

PRODUCT CERTIFICATE

Certificate No VTT-C-4026-09
Translation 1 (2)

Enervent Oy

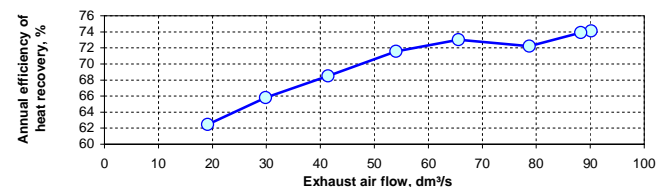
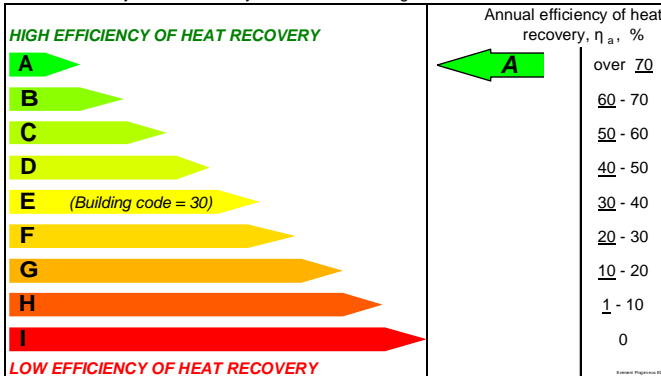
manufactures

ventilation units Enervent Pingvin eco ED

Enervent Pingvin eco ED is intended to be used as a ventilation unit of a dwelling. Efficiency of heat recovery and specific electrical power and thermal, aerodynamic and acoustic characteristics have been defined according to the certification criteria *VTT SERT R018-04: Ventilation unit of a dwelling*. A summary of the calculated energy efficiency of the ventilation unit in the weather conditions of South Finland is presented in the following:

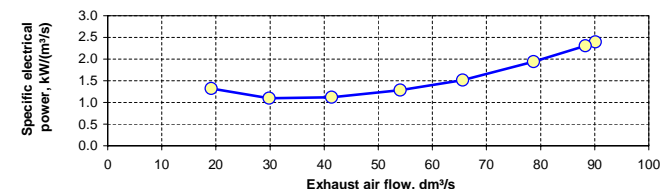
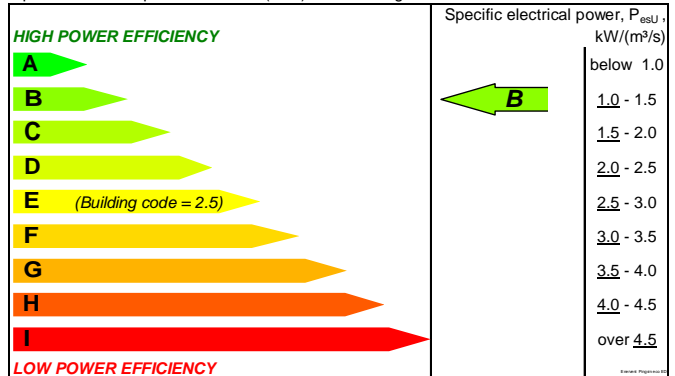
ANNUAL EFFICIENCY OF HEAT RECOVERY, η_a

Annual efficiency of heat recovery is 71 % when average exhaust air flow is 50 dm³/s



SPECIFIC ELECTRICAL POWER, P_{esU}

Specific electrical power is 1.3 kW/(m³/s) when average exhaust air flow is 50 dm³/s



The properties of the ventilation unit, and the source information and the results of the energy efficiency calculation, are presented in an appendix to the certificate. The ventilation unit meets the requirements presented in the above-mentioned certification criteria.

This certificate is valid until 23 April 2014 on condition that no significant changes take place in the product and that the manufacturer has a valid quality assurance agreement with VTT. The validity of the certificate can be checked with VTT or on the Internet at <http://www.vtt.fi/>. Other conditions are presented at the end of the certificate.

