NB: Unofficial translation, legally binding only in Finnish and Swedish

Annex to the explanatory memorandum for the Ministry of the Environment Decree on improving the energy performance of buildings undergoing renovation or alteration: Calculation

The Ministry of the Environment Decree on improving the energy performance of buildings undergoing renovation or alteration provides three options by which compliance of renovation or alteration work with the provisions on the improvement of the energy performance of a building can be demonstrated. The options are as follows:

1. Improve the thermal resistance of building elements.
2. Reduce the calculated energy use in the building to below a specific limit value specified by building category. Calculation instructions for new buildings can be applied for the calculation. Calculation is based on standardised use. The limit values for energy use are specified as calculated annual energy use per net heated area (kWh/(m^2a)).
3. Improve the calculated overall energy use in the building. The limit values per building-category are specified as a relative change compared to the calculated overall energy use in the original building or, if the intended use of the building has changed, to the calculated overall energy use in the building at the time of the last change in the intended use. The same calculation tools and instructions as for new buildings can be applied for the calculation. The overall energy use limit values are specified as calculated annual energy use per net heated area (kWh/(m^2a)). The energy carrier factors are issued separately by government decree, and are the same as for new buildings.

If the technical systems are updated, replaced or otherwise renovated, the limit values specified in the Decree should be followed irrespective of the options 1 to 3 selected.

The indoor temperature conditions in summer must not be impaired as a result of the renovation or alteration. When the improvement of the energy performance of the building is planned, adoption of passive means to prevent overheating of spaces in summer can be counted as a gain which reduces the energy need for cooling.

Areas

Net heated area

The net heated area is the sum total of heated storey areas including the inside areas of their external walls. Alternatively, the net heated area can be calculated from the gross heated area less the areas occupied by external walls.

The net heated area of the building is determined from up-to-date building documents, such as drawings or information models, or estimated on-site with sufficient accuracy. If no up-to-date documents are available, or estimating through measurement proves problematic, the net heated area of the building can be estimated to be 90% of the gross heated area. If the gross area of the building is unknown, this can be estimated from the building's outer dimensions and its number of storeys. The gross heated area is determined by subtracting the area of unheated space from the gross area.

Semi-warm spaces, such as attic and other storage areas in the building, are considered as heated space. Unheated spaces are not within the scope of the assessment and their areas should be excluded from the calculation.

Areas of building elements

The areas of building elements are determined from up-to-date building documents, such as drawings or information models, or estimated on-site with sufficient accuracy.

For the purpose of calculating the building's energy use and overall energy use, the areas of the different building elements of the building envelope are determined according to the overall inner dimensions of the building.

The floor area is calculated using the inner dimensions without subtracting openings or areas occupied by structures. Lead-through areas in floors, such as ducts, columns, drains and water pipes, are not subtracted from the floor area.

The ceiling (roof) area is calculated using the inner dimensions of the external walls, subtracting the areas of skylights. Lead-through areas in roofs, such as ducts, flues and ventilation pipes, are not subtracted from the roof area.

The external wall area is calculated using the inner dimensions from the floor surface to the ceiling, subtracting the areas of windows and door openings.

The areas of windows and doors are calculated using the outer dimensions of the frame. The area of a window that differs considerably from the façade or roof shape, of a dome-shaped skylight, or of a glazed smoke and heat exhaust ventilator is calculated on a case-by-case basis by applying the general guidelines.

Demonstrating compliance with requirements for specific building-elements

The Decree specifies the limit values for the improvement of the thermal resistance of different building elements in terms of relative improvement from the original level, while the maximum values are also specified. Thermal transmittance indicating the thermal resistance of building elements is calculated according to Section C4 of the valid National Building Code of Finland regarding thermal insulation.

Thermal transmittance values for the original structures are determined in inspections carried out in connection with project planning; or from up-to-date building documents, such as drawings or information models; or from other documents, such as the building code valid at the time the building permit was granted, or different guidelines followed at that time. If the properties of the structures cannot be determined from the documents, and if they are not determined or evaluated in connection with project planning, the thermal transmittance values shown in Table 1 are used.

A reliable thermal transmittance value specified by the manufacturer can be used as a new value for building elements that are to be completely renovated.

A new thermal transmittance value for a structure can be calculated from the original structure's thermal transmittance, estimated with the help of Table 1 or by other methods, by taking into account the properties of the material layers removed from and added to the structure.

