MINERGIE®

Minergie® LATAM

Application Guide for Minergie Certification® in Latin America and the Caribbean

Version 2023.1, July 2023

Minergie LATAM

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Table of Contents

1 Glossary

Airtightness Perimeter	See definition provided under the explanation in Requirement A1. Project Data and Space Definition
CCA	Copper, Chromium and Arsenic
CDD	Cooling Degree Day (the number appearing next to CDD, e.g., CDD 10, indicates that 10°C is considered to be the reference temperature for calculating the CDD).
CES	Sustainable Building Certification
CEV	Housing Energy Rating (Ministry of Housing and Urbanism of Chile)
CLT	Cross Laminated Timber
Conditioned Area	See definition provided under the explanation in Requirement A1. Project Data and Space Definition
CVS	Sustainable Housing Certification
DAP	Environmental Product Declaration
DHW	Domestic Hot Water
DITEC	Technical Division for the Study and Development of Housing, Ministry of Housing and Urban Development of Chile
EETT	Technical Specifications
Envelope Area	See definition under the explanation in Requirement A2. Thermal Insulation of the Building Envelope
ERA	Energy Reference Area (see "Conditioned Area")
FSC	Forest Stewardship Council
HDD	Heating Degree Days (the number appearing next to HDD, e.g., HDD 18, indicates that 18°C is considered to be the reference temperature for calculating the HDD)
Insulation Perimeter	See definition provided under the explanation in Requirement A1. Project Data and Space Definition
LATAM	Latin America
MINVU	Ministry of Housing and Urban Development
NCh	Chilean Standard
NMX	Mexican Standard
NOM	Mexican Official Standard
OGUC	General Ordinance of Urbanism and Construction of Chile
PDA	Atmospheric Decontamination Plans
SBX	Boron oxide
SEER	Seasonal Energy Efficiency Ratio
SHGC	Solar Heat Gain Coefficient (See also the explanation provided under Requirement A5. Exterior Solar Protection of Windows)
Total Area	See definition provided under the explanation in Requirement A1. Project Data and Space Definition
Usable Area	See definition provided under the explanation in Requirement A1. Project Data and Space Definition
VOC	Volatile Organic Compounds

2 Introduction

2.1 Purpose and Method of Use

This MINERGIE®[1] LATAM building system application guide (hereinafter the "Application Guide") is based on Minergie LATAM Regulations (Version 2023.1). The purpose of this document is to illustrate the requirements provided under said regulations. The intent is to simplify the design, submission and certification processes for all project participants whilst promoting quality assurance and allowing for uniform application throughout Latin America and the Caribbean. The figure below provides a summary of the various aspects that Minergie Certification takes into account:

In Latin America where Minergie has physical representation offices and/or has gained certain market relevance, specific national regulations based on the Minergie LATAM standard regulations (e.g., Chile, Mexico) will apply. However, this Application Guide applies in these countries as well. In the event national specifications have to be taken into account during implementation of a requirement, this is indicated at the beginning of the requirement and the corresponding information can be found in the last two chapters herein: Chapter 8 Chile-Specific Aspects and Chapter 9 Mexico-Specific Aspects.

This guide is for information purposes only. In the event of inconsistencies, the Minergie LATAM Regulations available at www.minergie.com take precedence.

1 MINERGIE® is a protected registered trademark. For purposes of readability, the term "MINERGIE®" is replaced by "Minergie" throughout this document.

3 Certification Terms and Types

3.1 Definition of Main Terms

Building

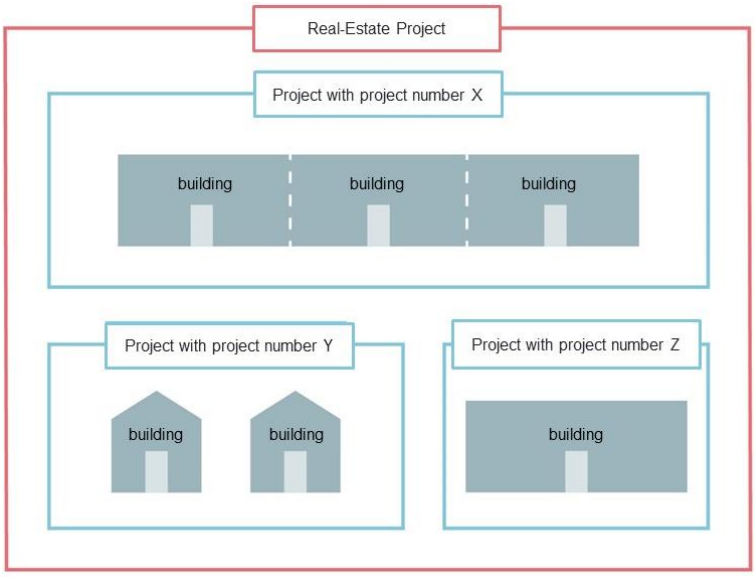
A Minergie certification is issued per each building as a whole, including both the building's structural parts and interior. A building is an independent structure that has its own entrance/house number and has a closed insulation perimeter or a continuous wall separating it from other structures. All questions regarding the definition of a building should be clarified with the certification body early on.

Project

One or more buildings are registered on the Minergie online platform under a unique project name and number. This number is not the same as the number that will appear on the buildings' Minergie certificate. It is important to note that all buildings entered under the same project must be certified simultaneously, since the compliance verification request on the online platform covers the entire project at once.

Real-Estate Project

It may be that for a given real-estate project several projects are opened on the Minergie online platform. The certification body will issue a summary of the projects opened on the platform for the same real-estate project.



High-Rise Building

A high-rise building is defined as a building having at least four stories and that is taller than it is wide.

Certification Number

The Minergie certificate number (e.g., CHL-0001) is assigned during the provisional certification process. It contains the country abbreviation according to ISO 3166 ALPHA-3 and a number corresponding to the number of certified buildings. A certificate number is assigned to each entrance/house number, i.e., to each building.

Platform

The platform is where all projects seeking certification must be registered. It is also where applicants will upload information documenting compliance with certification requirements and submit project validation requests. The platform also provides a section where applicants can engage in dialogue with the certification body, and where information exchanged is stored as history. See chapter 5.2 for the access to the platform.

Minergie Form

The Minergie Form (verification form) is an Excel spreadsheet that can be downloaded from the website (see link in chapter 5.1). It serves as the basic document for certification in accordance with the Minergie building standard. It must be uploaded to the platform with all the other supporting documents before applicants can request project verification.

3.2 System Boundary

The system boundary is defined by the building and its immediate surroundings (the property). Any special foundations or elements located outside the official boundary of the project plot(s) are excluded from consideration. Although these elements may bear relevant weighting in the overall environmental impact of a building, they are not included in the assessment so as to allow for comparing buildings with each other.

3.3 Certification Type

It is important to enter project information correctly when creating a Minergie project on the platform. The following principles apply:

- One Minergie certificate number is issued per entrance/home number.
- A project corresponds to a building on the platform, i.e. each project contains only one building.

The following registration and presentation formats are derived from these principles.

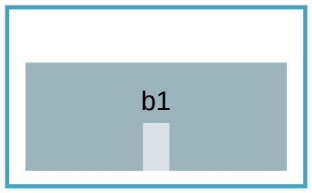
3.3.1 Single Building

The registration process for a single building is as follows:

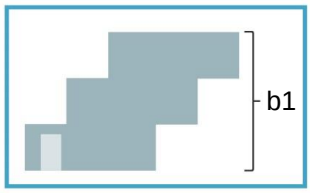
- The applicant opens a Minergie project on the platform and creates the building under the project.
- The building's entire conditioned area is referenced when filling out supporting documents, including the Minergie Form.

Practical examples of single buildings:

Single-family house



Multi-family building



Buildings on terraces
The following applies here: The building has only one house number.

3.3.2 Repetitions of the Same Building (Condominiums)

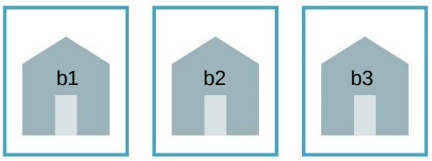
Repetitions of the same building (i.e., extension) apply when identical houses are grouped by typology, with the same orientation, the same envelope configuration, the same use and the same usable area on all floors. It is only possible to tolerate a 20% difference of the underground usable area. Should you have questions regarding this matter, contact the certification body early on.

The registration process for repetitions of the same building is as follows:

- The building with the most unfavorable conditions in terms of heating/cooling demand is selected.
- The applicant opens a Minergie project on the platform and creates the unfavorable building under the project. The number of buildings is mentioned in the project information.
- The entire conditioned area of the unfavorable building selected is referenced when filling out supporting documents, including the Minergie Form.

After having successfully verified that the building complies with Minergie requirements, the certification body will issue a Minergie certificate for each building in the project.

Practical examples of repetitions of the same building:



Condominium with single-family or multi-family dwellings

3.3.3 Buildings with Multiple Entrances

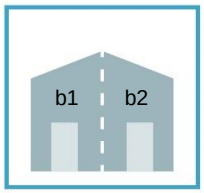
Buildings with multiple entrances are considered multiple-entry buildings when they have several entrances/house numbers for the same building, for example, in the case of semi-detached dwellings.

The registration process for multiple-entry buildings is as follows:

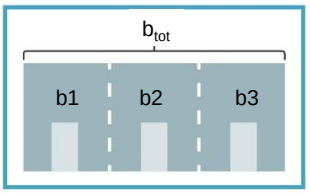
- The applicant opens a Minergie project on the platform and creates one building (all entrance/house numbers together). The entrances/house numbers are mentioned in the project information.
- The complete conditioned area of the entire building as a whole (sum of the areas per entrance) is referenced when filling out supporting documents, including the Minergie Form.

After having successfully verified that the building complies with Minergie requirements, the certification body will issue one Minergie certificate for entrance/project house number.

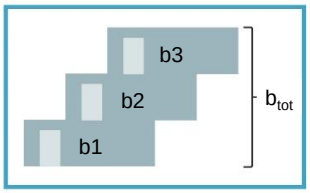
Practical examples of buildings with multiple entrances (multiple-entry buildings):



Semi-detached house



Single-family semi-detached house, multi-family house or house with several entrance numbers/houses



Building on terraces
The following applies here: The building has one house number per apartment.

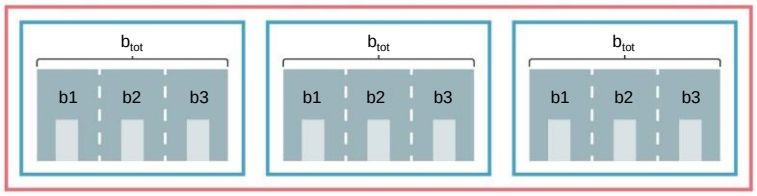
3.3.4 Repetitions of Buildings with Multiple Entrances

The registration process for identical repetitions of buildings with multiple entrances is as follows:

- The applicant opens one Minergie project on the platform for each repetition and creates one building with indication of all entrances/house numbers in the project information.
- The supporting documentation, including the Minergie Form, are filled out for each repetition, referencing the complete conditioned area of the entire building as a whole (sum of the areas per entrance).

After having successfully verified that each repetition complies with Minergie requirements, the certification body will issue one Minergie certificate for entrance/house number in the project.

Practical examples of repetitions of buildings with multiple entrances:



Several similar apartment buildings in one real-estate project

3.3.5 Separate Building

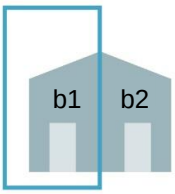
A building attached to another building and separated from it by a clear vertical or horizontal boundary (e.g., concrete wall) is considered a separate building. Each building must have a separate entrance/house number and must be able to have a separate development (e.g., installation of thermal insulation in only one part of the building).

The registration process for separate buildings is as follows:

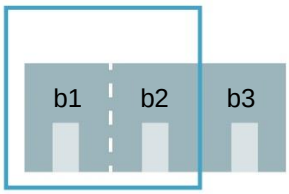
- The applicant opens a Minergie project on the platform and creates a building for the entrance/house number seeking certification.
- The partial conditioned area of the entrance/house number seeking certification is referenced when filling out supporting documents, including the Minergie Form.

After having successfully verified that this part of the building complies with Minergie requirements, the certification body will issue a Minergie certificate for this entrance/house number.

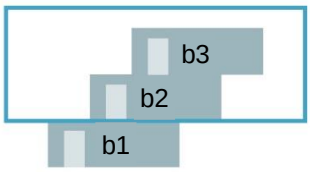
Practical examples of separate buildings:



Half of a semi-detached house



Multi-family house
The following applies here: Buildings with continuous commercial space cannot be divided.



Building on terraces

3.3.6 Non-Certifiable Elements

Buildings whose use is not listed under Chapter 3 Scope and Boundaries of the Minergie LATAM Regulations cannot be certified.

In addition, Minergie cannot certify parts of buildings, such as, for example:

- Ground floors or attics of a multi-story building
- Parts of buildings that do not have separate addresses (entrance/house number)

Should you have questions regarding this matter, contact the certification body early on.

3.4 Boundaries between New Buildings and Renovations

In order to be certified as a new building, the project must be under design or have been completed in less than three years at the time of submitting the project validation on the platform.

The following rules apply to building renovations:

3.4.1 Major Changes to an Existing Building

In the event a building is dismantled down to its structural elements as part of a renovation, the project can/must, under certain conditions, apply for a Minergie certification for new buildings. The following must be taken into consideration:

- A Minergie certification for new buildings can/must be applied for if the walls and mezzanines are being replaced.
- However, the project is considered a renovation if the walls and mezzanines are kept intact. Minergie certification is not currently available for renovations in Latin America and the Caribbean.

3.4.2 Modernizing a Building Originally build without a Heat/Air-Conditioning System

- Should an industrial or unconditioned building (i.e., without air-conditioning system) undergo a change of use and be converted into a conditioned building (e.g., a dwelling or an office), the project can/must apply for a Minergie certification for new buildings.
- If the original building was already conditioned, despite a change of use, it will be considered a renovation (Minergie certification is not currently available for renovations in Latin America and the Caribbean).

4 Responsibilities and Roles

4.1 Owner

The Owner is defined as the owner of the property and the party to whom the Minergie Expert must send the Minergie certificate. The owner's address is requested on the platform, only for the purpose of sending the process-related invoice.

4.2 Applicants

The person who has most of the building information required should provide the documentation that justifies compliance with the criteria. This is usually the architect and is designated as the applicant. This person may be supported by different specialists.

4.3 Minergie Expert

Each project must have a Minergie expert whose knowledge has been accredited after receiving training by the certification body (see **Expert - Minergie Chile**, **Expert – Minergie México**). Only projects registered by Minergie experts will be validated.

Minergie experts are the only points of contact between applicants and the certification body.

The Minergie expert is responsible for gathering and controlling supporting documentation. He/she must upload them to the platform and indicate compliance or non-compliance with the different requirements, including a brief additional clarification. He/she must also ensure the quality of the project delivered and advise applicants on the design, if necessary.

4.4 Certification Body

The certification body contributes to the quality assurance of the building by:

- Providing advice and support during preparation of the verification request.
- Verifying quality:
  - Information provided is complete.
  - Controls based on plans and other supporting documents.
- Following up of inconsistencies or test reports that have been rejected, evaluated, issued.
- Providing advice and support regarding optimization (if necessary).
- Site inspections
- Statistics evaluations

5 Instructions regarding Verification Documents

5.1 Minergie Form

A Microsoft Excel-based form is available to justify compliance with several of the Minergie requirements. Applicants can download this form (hereinafter the "Minergie Form") free of charge from the Minergie home page (Chile: **www.minergie.cl**, Mexico: **www.minergie.mx**, other countries: **www.minergie.com**). Tools recognized by other national labeling or evaluation systems are also used. The applicant is always free to propose alternative pieces of evidence, as long as they clearly demonstrate compliance with Minergie requirements.

5.2 Platform

All completed verification documents and supporting documentation must be uploaded to the **Minergie International platform**. This platform has its own user guide which can be found under the "Supporting Documents" tab on the platform and downloaded.

6 Climate Zones

In order to allow international use of the Minergie LATAM regulations, the certification system uses the climate zone classification published by the ASHRAE 169-2021 International Standard, Climate Data for Building Design Standards:

No.	Name	Thermal Criteria
0A	Extremely Hot Humid	6000 < CDD
0B	Extremely Hot Dry	
1A	Humid Very Hot	5000 < CDD
1B	Dry Very Hot	
2A	Hot humid	3500 < CDD ≤ 5000
2B	Hot dry	
3A	Humid Warm	2500 < CDD ≤ 3500
3B	Dry Warm	
3C	Marine Warm	CDD ≤ 2500 and HDD ≤ 2000.
4A	Humid temperate	CDD ≤ 2500 and 2000 < HDD ≤ 3000
4B	Dry Mixed	
4C	Marine Mixed	2000 < HDD ≤ 3000
5A	Humid Cool	3000 < HDD ≤ 4000
5B	Dry Cool	
5C	Marine Cool	
6A	Humid Cold	4000 < HDD ≤ 5000
6B	Dry Cold	
7	Very Cold	5000 < HDD ≤ 7000
8	Subarctic	7000 < HDD

This standard defines heating degree days (HDD) based on a temperature of 18°C and cooling degree days (CDD) based on a temperature of 10°C.

The data required to categorize project locations can be easily downloaded free of charge at **http://www.degreedays.net**.

For countries with national Minergie regulations, you will find relevant aids under the corresponding regulation indicating the equivalent of the ASHRAE climate zones according to the local regulations.

7 Requirements

A ARCHITECTURE

A1. Project Data and Space Definition

A1. Project Data and Space Definition	**Mandatory Requirement**

Country-Specific Aspects

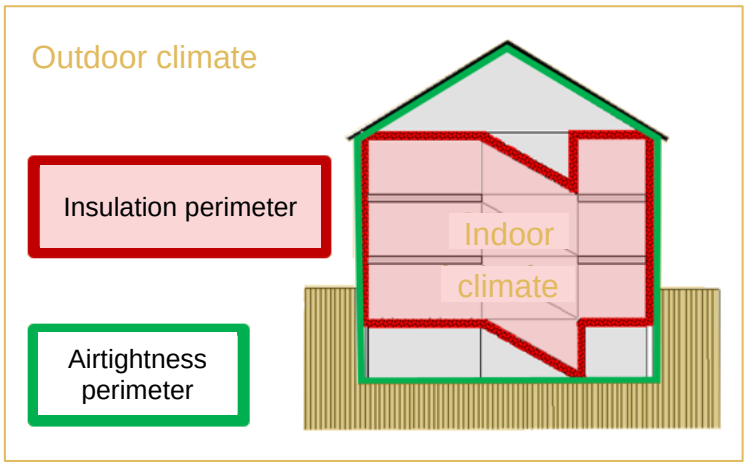
Country	**Chile**	**Mexico**
National specifications to be considered:	See Chapter 8	None

Explanation of the Regulations

Pursuant to the main objective of Requirement A1, a statement with general project information related to location, orientation, architectural design and insulation characteristics is required. Such information is described in detail on the Minergie Form and must be completed directly there.

The following definitions are considered:

- Insulation perimeter: Continuous thermal insulation perimeter that demarcates the conditioned area, in the event a permanently high level of thermal comfort cannot be guaranteed through passive design strategies. The defined volume is delimited by the building's thermal envelope, generally consisting of the roof, floor, wall, window and door surfaces, which form a closed geometric body.
- Airtightness perimeter: Continuous perimeter of materials that ensure airtightness (e.g., windows, membranes, insulating strips, etc.). This defined volume is generally delimited by the building's thermal envelope, but it may be different in some cases (e.g., basement, crawl space, etc.).
- Total project area: This consists of the built area, including, for example, evacuation stairs, all (100%) terrace surfaces, attic roofs with a height of less than 1.6 meters, among others.
- Project conditioned area: Area delimited by the insulation perimeter, composed of enclosures normally used by the users and that includes heating or cooling systems, and/or that passively maintains the temperature within the thermal comfort range. The surface area is measured in gross terms, so it includes cross-sections of walls and shafts. As a result, in many situations the area of a floor is determined by multiplying the length by the width of the building.
- Project usable area: This is calculated according to the national definitions in force in the country where the project is carried out. If no such definition exists, the following definition is used: "sum of the area of the units that make up a building, calculated up to the axis of the walls or dividing lines between them and the common area. It is calculated horizontally per floor, not including voids, vertical ducts and evacuation stairways."



1. Schematic explanation defining the airtightness and thermal protection perimeters (Source: Armin Binz, 2021).

Verification Documents for Provisional Certification:

- Minergie Form, tab A1.
- Project planimetric diagrams, table with surface areas and technical specifications.
- Thermal insulation: Schematic plan with marked perimeter; Vertical sectional diagram with marked perimeter.
- Airtightness: Schematic plan with marked perimeter; Vertical sectional diagram with marked perimeter.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of the project for inclusion on the list of Minergie projects posted on the Minergie website (indicate copyright).

Examples

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Frequently Asked Questions and Complex Cases

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A2. Thermal Insulation of the Building Envelope

A2. Thermal Insulation of the Building Envelope	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	See Chapter 8	None

Explanation of the Regulations

The following definition is considered:

- Area of the building envelope: Sum of the areas of all parts of the building envelope according to the insulation perimeter. Areas that are not in direct contact with the outside air (i.e., floor to ground or walls to unconditioned enclosed spaces (e.g., basements, garages etc.) can be multiplied by a factor of 0.5.

Minergie regulations establish a minimum thermal insulation requirement for the envelope of projects wishing to be Minergie-certified. The step-by-step procedure to verify insulation compliance is explained in detail below:

- Firstly, applicants must declare the thermal insulation materiality and characteristics of every element making up the building's thermal envelope (roof, walls, floors, windows and doors).
- Secondly, applicants must declare compliance with the thermal transmittance values provided under the Regulations.

It should be noted that the methodology required to calculate the thermal transmittance value is provided under local regulations in force (in Chile NCh 853: 2007; in Mexico NOM-020-ENER-2011) and that density, thermal conductivity and specific heat characteristics of the materials used in the calculation can be found under Table 2.2.1 Building Materials, Appendix 2.2 of Chile's Sustainable Construction Standards for Housing Volume II Energy[2] (*Estándares de construcción sustentable para viviendas de Chile Tomo II Energía*), or in Informational Appendix D Thermal Conductivity and Insulation Values of Various Materials of NOM-20-ENER-2011[3] *(Apéndice D Informativo Valores de Conductividad y Aislamiento Térmico de Diversos Materiales).*

The following table shows the thermal insulation thicknesses that comply with typical thermal transmittance U values:

Table 1 Example of thermal insulation thicknesses for compliance with a given thermal transmittance.

U-value ($W/(m^2 K)$)	Insulation thickness (considering insulating material with a conductivity λ= 0.37 W/mK)
0,6	e= 50 mm
0,5	e= 70 mm
0,4	e= 80 mm
0,3	e= 120 mm
0,25	e= 140 mm
0,18	e= 200 mm

In climate zones 0, 1, 2 and 3, the thermal transmittance threshold values as defined under the Regulations vary according to whether the opaque material is considered "solid/heavy" or "light/lightweight." Several examples of solid and lightweight constructions are listed below. In the event the project's construction solution is not listed, the calculation can be performed on the Minergie Form, in tab A4 (Alternative Calculation).