Granted in Espoo 24 April 2009.



Liisa Rautiainen
Assessment Manager



Juhani Laine
Senior Research Scientist



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Conditions of the validity of the certificate:

Where reference is made in this certificate to any regulations, publications, standards or other documents, it shall be construed as a reference to such publication in the form of which it is in force at the date of this certificate.

The manufacturer is responsible for the quality and continuous quality control of the product. In granting this certificate, VTT does not accept responsibility to any person or body for any loss or damage incurred in respect of personal injury arising as direct or indirect result of the use of this product.

The use of VTT's name in advertising or the distribution of a partly copied certificate is allowed only with permission from VTT in writing.

PRODUCT CERTIFICATE

An appendix to VTT's product certificate No VTT-C-4026-09
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Information on the product: Enervent Pingvin eco ED ventilation unit of a dwelling
 Manufacturer and representative of the device: Enervent Oy, Kipinätie 1, FI-06150 Porvoo, Finland.
 tel. +358 207 528 800, www.enervent.fi
 Outer dimensions: 580 mm (width) x 520 mm (height) x 480 mm (depth)
 Weight: 49 kg
 Air duct connections: four connections from the top of the unit, diameter of the duct 160 mm
 Electrical connection: 230 V, 10 A, cable coupler
 Fans: EC direct current fans, 2 x 119 W, Ebm Papst G3G146-ED23-06
 Control of air flows: stepless transformer (20 – 100 %)
 Air filters: supply air EU7 (F7) and EU4/5 (G4), exhaust air EU4/5 (G4)
 Heat recovery (HR): non-hygroscopic rotating heat exchanger, nominal power of the rotating motor is 9 W, measured power is 5 W
 Method of preventing freezing of the HR: stopping of the supply air fan according to the temperature of the exhaust air after heat recovery
 Heating radiators: after-heating of supply air: no after heating

The certified ventilation unit of a dwelling meets the requirements presented below.

Property	Determination method	Requirement	Result
Leakage	EN 308, EN 13141-7	Building code, part D2	Meets the requirement
Air filter by-pass leakage	EN 13141-7	EN 13141-7	Meets the requirement
Aerodynamic performance (pressure / air flow)	EN 308, EN 13141-7	-	The measured values correspond to the values declared by the manufacturer
Acoustic performance	ISO 3741, ISO 5135, EN 13141-7	-	The measured values correspond to the values declared by the manufacturer
Temperature ratio	EN 308, EN 13141-7	Building code, part D2	Meets the requirement
Operation at low outdoor air temperatures	EN 308	Building code, part D2	Meets the requirement
Specific electrical power	EN 308, EN 13141-7	Building code, part D2	Meets the requirement
Annual efficiency of the heat recovery of exhaust air	Handout 122/2003 from the Ministry of the Environment	Building code, part D2	Meets the requirement

The requirements according to the provisions and guidelines of building code, part D2:

The requirement for leakage (building code, part D2, guideline 3.7.1.3): Leakage class A of the casing, leakage air flow rate between the supply air and exhaust air sides not over 6 per cent of the nominal air flow rate of the air supply unit at test pressure of 300 Pa.

The requirement for temperature ratio (building code, part D2, guideline 4.1.2.1): at least 50 %.

The requirement for operation with low outdoor air temperatures (building code, part D2, guideline 4.1.2.1): The freezing protection and the removal of water condensing from exhaust air have been implemented reliably.

The requirement for specific electrical power (building code, part D2, guideline 4.1.1.4): at most 2.5 W/(dm³/s)

The requirement for the annual efficiency of the heat recovery (building code, part D2, provision 4.1.2): at least 30 %.

