity	Purpose
Consultancy assignments, interview studies, surveys, etc.	To examine the impact of the existing regulatory framework, and to map the situation in the construction industry in order to assess the extent to which limit values should be reduced.
An analysis of the information in the climate declaration register.	A basis for assessing factors such as an reduction of limit values and appropriate design of the requirements.
An analysis of the information from Boverket's supervision.	A basis for identifying factors such as the need for other amendments to the regulatory framework in connection with the review of the limit values.

Table 7. Examples of activities in an evaluation prior to reduction of limit values.

Figure 17 describes the above in outline.

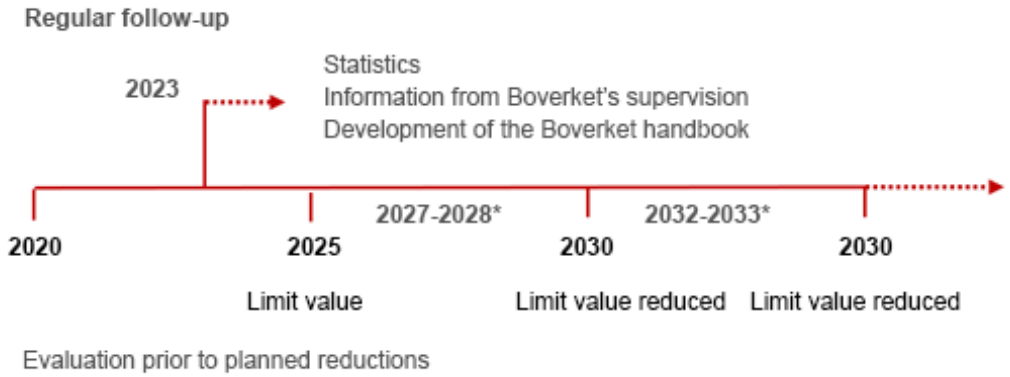

Figure 17. A schematic illustration of how the climate declarations can be followed up and evaluated.

The reference value study has been key to the proposals for limit values in this investigation (Malmqvist et al., 2023). However, there are no robust reference values on which to base limit values for the building types included in Group 2. See the section entitled “Different limit values for different building types”. Going forward, the climate declaration register will provide a good foundation for the development reference values as climate declarations are submitted for more buildings. That said, there is greater uncertainty in data from the register than reference values produced in a study where the methodology and calculation base are specifically quality assured. Boverket therefore sees a need for a supplementary reference value study similar to the one conducted in 2023, prior to a planned reduction of limit values in 2030. The reason for this is to achieve a sufficiently qualitative basis to be able to specify balanced limit values for the building types included in Group 2. This would mean that the regulatory framework for climate declarations would steer more effectively towards lower climate impact.

Resource requirements

Table 8 provides an assessment of the resource requirements for follow-up and evaluation, and for conducting a supplementary reference value study. Boverket sees a need of that the State allocate special funds for this prior to planned reduction of limit values.

An evaluation is needed before limit values are reduced in 2030. The evaluation needs to cover costs and other impacts on various stakeholders, especially small and medium-sized enterprises, as well as the impact on housing construction and building owners. The evaluation also needs to cover how much progress has been made in the transition for the major material groups; and also how the regulations affect the choice of design solutions and the risk of undesirable effects on technical property requirements such as fire, moisture and noise protection, and durability. The potential conflicting objectives that may arise also need to be evaluated. This may include building design and architecture, functionalities, and

factors such as energy management and thermal insulation. The chances of single-family houses meeting stricter requirements by 2030 need to be specifically evaluated. In connection with the evaluation, Boverket should be commissioned to submit proposals for stricter limit values for the climate impact of buildings.

Follow-up and evaluation	Resource requirements
Regular follow-up	Approximately 4 – 5 person-months per year
Evaluation prior to reduction of limit values	Approximately 10 – 11 person-months
Supplementary reference value study	Approximately 19 – 22 person-months

Table 8. An assessment of resource requirements for follow-up and evaluation, and for conducting a supplementary reference value study. Resource requirements are expressed in person-months. This includes both in-house human resources at Boverket and external resources in the form of consultancy fees.

Impact assessment

This chapter describes the consequences of the proposed limit values for new buildings, as well as the expansion of the climate declaration to the entire life cycle of the building, groundworks and ground improvements, and in the event of refurbishment (alteration). The consequences are described for different groups of stakeholders in the construction industry, as well as for the State and municipalities. Each section is summarised with effects on costs.

The existing policy instruments that affect greenhouse gas emissions

The carbon tax and the EU Emissions Trading Scheme (EU ETS) are the two main economic instruments affecting greenhouse gas emissions in the construction stage. Both of these policy instruments are applied directly at the source of the emissions. The carbon tax affects the life cycle of a building during the construction, use and end-of-life stages, as well as all the transport taking place during these stages. A large proportion of emissions from the construction industry are included in the EU Emissions Trading Scheme (EU ETS), such as emissions from cement and steel building material manufacturers. Emissions in these sectors are exempt from the carbon tax, and are instead priced through the trading scheme. However, industry not included in the EU ETS is affected by the carbon tax.

There are a number of other policy instruments in addition to these that directly or indirectly affect greenhouse gas emissions during the life cycle of a building. Among other things, all policy instruments for the transport sector have an indirect impact on the construction project, the reduction obligation probably having the greatest impact. This is because it affects greenhouse gas emissions from all transport, including the machinery used in the construction project. Emissions are also affected by the energy tax, the landfill tax, and other building regulations and instructions, as well as the various subsidies and investments made in areas such as the Klimatklivet och Industriklivet schemes, the forestry industry and the recycling industry.

Policy instruments at the product stage

Greenhouse gas emissions arising during the product stage are generated during the supply of raw materials, transport to manufacturing, and during the manufacturing process of construction products and components. The policy instruments that affect greenhouse gas emissions at the product stage are either the carbon tax (including all transport) or EU emissions trading (e.g. steel and cement construction product manufacturers). The energy tax also has an indirect impact on carbon emissions as it helps

to increase the price of goods, which in turn leads to lower volumes being used.

Policy instruments at the construction stage

Greenhouse gas emissions are generated by energy-intensive activities during the construction stage on the construction site, transport of construction products, and the production of materials that are damaged or become waste during transport to or on the actual construction site. Greenhouse gas emissions will vary depending on construction methods and choice of materials. For instance, different technical property requirements must be taken into account and met for the finished building, depending on the choice of materials. These technical property requirements include energy performance, fire protection, accessibility and load-bearing capacity, all of which affect greenhouse gas emissions and are specified in Boverket's building regulations.

The economic instruments that affect these emissions are the carbon tax and energy tax (transport, use of machinery on the construction site) and EU emissions trading (use of electricity and district heating during the construction period).

Other policy instruments also have an impact on carbon emissions, such as the Planning and Building Act (2010:900), the Environmental Code and the issuing of permits for the various processes. This is because some elements of these can add to the cost of construction processes and affect how and where buildings are erected. A more expensive construction process leads to less construction and fewer buildings that emit carbon dioxide, while – for example – various regulations in the Environmental Code affect land use, which in turn affects carbon emissions.

Policy instruments at the use stage

Greenhouse gases produced during the use stage are generated from energy use, but also from repairs, replacements and refurbishment. These are covered by the regulations and general recommendations contained in Boverket's building regulations (BBR) and Boverket's construction regulations (EKS). For instance, there are energy requirements that help to reduce energy consumption during the use stage, which in turn indirectly affects greenhouse gas emissions. Energy declarations are another policy instrument (information instrument) that can influence greenhouse gas emissions by incentivising energy efficiency improvements.

Emissions during the use stage are also affected by economic instruments, carbon tax and the EU Emissions Trading Scheme, primarily in respect of building materials used in repairs, replacements and refurbishment. However, there is also a lot of transport involved in the management and renovation of existing buildings.

Policy instruments for construction and demolition waste

Waste incineration plants are included in the EU ETS. These plants also pay for the incineration of waste and the release of carbon dioxide. Waste is generated at different stages of the building's life cycle, and is subject to landfill tax and waste incineration tax. These policy instruments aim to reduce the amount of waste that is sent to landfill and incinerated by making these activities more expensive. This in turn can also encourage stakeholders to minimise construction and demolition waste, and ultimately reduces greenhouse gas emissions. There are also provisions in the Waste Directive that can affect emissions for construction and demolition waste, as there is a separation requirement for parties producing construction and demolition waste. Certain types of waste therefore have to be sorted and stored separately from other waste, which in turn increases the chances of achieving more circular flows of materials in construction and demolition activities.

Overall picture of the impact of policy instruments

It is important to recognise that regulations and policy instruments affect greenhouse gas emissions from buildings in different ways. Some policy instruments, such as the carbon tax and the EU Emissions Trading Scheme (EU ETS), are directly targeted at reduction of carbon emissions. Other elements are support and requirements leading to actions that may reduce greenhouse gas emissions. Rather, additional policy instruments affect the construction process, and thus indirectly the carbon emissions of buildings.

Climate declarations and limit values overlap with the EU ETS at international level to some extent. Dynamic effects within the "emissions bubble" make it difficult to quantify the impact of the requirement for a climate declaration and limit value.[62] The requirement does not provide full "leverage", but allowances can be cancelled in some cases, resulting in an actual reduction. It may also be easier to reduce the ceiling of the bubble at a faster pace. The climate declaration and limit value can also help to bring about learning and technology development, and help make more climate-smart solutions available. This reduces the risk of delayed market introduction of new technologies and new approaches.

The overall picture of steering is difficult to grasp, therefore. There may also be gaps, mismanagement, and too much management or double management in this plethora, making it unclear how greenhouse gas emissions are affected overall. For instance, several of the policy instruments may lead to recoil effects that cancel out any emission reductions achieved. A limit value for the building, on the other hand, can be a good

[62] The "emissions bubble" contains the greenhouse gas emissions defined as a ceiling by the EU and consists of all the allowances in the EU Emissions Trading System (EU ETS).

way of regulating matters to reduce emissions when new buildings are erected. However, it may also be the case that a limit value does not contribute any additional effect beyond the policy instruments already in place. However, interaction of policy instruments at different levels favours development towards climate neutrality in the longer term.

Regulations on climate declaration and the link to climate targets

Sweden has a number of climate targets. The long-term climate target for 2045 is for Sweden to have no net emissions of greenhouse gases into the atmosphere for emissions occurring within Sweden's borders (territorial emissions).

The government has also adopted a number of environmental targets, one of which is the environmental quality objective Reduced Climate Impact. The parliaments definition of this environmental quality objective is as follows:

"In accordance with the UN Framework Convention on Climate Change, concentrations of greenhouse gases in the atmosphere must be stabilised at a level that will prevent dangerous anthropogenic interference with the climate system. This goal must be achieved in such a way and at such a pace that biological diversity is preserved, food production is assured and other goals of sustainable development are not jeopardised. Sweden, together with other countries, must assume responsibility for achieving this global objective".

The parliament has also defined the target more specifically:

"The increase in global average temperature is to be limited well below 2 degrees Celsius above pre-industrial levels, and efforts are to be pursued to limit the increase to 1.5 degrees Celsius above pre-industrial levels. Sweden will press internationally for global efforts to be directed towards achieving this target."

The calculations of emissions during the construction process are based on a life cycle perspective. Emissions are therefore included from the extraction and production of building materials used in Sweden, but whose emissions occur abroad. The total greenhouse gas emissions from the construction and real estate sector in 2020 amounted to 15.9 million tonnes of carbon dioxide equivalent, including emissions from imported products, according to Boverket's environmental indicators: see Figure 1. One third of greenhouse gas emissions from the construction and real estate sector relate to potential emissions abroad. New construction accounts for just under 20 per cent of total emissions (domestic and imported) from the sector in 2020, heating accounts for 25 per cent, and

property management (including renovation, refurbishment, extension and other property management) for 55 per cent.[63]

A new EU-wide emissions trading scheme

A new EU-wide emissions trading scheme has been proposed under the EU Green Deal (also known as Fit for 55), which will include emissions from road transport and internal heating of buildings. Fit for 55 brings changes to virtually every aspect of EU climate policy. The changes include a sharp reduction in the supply of emission allowances within the EU ETS, phasing out the free allocation of emission allowances, introduction of carbon taxes on the import of certain goods, introduction of emissions trading for buildings and transport, reduced national emission quotas for the Member States' ESR sectors,[64] and stricter requirements for the Member States' net removal of carbon dioxide in the land use sector. These changes are likely to affect Sweden in several ways: for instance, Swedish enterprises can be expected to face higher costs for carbon emissions in the EU ETS and the land use sector. These changes may also lead to consequences for Swedish national climate policy other than those planned.

The new system is expected to have a limited effect on Swedish real property owners as Swedish properties are mainly heated using district heating and heat pumps and do not generally use the fuels targeted by the EU Emissions Trading Scheme. The obligation under the scheme is placed on fossil fuel suppliers, such as fuel distributors and gas suppliers. Hence the new system is not expected to affect multi-dwelling blocks or commercial properties to any great extent. The fuels included are those used for internal heating, such as domestic heating oil and pellets.

For climate declarations, however, the revision is of major importance as a large part of the emissions covered by climate declarations are also covered by the EU ETS. That is why it is important in the future to analyse how limit values can be set at a level that makes them additional in the interaction with the EU ETS, given the higher ambition and stricter requirements in the EU ETS.

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[63] Boverket's environmental indicators were updated in 2022. This update resulted in a new value for 2020, but also a revision of the previous time series. The changes are major for the subsectors, but not overall. Greenhouse gas emissions from construction in a given year are significantly lower than previous calculations have shown, while emissions from property management (including renovation, refurbishment and extension and other property management) are significantly higher.

[64] ESR is an acronym for the EU's Effort Sharing Regulation, which was adopted in May 2018. The ESR covers the sectors not included in the EU Emissions Trading Scheme (ETS) and regulates emissions from buildings, agriculture, waste disposal, transport and small-scale industry.

Introduction of a limit value for new buildings is proposed for 2025

A limit value will be introduced two years earlier than proposed in Boverket's report "Regulation on climate declarations for buildings"[65] , and means that the industry needs to meet a maximum climate impact level earlier.

The regulations that applied for the climate declaration from 2022 will provide the starting point when limit values are introduced in 2025. Limit values are proposed for the erection of new buildings, and for modules A1–A5. Compared to the current regulations, more building elements, interior finishes, fixed interior design and technical equipment are also added, so that all parts of the building from the foundation and its insulation are included.

The industry has been deemed to be ready for management via limit values as early as 2025. For example, many construction stakeholders have already defined internal targets for maximum climate impact from construction. The fact that 2025 is realistic for the industry is also apparent from the survey that was available in connection with Boverket's hearing in August 2022, which involved 48 respondents in the industry.[66] Of the stakeholders surveyed, 96 per cent responded that the proposal is reasonable in terms of the timing for introduction of a limit value. Those who disagreed were of the opinion that limit values should be introduced earlier.

One consequence of introducing limit values earlier than proposed in Boverket's report "Regulation on climate declarations for buildings" is that the time for developing the regulatory framework and associated support for developers is shortened. This is deemed possible as regards the changes to the regulatory framework relating to the introduction of limit values. Another consequence of introducing limit values earlier is that the industry needs to fulfil a maximum climate impact level earlier. This has been dealt with in the study's proposal by suggesting an initial level for the limit values which is deemed to involve relatively little effort by developers and contractors. Developments in the building materials industry mean that many materials already have a lower impact than those used as representative climate data in Boverket's climate database. This means that all construction projects need to analyse their climate impact (which is already required today), but only a small proportion of construction projects need to take action during project planning or production.

There are still difficulties in obtaining quality-assured calculations. There is already a major need for LCA support and expertise in the construction

[65] Boverket, 2020.
[66] Questionnaire for the Boverket hearing, 31 August 2022.

sector, with the introduction of the regulatory framework for climate declaration in 2022. There has been very rapid development in knowledge building and expressions of will regarding the issue of the climate impact of the construction stage in the industry; even since Boverket's report "Regulation on climate declarations for buildings" was presented, although that was only two and a half years ago. That said, it is uncertain whether this will suffice, but bringing forward the limit values gives very clear signals to the market to dare to invest in further development of skills and services. Similarly, a plethora of tools are currently emerging to support simple, quality-assured calculations. Incentives to develop better tools can be increased by including a limit value requirement in the legislation.

Another issue that has been considered is whether major projects for which project planning begins many years before building permits are applied for could be affected by more rapid introduction of limit values. This risk is deemed to be low, given the speed with which the sector has worked to introduce climate calculations, and in particular the fact that major stakeholders have already made a great deal of progress.

Consequences for construction stakeholders

Although the construction industry is generally in favour of introducing limit values by 2025, this proposal has a number of consequences for the various construction stakeholders. These consequences for the various construction stakeholders are described in more detail below. Annex 5 shows the number of construction stakeholders affected by the climate declaration regulations.[67] The statistics in the annex are broken down into small enterprises (0–49 employees), medium-sized enterprises (50–199 employees) and large enterprises (200–500+ employees).

Consequences for developers

Administrative costs for developers are expected to increase slightly due to the introduction of limit values. Besides the climate declaration introduced in 2022, more building elements need to be reported, and more people will follow-up emissions during the construction process. Developers also need to bring forward their calculation work to early stages of the construction process in order to ensure that they meet the limit value.[68] Some are of the opinion that they need to buy in more consultancy services. Other developers (five out of a total of 15 respondents) state in the survey that there is no additional work for them because they are already below the limit value.

There will be higher consultancy costs on account of the extra work involved in calculating climate declarations. This is the opinion of one of

[67] Annex 5 Number of construction stakeholders affected.
[68] Questionnaire for the Boverket hearing, 31 August 2022.

the major developers interviewed as part of this investigation, which purchases turnkey contracts and thus does not calculate limit values itself. They also argue that additional costs may be incurred on account of increased building material prices for climate-improved products.[69] Other stakeholders in the construction industry perceive a short-term risk of shortages of building materials and rising prices for climate-improved products due to the increased demand.[70] Higher prices for new buildings are a cost that consumers are at risk of having to pay, according to one of the major developers interviewed. This is considered problematic in relation to the goal of building for everyone in society, not just people with the highest willingness to pay.[71] That said, other stakeholders argue that the limit values for 2025 are defined so that additional costs for building materials will not be incurred, or that these costs can be saved in other ways through more resource-efficient use of materials.[72]

Shortening the time for Boverket to develop the regulatory framework and associated support for developers is a further consequence of introducing limit values earlier than proposed in Boverket's report "Regulation on climate declarations for buildings". This in turn may mean that there is not enough time to develop support and tools for construction stakeholders which are important for developers to meet the limit values. Among other things, there is a need for LCA support, skills development and verification of quality-assured calculations.

Consequences for building contractors

A building contractor's responsibility for climate calculations in a construction project is largely dependent on the type of contract. The developer and its consultants are the ones who perform climate calculations for a construction contract. Instead, it is the building contractor who in practice is responsible for the climate calculations in the case of a turnkey project. The latter may be more or less controlled by the client, which makes it particularly important for the client (the developer) together with the outsourced contractor to have the knowledge needed to make the right choice when it comes to achieving the limit values. This may result in developers with insufficient expertise in this field handing over more responsibility to their contractors. This is a role that contractors are not used to, according to one interviewee from a medium-sized contractor, as they otherwise do what the client tells them to.

Building contractors' administrative costs are also expected to increase slightly, as more time will be spent on climate calculations for limit

[69] Interviewee, Riksbyggen, 2022.
[70] Interviewee, Swedisol, 2022, Regional building contractor, 2022.
[71] Interviewee, Riksbyggen, 2022.
[72] Interviewee, Major building contractor and developer, 2022, Swedish Construction Federation (Byggföretagen), 2022.

values; particularly until the digital systems are in place. Moreover, introducing limit values may mean that different materials are chosen, which in turn will lead to changes in working practices during the construction stage.[73] The knowledge required to meet the limit value requirements and the climate-improved material do not pose a problem according to the assessment, regardless of the size of a contractor. However, introducing a limit value may affect the construction time, cost or a change in construction method due to using a different building material.