If more than one building element is renovated at the same time, their compliance can be demonstrated by performing the balancing calculation so that the reference values used are the specific building-element requirements for the building elements to be renovated. The balancing calculation is performed for the building elements that are subject to renovation, in accordance with point 2.5 in Section D3 of the National Building Code of Finland ("Rakennusten energiatehokkuus" / energy management in buildings). Unlike as specified in point 2.5.4 in Section D3, however, the areas to be used for reference and design are the building element areas before and after the renovation project, respectively. The areas of the building and building elements are determined according to the area calculation guidelines mentioned above, or according to the valid calculation guidelines for new buildings.

If the compliance is demonstrated by balancing calculation, the improvement of air tightness can be taken into account in the calculation. In such a case, air tightness must be measured both before and after the renovation project. The measured values must be used in the balancing calculation.

Table 1: Thermal transmittance for different structures, W/m^{2}K.

ıt	**Building permit pending in year**								
	–1969	**1969–**	**1976–**	**1978–**	**1985–**	**10/2003–**	**2008–**	**2010–**	**2012–**
Heated spaces									
External wall	0.81	0.81	0.40	0.35	0.28	0.25	0.24	0.17	0.17
Ground-supported floor	0.47	0.47	0.40	0.40	0.36	0.25	0.24	0.16	0.16
Floor with crawl space	0.47	0.47	0.40	0.40	0.40	0.20	0.20	0.17	0.17
Floor butting against outdoor air	0.35	0.35	0.35	0.29	0.22	0.16	0.16	0.09	0.09
Roof	0.47	0.47	0.35	0.29	0.22	0.16	0.15	0.09	0.09
Door	2.2	2.2	1.4	1.4	1.4	1.4	1.4	1.0	1.0
Window	2.8	2.8	2.1	2.1	2.1	1.4	1.4	1.0	1.0
Semi-warm spaces									
External wall	0.81	0.81	0.70	0.60	0.45	0.40	0.38	0.26	0.26
Ground-supported floor	0.60	0.60	0.60	0.60	0.45	0.36	0.34	0.24	0.24
Floor with crawl space	0.60	0.60	0.60	0.60	0.40	0.30	0.28	0.26	0.26
Floor butting against outdoor air	0.60	0.60	0.60	0.60	0.45	0.30	0.28	0.14	0.14
Roof	0.60	0.60	0.60	0.60	0.45	0.30	0.28	0.14	0.14
Door	2.2	2.2	2.0	2.0	2.0	1.8	1.8	1.4	1.4

Window	3.1	3.1	3.1	3.1	3.1	1.8	1.8	1.4	1.4

Demonstrating the compliance of technical systems

With regard to ventilation, the Decree specifies the requirements for the annual efficiency of heat recovery and for specific fan power.

Annual efficiency of ventilation heat recovery

The annual efficiency of ventilation is calculated in accordance with the valid balancing calculation guidelines.

Calculation must be performed by using the temperature ratio for supply air that is specified by the manufacturer and measured, for example, according to standard SFS-EN 308 (the mass flows of supply and exhaust air are equal), or by using efficiency that is measured in accordance with the valid type approval guidelines. The temperature ratio is determined with verified air flows.

The ratio of supply and exhaust air flows, operation of frost protection and, if applicable, restriction of supply air temperature must be taken into account when determining the annual efficiency of the ventilation unit.

When calculating the annual efficiency of ventilation, all ventilation systems of the building are usually taken into account, with the exception of cases where constructing a heat recovery system for some air flows is demonstrated to be impractical. If the renovation or alteration project does not include all ventilation systems of the building, the requirement for the annual efficiency of ventilation may, where appropriate, be applied only to the parts of the ventilation system that are subject to renovation or alteration.

An application for the calculation can also be found on the website of the Ministry of the Environment: www.ymparisto.fi/rakentamismaaraykset.

If more than one building element is renovated at the same time as the ventilation system, their compliance can be demonstrated as a whole by performing the balancing calculation so that the reference values used are the specific building-element requirements for the building elements to be renovated and the requirement for the annual efficiency of ventilation heat recovery. The balancing calculation is performed for the ventilation system and for the building elements that are subject to renovation, in accordance with point 2.5 in Section D3 of the National Building Code of Finland (“Rakennusten energiatehokkuus” / energy management in buildings). Unlike as specified in point 2.5.4 in Section D3, however, the areas to be used for reference and design are the building areas before and after the renovation project, respectively. The areas of the building are determined according to the valid calculation guidelines for new buildings. Section D3 of the National Building Code of Finland (2012) specifies the air flows and ventilation operating times per building type based on standardised use, and these values must be used for the heat loss balancing calculations, with the exception of a situation where the building's air volumes are measured before and after the renovation project and are higher than the standardised-use air flows referred to above. The ventilation air flow is the same for both reference and design solutions.

If the compliance is demonstrated by balancing calculation, the improvement of air tightness can be taken into account in the calculation. In such a case, air tightness must be measured both before and after the renovation project. The measured values must be used in the balancing calculation.