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Ventilation unit Enervent Pingvin eco ED

Southern Finland

Source data for calculation of energy efficiency of the ventilation unit

Climate	Helsinki test year 1979
Dimensioning temperature of outdoor air	-26 °C
Average temperature of outdoor air (heating period)	-0.2 °C
Exhaust air temperature	21 °C
Set point of supply air heater	15 °C
Maximum supply air temperature (limitation)	no limitation
Minimum temperature of exhaust air (freeze protection of HR ¹⁾)	-8 °C
Maximum outdoor air temperature for heating	12 °C
Average exhaust air flow rate	50 dm ³ /s

¹⁾ HR = heat recovery

Measured source data of the ventilation unit in calculation

Time of use	Set point	Total pressure of the unit (supply)	Supply air flow rate	Total pressure of the unit (exhaust)	Exhaust air flow rate	Air flow ratio (supply/exhaust)	Electrical power	Temperature ratio of supply air in HR
		Pa	dm ³ /s	Pa	dm ³ /s	%	W	%
0.0 h/day	100 %	131	84	244	90	94	217	80
0.0 h/day	90 %	124	82	234	88	93	205	80
2.0 h/day	80 %	90	70	186	79	89	155	81
0.0 h/day	70 %	64	59	129	66	90	101	82
15.9 h/day	60 %	41	47	88	54	88	71	82
0.0 h/day	50 %	23	35	51	41	85	48	81
6.1 h/day	40 %	11	24	27	30	82	34	81
0.0 h/day	30 %	4	14	11	19	75	27	83

Calculation method

A calculation method based on outdoor temperature duration curve according to the guidelines of the Ministry of the Environment (no 106 and no 122). VTT's calculation model LTOCALC was used.

Results of the calculation of the energy efficiency of ventilation unit

Calculated energy demand of ventilation, kWh per year

Heating energy demand of ventilation without heat recovery	8 117 kWh/a	100 %
Heating energy demand of ventilation with heat recovery	2 372 kWh/a	29 %
Thermal energy recovered from exhaust air	5 745 kWh/a	71 %

Energy consumption of the heating radiator of supply air 1)	0 kWh/a
Additional heating energy consumption of the ventilation unit	0 kWh/a
Electricity consumption of the ventilation unit (excluding heating) 2)	589 kWh/a

1) No heating radiator of supply air. According to the calculation HR is not able to keep supply air temperature at the set point. Calculated minimum temperature of supply air is 13.2 °C.

2) Electricity consumption of the motor of the rotating heat exchanger (HR-rotor) is included in electricity consumption of the ventilation unit.

Annual efficiency of the heat recovery of exhaust air, η_a	71 %
Specific electrical power of the ventilation unit 3)	1.3 kW/(m³/s)
Coefficient of performance 1 kWh of electricity produces	9.8 kWh heating energy

3) Electricity power of the motor of the rotating heat exchanger (HR-rotor) is included in specific electrical power of the ventilation unit.

The actual energy consumption and the annual efficiency of the heat recovery depend on use and the climate.

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Ventilation unit Enervent Pingvin eco ED

Southern Central Finland

Source data for calculation of energy efficiency of the ventilation unit

Climate	Jokioinen test year 1979
Dimensioning temperature of outdoor air	-29 °C
Average temperature of outdoor air (heating period)	-0.3 °C
Exhaust air temperature	21 °C
Set point of supply air heater	15 °C
Maximum supply air temperature (limitation)	no limitation
Minimum temperature of exhaust air (freeze protection of HR ¹⁾)	-8 °C
Maximum outdoor air temperature for heating	12 °C
Average exhaust air flow rate	50 dm ³ /s

¹⁾ HR = heat recovery

Measured source data of the ventilation unit in calculation

Time of use	Set point	Total pressure of the unit (supply)	Supply air flow rate	Total pressure of the unit (exhaust)	Exhaust air flow rate	Air flow ratio (supply/exhaust)	Electrical power	Temperature ratio of supply air in HR
		Pa	dm ³ /s	Pa	dm ³ /s	%	W	%
0.0 h/day	100 %	131	84	244	90	94	217	80
0.0 h/day	90 %	124	82	234	88	93	205	80
2.0 h/day	80 %	90	70	186	79	89	155	81
0.0 h/day	70 %	64	59	129	66	90	101	82
15.9 h/day	60 %	41	47	88	54	88	71	82
0.0 h/day	50 %	23	35	51	41	85	48	81
6.1 h/day	40 %	11	24	27	30	82	34	81
0.0 h/day	30 %	4	14	11	19	75	27	83

Calculation method

A calculation method based on outdoor temperature duration curve according to the guidelines of the Ministry of the Environment (no 106 and no 122). VTT's calculation model LTOCALC was used.