Another aspect of construction and material selection concerns the impact on the designed living environment. One question that can be asked is whether the building type might be affected by a major reduction in the limit value in the future. For instance, a premium could be put on tower blocks, since a tower block has a smaller building envelope area in relation to its gross floor area, which means a lower climate impact. However, previous studies have shown that there are no significant differences between different types of multi-dwelling blocks. The reference value study also failed to show that buildings with a higher form factor (larger building envelope area compared to GFA) had a greater climate impact.[74] It was argued at the Boverket hearing that it is more difficult to achieve the limit value for single-storey detached houses and buildings with brick façades. Requirements for brick façades, for example, may be defined in the detailed development plan in terms of choice of façade, which makes it more difficult to achieve the limit value. It is deemed to be entirely possible to achieve a stricter limit value if only façade materials are taken into account, as this is a delimited building element. Hence there is no significant indication that the limit value in 2025, or a reduction of the limit value, would result in an impact on the designed living environment due to the influence of the choice of building type and façade material.

Consequences for project designers

Introduction of limit values by 2025 will mean a likely change in approach to the project planning of buildings. Developers will need to know that limit value requirements will be met at an early stage, and the role of the design engineer is expected to expand, including providing support to production managers.[75]

The project designer has a major part to play in reducing the climate impact of a building at an early stage, as the conditions for reducing a building's climate impact mainly occur during the planning and project planning of a building when different designs, solutions and methods are discussed.[76] The opportunities available to project designers may potentially

[73] Interviewee, Regional building contractor, 2022.
[74] Malmqvist et al., 2023, p. 85.
[75] Interviewee, Regional building contractor, 2022.
[76] Boverket, 2022c.

be hindered, either because a client (the developer) has no interest in reducing climate impact, or because the project designer lacks knowledge of which measures reduce climate impact.

According to one of the major developers interviewed for this investigation, the designer (project designer) will become the principal, and this will result in increased project planning costs.[77] This is due to an increased need for climate calculations, as well as an increased need to investigate whether it is possible to build in alternative ways in order to achieve a lower carbon footprint. Environmental consultants may also need to be engaged.[78] The project designers who referred to consequences in Boverket's survey are of the opinion that climate calculations form part of their work, and that project designers and consultants are flexible.[79]

Consequences for construction product manufacturers

Construction product manufacturers are merely subcontractors and will not be directly affected by the introduction of limit values, according to the association for Swedish construction materials enterprises and the construction trade Optimera.[80] That said, construction product manufacturers will be indirectly affected by an increased demand for EPDs. This means increased costs for construction product manufacturers, as producing an EPD involves an approximate cost of around SEK 100,000–300,000 per product. This is an investment that is also associated with great uncertainty on account of the lack of standards. The ongoing revision of the Construction Products Regulation[81] also adds uncertainty.

Increased demand for climate-improved materials is another consequence of limit values. This will provide a competitive advantage for material manufacturers that are able to offer climate-efficient products. The need to develop more climate-improving materials also involves costs that have to be passed on to products. However, these costs per product are not deemed to be significant. Both the association for Swedish construction materials enterprises and Swedisol fear a risk of suboptimisation towards products that are good during the construction stage, and that the operational stage will be forgotten in the longer perspective. The fact that introducing limit values by 2025 will distort competition in favour of products that are worse for the climate in the long term is therefore considered a risk. However, suboptimisation is deemed to be a potential risk

[77] It should be noted here that architects are also important project designers.
[78] Interviewee, Riksbyggen, 2022.
[79] Questionnaire for the Boverket hearing, 31 August 2022.
[80] Interviewee, association for Swedish construction materials enterprises (Byggmaterialindustrierna), 2022; Optimera, 2022.
[81] Ministry of Finance (2022).

only with a major reduction of the limit value in the future. See Annex 2, which shows the investigation commissioned by Boverket on the issue.[82]

Consequences for small and medium-sized enterprises

There are stakeholders who made less progress in the transition (such as small and medium-sized enterprises), although several large construction stakeholders are well advanced in terms of calculation methods and targets in respect of maximum climate impact from new construction. Within small and medium-sized enterprises, smaller developers and building contractors are the groups that are expected to be particularly affected. In particular, the group comprising building contractors with 20–49 employees is expected to be affected. Of the more than 450 building contractors with 20–49 employees, not all those covered by the requirement to provide a climate declaration act as developers or contractors for the new construction of buildings. Besides building contractors, there are also smaller real property owners – not included in the statistics – who act as developers. This group is likely to be dominated by private property enterprises, and small public housing enterprises in smaller municipalities.

For smaller developers, early-stage climate calculations are likely to need to be handled via consultants as part of a general contract,[83] or through a combination of consultants and contractors via turnkey contracts.[84] The estimated cost of consultancy is around SEK 60,000 for early-stage climate calculations. Smaller enterprises will increasingly have to rely on consultancy services, unlike larger enterprises which often have in-house expertise. These consultancy services are considered more expensive than carrying out climate declarations using in-house expertise.[85] Some industry associations, such as Swedish Concrete (Svensk Betong) and Swedish Wood (Svenskt Trä), have developed what are known as EPD generators to make it easier for smaller enterprises to produce EPDs. The estimated cost of producing an EPD via one of the trade associations' EPD generators starts at SEK 75,000, compared to a third party reviewed Environmental Product Declaration (EPD) costing SEK 100,000–300,000 per product.

The Swedish Construction Federation (Byggföretagen) is of the opinion that its members, which include small and medium-sized enterprises, will be capable of introducing limit values by 2025, although several stakeholders, such as the association for Swedish construction materials

[82] Annex 2 Concerns about not to include the whole building life cycle in the limit value.
[83] General contracts are a form of procurement that, unlike divided contracts, means that only one contractor is contracted. This contractor is known as the general contractor, and may in turn enter into contracts with several subcontractors. However, the client itself is responsible for the project design.
[84] Interviewee, Optimera, 2022.
[85] Interviewee, Swedish Construction Federation (Byggföretagen), 2022.

enterprises, believe that smaller stakeholders will find it difficult to do so as the limit values are set at a reasonable level. The investigations assessment is that introducing a limit value by 2025 would not be more difficult for small and medium-sized enterprises to fulfil. This conclusion also applies when the level of the limit values is ramped up, and when more and more extensive climate-improving measures will be demanded. However, the digitalisation required to perform cost-effective climate calculations at an early stage is considered likely to constitute an administrative barrier for small and medium-sized enterprises unless solutions suited to the target group are developed by 2025.

One small construction company interviewed as part of this investigation believes that there will be no problem in complying with the proposed limit values expected to be introduced in 2025.[86] The consequences that can be expected to arise are increased costs for materials, and increased administration for reporting limit values and climate declarations. The requirement to report limit values will also mean that construction enterprises will need to train their employees to perform climate calculations. Construction enterprises will find it difficult to estimate the cost of the consequences as they do not know the current greenhouse gas emissions of their buildings. There is therefore a risk of potentially high additional costs if they turn out to be a long way off the limit value.

Another consequence for small construction enterprises will involve finding subcontractors that are able to meet the requirements that will be defined by the construction enterprises.[87] They say it is difficult for them to motivate subcontractors to work in a way that allows them to meet the limit value. There is therefore a risk that there will be fewer subcontractors in the market, as they will choose to be subcontractors only for construction projects for private individuals where the developer does not need to submit a climate declaration or meet the limit value.

It is important for Boverket's supervision to work for the smaller construction enterprises, and for the industry to be aware that the limit values will be followed-up.[88] The smaller construction enterprises that comply with the regulatory framework say that unless the limit values are followed-up properly by Boverket, they would lose jobs as their customers are often price-sensitive.

Consequences for the State

The State, through Boverket, will need to produce new information and guidance, update the climate database and develop the climate declaration register. Moreover, Boverket needs to change the supervision of the

[86] Interviewee, SJB, 2022.
[87] Interviewee, SJB, 2022.
[88] Interviewee, SJB, 2022.

climate declarations in order to check that the buildings meet the climate requirements or to carry out some other type of control in addition to the ongoing supervision.

There are currently training programmes for construction stakeholders on how the calculations for the climate declaration are to be performed and quality assured. These training programmes will need to be developed. It has emerged from the interviews that Boverket's training is good, but that the texts can be difficult to access, or that people in the industry do not have time to attend the training programmes. There is a need for simple, digital training programmes that people can go back to. There is a need for more practical help and an opportunity to practise.[89]

Reducing the time for Boverket to develop the regulatory framework and associated support for developers and contractors is a consequence of introducing limit values earlier than proposed in Boverket's report. This is expected to lead to an increased workload in 2024.

Consequences for municipalities

Municipalities will need to provide information on limit values. The proposal has no consequences beyond the fact that information has to be provided on limit values, as the municipality is not responsible for checking compliance with the limit value.

Effects on costs

Regulation via a limit value corresponding to the median means that half of the projects need to take action. The impact on the costs of introducing a limit value in 2025 is deemed to be limited, according to the interviews and the survey.[90]

The following sample calculation is used to illustrate a potential impact on costs from the choice of materials in an individual project in order to fulfil the limit value in 2025. Boverket (2018) refers to a study of the costs for reducing the climate impact from the choice of materials for the frame (climate-improved concrete and timber) for a multi-dwelling block, in relation to a reference building with a concrete frame.[91] The measures to reduce climate impact involve increased costs of between SEK 4 and 18 per kg CO_2e per square metre of GFA.[92]

These measures will result in cost increases of between SEK 200 and 900 per square metre of GFA, for a single multi-dwelling block that needs to reduce emissions by 50 kg CO_2e per m^2. This can be related to the building price per square metre of apartment space, which was SEK 32,832 in

[89] Interviewee, Svensk Byggtjänst, 2022.
[90] Questionnaire for the Boverket hearing, 31 August 2022.
[91] Mogues et al., 2018.
[92] Ibid.

2018 and, converted to GFA, is SEK 18,911. The cost increase for reducing emissions by 50 kg CO_2e per square metre for a specific construction project ranges from 1.1 per cent to 4.8 per cent. According to the interviews, savings can also be made by optimising building materials and design solutions.[93] This suggests that the cost increase in the sample calculation may be smaller. The fact that a practice has developed in the industry whereby more material is used than is needed is one explanation given for why optimisation does not take place anyway. Sticking to practice means that project designers and contractors know what works, and deviating from practice would require more accurate design calculations.[94]

Increased costs for building materials will be incurred in some projects, but not necessarily if the use of materials can be optimised at the same time. The cost increases are estimated to be in the order of 1–5 per cent for those projects that have increased costs for materials, according to the sample calculation above. The need for project engineers and increased consultancy costs present another cost increase that mainly affects developers and smaller contractors. Other aspects raised include the need for upskilling, which mainly impacts on costs in an initial stage, especially for small and medium-sized contracting firms and developers. Construction product manufacturers state that the costs of EPDs can be significant, especially if the manufacturer has a lot of products. Cost estimates of SEK 100,000–300,000 per product have been mentioned. The group that states in the survey that there may be problems with exposure to competition[95] is mainly made up of construction product manufacturers.[96] The other stakeholders do not perceive exposure to competition as a major issue. There are potentially high administrative costs for the State at the initial stage. See the section entitled “Costs for the State” below.

Effects of cost increases on housing construction

A decision to build or not to build is influenced by the profitability of the project. The emphasis is usually on anticipated profitability, as construction decisions are made a few years before the building is completed.[97]

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[93] Interviewee, Swedish Construction Federation (Byggföretagen), 2022 See also WSP, 2019.
[94] Ibid.
[95] Measuring exposure to competition means the number of bankruptcies in relation to the number of enterprises in an industry.
[96] Questionnaire for the Boverket hearing, 31 August 2022.
[97] The flow of rental income is what is of interest – even rental income that is far in the future. This means that the discount rate has a major impact on the profitability of the project. It is probably particularly difficult at present to set a correct discount rate as the discount rate is determined on the basis of a risk-free interest rate, a risk premium and inflation. This may cause the company to overextend itself, in turn making it more difficult to achieve profitability. A high discount rate reduces the value of incomes, which mainly occur in the future, while the production costs incurred today are comparatively high.

That is to say, whether an expected rent or sales price can cover production costs plus the developer's required rate of return.

Increased production costs and/or lower sales prices affect the decision to build. Developments in the 2010s have shown that construction costs have increased at the same time as housing construction. One important explanation for this is that higher prices of dwellings have been able to offset the effect of higher construction costs. Low interest rates and rising incomes have made it possible to raise prices. Interest rates and income are the most important factors for determining sales prices.[98]

For rental apartments, the developer performs a calculation to determine whether the project will be profitable given the construction costs, based on the rent level and the state of the rental market. The rental income is usually what determines profitability even for non-residential premises. Tenant-owned apartments in multi-dwelling blocks or in group-built single-family houses, but also privately owned apartments, are usually produced when a certain percentage of the homes have been sold. Purchases are usually made a few years before access, and a project may suffer if too few apartments are sold as this delays the start of production.[99]

Production costs include a variety of components such as material costs, salaries and developer costs. It is difficult to isolate the impact of rising construction costs on construction by means of statistical regression analyses.[100] The results of studies conducted to isolate the impact of construction costs on construction vary widely. The impact of a 1 per cent increase in construction costs (factor price index) ranges from a 6 to 0.8 per cent reduction in construction[101], and the lower end of the range may possibly be lower.[102] The authors use an alternative approach in a study of how construction costs are affected by a 5 per cent cost increase, the impact on construction being simulated in a model that explains the link between housing stock, rent and the depreciation of the stock.[103] According to the results of the simulation model, a 5 per cent increase in costs leads to a 1.2 per cent decrease in construction, while rents increase by 2.4 per cent.[104]

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[98] Bjellerup & Majtorp, 2019.
[99] Actually a type of "advance booking" of dwellings.
[100] One difficulty is that supply and demand are determined simultaneously, which has to be taken into account in the statistical analysis.
[101] BKN, 2011; Blackley, 1999.
[102] In a statistical analysis of the Swedish housing market, Caldera Sánchez and Johansson (2011) report lower sensitivity to construction costs (0.3), but the result is not statistically significant.
[103] Andersson et al. (2016), The effect of minimum parking requirements on the housing stock, Transport Policy, Vol. 49, 206–215.
[104] Ibid.

The impact on costs of introducing limit values is expected to be moderate for most construction stakeholders, but there will be exceptions. It is estimated that the cost increase may be in the order of 1–5 per cent of the production cost, excluding land costs, for projects that take action by changing the choice of materials.

Construction product manufacturers will be indirectly affected by an increased demand for materials with EPDs. The cost may be significant for manufacturers who have many products. Cost estimates of SEK 100,000–300,000 per product have been mentioned. Nevertheless, it is thought that the cost will not be significant in relation to sales of the product.

Given the fact that the limit value is binding for about half of the buildings, not all projects will need to change the choice of materials. Moreover, the cost increase can be offset by optimising the use of materials, which will also help to achieve a lower climate impact.

Other costs that have been identified – and that potentially affect all construction projects – are increased consultancy and project planning costs due to an increased need for climate calculations, and calculations of whether it is possible to build in alternative ways in order to achieve a lower carbon footprint. Climate calculations at early stages and additional project planning costs are likely. These costs ought to represent a relatively small percentage of production costs. Project planning costs are included in the developer's costs, which together with a range of other expenses collectively make up around 12 per cent of the production cost.

Other aspects that increase costs include the need for upskilling, which mainly impacts on costs in an initial stage, especially for small and medium-sized contracting firms and developers. Upskilling may include climate calculations, knowledge of which measures result in a lower carbon footprint and application of a new way of building. Other initial costs may relate to the purchase of software for climate calculations.

To summarise, the foreseeable cost increases for construction stakeholders are not all that great. That said, it has not been possible to quantify all the above-mentioned items. There is limited empirical evidence in this regard, but the results of the above-mentioned simulation study can be used to relate to a cost increase that corresponds to the higher value in the range of cost increases when the choice of materials is changed.[105] Housing construction fell by 1.2 per cent with a 5 per cent increase in construction costs, while rents increased by 2.4 per cent.

[105] Andersson et al. (2016), The effect of minimum parking requirements on the housing stock, Transport Policy, Vol. 49, 206–215.

Consequences on the erection of single-family houses in particular

Following special review, Boverket concludes that a single-family house with a concrete frame will not meet the limit value proposed in this report. This is true even if standard concrete is replaced by what is known as climate-improved concrete. However, Boverket has been unable to identify any cases where the developer is a business, which would then be covered by the limit value. Private individuals as developers are exempt from the requirement for a limit value (and climate declaration).

There are enterprises that build single-family houses out of lightweight concrete, but Boverket has been unable to identify any cases where the developer is a business. The variants of single-family houses on the market that use concrete are single-family houses with lightweight concrete façades and larger terraced houses with concrete walls between fire compartments for fire protection. In the first case, climate-improving measures such as climate-improved concrete, replacement of generic data with EPDs, and choices of materials with less climate impact can make it possible to meet the limit value. In the second case, these terraced houses will have no problems meeting the limit value. A fireproof wall, sometimes made of concrete, is needed between the dwellings for rows of terraced houses over 800 square metres. This is not deemed to affect the chances of meeting the limit value as the climate impact of the concrete wall is spread over a large area.

Furthermore, Boverket states that a single-family house with a brick façade, and otherwise with a standard design, will probably not meet the limit value. However, certain measures can ensure that such as single-family house still meets the limit value. One such measure involves replacing bricks with climate-improved bricks, and another involves replacing generic data with EPDs. These two measures can help to ensure that a classic single-family house with a brick façade is able to meet the proposed limit value.

Climate declaration of a building’s entire life cycle from 2027

Boverket proposes that the 2027 climate declaration be expanded to include additional information modules, so that the entire life cycle is covered with a reference study period of 50 years. Modules A1–A5, B2, B4, B6 and C1–C4 are proposed for inclusion in the climate declaration. However, the final design of the regulations needs to be aligned with regulations adopted by the EU. The building elements to be included in the expanded climate declaration from 2027 are the same as those included in the proposed regulations from 2025 that are presented in this report. Besides the expansion of the climate declaration to include new information modules, groundworks and ground improvements are added in modules

A1–A5. Use of default values will be permitted in the declaration for groundworks and ground improvements.

Expansion of the climate declaration will result in a need for upskilling. For small businesses, finding the time and resources needed to increase knowledge can be a challenge. That is why there is a need for a new type of simple and practical training programmes; ideally digital training programmes that people can go back to and provide opportunities for practice.

For the State, this proposal involves additional costs for supervision. There will also be a need to update the climate database with new default values, and to implement information and training activities.

An expanded climate declaration as proposed by Boverket will increase the complexity of the regulatory framework. One issue that may be difficult to communicate is that the calculation of climate impact for modules A1–A5 needs to be split, as groundworks and ground improvements would be included in the declaration but not in the limit value. The proposal in respect of groundworks and ground improvements is discussed separately below.

A climate declaration for groundworks and ground improvements will be introduced in 2027

Expansion of the climate declaration to include groundworks and ground improvements is proposed, and this will be introduced in 2027. The climate impact of groundworks and ground improvement materials will form part of the expanded climate declaration. This declaration concerns new construction and does not include a limit value. The term “groundworks and ground improvement” refers to soil stabilisation measures, capillary breaking layers and drainage on the site where the building is to be erected up to insulation under the foundation, including measures two metres outside the building’s façade. Measures that relate to connection of media up to insulation on the ground are not included. Inclusion of all resources (energy and materials) within this system boundary is proposed.

The design means that emissions from groundworks and ground improvement materials will form a separate part of the climate declaration. The reason why these elements are outside the regulatory framework for limit values is that ground conditions are of major significance for climate impact, and that developers have only limited opportunity to influence emissions.