Solid construction elements:

[2] https://csustentable.minvu.gob.cl/wp-content/uploads/2018/09/ESTANDARES-DE-CONSTRUCCION-SUSTENTABLE-PARA-VIVIENDAS-DE-CHILE-TOMO-II-ENERGIA.pdf

[3] https://csustentable.minvu.gob.cl/wp-content/uploads/2018/09/ESTANDARES-DE-CONSTRUCCION-SUSTENTABLE-PARA-VIVIENDAS-DE-CHILE-TOMO-II-ENERGIA.pdf

- Reinforced concrete wall (minimum 10 cm thick)
- Masonry wall (minimum 20 cm thick)
- Adobe wall (minimum 17 cm thick)

Lightweight construction elements:

- Cross-laminated timber (CLT) wall (less than 27 cm thick)
- Timber frame construction system (wood partition walls)
- Metal frame construction system (metal partition walls)

Generally, lightweight construction systems are heterogeneous and have different sections in which the thermal transmittance U-value varies (e.g., a wooden partition wall). In these cases, the U-value of the complete element must be calculated, considering all its sections and taking into account the percentage of the wall surface occupied by each section.

Finally, the thermal transmittance values for each element must be entered on the Minergie Form and the calculation log must be attached.

For requirement verification purposes, once the building has been built, photographs of the installation of insulation of each element making up the thermal envelope must be submitted, including photographs of thermal insulation in joints between elements, to verify that the insulation layer has been installed in a continuous manner.

In climate zones 0, 1, 2 and 3, adopting the following rooftop strategies can improve envelope performance:

- A canopy layer to provide shading over the surface, e.g., with photovoltaic panels or solar thermal collectors (see also Requirement T1. Fossil Fuel-Free, Efficient Energy Production).
- Green roof with native vegetation (see also Requirement A8.a Green Roof), providing additional insulation and evapotranspiration which reduce the ambient temperature. This can be combined with photovoltaic panels or solar thermal collectors.
- Applying reflective material with high reflectance and/or emissivity (e.g., white paint, cool roof type water-proofing).

Verification Documents for Provisional Certification

- Thermal insulation description and strategy
- Minergie Form, tab A2.
- Calculation log of thermal transmittance values, indicating source of material values and including compactness calculation.
- Scantling plan or sectional diagram for each façade.
- Architectural technical specifications including details of insulation and type of windows.

Verification Documents for Final Certification

- Provisional certification documentation (updated)
- Data sheets for all insulation materials, glass and window frames, specifying thermal transmittance (U-values).
- Photographs of the on-site installation of the thermal insulation layer.

Examples

The examples shown below have been calculated pursuant to NCh 853 2007 but could be applied to any national standard in Latin American and Caribbean countries.

Example 1: U-value calculation of a timber frame construction system (heterogeneous lightweight construction):

The example below is a wood wall with a lightweight panel structure placed on 115x90 mm studs with cellulose fiber insulation (26 kg/m^3 density and 11.5 cm thick) in-between the studs.

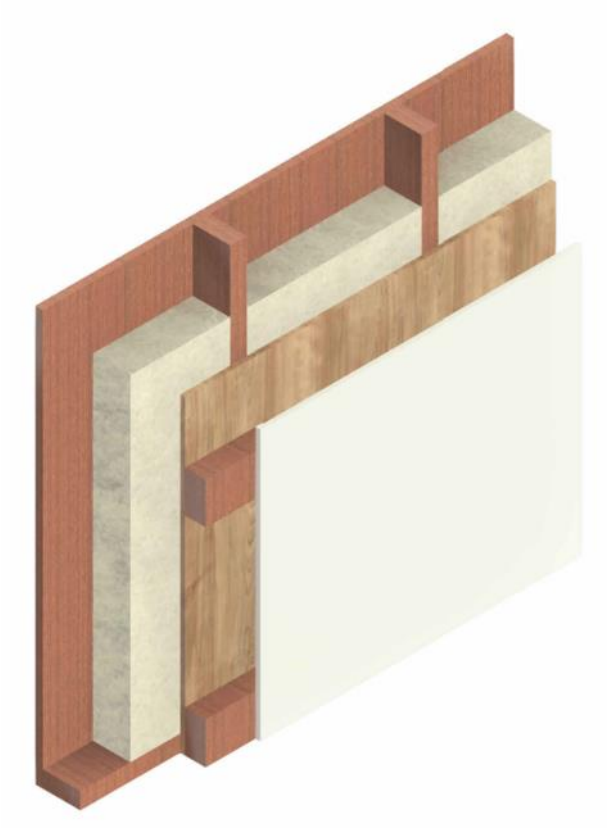

Figure 2 Example of a timber frame construction system

The calculations performed correspond to section 1, which crosses the right stud, and section 2, which crosses the insulating material.

Table 2 U-value calculation. Mixed construction system (2 or more sections) with wood structure.

Section 1				
Material	Thickness (m)	Density (Kg/m3)	Conductivity (W/mK)	Resistance (m2K/W)
Inner surface resistance				0.120
Wood, fiberboard_850	0.015	850	0.23	0.065
Wood pine	0.115	410	0.104	1.106
Wood, fiberboard_850	0.015	850	0.23	0.065
External surface resistance				0.050
Thermal resistance (m2K/W)				1.406
Thermal transmittance (W/m2K)				0.711
Section 2				
Material	Thickness (m)	Density (Kg/m3)	Conductivity (W/mK)	Resistance (m2K/W)
Inner surface resistance				0.120
Wood, fiberboard_850	0.015	850	0.23	0.065
Cellulose insulation	0.115	26	0.041	2.805
Wood, fiberboard_850	0.015	850	0.23	0.065
External surface resistance				0.050
Thermal resistance (m2K/W)				3.105
Thermal transmittance (W/m2K)				0.322
U-value weighting		% en la superficie		Valor U ponderado
U-value section 1		0.2		0.142
U-value section 2		0.8		0.258
		Valor U total (W/m2K)		0.400

The calculated U-value is the average of the U-value corresponding to each section, depending on the surface area of each section. In this example, section 1 corresponds to 20% of the wall surface, while section 2 corresponds to 80% of the wall surface.

$U = (0.711 \times 0.2) + (0.322 \times 0.8) = 0.400\ W/m^2K$

Example 2: U-value calculation of thermally insulated concrete exterior wall (solid and homogeneous construction):

The example used is a 20-cm reinforced concrete wall with thermal insulation placed on the outer face of the wall. The thermal insulation is expanded polystyrene (EPS) foam with a density of 20 kg/m^3 and 9 cm thick.

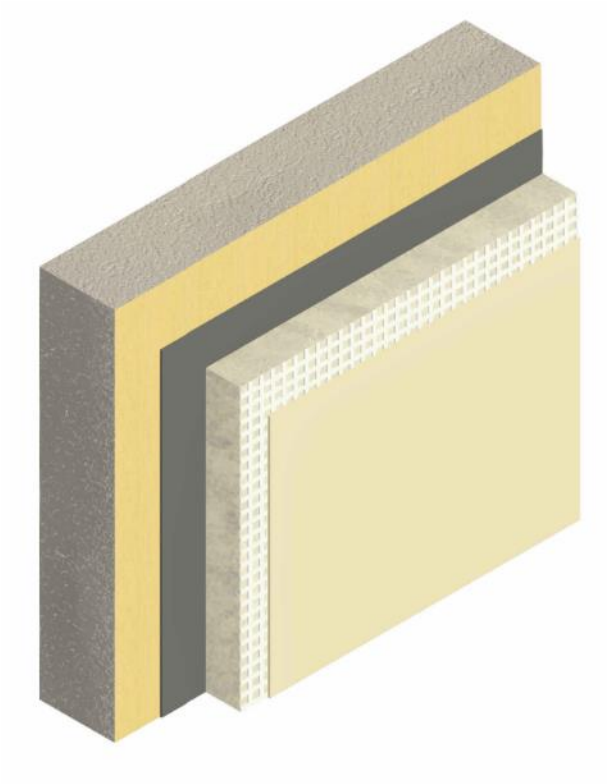

Figure 3 Solid construction layered view.

Table 3 U-value calculation of solid construction example

Material	Thickness (m)	Density (Kg/m3)	Conductivity (W/mK)	Resistance (m2K/W)
Inner surface resistance				0.120
Reinforced concrete (normal)	0.2	2400	1.63	0.123
Expanded polystyrene_20	0.09	20	0.038	2.368
External surface resistance				0.050
Thermal resistance (m2K/W)				2.661
Thermal transmittance (W/m2K)				0.376

In this case, the U-value is 0.376 $\mathrm{W/m^2K}$ since it is a homogeneous construction element that does not contain different sections.

Example 3: Windows:

There are two ways to justify the U-value of a window, as follows:

- **Simple option:** the general values of 15% of the frame and 85% of the glass can be used as the default form for calculating window's total U-value.
- **Detailed option:** The calculation is carried out using the DITEC window calculation tool[4] or a similar tool for all window types in the building. The total U-value of each window type shall be provided in detail considering the U-value of the glass and the frame, as well as the relationship between these two elements.

[4] You can download the tool here (only in Spanish): http://xi.serviu.cl/pda/pda.htm

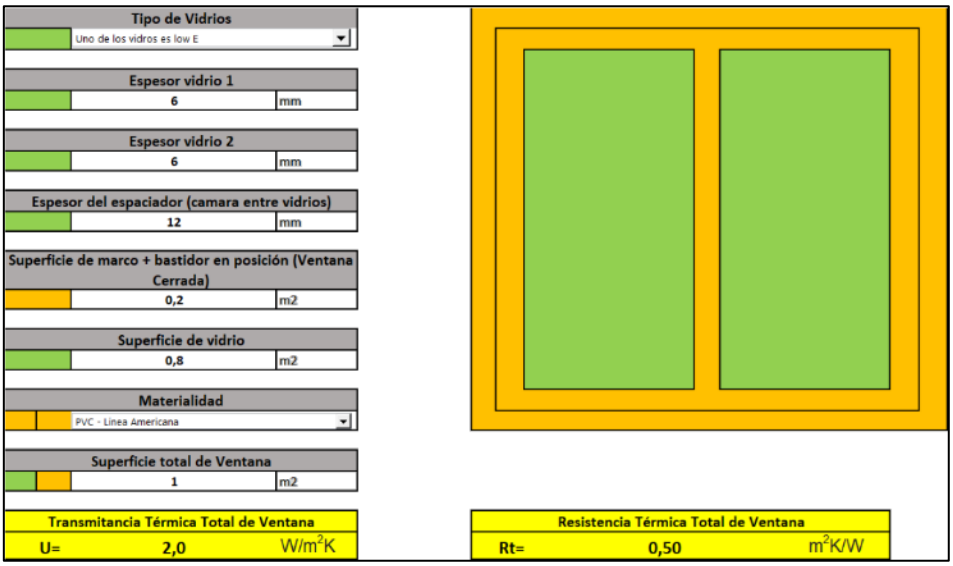

Figure 4 Example of a window U-value. DITEC tool (only in Spanish)

The thermal transmittance of the glass and the frame are used to obtain the window's total U-value.

Example 4: Calculating compactness for multifamily housing:

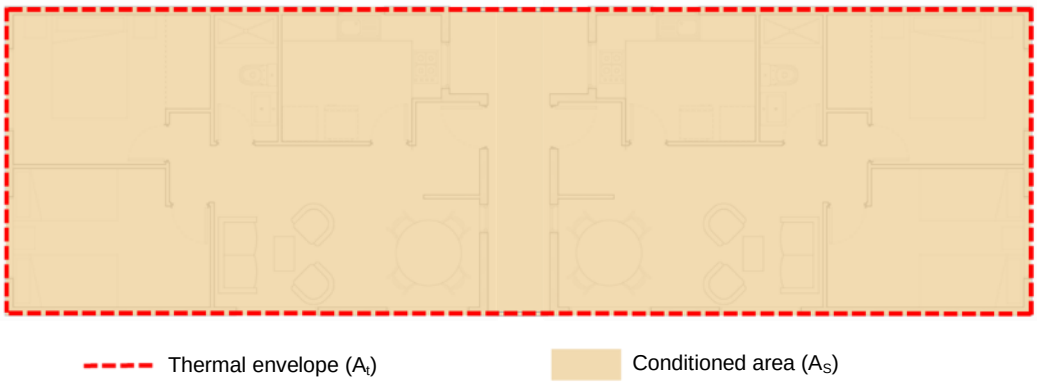

Figure 5 Typical floor plan. Calculating compactness.

The building selected as an example of how to calculate compactness has a clear interior height of 2.4 meters between floors, with a total of six floors.

- Thermal envelope: 907.2 m^2 (sum of exterior walls, roof, floor above ground and windows)
- Conditioned area: 108 m^2 for each floor, for a total of 648 m^2

$$C = A_t / A_s = 907.2 / 648 = 1.4$$

$$C_a = ((3 / (1 + 1.4) - 1) * 0.5 + 1 = 1.13$$

The attenuated U-value is 0.50 (minimum U-value in W/m^2 K) *C_a (1.13 according to higher calculation) = 0.56 W/m K^2

Depending on the type of dwelling, it may or may not be possible to obtain a good compactness value to attenuate the minimum thermal transmittance requirement. By way of advice, it can be established that if a C>1.5 value is obtained, it is likely that the attenuation of the U-value will not be sufficiently beneficial to generate a significant difference with respect to the minimum required value.

Frequently Asked Questions and Complex Cases

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A3. Reducing Thermal Bridges and Airtightness

A3. Reducing Thermal Bridges and Airtightness	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

This requirement deals with thermal bridges and airtightness. Regarding airtightness, it is necessary to comply with the Regulations and demonstrate the continuity of the airtightness layer indicated in Requirement A1 (included in doors and windows). Regarding thermal bridges, the following explanation applies.

The requirements applicable to the building envelope's U-values explained under Requirement A2 take into account the existence of small thermal bridges, in these cases no additional justification is requested. In the case of significant thermal bridges in the thermal envelope, i.e., linear thermal bridges with Psi values greater than 0.5 W/(m K) and point thermal bridges with Chi values in the order of 0.5 W/K, additional justification must be provided.

Linear thermal bridges (Psi-value) are alterations of the thermal transmittance value of a building element due to changes in its materiality and which can be related to a length, e.g., balcony connections, roof boundaries, etc. The Psi-value in W/(m K) represents the additional loss of heat or cold per linear meter of joint or junction, considering a temperature difference of one degree Celsius between the outside and inside air. This value also depends on the thermal transmittance of the adjacent building components, the quality of the construction joint and the reference point for its calculation.

Point thermal bridges (Chi-value) are alterations of the thermal transmittance value of a building element due to changes in its materiality and which can be related to a point, e.g., façade fasteners, columns, etc. The Chi-value in W/K represents the additional heat or cold loss due to thermal bridging, for a temperature difference of one degree Celsius between the outside and inside air.

Minergie requests that applicants justify that the major linear thermal bridge values (Psi) respect the threshold values for thermal bridges. There are two options for this:

Simple option:

Thermal bridges can be compensated for with a 10% improvement over the minimum required U-value, i.e., major thermal bridges above 0.5 W/(m K) can be compensated for with U-values that are 10% below the minimum required under Requirement A2 in adjacent areas. In the case of point thermal bridges greater than 0.5 W/K, compensation is achieved the same way with U-values that are 10% below the minimum required thermal transmittance under Requirement A2.

Detailed option:

A complete list of the major thermal bridges can be submitted, including detailed information on the quantity and surface area, in addition to calculating the specific heat flux of each type of thermal bridge based on Table 4,

Table 5, Table 6 and to compensate by improving the U-values of any part of the envelope. If it is not possible to compensate through improvements to the envelope's U-value, applicants can solve the thermal bridge issue by taking as a reference the thermal bridge solutions included in Table 7.

Major linear thermal bridges, i.e., Psi > 0.5 W/(m K) occur along the thermal envelope where there are discontinuities in the thermal insulation layer as a result of the compact materials passing completely through the envelope. Some examples are: Concrete slabs exiting from the interior to the exterior, plinth walls and supports exiting uninsulated to the exterior or to the unheated basement, etc.

The linear thermal bridging Psi value is determined by comparing the construction detail of each point of encounter considered in the project with the corresponding example considered in the list of thermal bridges, located in the examples section of this requirement.

The following is a list of what Minergie considers to be major linear thermal bridges. This list can be used as a reference to estimate heat flow. These values can be used as references as long as there are no significant differences between the reference case and the project.

Table 4 Reference values for major linear thermal bridges in roofs

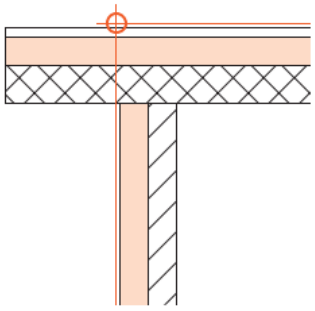
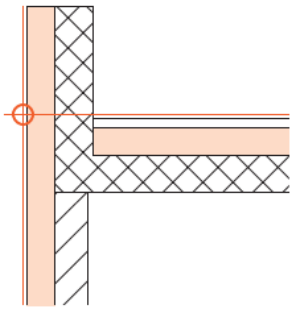
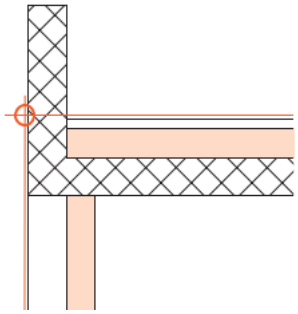
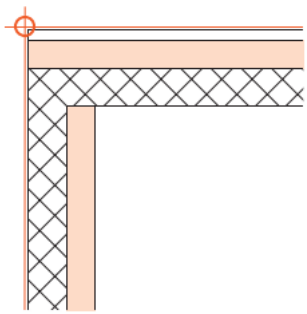
<table>
<tr><td colspan="2">Roof</td><td>Comment: Major thermal bridges in roofs usually occur due to the discontinuity of thermal insulation caused by wall/roof junctions, or the existence of eaves and/or parapets.</td></tr>
<tr><td>Detail 1: Discontinuity due to existence of eaves</td><td>Detail 2: Discontinuity due to the existence of a parapet considering the thermal insulation of the exterior wall.</td><td>Detail 3: Discontinuity due to the existence of a parapet considering the thermal insulation of the interior wall.</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Psi = 0.51 W/mK</td><td>Psi = 0.51 W/mK</td><td>Psi = 0.64 W/mK</td></tr>
<tr><td colspan="2">Detail 4: Discontinuity due to the wall/roof junction.</td><td rowspan="3"></td></tr>
<tr><td colspan="2">  </td></tr>
<tr><td colspan="2">Psi = 0.56 W/mK</td></tr>
</table>

Table 5 Reference values for major linear thermal bridges in walls

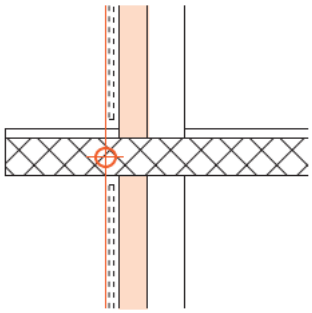
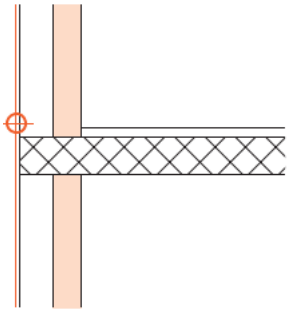
Wall	Comment: Major thermal bridges in walls usually occur due to the discontinuity of thermal insulation caused by the existence of slabs or eaves, both horizontal and vertical.	
Detail 5: Discontinuity due to the existence of an exterior slab.	**Detail 6:** Discontinuity of the interior thermal insulation due to the slab between floors.	
		
Psi = 1.01 W/mK	Psi = 0.73 W/mK	

Table 6 Reference values for major linear thermal bridges in basements

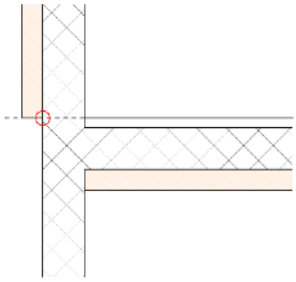
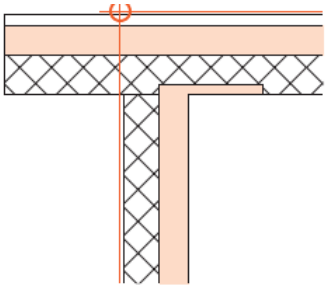
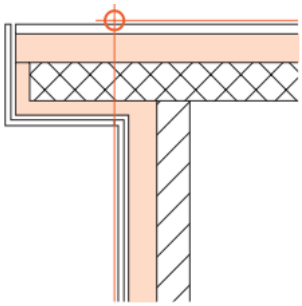
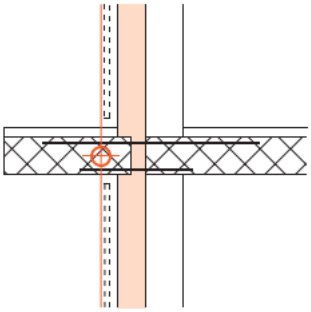
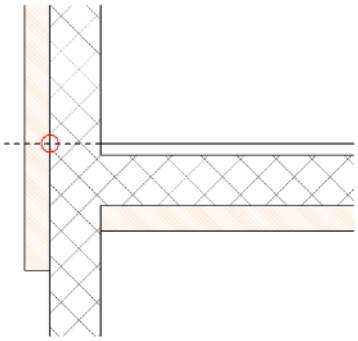
Basement	Comment: Major thermal bridges in basements usually occur due to the discontinuity of the thermal insulation caused by the point of encounter of a wall with the walls against the ground or slabs of unconditioned enclosures.	
Detail 7: Discontinuity due to the point of encounter between a slab and the basement floor wall, wall with exterior thermal insulation.		
		
Psi = 0.85 W/mK		

Table 7 Solution for major linear thermal bridges in roofs, walls and basements

Thermal bridges solution	Comment: The purpose of the thermal bridge solution is to maintain the continuity of the thermal insulation by modifying the point of encounter.	
Detail 10: Discontinuity due to the existence of eaves on the roof.	**Detail 11:** Discontinuity due to the existence of eaves on the roof.	**Detail 12:** Discontinuity due to the existence of an exterior slab in the wall.
		
Psi = 0.26 W/mK	Psi = 0.11 W/mK	Psi = 0.23 W/mK
Detail 13: Discontinuity due to the point of encounter of exterior wall with basement floor wall, continue exterior thermal insulation an additional 50 cm below floor level in the wall.		
		
Psi = 0.25 W/mK		

With respect to airtightness, adding certain materials to the thermal envelope of the building is one way to be compliant with the requirement:

Table 8 List of materials that can be added to improve airtightness.

Air Leaks	Description of Material Type
Inner face of walls and roofs	Windtight or waterproof barrier with a Sd value greater than 50, expressed in meters.
Barrier joints in sealing layer	Adhesive tapes.
Window/door to wall junction	Adhesive tapes, self-expanding tapes.
Installations joints	Adhesive tapes,[5] installation boxes and membranes for duct passages.