Results of the calculation of the energy efficiency of ventilation unit

Calculated energy demand of ventilation, kWh per year

Heating energy demand of ventilation without heat recovery	8 503 kWh/a	100 %
Heating energy demand of ventilation with heat recovery	2 502 kWh/a	29 %
Thermal energy recovered from exhaust air	6 000 kWh/a	71 %

Energy consumption of the heating radiator of supply air 1)	0 kWh/a
Additional heating energy consumption of the ventilation unit	0 kWh/a
Electricity consumption of the ventilation unit (excluding heating) 2)	590 kWh/a

1) No heating radiator of supply air. According to the calculation HR is not able to keep supply air temperature at the set point. Calculated minimum temperature of supply air is 13.2 °C.

2) Electricity consumption of the motor of the rotating heat exchanger (HR-rotor) is included in electricity consumption of the ventilation unit.

Annual efficiency of the heat recovery of exhaust air, η_a	71 %
Specific electrical power of the ventilation unit 3)	1.3 kW/(m³/s)
Coefficient of performance 1 kWh of electricity produces	10.2 kWh heating energy

3) Electricity power of the motor of the rotating heat exchanger (HR-rotor) is included in specific electrical power of the ventilation unit.

The actual energy consumption and the annual efficiency of the heat recovery depend on use and the climate.

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Ventilation unit Enervent Pingvin eco ED

Central Finland

Source data for calculation of energy efficiency of the ventilation unit

Climate	Jyväskylä test year 1979
Dimensioning temperature of outdoor air	-32 °C
Average temperature of outdoor air (heating period)	-1.2 °C
Exhaust air temperature	21 °C
Set point of supply air heater	15 °C
Maximum supply air temperature (limitation)	no limitation
Minimum temperature of exhaust air (freeze protection of HR ¹⁾)	-8 °C
Maximum outdoor air temperature for heating	12 °C
Average exhaust air flow rate	50 dm ³ /s

¹⁾ HR = heat recovery

Measured source data of the ventilation unit in calculation

Time of use	Set point	Total pressure of the unit (supply)	Supply air flow rate	Total pressure of the unit (exhaust)	Exhaust air flow rate	Air flow ratio (supply/exhaust)	Electrical power	Temperature ratio of supply air in HR
		Pa	dm ³ /s	Pa	dm ³ /s	%	W	%
0.0 h/day	100 %	131	84	244	90	94	217	80
0.0 h/day	90 %	124	82	234	88	93	205	80
2.0 h/day	80 %	90	70	186	79	89	155	81
0.0 h/day	70 %	64	59	129	66	90	101	82
15.9 h/day	60 %	41	47	88	54	88	71	82
0.0 h/day	50 %	23	35	51	41	85	48	81
6.1 h/day	40 %	11	24	27	30	82	34	81
0.0 h/day	30 %	4	14	11	19	75	27	83

Calculation method

A calculation method based on outdoor temperature duration curve according to the guidelines of the Ministry of the Environment (no 106 and no 122). VTT's calculation model LTOCALC was used.

Results of the calculation of the energy efficiency of ventilation unit

Calculated energy demand of ventilation, kWh per year

Heating energy demand of ventilation without heat recovery	9 056 kWh/a	100 %
Heating energy demand of ventilation with heat recovery	2 686 kWh/a	30 %
Thermal energy recovered from exhaust air	6 370 kWh/a	70 %

Energy consumption of the heating radiator of supply air 1)	0 kWh/a
Additional heating energy consumption of the ventilation unit	0 kWh/a
Electricity consumption of the ventilation unit (excluding heating) 2)	590 kWh/a

1) No heating radiator of supply air. According to the calculation HR is not able to keep supply air temperature at the set point. Calculated minimum temperature of supply air is 13.2 °C.