Specific fan power of the ventilation system

The specific fan power of the ventilation system is the total electric power taken from the power network by all the fans, any frequency converters and other power control devices, divided by the total designed waste air rate or designed outdoor air rate of the ventilation system (whichever is higher).

The specific fan power of the ventilation system may be higher than the specified limit value if, for example, controlling the indoor climate of the building requires non-standard ventilation solutions. Normally, all ventilation systems of the building are taken into account when calculating the specific fan power of the ventilation system. If the renovation or alteration project does not include all ventilation systems of the building, the requirement for the specific fan power may, where appropriate, be applied only to the parts of the ventilation system that are subject to renovation or alteration. If the renovation or alteration project consists only of the replacement of the ventilation unit, and ducting is not changed, an exception to the specific fan power requirement may be granted if the ducting design principles essentially differ from those required for meeting the specific fan power requirement, or if the project essentially increases the air volumes.

Demonstrating the compliance with the requirements for energy use and overall energy use in the building

The calculation is performed in accordance with the rules specified in Chapters 3 and 4 in Section D3 of the National Building Code, unless otherwise provided in this Decree, and by using the calculation methods and tools specified in Chapter 5 in Section D3 of the National Building Code. The calculation method for monthly levels can be used for non-cooled buildings or buildings with only individual cooled spaces. Unlike as specified in Section D3 of the National Building Code, the monthly-level calculation method for non-cooled buildings can also be used for cooled buildings, if the delivered energy for cooling is calculated as specified in Section "Alternative calculation method for the delivered energy for cooling" of this Annex. The calculation method specified in Section D5 of the National Building Code or similar methods can be used as the calculation method for monthly levels.

The delivered energy use in the building must be calculated for weather zone I (i.e. using the Helsinki-Vantaa weather data) in accordance with Section D3 of the National Building Code.

The delivered energy use in the building must be calculated with the following standardised initial values that are specified by building type in Section D3 of the National Building Code:

- indoor climate conditions (ventilation air volumes and indoor temperatures);
- standardised use of the building and internal heat loads; and
- domestic hot water consumption.

The measured air flows must be used if the building's air volumes are measured before and after the renovation project and are higher than the standardised-use air flows referred to above.

The standardised use of the building means specified ventilation operating time, electricity consumption of lighting and appliances, and heat load generated by people. The heat load generated by lighting and appliances is of the same magnitude as their electricity consumption.

If a demand-controlled ventilation or lighting system is taken into account when calculating the delivered energy use, the provisions laid down in Chapter 3 in Section D3 of the National Building Code must be observed.

Technical systems that are not listed in point 4.1. in Section D3 of the National Building Code, such as exterior lighting, lifts, or trace heating cables, are not taken into account in the calculation.

If the building has special premises, such as professional kitchens, restaurants, canteens, cafés or laboratories, these are not taken into account in the calculation; the energy calculation is performed using the initial values that correspond with the intended use of the building or building unit as specified in Section D3 of the National Building Code.

Other initial values for the calculation are determined during the project in connection with an on-site inspection; or from up-to-date building documents, such as drawings or information models; or from other documents, such as the building code valid at the time the building permit was granted, or different guidelines followed at that time.

Energy use in the building

The energy use in the building means the overall calculated amount of energy used in the building for heating, appliances and cooling during one year, calculated using the rules and initial values specified in these regulations per net heated area, and excluding the energy production loss of energy produced inside or outside the building from various energy carriers.

The Decree specifies a limit value for the calculated energy use in the building per net heated area ($kWh/(m^2a)$) by building category, and the renovation project must result in a performance that is better than the required level.

Overall energy use in the building

The overall energy use in the building, i.e. E-value (kWh/m^2), means the calculated annual use of delivered energy in the building, weighted by the energy carrier factors and calculated using the rules and initial values specified for new buildings per net heated area.

The limit values per building-category are specified as a relative change compared to the calculated overall energy use in the original building. The reference used is the original building or, if the intended use of the building has changed, the building at the time of the last change in the intended use. The requirement level is the relative decrease in the calculated overall energy use set by using a reference value calculated for the reference building.

Calculating energy use and overall energy use in the building

Structures

Thermal transmittance values for the structures are determined in connection with project planning; or from up-to-date building documents, such as drawings or information models; or from other documents, such as the building code valid at the time the building permit was granted, or different guidelines followed at that time. If the properties of the structures cannot be determined from the documents. and if they are not determined or evaluated in connection with project planning, the thermal transmittance values shown in Table 1 are used.