Verification Documents for Provisional Certification

[5] Self-expanding foams are not recommended because of their short service life and high contamination.

- Detailed construction drawing (schematic)
- Floor plan, showing airtightness perimeter.
- Scantling plan
- Technical specification of materials used to improve airtightness and their corresponding data sheets. Indicate the airtightness of the selected doors and windows.
- Minergie Form, tab A3.

Verification Documents for Final Certification

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

Example of detailed calculation option:

Situation: There are 10 meters of major linear thermal bridging in a wall with a Psi value = 1.01 W/mK.

Calculations: The heat flux corresponding to the thermal bridge is (10 x 1.01) = 10.1 W/K.

Remediation: It is possible to compensate for this thermal bridging by increasing the insulation in the roof, which has an area of 100 m^2. The minimum U-value required according to Requirement A2 is 0.5 W/m^2 K. The improved U-value to compensate for the linear thermal bridging in the wall should be 0.4 W/m^2 K (0.5-(10.1/100)).

Verification: (100 x (0.5 - 0.4) = 10 W/K.

Frequently Asked Questions and Complex Cases

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A4. Passive Use of Solar Radiation

A4. Passive Use of Solar Radiation	Mandatory Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

In places with periods of average daily temperatures below 14°C, the positioning of the windows should consider the position of the sun to take maximum advantage of solar radiation in the cooler months (without generating overexposure in hot periods). It should be noted that average daily temperatures below 14°C can also occur in areas with hot (dry) climates. To justify compliance with the requirement, documentation must specify the dates on which the average daily temperatures are below 14°C and show the solar radiation input allowed on these dates (diagram or simulation).

With regard to maintaining a comfortable temperature 24 hours a day, in addition to optimal window orientation and sizing, it is important to consider placing heavy materials (i.e., with thermal inertia) inside the conditioned spaces. In order to comply with the requirement, each conditioned space must have an Effective Interior Thermal Energy Storage Capacity (CEATI) greater than 280 (kJ/m^2 *K). A maximum tolerance of 20% non-compliance with the requested limit in conditioned enclosures is permitted.

Heat capacity is calculated using the following equation:

$$X = \sum(xp \times Sp)$$

Where:

X: Effective Interior Thermal Energy Storage Capacity (CEATI) (kJ*K)

xp: Heat capacity of the construction package p (kJ/m^2 *K)

Sp: Surface area of the construction package p in contact with the air of the calculated enclosure (m)^2

You can use tab A4 of the Minergie Form to calculate the CEATI, using reference values of heat storage capacity of typical building packages for walls, floors, ceilings or you can use a duly justified value derived from calculation tools such as Ubakus[6] or equivalent.

Verification Documents for Provisional Certification

- Explanation of solar radiation utilization strategy and radiation input schemes in winter pursuant to the orientation and angle of the sun.
- Plan of interior finishes and finishings.
- Architectural technical specifications.
- Minergie Form, A4 tab.

Verification Documents for Final Certification

- Provisional certification documentation (updated)

[6] https://www.ubakus.de/u-wert-rechner/

Examples

Example of solar radiation angle calculation in winter:

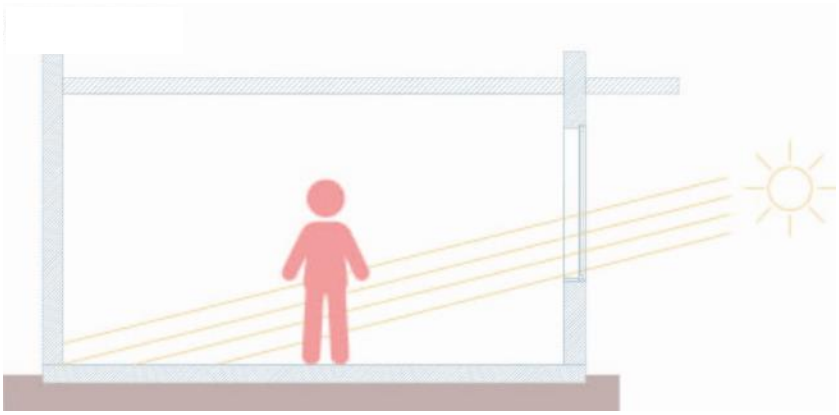


Figure 6 Winter sun angle

Example of how to verify thermal mass compliance in an enclosure:

It is possible to perform the calculation by grouping zones or conditioned enclosures that share the same construction packages.

The Minergie Form includes a tool to perform this calculation based on the Effective Interior Thermal Energy Storage Capacity (CEATI) of each element or building package of the enclosure. These CEATI values were previously calculated using the Ubakus tool for building packages commonly used in construction. However, you can also perform the calculations in another tool and enter the data on the Minergie Form.

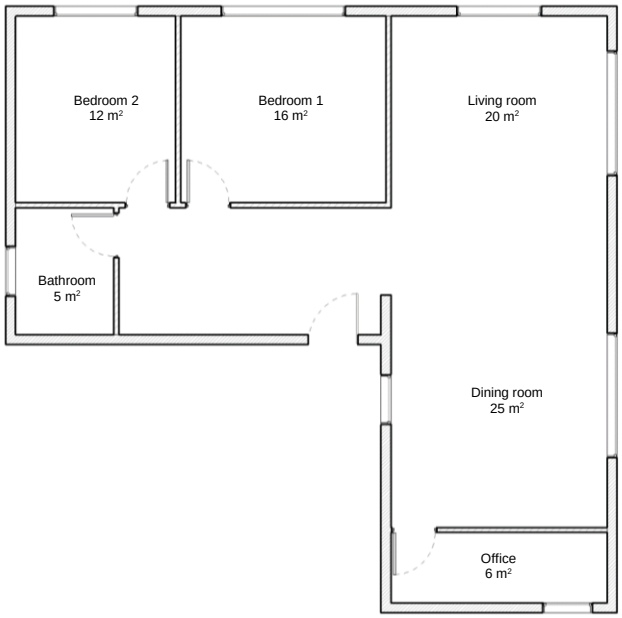
The following is an example of a calculation in the Minergie Form for a one-story house with the following characteristics:

Example	**m2**	**Window (m2)**
Constructed area (m2):	100	18

Enclosure	**m2**	**Windows (m2)**	**Enclosure depth**	**Enclosure width**	**Enclosure height**	**Walls**	**Floor**	**Ceiling**	**Interior partition walls**
Bedroom 1 (m2):	16	4.8	4mts	4mts	2.3mts	M5	P2	C3	M6
Bedroom 2 (m2):	12	2.4	4mts	3mts	2.3mts	M5	P2	C3	M6
Office (m2):	6	1.2	1.5mts	4mts	2.3mts	M5	P2	C1	M2
Dining room/kitchen (m2):	25	5	6.25mts	4mts	2.3mts	M5	P2	C1	M2
Living room (m2):	20	4.6	5mts	4mts	2.3mts	M5	P2	C1	M2

	Walls	kJ/m2K
M5	200mm Reinforced Concrete + 80mm Expanded Polystyrene Insulation	351
M6	20mm Cement mortar + 143mm Machine-made brick + 20mm Cement mortar + 20mm Cement mortar	73
M2	15mm OSB + 160mm Mineral wool + 15mm OSB + ventilated air chamber + exterior siding finishing	23
	Floors / Mezzanines	**kJ/m2K**
P2	10 cm Reinforced Concrete Slab + 12cm Thermal Insulation + 0.2mm Polyethylene + 10cm Gravel	211

	Ceilings and Roofs	kJ/m2K
C1	10 mm gypsum board on 2x2" wood lathing + wood trusses and sides + air chamber between ceiling board and 50 mm insulation + expanded polystyrene insulation on 117 mm lathing + variable semi-ventilated air chamber + humidity barrier + 4 mm fiber cement board finish.	2.5
C3	10mm gypsum board + 100mm expanded polystyrene insulation with embedded steel profiles + electro-welded wire mesh + 65mm average thickness concrete slab + 30mm light concrete over slab.	14.6



Case Study Reference Floor Plan

Bedroom 1: 16m2

Intermediate Results:

Floor	16	m2
Ceiling	16	m2
Envelope (no windows / doors)	4.4	m2
Interior wall surface	27.6	m2
Conditioned floor area (CFA)	16	m2
Total opaque surface	64.0	m2

Results:

Total storage mass	7169	kJ/K
Average CEATI	112	kJ/m2/K
Heat storage capacity	**448**	**kJ/m2/K**
Heat storage capacity	124	Wh/m2

Bedroom 2: 12m2

Intermediate Results:

Floor	12	m2
Ceiling	12	m2
Envelope (no windows / doors)	4.5	m2
Interior wall surface	25.3	m2
Conditioned floor area (CFA)	12	m2
Total opaque surface	53.8	m2

Results:

Total storage mass	6134	kJ/K
Average CEATI	114	kJ/m2/K
Heat storage capacity	**511**	**kJ/m2/K**

Heat storage capacity	142	Wh/m2

Living Room & Dining Room/Kitchen: 45m2		
Intermediate Results:		
Floor	45	m2
Ceiling	45	m2
Envelope (no windows / doors)	25.5	m2
Interior wall surface	35.075	m2
Conditioned floor area (CFA)	45	m2
Total opaque surface	150.6	m2
Results:		
Total storage mass	19356	kJ/K
Average CEATI	129	kJ/m2/K
Heat storage capacity	**430**	**kJ/m2/K**
Heat storage capacity	119	Wh/m2

Office: 6m2		
Intermediate Results:		
Floor	6	m2
Ceiling	6	m2
Envelope (no windows / doors)	8.0	m2
Interior wall surface	16.1	m2
Conditioned floor area (CFA)	6	m2
Total opaque surface	36.1	m2
Results:		
Total storage mass	4459	kJ/K
Average CEATI	124	kJ/m2/K
Heat storage capacity	**743**	**kJ/m2/K**
Heat storage capacity	206	Wh/m2

Summary of Enclosures	KJ/m2K	Minergie Limit KJ/m2K
Bedroom 1: 16m2	448	280
Bedroom 2: 12m2	511	280
Living Room & Dining Room/Kitchen: 45m2	430	280
Office: 6m2	743	280

Frequently Asked Questions and Complex Cases

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A5. Exterior Solar Protection of Windows

A5. Exterior Solar Protection of Windows **Mandatory Requirement**

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	See Chapter 8	None

Explanation of the Regulations

SHGC, $SHGC_{total}$ and $SHGC_{modified}$

The SHGC (Solar Heat Gain Coefficient) represents the fraction of incident solar radiation admitted through a transparent element as radiation and with the secondary heat generated by the heating of the glass. Its value ranges between 0 (radiation does not enter) and 1 (radiation enters in its entirety). For Minergie certification purposes, the SHGC values and the solar factor g or SF (total solar energy transmittance) will be considered as equal.

The following SHGC values are defined:

- SHGC: corresponds to the energy transmittance through the transparent element viewed independently (without influence of window frames, eaves or blinds).
- $SHGC_{total}$: corresponds to the energy transmittance through the transparent element with its solar protection (e.g., an exterior blind and/or an interior curtain).
- $SHGC_{modified}$: corresponds to the energy transmittance through the transparent element with its solar protection (e.g., an exterior blind) and with the other elements that influence the solar radiation ingress, such as window edges, eaves, neighboring buildings, trees, etc.

Interpretation of the requirement

Minergie regulations require demonstrating compliance with $SHGC_{modified} < 0.2$, i.e., taking into account sun shading and the environment in which the glazed surface under study is located.

Using movable external shading is encouraged to comply with this requirement. In fact, the $SHGC_{total}$ reduction efficiency of a shading element is twice as high if it is positioned on the outside of the window as opposed to being positioned against the interior face of a window. In addition, windows protected with the following external shades are exempted from submitting a calculation to justify compliance with $SHGC_{modified} < 0.2$ (it is sufficient to justify with the type of shade):

- Exterior blackout curtain (completely opaque, between 0 to 3% visible transmission), regardless of color.
- Exterior shades defined as "moderately translucent" according to UNE-EN 13363-1 (3 to 6% visible transmission, see Minergie Form, tab A5), in white, pastels or light colors.
- Exterior blinds that can vary the degree of translucency until they are completely dark (e.g., horizontal slats with variable angles).

Clarifications regarding compliance with the requirement

In addition to the requirement provided under the Regulations, the following must be taken into account when choosing the glass to comply with the requirement:

- The selected windowpanes must ensure a light transmittance of at least 60%.

- Solar control glazing, i.e., window glazing with a SHGC < 0.45, is prohibited in ASHRAE zone 3 and Chilean climate zones C and D.

These two clarifications are related to ensuring good lighting comfort for users (taking advantage of daylight) and allowing solar radiation to enter during cold periods in climate zones that require heating at certain times of the year. The latter in order to reduce heating demand and not go against Requirement A4. Passive Use of Solar Radiation.

Demonstrating compliance

Compliance with the requirement is first demonstrated by identifying the transparent surfaces of the building exposed to the sun during the hours when the outside temperature is above 28°C. Window shading can be demonstrated by proving a calculation of solar angles or a shading study on the windows in question (geometry or simulation with 3D modeling software using climate data from the project location). This means that if a windowpane is protected from the sun during hours when the outside temperature is above 28°C, for example by an overhang or the geometry of the building, then this window meets the requirement and a $SHGC_{modified}$ calculation is not required for that window.

The next step is demonstrating that 90% of glazed surfaces exposed to solar radiation during hours when the outside temperature is above 28°C have a $SHGC_{modified} < 0.2$.

For windows that do not have movable exterior blinds, compliance with the requirement may be demonstrated by taking into account an interior blind or curtain when calculating $SHGC_{modified}$. This can be calculated using the Minergie Form, tab A5, which also provides examples of reference values for calculating $SHGC_{total}$.

Verification Documents for Provisional Certification

- Explanation and sketch of solar radiation protection system.
- Shading calculations or sketch during hours when the outside temperature is above 28°C.
- Optional: Shade study performed with software.
- Optional: Calculation of the SHGC of the exposed windows taken from the Minergie Form, tab A5.
- Inclusion of the solar protection element in architectural drawings (details and scantlings) in a sketch showing how encounters with the thermal insulation are resolved.
- Architectural technical specifications indicating the solar protection elements.

Verification Documents for Final Certification

- Provisional certification documentation (updated)
- Technical data sheets of movable solar protection elements with SHGC value / g highlighted.
- Photographs of on-site implementation

Examples

Example of fixed sun protection:

A fixed horizontal eaves provides total shading of the window from the sun angles during hours when there is a risk of overheating.

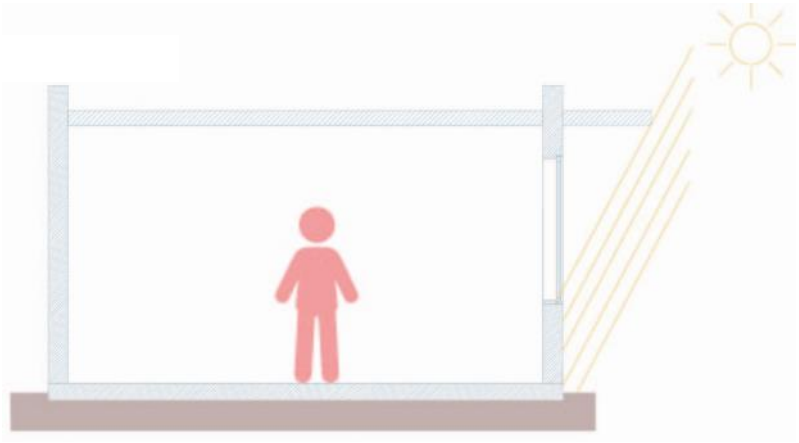


Figure 7 Summer sun angle with fixed sun protection

Example of movable sun protection:

The SHGC value of the window is less than 0.2 due to the movable exterior solar shading since the fixed horizontal eaves is not able to completely shade the window. This is the most effective strategy for preventing overheating on east- and west-facing façades.

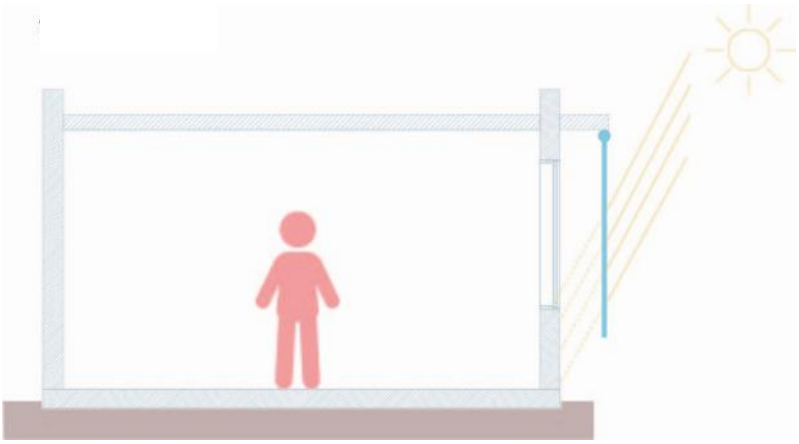


Figure 8 Summer sun angle with movable sun protection

Frequently Asked Questions and Complex Cases

Buildings with few windows exposed to solar radiation during hours when there is a risk of overheating.

Compliance with the requirement may be less stringent for buildings whose façades are exposed to solar radiation when there is a risk of overheating and whose glass surface does not exceed 40%. The figure below shows the $SHGC_{modified}$ that has to be demonstrated per exposed façade as a function of the glass surface of that façade.

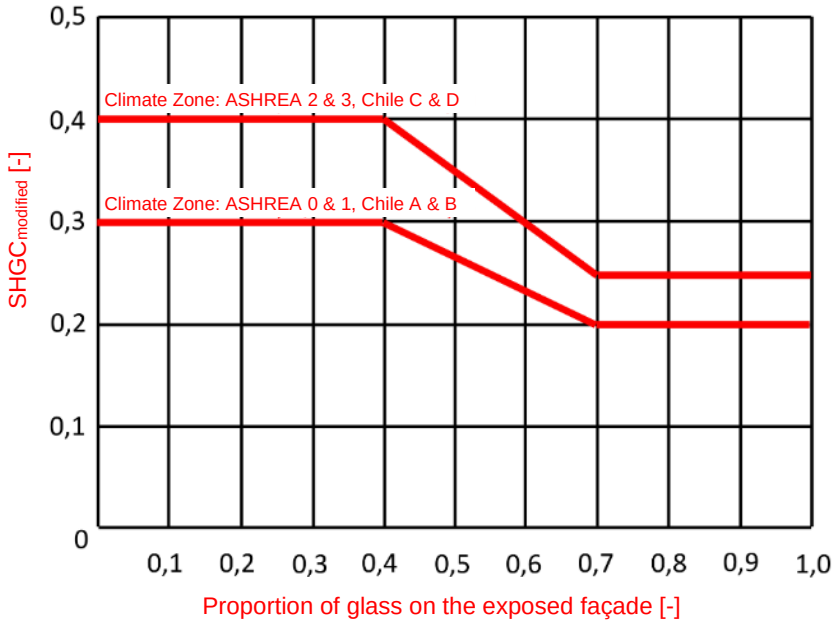


Figure 9 $SHGC_{modified}$ requirements as a function of the proportion of glass on the exposed façade.

A6. Natural Ventilation

A6. Natural Ventilation	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

The natural ventilation strategy should consider both wind direction and wind speed in the area where the building is located, in order to determine the best possible location of windows to promote natural cross ventilation. Bear in mind that hot air is lighter than cold air—therefore, hot air tends to rise, and cold air tends to fall—and this factor should be taken into account when designing passive ventilation systems.

Natural ventilation from wind depends on the pressure that the wind exerts on the façades of the building. As such, we will have a positive pressure on those façades facing the direction from which the wind comes and negative pressure on the other façades with different orientations. Therefore, by locating the windows on façades with positive pressure, there will be greater air flow from the higher pressure area to the low pressure area.

The effective ventilation area will depend on the type of window (openings). The most airtight windows are awning, casement and tilt and turn windows; the use of sliding windows is not recommended as they are prone to a high level of leakage.

Natural cross ventilation is defined as a given space with opposite or adjacent walls with openings that allow for air to enter and exit.

In warm areas with reinforced requirements, compliance with requirements A and B is ensured by proving compliance with requirement B (protection of openings against rain and burglary, position of openings, with respect to local regulations or a 10% area of the floor area if there are no local regulations in this respect).

Applicants must state on the Minergie Form the amount of effective area of natural ventilation and the type of opening for each space in the dwelling.

Verification Documents for Provisional Certification

- Floor plan showing the location of windows and/or openings, as well as their type, for cross ventilation. Include a wind rose showing the predominant direction of incoming airflow.
- Explanation and description of natural ventilation strategy, including information on local regulations that apply to the project regarding natural ventilation and compliance.
- Minergie Form, tab A6.
- Architectural technical specifications specifying the type of window openings and with reinforcement, rain and burglary protection (in hot climate zones).
- Detailed drawing of windows.

Verification Documents for Final Certification

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

<u>Example of natural cross ventilation:</u>

The figure below illustrates how the largest window surface has been arranged towards the façade with the highest wind pressure and another window has been placed on the opposite wall at a distance of five meters.

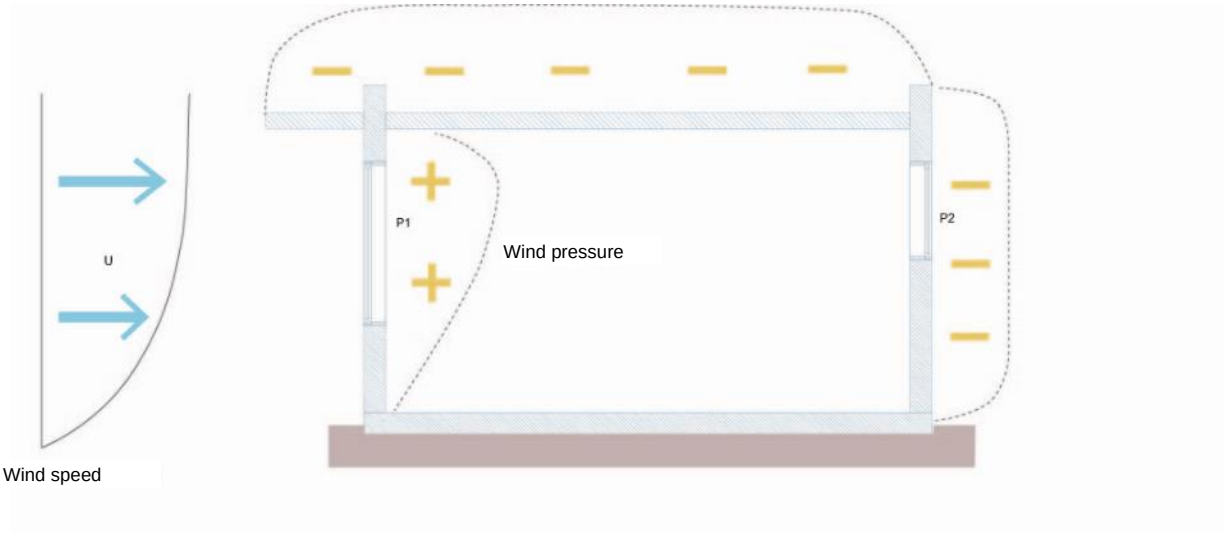


Figure 10 Cross ventilation drawing based on wind pressure.