2) Electricity consumption of the motor of the rotating heat exchanger (HR-rotor) is included in electricity consumption of the ventilation unit.

Annual efficiency of the heat recovery of exhaust air, η_a	70 %
Specific electrical power of the ventilation unit 3)	1.3 kW/(m³/s)
Coefficient of performance 1 kWh of electricity produces	10.8 kWh heating energy

3) Electricity power of the motor of the rotating heat exchanger (HR-rotor) is included in specific electrical power of the ventilation unit.

The actual energy consumption and the annual efficiency of the heat recovery depend on use and the climate.

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Ventilation unit Enervent Pingvin eco ED

Northern Finland

Source data for calculation of energy efficiency of the ventilation unit

Climate	Sodankylä test year 1979
Dimensioning temperature of outdoor air	-38 °C
Average temperature of outdoor air (heating period)	-3.5 °C
Exhaust air temperature	21 °C
Set point of supply air heater	15 °C
Maximum supply air temperature (limitation)	no limitation
Minimum temperature of exhaust air (freeze protection of HR ¹⁾)	-8 °C
Maximum outdoor air temperature for heating	12 °C
Average exhaust air flow rate	50 dm ³ /s

¹⁾ HR = heat recovery

Measured source data of the ventilation unit in calculation

Time of use	Set point	Total pressure of the unit (supply)	Supply air flow rate	Total pressure of the unit (exhaust)	Exhaust air flow rate	Air flow ratio (supply/exhaust)	Electrical power	Temperature ratio of supply air in HR
		Pa	dm ³ /s	Pa	dm ³ /s	%	W	%
0.0 h/day	100 %	131	84	244	90	94	217	80
0.0 h/day	90 %	124	82	234	88	93	205	80
2.0 h/day	80 %	90	70	186	79	89	155	81
0.0 h/day	70 %	64	59	129	66	90	101	82
15.9 h/day	60 %	41	47	88	54	88	71	82
0.0 h/day	50 %	23	35	51	41	85	48	81
6.1 h/day	40 %	11	24	27	30	82	34	81
0.0 h/day	30 %	4	14	11	19	75	27	83

Calculation method

A calculation method based on outdoor temperature duration curve according to the guidelines of the Ministry of the Environment (no 106 and no 122). VTT's calculation model LTOCALC was used.

Results of the calculation of the energy efficiency of ventilation unit

Calculated energy demand of ventilation, kWh per year

Heating energy demand of ventilation without heat recovery	11 064 kWh/a	100 %
Heating energy demand of ventilation with heat recovery	3 424 kWh/a	31 %
Thermal energy recovered from exhaust air	7 640 kWh/a	69 %

Energy consumption of the heating radiator of supply air 1)	0 kWh/a
Additional heating energy consumption of the ventilation unit	0 kWh/a
Electricity consumption of the ventilation unit (excluding heating) 2)	589 kWh/a

1) No heating radiator of supply air. According to the calculation HR is not able to keep supply air temperature at the set point. Calculated minimum temperature of supply air is 13.2 °C.

2) Electricity consumption of the motor of the rotating heat exchanger (HR-rotor) is included in electricity consumption of the ventilation unit.

Annual efficiency of the heat recovery of exhaust air, η_a	69 %
Specific electrical power of the ventilation unit 3)	1.3 kW/(m³/s)
Coefficient of performance 1 kWh of electricity produces	13.0 kWh heating energy

3) Electricity power of the motor of the rotating heat exchanger (HR-rotor) is included in specific electrical power of the ventilation unit.

The actual energy consumption and the annual efficiency of the heat recovery depend on use and the climate.