The total solar energy transmittance factor for solar radiation passing perpendicularly through a daylight opening ($g_{perpendicular}$) is taken from the product information provided for the windows or, if such value is not available, the value to be used is 0.6. If the calculation method specified in Section D5 of the National Building Code (2012) is used, the value to be used as the total correction factor for solar energy transmittance ($F_{transmittance}$) is 0.5, or some other, more accurate value can also be used. Other factors with similar effect can be used for other calculation methods.

The heat loss caused by thermal bridges in joints between structures must be calculated. The specific heat losses from joints between structures and the related lengths are determined from the building documents. If more accurate data is not available, the values provided in tables in Chapter 3 in Section D5 of the National Building Code (2012), among others, can be used as the specific heat loss for calculating the thermal bridges. With regard to existing buildings, the effect of thermal bridges can be estimated simply by adding 10% to the conduction heat loss of the building envelope.

The internal effective heat capacity of the building is determined on the basis of the building properties. If more accurate data is not available, the values provided in Table 5.6 in Section D5 of the National Building Code (2012) may be used as initial values, among others.

Ventilation

With regard to the ventilation operating time and air volume, the values specified by building type in Section D3 of the National Building Code are used. If a demand-controlled ventilation system is taken into account when calculating the delivered energy use, the provisions laid down in Chapter 3 in Section D3 of the National Building Code must be observed.

When calculating the energy need for ventilation heating and ventilation electricity consumption, the annual efficiency of ventilation heat recovery and specific fan power are values established by various means or taken from up-to-date building documents, such as drawings or information models; or from other documents.

The energy need for ventilation heating means the heating energy need which arises from heating air to the supply air temperature after heat recovery, and possibly from heating prior to heat recovery to prevent freezing. The heating of supply and make-up air in a space is part of the energy need for space heating, and is calculated in that context. The annual efficiency of ventilation heat recovery can be calculated from the temperature ratios provided with the equipment and by, for example, using the method specified in the Ministry of the Environment Bulletin 122 on the ventilation heat recovery in the heat loss balancing calculations (“Ilmanvaihdon lämmöntalteenotto lämpöhäviöiden tasauslaskennassa”).

If the annual efficiency of ventilation heat recovery cannot be determined with the methods referred to above, the annual efficiency values provided in Table 2 must be used.

If the specific fan power of the ventilation system cannot be determined with the methods referred to above, the values provided in Table 3 must be used.

The electrical energy use for ventilation means the electrical energy use for fans and any auxiliary devices (fans, frequency converters, control devices). The heating of supply air is included in the energy use for ventilation.

Table 2: Annual efficiency values of ventilation heat recovery.

Building permit pending in year	–1969	1969–	1976–	1978–	1985–	10/2003–	2008–	2010–	2012–

Annual efficiency	0%	0%	0%	0%	0%	30%	30%	45%	45%

Table 3: Specific fan power values.

Ventilation system	**Building permit pending in year**	
	–2012	**2012–**
Natural	0.0 kW/m^3/s	0.0 kW/m^3/s
Mechanical extract ventilation	1.5 kW/m^3/s	1.0 kW/m^3/s
Balanced ventilation	2.5 kW/m^3/s	2.0 kW/m^3/s

Air infiltration

The calculation of energy used for heating air leaking into spaces is based on the air tightness of the building or building unit, expressed as air leakage rate.

The air leakage flow is calculated from the building envelope air leakage rate q_{50} as specified in Section D3 of the National Building Code. The air leakage rate q_{50} (m^3/(h m^2)) means the average air leakage flow of the building envelope per hour with a 50-Pa pressure difference per the overall building envelope area determined according to the overall inner dimensions.

The building envelope air leakage rate is determined by measuring or from the plans or up-to-date building documents.

If the building envelope air leakage rate cannot be determined with the methods referred to above, it must be determined by using the values provided in Table 4. The table also includes building air leakage rates n_{50}, because that method has been previously used for indicating the air tightness.

The building envelope air leakage rate (q_{50}) can be calculated from the building air leakage rate (n_{50}) with equation

$$q_{50} = \frac{n_{50}}{\mathrm{A}_{\mathrm{vaippa}}} V$$

where

q_{50}	building envelope air leakage rate with a 50-Pa pressure difference, m^3/(h m^2)
n_{50}	building air leakage rate with a 50-Pa pressure difference, 1/h
V	air volume of the building, m^3
$A_{envelope}$	building envelope area (including floor), m^2

Table 4: Air leakage rate of the building envelope and building.