The climate declaration, including the separate part, must be entered in Boverket’s climate declaration register. Confirmation of the registered climate declaration must then be submitted to the municipality’s building

committee as a basis for final clearance. The developer will not be required to make an additional climate declaration: instead, the regulation means that the party performing the climate declaration for new construction will fill in a separate part of the climate declaration for groundworks and ground improvements.

If groundworks and ground improvements are included in the regulatory framework for climate declaration, the complexity increases slightly as there is an additional element to deal with. This is primarily because the system boundary will be different for the limit value element of the regulations and the climate declaration element, which may be slightly challenging to communicate. If default values are permitted for this element, as proposed, the actual implementation of the calculation may be facilitated for the developer. It is important for default values to be formulated and selected in a way that allows them to reflect the specific criteria for the project so as to ensure that the use of default values does not lose sight of the purpose of submitting a climate declaration for this element. If the digital platform that the industry is working on is available in 2027, it will also be possible to automatically gather the quantification of energy and material resources for groundworks and ground improvements.

The proposal means that groundworks and ground improvements are not included in the limit value. The issue then is how much climate benefit can be achieved with the declaration. It is also deemed unreasonable to demand submission of a climate declaration in connection with a building permit, for example, when the rest of the climate declaration has to be submitted in connection with final clearance. This could have increased the incentives for implementing reduction measures in the soil preparation work. However, the fact that the climate impact from this part is reported separately in the climate declaration is deemed to be a way of encouraging increased knowledge, and hence any measures.

Many different variants of alternatives for dealing with this part in the regulatory framework have been considered. A more ambitious alternative would have been to propose inclusion of this part in the limit value, and more active measures would then be required in order to reduce the climate impact for the rest of the building. The benefit – besides providing more guidance – would also involve facilitating communication; that is to say, the fact that the proposal above means that all parts would be handled in the same way in the limit value part and the declaration part of the regulatory framework.

Consequences for construction stakeholders

97 per cent of respondents during Boverket's hearing (a total of 30 stakeholders) thought that the proposal for a climate declaration for groundworks and ground improvements was reasonable. Furthermore, a slightly smaller proportion (92 per cent of respondents, 24 respondents in total)

felt that the proposal was reasonable in respect of climate benefits compared to the administrative burden.

A more detailed account of how the proposal may affect the various construction stakeholders is presented below.

Consequences for developers

The collection of verifications from new groups of subcontractors is a consequence for developers of the fact that the climate declaration will be expanded to cover groundworks and ground improvements by 2027. Furthermore, the two major property developers interviewed in this investigation reckon there may be slightly higher costs as a result of more calculations needing to be performed.[106]

It also emerged during the interviews that the inclusion of groundworks and ground improvements in the climate declarations could affect where developers choose and are allowed to locate new buildings and parking. According to Riksbyggen, this requirement could lead to fewer areas becoming available for construction because the municipality, which holds the planning monopoly, is increasingly taking into account the impact of land on our climate when drawing up comprehensive plans and detailed development plans.[107] However, the consequences for localisation are unlikely to be attributable to the expansion of the climate declaration to groundworks and foundations.

Consequences for building contractors

Building contractors are likely to be affected on account of additional work to collect verifications for more elements. Land contractors are usually subcontractors or parallel contractors in a building construction project. According to the contractor from a regional construction company who was interviewed, the feeling is that the climate declaration of groundworks in particular requires an extra large knowledge boost compared to the inclusion of other elements. This is because at present, the industry is not used to adapting groundworks for climate calculations.[108]

Certainly, the climate declaration does provide information on the climate impact of foundations and groundworks. This information does not necessarily lead to action. However, it is possible that environmentally conscious developers will demand action to reduce climate impact, which also have an impact on the designed living environment.

Consequences for construction product manufacturers

A demand for climate data for new product groups is a likely consequence for building material manufacturers. This includes construction

[106] Interviewee, Riksbyggen, 2022, Major building contractor and developer, 2022.
[107] Interviewee, Riksbyggen, 2022.
[108] Interviewee, Regional building contractor, 2022.

product manufacturers who provide building materials for ground improvements, and who will now have an increased need to provide information on the climate impact of their products (EPDs). This proposal could lead to an increased demand for lighter building materials, according to the association for Swedish construction materials enterprises, which could reduce the need for ground improvements and thus reduce the carbon footprint of the building.

Consequences for small and medium-sized enterprises

Small and medium-sized enterprises are often engaged as subcontractors for groundworks and foundation works. Subcontractors that are in possession of machinery are often sole proprietorships, or they may have an employee. These will need to provide verifications to contractors or developers, and may need training to help them understand the context. However, expensive machinery and high productivity requirements may prevent small stakeholders from finding time for skills development.

Consequences for the State

The State, through Boverket, will need to clarify ambiguities, for example regarding the boundaries through new guidance, develop generic climate data for groundworks and ground improvements, and increase the supervision of climate declarations. New information also needs to be developed. For the State, the expansion will lead to increased administrative costs.

Consequences for municipalities

The proposal to expand the climate declaration to include groundworks and ground improvements is not anticipated to have any administrative consequences for municipalities.

Effects on costs

The costs of upskilling can be anticipated for a new group of entrepreneurs, often small businesses. Administrative costs are not expected to increase other than initially, as these are often subcontractors. The administrative costs may also increase slightly for the party preparing a climate declaration, and consist of time spent collecting verifications from another stakeholder (land contractors). This will result in initial costs for building material manufacturers if the demand for EPDs increases, which is less likely as default values will be available in Boverket’s climate database. There will initially be administrative costs for the State for initiatives which include updating the climate database. The fact that Boverket will need to review more documentation and more calculations in its supervision of climate declarations are ongoing costs that can be anticipated.

A climate declaration for alterations will be introduced in 2027

There is a proposal to make certain alterations requiring a building permit pursuant to Chapter 9, Section 2(3) of the PBL subject to a requirement for a climate declaration. A climate declaration for alterations is proposed for introduction in 2027, but with no requirement for a limit value for greenhouse gas emissions resulting from an alteration to the building. This proposal is deemed to involve clearer regulation, compared with restriction to construction projects covered by the concept of refurbishment in the Planning and Building Act (PBL). A climate declaration for alterations of a building includes additional material resources (not demolition) for modules A1–A4 and A5 construction product waste. Otherwise, the same exemptions apply as for climate declarations for new buildings.

Consequences for construction stakeholders

Making alterations subject to a climate declaration means that more projects will be required to register climate declarations. It is thought that this requirement will not affect alterations to single-family houses, given the fact that private individuals are exempt from climate declarations. Small and medium-sized developers and building contractors who have not been affected by the climate declaration regulations from 2022 will be affected.

Consequences for developers

The potential impact of introducing a climate declaration for alterations is that developers will need to establish a requirement for contractors when procuring materials.[109] The concern is that developers will receive fewer tenders, which in turn will lead to higher costs. Developers are also expected to have to hire more consultants, which will lead to increased costs for developer organisations. Moreover, developers are also expected to need their supervisors to undergo skills development.

Another consequence is that developers are likely to have an additional work step in which the sustainability department has to support the tendering process and check whether they meet the requirements.[110] There is also a concern among developers that the requirement for a climate declaration for alterations will generate more administration that does not create environmental benefits, and that will be placed on supervisors (who already have a lot of administration work to do).

Consequences for building contractors

Building contractors are the group most likely to be affected by the proposal, particularly smaller stakeholders specialising in refurbishment.

[109] Interviewee, Riksbyggen, 2022.
[110] Interviewee, Riksbyggen, 2022.

The anticipated impact of the proposal is that it may be difficult for building contractors to define which refurbishment projects are covered.[111] It is likely that many smaller building contractors will need to assimilate knowledge in order to produce or deliver data for climate declarations for refurbishment projects. Whilst a climate declaration for alterations may potentially influence the choice of materials, in most cases a refurbishment project is not expected to affect the façade (or other building exterior) and hence the designed living environment. However, the alteration may involve replacing the windows, installing new windows or doors, adding insulation to the building, replacing the façade material or replacing the roofing material. The designed living environment may of course be affected in such cases.

Consequences for construction product manufacturers

Stakeholders in the building materials industry state that the proposal will not make a significant difference, with roughly the same costs and parties involved as for new construction. However, they point out that it is important to look at the entire life cycle; and there is a risk of countering energy efficiency if this is not done. However, Boverket does not perceive this risk. See also Annex 2 if there are concerns about not including the entire life cycle. In interviews for this investigation, building materials merchants emphasise that costs are not expected to increase because refurbishment is included.[112]

Consequences for small and medium-sized enterprises

It has emerged from the interviews that the stakeholders who will be particularly affected by the proposal for a climate declaration for alterations are the small and medium-sized building contractors who largely work only with extensions and refurbishment s. For instance, small and medium-sized building contractors will need to assimilate knowledge in order to be able to produce materials for a climate declaration for alterations.[113] Smaller contractors may also need to bring in consultants as they do not have the expertise in-house.

Consequences for the State

The State, through Boverket, will need to increase its supervision of climate declarations, as more climate declarations will be entered, resulting in increased administrative costs. Small building contractors will need to assimilate knowledge, according to several stakeholders, so that they can develop materials for climate declarations for alterations. Boverket may therefore need to implement training programmes aimed at small and medium-sized building contractors who carry out alterations. There have

[111] Interviewee, Swedish Construction Federation (Byggföretagen), 2022.
[112] Interviewee, Optimera, 2022.
[113] Interviewee, Riksbyggen, 2022.

also been requests in the interviews to clarify what constitutes an alteration project.

Consequences for municipalities

Municipalities will need to publicise the requirement to submit a climate declaration in connection with alterations. Administration will be added as more climate declarations need to be processed.

Effects on costs

The initial costs for skills development are mainly expected to be incurred by construction stakeholders. Material costs may increase in alteration projects, but not necessarily because alteration projects have no cap on emissions. The administrative costs of supervision will increase for the State as more climate declarations will be registered.

Impact on the pace of renovation

According to the government assignment, Boverket has to provide a description and assessment of how an expanded climate declaration may affect the pace of renovation. How might the proposal to prepare a climate declaration for alterations affect the pace of renovation? Could the requirement for a climate declaration for alterations also affect how a building owner carries out a renovation?

The cost of preparing a climate declaration can be assumed to affect renovations. This could, for example, mean that a real property owner would choose to implement fewer measures than they would otherwise so as to avoid preparing a climate declaration. The cost of preparing a climate declaration in relation to the total cost of the project is crucial to the impact on the pace of renovation. There could be a significant impact if it constitutes a high proportion.

A climate declaration could potentially push for more measures to improve standards. The climate declaration does not affect the utility value, and it is not allowed to form the basis for a rent increase. This is similar to most energy efficiency measures. However, measures to improve standards are used to determine rent. To get a better return from the project, as well as compensating for the cost increase from the climate declaration, the cost of a declaration may result in real property owners implementing measures to improve standards. This, in turn, may affect tenants due to higher rents.

To summarise, it can be stated that the impact that the climate declaration requirement can have when alterations are made to an individual project is dependent on the cost of making a climate declaration in relation to the project size and costs. For a more review, more information is needed than was possible within the framework of this assignment.

Limit values from 2030 onwards

The reduction of the limit value may reduce emissions by about 23 per cent about a year after 2030[114] if the limit value for new buildings is reduced by 25 per cent by 2030, compared to the reference scenario (2025 baseline). Emission reductions could reach around 45 per cent if the reduction for new construction is 50 per cent in 2030 instead, compared to the reference scenario (2025 baseline).

In theory, a cost-effective pathway should ensure that the marginal cost of reducing emissions is the same over time. The equalisation of marginal costs over time also needs to take into account the fact that costs today are more onerous than costs that are postponed to the future. A cost-effective pathway has lower emission requirements in the beginning and the requirements increase over time, as the emission cost increases with stricter emission requirements. This indicates that a 25 per cent reduction is preferable to a 50 per cent reduction.[115]

It can also be noted that a reduction rate with repeated adjustments of the limit value that is smaller at the start of the period but increases over time until 2045 could lead to a more cost-effective pathway. That said, these adjustments must be balanced against the increased administrative costs in the event of more frequent reductions.

Costs for the State

There will potentially be major administrative costs for the State when limit values and an expanded climate declaration with more building elements are introduced in 2025 as proposed. In the next step, the introduction of climate declarations for building alterations in 2027 will increase the number of climate declarations. This will increase the administrative costs for supervision. At the same time, the climate declaration will also be expanded to cover the entire life cycle of the building, as well as groundworks and ground improvements. This means there will be a need

[114] The phrase “about a year after” refers to the fact that it will take time for the reduction to take effect. This applies to building permits granted as of 1 January 2030. Emission reductions will only start to come about during the construction period. The time between building permit and construction is difficult to determine as there may be a delay before construction begins.

[115] In theory, a cost-effective pathway should ensure that the marginal cost of emission reduction is equal over time. When applied in reality, this can be roughly equivalent to spreading the emission requirements over time, as evenly as possible. The idea is that when emissions are regulated with quantitative regulations, the marginal cost of these regulations should be calculated and set as equal for each time period. The equalisation of marginal costs over time needs to take into account the time preference, which means that costs incurred today are more onerous than costs that are postponed to the future. That is to say, giving up a sum of money today is a greater sacrifice than giving up the same amount in the future. As the cost of emissions increases as emission requirements are made stricter, this means that a cost-effective pathway has lower emission requirements at the start of a period and increase over time.

to update the information in the climate database again, and to expand the online service for registering climate declarations. There will also be costs for the development of the online service for registering climate declarations, as well as for information and guidance.

Table 9 summarises the State expenditure expected to result from the report's proposals in the period 2024–2027.

Table 9. Expenditure for the State arising on account of the proposals, SEK thousands

Expenditure	2024	2025	2026	2027
Boverket: see also Table 10	**8,000**	**7,800**	**7,900**	**12,700**
National Agency for Public Procurement, developed criteria for procurement	**1,000**			
Total	**9,000**	**7,800**	**7,900**	**12,700**

Swedish National Board of Housing, Building and Planning

Boverket (Swedish National Board of Housing, Building and Planning) is an administrative authority whose tasks include investigating, analysing and producing regulations and guidelines. The following new information has been included since the introduction of climate declaration regulations in January 2022.

The government authority administers the climate declaration register, an online service for registering climate declarations.[116] The information provided in the climate declaration register is used to enable Boverket to conduct effective supervision, follow-up and analyse the climate impact of the building stock.

Boverket is responsible for providing guidance on the regulations on climate declarations to developers and contractors, among others, by means of a digital handbook on climate declarations, online training programmes and seminars.[117]

Boverket provides and administers the climate database.[118] Boverket's climate database contains generic climate data to be used in climate declarations for construction products if no specific climate data is available. Boverket has a supervisory responsibility for climate declarations, and

[116] Boverket, 2022d.
[117] Boverket, 2022e.
[118] Boverket, 2022f.

conducts various checks to ensure that climate declarations are reasonable.

Table 10 shows the increased resource requirements for Boverket in 2024–2027 if the proposals in this report are to be implemented.

Table 10. Boverket's increased resource requirements as a result of the proposals, SEK thousands

Expenditure	2024	2025	2026	2027
Development of IT support for registers and supervision	**3,800**	**1,100**	**2,200**	
Management of IT support for registers and supervision		**600**	**1,300**	**1,700**
Reference values for limit values	**400**	**400**		
Development of quality management system for climate declaration review		**1,800**		
Operational supervision of limit values			**300**	**3,000**
CoClass study	**600**			
Climate database, development of climate data and IT support	**1,400**	**1,600**	**1,700**	
Climate database, administrative expenditure		**200**	**300**	**700**
Information and guidance initiatives	**1,800**	**2,100**	**2,100**	**900**
Evaluation				**1,700**
Supplementary reference value study				**4,000**
Preparation of new/updated limit values				**700**[119]
Total	**8,000**	**7,800**	**7,900**	**12,700**

Development of IT support for registers and supervision

In the event of an expanded climate declaration, Boverket's online service for registration of climate declarations needs to be expanded from the current 40 or so data fields to about 750 data fields. All new fields are

[119] The cost may be added to 2028.

necessary to be able to break down the reporting of the climate impact of buildings. These climate calculations can then be compared with reference values to assess whether the building meets the defined limit value. Boverket's IT support for supervision (administrator support) also needs to be developed due to the introduction of limit values. The proposals in the report will also involve increased costs for **management of IT support for registers and supervision**. The cost estimate includes the work of experts at Boverket and consultancy costs.

Reference values for checking limit values

A reference value for different building types needs to be developed within the framework of Boverket's supervision of climate declarations, describing information on design solutions and material choices in accordance with the CoClass classification system. This reference value must coincide with the limit value for the building type. The cost estimate includes the work of experts at Boverket and consultancy costs.

Development of quality management system for climate declaration review

Boverket needs to develop a quality management system for the qualification of reviewers and ensure resources to maintain this system within the framework of Boverket's supervision when limit values are introduced. Boverket needs to develop a qualification system that corresponds to what an accredited personal certification body would need to develop in order to offer certification. Boverket proposes that an review be conducted by Boverket using qualified in-house and/or external reviewers. The cost estimate includes the work of experts at Boverket and consultancy costs.

Operational supervision of limit values

Qualified expert reviewers will be necessary for supervision when limit values for the climate impact of buildings are introduced. It is difficult to estimate the costs for a system built from scratch. The time needed for each review will vary, but is estimated to be around 200 hours for reviews in 2026, subsequently increasing to 2000 hours from 2027. The review is proposed to be conducted by Boverket using qualified in-house and/or external reviewers. The cost estimate for 2026 and 2027 is based on 10 per cent of the expected number of climate declarations received being subject to review. Each review is estimated to take about 16–24 hours and involves an investigation to ensure that the result – taking into account the existing data and uncertainties – is below the limit value.

CoClass studies

The current classification of buildings into building elements used for reporting climate impact in a climate declaration is too coarse and unclear. A clearer classification system should be introduced for building elements when limit values are introduced. This will also promote legally certain and cost-effective supervision. The cost estimate for investigating

which CoClass level should be used in a climate declaration and whether the State should take over ownership and management responsibility includes the work of experts at Boverket and consultancy costs.

Climate database, development of climate data and IT support

Generic climate data is available for over 200 resources in Boverket's climate database. This needs to be developed prior to the rule change in 2025 with a new type of resource, and default values need to be developed and added to the climate database for technical equipment, interior finishes and fixed interior design. But also climate data for construction products contained in these building elements, in kg CO_2e per kg or equivalent. IT support needs to be developed by creating new categories in Boverket's climate database for the additional building elements: technical equipment, interior finishes and fixed interior design.

From 2027, the climate database also needs to be populated with climate data for the additional modules B2, B4, B6 and C1–C4, as well as climate data for groundworks and ground improvements.

Scenarios need to be developed for electricity and district heating. This will involve developing relevant emission factors and developing scenario-based emission factors for electricity and district heating.

Climate database, administrative expenditure

The development of Boverket's climate database involves more resources and more climate data per resource. It also involves a cost for the development of IT support, as well as an increase in management costs. More resources will mean more questions needing to be answered. More climate data will increase the amount of information available, and hence the risk of errors that need to be addressed. It also increases the time spent by Boverket on troubleshooting, meetings and corrections.

Information and guidance initiatives

New information material needs to be produced for the introduction of limit values and an expanded climate declaration. A new and updated guide also needs to be produced for Boverket's digital handbook, including the Boverket online training programme. Moreover, materials need to be produced for the planned dialogue meetings and webinars. The information initiatives will also include advertising in the trade press in order to provide information on the new regulations adopted.

The EU regulations as proposed in the EPBD (revised EPBD) are expected to enter into force on 1 January 2027. We have used this date when calculating expenditure for information and guidance initiatives. The information and guidance initiatives include the work of experts and PR officers at Boverket, as well as an estimated need for consultancy work during the period 2024–2027.