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Ventilation unit Enervent Pingvin eco ED

Southern Germany

Source data for calculation of energy efficiency of the ventilation unit

Climate	Munich [IWEC- WMO#108660 ASHRAE 2001]
Dimensioning temperature of outdoor air	-16 °C
Average temperature of outdoor air (heating period)	2.1 °C
Exhaust air temperature	21 °C
Set point of supply air heater	15 °C
Maximum supply air temperature (limitation)	no limitation
Minimum temperature of exhaust air (freeze protection of HR ¹⁾)	-8 °C
Maximum outdoor air temperature for heating	12 °C
Average exhaust air flow rate	50 dm ³ /s

¹⁾ HR = heat recovery

Measured source data of the ventilation unit in calculation

Time of use	Set point	Total pressure of the unit (supply)	Supply air flow rate	Total pressure of the unit (exhaust)	Exhaust air flow rate	Air flow ratio (supply/exhaust)	Electrical power	Temperature ratio of supply air in HR
		Pa	dm ³ /s	Pa	dm ³ /s	%	W	%
0.0 h/day	100 %	131	84	244	90	94	217	80
0.0 h/day	90 %	124	82	234	88	93	205	80
2.0 h/day	80 %	90	70	186	79	89	155	81
0.0 h/day	70 %	64	59	129	66	90	101	82
15.9 h/day	60 %	41	47	88	54	88	71	82
0.0 h/day	50 %	23	35	51	41	85	48	81
6.1 h/day	40 %	11	24	27	30	82	34	81
0.0 h/day	30 %	4	14	11	19	75	27	83

Calculation method

A calculation method based on outdoor temperature duration curve according to the guidelines of the Ministry of the Environment (no 106 and no 122). VTT's calculation model LTOCALC was used.

Results of the calculation of the energy efficiency of ventilation unit

Calculated energy demand of ventilation, kWh per year

Heating energy demand of ventilation without heat recovery	6 174 kWh/a	100 %
Heating energy demand of ventilation with heat recovery	1 791 kWh/a	29 %
Thermal energy recovered from exhaust air	4 383 kWh/a	71 %

Energy consumption of the heating radiator of supply air 1)	0 kWh/a
Additional heating energy consumption of the ventilation unit	0 kWh/a
Electricity consumption of the ventilation unit (excluding heating) 2)	587 kWh/a

1) No heating radiator of supply air. According to the calculation HR is not able to keep supply air temperature at the set point. Calculated minimum temperature of supply air is 14.1 °C.

2) Electricity consumption of the motor of the rotating heat exchanger (HR-rotor) is included in electricity consumption of the ventilation unit.

Annual efficiency of the heat recovery of exhaust air, η_a	71 %
Specific electrical power of the ventilation unit 3)	1.3 kW/(m³/s)
Coefficient of performance 1 kWh of electricity produces	7.5 kWh heating energy

3) Electricity power of the motor of the rotating heat exchanger (HR-rotor) is included in specific electrical power of the ventilation unit.

The actual energy consumption and the annual efficiency of the heat recovery depend on use and the climate.

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Ventilation unit Enervent Pingvin eco ED

Southern Finland

Source data for calculation of energy efficiency of the ventilation unit (Extra case)

Climate	Helsinki test year 1979
Dimensioning temperature of outdoor air	-26 °C
Average temperature of outdoor air (heating period)	-0.2 °C
Exhaust air temperature	21 °C
Set point of supply air heater	15 °C
Maximum supply air temperature (limitation)	no limitation
Minimum temperature of exhaust air (freeze protection of HR ¹⁾)	-8 °C
Maximum outdoor air temperature for heating	12 °C
Average exhaust air flow rate	68 dm³/s

¹⁾ HR = heat recovery

Measured source data of the ventilation unit in calculation

Time of use	Set point	Total pressure of the unit (supply)	Supply air flow rate	Total pressure of the unit (exhaust)	Exhaust air flow rate	Air flow ratio (supply/exhaust)	Electrical power	Temperature ratio of supply air in HR
		Pa	dm ³ /s	Pa	dm ³ /s	%	W	%
2.5 h/day	100 %	131	84	244	90	94	217	80
0.0 h/day	90 %	124	82	234	88	93	205	80
0.0 h/day	80 %	90	70	186	79	89	155	81
21.5 h/day	70 %	64	59	129	66	90	101	82
0.0 h/day	60 %	41	47	88	54	88	71	82
0.0 h/day	50 %	23	35	51	41	85	48	81
0.0 h/day	40 %	11	24	27	30	82	34	81
0.0 h/day	30 %	4	14	11	19	75	27	83

Calculation method

A calculation method based on outdoor temperature duration curve according to the guidelines of the Ministry of the Environment (no 106 and no 122). VTT's calculation model LTOCALC was used.