Frequently Asked Questions and Complex Cases

-

A6.a Openings Designed to Promote Natural Air Flow — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

The objective of this requirement is for the architectural design of the building to include strategies that favor natural cross ventilation to renew indoor air, while improving thermal comfort during hot periods.

The follow design strategies allow for compliance with this Elective Requirement:

- Solar chimney: this strategy boosts airflow due to the difference in density between hot air and cold air. During the day, solar radiation heats the upper part of the solar chimney and causes the mass of hot air to move upwards, thus creating airflow inside the ventilated space.
- Canadian well: Canadian wells are air ducts that are buried in the ground with an external air intake located at a distance from the building and air injection points that inject this air into the building. Thanks to this principle, there is a temperature exchange between the outside air entering the building through the underground duct and the ground, lowering the air temperature. This favors thermal comfort inside the dwelling, in addition to renewing the indoor air.
- Interior courtyard: Interior courtyards favor air ventilation by helping to generate more façades where windows can be located and thus generate cross ventilation. The use of interior patios can also favor thermal comfort by generating a microclimate through shading or evaporative cooling strategies.

If a design strategy other than those listed above is chosen, it may be approved provided the design team provides the necessary analysis to justify its performance.

Verification Documents for Provisional Certification:

- Explanation and description of strategy for increasing natural ventilation.
- Floor plan and sectional drawings showing natural ventilation strategy design.
- Technical specifications with requirements clearly indicated.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

-

Frequently Asked Questions and Complex Cases

-

A6.b Low-Tech Measures for Creating Air Flow — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

The purpose of this requirement is to increase airflow. This can be achieved with mechanical fans located in the ceiling of each space to increase the air flow of natural ventilation through the windows. Increased air flow helps to improve the thermal sensation of the user due to an increase in air velocity inside the room.

If a low-tech design strategy for creating airflow other than a ceiling fan is chosen and it is not included in the list under Requirement A6.a Openings Designed to Promote Natural Air , it may be approved provided that the design team submits the necessary studies to justify its operation.

Verification Documents for Provisional Certification:

- Location of fans or other corresponding technologies in the building.
- Technical specifications with requirements clearly indicated.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Equipment data sheet.
- Photographs of on-site implementation

Examples

-

Frequently Asked Questions and Complex Cases

-

A6.c Passive Cooling through Humidification — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

This requirement is met by way of direct natural humidification of airflow by, for example, spraying water or placing wet panels in the cold air injection point.

Evaporative cooling increases the humidity of the environment, so it is not recommended in places with high relative humidity during the hot hours of the day (resulting in low efficiency and deterioration of comfort due to excessive humidity). In addition, bear in mind that this system requires a continuous flow of outside air that is greater than the demand for fresh air.

Verification Documents for Provisional Certification:

- Architectural concept with explanation of passive cooling system.
- Technical specifications with requirements clearly indicated.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

-

Frequently Asked Questions and Complex Cases

-

A7. Sustainable Materials and Reducing the Carbon Footprint

A7. Reducing the Carbon Footprint	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

At this early stage of Minergie in Latin America, the aim is to determine a baseline of the carbon footprint of Minergie buildings, in order to impose threshold values for certification in future versions of the Regulations.

Calculating the Building's Operational Carbon Footprint (Operations Stage)

A direct estimate can be made on the Minergie Form, or a recognized program can be used to calculate the value (e.g., in Chile the operational carbon value calculated in the CEV, or in Mexico the operational carbon value calculated in the Energy Efficient Housing Design sheet, DEEVi). The main calculation assumptions should be supported with a brief justification.

Calculating the Building's Embodied Carbon Footprint (Construction Stage)

An approximate value is calculated on the Minergie Form (in Chile only) based on the most relevant construction elements in the building:

- In the substructure:
  - Foundations

- In the superstructure:
  - Pillars
  - Beams
  - Structural walls
  - Walls of the envelope
  - Slabs
  - Roofing
  - Windows and exterior doors
  - Stairs or ramps

When using the following materials in the project, they must always be included in the calculations:

- Steel
- Concrete
- Brick
- Glass
- CLT (cross laminated timber)

The carbon footprint calculation should include the following phases of a product's life cycle:

- A1 Supply of raw materials
- A2 Transportation
- A3 Production of construction materials

A good summary of the different phases of the product life cycle can be found **here**.

Only fossil (not biogenic) emissions are taken into account. Consequently, CO storage$_2$ (e.g., in wood) is not taken into account.

The results are expressed in kilograms of CO_2 equivalent per year. This annual figure makes it easy to add the operational carbon footprint and the embodied carbon footprint for an overall assessment of the project during its entire life cycle.

Prioritizing Regionally Sourced Construction Materials and Products

Materials and products coming from a country other than the country where the project is being built or produced more than 500 km from the project site (road transport distance), must be identified. When it comes to these materials, applicants must demonstrate that a similar material or product of equivalent technical quality does not exist in the country or within 500 km of the project site (the most demanding condition). To do so, information should be provided for at least three similar materials or products produced in the country or within a 500 km radius, along with a justification as to why these materials or products were not used in the project (e.g., by showing why the technical quality is not equivalent).

Regarding projects that use wood, whether structural or non-structural, the requirement will be considered fulfilled only if 80% of the volume of the wood used in the project is FSC certified or equivalent. In the event that no sustainable wood production or origin certification is available in the country or within a 500 km radius, an exception will be made to accept wood produced elsewhere, as long as this place is the closest place where certified wood of the same technical quality can be obtained.

Verification Documents for Provisional Certification:

- Minergie Form, tab A7, or report from a recognized calculation tool.[7]
- Plauzibilization of the energy consumption values in the operation stage, as well as of the energy source used.
- Construction site itemization highlighting all products included in the embodied carbon footprint calculation (at the construction stage) (on the Minergie Form).
- Technical specifications with regional and/or certified material requirements (e.g., FSC wood) clearly mentioned.

Verification Documents for Final Certification:

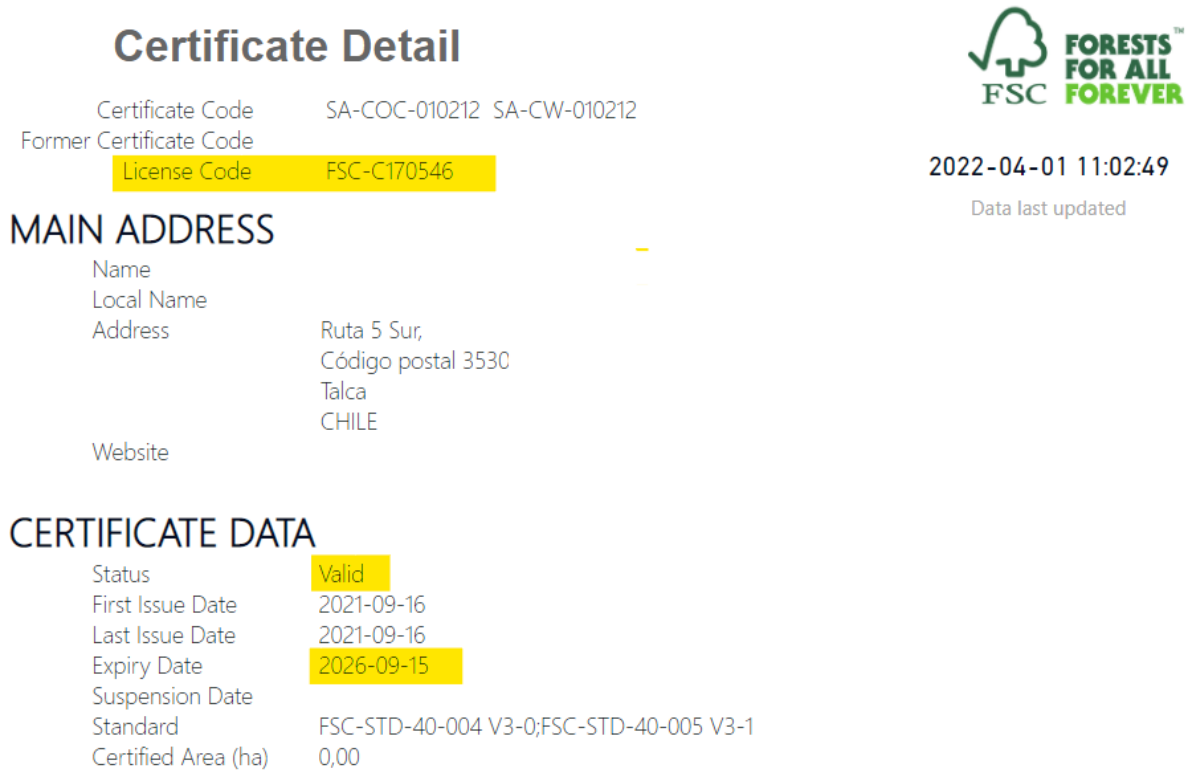
- Provisional certification documentation (updated)
- Attach DAP or supplier file in the case you have recycled content or biogenic carbon and want to use these specific values in the calculation on the Minergie Form.
- Justification when using materials coming from another country or from more than 500 km away.
- FSC certificates or equivalent for sustainable wood products and derivatives (requested upon product deliver to the construction site).
- Photographs of on-site implementation

Examples

Carbono Incorporado (A1-A3)	Elemento	Material	Unidad de medida	GWP (KgCO2e)*	GWP justificado (KgCO2e)	Cantidad (respetando unidad de medida)	Total KgCO2e	Total KgCO2e justificado	Comentario
Subestructura (Fundaciones, cimientos, sobrecimientos, aislación barrera de humedad. Todo lo referido a materiales bajo el nivel de terreno)	Cimientos	Hormigón G25	m3	294		6,7	1.969,80	0,00	
Superestructura (Marcos, losas de entrepiso, techumbre, escaleras, rampas, muros exteriores, ventanas y puertas exteriores)	Muros envolvente	Hormigón G25	m3	294		11,7	3.439,80	0,00	
Superestructura (Marcos, losas de entrepiso, techumbre, escaleras, rampas, muros exteriores, ventanas y puertas exteriores)	Losas / piso	Hormigón G25	m3	294		7,5	2.205,00	0,00	
Superestructura (Marcos, losas de entrepiso, techumbre, escaleras, rampas, muros exteriores, ventanas y puertas exteriores)	Techumbre	Hormigón G25	m3	294		67,7	19.903,80	0,00	
Superestructura (Marcos, losas de entrepiso, techumbre, escaleras, rampas, muros exteriores, ventanas y puertas exteriores)	Aislamiento	Lana de vidrio 50mm	m2	1,9		45,4	86,26	0,00	
Superestructura (Marcos, losas de entrepiso, techumbre, escaleras, rampas, muros exteriores, ventanas y puertas exteriores)	Aislamiento	Lana de vidrio 50mm	m2	1,9		45,4	86,26	0,00	
Superestructura (Marcos, losas de entrepiso, techumbre, escaleras, rampas, muros exteriores, ventanas y puertas exteriores)	Techumbre	Plancha de OSB	m3	-826		1,0155	-838,80	0,00	
Superestructura (Marcos, losas de entrepiso, techumbre, escaleras, rampas, muros exteriores, ventanas y puertas exteriores)	Techumbre	Plancha volcanita 10mm	m2	2,5		45,4	113,50	0,00	
Superestructura (Marcos, losas de entrepiso, techumbre, escaleras, rampas, muros exteriores, ventanas y puertas exteriores)	Techumbre	Plancha de fibrocemento	m2	9,78		12	117,36	0,00	
Superestructura (Marcos, losas de entrepiso, techumbre, escaleras, rampas, muros exteriores, ventanas y puertas exteriores)	Techumbre	Pino radiata	m3	-900		1,226	-1.103,40	0,00	
Superestructura (Marcos, losas de entrepiso, techumbre, escaleras, rampas, muros exteriores, ventanas y puertas exteriores)	Ventanas /puertas	Ventanas PVC	m2	63,7		11,7	745,29	0,00	
							26.724,87	0,00	
						CARBONO INCORPORADO (A1-A3) / M2 ANUAL	**1,54**	**0,00**	

Figure 11 Approximate calculation of most relevant embodied carbon elements (Minergie Form, currently only in Spanish)

[7] For instance: https://www.buildingtransparency.org/ or www.oneclicklca.com



Certificate Detail

FORESTS FOR ALL FOREVER

2022-04-01 11:02:49

Data last updated

Certificate Code SA-COC-010212 SA-CW-010212
Former Certificate Code
License Code FSC-C170546

MAIN ADDRESS

Name
Local Name
Address Ruta 5 Sur,
Código postal 3530
Talca
CHILE
Website

CERTIFICATE DATA

Status Valid
First Issue Date 2021-09-16
Last Issue Date 2021-09-16
Expiry Date 2026-09-15
Suspension Date
Standard FSC-STD-40-004 V3-0;FSC-STD-40-005 V3-1
Certified Area (ha) 0,00

Figure 12 FSC wood certificate section indicating valid responsible forest management (FSC)

Frequently Asked Questions and Complex Cases

-

A7.a Local Renewable Materials as Main Structure — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

The percentage of the above-ground load-bearing structure is calculated on the Minergie Form based on the itemized work in square meters of structure. For this purpose, the total area of the following elements is considered part of the load-bearing structure:

- Envelope elements (exterior walls and roofs; windows and doors are excluded)
- Slabs on grade
- Above-ground load-bearing walls

The following construction elements are not included in the calculation of the total area of the load-bearing structure under this requirement:

- Stairs
- Elevator pits
- Concrete overlays up to 8-cm thick

Then we look at the percentage of these elements that are made from local renewable materials. The following materials are recognized as local renewable materials when they are produced within a distance of up to 300 km (road transport distance):

- Wood[8]
- Adobe
- Straw
- Soil
- ...

If a material not included in the above list is chosen, it may be approved as long as the design team provides the necessary justification to demonstrate its local origin and renewable nature.

Verification Documents for Provisional Certification:

- Minergie Form, tab A7.a.
- Itemized work list highlighting all elements relevant for the Minergie Form.
- Description of local renewable materials used in the project (origin, nature).
- Technical specifications with regional material requirements clearly mentioned.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

Calculating the percentage of local renewable material in a wood construction:

[This example will be completed in the next update of the Minergie application guide].

Frequently Asked Questions and Complex Cases

-

A7.b Local Renewable Materials as Main Non-Structural Materials — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

The percentage of the non-structural construction systems is calculated on the Minergie Form based on the itemized work in different units. The following elements are considered for this purpose:

- Interior partition structure (e.g., metal or wood)

[8] A thermally insulated and windproofed wood wall (e.g., OSB) counts as a wood construction.

- Fixed furniture
- Interior doors

Then we look at the percentage of these that are made from local renewable materials. The definition of local renewable material provided under Requirement A7.a Local Renewable Materials as Main Structure applies here.

If a material not included in the above list is chosen, it may be approved provided that the design team provides the necessary justification to demonstrate its local origin and renewable nature.

Verification Documents for Provisional Certification:

- Minergie Form, tab A7.b.
- Itemized work list highlighting all elements relevant for the Minergie Form.
- Description of local renewable materials used in the project (origin, nature).
- Technical specifications with regional material requirements clearly mentioned.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

-

Frequently Asked Questions and Complex Cases

-

A7.c Ease of Maintenance — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

In order to comply with this requirement, the following elements must be considered "wear parts:"

- Fixed furniture and fixtures in the building (e.g., shelves, hooks, etc.).
- Built-in appliances.
- Technical systems in their entirety, including pipes with a diameter greater than 5 cm (not taking into account the thickness of the insulation).
- Floor or ceiling coverings other than a simple finish.

At least 80% of these wear parts must be accessible for replacement or maintenance purposes (e.g., cleaning) without damaging adjoining materials. This involves planning:

- Spans, doors and aisles large enough to move technical equipment that cannot be disassembled.

- Access doors or walls to technical systems that can be easily removed (includes walls that can be dismantled without damage, but also non-structural partitions in bricks up to 10 cm thick if they are not covered with ceramic, as well as partitions covered with ceramic if they are made of plaster or wood-derived panels).
- Mechanical fasteners between the wear parts and the rest of the building (no adhesives).

In the case of electrical cables, for example, the requirement is considered met if they are visible, or behind a removable false ceiling, or routed through a sheath in the walls (and can thus be easily replaced).

The requirement is also considered met in the case of linoleum, wood parquet or ceramic floor coverings glued to the floor since they are easy to remove. This is not the case for non-overlapping floor coverings and liquid waterproofing in synthetic materials: their use implies non-compliance with this requirement.

Verification Documents for Provisional Certification:

- Minergie Form, Tab A7.c.
- Technical specifications showing the planning of non-damaging disassembly / wear part maintenance solutions.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

Use of the Minergie Form to verify compliance with Requirement A7.c:

[This example will be completed in the next update of the Minergie application guide].

Frequently Asked Questions and Complex Cases

-

A7.d Ease of Disassembly — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

Not all construction components in a building have the same lifespan. This means that they have to be renewed or replaced at different frequencies. As an example, Table 9 contains a list of the lifespans used in life cycle calculations under the RICS methodology to calculate embodied carbon:

Table 9: Life span per building element according to RICS methodology (RICS professional standards and guidance, UK, Whole life carbon assessment for the built environment, November 2017).

Building part	Building elements/components	Expected lifespan
Roof	Roof coverings	30 years
Superstructure	Internal partitioning and dry lining	30 years
Finishes	Wall finishes: Render/Paint	30/10 years respectively
	Floor finishes Raised Access Floor (RAF)/Finish layers	30/10 years respectively
	Ceiling finishes Substrate/Paint	20/10 years respectively
FF&E	Loose furniture and fittings	10 years
Services/MEP	Heat source, e.g. boilers, calorifiers	20 years
	Space heating and air treatment	20 years
	Ductwork	20 years
	Electrical installations	30 years
	Lighting fittings	15 years
	Communications installations and controls	15 years
	Water and disposal installations	25 years
	Sanitaryware	20 years
	Lift and conveyor installations	20 years
Facade	Opaque modular cladding e.g. rain screens, timber panels	30 years
	Glazed cladding/Curtain walling	35 years
	Windows and external doors	30 years

To meet this requirement, it must be possible to dismantle construction elements that have a different life span than the adjoining elements, without damaging the other materials. In simple terms, the use of mechanical or non-damaging fasteners between the different levels (structures) of building components is requested: the secondary structure or the tertiary structure must be removable without damaging the primary structure or the secondary structure respectively. If Requirement A7.c Ease of Maintenance is met, the joints between the secondary and tertiary structure are considered removable and the applicant only has to justify compliance with Requirement A7.d for areas between the secondary and primary structure.

- Primary structure or superstructure: the building's load-bearing structure.
- Secondary structure: These are construction elements with an average lifespan (20 to 30 years) such as non-structural interior partitions and other construction finishes (surface coatings, waterproofing, windows, non-structural façades, roofing and tiling, etc.).
- Tertiary structure: These are construction elements with a short lifespan (5 to 20 years), such as floor coverings, built-in equipment or technical building systems.

Disassembling and reassembling the adjoining construction elements is permitted, if necessary, as long as this is done without damaging these elements. Nails are prohibited. Screws must be used.

The requirement applies per building specialty and must be met by at least 80% of the construction elements produced by each specialty.

This requirement does not request that the components of the primary structure be removable from each other. Similarly, elements where each layer is part of the same type of material (e.g., plaster on plasterboard or mineral plaster on brick wall) are not affected by this requirement.

Verification Documents for Provisional Certification:

- Minergie Form, tab A7.d.
- Scantlings and floor plan showing compliance with the requirement.
- Technical specifications showing compliance with the requirement.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

-

Frequently Asked Questions and Complex Cases

-

A8. Environmental Impact of the Building and Outdoor Space

A8. Bioclimate Outdoor Space	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

The following definitions are considered when applying the Minergie Regulations:

Spaces around a building: Surface or surface area of the land, minus the surface occupied by the building.

The 5% occupied by shrubs, hedges, rows or groups of trees is calculated on the basis of the expected crown diameter of the tree or shrub in its adult form.

Outdoor spaces: Include the spaces around a building, as well as:

- Flat roofs
- Balconies and terraces in the common spaces of the building. Balcones and terraces in private spaces do not apply.
- In a detached house, a terrace/balcony is part of the outdoor space.

The following elements are not considered part of the exterior spaces:

- Non-flat roofs
- Balconies and terraces in private spaces in buildings.

Unsealed vegetation or soil: The following items are acceptable:

- Soil at least 25 cm thick, with vegetation.
- On balconies and terraces that are not at ground level: Planters with vegetation with a minimum depth of 25 cm of soil.
- Concrete tiles with holes (*Adocesped* or *Adopasto*).

Figure 13 Example of a lawn

Native or adapted vegetation: Species from official local (national or state) lists are recognized. For example:

- The list applied in Chile is Annex 4 of the CVS Manual, with the species registered as "native" or "endemic."

- In Mexico, those recognized by the Ministry of the Environment and Natural Resources (SEMARNAT), by the Federal Attorney's Office for Environmental Protection (PROFEPA), or by the corresponding local and/or state authority.
- In other countries, the official local list used must be indicated.

Verification Documents for Provisional Certification:

- Minergie Form, tab A8.
- Landscaping project planimetric diagrams. The location and area of vegetated portions, as well as a summary of the exterior surfaces considered for Minergie and the percentage with vegetation and unsealed soil must be available.
- Written document indicating the concepts referring to the vegetation implemented in the project, including the "native" or "endemic" classification of all species considered.
- Technical specifications with clearly stated requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

-

Frequently Asked Questions and Complex Cases

In the event not all vegetation used in the project is native, but irrigation water consumption has been controlled and it has been ensured that the planned vegetation is well-adapted to the site, the certification office can be contacted and a well-justified exception to this criterion can be discussed.

A8.a Green Roof — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

A green roof has several benefits for the building and its environment. By allowing it to be covered with soil instead of another massive material, it does not absorb heat the same way and therefore releases less heat during the night. The "heat island" effect is also reduced thanks to the water retained in the vegetated soil, which will evaporate on hot days, thus helping to reduce the temperature in the environment. In addition, the layer of soil on the roof acts as an additional layer of thermal insulation, regulating heat and cold exchanges between the building and its surroundings. The presence of vegetation on the roof also promotes biodiversity and functioning of the local ecosystem.

Within the framework of this requirement, the total area of the roof (including spaces reserved for technical purposes, for example) is considered. In the case of intermediate terraces, due to a reduction in the building's

surface area on the higher floors, these terraces must also be counted as roof area. This criterion is in compliance when at least 50% of this total roof area has a green roof with a minimum substrate thickness of 7 cm and is implemented in compliance with current national standards (e.g., in Chile, NCh 3626:2020 "Green roofs," and in Mexico, NMX-AA-164-SCFI-2013 26/153, Chapter 5).