Evaluation

An evaluation regarding the consequences of the regulations is needed and should be carried out two to three years ahead of the planned reductions, preferably in 2027. This evaluation will include consultancy assignments, interview studies, surveys, etc. The evaluation needs to cover costs and other impacts on various stakeholders, especially small and medium-sized enterprises, but also the impact on housing construction and building owners. The evaluation also needs to include the progress made in the transition in terms of different materials. It is important to evaluate how the regulations govern the choice of different design solutions and whether undesirable effects may arise in terms of technical property requirements. There is also a need to evaluate any potential conflicting objectives that may arise and the chances of single-family houses meeting stricter requirements for limit values in 2030. The cost estimate includes the work of experts at Boverket and consultancy costs.

Supplementary reference value study

Boverket sees the need of a supplementary reference value study to be carried out in 2027 in order to obtain sufficiently good data for deciding on balanced limit values for the building types included in Group 2 (other buildings where no robust reference values are available) ahead of a planned reduction of limit values in 2030. The cost estimate includes the work of experts at Boverket and consultancy costs.

Preparation of new/updated limit values

In connection with the evaluation in 2027, Boverket should be commissioned to submit proposals for stricter limit values for the climate impact of buildings. The cost estimate includes the work of experts at Boverket and consultancy costs.

An increase in Boverket's resource requirements

To summarise, it can be stated that the State is the stakeholder that will incur the greatest administrative costs as a result of the proposals. The State is also expected to incur costs for training programmes in connection with the introduction of limit values and an expanded climate declaration.

The costs of supervision will increase for the State due to the increase in the scope and number of climate declarations, and for checking compliance with the limit values. Ongoing costs will also be incurred for the operation and maintenance of the climate database and the climate declaration register. The introduction will also require an update of the climate database, with new default values, and the implementation of information initiatives.

For Boverket, the proposals are expected to lead to an increase in the government authority's resource requirements by a total of approximately

SEK 36 million during the period 2024–2027. These costs will cover both the development and management of the new systems. Our proposal is that Boverket be given at least SEK 8 million per year in 2024–2026 to develop and manage the next step of the regulations on climate declarations. A higher resource requirement of about SEK 13 million is predicted for Boverket in 2027.

National Agency for Public Procurement

The cost of developing procurement criteria linked to the expanded climate declarations with limit values can be estimated at around SEK 1 million. It is important to reach early stages of the construction process in order to ensure the efficacy of the procurement requirement, and that the requirement is really embedded in the project design. The National Agency for Public Procurement has worked with this perspective in the current version of the climate declaration. The cost is dependent on the level of ambition. The existing climate-related criteria need to be updated and adapted initially. This work is estimated to cost about SEK 500,000. New development of the digital procurement support linked to a new legal requirement will then be required. This development work is estimated to cost around SEK 300,000. Finally, the system will have to be tested by users. User testing is estimated to involve expenditure of around SEK 200,000. This means that the total is estimated to amount to approximately SEK 1 million for the National Agency for Public Procurement in order to develop criteria for procurement.

Discussion and conclusions

The starting points for the development of the proposals made in the report were:

- **To minimise complexity when the regulatory framework is expanded.** A balance has been struck between avoiding additional administrative burdens that focus on performing calculations rather than implementing reduction measures, and the fact that there is a strong desire from the industry to develop the regulatory framework further by including several parts of the life cycle, for example.
- **To minimise the risk of undesirable effects from the regulatory framework when limit values are introduced.** Overly strong emphasis on the climate impact of actual construction risks overshadowing other key sustainability issues such as the energy performance of buildings, a good indoor environment and aesthetic values. It is thought that the limit values proposed from 2025 need not conflict with other sustainability aspects, based on analyses of a number of such characteristics; and there is plenty of time to evaluate any undesirable effects of the regulatory framework until future reductions are implemented. The issue has also been discussed repeatedly with industry representatives. It will also be useful to study in future evaluations how decisions on reduction measures in projects are actually made; whether they involve one-sided comparison of the climate impact of individual products at the product stage, or whether they also lead to developments in terms of the optimisation of different resources in projects.
- **To maximise use of the policy instrument to encourage genuine action to reduce climate impact.** It is felt that introducing limit values for modules A1–A5 only is a well-balanced choice. This covers the vast majority of climate impacts from a life cycle perspective, while also placing focus on steering towards the reduction of climate impact that is taking place today when new buildings are erected, and that can be measured and verified, and that is not regulated in any other way by means of regulations on erection, for instance. Making additional parts of the building's life cycle mandatory does not automatically mean that the regulatory framework will lead to further reductions in climate impact. Scenarios need to be clearly defined using a robust methodology. However, it is thought that an expanded climate declaration need not be so costly through the provision of scenarios and standardised value, and it can nevertheless provide guidance on how choices can be made to ensure a low climate impact over the entire life cycle.

The collective proposals in the report represent a major expansion of the regulatory framework. It is felt that this is possible for users, and the construction sector is already working actively on a number of the issues proposed for inclusion in the regulatory framework. For the State, a number of measures are required to specify the future regulatory framework and provide tools to help users implement the changes. Moreover, major information initiatives are needed in order to communicate the regulatory changes, while smaller enterprises are still not fully aware of the current regulatory framework. This presents a communication challenge, and the supervisory apparatus needs to be built up in terms of expertise and include new elements. The regulations on limit values should given priority, if there is any need to prioritise between policy instruments.

One recurring issue in the work on the assignment considers how small and medium-sized stakeholders in the construction industry will be able to cope with the regulatory requirements. It is thought that the limit value levels proposed for 2025 will not be more difficult to achieve for smaller stakeholders than for others. However, the State may need to find ways of facilitating the administrative work involved in preparing the climate declaration, particularly for smaller stakeholders. However, most of this administration is already linked to current regulatory requirements, although the complexity will increase slightly with an expanded climate declaration.

The regulatory framework – both now and as it expands – contains a great deal of detail that is difficult to grasp fully, although simplicity has been a guiding principle when developing the proposals. The focus has been on developing a robust and simple method, especially for the limit value element. The fact that the limit values and the expanded climate declaration have different system boundaries therefore presents another communication challenge.

That said, the overall assessment is that the entire industry really wants the developed regulatory framework, not least with limit values. At the hearing held in August 2022, half of the respondents to the survey said they would have liked to see stricter requirements than the proposed levels for limit values. There are also examples of cost-effective new construction concepts that are already significantly lower than the proposed limit value levels even now. There has been rapid advance in the development of tools, implementation and learning about climate calculations, as well as various initiatives for driving rapid reductions. This is applicable not only to developers and contractors: rapid developments can also be seen among material producers earlier in the value chain. There is deemed to be major potential for new markets.

The issue of whether climate declarations should also be introduced for refurbishment and how this should be achieved has presented a challenge.

It is difficult to find a suitable existing definition in the Planning and Building Act that can simultaneously “capture” renovation projects and measures with major climate impact. Achieving good quality for the data for climate calculations, i.e. the resource summaries, still presents a challenge. This is still under development for refurbishment projects. That said, renovation, refurbishment and maintenance of existing buildings represents a major climate impact in the construction and real estate sector.

Continued digitalisation and interlinking of digital systems is key to minimising the administrative burden on project stakeholders when preparing climate declarations. The State needs to ensure that smaller stakeholders also have access to and benefit from the major digitalisation projects that are in progress, with the aim of simplifying the provision of information.

Legal commentary

Proposal for an act amending the Act on climate declaration for buildings (2021:787)

Step 1, entry into force on 1 July 2025

9 a §

A new section with a new heading, “Limit value”, regulates the introduction of a limit value for maximum climate impact when erecting new buildings.

When the Act and Ordinance on climate declaration for buildings entered into force on 1 January 2022, the regulations meant that this involved declaring the climate impact. There was no requirement for a certain maximum climate impact not to be exceeded.

The government will issue more detailed regulations on the limit value.

16 a §

A new section is added. An authority can entrust administrative tasks to an individual, that is to say a natural or legal person who is not a authority or other public body. However, if the task involves the exercise of authority, the task may only be transferred pursuant to the law, as stated in Chapter 12, Section 4, second paragraph of the Instrument of Government. This provision refers to the entire processing of a case. Legal support is given to Boverket so that it can enter into agreements to outsource to an external party assignments in respect of supervision that would otherwise be regarded as exercise of authority, such as the review stage in the processing of a supervision case. However, assignments involving assessments leading to a decision cannot be outsourced to an external party. Only Boverket is able to examine and make decisions on supervision cases.

17 §

The section has been amended. During supervision, Boverket must not alter the recorded value to the value calculated by the authority. It is not possible for Boverket to calculate a new value for the climate impact of a building. Boverket must review and assess the calculation base that will verify the declared value and the information in the climate declaration. If the value differs from the declared value or exceeds a limit value when this check has been performed, the climate declaration can be selected for detailed supervision. In the detailed supervision, Boverket must have the

option of requesting verifications that confirm the value of the climate impact declared.

Boverket's supervision is based on a desk review. This supervision means that Boverket has to assess whether a correct calculation has been performed. If Boverket's supervision finds that the calculation is incorrect, the developer must be given the opportunity to rectify it and submit a correct calculation or correct documentation.

18 §

The section has been amended and supplemented. An addition is made to the first paragraph, item 1, stating that a sanction fee may be levied if the developer submits incorrect documentation and should reasonably have realised this.

Item 2 of the first paragraph has been amended to state that a sanction fee may be levied if the building's declared climate impact value exceeds the limit value pursuant to 9 a §. The previous case – where a declared value substantially deviates from the supervising authority's calculated value – has been moved to Section 17, replacing "deviates from the supervising authority's calculated value" with "deviates from a value that is reasonable in the opinion of the authority".

The second item of the first paragraph is amended to state that a sanction fee may be levied if the declared value exceeds the limit value pursuant to 9 a §. For a limit value to be meaningful, there needs to be an associated sanction. Having an associated sanction in order to have a limit value regulation at all is a matter of credibility.

Parallels can initially be drawn with other areas and the sanctions linked to corresponding types of limit value regulations.

Environmental Code (1998:808)

The closest situation within the Environmental Code that resembles the current limit value regulation involves permits linked to direct activities and associated emission conditions (regarding emissions of nitrogen oxides, for example). However, this is not a direct parallel as there are often permits with emission conditions that allow a value to be exceeded, but only a few times a year. The value that cannot be exceeded is known as a restriction value. Different types of sanctions can be applied, starting with the injunction, which is the least intrusive, then combining the injunction with a contingent fine, and finally a ban.

There is a special Ordinance on environmental sanction fees (2012:259) linked to the Environmental Code. This provides for an environmental sanction fee to be paid if, for example

- a sewage system has been installed without a permit, even though such a permit is required (Chapter 3, Section 1).
- a ship has used marine fuel which, according to the Sulphur Ordinance, has too high a sulphur content (Chapter 7, Section 17).

Planning and Building Act (2010:900)

The Planning and Building Act contains a number of different types of sanctions. This is essentially basically based on a system of building permits and supervision and inspection regulated in Chapters 9 and 10 of the PBL. Boverket's building regulations (BBR) and Boverket's construction regulations (EKS) contain specifications of requirements for buildings among other when a building erects. For example, this may relate to the requirement for the annual average of the activity concentration of radon in the indoor air not to exceed 200 Bq per m^3 (section 6:23 of the BBR). Another example relates to regulations on emissions to the environment (section 6:7 of the BBR). This section regulates the amount of emissions permitted from buildings with solid fuel boilers or space heating appliances.

Sanctions in the PBL include injunctions, such as action injunctions and correction injunctions that may be combined with contingent fines. Bans may also be imposed on, for example the continued use of a building. One example of a sanction that may be linked to the regulation on radon is an action injunction in the building to bring the activity concentration below 200 Bq per m^3. A large number of construction sanction fees are also available. This may, for example, involve starting a construction project even though no starting clearance has been given.

Act on energy declarations for buildings (2006:985) and Ordinance on energy declarations (2006:1592)

In a decision, Boverket can order a developer to submit an energy declaration for one or more buildings. If the deadline for the injunction has passed with no action being taken, the injunction may be accompanied by a contingent fine. If the time for injunction with a contingent fine also has expired, Boverket can apply to a court for the contingent fine to be imposed.

Generally speaking, sanctions can in some cases be used as a means of exerting pressure to persuade a party for instance to take action. By way of example, the organisation may have emitted excess nitrogen oxides during the year, and the sanction is then a means of exerting pressure to ensure that the organisation in question does not continue along this path in future. Another example is where the newly erected building has too high radon level in the indoor air, but the radon level in the building is reduced by exerting pressure.

This case does not involve a means of exerting pressure. Instead, the "damage" has already been done: in other words, the climate impact was too great up to the time the building was erected. The building has already been erected. What the climate declaration regulations aim to achieve until the time the building is erected has already been implemented.

A sanction must not lead to further climate impact linked to the individual project because for example the sanction involves demolishing a certain part or all of the building. That said, a sanction must act as a deterrent by being financially severe. The aim is to ensure that the developer in question will be vigilant of their climate impact the next time they erect a building, and adapt various choices during an early stage of construction so as to minimise the climate impact and hence not exceed the limit value.

There is an ongoing discussion in society about carbon offsetting measures such as installing solar cells, growing trees, etc. This could be an appropriate alternative for a sanction. However, it would be difficult to determine what kind of measures would be involved. Moreover, it raises several legal issues, such as who has the resourcefulness to undertake such measures, and when this has to be done. That is why applying carbon offsetting measures as sanctions is of no relevance.

The sanction needs to be proportionate. It is not proportionate per se to have to demolish a building because the limit value is exceeded.

Contingent fines are not relevant as they are an enforcement tool used to ensure compliance with injunctions or bans.

All in all, the most appropriate sanction is a sanction fee for the situation where the declared value of the climate impact exceeds the limit value. This is an effective and appropriate sanction in this case. The sanction fee is already available as a sanction pursuant to applicable regulations in the Act and Ordinance on climate declaration. This argues in favour of continuing to apply the sanction fee as a sanction for consistency, and even then having it linked to exceeding of the limit value.

More information on the sanction fee

This section also regulates communication prior to a decision on a sanction fee. A supervising authority must give the developer the opportunity to give an opinion before making a decision on a sanction fee. Corresponding wording for construction sanction fees can be found in Chapter 11, Section 58 of the PBL.

A sanction fee is not a penalty, but an administrative sanction. However, it cannot be excluded that a sanction fee is a sanction of a penal nature such that Section 6 of the European Convention on Human Rights

(ECHR) is applicable (cf. p. 346 of Government Bill 2009/10:170). It is up to the supervising authority to demonstrate that the conditions for imposing a sanction fee have been met. Legal certainty related to the sanction fee is key.

Two different sanction fees may not be imposed for the same matter. That is to say, there must not be "double punishment" for the same thing (ne bis in idem). A sanction fee may not be levied pursuant to paragraph 1, item 1 if a sanction fee is levied pursuant to paragraph 1, item 2. This is clarified in the penultimate paragraph of the provision. The most severe sanction fee – which is the sanction fee for exceeding a limit value – will essentially be imposed.

A ceiling is added to the provision for the extent of the sanction fee, which is 20 price base amounts. In the current regulations, the ceiling is 10 price base amounts (regulated in Section 13 of the Ordinance on climate declaration for buildings). The ceiling is being raised following a comparison with the production costs involved in erecting buildings. For instance, the average production cost in Sweden for a small multi-dwelling block of 1000 square metres was SEK 44.4 million in 2021. This suggests that the ceiling can be increased. The fact that Section 18 a introduces an option to reduce or completely waive the sanction fee under certain conditions has also been taken into account here. On balance, it is reasonable to work on the basis of the current ceiling, but to increase it by doubling it.

18 a §

A new section. The option of reducing a sanction fee is based on the provisions on the reduction of sanction fees in Chapter 11, Section 53 a of the PBL. An addition has been made which makes it possible to take into account whether the sanction fee will impose a disproportionate burden on a developer. This will make it possible to take into account whether the sanction fee without a reduction would involve a risk of bankruptcy for a smaller company, for example. The wording does not specify the extent by which the sanction fee may be reduced, unlike the aforementioned section of the PBL.

The wording about not levying a sanction fee at all is based on the regulation about completely waiving the construction sanction fee pursuant to Chapter 11, Section 53 paragraph 2, items 2 and 3 of the PBL.

It is reasonable that all situations covered by the sanction fee provision are subject to an option to reduce and completely waive the sanction fee.

18 b §

A new section that allows Boverket to order a developer to submit verification and documentation. This opportunity is not provided in the current

provisions. At present, it is only possible to ask the developer to submit documentation, but there is no real means of exerting pressure to demand the documentation. The injunction must serve as a means of exerting pressure in order to persuade a developer to submit documentation, verification and/or a correction. The option of attaching a contingent fine as an enforcement tool is also introduced.

The second paragraph is based on Article 4 of Protocol No. 7 to the European Convention, which regulates the right not to be prosecuted or punished twice for the same offence ("ne bis in idem"). The matter of whether or not an injunction with a contingent fine has or has not been breached is not in itself relevant to the matter of a sanction fee. For instance, the supervising authority may be of the opinion that it is futile to apply for the imposition of a contingent fine due to a previous formal error in connection with an injunction with a contingent fine, but then decide to impose a sanction fee instead (see Government Bill 2009/10:170 p. 350; and see, for example, NJA 2013 p. 502 and NJA 2014 p. 371, and also HFD 2013 ref. 71 and HFD 2014 ref. 35).

19 §

Amendment to the section. A consequential amendment, as decisions to amend the recorded value are removed.

Decisions on sanction fees may be appealed to a general administrative court. Decisions on injunctions and injunctions with contingent fines can also be appealed.

Entry into force and transitional provisions

It is proposed that the regulations should enter into force on 1 July 2025. As this report shows, it is possible to introduce limit values earlier than 2027. The proposed date is 1 July 2025, after taking into account the time needed for the legislative process.

The new and amended regulations shall apply to new buildings erected, where an application for a building permit has been received by the building committee on or after 1 July 2025. This means that a limit value with a maximum climate impact exists for these buildings at the time of erection.

Proposal for an ordinance amending the Ordinance on climate declaration for buildings (2021:789)

Step 1, entry into force on 1 July 2025

3 §

This section is supplemented with a second section on calculation bases. The calculation base must be submitted to Boverket when the climate declaration is registered. According to the proposal, the calculation base must be submitted when the climate declaration is registered. This differs from the current regulations where only the climate declaration is submitted to Boverket, and where Boverket can request documentation at a later stage in its supervision. When the developer has registered the climate declaration and the calculation base, an automated initial review is carried out ahead of possible selection. The purpose of this is to conduct an automated and digital check of all climate declarations when they are registered.

Boverket may issue regulations on how declarations are to be submitted. According to applicable regulations, the climate declaration must be submitted by the declarant on a form defined by Boverket. The calculation base must be submitted in a digitally defined format when the climate declaration is registered.

Boverket may issue regulations stating that a calculation base may be submitted together with a climate declaration in a form. The existing form may be expanded to include the calculation base.

There is a need for confidentiality in respect of the calculation base. Confidentiality pursuant to the Public Access to Information and Secrecy Act (2009:400) and the Public Access to Information and Secrecy Ordinance (2009:641) applies only to documentation in an supervision case, not to documents in the climate declaration register. An addition needs to be made to the regulations on information and secrecy.

Boverket may also issue regulations stating that climate declarations and calculation bases may be submitted and transferred electronically to the climate declaration register.

5 §

This section has been supplemented.

Amendment to the regulation which means that a climate declaration has to be submitted for more parts of the building.

Technical equipment and fixed interior design must also be declared. However, Boverket intends to exempt technical equipment and fixed interior design needed to conduct business from the regulations for other buildings pursuant to Section 7 a paragraph 1, item 7, such as supermarkets. For supermarkets, such a provision would mean that the technical equipment and fixed interior design needed to conduct their trade would not require submission of a climate declaration.

Boverket intends to exempt fixed equipment in regulations.