Building permit pending in year	**–1969**	**1969–**	**1976–**	**1978–**	**1985–**	**10/2003–**	**2008–**	**2010–**	**2012–**

Building air leakage rate n_{50}	6.0	6.0	6.0	6.0	6.0	4.0	4.0	4.0	
Building envelope air leakage rate q_{50}									4.0

Domestic hot water

The values presented in Table 5 in Section D3 of the National Building Code are used for the energy need for domestic hot water. The delivered energy use for domestic hot water is calculated from the energy need, taking into account the losses from distribution, circulation, storing and production. Production is discussed later.

The domestic hot water distribution efficiency can be determined with a separate assessment, and the resulting value must be used in the calculation. If the distribution efficiency has not been determined, the values presented in Table 5 in this Annex are used. If the insulation level of the domestic hot water piping has not been determined, the specific values per building type for non-insulated pipes presented in Table 5 are used for the domestic hot water distribution efficiency.

If the building is equipped with a domestic hot water circulation pipe, its heat losses must be determined and taken into account in the calculation. The specific power of domestic hot water circulation pipe heat loss can be determined with a separate assessment, and the resulting value must be used in the calculation. Otherwise, the specific value per building type presented in Table 6 is used for the specific power of domestic hot water circulation pipe heat loss.

With regard to the length of the domestic hot water circulation pipe, the specific value per building type presented in Table 7 is used, unless the length cannot be determined from the building documents, such as drawings or information models, from other documents, or on site. The circulation pipe length is calculated from the specific length by multiplying the length with the net heated area of the building.

The loss from domestic hot water storage can be determined in connection with project planning, and the resulting value must be used in the calculation. Otherwise, the appropriate value presented in Table 8 is used for the loss from domestic hot water storage.

Unless otherwise demonstrated by calculations, 50% of the calculated loss from domestic hot water circulation and storage is converted to heat loads into spaces.

The electrical energy use of the domestic hot water circulation pump is calculated in accordance with point 6.3.4 in Section D5 of the National Building Code (2012), or by other similar method.

Table 5: Domestic hot water distribution efficiency.

Building type	Domestic hot water distribution efficiency, $\eta_{dhw, transfer}$				
	Circulation	No circulation			
		non-insulated	in a housing pipe	insulated, basic level[1)]	insulated, better[2)]
Detached houses and terraced and other attached houses	0.96	0.75	0.85	0.89	0.92

Blocks of flats	0.97	0.76	0.86	0.90	0.94
Office buildings	0.88	0.69	0.78	0.82	0.85
Commercial buildings	0.87	0.68	0.77	0.81	0.84
Hotel buildings	0.97	0.76	0.86	0.90	0.94
Educational buildings and day-care centres	0.89	0.70	0.79	0.83	0.86
Sports halls	0.98	0.77	0.87	0.91	0.95
Hospitals	0.94	0.74	0.84	0.88	0.91
[1)] Basic level of insulation means a minimum insulation thickness of 0.5 x D, where D is the pipe diameter.					
[2)] Better level of insulation means a minimum insulation thickness of 1.5 x D, where D is the pipe diameter.					

Table 6: Specific power of domestic hot water circulation pipe heat loss.

Insulation level	**Specific power of circulation pipe heat loss $\phi_{dhw, circloss, spec}$**
not known	40 W/m
0.5 D	10 W/m
1.5 D	6 W/m
housing pipe	15 W/m
housing pipe + 0.5 D	8 W/m
housing pipe + 1.5 D	5 W/m

Insulation level 0.5 D means that the thickness of insulation is half the diameter of the pipe to be insulated. Insulation level 1.5 D means that the thickness of insulation is 1.5 times the diameter of the pipe to be insulated.

Table 7: Length of the domestic hot water circulation pipe.

Building type	Specific length of the circulation pipe, m/m^2
Detached houses and terraced and other attached houses	0.043
Blocks of flats	0.043
Office buildings	0.020
Commercial buildings	0.020
Hotel buildings	0.043
Educational buildings and day-care centres	0.020
Sports halls	0.020
Hospitals	0.043

Table 8: Loss from domestic hot water storage.

Storage tank volume, l	Storage tank heat loss, $Q_{dhw, storage}$, kWh/a	
	40-mm insulation	100-mm insulation
50	440	220
100	640	320
150	830	420
200	1,000	500
300	1,300	650
500	1,700	850
1,000	2,100	1,100
2,000	3,000	1,500
3,000	4,000	2,000

Heating system

Spaces

The heating system's energy use for space heating is calculated by dividing the energy need for space heating by the efficiency of heat distribution and heat emission of the heating system.

The annual efficiency and electricity consumption of auxiliary devices can be determined in connection with project planning, and the resulting values must be used in the calculation. Otherwise, the values concerning annual efficiency of heat distribution and heat emission, and specific electricity consumption of auxiliary devices of heat distribution and heat emission systems presented in Table 9 are used in the calculation.