In general, a vegetative cover has the following layers (some products provide the functions of several layers at the same time):

- Native or adapted vegetation.
- Soil substrate (minimum 7 cm)
- Filter, water retention and drainage
- Intermediate mechanical protection layer (to avoid damaging the sealing layer by weight, its quality and/or thickness increases according to the thickness of the substrate and the nature of the vegetation).
- Optional: Geotextile root repellant (required only when the waterproofing layer is not root repellant)
- Waterproof layer with root repellant
- Thermal insulation
- Vapor control
- Roof

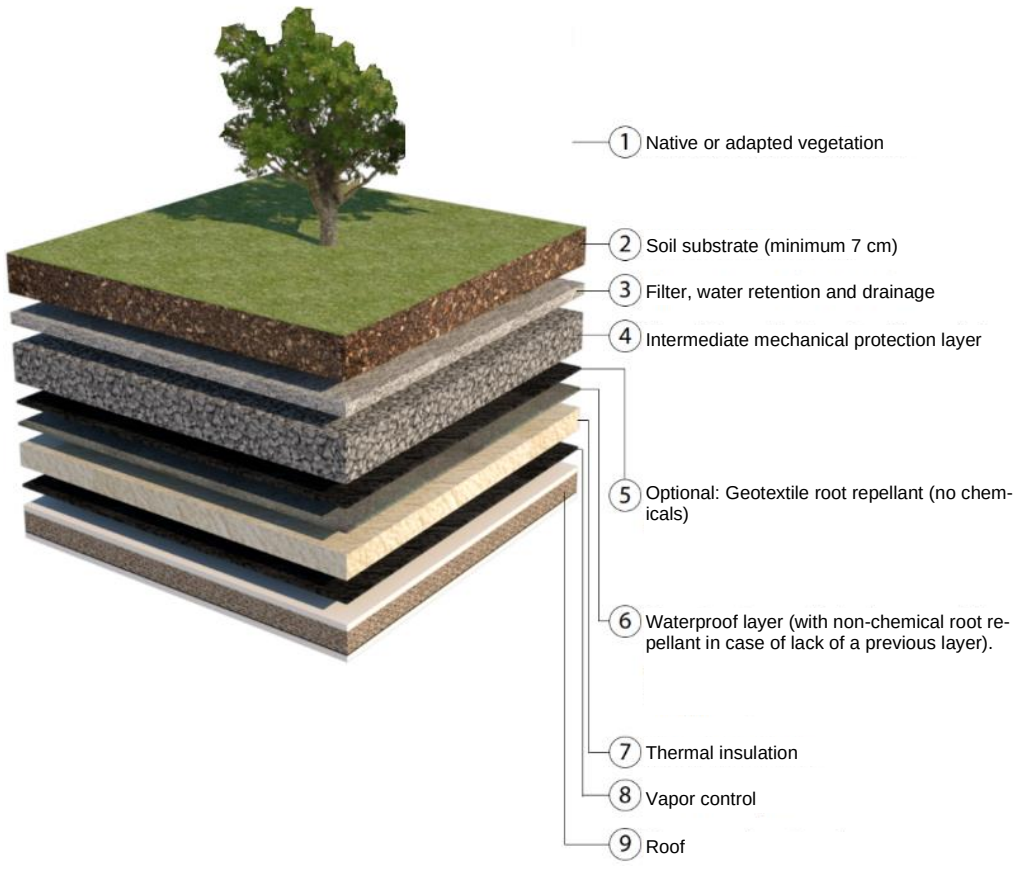


Figure 14 Typical layers of a vegetation cover (Prepared by the authors).

Note that a large vegetation cover (up to 15 cm substrate thickness) and the installation of photovoltaic panels are not incompatible. On the contrary, this combination generates favorable conditions for optimal operation of the photovoltaic panels.

Some elements to consider when planning a green roof are:

- It is important that the waterproofing layer is raised on the sides of the roof higher than the substrate to ensure its waterproofing function. However, it can be damaged by exposure to UV rays or by birds. For this reason, it must be protected on the sides of the roof and not be exposed.
- Waterproofing with liquid plastic materials is difficult to separate from the substrate during de-construction and should therefore be avoided or applied only in small areas.
- In the case of abundant vegetation, it is essential to study well how the drainage will be carried out and to install a rodent control layer, so that they do not perforate the waterproofing layer.
- At the edges of the roof and the technical spaces or chimney, it is advisable to leave an area of at least 20 cm free of substrate and vegetation for fire protection purposes.

Verification Documents for Provisional Certification:

- Calculations of the roof surfaces and drawings with the location and surface of the green roofs.
- Description of the green roof project and compliance with current national standard.
- Technical specifications with the clearly mentioned requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

-

Frequently Asked Questions and Complex Cases

-

A8.b Heavy Metal-Free Construction Components Exposed to Rain — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulation

Metal products containing heavy metals are "washed" away by rain, which causes the heavy metals to be discharged into the soil and pipes. There are more than 40 types of heavy metals that have a negative impact on health and the environment. The most closely monitored heavy metals are arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium and zinc. This is why their use should be limited on rain-exposed surfaces.

Galvanized steel parts that are exposed to weathering, for instance, must be additionally protected with surface coatings. For this purpose, a duplex coating or duplex system must be applied, i.e.:

- A hot-dip galvanized steel, factory coated with a heavy metal-free powder coating (longer lasting and more efficient than the following solution).

- Or, a hot-dip galvanized steel, factory coated with a wet coating that does not contain heavy metals (e.g., polyethylene pre-painted, lacquered, etc.).

Verification Documents for Provisional Certification:

- Minergie Form, tab A8.b.
- Technical specifications with clearly mentioned requirements for construction elements exposed to rain.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Product data sheet for metals in roofs, façades and edges, as well as safety data sheet for the treatment of these metal surfaces.
- Photographs of on-site implementation

Examples

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Frequently Asked Questions and Complex Cases

Hot-dip galvanization (HDG) is a method of hot-dip galvanizing steel. It is not related to the duplex coating mentioned below.

A8.c No Chemical Root Protection on Sealing Membranes — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

Only products not containing chemical root protection (biocides) may be used. Chemical root protection (biocides) on geomembranes can be washed away and endanger the environment. Rainwater contamination varies greatly depending on the root protection agent used.

A valid alternative would be, for example, glass-fleece reinforced polyolefin membranes (TPO/FPO), loosely laid or solvent-free bonded to the substrate. In addition to end-of-life disassembly, an advantage of loose fleece is its easy upkeep. The nature of the material and its thickness prevent roots from penetrating it. To achieve a good barrier, it is also important that the overlapping zones between the different pieces of the sealing layer have a width of at least 15 cm (or that the sealing layer is a single piece in the vegetated zone) and that the sealing layer is protected by an intermediate layer (see Figure 14 under Requirement A8. Bioclimate Outdoor Space).

Verification Documents for Provisional Certification:

- Description of the different layers of the roof (diagram with legend and possibly an explanation).
- Technical specifications with the clearly mentioned requirements.

- List of products used in sealing membranes.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Material Safety Data Sheets / Environmental Product Declarations.
- Photographs of on-site implementation

Examples

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Frequently Asked Questions and Complex Cases

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A9. Healthier Indoor Spaces

A9. Healthier Indoor Spaces	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

Minergie focuses on limiting the following products due to their negative impact on human health:

- The effect of lead on human health is felt only after a long period of exposure because it builds up in the body, particularly in the bones. However, even in small quantities, lead is toxic and alters metabolic processes, causing anemia, asthma, fatigue, hypertension, kidney damage or weakened immune system, for example. It is particularly harmful to fetuses and young children.
- CCA (copper, chromium and arsenic) and SBX-based products release harmful fumes that can cause cancer.
- Volatile organic compounds (VOCs), present in all solvents and some other products, are carbon-based elements that are easily transformed into gases and thus enter our body. They can also enter through the skin, where they build up. The effects are varied, depending on the compound and the length of the exposure period. In the long term, they can damage the liver, kidneys, central nervous system, small intestine, and cause cancer.
- Formaldehyde is used as a base compound in the chemical industry. It is a VOC that irritates mucous membranes (eyes and respiratory tract) and causes headaches and skin irritation.
- Respirable mineral fibers enter the lungs where they accumulate and have a very long degradation time before they may eventually disappear. As such, they alter respiratory capacity.

The presence of these elements in construction products and materials to be used in the building must be controlled. In general, the corresponding information can be found on product safety data sheets and technical data sheets.

Wood and wood-based products are considered to have a low formaldehyde content when the formaldehyde content is less than or equal to 8 mg/100 g of wood (or 0.1 ppm or 0.124 mg/m^3 of air). E0-, E1-, CARB2-, EPA-certified products and products with more demanding certification standards meet this Minergie requirement and can be used. In general, wood and wood-based products containing PMDI-based adhesives (diphenylmethane diisocyanate polymer, e.g., polyurethane) meet these emission requirements, however, compliance with the requirement must be verified with one of the abovementioned certificates or a formaldehyde emission test.

Products containing mineral fibers should be handled with gloves, masks and goggles during installation and should be kept separate from the interior environment of buildings with a continuously installed lining of boards, fleece or reinforced paper (connections should be secured with adhesive tape).

Verification Documents for Provisional Certification

- Technical specifications with the clearly mentioned requirements.
- Sectional diagrams or construction details indicating the installation of mineral fiber materials, if applicable.

Verification Documents for Final Certification

- Provisional certification documentation (updated)
- Excel list with all relevant materials and products (paints, solvents, wood treatments, varnishes, adhesives, glued wood products, fiber-based insulation materials, surface coating products, etc.).
- Safety data sheets and technical data sheets of all products used. Tests or analyses from independent laboratories are also accepted.
- Photographs of the implementation of fleece for the installation of materials containing mineral fibers, if applicable.

Examples

To monitor compliance with these requirements, a table similar to the following can be completed and submitted with the verification documents:

Table 10 Example of data collection for verification of compliance with Mandatory Requirement A9

Paints					
Product Name	**Manufacturer's Name**	**Building where it is used**	**Lead-free?**	**Number of VOCs**	
Varnishes					
Product Name	**Manufacturer's Name**	**Building where it is used**	**Number of VOCs**		
Wood					
Product Name	**Manufacturer's Name**	**Building where it is used**	**CCA-free?**	**SBX-free?**	**Formaldehyde content**

Wood and wood-based products					
Product Name	**Manufacturer's Name**	**Building where it is used**	**Formaldehyde content**		
Materials releasing respirable mineral fibers					
Product Name	**Manufacturer's Name**	**Building where it is used**	**Is there an airtight air gap with the air inside the room?**		

Frequently Asked Questions and Complex Cases

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A9.a Noise Protection **Elective Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

Applicants may provide the test results performed with a recognized program or use the typical nationally-recognized building elements to justify the acoustic reduction value of building elements, as shown below:

- In Chile: The acoustic reduction values of typical construction elements are defined in the List of Construction Solutions for Acoustic Conditioning (LSCAA) of MINVU or the list in Appendix 7 of CES.
- In Mexico, the indoor environment quality values and the definition of Maximum Exposure Times per sound level are indicated in NMX-AA-164-SCFI-2013 152/153

Minimum acoustic reduction value for vertical and horizontal elements

The level of airborne sound insulation of the proposed construction solution must be indicated for all vertical and horizontal elements making up the dwelling. Airborne noise is understood as any noise that travels through the air (whether in an urban or rural environment). Vertical elements are understood as exterior walls and partition walls between different dwelling units (not within the same dwelling). Horizontal elements are considered to be slabs between floors separating different housing units. In terms of the exterior envelope of the building, only the doors and windows are considered.

Minimum standardized impact sound pressure value of horizontal slabs

Impact noise must be reduced by preventing vibrations from traveling through partitions, slabs and installations by means of elastomeric elements. For this purpose, the construction solution must incorporate and specify the elastomeric elements that prevent the transmission of these vibrations.

This requirement only applies to housing units that are on two different floors.

Comments on technical solutions

Among the existing solutions to ensure compliance with this requirement, it is advisable to avoid the use of expansive foam fillers (e.g., polyurethane), even if they do not contain solvents. Instead, we recommend using alternative methods such as fillers or strips/buffers (rubber, silicone or foam) because they are much less harmful to the environment and human health.

Verification Documents for Provisional Certification:

- Written document indicating the acoustic compliance of each construction solution and how they comply with the threshold values. Provide all calculations necessary to demonstrate compliance.
- Planimetric diagrams that clearly indicate the percentages of glazed surface with respect to the total façade surface. In addition, provide drawings (plans) of the project's window types, specifying size, acoustic specifications and quantities.
- Technical specifications that clearly indicate the requirements mentioned above.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of the construction process showing the insulation elements.

Examples

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Frequently Asked Questions and Complex Cases

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A9.b No Biocides in Indoors Spaces — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

Biocides can cause cancer, a weakened immune system and a host of other symptoms. For this reason they are prohibited in heated indoor spaces, except for spaces such as kitchens and bathrooms where they are tolerated.

Biocides for preservation in original packaging or for impregnation against blue stain on wooden windows are exempt from this requirement. Biocides for preservation in original packaging are recognized by their low concentration (total sum ≤0.04% of mass).

Verification Documents for Provisional Certification:

- Technical specifications with the clearly mentioned requirements.

Verification Documents for Final Certification:

- Excel spreadsheet containing a list of relevant products (paints, solvents, wood treatments, varnishes, adhesives, surface coating products, etc.).
- Material Safety Data Sheets / Environmental Product Declarations

Examples

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Frequently Asked Questions and Complex Cases

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T TECHNOLOGIES

T1. Fossil Fuel-Free, Efficient Energy Production

T1. Fossil Fuel-Free, Efficient Energy Production	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

Heating, cooling and domestic hot water consumption cannot include systems that consume fossil fuels on site, for example, gas boilers or califonts and oil boilers. Biomass boilers and heaters/stoves may be used.

Verification Documents for Provisional Certification:

- Minergie Form, tab T1
- Air conditioning and DHW project drawings
- Calculation logs
- Air conditioning technical specifications

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Equipment data sheets
- Photographs of equipment installed.

Examples

Below are some reference values for energy efficiency coefficients according to the type of heating/cooling equipment. These can be used at an early stage in the project to determine which solution to implement.

Efficiency	**Efficiency Coefficient**	**Reference**
Individual wood heater	0.68	In 2021, 50% of heaters were labeled C and 40.7% labeled D. Average efficiency for the 2016-2020 period was 68.57%.
Individual pellet heater	0.85	In 2021, 96.3% of heaters were labeled A. Average efficiency for the 2016-2020 period was 85.5%.
Gas condensing boiler	0.92	https://www.energy.gov.au/sites/default/files/hvac-factsheet-boiler-efficiency.pdf
Central gas boiler	0.8	hvac-factsheet-boiler-efficiency.pdf (energy.gov.au)
Central wood-fired boiler	0.63	CES (higher value)

Central pellet Boiler	0.81	CES (higher value)
Air-to-water heat pump	3.35	Split; greater than 65,000 btu/h and less than 135,000 Nbtu/h Contracting for Efficiency. A Best Practices Guide for Energy-Efficient Product Procurement. https://escholarship.org/content/qt5rf334nq/qt5rf334nq.pdf?t=p3w3ji
Open cycle water-to-water heat pump	3.5	Contracting for Efficiency. A Best Practices Guide for Energy-Efficient Product Procurement. https://escholarship.org/content/qt5rf334nq/qt5rf334nq.pdf?t=p3w3ji
Closed cycle water-to-water heat pump	3.1	Contracting for Efficiency. A Best Practices Guide for Energy-Efficient Product Procurement. https://escholarship.org/content/qt5rf334nq/qt5rf334nq.pdf?t=p3w3ji
Soil-to-water heat pump	3.6	Contracting for Efficiency. A Best Practices Guide for Energy-Efficient Product Procurement. https://escholarship.org/content/qt5rf334nq/qt5rf334nq.pdf?t=p3w3ji

Frequently Asked Questions and Complex Cases

Direct electric resistance heating

Resistance heaters powered exclusively by self-generated electricity are exempt from the above restriction and can be implemented under these conditions in Minergie-certified homes.

Other offsets

Transitional solution: In the early days of Minergie certification in Latin America, certification of projects that do not fully comply with this requirement is tolerated in justified cases. When this occurs, greenhouse gas emissions generated by fossil-fuel sources must be offset by electricity production from on-site renewable sources (e.g., by photovoltaic electricity production, in addition to what is needed to meet requirements under T2. Self-Generated Energy).

Example:

- Building with 200 m^2 ERA in Chile
- Consumption for heating: 500 kWh/y, energy source: gas (LPG)
- LPG emission factor (according to Minergie Form): 0.201 kgCO /kWh_{2e}
- Electricity emission factor in Chile according to Minergie Form: 0.337 kgCO /kWh_{2e}

→ Greenhouse gas emissions: 500 kWh/y * 0.201 $kgCO_{2e}$ /kWh = 100.5 kgCO /a_{2e}

→ Offset: 100.5 $kgCO_{2e}$ /a / 0.337 $kgCO_{2e}$ /kWh = 298 kWh/a

In order to be eligible for offsets, the building must produce 298 kWh/y of electricity (in addition to the self-production needed to meet requirements under T2. Self-Generated Energy).

APENDICE A

Parámetros Conversión de Densidad, Poder Calorífico inferior [TJ/ton] y Factores de emisión de Dióxido de carbono (CO2), metano (CH4) y Óxidos de nitrógeno (NO2) utilizados en la obtención de emisiones.

Combustible	Unidad	Densidad [ton/XX]	PCI [TJ/ton]	FE CO2 [tCO2/TJ]	FE CH4 [tCH4/TJ]	FE NO2 [tN2O/TJ]
Biogas	m3	0,0012	0,0504	0	0,001	0,0001
Biogas	Nm3	0,0012	0,0504	0	0,001	0,0001
Biomasa	m3	0,59	0,0156	0	0,03	0,004
Biomasa	Ton	1	0,0156	0	0,03	0,004
Biomasa-Licor Negro	m3	1,08	0,0118	0	0,003	0,002
Butano	Ton	1	0,0473	63,1	0,001	0,0001
Carbón	ton	1	0,0258	94,6	0,003	0,0015
Gas Natural	m3	0,00065	0,048	56,1	0,001	0,0001
GLP	m3	0,00055	0,0473	63,1	0,001	0,0001
GLP	Ton	1	0,0473	63,1	0,001	0,0001
GNL	m3	0,00065	0,0442	64,2	0,003	0,0006
Licor Negro	Tss	1	0,0118	0	0,003	0,002
Petcoke	Ton	1	0,0325	97,5	0,003	0,0006
Petróleo Diesel	m3	0,855	0,043	74,1	0,003	0,0006
Petróleo IFO-180	Ton	1	0,0404	77,4	0,003	0,0006
Petróleo IFO-380	Ton	1	0,0404	77,4	0,003	0,0006
Petróleo N°6	Ton	1	0,0404	77,4	0,003	0,0006
Propano	Ton	1	0,0473	63,1	0,001	0,0001

Fuente: Factores de emisión: Densidades: BNE. PCI: IPCC 2006 (Vol 2; Cap 1) IPCC 2006 (Vol 2; Cap 2)

Fossil-fuel electricity generation

The use of fossil fuel-based electricity generators as a necessary backup for safety or health reasons is tolerated on a case-by-case basis. This must be discussed early on with the certification office, justifying the necessary use. Only up to 20% of the installed load can be backed up in these cases and used exclusively for the following: lighting in main circulation spaces, food refrigeration, water pump and servers and/or data center and/or power supply of medical equipment.

T1.a Insulation of Distribution Pipelines **Elective Requirement**

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

Hot water and refrigerant distribution pipes should be covered with thermal insulation. This can be specified in the air conditioning project.

The following pipe types are exempt from the thermal insulation requirements indicated in the table contained in the Regulations:

- Piping from solar thermal systems (indoor and outdoor),
- Pipelines without recirculation with a length of less than 20 m, when they are inside the insulation perimeter (i.e., in a conditioned environment).

It should be remembered that hot water pipes for heating and coolant are generally recirculated and therefore have to comply with the thermal insulation requirements indicated in the table contained in the Regulations.

It is advisable to plan shaft/ducts that group the different pipes together, thus facilitating their maintenance. The heating and cooling lines should be separated or with thermal insulation between them.

Verification Documents for Provisional Certification:

- Technical specifications with the insulation of hot water accumulator tanks and piping clearly mentioned.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

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Frequently Asked Questions and Complex Cases

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T2. Self-Generated Energy

T2. Self-Generated Energy	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

A solar thermal, photovoltaic, wind or other renewable energy source is considered a self-generated energy system.

The photovoltaic generation requirement varies depending on the type of building. The Minergie LATAM Regulations establish a minimum size for the self-production installation for all types of projects, but in detached or semi-detached houses there is no maximum limit, therefore, the size of the self-production system may be determined according to what the design team deems appropriate as long as it complies with the minimum established.

In the case of high-rise buildings where the minimum value exceeds the roof area, using the entire available roof area (i.e., area not required for other uses) for the photovoltaic installation must be considered, and must be at least half of the total roof area.

Verification Documents for Provisional Certification:

- Documentation indicating the electrical project prior to the installation of the electrical system for photovoltaic panels or non-conventional renewable energy project documentation.
- Planimetric diagrams showing the roof area designated for the photovoltaic panels.
- Minergie Form, tab T2

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Technical data sheet of the panels used in the project.

Examples

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Frequently Asked Questions and Complex Cases

In multi-family residential buildings that are constructed for sale to third parties and demonstrate a total energy consumption (cooling, heating, domestic hot water, cooking) lower than those provided in the table below (or CEV category B or better, in the case of Chile), partial compliance may be justified by pre-installation of the self-production system. The sales documents for each housing unit provided to interested homeowners must offer the possibility of installing this system. The total energy demand must be calculated in a comprehensible way and presented to the certification body.

Table 11 Maximum total energy consumption to qualify for the partial compliance exception under Requirement T2

Climate Zone	Maximum Total Energy Consumption [kWh/m2 a]		
	Residential Area	Lobby Area	Total
0A	72.5	129.3	86.7
0B	83.6	113.9	91.2
1A	78.5	93	82
1B	77.9	107.6	85.5
2A	76.3	93.7	80.4
2B	73.5	74.4	73.5
3A	68.1	94.6	74.7
3B	62.8	94.9	70.6
3C	63.4	59.9	62.4
4A	65.9	88.3	71.6
4B	65	75.7	67.5
4C	67.5	63.7	66.5
5A	65.3	81.7	69.4
5B	61.8	86.7	68.1
5C	63.7	60.2	62.8
6A	65.6	102.5	74.7
6B	69.4	75.1	70.6
7	72.9	83.3	75.4
8	70.6	107.9	79.8

The pre-installation of a self-production system is understood to be all the necessary equipment in the electrical system to be able to subsequently arrange a renewable energy generation installation, planned in detail and ready for execution. In the example of photovoltaic panels, the following must be implemented:

- Define a reserved roof area for this purpose: Indicate the area of reserved roof area that has access to solar radiation and allows compliance with the minimum self-production required by Minergie.