A certain minimum coverage ratio of 80 per cent is required in the climate declaration. The climate impact needs to be calculated up to 100 per cent if the coverage ratio is lower than 100 per cent. The provision defines the coverage ratio and specifies how the coverage ratio is to be calculated. The coverage ratio indicates how much of a building's climate impact has been calculated, and how well the calculation reflects the erected building. The coverage ratio is calculated for included construction products. A method needs to be devised for calculating up the coverage ratio. The calculation method/formula is specified in a regulation. Boverket's authorisation needs to be expanded, and this is regulated in Section 7.

7 §

Addition to the section.

The authorisations to Boverket are expanded so that Boverket is entitled to write regulations on the coverage ratio and how climate impact is to be calculated to correspond to a 100 per cent coverage ratio.

7 a §

There is a new section with a new heading, Limit value, which sets the level of the limit value for different types of buildings erected.

Considerations for the choice of the limit value level and classification into different building types can be found in the chapter entitled Levels for limit values in 2025. The building types are defined according to Boverket's Purpose Catalogue.

If a building is to include a number of uses, the limit value needs to be defined on the basis of the area of the different uses. For instance, if half of the area in a building 2000 square metres in area is made up of multi-dwelling blocks and half is made up of offices, the limit value is defined on the basis of the following calculation (multi-dwelling blocks have a limit value of 375, while offices have a limit value of 385):

((1000/2000) x 375 + (1000/2000) x 385)/2). The limit value is therefore 380 kilograms of carbon dioxide equivalent per square metre of gross floor area.

The climate impact associated with a limit value must be calculated pursuant to applicable regulations. That is to say, this must apply to the climate impact of parts of a building's life cycle pursuant to Section 8 of the Act on climate declaration for buildings (construction stage A), as well as the parts of the building regulated in Section 5 of the Ordinance on climate declaration for buildings. However, the regulation states that the climate impact of solar cells is not to be included in the climate impact linked to the limit value. This applies to both surface-mounted and

building integrated solar cells. That said, surface-mounted and building integrated solar cells must be included in the actual declaration of the building's climate impact, but these must be declared separately.

Special housing is defined in the section.

12 §

This section is supplemented with a second paragraph stating that Boverket may issue regulations on how the information and documents referred to in Section 16 of the Act on climate declaration for buildings are to be submitted to Boverket.

12 a §

A new section.

Contains regulations on the content of what can be verified. Documentation must be presented at the request of Boverket. The documentation must be digital. The documentation must include verification of construction products purchased, as well as verification of product and supplier-specific climate data. Verification of construction products purchased must cover at least 75 per cent of a building's total climate impact. Verification of product- and supplier-specific climate data must be available in full. The verifications control the point in time from which the climate data was retrieved. This time must be the time of delivery to the construction site.

13 §

This section is supplemented with a sanction fee for the additional situations where a sanction fee may be imposed. How the sanction fee is to be calculated needs to be regulated at an ordinance level, as well as pursuant to the current regulations. These are regulations that can be viewed as being of a penal nature.

It is reasonable to equate the situations pursuant to Section 18 paragraph 1, item 1 of the Act and have the same sanction fee level for them. It is necessary to consider whether a sanction fee should be formulated in a different way and at a different level, as regards the situation in item 2 of the Act, where the declared value exceeds the limit value. When registration takes place, Boverket will carry out an automatic check against the intended use of the building and the declared climate impact will be checked against the limit value.

It is important for the design of a sanction fee to make it possible to predict how large the sanction fee will be. This is predictable by means of a clear link to price base amounts, the area of the building and the maximum amount. The maximum amount is set out in Section 18 of the Act.

This is the same approach as for the current regulations on sanction fees. Maintaining the same parameters is natural. It is appropriate to use the area of a building as this affects the overall climate impact.

Whether to include an additional parameter in the form of the extent by which the limit value has been exceeded has been considered in the case involving a link to the limit value. However, this has not been considered necessary as the limit value can be reduced or waived completely and the extent by which the limit value has been exceeded can be taken into account in the case in question. It must always be considered whether reduction of a fee is appropriate, or whether the fee should be waived completely.

It is reasonable to work on the basis of the sanction fee that already exists in Section 13 of the Ordinance on climate declarations when determining the level of the fee. There is a need to grade which sanction fee should be the most financially severe. When the limit value is exceeded, this should reasonably lead to the most severe sanction. The reason is that the purpose of the Act is to reduce climate impact, so reasonably excessive climate impact is the event that must be most financially severe. However, there is only a minor difference in the design of the sanction fees. This amounts to 0.002 price base amount per square metre if the limit value is exceeded, instead of 0.001 price base amount per square metre.

If it is noted during supervision by Boverket that the limit value has actually been exceeded, a sanction must still be imposed pursuant to Section 18 paragraph 1, item 1 of the Act.

Examples of the outcome of the sanction fee are described here for three buildings of different sizes as a function of what type of offence. The price base amount for 2023 is SEK 52,500.

Section 13 paragraph 3: exceeding the limit value pursuant to Section 18 paragraph 1, item 2 of the Act (the fee is then one price base amount plus 0.002 price base amount per square metre of the total gross floor area of the building, and the fee may not exceed twenty price base amounts [SEK 1,050,000]):

Building 101 sq m	SEK 63,105
Building 2,000 sq m	SEK 262,500
Building 10,000 sq m	SEK 1,050,000

Section 13 paragraph 2: offence pursuant to Section 18 paragraph 1, item 1 of the Act (the fee is then one price base amount plus 0.001 price base amount per square metre of the total gross floor area of the building, and the fee may not exceed twenty price base amounts [SEK 1,050,000]):

Building 101 sq m	SEK 57,802
Building 2,000 sq m	SEK 157,500
Building 10,000 sq m	SEK 577,500

Entry into force and transitional provisions

It is appropriate for the Ordinance to enter into force at the same time as the Act and have the same transitional provisions. Entry of the Ordinance into force is therefore proposed to take place on 1 July 2025. The regulations shall apply to new buildings erected where an application for a building permit is received by the building committee on or after 1 July 2025.

Proposal for an act amending the Planning and Building Act (2010:900)

Step 1, entry into force on 1 July 2025

Chapter 10

Section 19

Addition to the section on what has to be covered in the technical consultation. A new item stating that the need for a climate declaration is to be reviewed.

It is necessary to clarify in the Act that the issue of whether or not a climate declaration needs to be prepared has to be raised during the technical consultation. A parallel may be drawn with the item in the regulation stating that the need for completion protection must be reviewed. In both instances, the requirement for this is regulated in legislation other than the PBL.

The climate declaration is linked to the construction process in Chapter 10 of the PBL, and the building committee cannot issue final clearance if a climate declaration is to be prepared but this does not happen. That is why it is important to ensure that the need to prepare a climate declaration and register it with Boverket is reviewed during the technical consultation.

The building committee decides on whether the building is subject to a climate declaration requirement.

Entry into force and transitional provisions

It is proposed that the regulations should enter into force on 1 July 2025. It is appropriate for the amendments to the Planning and Building Act to be implemented at the same time as the amendments to the Act on climate declaration for buildings.

However, the amendments to the Planning and Building Act do not require transitional regulations. These are clarifications on the technical consultation that can start to be applied directly to cases linked to climate declarations. Boverket has had guidance on the subject in the handbook entitled PBL kunskapsbanken [The PBL knowledge base], since the climate declaration regulations entered into force on 1 January 2022.

Proposal for an act amending the Act on climate declaration for buildings (2021:787)

Step 2, entry into force on 1 January 2027

2 §

Additions are made to the section regarding the situations in which a climate declaration is required. This requirement no longer applies merely to the erection of new buildings, but also to certain alterations other than extensions. The requirement for alterations other than extensions is linked to the obligation to obtain a building permit. In other words, in the same way as with erection, these erection operations must require a building permit in order for the requirement for a climate declaration to be of relevance. Therefore, the input has to be a building permit requirement for climate declarations, which is consistent.

This involves the requirement for a climate declaration in two instances involving alterations. Alterations requiring building permits that are regulated in Chapter 9, Section 2 item 3 a and Chapter 9, Section 2 item 3 b of the PBL. This makes it easy for the developer in question – as well as the municipality – to know when a climate declaration is required, the municipality ultimately decides whether or not a climate declaration is required.

Alterations other than extensions that require a building permit pursuant to Chapter 9, Section 2 item 3 c of the PBL are not covered. Extensions – that is, increasing the volume of the building – are still not subject to climate declaration requirements. Nor are any alterations covered that are notifiable pursuant to the Planning and Building Ordinance.

The buildings that may essentially be of relevance for climate declaration are the same as those under the current regulations. In other words, the exemptions pursuant to Sections 5 and 6 of the Act on climate declaration for buildings and Section 4 of the Ordinance on climate declaration for

buildings are also applicable in connection with the alteration of a building. For instance, a requirement for climate declaration of a building cannot be specified if the alteration relates to a building of 100.0 square metres or less.

Chapter 9, Section 2 item 3 a is applicable if the building in whole or in part is used or equipped for a significantly different purpose other than the one for which the building was last used or for which it has been adopted, according to the latest building permit granted, without the intended use having come about. This may involve altering a building with dwellings to create an office, for example.

Chapter 9, Section 2 item 3 b is applicable if alterations to the building provide additional dwellings or additional non-residential premises for retail, trade or industry. This may, for example, involve the creation of additional dwellings in an “cold attic”. However, there is no requirement for a climate declaration if no building permit is required pursuant to Chapter 9, Section 4 c. Chapter 9, Section 4 c states that: “For one dwelling houses, despite Section 2, no building permits are required to provide an additional dwelling in the building. This does not apply, however, to a dwelling that constitutes an accessory dwelling.” If furnishing additional non-residential premises for industry is involved, climate declarations are of no relevance as industry is exempt from the requirement for climate declarations pursuant to Section 5 of the Act on climate declaration for buildings.

If such an alteration is made to a building for which a climate declaration is required, the developer is required to have shown that a climate declaration has been submitted in order to obtain final clearance pursuant to the Planning and Building Act.

More detailed considerations can be found in the chapter entitled Climate declaration for refurbishment and extension.

5 §

Addition to the section. Climate declarations must also be submitted for certain alterations to buildings requiring a building permit, and not just the erection of buildings. The exemptions from climate declaration requirements in the regulations are expanded to apply in the case of alterations as well.

6 §

Addition to the section. Climate declarations must also be submitted for certain alterations to buildings requiring a building permit, and not just the erection of buildings. The exemptions from climate declaration requirements in the regulations are expanded to apply in the case of alterations as well.

8 §

Addition to the section, which applies only to the erection of a building, on the parts of the life cycle for which a climate declaration must be submitted.

The climate declaration is expanded to cover not only stages A1–5 (construction stage), but also some parts of stage B (use stage) and all of stage C (end-of-life stage).

8 a §

New section. When submitting a climate declaration for an alteration other than an extension to a building, the climate declaration must cover all additional construction products included in the alteration that are subject to a climate declaration requirement. This relates to A1–A5 (construction stage). The use stage and end-of-life stage do not require submission of a climate declaration, unlike the erection stage. Pursuant to authorisation, Boverket can regulate in regulations that submission of a climate declaration is not required for energy use in the construction production stage.

9 §

Addition to the authorisation in Section 9 paragraph 2, item 2. Submission of a climate declaration is also required for groundworks and ground improvements: see Section 5 a of the Ordinance. An addition is therefore made to the authorisation so that it applies not only to regulations on which parts of the building are to be declared, but also to regulations on measures related to the building.

Entry into force and transitional provisions

It is proposed that the regulations should enter into force on 1 January 2027. The date is set to coordinate and coincide with amendments to the Energy Performance of Buildings Directive. The date needs to be amended if there are any amendments linked with the Energy Performance of Buildings Directive.

The new and amended regulations must apply to new buildings that are erected, and to buildings that are altered in accordance with Chapter 9, Section 2 item 3 a or Chapter 9, Section 2 item 3 b of the Planning and Building Act where an application for a building permit is received by the building committee on or after 1 January 2027.

Proposal for an ordinance amending the Ordinance on climate declaration for buildings (2021:789)

Step 2, entry into force on 1 January 2027

4 §

Addition to the section. Climate declarations must also be submitted for certain alterations to buildings requiring a building permit, and not just the erection of buildings. The exemptions from climate declaration requirements in the regulations are expanded to apply in the case of alterations as well.

5 a §

A new section regulating the fact that a climate declaration has to be submitted for groundworks and ground improvements when a building is erected. This provision explains what is meant by groundworks and ground improvements. Measures that relate to connection of media up to insulation on the ground are not included. These are media connections in the form of district heating, water, sewage, electricity and data or similar.

For groundworks and ground improvements, a climate declaration only has to be submitted for the construction stage A1–A5. This can be regulated in regulations. Boverket is authorised to issue regulations granting exemptions from parts of the requirements defined for the content and scope of the climate declaration.

Groundworks and ground improvements must be reported separately.

An authorisation has been added to Section 9 paragraph 2, item 2 of the Act in order to regulate the fact that climate declarations must also be submitted for groundworks and ground improvements.

7 a §

Addition to the section which regulates the limit value applicable when buildings are erected. It is necessary to clarify the fact that the limit value is merely linked to the climate impact from the construction stage (stage A), as climate declarations must also be submitted for more parts of the life cycle than before. This is done by adding: with regard to 8 § item 1–5 of the Act on climate declaration for buildings.

It is further clarified that groundworks and ground improvements are not to be included in the climate impact linked to the limit value.

Entry into force and transitional provisions

It is appropriate for the Ordinance to enter into force at the same time as the Act and have the same transitional provisions. Entry of the Ordinance into force is therefore proposed to take place on 1 January 2027. The regulations must apply to new buildings that are erected, and to buildings that are altered in accordance with Chapter 9, Section 2 item 3 a or 3 b of the Planning and Building Act where an application for a building permit is received by the building committee on or after 1 January 2027.

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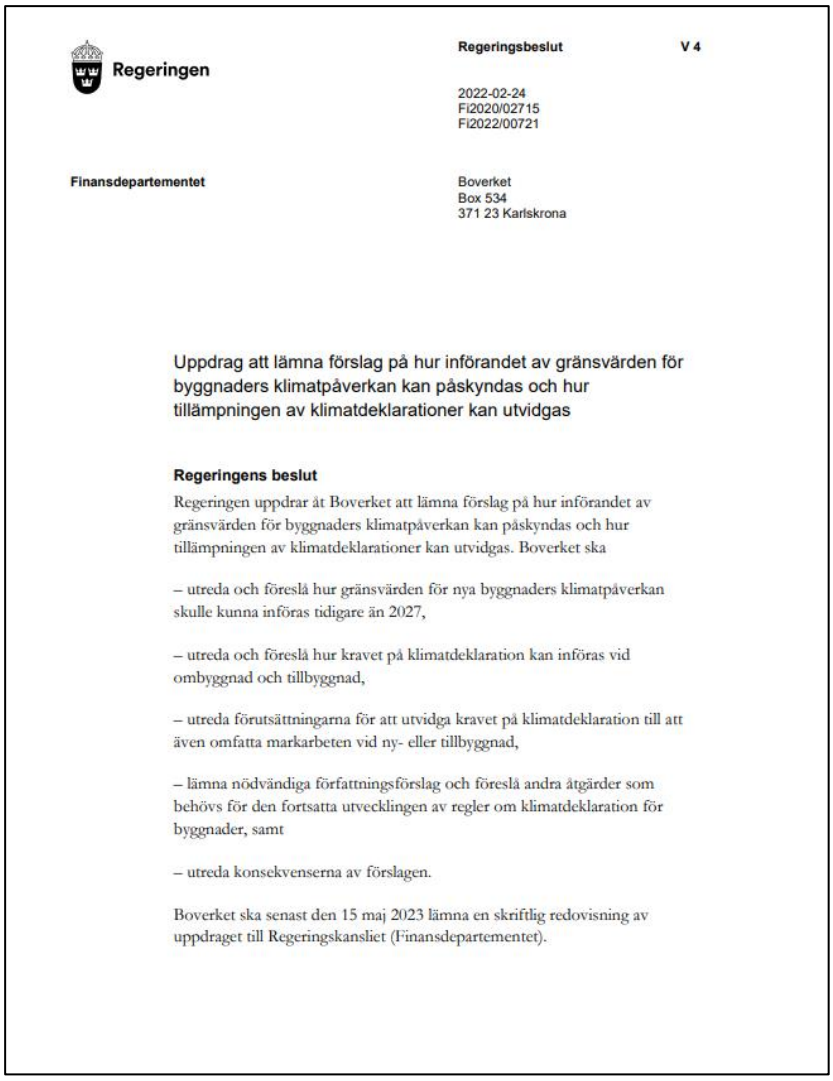
- Interviewee, Swedish Construction Federation (Byggföretagen), 2022

- Interviewee, association for Swedish construction materials enterprises (Byggmaterialindustrierna), 2022
- Interviewee, Optimera, 2022
- Interviewee, Regional building contractor, 2022
- Interviewee, Riksbyggen, 2022
- Interviewee, SJB, 2022
- Interviewee, Major building contractor and developer, 2022
- Interviewee, Svensk Byggtjänst, 2022
- Interviewee, Swedisol, 2022

Annex 1 Governmental assignment



Regeringen

Regeringsbeslut V 4

2022-02-24
Fi2020/02715
Fi2022/00721

Finansdepartementet

Boverket
Box 534
371 23 Karlskrona

Uppdrag att lämna förslag på hur införandet av gränsvärden för byggnaders klimatpåverkan kan påskyndas och hur tillämpningen av klimatdeklarationer kan utvidgas

Regeringens beslut

Regeringen uppdrar åt Boverket att lämna förslag på hur införandet av gränsvärden för byggnaders klimatpåverkan kan påskyndas och hur tillämpningen av klimatdeklarationer kan utvidgas. Boverket ska

– utreda och föreslå hur gränsvärden för nya byggnaders klimatpåverkan skulle kunna införas tidigare än 2027,

– utreda och föreslå hur kravet på klimatdeklaration kan införas vid ombyggnad och tillbyggnad,

– utreda förutsättningarna för att utvidga kravet på klimatdeklaration till att även omfatta markarbeten vid ny- eller tillbyggnad,

– lämna nödvändiga författningsförslag och föreslå andra åtgärder som behövs för den fortsatta utvecklingen av regler om klimatdeklaration för byggnader, samt

– utreda konsekvenserna av förslagen.

Boverket ska senast den 15 maj 2023 lämna en skriftlig redovisning av uppdraget till Regeringskansliet (Finansdepartementet).

Translation of governmental assignment

Assignment to submit proposals on how to accelerate the introduction of limit values for the climate impact of buildings and how to expand the application of climate declarations

The Government's decision

The Government instructs Boverket (the Swedish National Board of Housing, Building and Planning) to submit proposals on how to accelerate

the introduction of limit values for the climate impact of buildings and how to expand the application of climate declarations. Boverket shall

- investigate and propose how limit values for the climate impact of new buildings could be introduced earlier than 2027,
- investigate and propose how the requirement for climate declarations can be introduced for refurbishment and extensions,
- investigate the conditions for expanding the requirement for a climate declaration to include groundwork for new construction or extensions,
- submit the necessary legislative proposals and propose other measures needed for the further development of regulations on climate declaration for buildings, and
- investigate the consequences of the proposals.

Boverket shall submit a written report on the assignment to the Government Offices of Sweden (Ministry of Finance) no later than 15 May 2023.

Background

The construction and real estate sector accounts for a significant part of society's climate impact. In 2019, the sector's total greenhouse gas emissions, i.e. including emissions from imported goods, amounted to around 19 million tonnes of carbon dioxide equivalent from a life cycle perspective. The sector's domestic emissions of greenhouse gases, i.e. excluding emissions from imported goods, amounted to about 12 million tonnes of carbon dioxide equivalent, which is equivalent to about one fifth of Sweden's domestic emissions.