If the control valves of the building's water-based heating systems' heating installations are mainly manual, applicable efficiency value presented in Table 9, multiplied by 0.9, is used. The electricity consumption of auxiliary devices of heat distribution and heat emission systems is calculated by multiplying the specific electricity consumption values by the net heated area of the building.

Table 9: Guideline values for annual efficiency of heat distribution and heat emission and for electricity consumption of auxiliary devices.

Heating solution	**Annual efficiency** η_{spaces} -	**Electric** e_{spaces} **kWh/(m² a)**
Water radiator 45/35 ºC		
insulated distribution pipes	0.90	2
non-insulated distribution pipes	0.85	
Water radiator 70/40 ºC		
insulated distribution pipes	0.9	2
non-insulated distribution pipes	0.8	
Water radiator 90/70 ºC		
insulated distribution pipes	0.85	2
non-insulated distribution pipes	0.80	
Water radiator 70/40 ºC with manifold		
	0.80	2
Water radiator 45/35 ºC with manifold		
	0.85	2
Water-based underfloor heating 40/30 ºC		
structure butts against ground	0.8	2.5
structure butts against crawl space	0.8	
structure butts against outdoor air	0.75	
structure butts against warm space	0.85	
Roof heating (electric)		
structure butts against outdoor air	0.85	0.5
structure butts against warm space	0.9	0.5
Window heating (electric)		
	0.80	0.5
Ventilation heating (1		
room-specific control	0.90	0.5
Electric radiator		
	0.95	0.5

Electric underfloor heating		
structure butts against ground	0.85	0.5
structure butts against crawl space or outdoor air	0.8	0.5
structure butts against warm space	0.85	0.5
Other heating installations		
	0.8	0.5

(1 The ventilation heating efficiency applies to systems in which the supply air is heated with room-specific terminals. Efficiency values of variable air flow systems must be calculated with a more accurate method.

Ventilation

When calculating the heating energy use for ventilation, the efficiency of ventilation unit radiators can be assumed to be 1.0.

Production

The delivered energy use for the heating system is calculated by heat production system. The heating system production covers the energy use for space heating, ventilation and domestic hot water. The delivered energy use for the heating system is calculated by dividing the sum total of the energy use for space heating, ventilation and domestic hot water and any separate storage tank heat losses by the production efficiency of the heat production system in question, such as by boiler efficiency or the heat pump's seasonal coefficient of performance.

The efficiency values of heat production systems can be determined in connection with project planning, and the resulting values must be used in the calculation. The efficiency values can be determined from, for example, the specifications of the equipment. If the efficiency values cannot be determined with the methods referred to above, the values provided in Tables 10 and 11 must be used for the efficiency values of heat production systems.

Electricity consumption of auxiliary devices of heat production systems

The electricity consumption of auxiliary devices of the heating system consists of the electricity consumption of auxiliary devices of heat distribution and heat emission systems and the electricity consumption of auxiliary devices of production systems. The electricity consumption of auxiliary devices of the heat production system can be determined in connection with project planning, and the resulting values must be used in the calculation. Otherwise, the electricity consumption of auxiliary devices of the heat production is calculated with the help of Tables 10 and 11, by multiplying the specific electricity consumption values by the net heated area of the building.

Table 10: Guideline values for heat production efficiency and electricity consumption of auxiliary devices – detached houses and terraced and other attached houses

Heat production	**Annual efficiency** **-**	**Specific electricity consumption of auxiliary devices** **kWh/(m² a)**
standard oil/gas	0.81 (3	0.99 (1 0.59 (2
condensation oil	0.87 (3	1.07
condensation gas	0.92 (3	0.68
wood-pellet boiler	0.75 (3	0.77
wood boiler with energy storage	0.73	0.38
electric boiler	0.88 (3	0.02
district heating	0.94	0.60
room-specific electric heating	1.00	0.00

(1 oil

(2 gas

(3 The annual efficiency includes the losses from a storage tank integrated into a typical heat production unit. If the storage tank is separate, its losses can be interpolated from the loss from domestic hot water storage, if more accurate calculation does not exist.

Table 11: Guideline values for heat production efficiency and specific electricity consumption of auxiliary devices – other buildings.

Heat production	**Annual efficiency** **-**	**Specific electricity consumption of auxiliary devices** **kWh/(m² a)**
standard oil/gas	0.90	0.24 (1 0.11 (2
condensation oil (3	0.95	0.25
condensation gas (3	1.01	0.12
wood-pellet boiler	0.84	0.13
wood boiler with energy storage	0.82	0.25
district heating	0.97	0.07
room-specific electric heating	1.00	0.00

(1 oil

(2 gas

(3 efficiency in accordance with lower calorific value

Heat pumps

If the building is equipped with a heat pump used for heating, its heat production and electricity consumption are calculated as specified in Section D5 of the National Building Code (2012), or by other similar method.