Results of the calculation of the energy efficiency of ventilation unit

Calculated energy demand of ventilation, kWh per year

Heating energy demand of ventilation without heat recovery	11 063 kWh/a	100 %
Heating energy demand of ventilation with heat recovery	2 967 kWh/a	27 %
Thermal energy recovered from exhaust air	8 097 kWh/a	73 %

Energy consumption of the heating radiator of supply air 1)	0 kWh/a
Additional heating energy consumption of the ventilation unit	0 kWh/a
Electricity consumption of the ventilation unit (excluding heating) 2)	978 kWh/a

1) No heating radiator of supply air. According to the calculation HR is not able to keep supply air temperature at the set point. Calculated minimum temperature of supply air is 13.2 °C.

2) Electricity consumption of the motor of the rotating heat exchanger (HR-rotor) is included in electricity consumption of the ventilation unit.

Annual efficiency of the heat recovery of exhaust air, η_a	73 %
Specific electrical power of the ventilation unit 3)	1.6 kW/(m³/s)
Coefficient of performance 1 kWh of electricity produces	8.3 kWh heating energy

3) Electricity power of the motor of the rotating heat exchanger (HR-rotor) is included in specific electrical power of the ventilation unit.

The actual energy consumption and the annual efficiency of the heat recovery depend on use and the climate.

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Ventilation unit Enervent Pingvin eco ED

Central Finland

Source data for calculation of energy efficiency of the ventilation unit (Extra case)

Climate	Jyväskylä test year 1979
Dimensioning temperature of outdoor air	-32 °C
Average temperature of outdoor air (heating period)	-1.2 °C
Exhaust air temperature	21 °C
Set point of supply air heater	15 °C
Maximum supply air temperature (limitation)	no limitation
Minimum temperature of exhaust air (freeze protection of HR ¹⁾)	-8 °C
Maximum outdoor air temperature for heating	12 °C
Average exhaust air flow rate	68 dm³/s

¹⁾ HR = heat recovery

Measured source data of the ventilation unit in calculation

Time of use	Set point	Total pressure of the unit (supply)	Supply air flow rate	Total pressure of the unit (exhaust)	Exhaust air flow rate	Air flow ratio (supply/exhaust)	Electrical power	Temperature ratio of supply air in HR
		Pa	dm ³ /s	Pa	dm ³ /s	%	W	%
2.5 h/day	100 %	131	84	244	90	94	217	80
0.0 h/day	90 %	124	82	234	88	93	205	80
0.0 h/day	80 %	90	70	186	79	89	155	81
21.5 h/day	70 %	64	59	129	66	90	101	82
0.0 h/day	60 %	41	47	88	54	88	71	82
0.0 h/day	50 %	23	35	51	41	85	48	81
0.0 h/day	40 %	11	24	27	30	82	34	81
0.0 h/day	30 %	4	14	11	19	75	27	83

Calculation method

A calculation method based on outdoor temperature duration curve according to the guidelines of the Ministry of the Environment (no 106 and no 122). VTT's calculation model LTOCALC was used.