The Act on climate declaration for buildings (2021:787) was introduced on 1 January 2022. This regulatory framework means that the developer is responsible for preparing and submitting a climate declaration to Boverket when a new building is erected. The climate declaration shall reflect the climate impact occurring the construction stage when erecting a new building.

The requirement for developers to prepare climate declarations was introduced as part of the policy towards reducing the climate impact of buildings from a life cycle perspective (Government Bill 2020/21:144). The purpose of climate declarations is for these to provide support to stakeholders in the construction sector with the implementation of measures to reduce climate impact. The requirement for climate declarations creates the conditions making it possible in the long term to define minimum requirements for construction regarding the climate impact of buildings from a life cycle perspective.

Boverket has worked on behalf of the Government to develop a plan for the further development of the regulations on climate declaration for buildings (Boverket report 2020:13). Boverket proposes, inter alia, that

the climate declarations from 2027 be expanded to include reporting of greenhouse gas emissions for further parts of a building's life cycle (known as life cycle modules) during the use and end-of-life stages, as well as other environmental information. Furthermore, the Government authority proposes simultaneous introduction of limit values for the climate impact of buildings during the construction stage.

Accelerating the societal transition towards significant reductions in greenhouse gas emissions is required if the climate targets are to be achieved. There is therefore a need to review how the introduction of limit values for the climate impact of buildings can be accelerated. However, faster introduction of limit values for the climate impact of buildings during the construction stage must not prevent opportunities in the longer term to be able to define minimum requirements from a life cycle perspective.

There is currently no requirement to prepare a climate declaration for refurbishments and extensions. However, the turnover of building materials that these measures involve, and the climate impact that this entails, means that it should be considered in the long term whether the requirement for a climate declaration should apply to these measures as well.

Groundworks represent a significant climate impact during the construction phase in many cases. There may therefore be reason to consider this in the climate declaration as well. At the same time, groundworks are largely related to physical planning, which may limit the steering effect of the climate declaration. Against this background, there is a need to investigate the conditions for expanding climate declarations to include groundworks as well.

Detailed description of the assignment

Boverket should make appropriate use of the knowledge and experience in this field that are available within the Swedish Environmental Protection Agency (Naturvårdsverket), the Swedish National Heritage Board (Riksantikvarieämbetet), the Swedish Energy Agency (Statens energimyndighet) and the Swedish Transport Administration (Trafikverket). Boverket should also provide municipalities, relevant trade organisations and other interested parties with an opportunity to submit comments.

The report on the conditions for expanding the use of climate declarations shall include a description and assessment of how this may affect the implementation of land and refurbishment measures and the pace of renovation. Furthermore, Boverket's analysis of other measures that are needed for the further development of regulations on climate declaration should include a review of the need to provide life cycle based emission factors for fuels, electricity generation, heat and transport, for example, that are applicable at the organisational level.

The consequences of the proposals submitted shall be assessed and reported pursuant to the Regulatory Impact Assessment Ordinance (2007:1244). Besides what follows from the Ordinance, an assessment and report must be made in respect of the impact of the proposals in terms of greenhouse gas emissions and other environmental impact. Boverket shall also describe and assess the socio-economic effects of the proposals, including effects on housing construction and the impact on the designed living environment.

When carrying out this task, Boverket shall take into account the ambition set out by the Nordic Construction and Housing ministers to increase Nordic cooperation and harmonise approaches, methods, data and tools for carbon neutrality in the built environment. Particular attention should be paid to the experience gained from the Nordic Council of Ministers' vision project "Norden som ledare för en hållbar och konkurrenskraftig bygg-, anläggnings- och fastighetssektor med minskad klimatpåverkan 2021–2024" [The Nordic Region as a leader for a sustainable and competitive building, construction and real estate sector with reduced climate impact 2021–2024]. Furthermore, the Government authority should take into account the ongoing efforts in this area in the EU, in particular the framework for reporting on the sustainability of buildings.

On behalf of the Government

Johan Danielsson, Sofia Wellander

Copies to
Prime Minister's Office / SAM
Ministry of Finance / BA, K and SPN
Ministry of the Environment / KL and V
Ministry of Enterprise and Innovation / BI and MK
Ministry of Culture / KL Ministry of Infrastructure / E and US
Swedish Environmental Protection Agency
Swedish National Heritage Board
Swedish Energy Agency
Swedish Transport Administration

Annex 2 Concerns about not to include the whole building life cycle in the limit value.

This annex describes, module by module, the stages that are not proposed for inclusion in the limit value from 2025, the purpose of calculating them, the concerns about not including them in the limit value, and the current calculation practice for these modules.

Calculation practice for modules at stages B, C and D

Module B1 use

Module B1 use includes climate impact during the building's life cycle that are not addressed in the other modules in stage B. For instance, module B1 includes carbonation from concrete, or the importance of a temporary biogenic carbon sink in theory. The standard EN 15978 does not specify in detail what has to be included, so what has to be included is still open to interpretation. There is no calculation of module B1 in most of the life cycle analyses of buildings carried out to date.

However, certain types of activities and processes have started to be discussed more and more in this module in recent years. In particular, the emissions of refrigerants during the reference study period and the absorption of carbon dioxide through the carbonation of concrete (during the useful life of the building) have been discussed, and sometimes included, in terms of climate impact. Carbonation is an ongoing process, but it diminishes over the years. The carbonation of concrete is primarily included in the Swedish context on occasions as there is now a standardised method for calculating it; Annex BB in EN 16757 (European Committee for Standardization, 2017). There is data for carbonation in module B1, in the EPD from the EPD tool used by Svensk Betong. The magnitude of carbonation for buildings has been calculated in a number of studies. Sacchi & Bauer (2020), for example, performed a detailed statistical analysis of carbonation in 978 different cement-consuming "activities". It was found in a few cases that the GWP effects could be reduced by up to 35 per cent during the reference study period; for the use of cement for soil stabilisation, for example. The GWP was reduced by less than 5 per cent in 90 per cent of the studied cases of comparative LCA studies by including carbonation in the calculation; and the GWP was reduced by less than 1 per cent in 65 per cent of cases (Sacchi & Bauer, 2020).

Carbonation for the Swedish building stock has been calculated pursuant to EN 16757, based on a typical building with concrete in both the façade

and the frame, and where 10 per cent of the surface is assumed to be exposed on the outside and the rest on the inside (Erlandsson, 2019). The resulting carbonation over 100 years is 0.054 kg CO_2 per kg of CEM I type binder (i.e. 10 per cent of the original emissions) according to the assumptions made. This is consistent with the calculations of Löfgren (2021), who studied a similar typical building with sandwich elements in the façade, load-bearing interior walls made of concrete painted on the inside, and with a floor structure with a finish on top and a painted underside. Again, the carbonation over 100 years accounted for 10 per cent of initial emissions (modules A1–A3) for cement products in the building. This represents 8–9 per cent of the initial emissions of concrete products. Approximately 70 per cent of the carbonation is estimated to occur during the first 50 years, and the remainder during year 100 (Löfgren, 2021). Over 50 years, carbonation would correspond to about 3.5 per cent of the building's initial emissions (modules A1–A3), based on the initial emissions for an entire multi-dwelling block of this type, given the fact that just over 60 per cent of the emissions are linked to the use of concrete (Malmqvist et al., 2023). This proportion does of course decrease if a higher proportion of alternative binders (such as slag) is used in cement and concrete production. The timing of emissions and removal also differs as the removal of carbon dioxide through carbonation is gradual and slow over the lifespan of a building.

According to concrete and cement producers, this is a module that should normally be included in a limit value, or at least in the expanded climate declaration, as sufficiently exposed concrete products on site mean that a carbon sink is gradually built up during the useful life of the building. This is usually (as highlighted above) a relatively limited "compensation", which is why inclusion of carbonation of concrete in module B1 is unlikely to result in any significant influence on product selection decisions. That said, this could affect design decisions as carbonation increases significantly when the concrete is more exposed (see Löfgren, 2021). On the other hand, if a higher proportion of climate-improved concrete is used in construction, the effect of such a carbon sink will also decrease with the prevailing trend towards more and more alternative binders in cement and concrete production. Thus there needs to be further definition of which other emissions and removal should also be reported in module B1 if this is to be added, besides the carbonation of concrete.

Module B2 maintenance

Inclusion of module B2 maintenance in the expanded climate declaration was proposed in Boverket (2020). The reason for including module B2 in the calculation is to visualise the trade-off between initial climate impact and the maintenance needs of the products and building design. To ideally and somewhat simplistically be able to select the product/design with the lowest climate impact when combining A1–A3 + B2 during the

reference study period. The concern with not including module B2 in the calculation is that this would steer decisions on new construction towards products and designs with a low initial climate impact, but which cost a lot of climate impact when they are maintained.

The calculation practice for module B2 is not considered to have changed compared to 2020, when Boverket's report "Regulation on climate declarations for buildings" was compiled. Far from all international calculation methods even calculate or distinguish module B2 from module B3 or B4 (Lützkendorf & Balouktsi, n.d.). Therefore, the proposal in Boverket (2020) was not to report module B2 separately, but to aggregate it with module B4 if it is included in the expanded climate declaration.

It needs to be possible to define specific maintenance intervals for products and building elements if module B2 is to be included in the limit value and to be able to achieve the desired steering effect; that is, not to choose construction products and designs that have a high climate impact during maintenance. At the same time, there has to be clear regulations on how such specific scenarios are to be defined in this case, so that the calculations are robust and comparable. Lifespans in EPDs can be used for construction products, while it may be more difficult to verify that a particular design would reduce maintenance. Boverket also needs to provide generic lifespans for different construction products in the climate database in order to facilitate calculations. At the same time, potential climate-improving project planning choices will not be apparent in the calculation of module B2 if these generic lifespans are used.

Module B2 generally has a low climate impact in the LCA of buildings (see, for example, Barjot, 2021, Francart et al., 2021), which is why it is deemed to have a minimal impact on decisions for new construction. However, it may be more important to include module B2 in life cycle cost analyses. Cost considerations that would tend to steer away from solutions with high maintenance needs, at least when a developer builds for structures its own management.

Module B3 repair

Module B3 repair includes repairing damaged components to restore them to their expected level of performance (by inserting a new pane of glass into a broken window, for example). The reason for including module B3 in the calculation is to visualise the trade-off between the initial climate impact and the needs for repairs of products and design solutions, to ideally and somewhat simplistically select the solution with the lowest climate impact when combining A1–A3 + B3 during the reference study period. The concern with not including module B3 in the calculation (as with module B2) is that this would steer decisions on new construction towards products and solutions with a low initial climate impact but which break down easily.

Module B3 is easily confused with maintenance in module B2, and it is very difficult to define fair scenarios for this as it is hard to predict. Including this would need to be based on more detailed building damage statistics than are currently available. This is why most international calculation methods do not deal with this module at all. Alternatively, only a percentage value of the initial climate impact is applied, and then no premium will be placed on any solutions that have taken into account the avoidance of costly repairs. Hence there are no sufficiently robust calculation methods for this part that can have the anticipated steering effect, which is why Boverket (Boverket, 2020) proposed not to include this in the expanded climate declaration.

Module B4 replacement

Inclusion of module B4 replacement in the expanded climate declaration was proposed by Boverket (Boverket, 2020). The reason for including module B4 in the calculation is to visualise the trade-off between the initial climate impact and the lifespans of products, to ideally and somewhat simplistically select the product with the lowest climate impact when combining A1–A3 + B4 during the reference study period. The concern with not including module B4 in the calculation is that this would steer decisions on new construction towards products and solutions with a low initial climate impact but a short lifespan.

The calculation practice for module B4 is not considered to have changed compared to 2020, when Boverket's report "Regulation on climate declarations for buildings" was compiled. The majority of international calculation methods calculate this element, as it is generally the module with the third greatest climate impact after A1–A3 and B6. It needs to be possible to define specific maintenance intervals for products and building elements if module B4 is to be included in the limit value and provide the desired steering effect. This involves not choosing construction products and designs that have a high climate impact during maintenance. At the same time, there has to be clear regulations on how such specific scenarios are to be defined in this case, so that the calculations are robust and comparable. Lifespans in EPDs can be used for construction products, but Boverket should also provide generic lifespans for different construction products in the climate database to facilitate calculations. At the same time, potential climate-improving project planning choices will not be apparent in the calculation of module B4 if these generic lifespans are used.

An ongoing study is studying how design and construction choices would potentially change if a limit value in addition to modules A1–A5 had also included modules B2–B4, based on the buildings in the reference value study (Malmqvist et al., 2023). The preliminary results to date show that the ranking of the buildings within the building types studied, with the highest to the lowest climate impact, does not change compared to if only modules A1–A5 are included (Barjot et al., n.d.). This indicates that the

inclusion of these modules in the limit value would have hardly any impact on the decisions made during the design and project planning process. However, closer comparisons between different façade materials such as brick or gypsum, for instance, could mean that different decisions would be made if only modules A1–A5 are calculated, compared to adding module B4 as well (Barjot, 2021, Francart et al., 2021). As things stand present, above all brick may be slightly disadvantaged by not including modules B2 and B4 in the limit value. However, a reference study period longer than 50 years also needs to be used in the calculation for this to be the case (Francart et al., 2021).

Module B5 renovation

Module B5 renovation deals with renovation on a larger scale than replacement of construction products (recorded in B4), and maintenance and repairs (recorded in B2 and B3). The practice is not to include this module in the LCA for new buildings, as it is very difficult to predict how a building will be reconstructed in the future when it is designed. One of the reasons for including it is to highlight the fact that a building is designed for flexibility and adaptability. That is to say, a design that can minimise the climate impact if an owner decides to alter its features and purposes in the future, in order to ideally and somewhat simplistically be able to select the design with the lowest climate impact when combining A1–A3 + B5 during the reference study period. The concern with not including module B5 in the calculation is that this would steer decisions on new construction towards a non-flexible design that has a low initial climate impact, but a high climate impact later on if there is a desire to alter features by having to demolish parts of the building and install new materials on a large scale, or even to demolish the whole building long before the end of its technical service life. Studying the module may therefore be more interesting in specific life cycle analyses, where work is done to achieve a flexible design. Moreover, it is conceivable that it would be better to have policy instruments that more directly require design for future flexibility, instead of trying to calculate future climate savings.

Module B6 energy use

Inclusion of module B6 energy use in the expanded climate declaration was proposed by Boverket (Boverket, 2020). The theoretical reason for including module B6 in the calculation is primarily to visualise the trade-off between an energy-efficient building envelope and a low climate impact for the product stage (modules A1–A3). This means that it is possible, ideally and somewhat simplistically, to select the design with the lowest climate impact when combining A1–A3 + B6 during the reference study period. The concern with not including module B6 in the calculation is that this would steer decisions on new construction towards buildings with a building envelope with low energy efficiency. That said, the

energy performance of buildings is already regulated by the building codes and cannot be overridden by a climate declaration. As such, this concern is unfounded.

The calculation practice for module B6 is not considered to have changed compared to 2020, when Boverket's report "Regulation on climate declarations for buildings" was compiled. However, the current revision of EN15978 clarifies which parts of a building's energy use should be included in the calculation. The climate impact for module B6 is relatively low in the Swedish context, based on a 50-year reference study period. Its proportion is further reduced, as Boverket (Boverket, 2020) also suggested that "dynamic" climate data should be used in the calculation. Perhaps the insulation industry in particular has opinions on the fact that module B6 should be included in the limit value, as slightly more climate-impacting products in modules A1–A3 can provide savings in module B6. The reference value study (Malmqvist et al., 2023) analysed whether the climate impact of modules A1–A3 increased for more well-insulated buildings (i.e. buildings with a higher average U-value). However, no such pattern could be discerned for the sample of buildings. The fact that modules A1–A5 are only included in the limit value could have an impact on the choice of products for those building types where insulation materials account for a larger proportion of the climate impact of modules A1–A3 (especially single-family houses and preschools). However, including module B6 in the calculation would probably not highlight this. Gradual tightening of energy requirements is probably a better policy instrument.

Module C end-of-life stage

The module C end-of-life stage, as described in EN15978, includes the dismantling and demolition of the building, and waste processing of embedded materials when the building has no further use. Module C is divided into on-site demolition and dismantling processes (C1), transport of material (C2), waste processing (C3) and final removal of waste, including incineration and landfill (C4).

The reason for including stage C in the calculation is perhaps above all to provide a more complete picture of the climate impact of a building over a life cycle, and to highlight the good recyclability of products. The need to include stage C is often considered to be because it can encourage increased recycling and reuse of construction products. At the same time, stage C provides an illustration of what is expected to happen far into the future (50 years from now when the time of this reference study is used), so it is very doubtful that including it in the declaration will lead to encouragement for recycling and reuse in today's construction. Moreover, any environmental benefits from materials that are recycled or reused after the life cycle of a building must be recognised in module D (see the next paragraph).

Stage C generally accounts for a low proportion of climate impact in the Swedish context in respect of LCA for buildings. Steering can therefore be expected to be limited.

The calculation practice for stage C is not regarded to have changed compared to 2020, when Boverket compiled its report “Regulation on climate declarations for buildings”. The majority of international calculation methods calculate this part in some way, but by no means all of them include all stage C modules. The climate impact may be significantly higher for module C and in particular for buildings with timber frames, in methods where biogenic carbon removal is recognised as a negative item in modules A1–A3 (e.g. in Germany and Denmark).

Module D

What is known as module D is included as additional information in the European standard EN 15978. Calculated values in module D cannot and must not be compared with or added to other modules A–C in what is known as accounting LCA, which provides the starting point for the climate declaration. Module D can provide information that is of interest for more circular construction in the future, as it provides information on which recycling option is the most beneficial for different materials when the material leaves the building as “waste”. For example, module D can be used to calculate what the positive effects are of energy recovery from wood as a fuel, depending on what fuel it is assumed to be replacing. Similarly, the climate benefit of future metal recycling can be calculated, which is reliant on how much primary material the recycling of materials is assumed to replace, and where the outcome depends on the manufacturing process selected for the replaced metal. This is known as consequence LCA. In general, calculating module D provides the same recommendations as following the EU waste hierarchy, and experience also shows that demanding such calculations can be costly. Requiring these calculations therefore risks increasing the cost of a declaration without adding much in the way of decision guidance.

The steel industry in particular sees itself as disadvantaged unless module D is included in the limit value, as the products are so long-lived but currently have a high climate impact for production. However, module D is calculated using consequence LCA and cannot be added to the results from modules A to C, which are based on accounting LCA. One important problem when calculating module D is that the effects of future recycling are so far in the future. This means that, with climate targets set, we can expect the climate impact of producing these materials to have a very low climate impact after a reference study period of 50 years (see, for example, the calculation instructions for NollCO2 [Zero CO2]). This means that the positive climate impact in module D will also be low, as the future replacement product will have a low climate impact. Recycling should therefore be favoured as it avoids the extraction of virgin

raw materials and the resulting impact on ecosystems. However, this effect is not measured in the GWP and so cannot be visualised in such a climate declaration, but it does need to be addressed by other forms of policy instruments.

When different emissions occur

The texts above have discussed the difficulties of including more parts of the life cycle, and also whether including more parts of the life cycle in a limit value could affect decisions, in terms of the choice of construction products, construction solutions and design in the planning of new buildings today. There is a further argument in addition to those referred to above, which is important to bear in mind when designing a policy instrument, such as defining a maximum climate impact in a life cycle perspective.

Current practice in life cycle assessment of buildings, in accordance with EN 15978, involves using climate data representing the current production of various resources. This was introduced in the first version of the standard, partly to support the option of verifying the climate impact of the energy system as far as possible, based on statistics. Instead, the revision of the same standard requires national (or regional) scenarios to be developed by the relevant government authority (such as the Swedish Energy Agency). It may be noted that there are currently no such scenarios 50 years into the future, from any of the Swedish government authorities.