With regard to the heat pump systems, the heating system's energy use for additional heating (usually electric) is usually taken into account, unless the heat pump system is dimensioned for the maximum energy need. The energy use for additional heating is always calculated if the heat pump is of the air-to-water or air-to-air type. The calculation also takes into account that the output and coefficient of performance of the air-source heat pumps are highly dependent on the outdoor temperature.

The SPF-values for heat pumps can be determined in connection with project planning from the plans and product information. If they cannot be determined, the values provided in Tables 12 to 14 are used.

Table 12: SPF-values for air-source heat pumps.

Maximum supply water temperature, °C	**SPF-value**
Air-to-air	2.8
Air-to-water (*space heating*)	
30 °C	2.8
40 °C	2.5
50 °C	2.3
60 °C	2.2
Air-to-water (*domestic hot water heating*)	
60 °C	1.8

Table 13: SPF-values for ground-source heat pumps.

Ground-source heat pump	**SPF-value**	
	Annual mean temperature of ground loop return fluid, –3 °C	**Annual mean temperature of ground loop return fluid, +3 °C**
Space heating		
30 °C	3.4	3.5
40 °C	3.0	3.1
50 °C	2.7	2.7
60 °C	2.5	2.5
Domestic hot water heating		
60 °C	2.3	2.3

Table 14: SPF-values for exhaust air heat pumps in combined space and domestic hot water heating with exhaust air temperature of 21 °C.

Minimum temperature of waste air	**SPF-value**
–3 °C	2.4
+1 °C	2.1
+3 °C	2.0
+5 °C	1.9

Electricity

The electrical energy use in the building consists of the electrical energy use for ventilation, the electrical energy use for auxiliary devices of heating and cooling systems, and the electrical energy use for appliances and lighting. The electrical energy used for space heating or supply air heating is calculated as part of the heating system.

The electrical energy use for lighting and appliances is calculated in accordance with points 3.3 and 4.7 in Section D3 of the National Building Code. If a demand-controlled lighting system is taken into account when calculating the delivered energy use, or if the calculation is performed with illumination levels lower than those specified for standardised use, the calculation provisions laid down in Chapter 3 in Section D3 of the National Building Code must be observed.

Cooling

The energy use for the cooling system is included in the delivered energy use in the building only if the building is equipped with a cooling system. The energy use for the cooling system can be omitted from the calculation for buildings with only individual cooled spaces.

The energy use for the cooling system consists of the energy use for producing the cooling energy and the electricity consumption of auxiliary devices. The energy need for the building's cooling system, i.e. the energy need for cooling spaces and ventilation, is calculated for standardised use of the building as specified in Section D3 of the National Building Code by using a dynamic software that complies with the requirements. The energy use for the cooling system is calculated from the energy need for cooling, taking into account the losses from production, storing, distribution and emission, as well as conversions, as specified in, for example, Section D5 of the National Building Code (2012).

With regard to existing cooled buildings, the energy use for cooling can also be calculated by using the alternative method specified in Section 3 of this Annex.

Calculation methods for special cases

Slow heat release stove

A slow heat release stove generates part of the energy need for space heating. For the purpose of calculations, the maximum heat production, i.e. thermal energy released into a space, of a slow heat release stove is 2,000 kWh per stove. When calculating the delivered energy use, the overall annual efficiency of a slow heat release stove is 0.60 regarding the heat emitted, if more accurate data is not available.

If combustion efficiency is determined for the slow heat release stove for the purpose of CE marking, the overall annual efficiency of the stove can be calculated with equation

$$\eta_{tulisija} = 0{,}8\,\eta_{palaminen}$$

where

η_{stove}	overall annual efficiency of the slow heat release stove, -
0.8	heat emission efficiency of the slow heat release stove ("Other heating installations", Table 9 in Section 2.2.7 of this Annex)

$\eta_{combustion}$ combustion efficiency of the slow heat release stove in accordance with CE-marking, -.

If a slow heat release stove or other stove is connected to a water-based heating system or air heating system with a heat exchanger and it this way forms the main heating system, it is considered as a boiler in the calculation.

Air-to-air heat pump in detached houses and terraced and other attached houses

For detached houses and terraced and other attached houses, the maximum annual heat production values for an air-to-air heat pump that produces its heating energy directly into a space are presented in Table 15. The maximum values shown in the table are room-specific.

Table 15: Maximum amount of energy produced by an air-to-air heat pump for detached houses and terraced and other attached houses.