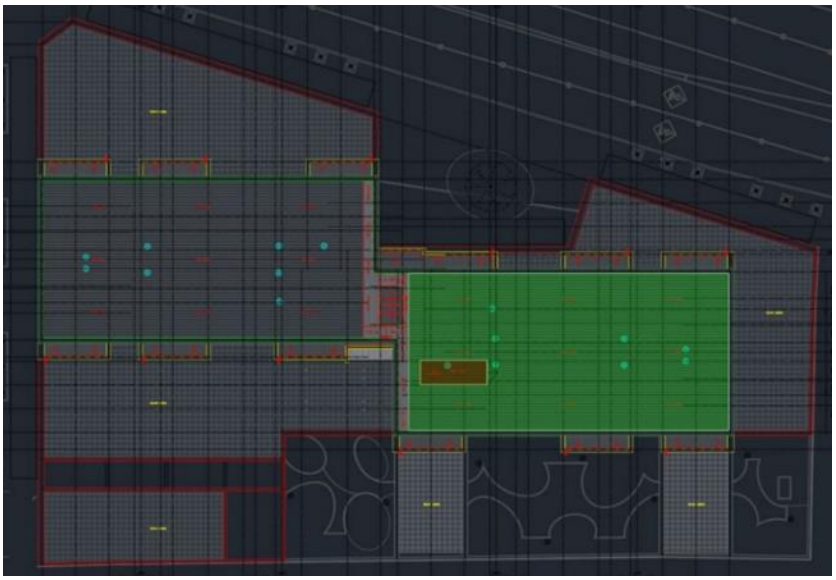

Figure 15 Reference area for available panels on roof

- Automatic switch on the electrical panel (fuse box) of each apartment with changeover contactor for switching between electric grid or photovoltaic panel (on grid connection).
- Room for rectifiers or inverters (e.g., in the crawl space, on the roof, in the machine room, etc.).
- Channeling to each department contemplating the possibility of "registers."
- Clear indication in the User Manual and Purchase and Sale Contract of the maximum power permissible for the photovoltaic panels that the users will install in the future, in order to ensure the correct operation of the inverters with the panels.

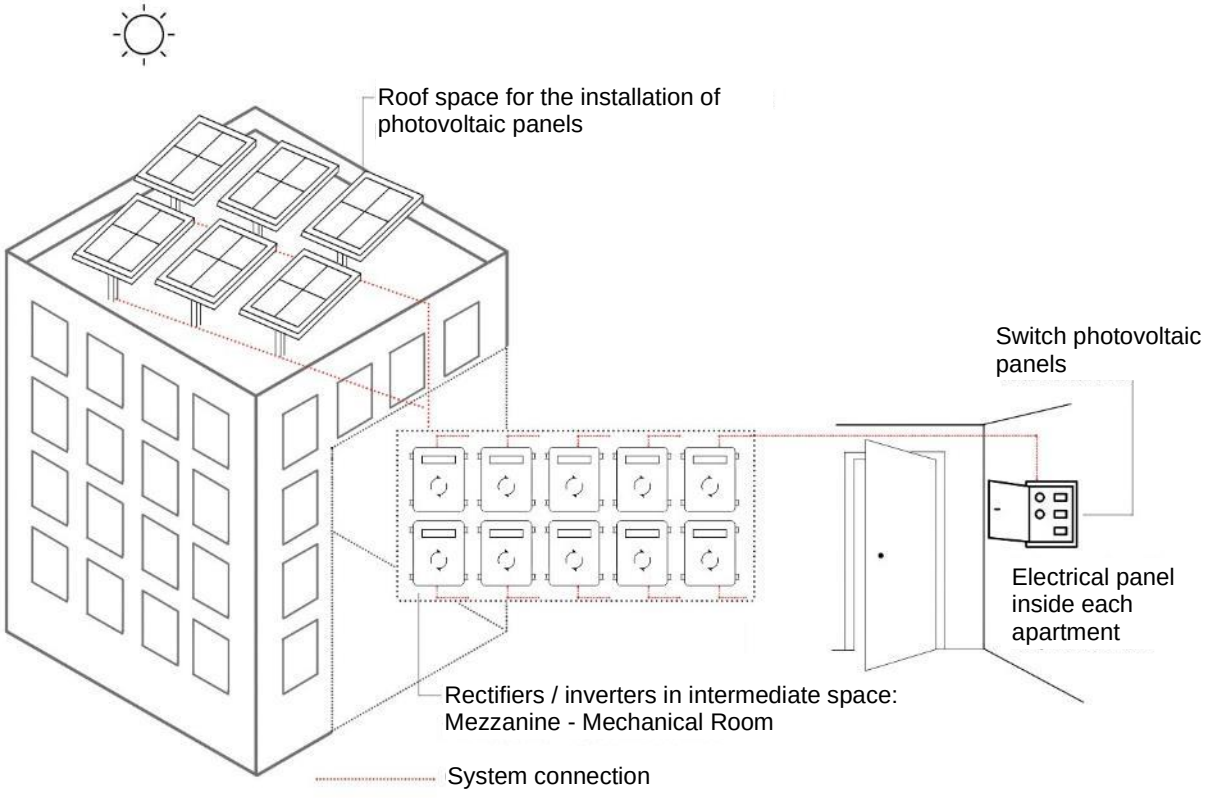

Figure 16 Schematic diagram of photovoltaic system components

T2.a Usable Roof Surface with Photovoltaic Panels **Elective Requirement**

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

Installing a self-production system covering the entire roof surface should be considered for all types of buildings. In the event the roof is used for other purposes, the self-production system must occupy at least two thirds of the roof, regardless of the roof's orientation. Other roof uses are understood as: habitable terraces, space reserved for other facilities or intensive green roofs (extensive green roof does not count since it can be combined with photovoltaic panels).

Should the project not want to occupy at least two thirds of the roof with photovoltaic panels because the average annual net energy consumption is already equal, the project will have to justify this with a detailed calculation log understandable by the certification office (in Chile, for example, with the CEV).

Verification Documents for Provisional Certification:

- Minergie Form, tab T2.
- Annual net energy consumption calculation log and photovoltaic energy demand coverage, if applicable.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

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Frequently Asked Questions and Complex Cases

Alternative justifications for photovoltaic generation systems that are not located on the roof (e.g., façades) will be accepted.

T3. Energy-Efficient Appliances and Lighting

T3. Energy-Efficient Appliances and Lighting **Mandatory Requirement**

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

Energy labeling is defined as the energy classification of an appliance according to a scale that evaluates its consumption in terms of the products available on the market. The Regulations require the use of appliances that have "one of the best energy efficiency labels available on the national market," which refers to the need to consider using appliances that have the lowest energy consumption according to this classification, i.e., the first two levels:

- In the case of A to F labeling, equipment labeled A and B is accepted.
- In the case of A+++ to D labeling, equipment labeled A+++ and A++ is accepted.

All appliances that are fixed and integrated with the furniture, such as stoves, refrigerators, ovens, washing machines, dishwashers, etc., must comply with this requirement.

Regarding lighting, all interior and exterior luminaires must be LED, including decorative luminaires.

Verification Documents for Provisional Certification:

- Technical specifications with the clearly mentioned requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Energy labels of household appliances or data sheets with power ratings.
- Appliance invoices/bills
- Photographs of on-site implementation

Examples

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Frequently Asked Questions and Complex Cases

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T4. Continuous Ventilation for a Comfortable and Healthy Indoor Environment

T4. Continuous Ventilation for a Comfortable and Healthy Indoor Environment	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

Given the requirement to have a high level of airtightness in the building envelope (see Requirement A3.) and the need to leave the windows closed when the indoor vs. outdoor temperature difference is significant, the question arises as to how to ensure sufficient fresh air exchange for the users. It is true that this can be achieved by users opening and closing the windows regularly (according to needs/temperatures). However, at times when heating or cooling is needed to ensure a comfortable indoor temperature, an air exchange

through the windows is related to heat (or cold) losses that are difficult to control. In addition, manual ventilation can also have a negative impact on comfort (resulting in drafts, large fluctuations in temperature and humidity, odors, pollutants and, in general, poor air quality). Pleasant, healthy air to breathe is the most important food for human beings. Because Minergie attaches a great deal of importance to optimal air quality, mechanical ventilation is mandatory in Minergie buildings located in certain climate zones. An automatic ventilation system offers the best solution for optimizing the quality of the air we breathe, as well as other advantages that can be leverage depending on the situation:

- Heat or cold recovery to prevent energy losses that are all important in more extreme climates.
- Acoustic insulation against outside noise
- Supply air filtration (particulate matter, pollen)
- Possibility of regulating humidity

As a good practice, in centralized ventilation systems, in addition to the F7 filter for supply air (see T4.a Supply Air Filtration), it is advisable to include a category G return air filter (according to ISO 16890, this is equivalent to a coarse particulate matter capture efficiency rate of ≥60%).

Using the energy content of exhaust air is possible in both decentralized and centralized systems.

Regarding sizing of ventilation systems, the ventilation rate used for this purpose will be defined by the local standard in force (in Chile: NCh 3309 2010). In addition, the dwelling's ventilation system must be balanced, meaning that the volume of the supply air must be equal to the volume of the exhaust air, and this balancing must be justified by means of a calculation log.

Additional Aspects for Chile:

The following table provides the reference degree days for each climate zone in Chile. These can also be calculated for a specific location.

Table 12 Reference degree days by climate zone in Chile

Climate zone	HDD 18	CDD 10
A Coastal North (Iquique)	400	3,000
B Interior North (Calama)	1,800	2,000
C Coastal Central (Viña del Mar)	1,700	1,500
D Interior Central (Santiago)	1,700	2,200
E Coastal South (Valdivia)	2,700	1,200
F Interior South (Temuco)	2,500	1,100
G South (Puerto Montt)	2,700	800
H Andean	2,700	800
I Extreme South (Coyhaique)	3,200	800

In the event that a project is located in a climate zone with more than 2,500 HDD, it may be exempt from the requirement to recover heat from the air system as long as it complies with Category B residential energy rating.

Verification Documents for Provisional Certification:

- Written document with an explanation of the planned system and mechanical ventilation scheme.
- Planimetric diagrams, plans and sectional drawings of the project relative to this point.
- Technical specifications with the clearly mentioned requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Ventilation equipment data sheets
- Photographs of on-site implementation

Examples

Example 1: Continuous centralized ventilation system

Description: Ventilation system based on a central unit and a network of ventilation ducts, with air injection in dry enclosures and extraction in wet enclosures.

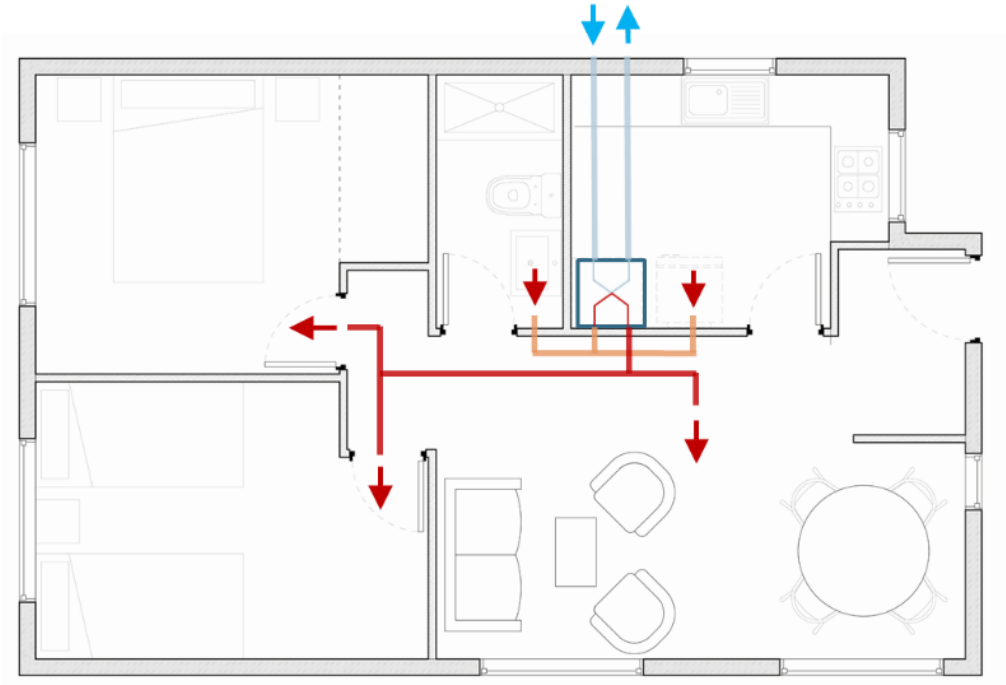

Figure 17 Centralized ventilation system.

Example 2: Continuous decentralized ventilation system

Description: Ventilation system based on unitary equipment installed in perimeter walls, with air injection equipment in dry enclosures and extraction equipment in wet enclosures.

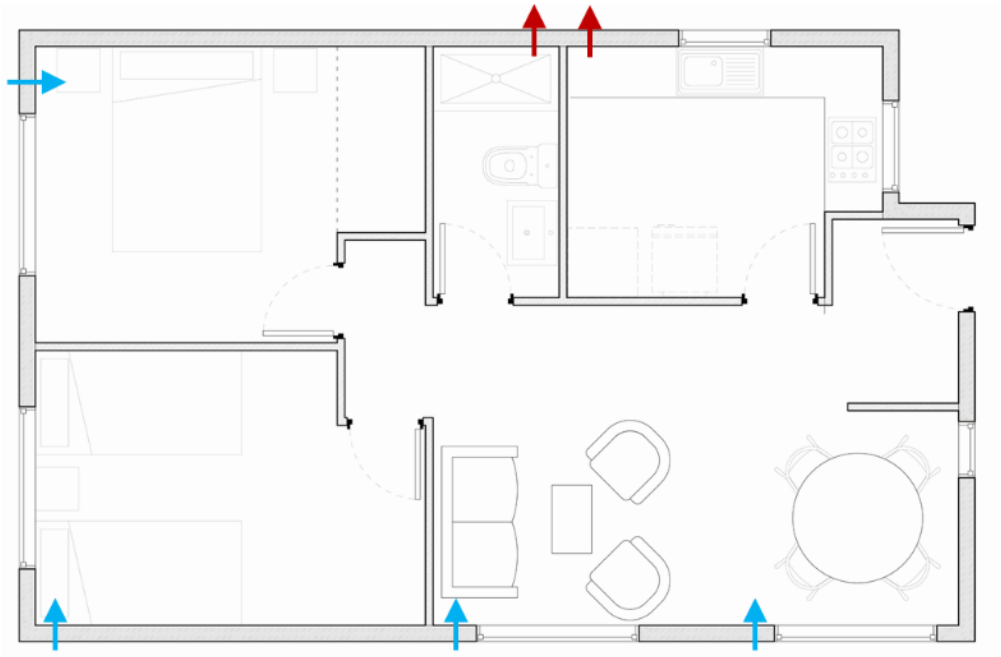

Figure 18 Decentralized ventilation system.

Frequently Asked Questions and Complex Cases

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T4.a Supply Air Filtration — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

Filter efficiency is defined by the EN779:2012 standard.

Table 13 Efficiency of particulate matter filters. (Source: https://www.venfilter.es/en/normative/comparative-guide-to-norms-for-the-classification-of-air-filters/)

Filter Type	PM1	PM2.5	PM10
F7	50-70%	>65%	>80%
F8	70-80%	>80%	>90%
F9	>80%	>90	>95%

The User Manual shall specify the frequency of filter replacements for the building user (see Requirement O1. User Manual).

Verification Documents for Provisional Certification:

- Technical specifications with the clearly mentioned requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Copy of the filter purchase invoice with its technical characteristics.
- Photographs of on-site implementation
- Reference to the chapter in the user manual where the filter replacement information can be found.

Examples

-

Frequently Asked Questions and Complex Cases

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T5. Efficient Cooling

T5. Efficient Cooling	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

There are several different ways to evaluate the energy efficiency of cooling equipment such as the Coefficient of Performance (COP), the Energy Efficiency Ratio (EER), the Seasonal Coefficient of Performance (SCOP) or the Seasonal Energy efficiency Ratio (SEER). For the purposes of Minergie certification, projects must report the SEER, which is defined as the Seasonal Energy Efficiency Ratio or the average EER value over the period of use of a cooling equipment during a season of use.

In the event a heat pump (designed for heating) is used for cooling in the warm months, a lower SEER is allowed. In this case, a state-of-the-art heat pump must be used in consultation with the certification body.

Regarding the use of refrigerant products, it is advisable to prefer the following products, as your first choice: R-170, R-290, R-717, R-718, R-744, R-600, R-600ª, R-1270, or in combination R-290/R-600ª, R-290/R-170, R-723, R-1234yf, R-1234ze, R-1336mzz(Z). The following products, equal to or better than R-32 in terms of GWP, can also be considered (since an alternative to this product is difficult to find and is very expensive): R32, R450A, R454C, R455A and R513A.

Verification Documents for Provisional Certification:

- Heating and AC system drawings
- Cooling system power calculation log
- Technical specifications with the clearly mentioned requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Technical data sheet of refrigeration equipment
- Photographs of the equipment installed.

Examples

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Frequently Asked Questions and Complex Cases

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T5.a Free Cooling — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

To achieve compliance with this requirement, active ventilation or cooling systems must include a free cooling option (i.e., not requiring the use energy for production). Passive ventilation strategies are excluded from this requirement.

Free cooling systems can be air-cooled, but there are also systems that use water or refrigerant mitigation. The idea is to have an automatic cooling system that injects outside air when outdoor conditions are favorable or takes advantage of ground temperature to cool the house.

Verification Documents for Provisional Certification:

- Brief explanation of the free-cooling operational concept.
- Technical specifications with the clearly mentioned requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

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Frequently Asked Questions and Complex Cases

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T5.b Indirect Cooling with Heat Exchanger	Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

The objective of this criterion is to use the mechanical ventilation system to cool the air without increasing the humidity level in the enclosures, thus ensuring a comfortable and healthy environment for building users. Although more complex, this solution prevents humidity levels in rooms from rising too high, which would otherwise create a favorable environment for spreading pathogens. This concept is also called "adiabatic cooling" and is particularly relevant in buildings with high loads (offices, schools).

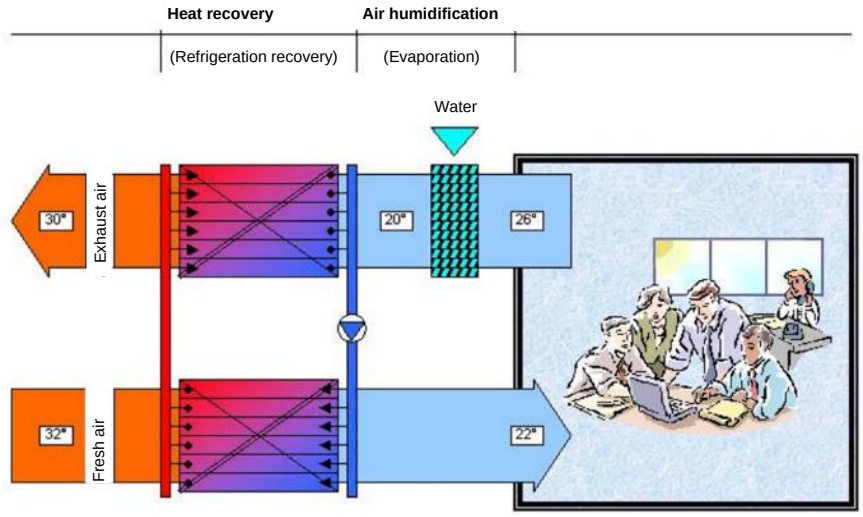

Figure 19 Principles of indirect refrigeration with heat exchanger, or adiabatic cooling

A technical solution consists of placing humidifying equipment in either the air inlet or the air extraction channel when the project's system includes a cold recovery feature.

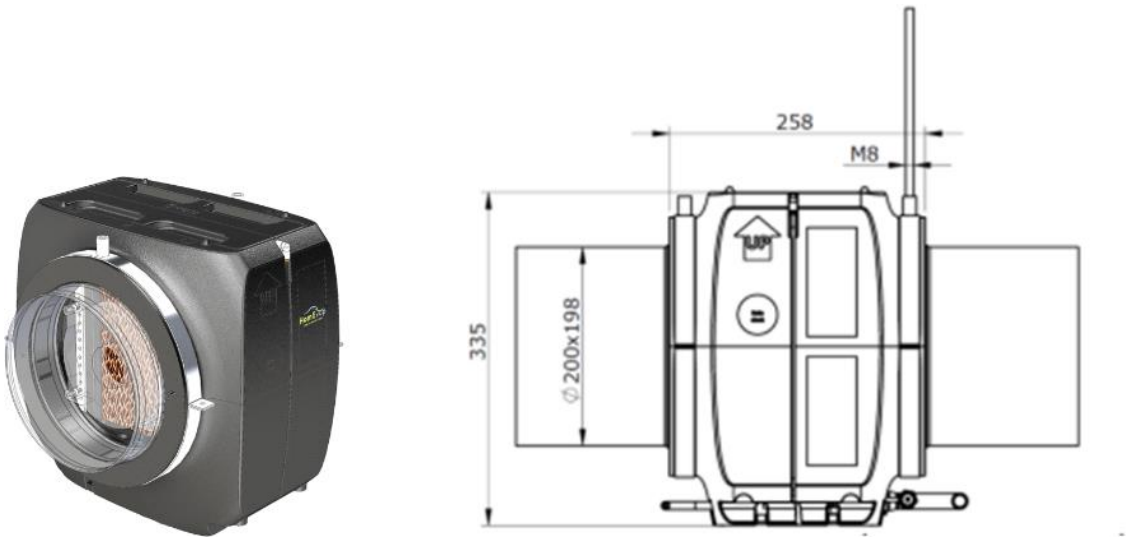

Figure 20 Example of humidifying equipment for ventilation system.

Verification Documents for Provisional Certification:

- Technical specifications with clearly stated requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Technical data sheet of the installed system.
- Photographs of on-site implementation

Examples

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Frequently Asked Questions and Complex Cases

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T6. Efficient Water Use

T6. Efficient Water Use	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	See Chapter 9

Explanation of the Regulations

Due to the decreasing availability of hydrological resources and the overexploitation of a large number of aquifers, it is essential to conserve this resource using optimization actions while considering additional capture of non-conventional sources such as rainwater, the resale and reuse of treated wastewater, and avoiding consumption of first-use water.

Used water should no longer be considered waste, especially when the resource is scarce. It is important to identify areas of opportunity to make better use of water, thereby contributing to water conservation and reducing water shortages by promoting water-saving actions.

Concept of efficient water use

The concept to be developed must contain at least the following:

- Evaluation of the annual water demand, depending on the use and number of people in the building.
- Amount of local rainwater per year.
- Description of measures to reduce potable water demand:
  - Efficiency of appliances used (toilet, sink, shower/tub, appliances if applicable).
  - Strategies to reduce potable water use for irrigation, including description of the irrigation system.
  - Rainwater harvesting, collection and use strategies.
- Short description of how the functional treatment of black water is carried out, in order to return clean water to the natural water cycle: on the land itself or to the municipality.

- Description of measures to reduce wastewater discharge into sewers:
  - Considerations regarding graywater treatment.

Compliance with maximum flow rate requirements

For compliance with maximum flow rates, the use of aerators is authorized as long as the project submits the technical data sheet of the aerator, and it can demonstrate reduction of the flow rate to the required limit.

Flow rates for kitchen and non-kitchen faucets are differentiated because in some countries more flow is required in the kitchen than in the other sinks.

Benefits in case of applying the elective criteria.