This means that a climate impact calculation for modules A1–A5 will be able to be quite close to the actual emissions associated with erecting a building. That said, commitments such as the Paris Agreement and Sweden's and the EU's climate law, which includes targets for net zero emissions by 2045, mean that greenhouse gas emissions for the production of various construction products and other resources in construction can be expected to decrease fairly rapidly (see also the sections entitled "Proposed levels for limit values in 2025" and "Limit values from 2030 onwards"). This means that these figures represent the current way of producing different materials, although life cycle analyses of buildings today show that parts of stages B and C are not insignificant. Climate impact is actually expected to be lower only in a number of years' time, and that is when maintenance and replacement of different components of a building, for example, will take place. That is to say, calculating stages B and C based on current data will become increasingly misleading at the current rate of transition. In practice, we can expect the climate impact of these modules to actually be lower than what the calculations show. This could be dealt with by means of what are known as dynamic scenarios, not only for module B6 but also for the other information modules in B, as well as stage C and module D. However, the methodological development of this has not progressed very far in order to calculate the climate

impact of operational energy for module B6, beyond the proposals to apply such climate data on the basis of anticipated development of the energy system in a country. However, the fact remains that the climate impact in stages B and C can be expected to account for a significantly lower proportion of the climate impact for the life cycle compared with stage A. There are therefore strong grounds for defining a limit value for stage A only. The benefit of including more life cycle modules in the limit value at a later date is deemed to be very limited, therefore, if the ongoing transition of energy systems and industry continues in a similar way.

Figure 18 visualises the difference in outline between the calculation practice for different modules today, compared to the anticipated development of climate impact for producing different resources; that is to say, the climate data that would be more realistic to use for calculating stages B and C (and D).

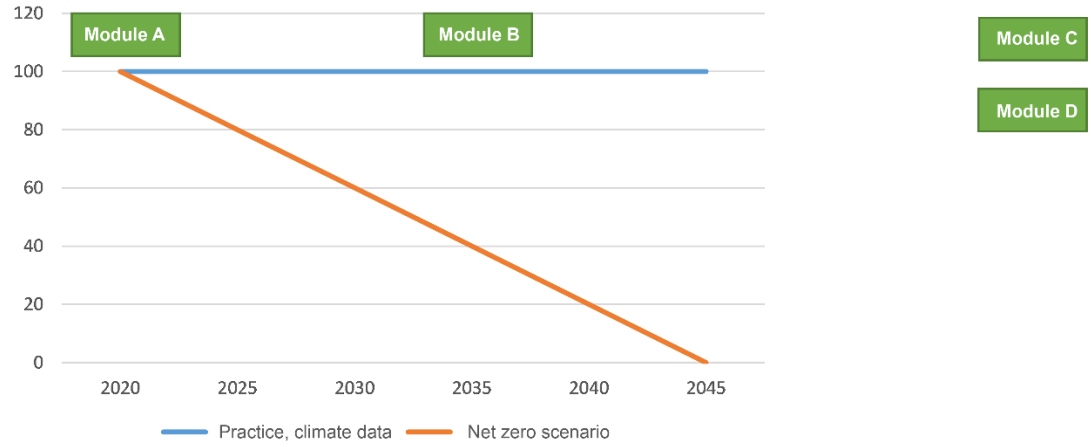


Figure 18. An outline illustration of the difference between current calculation practice (blue line) and the anticipated development (orange line).

Annex 3 Climate calculations for additional building types

KTH Royal Institute of Technology collected data for additional building types by contacting various stakeholders in the construction sector in order to complement the reference value study (Malmqvist et al., 2023). Unlike in the reference value study, the results of completed climate calculations were requested, and not the calculation base. The system boundary varied slightly for the calculations received in respect of building elements included and parts of the life cycle, and has therefore been adjusted for these to ensure comparability. The summary in this annex reports climate impact according to the same system boundaries as proposed for the limit value (see the chapter entitled “Levels for limit values”). However, the results should be interpreted with caution.

KTH Royal Institute of Technology requested climate calculations for the following building types: special housing (LSS (special needs) housing, for the elderly), sports halls, cultural buildings (e.g. museums, libraries, concert halls, cinemas and community centres), nursing and care homes, other buildings for health and medical care (primary care, dental care), trade, warehouses, hotels and restaurants. A total of 19 stakeholders in the sector were contacted. Results from studies conducted previously were also summarised. It was possible to compile climate calculations from a total of 33 buildings. Besides this reported data, climate calculations were also received from four hospital buildings. However, these have not been included in the report.

Figure 19 shows the results of the climate calculations adjusted to the same system boundary for building elements and life cycle modules as for the proposed limit value, as well as the number of calculations obtained for each building type (n). The number of calculations for all building types except special housing is very low, as shown in the figure. However, it can be seen that the values do not deviate significantly from the calculations performed for the building types included in the reference value study.

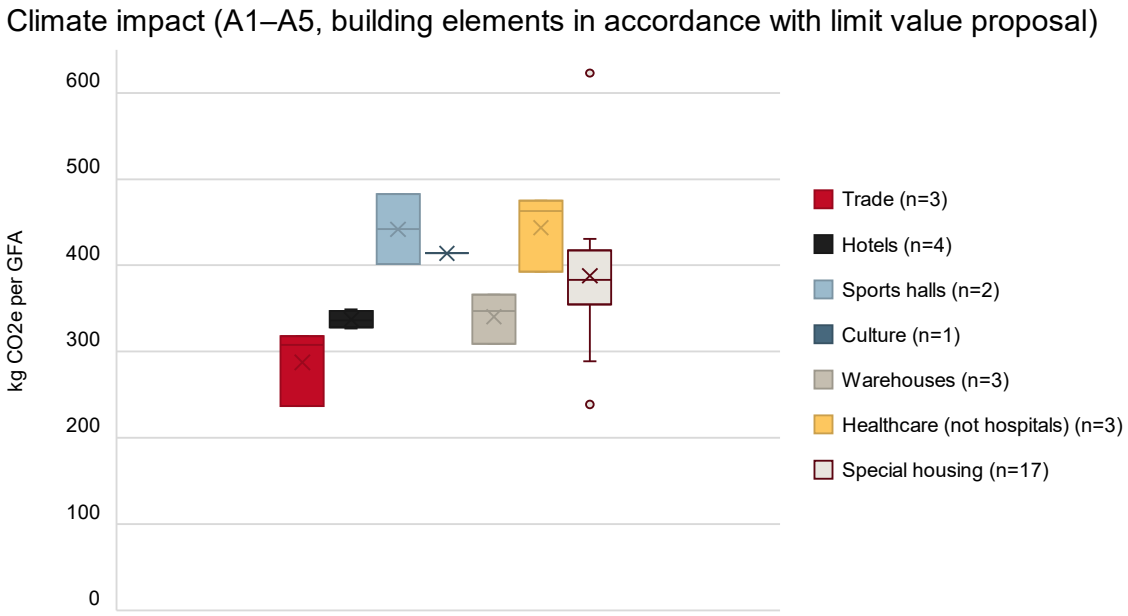


Figure 19. A presentation regarding the climate impact for the buildings reported by the interviewees. X is the mean, and the line in the centre marks the median. The upper and lower edges of the box mark the upper and lower quartiles. The lines mark the highest and lowest values, provided that these are within 1.5 times the distance between the quartile and the median. Otherwise, the value is marked as a point – an outlier.

The median value for special housing (n=17) was 375 kg CO_2e per GFA. Median values were produced for each group in order to investigate whether there was a significant difference between LSS housing and special housing for the elderly. These differed from the median value by less than 10 kg CO_2e per GFA, which is why it was deemed acceptable to treat them as a common building type. The anomalous value of 600 kg CO_2e per GFA for one of the buildings is worth noting, as well as the wide variation in special housing. The climate calculations have been performed by many different stakeholders, and it has not been possible to check whether the anomaly is due to a divergent building design, or quality shortcomings in the handling of the data.

Note that default values have been used in cases where these were not included in the original calculation, for the climate impact from interior finishes, fixed interior design, technical equipment and A5 energy. The values for multi-dwelling blocks have been used for special housing, which is probably an underestimate. The results for the individual buildings are presented in Figure 20.

The following organisations have contributed climate calculations – Stadsfastigheter Malmö, Lokalförvaltningen i Göteborg, IVL, Västfastigheter, Catena, Skanska, Faberge, Emrahus and NCC.

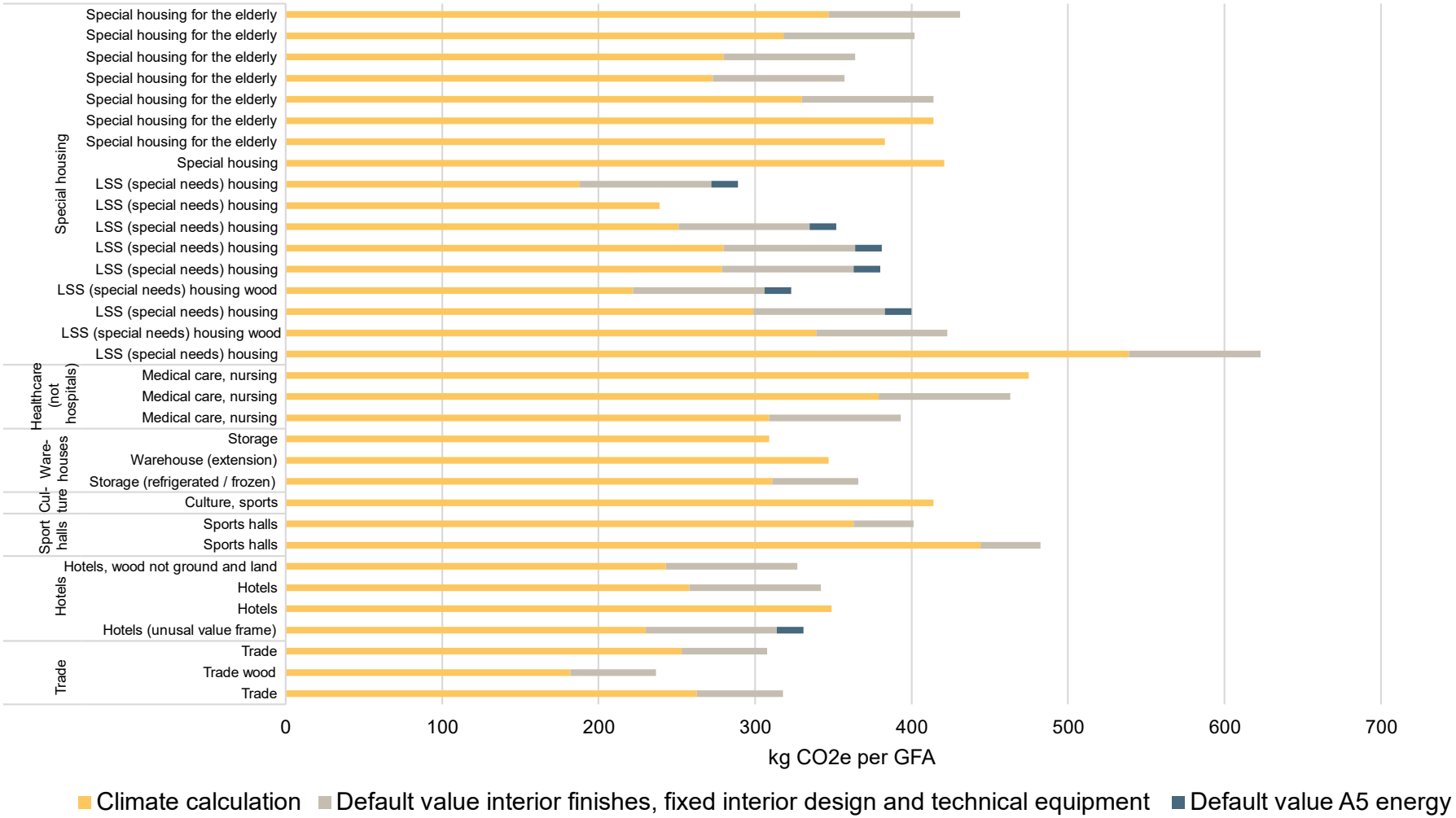


Figure 20. Climate impact per GFA. The results of the LCA calculations performed for the building types presented. The same default values have been used as in the reference value study (Malmqvist et al., 2023).

Annex 4 How much can climate impact be reduced throughout the value chain?

This annex presents the potential reduction for the climate impact of buildings according to the Mistra Carbon Exit research programme and an estimate of reduced climate impact according to the construction industry.

Potential reduction for the climate impact of buildings according to Mistra Carbon Exit

The Mistra Carbon Exit research programme studies the potential for reducing climate impact from various sectors of society.[120] The potential reduction has been estimated for all construction in Sweden, in two works by Ida Karlsson at Chalmers University of Technology. These are based on individual new construction projects (Karlsson et al., 2021), scenarios for development at national level (Karlsson et al., 2020), literature, stakeholder workshops and the industries' own roadmaps. The first study answers the question of the extent to which the climate impact of an individual building can be reduced. The second study focuses instead on the transfer of all new building construction in Sweden; and a number of scenarios have been selected because they represent likely developments. CCS (carbon capture) has an important role to play for cement as a binder in concrete in both scenarios, while there is considerable uncertainty about the introduction of the measure. Therefore, the scenarios are presented both with and without CCS for concrete. The likely reduction for Swedish new construction[121] is similar (23 per cent) for both scenarios until 2025 as shown in Figures 21 and 22, while it differs significantly for 2030 (61 per cent with CCS and 49 per cent without CCS). The estimates are probably conservative, according to Karlsson, given the potential for optimisation at each step of the value chain (that is, both reducing the climate impact of the production of construction products and the design of the building itself), and also given the developments that have taken place in recent years.

[120] https://mistra.org/program/mistra-carbon-exit/. Downloaded on 2 May 2023.

[121] In this case, KTH Royal Institute of Technology has assessed in discussion with Ida Karlsson (doctoral student at Chalmers University of Technology) that the most representative scenario is a combination of the original scenarios in the journal article. This means that the bio/CCS scenario was used for concrete, and the electrification scenarios were used for other materials, as well as construction processes and material transport. This means that these scenarios presented do not correspond to the scenarios published previously.

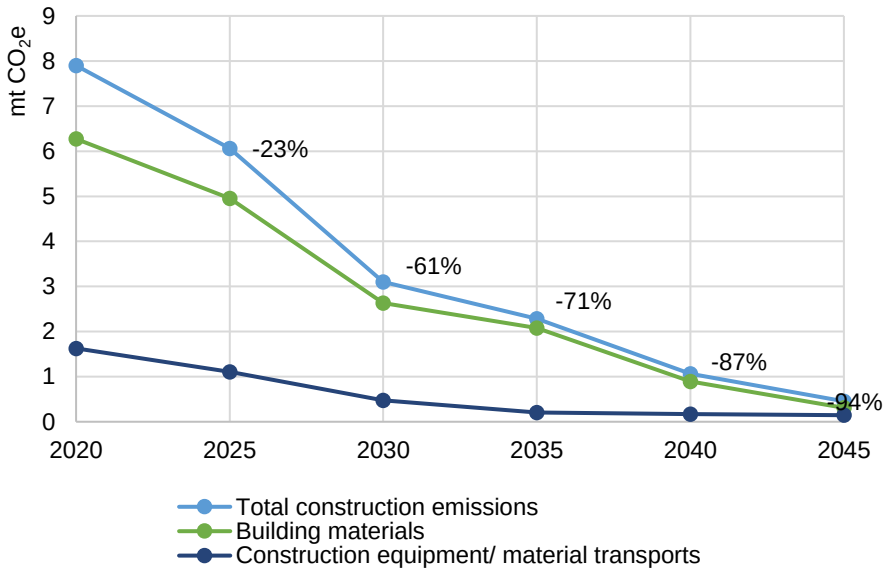


Figure 21. The potential to reduce climate impact, **including the potential for CCS** for concrete. This potential includes measures throughout the value chain, from designing buildings and manufacturing construction products, to construction. Total construction emissions are the sum of emissions from building materials, and emissions from transport and construction equipment/material transport. (Pathway 5. Electrification/bio/CCS combo and material efficiency.)

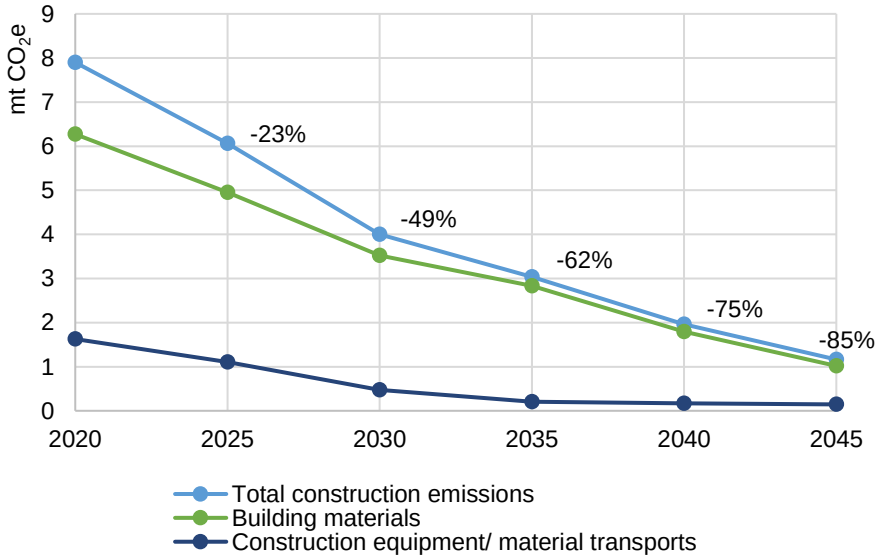


Figure 22. The potential to reduce climate impact, **excluding the potential for CCS** for concrete. This potential includes measures throughout the value chain, from designing buildings and manufacturing construction products, to construction. Total construction emissions are the sum of emissions from building materials, and emissions from transport and construction equipment/material transport. (Pathway 5b Electrification/bio/ME combo without cement CCS), processing of the data by (Karlsson I., Chalmers University of Technology, 2022).

Access will be limited initially when introducing measures/construction products with a lower climate impact. This means that there will be opportunities for individual construction projects to use the measure/product earlier, and to lead the transition compared to the national scenarios. Karlsson (Karlsson et al., 2021) has also examined the potential for individual construction projects to lead the way. One of the five building systems investigated, a multi-dwelling block with a concrete frame cast in situ, is presented below: building system 2 in (Erlandsson et al., 2018). The potential reduction with the best possible technology today (BAT Now) is as much as 40 per cent (as shown in Figure 23 and Figure 24 below), and is estimated to be more than 50 per cent for 2025. The potential reduction was estimated at almost 80 per cent for 2030 in a scenario with CCS, and it was estimated at just under 60 per cent in a scenario without CCS.