Results of the calculation of the energy efficiency of ventilation unit

Calculated energy demand of ventilation, kWh per year

Heating energy demand of ventilation without heat recovery	12 343 kWh/a	100 %
Heating energy demand of ventilation with heat recovery	3 380 kWh/a	27 %
Thermal energy recovered from exhaust air	8 963 kWh/a	73 %

Energy consumption of the heating radiator of supply air 1)	0 kWh/a
Additional heating energy consumption of the ventilation unit	0 kWh/a
Electricity consumption of the ventilation unit (excluding heating) 2)	977 kWh/a

1) No heating radiator of supply air. According to the calculation HR is not able to keep supply air temperature at the set point. Calculated minimum temperature of supply air is 13.2 °C.

2) Electricity consumption of the motor of the rotating heat exchanger (HR-rotor) is included in electricity consumption of the ventilation unit.

Annual efficiency of the heat recovery of exhaust air, η_a	73 %
Specific electrical power of the ventilation unit 3)	1.6 kW/(m³/s)
Coefficient of performance 1 kWh of electricity produces	9.2 kWh heating energy

3) Electricity power of the motor of the rotating heat exchanger (HR-rotor) is included in specific electrical power of the ventilation unit.

The actual energy consumption and the annual efficiency of the heat recovery depend on use and the climate.

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Ventilation unit Enervent Pingvin eco ED

Northern Finland

Source data for calculation of energy efficiency of the ventilation unit (Extra case)

Climate	Sodankylä test year 1979
Dimensioning temperature of outdoor air	-38 °C
Average temperature of outdoor air (heating period)	-3.5 °C
Exhaust air temperature	21 °C
Set point of supply air heater	15 °C
Maximum supply air temperature (limitation)	no limitation
Minimum temperature of exhaust air (freeze protection of HR ¹⁾)	-8 °C
Maximum outdoor air temperature for heating	12 °C
Average exhaust air flow rate	68 dm³/s

¹⁾ HR = heat recovery

Measured source data of the ventilation unit in calculation

Time of use	Set point	Total pressure of the unit (supply)	Supply air flow rate	Total pressure of the unit (exhaust)	Exhaust air flow rate	Air flow ratio (supply/exhaust)	Electrical power	Temperature ratio of supply air in HR
		Pa	dm ³ /s	Pa	dm ³ /s	%	W	%
2.5 h/day	100 %	131	84	244	90	94	217	80
0.0 h/day	90 %	124	82	234	88	93	205	80
0.0 h/day	80 %	90	70	186	79	89	155	81
21.5 h/day	70 %	64	59	129	66	90	101	82
0.0 h/day	60 %	41	47	88	54	88	71	82
0.0 h/day	50 %	23	35	51	41	85	48	81
0.0 h/day	40 %	11	24	27	30	82	34	81
0.0 h/day	30 %	4	14	11	19	75	27	83

Calculation method

A calculation method based on outdoor temperature duration curve according to the guidelines of the Ministry of the Environment (no 106 and no 122). VTT's calculation model LTOCALC was used.

Results of the calculation of the energy efficiency of ventilation unit

Calculated energy demand of ventilation, kWh per year

Heating energy demand of ventilation without heat recovery	15 080 kWh/a	100 %
Heating energy demand of ventilation with heat recovery	4 362 kWh/a	29 %
Thermal energy recovered from exhaust air	10 718 kWh/a	71 %

Energy consumption of the heating radiator of supply air 1)	0 kWh/a
Additional heating energy consumption of the ventilation unit	0 kWh/a
Electricity consumption of the ventilation unit (excluding heating) 2)	974 kWh/a

1) No heating radiator of supply air. According to the calculation HR is not able to keep supply air temperature at the set point. Calculated minimum temperature of supply air is 13.2 °C.

2) Electricity consumption of the motor of the rotating heat exchanger (HR-rotor) is included in electricity consumption of the ventilation unit.

Annual efficiency of the heat recovery of exhaust air, η_a	71 %
Specific electrical power of the ventilation unit 3)	1.6 kW/(m³/s)
Coefficient of performance 1 kWh of electricity produces	11.0 kWh heating energy

3) Electricity power of the motor of the rotating heat exchanger (HR-rotor) is included in specific electrical power of the ventilation unit.

The actual energy consumption and the annual efficiency of the heat recovery depend on use and the climate.