In the event the project opts for applying elective criteria T6.a + T6.b or T6.a + T6.c or all three, the Mandatory Requirement T6 is attenuated. For this purpose, the following is understood:

- Cascade system: A system in which water used at one point in the building (e.g., at sinks) is treated and used again, but in a lower quality use at another point in the building (e.g., in toilets or for washing clothes).
- Closed-cycle system: A system in which water used at one point in the building (e.g., at the sinks) is treated and can be used again at the same point, with no impact on water quality. It should be noted that in general, kitchen water cannot belong in a closed-cycle system.

Implementation of these Elective Requirements is particularly advisable where water is scarce.

Irrigation system water consumption reduction measures.

Implementation of a measure to reduce the amount of water consumed in an irrigation system is mandatory in ASHRAE climate zones 0B, 1B, 2B and 3B, or in climate zones A through E in Chile. The following automated irrigation systems are recognized as measures that minimize water consumption:

- Sprinkler irrigation (impact sprinkler, fixed sprinkler heads and rotors or MP rotators)
- Microjet and micro-sprinklers
- Drip

Irrigation by hose or non-automated irrigation systems is prohibited in the climatic zones mentioned above.

Verification Documents for Provisional Certification:

- Document with a written explanation and possibly diagrams describing concepts related to the use of water in the project.
- Technical specifications with the clearly mentioned requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Technical data sheets of sanitary devices, with water flows highlighted.
- Photographs of on-site implementation

Examples

Example 1: integral two-cycle quasi-closed system for residential water

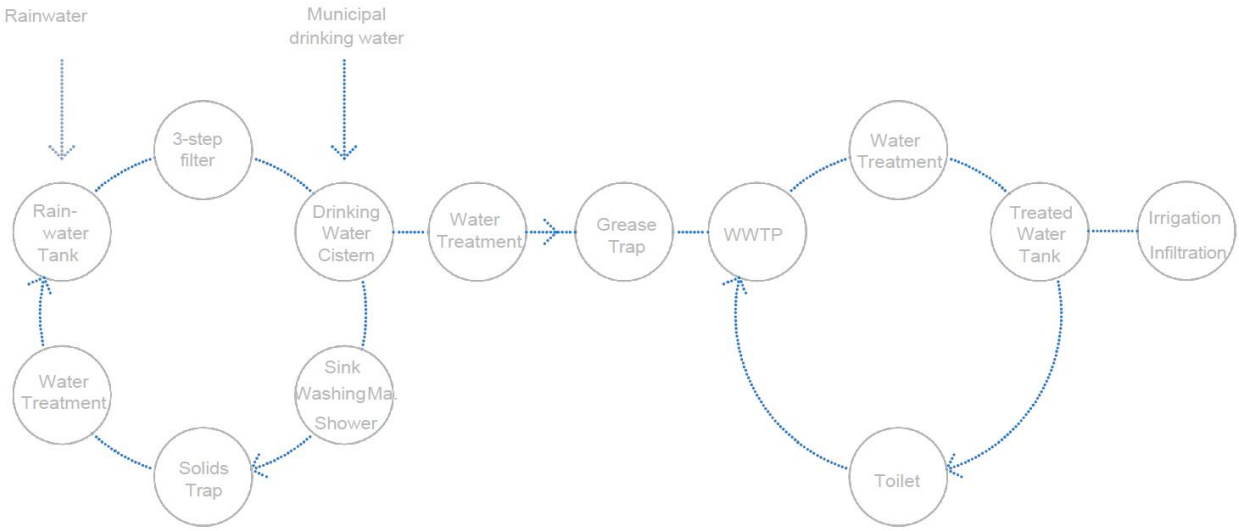

Figure 21 Integral two-cycle system, Prepared by the authors, Sustainable Living 2023

Example 2: integral cascade system for residential water

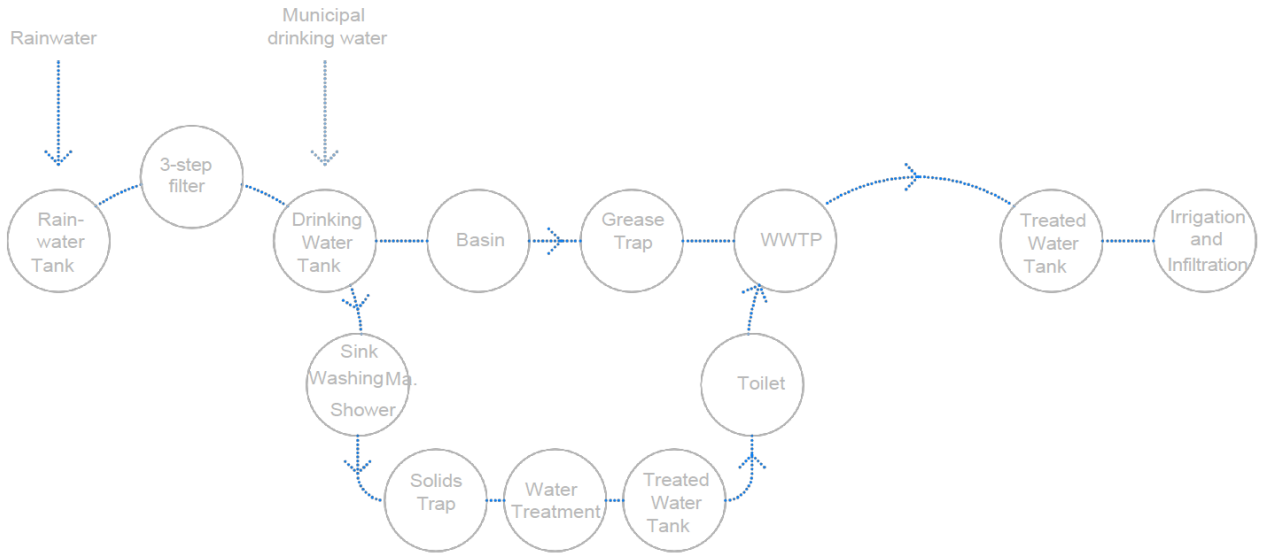

Figure 22 Integral cascading system, Prepared by the authors, Sustainable Living 2023

Frequently Asked Questions and Complex Cases

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T6.a Rainwater Harvesting and Use — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None*

*The only difference between Mexico and the rest of LATAM is that the water collected must be made potable for human consumption (according to example 2).

Explanation of the Regulations

In LATAM, rainwater collected does not have to be processed in order to be fit for human consumption. Only in Mexico does rainwater have to be made potable in order to obtain points for this Elective Requirement.

For the purpose of sizing the rainwater collection system, it is recommended that you follow the indications provided under local regulations. In particular:

- In Chile, you can refer to Annex 6 of the Application Manual for Sustainable Housing Certification (CVS).
- In Mexico, reference should be made to NOM-003-SEMARNAT-1997.

Verification Documents for Provisional Certification:

- Written document mentioning compliance with current regulations, storage capacity, makes and models of associated equipment (if applicable), and use considered for rainwater, including an estimate of the amount of potable water saved.
- Planimetric diagrams that clearly explain the system and its structure.
- Technical specifications with clearly stated requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of on-site implementation

Examples

Example 1: Simple stormwater cycle

If abundant water is available in the area (cascade system).

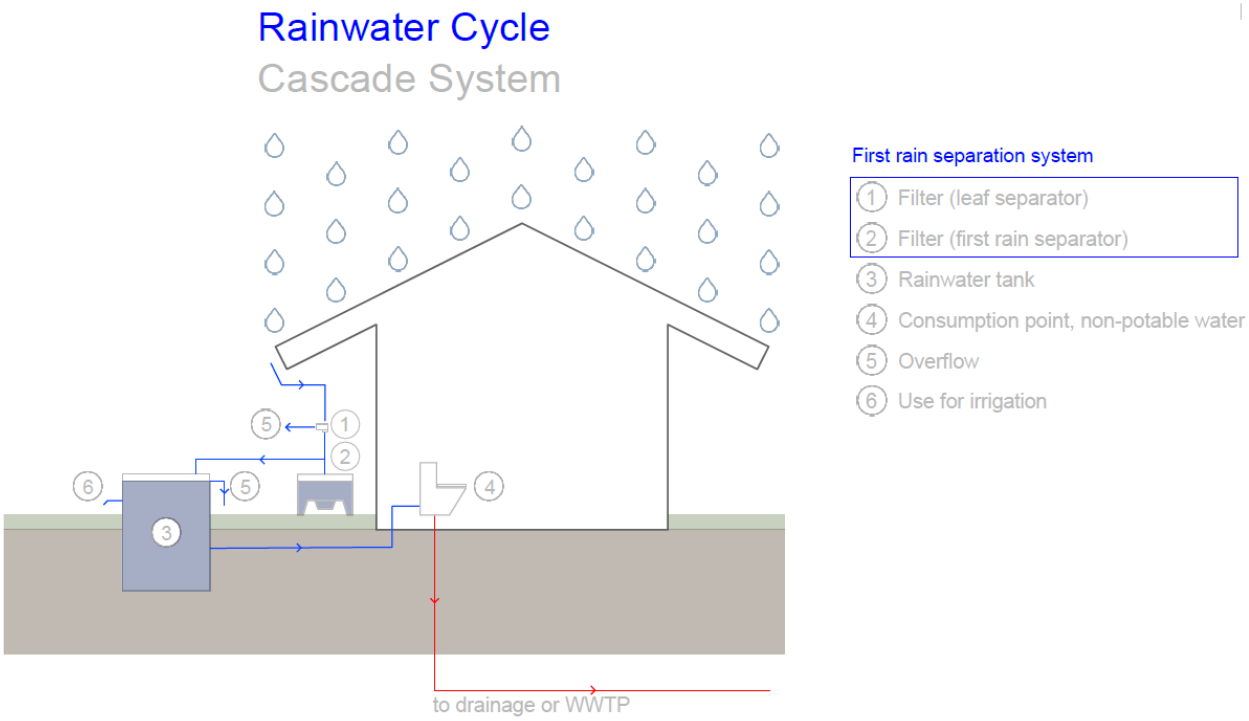

Figure 23 Simple stormwater cycle, Prepared by the authors, Sustainable Living 2023

Example 2: Advanced stormwater cycle (mandatory compliance in Mexico)

If abundant water is available in the area (cascade system).

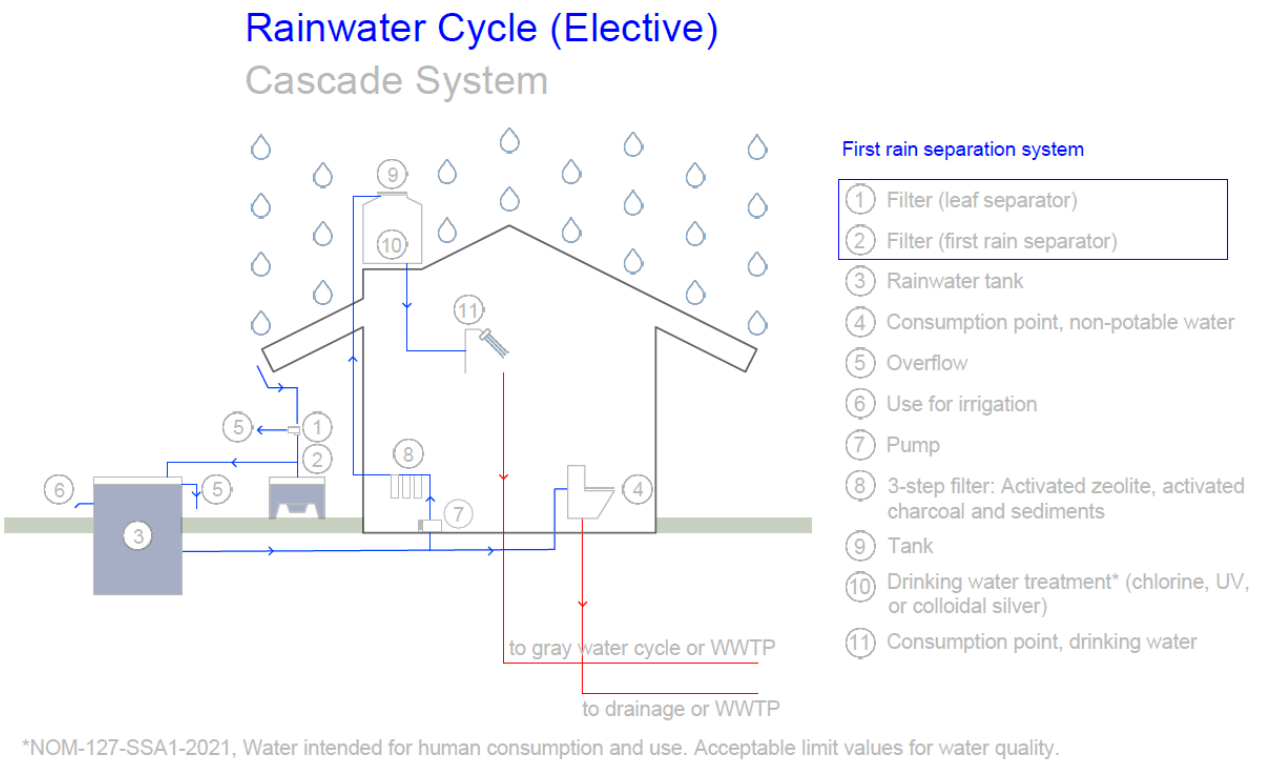

Figure 24 Advanced stormwater cycle, Prepared by the authors, Sustainable Living 2023

Frequently Asked Questions and Complex Cases

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T6.b Gray Water Use — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

Graywater is defined as domestic wastewater from bathtubs, showers, sinks, toilets and others, excluding blackwater. Blackwater, on the other hand, is wastewater containing excreta (Definition of Law 21.075, 2018 of Chile).

In order to reuse graywater, it must be collected in separate networks and treated according to current legislation (in Chile: Law 21.075, 2018; in Mexico: NOM-001-SEMARNAT-2021). Two purification treatments are applied:

- Physical treatment: using filters that prevent the passage of solid particles. Filters should be sized appropriately to retain particles that are usually discharged into the drains.
- Chemical treatment: chlorinating the water with sodium hypochlorite, through an automatic doser, so that it is rendered reusable.

Chile-Specific Aspects:

For more information, please refer to Annex 5 of the Sustainable Housing Certification Application Manual (CVS).

A graywater reuse system must be designed as set forth in the Regulations on Basic Sanitary Conditions for Graywater Reuse or in the Sustainable Building Standards for Housing 2018.

Mexico-Specific Aspects:

For more information refer to NOM-001-SEMARNAT-2021.

Verification Documents for Provisional Certification:

- Written document mentioning compliance with current regulations, separation and identification of networks, storage capacity, biological treatment and disinfection methods.
- Planimetric diagrams that clearly indicate the system and reserve volumes.
- Technical specifications with clearly stated requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Technical data sheets of the water reuse systems, indicating storage capacity, biological treatment and disinfection methods; brands and models of associated equipment, if applicable.
- Photographs of on-site implementation

Examples

Example 1: Gray water cycle for use with direct human contact

If water is scarce in the zone (closed loop system).

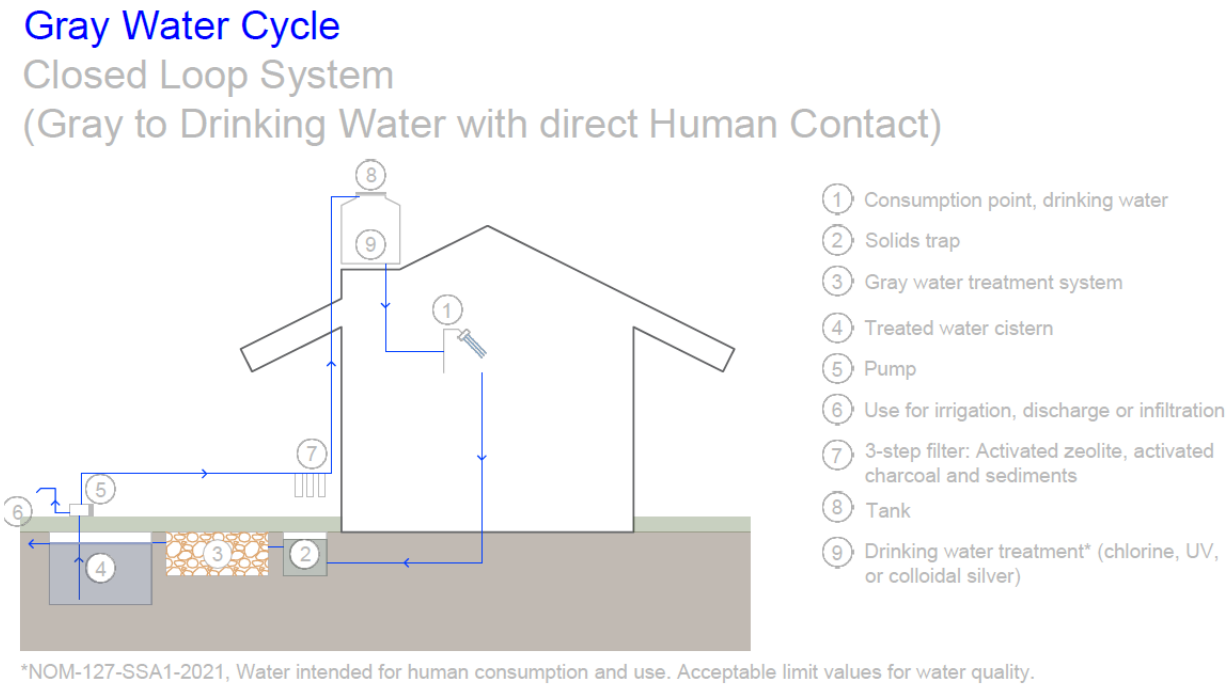

Figure 25 Gray water cycle for direct human contact, Prepared by the authors, Sustainable Living 2023.

Example 2: Gray water cycle for transformation to non-potable water

If water is scarce in the zone (cascade system).

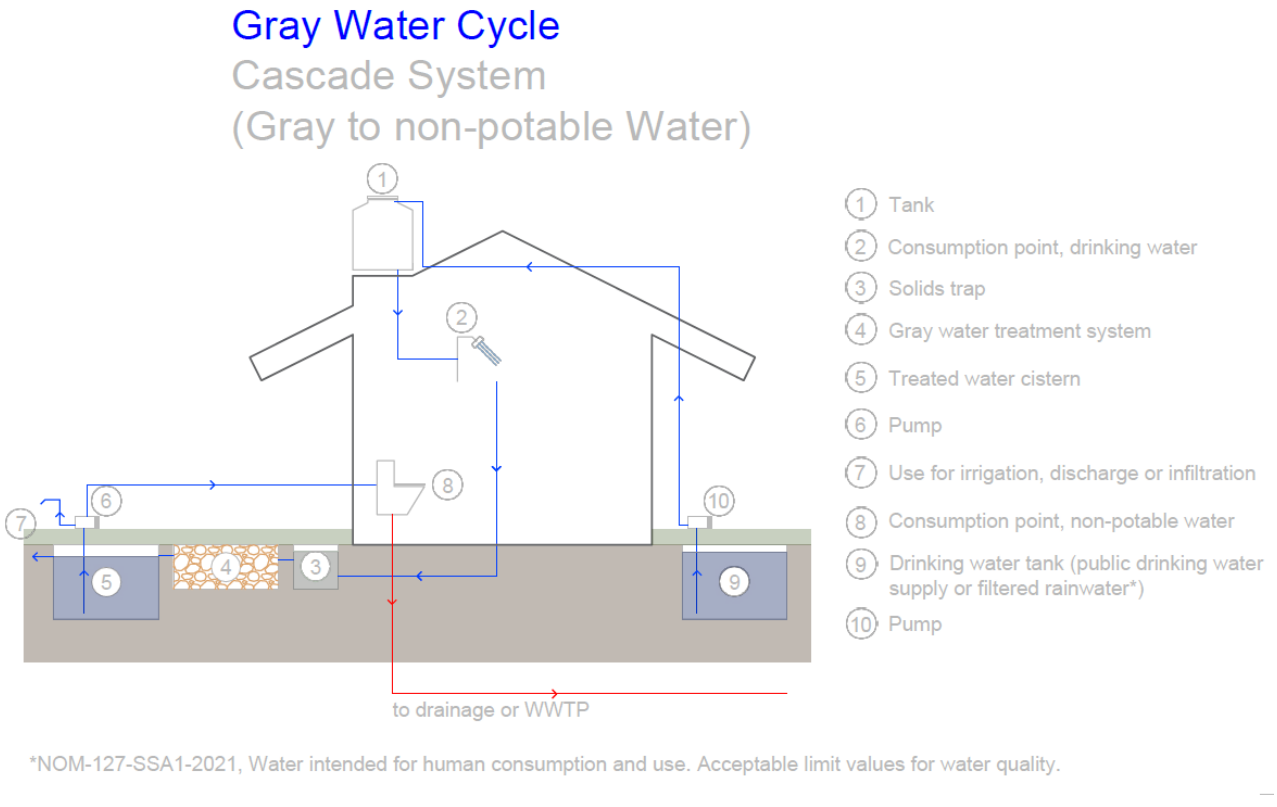

Figure 26 Gray water cycle for transformation to non-potable water, Prepared by the authors, Sustainable Living 2023.

Frequently Asked Questions and Complex Cases

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T6.c Small Water Treatment Plant — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	N/A	None

Explanation of the Regulations

The plant treats effluent water at the building site, in order to obtain a level of quality that allows for discharge into bodies of water. In the case of Mexico, in accordance with NOM-001-SEMARNAT-2021.

Verification Documents for Provisional Certification:

- Written document mentioning compliance with current regulations, separation and identification of networks, storage capacity, biological treatment and disinfection methods.
- Planimetric diagrams that clearly indicates the system and reserve volumes.
- Technical specifications with clearly stated requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Technical data sheets of the water treatment systems, indicating storage capacity, biological treatment and disinfection methods, brands and models of associated equipment, if applicable.
- Photographs of on-site implementation

Examples

Example 1: Black water cycle

If water is scarce in the zone (quasi-closed system).