Building permit pending in year	**–1985**	**1985–**	**10/2003–**	**2008–**	**2010–**	**2012–**
Energy produced by air-to-air heat pump	6,000 kWh/a, but not more than 40 kWh/(m²a)	5,000 kWh/a, but not more than 35 kWh/(m²a)	2,000 kWh/a	1,500 kWh/a	1,000 kWh/a	1,000 kWh/a

Wet room electric underfloor heating in other than electric-heated residential buildings

If the residential rooms have water-based heating and the wet rooms are equipped with electric underfloor heating, the shares of energy need for these heating systems must be evaluated. Unless otherwise demonstrated by calculations, 50% of the energy need for space heating is accounted for by the wet room electric underfloor heating and 50% by the heating system in the residential rooms.

Alternative calculation method for the delivered energy for cooling

Unlike as specified in Section D3 of the National Building Code, the monthly-level calculation method for non-cooled buildings can also be used for existing cooled buildings, if the delivered energy for cooling is calculated as specified here.

The energy need for cooling $Q_{cooling,\ net}$ can alternatively be calculated for monthly levels with equation

$$Q_{jäähdytys,netto} = (1 - \eta_{lämpö}) Q_{lämpökuorma} - \frac{(T_{s,\ lask,\ keskim.} - T_s)^{1,1}}{(T_s - T_u)} (Q_{tila} + Q_{iv})$$

where

$Q_{cooling,\ net}$ energy need for space cooling and ventilation cooling, kWh

η_{heat} degree of heat loads recovered by month, (Chapter 5 in Section D5 of the National Building Code (2012)), -

$Q_{heat\ load}$ heat load, (Chapter 5 in Section D5 of the National Building Code (2012)), kWh

$T_{i,\ calc,\ average}$ calculated monthly average indoor temperature (cooling setting), °C

T_i indoor temperature (heating setting, usually 21 °C), °C

T_o	outdoor temperature (monthly average, Annex 2 of Section D3 of the National Building Code), ºC
Q_{space}	energy need for space heating (Chapter 3 in Section D5 of the National Building Code (2012)), kWh
Q_{vent}	energy need for ventilation heating (Chapter 3 in Section D5 of the National Building Code (2012)), kWh
1.1	factor in exponent that takes account of the improvement in heat transfer as the temperature rises. If the calculated value for the base parenthetical expression is negative, factor 1 is used as the exponent.

When calculating the need for cooling, the cooling setting for normal spaces is 23 °C.

The energy use for space and ventilation cooling $Q_{cooling}$ is calculated with the energy need for cooling and cooling system efficiency for monthly levels with equation

$$Q_{jäähdytys,} = Q_{jäähdytys,netto} / \eta_{jäähdytys}$$

where

$Q_{cooling}$	energy use for space and ventilation cooling (cooling energy brought in the cooling system), kWh
$Q_{cooling,\ net}$	energy need for space cooling and ventilation cooling, kWh
$\eta_{cooling}$	space and ventilation cooling system efficiency, -.

The efficiency takes account, for example, of the losses from the cooling system piping and storages. The loss from the cooling system is the difference between the cooling energy brought into the cooling system and the energy need for cooling. The cooling system efficiency is 0.7, if more accurate data is not available.

The delivered electrical energy for cooling $W_{cooling}$ is calculated in a compressor cooling system with equation

$$W_{jäähdytys,osto} = Q_{jäähdytys} / \varepsilon_E$$

where

$W_{cooling}$	delivered electrical energy for cooling of the building, if the energy for cooling is produced with a compressor unit
$Q_{cooling}$	energy use for space and ventilation cooling, kWh
ε_E	annual energy efficiency ratio of the cooling energy production process, -.

With regard to the compressor unit, the annual energy efficiency ratio of the cooling unit is 3.

In a district cooling system, the delivered energy for cooling $Q_{cooling}$ is calculated with equation

$$Q_{jäähdytys,osto} = Q_{jäähdytys} / \varepsilon_Q$$

where

$Q_{cooling, delivered}$	delivered energy for cooling of the building, kWh
$Q_{cooling}$	energy use for space cooling, kWh
ε_Q	annual energy efficiency ratio of the cooling energy production process, -

With regard to the district cooling system, the annual energy efficiency ratio of the cooling unit is 1.

Summary

The Decree provides a number of alternative options for demonstrating compliance, and the most appropriate option can be selected on the basis of the extent of the project and the building elements and systems undergoing renovation. Depending on the project, the specified performance level varies between the different options for demonstrating compliance. Merely for this reason, each project should be assessed with different calculative methods so that its technical aspects and cost optimality can become one of the criteria for making decisions regarding the content and extent of the project.