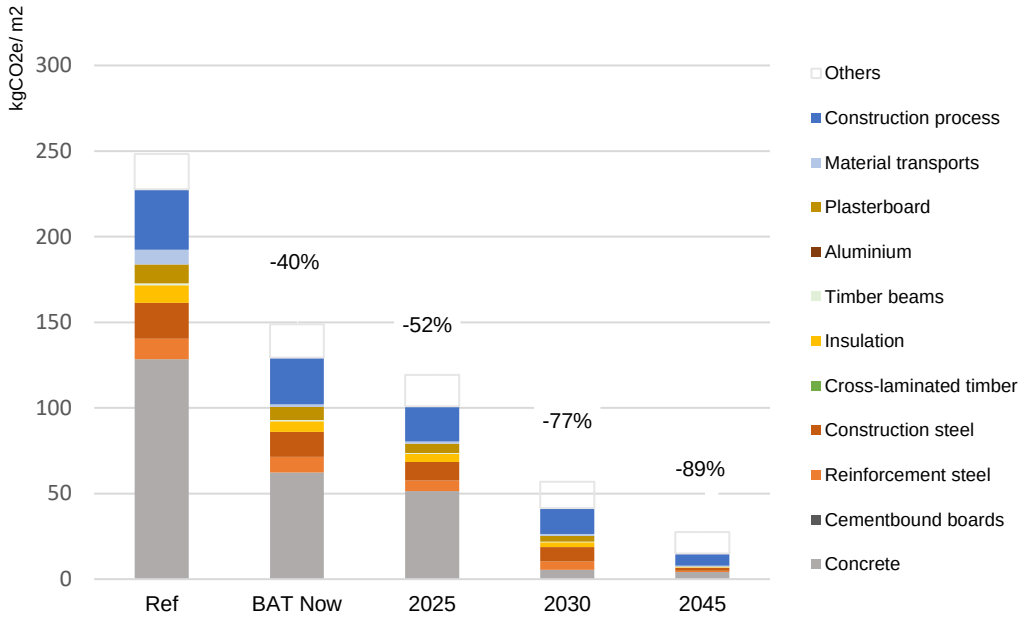


Figure 23. Climate impact of a multi-dwelling block (concrete frame cast in situ), as well as scenarios for reducing climate impact by 2045. These scenarios include CCS for concrete. They do not include technical equipment and lifts, carbon sequestration or any negative emissions. Source: Karlsson et al., Achieving net-zero carbon emissions in construction supply chains. A multidimensional analysis of residential building systems, Developments in the Built Environment, Volume 8, 2021, https://doi.org/10.1016/j.dibe.2021.100059.

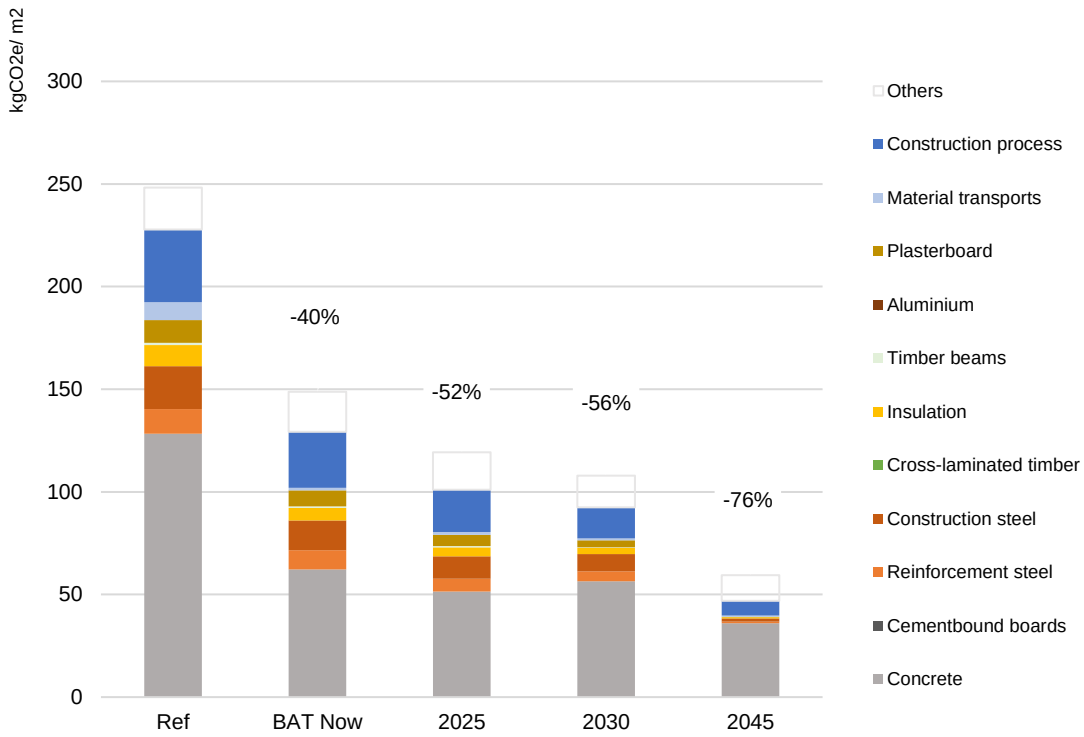


Figure 24. Climate impact of a multi-dwelling block (concrete frame cast in situ), as well as scenarios for reducing climate impact by 2045. These scenarios do not include CCS for concrete. They do not include technical equipment and lifts, carbon sequestration or any negative emissions. Source: Karlsson et al., Achieving net-zero carbon emissions in construction supply chains – A multidimensional analysis of residential building systems, Developments in the Built Environment, Volume 8, 2021, https://doi.org/10.1016/j.dibe.2021.100059.

The aim is for construction projects with a high climate impact to be forced to take action to meet the requirements when the limit values are introduced. This means purchasing climate-improved concrete, for instance. A sufficient supply of climate-improved concrete will be required for this measure to be feasible. That is why it is interesting to look at both the national scenarios and the potential of the individual project in order to analyse what will be possible to achieve for the share of construction projects that are forced to take action. This is particularly interesting as regards measures linked to the purchase of climate-improved materials. Measures such as lean design solutions, for example, are not reliant on a sufficient quantity of climate-improved products.

The estimate of reduced climate impact, according to the construction industry

In May 2022, a number of trade organisations and large manufacturers via the trade organisation Byggmaterialindustrierna, the association for Swedish construction materials enterprises, were asked to provide answers regarding the development of construction products, and the

uncertainties that existed. The estimates presented are summarised in Figure 25.

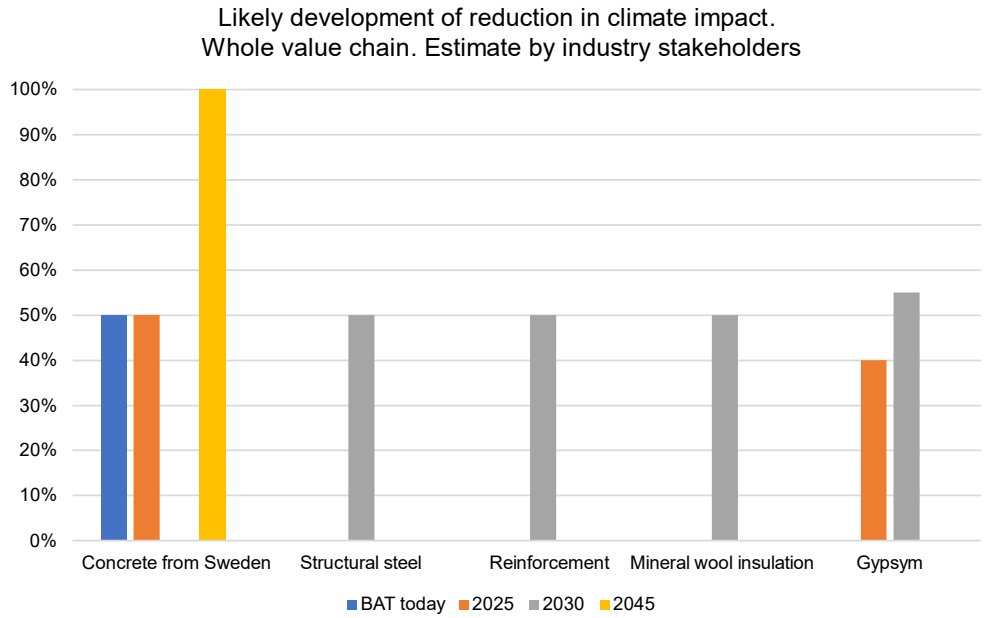


Figure 25. The estimated reduction in climate impact compared to 2022, made by industry stakeholders. These estimates include measures during the production of building materials (e.g. switching energy sources during manufacturing), during project planning (e.g. optimisation of construction), and during production (e.g. reducing waste).

A question was asked about the uncertainties each organisation perceived when it came to reducing climate impact. These answers are summarised in Table 11.

Table 11. A summary of uncertainties for each product group. Data from the industry stakeholders consulted.

Stakeholder (material)	**What are the major uncertainties in respect of this estimated reduction for each product/material category? How do these uncertainties affect climate impacts?**
Svensk Betong (concrete produced in Sweden, both ready-mixed concrete and prefabricated elements).	The geopolitical situation affects access to raw materials, material prices, fuel prices, energy, etc. CCS in Slite is required to meet the targets.
Swedish Institute of Steel Construction (structural steel).	For steel produced in Sweden, the uncertainties in achieving the target by 2030 are small. There are many uncertainties on a global level.
Celsa (reinforcement steel).	No major uncertainties.
Swedisol (Mineral wool, i.e. both stone wool and glass wool).	The availability of renewable electricity. The granting of environmental permits and suchlike. Willingness to pay. Evolution of legal requirements.

Stakeholder (material)	What are the major uncertainties in respect of this estimated reduction for each product/material category? How do these uncertainties affect climate impacts?
Knauf (gypsum).	Availability of fossil-free fuel (biogas, hydrogen, green LPG, etc.). Electricity supply in southern Sweden. The risk of shortcomings during a transition process.

Stakeholders were also asked whether they perceived any new material types with good potential to reduce the climate impact of buildings, with an opportunity to have a major impact before 2030. Svensk Betong emphasised that new types of binders will probably come about, as well as more recycling and reuse. Higher strength steel has good potential to reduce the climate impact of steel, according to the Swedish Institute of Steel Construction (SBI). Bio-based insulation materials are on the increase, according to Swedisol. Knauf is of the opinion that timber construction will increase, and that plastic as a packaging material will be greatly reduced, as transport and weather protection can be made from organic materials.

Figure 26 presents a comparison between Karlsson's work, various other works and the material industries' own estimates for concrete, structural steel and reinforcement; that is to say, some of the materials with the highest climate impact in new buildings. In the medium term, all materials show a large potential reduction in climate impact by 2030 and beyond.

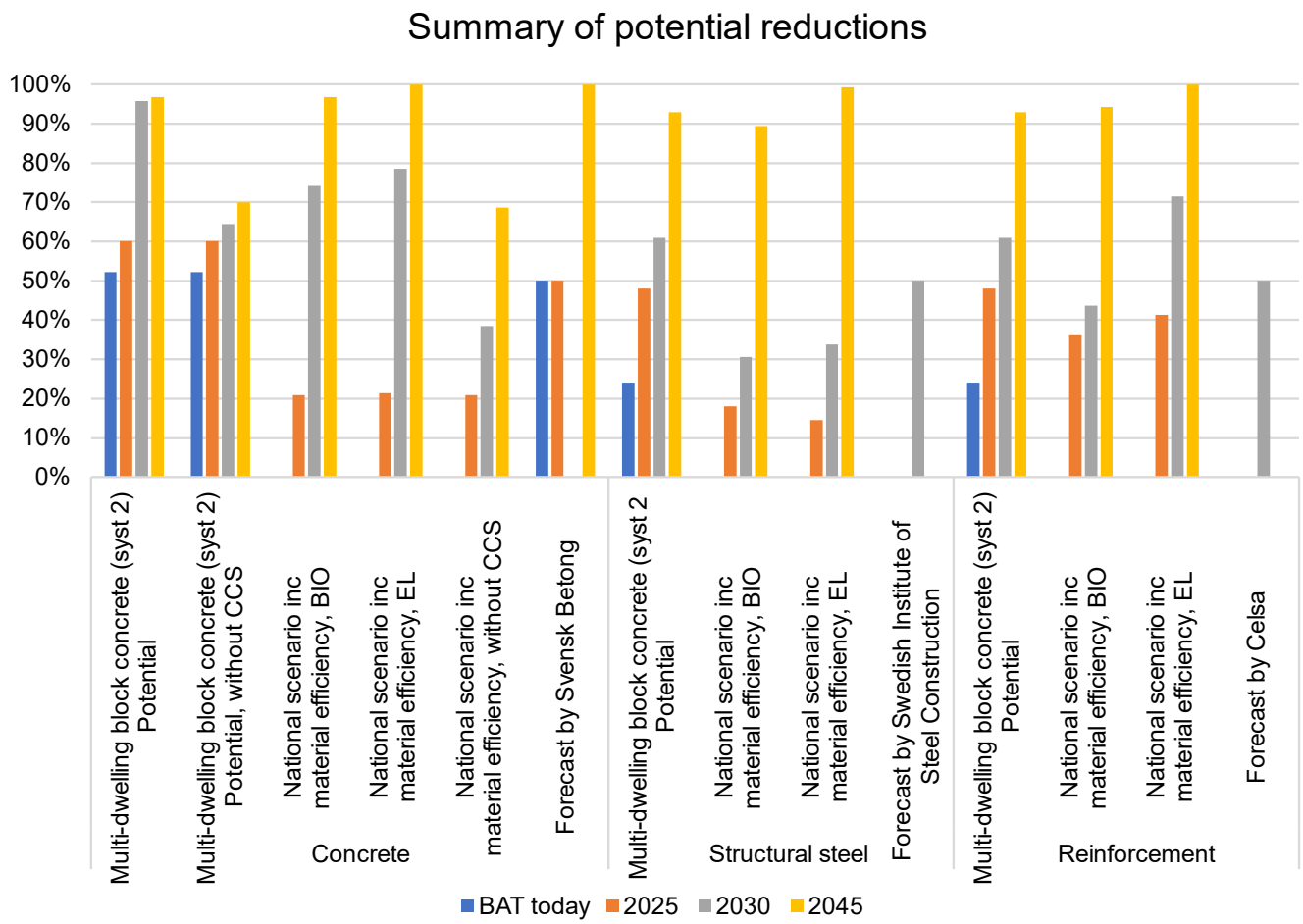


Figure 26. A summary of analyses for the reduction of climate impact until 2045. The potential for reduction for a multi-dwelling block, scenarios for the most likely development at a national level, and estimates by industry organisations (see more organisations' estimates below). BAT today represents the best available technology.

Annex 5 Number of construction stakeholders affected

This annex shows the number of construction stakeholders affected by the climate declaration regulations.

Developers

The developer is the stakeholder that has control over choices and decisions during a construction process. The developer is responsible for ensuring that construction, demolition and land measures are implemented in accordance with applicable regulations and for registering the climate declaration. The developer will be responsible for compliance with the limit value, just as the developer is responsible for registering the climate declaration. Developers are a heterogeneous group of clients ranging from people building their own homes to enterprises erecting large public buildings. Clients range from private individuals to major corporations.

A narrow definition of developers includes enterprises operating in the Development of building projects sector (SNI 41.1). According to Statistics Sweden's company database, there are 683 enterprises in the "Development of building projects" sector, all of which are classified as small and medium-sized enterprises (SMEs).

Table 12. Development of building projects (SNI 41.1) number of enterprises by size, 2021. Source: Statistics Sweden, Statistical Business Register.

Enterprise size	Number of employees	Number of enterprises
Small enterprises	0–49 employees	679
Medium-sized enterprises	50–199 employees	4
Large enterprises	200–500+ employees	0
Total		**683**

Large property developers that are involved in business activities and are not included in SNI code 41.1 include Familjebostäder and Svenska bostäder. These are classified under SNI codes 68.201 Letting Renting and operating of own or leased dwellings and 68.203 Renting and operating of own or leased other premises. Both include the development of

construction projects for their own operation. These two sectors include 22,026 and 23,346 enterprises respectively, of which about 30 are large enterprises and the rest are SMEs. However, it is not possible to specify how many of these are involved in developing construction projects.

Public and commercial property developers are affected by the policy instruments. The size of the group cannot be established by official statistics. What can be stated is that there are both large and small stakeholders belonging to different sectors. There is considerable heterogeneity, which means that the stakeholders responsible for the climate declaration and for ensuring that the building meets the limit value have different criteria for familiarising themselves with how the policy instruments work. This affects steering outcomes.

Project designers

Project designers are experts who are trained to translate ideas into action and include architects, designers, environmental consultants and other stakeholders involved in the planning, costing and design of construction projects. According to Statistics Sweden's business database, there are 14,329 enterprises involved in architectural activities and technical consultancy (SNI 71.11 and 71.12).

Of the 14,300 or so enterprises involved in architectural activities and technical consultancy, 44 enterprises are classified as large.

Table 13. Architectural offices and technical consultancies (SNI 71.11 and 71.12), number of enterprises by size, 2021. Source: Statistics Sweden, Statistical Business Register.

Enterprise size	Number of employees	Number of enterprises
Small enterprises	0–49 employees	14,126
Medium-sized enterprises	50–199 employees	159
Large enterprises	200–500+ employees	44
Total		**14,329**

As the conditions for reducing a building's climate impact mainly occur during the project planning of a building when different designs, solutions and methods are discussed, the project designer has a major part to play in reducing a building's climate impact at an early stage. The

opportunities available to project designers may potentially be hindered, either because the client (the developer) has no interest in reducing climate impact, or because the project designer lacks knowledge of which measures reduce climate impact.

Building contractors

The majority of all construction is managed and carried out by building contractors. These stakeholders erect buildings on behalf of the developer. The building contractor usually has construction contracts directly with the developer. There are also other contractor groups in the construction industry, such as land contractors, machinery and crane enterprises, and plumbers and electricians. These are often subcontractors hired by the building contractor to perform certain tasks. There are currently a large number of small construction companies and seven large enterprises. The five largest enterprises – Peab, Skanska, NCC, Veidekke and JM – employ over a thousand people each. These large enterprises are active in most areas, but largely devote themselves to project development. This means that they erect buildings on their own land, rent and manage them and then sell them on. The small enterprises often focus on refurbishment projects and small new construction projects or are hired as subcontractors on construction sites.

The enterprises covered are mainly active in the Construction of residential and non-residential buildings sector (SNI 41.2). According to Statistics Sweden's Statistical Business Register, there are 26,632 enterprises within this SNI code: 27 companies classified as large enterprises, and the rest SMEs.

Table 14. Construction of residential and non-residential buildings (SNI 41.2), number of enterprises by size, 2021. Source: Statistics Sweden, Statistical Business Register.

Enterprise size	Number of employees	Number of enterprises
Small enterprises	0–49 employees	26,435
Medium-sized enterprises	50–199 employees	170
Large enterprises	200–500+ employees	27
Total		**26,632**

Contractors are the stakeholders that implement the plans developed by the project designer and have the opportunity to influence the climate impact of the building mainly by means of their choice of materials. That said, the contractor needs to relate to the choices made at earlier stages and needs information from the project designers regarding blueprints and plans, as well as information from the developer in respect of resources. The contractor has no responsibility for climate declarations and limit values in public law, but it may obtain this through the civil law contracts established by the developer. In these, the developer can define supplementary requirements relating specifically to responsibility for climate declarations and limit values. Communication from earlier stages is an important prerequisite if the contractor is to meet objectives to reduce climate impact. Obstacles to reducing climate impact may include inadequate communication from earlier stages, insufficient knowledge on the part of the contractor regarding emissions from construction and a lack of resources for climate adaptation.

Construction product manufacturers

A construction product manufacturer is the stakeholder that manufactures the construction products (such as concrete, sheet metal, timber, steel, insulation materials, etc.) to be used in building construction.

The Swedish construction enterprises that contribute to greenhouse gas emissions include enterprises manufacturing concrete products (23.61), cement (23.51), gypsum products for construction purposes (23.62), timber products (16.21-2), pipes and tubes (24.2) and insulation (23.991). These can be found in a number of different industries, and there were a total of 330 enterprises in Sweden in these industries in 2021. Of these, 17 enterprises are classified as large enterprises and the rest are classified as SMEs.

Table 15. Manufacturers of construction products for residential and non-residential buildings (SNI 23.61, 23.51, 23.62, 16.21-2, 24.2 and 23.991), number of enterprises by size, 2021. Source: Statistics Sweden, Statistical Business Register.

Enterprise size	Number of employees	Number of enterprises
Small enterprises	0–49 employees	290
Medium-sized enterprises	50–199 employees	23
Large enterprises	200–500+ employees	17

Enterprise size	Number of employees	Number of enter-prises
Total		**330**

Building materials used on construction sites are provided by enterprises in the wholesale or specialised trade working with building materials, iron and timber products and plumbing. Concrete cannot be stored, which means it is delivered to construction sites by concrete manufacturers.

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