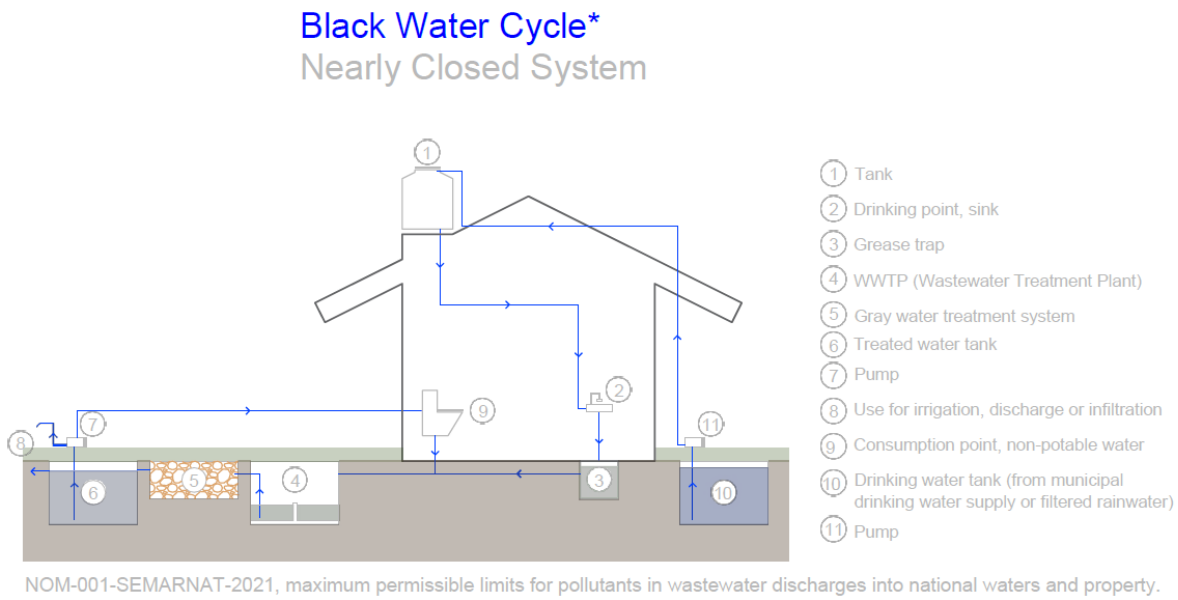

Figure 27 Black water cycle, Prepared by the authors, Sustainable Living 2023

Example 2: Black water cycle

If water is scarce in the zone (discharge quality water).

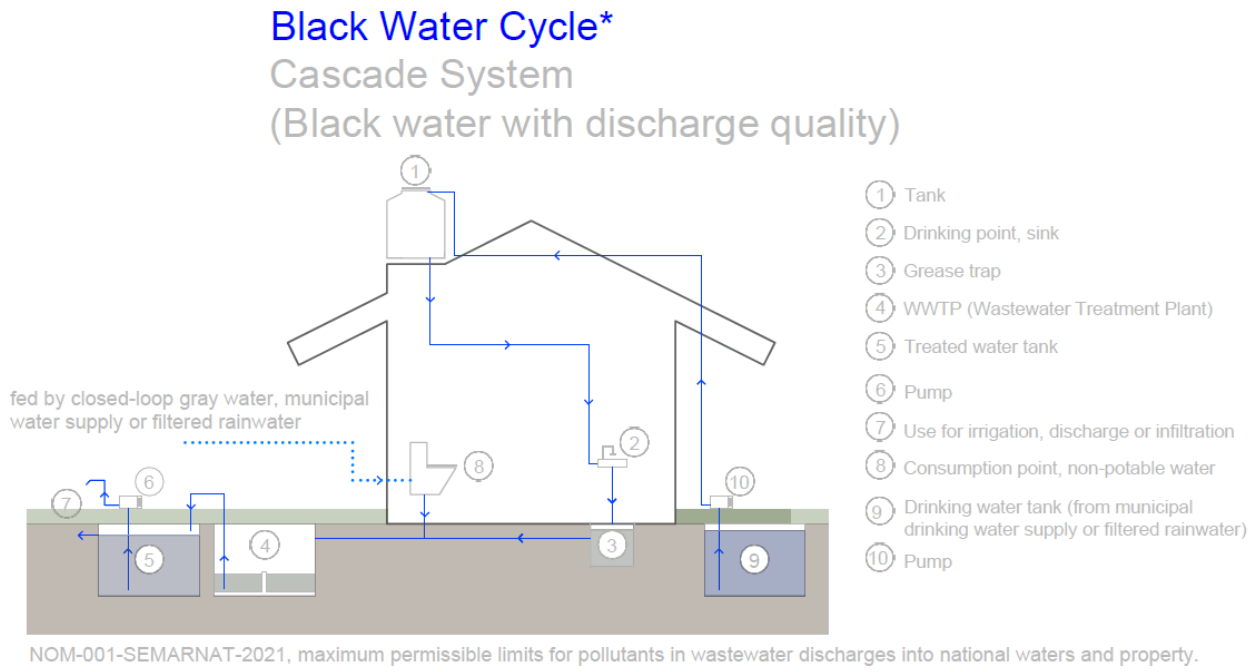

Figure 28 Black water cycle, Prepared by the authors, Sustainable Living 2023

Frequently Asked Questions and Complex Cases

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O OPERATION

O1. User Manual

O1. User Manual	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

The user receives a manual that helps him/her familiarize himself/herself with the building and its technical equipment. This manual contains documentation on the technical installations and equipment, in terms of their operation, maintenance, usage parameters, etc. Simple operating optimization tips are also included (e.g., night ventilation, shower time guaranteed with solar thermal collectors, etc.).

In the case of implementing Elective Requirements, the user manual must provide the following information:

- T4.a Supply Air Filtration - The recommended filter replacement frequency and model should be provided to facilitate filter purchase.
- O2.b Temperature and Humidity Control - The project should provide advice on the steps to be taken in the event that the temperature and humidity are outside the comfort range, which is defined by the project design team specialist.

In the future, Minergie will develop a standardized user manual.

Verification Documents for Provisional Certification:

- User Manual (preliminary structure).

Verification Documents for Final Certification:

User Manual (finalized).

- Letter of receipt and commitment signed by the user or copy of the purchase contract, which includes the user manual as an attachment.

Examples

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Frequently Asked Questions and Complex Cases

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O2. Measuring Consumption

O2. Measuring Consumption	**Mandatory Requirement**

Country-Specific Aspects

Country	**Chile**	**Mexico**
National specifications to be considered:	None	None

Explanation of the Regulations

The user is advised to monitor the building's electricity and water mains consumption at least once a year, in order to control the correct operation and identify opportunities for optimization. A sample data upload form can be downloaded from the "Supporting Documents" tab on the Minergie Platform (you can enter either monthly or annual totals, as you prefer). The following steps must be performed once a year in order to report these consumptions:

1 Show where the information for the energy and potable water consumption report is taken from (photograph of the meter or consumption information on the electricity and water bills). In the case of multi-family buildings, consumption for each housing unit will be reported.
2 Make an Excel spreadsheet or fill out the reference spreadsheet with the consumption data. Check for changes in consumption or maintenance values over time.
3 Send the data to **contacto@minergie.cl**, specifying the project location for identification purposes.

The recommendation is to submit consumption data to Minergie for the first three years of use of the building. Data collected will be used to create a baseline for Minergie buildings' energy and water consumption. The data will not be communicated to third parties and can only be used anonymously without identification of the corresponding project.

Submittal of consumption data does not lead to losing Minergie certification and Minergie's certification office will not perform personalized analysis of this data for users.

Should users or owners wish to receive support for the energy efficiency analysis and optimization of their building based on the data shared, they can issue a request to the certification body (consultancy subject to additional costs).

Verification Documents for Provisional Certification:

- Planimetric diagrams indicating the location of the meter.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Photographs of the meters.
- Energy consumption declaration form delivered to the user.

Examples

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Frequently Asked Questions and Complex Cases

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O2.a Energy Consumption Control — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

There is a metering system for each of the electrical and thermal energies existing in the building, as well as the renewable energy generated on site. It may consist of either a single metering system or a combined system with a display screen/meter for each element.

All available consumption values must be recorded and shared with the Minergie certification office in keeping with the same procedure described under Requirement O2. Measuring Consumption . A single spreadsheet containing all the information may be submitted, if so desired.

Verification Documents for Provisional Certification:

- State the type of metering system that will be implemented to keep track of all project energies and show how the user is able to access this information.
- Technical specifications with the clearly mentioned requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Technical data sheet of the meters.
- If applicable, information from the monitoring system.
- Photographs of on-site implementation

Examples

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Frequently Asked Questions and Complex Cases

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O2.b Temperature and Humidity Control — Elective Requirement

Country-Specific Aspects

Country	Chile	Mexico
National specifications to be considered:	None	None

Explanation of the Regulations

The following spaces are deemed part of the insulation perimeter or conditioned spaces: kitchen, dining room, living room, bedroom, office, game room or conditioned spaces: kitchen, dining room, living room, bedroom, desk, game room or any other use that the user plans on occupying on a regular basis.

The purpose is to provide the user with knowledge regarding the temperature and humidity in the room where he/she is located. The User Manual (Requirement O1) provides guidance on the steps to be taken should the temperature and humidity fall outside the comfort range, which is defined by the project design team specialist.

These temperature and humidity measurement systems may be linked and displayed on a cell phone or computer application.

Verification Documents for Provisional Certification:

- Planimetric diagrams showing the location of the sensors.
- Technical specifications with the clearly mentioned requirements.

Verification Documents for Final Certification:

- Provisional certification documentation (updated)
- Technical data sheet of the sensors.
- Photographs of the sensors.

Examples

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Frequently Asked Questions and Complex Cases

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8 Chile-Specific Aspects

Minergie has a representative office in Chile and there are Minergie-Chile Regulations, adapted to Chile's national regulations and market. That is why additional detailed indications relative to certain criteria have been developed and that can be interpreted pursuant to local Minergie Regulations

General assistance and additional information for Minergie in Chile

- Housing Energy Rating (CEV), Chilean Ministry of Housing and Urbanism: **https://www.calificacionenergetica.cl/**
- Sustainable Housing Certification, Chilean Ministry of Housing and Urbanism: **https://csustentable.minvu.gob.cl/item/sello-de-construccion-sustentable-de-viviendas-en-chile/**
- Construction standards with sustainability criteria, Ministry of Housing and Urbanism of Chile: **https://csustentable.minvu.gob.cl/estandares-cs/**
- Sustainable building certification, Ministry of Public Works / Chilean Chamber of Construction / Association of Architects / Construction Institute: : **https://certificacionsustentable.cl/**

Compliance facilitated by way of CEV B

In Chile, if applicants submit the evaluations pursuant to the Housing Energy Rating (CEV), which confirms that the project qualifies as a Class B or more efficient project, the building is exempt from demonstrating additional proof of compliance with various requirements. In order to take advantage of this simplification, compliance with CEV B must be demonstrated using the PBTD1 and PBTD3 forms for each type of housing unit, particularly those that are most exposed to heat and cold.

In general, should applicants wish to justify special cases in terms of requirement compliance: in order to demonstrate the benefit of using movable solar shading on the results of cooling demands in a Minergie dwelling, it is allowed to weigh the energy demand results obtained in the CEV dwelling energy rating calculation tool is allowed, between an evaluation case without solar shading (winter situation with open movable shading) and an evaluation case with closed movable solar shading.

A1. Project Data and Space Definition

A1. Project Data and Space Definition	**Mandatory Requirement**

Explanation of the Regulations

This criterion applies identically in Chile and in all LATAM countries. The only differences are:

- The project thermal zone must also be reported according to the CEV Thermal Zoning Map.
- The definition of the total surface area of the project is the as-built surface area according to the OGUC.

A2. Thermal Insulation of the Building Envelope

A2. Thermal Insulation of the Building Envelope — Mandatory Requirement

Explanation of the Regulations

The following definition is considered:

- Area of the building envelope: The sum of the areas of all parts of the building envelope pursuant to the insulation perimeter. Areas that are not in direct contact with the outside air (i.e., floor to ground or walls to unconditioned enclosed spaces (e.g., basements, garages etc.) can be multiplied by a factor of 0.5.

Minergie regulations establish a minimum thermal insulation requirement for the envelope of all projects wishing to be Minergie certified. The step-by-step process to verify insulation compliance is described in detail below.

Applicants must first declare the materiality and characteristics of the thermal insulation for all elements making up the thermal envelope of the building (roof, walls, floors, windows and doors).

Secondly, they must demonstrate compliance with the thermal transmittance values provided under the Regulations, or if the project is rated with a B label or better according to the **Housing Energy Rating** methodology, justifying compliance with this requirement will not be necessary. In all cases, projects must comply with the insulation values required under the thermal regulations and the environmental decontamination plans that apply to each project.

It should be noted that Chilean standard NCh 853: 2007 is the required methodology for calculating thermal transmittance (U-value), and the density, thermal conductivity and specific heat characteristics for the materials used in the calculation can be found in Table 2.2.1 Construction Materials in Annex 2.2 of the Sustainable Construction Standards for Chilean Housing Volume II Energy.[9]

The following table shows the mandatory thermal insulation thicknesses for each climatic zone:

Table 14 Reference thermal insulation thicknesses

Climate zone	Maximum U-value ($W/(m^2 K)$)	Corresponding insulation thickness (Considering an insulating material with a conductivity λ= 0.37 W/mK)
A, B	0.4 (0.6)	e= 80 mm (e= 50 mm)
C, D	0.3 (0.5)	e= 120 mm (e= 70 mm)
E, F, G	0.25	e= 140 mm
H, I	0.18	e= 200 mm

In climate zones A, B, C and D, the thermal transmittance threshold values defined under the Regulations vary, depending on whether the opaque component is considered "solid" or "lightweight." Below are several examples of solid and lightweight constructions. In the event the project's construction solution is not included in the examples, the calculation can be performed on the Minergie Form, in tab A4 (Alternative Calculation).

Solid construction elements:

[9] https://csustentable.minvu.gob.cl/wp-content/uploads/2018/09/ESTANDARES-DE-CONSTRUCCION-SUSTENTABLE-PARA-VIVIENDAS-DE-CHILE-TOMO-II-ENERGIA.pdf

- Reinforced concrete wall (minimum 10 cm thick)
- Masonry wall (minimum 20 cm thick)
- Adobe wall (minimum 17 cm thick)

Lightweight construction elements:

- CLT wall (less than 27 cm thickness)
- Wooden partitioning
- Metal partitioning

Generally speaking, lightweight construction systems are heterogeneous and have different sections where the U-value varies (e.g., a wooden partition wall). In these cases, the U-value of the complete element must be calculated, taking into consideration all of its sections and the percentage of the wall surface occupied by each section.

Finally, the thermal transmittance (U-values) of each element must be entered into the Minergie Form and the calculation log must be attached.

Regarding verification of this requirement once the building has been constructed, the project must submit photographs of the insulation installation for each element in the thermal envelope, in addition to highlighting the photographs of thermal insulation at the joints between elements in order to facilitate verification that the insulation layer has been executed in a continuous manner.

In climate zones A, B, C and D, implementation of the following rooftop strategies can improve envelope performance:

- Over roofing for surface shading, for example with photovoltaic panels or solar thermal collectors (see also Requirement T1. Fossil Fuel-Free, Efficient Energy Production.
- Green roofing with native vegetation (see also Requirement A8.a Green Roof) provides additional insulation and evapotranspiration that reduces the ambient temperature. This can be combined with photovoltaic panels or solar thermal collectors.
- Applying a reflective material with high reflectance and/or emissivity (e.g., white paint, waterproofing).

Verification Documents for Provisional Certification:

Option 1: Prescriptive

- Explanation and description of thermal insulation strategy.
- Minergie Form, tab A2.
- Calculation logs of thermal transmittance values, indicating source of material values and including compactness calculation.
- Scantling plan
- Architectural technical specifications showing details of insulation and window types.

Option 2: CEV Simulation (only in cases of CEV B label or better)

- CEV tool calculation logs for each housing typology.
- Scantling plan
- Architectural technical specifications showing details of insulation and window types.

Verification Documents for Final Certification:

Option 1: Prescriptive

- Provisional certification documentation (updated)
- Insulating materials, glass and window frame sheets, where the thermal transmittance value is highlighted.

- Photographs of the on-site installation of the thermal insulation layer.

Option 2: CEV Simulation (only in cases of CEV B label or better)

- Provisional certification documentation (updated)
- Insulating materials, glass and window frame sheets, where the thermal transmittance value is highlighted.
- Photographs of the on-site installation of the thermal insulation layer.

Examples

See examples provided in the general section of the Regulations (A2. Thermal Insulation of the Building Envelope).

For thermal transmittance calculations, you can use your own documents, the DITEC calculation tool or the CEV calculation log.

A5. External Solar Protection of Windows

A5. Exterior Solar Protection of Windows	**Mandatory Requirement**

Explanation of the Regulations

This criterion applies identically in Chile and in all LATAM countries.

Verification Documents

This criterion applies identically in Chile and in all LATAM countries.

Examples

See examples provided in the general section of the Regulations (A5. Exterior Solar Protection of Windows).

Frequently Asked Questions and Complex Cases

See examples provided in the general section of the Regulations (A5. Exterior Solar Protection of Windows).

Additionally:

For buildings higher than four stories, certified with a CEV-B label or greater, interior movable solar shading may be used instead of exterior movable solar shading. In this case, windows must have a total solar heat gain coefficient ($SHGC_{total}$), $g\text{-}value_{total}$ or a Modified Solar Factor (MSF) <0.4.

9 Mexico-Specific Aspects

Minergie has a representative office in Mexico and there are Minergie-Mexico Regulations, adapted to Mexico's national regulations and market. That is why additional detailed indications relative to certain criteria have been developed and that can be interpreted pursuant to local Minergie Regulations

T6. Efficient Water Use

T6. Efficient Water Use	**Mandatory Requirement**

Explanation of the Regulations

This criterion applies identically in Mexico and in all LATAM countries. The only differences are the maximum flow rates and the benefits of implementing Elective Requirements. This is due to the fact that the country has crossed the threshold between medium and low availability, since it is among the countries that have less than 3,500 thousand m^3 of water per inhabitant per year; in addition, the irregular regional and temporal distribution of water resources and a drop in water volume due to contaminated water must be taken into account. Figure 29 shows the differences in water volume availability in various countries in the Americas and Mexico.

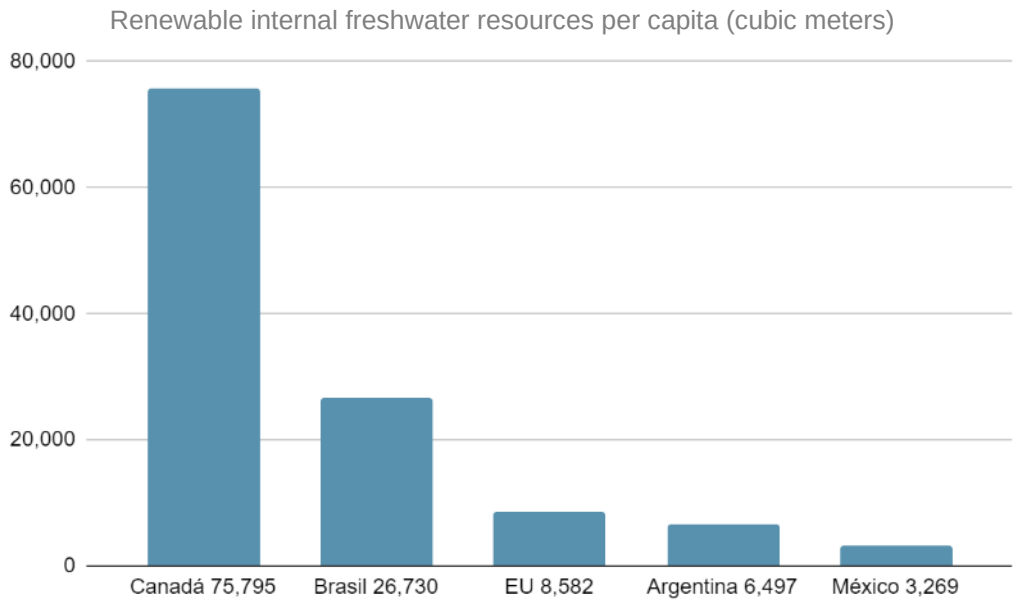

Figure 29 Average water availability in various countries in the Americas, Food and Agriculture Organization of the United Nations, AQUASTAT 2019 data.

With a view to tackling today's challenges, our country divisions have been reorganized into 13 regions congruent with the natural distribution of water, identified as natural and administrative units and comprised by the municipalities located in each region.

Table 15 Hydrological-Administrative Regions in Mexico

I	Baja California Peninsula
II	Northwest
III	North Pacific
IV	Rafts
V	South Pacific

VI	Rio Bravo
VII	North Central Basins
VIII	Lerma-Santiago-Pacific
IX	Northern Gulf
X	Gulf Center
XI	Southern Border
XII	Yucatan Peninsula
XIII	Valley of Mexico

Figure 30 illustrates the distribution of water availability in these regions and the diversity of climate conditions prevailing in Mexico. It also offers a range of scenarios that allow us to compare water availability in the Southern Border Region with Argentina; in the South Pacific Region with the United States; and the severe situations in the Northern Central Basins and the Valley of Mexico, with other countries such as Israel and Egypt, with 330 and 160 m3 per inhabitant per year, respectively.

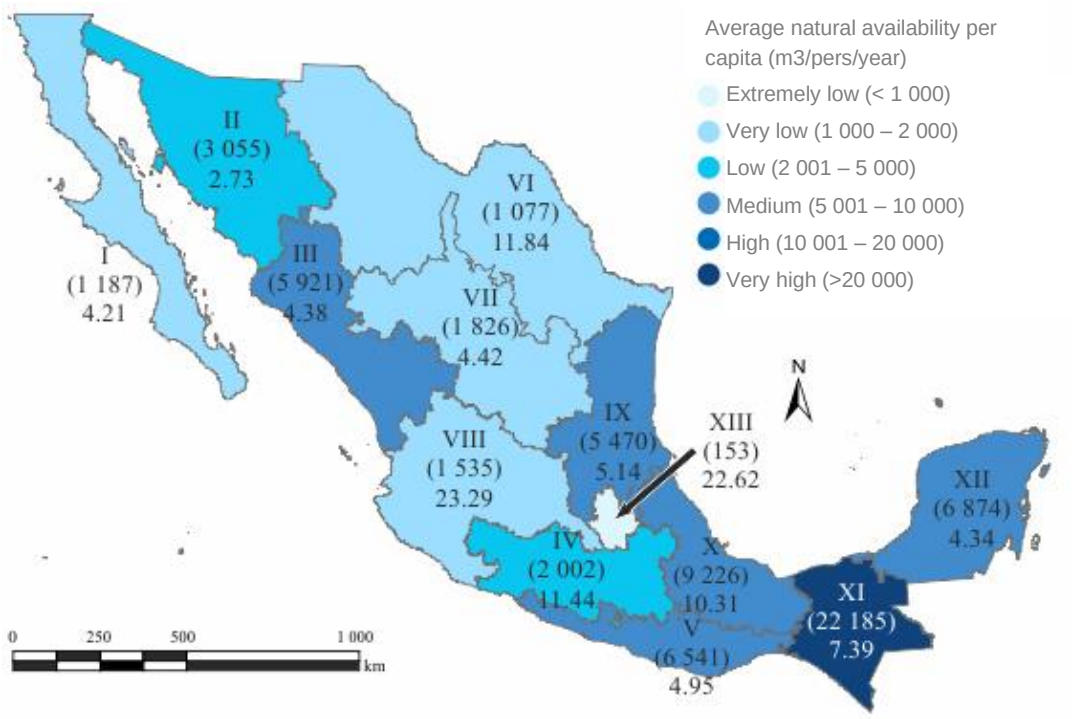

Figure 30 Water availability by administrative region (2000). Availability classification is according to *World Resources Institute*. CNA. *Compendio Básico del Agua en México*, 2002.

Verification Documents

This criterion applies identically in Mexico and in all LATAM countries.

Examples

See examples provided in the general section of the Regulations (T6. Efficient Water).

Frequently Asked Questions and Complex Cases

See examples provided in the general section of the Regulations (T6. Efficient Water).