

# Certificate

## Certified Passive House Component

For cool, temperate climates, valid until 31 December 2019

Category: **Compact unit**  
Manufacturer: **Vaillant GmbH**  
**42859 Remscheid, GERMANY**  
Product name: **recoCOMPACT**

Passive House Institute  
Dr. Wolfgang Feist  
64283 Darmstadt  
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**This certificate was awarded based on the following criteria:**

Primary Energy Demand	$PE_{\text{total}} \leq 55 \text{ kWh}/(\text{m}^2\text{a})$
Thermal comfort	$\theta_{\text{supply air}} \geq 16.5 \text{ }^\circ\text{C}$ at $\theta_{\text{outdoor air}} = -10 \text{ }^\circ\text{C}$
Effective heat recovery rate	$\eta_{\text{HR,eff}} \geq 75 \%$
Electric power consumption	$P_{\text{el}} \leq 0.45 \text{ Wh}/\text{m}^3$
Airtightness	Interior and exterior air leakage rates less than 3 % of nominal air flow rate
Balancing and adjustability	Air flow balancing possible: <b>yes</b> Automated air flow balancing: <b>yes</b>
Sound insulation	Sound level $L_w \leq 35 \text{ dB(A)}$ not met Here $L_w = 53.0 \text{ dB(A)}$ Unit should be installed so that it is acoustically separated from living areas
Indoor air quality	Outdoor air filter at least F7 Extract air filter at least G4
Frost protection	Frost protection for the heat exchanger with continuous fresh air supply down to $\theta_{\text{outdoor air}} = -15 \text{ }^\circ\text{C}$

Further information can be found in the appendix of this certificate.

(\*\*) for heating, domestic hot water (DHW), ventilation, auxiliary electricity in the reference building, explanation see attachment.

**Certified for air flow rates of**

**110 - 280 m<sup>3</sup>/h**

$\eta_{\text{HR,eff}}$

**83-87 %**

**Electric power consumption**

**0.33- 0.34 Wh/m<sup>3</sup>**

**Total Primary Energy Demand (\*\*)**

**36.1- 48.7 kWh/(m<sup>2</sup>a)**

cool, temperate climate



**CERTIFIED COMPONENT**

Passive House Institute

# Appendix to the certificate Vaillant GmbH, recoCOMPACT

**Manufacturer:** Vaillant GmbH  
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 Tel: +49 (0) 2191 18 0  
 E-Mail: info@vaillant.de, www.vaillant.de

## Measured values to be used in PHPP- recoCOMPACT 7kW VWL 79/5 230V (ID: 1324ch03) useful air flow rates 110 to 280 m<sup>3</sup>/h

### Heating

		Test point 1	Test point 3	Test point 3	Test point 4	
Outside Air Temperature	T <sub>amb</sub>	-7	2	7		°C
Thermal Output Heating Heat Pump	P <sub>WP,Heiz</sub>	6.38	8.00	8.43		kW
COP number Heating Heat Pump	COP <sub>Heiz</sub>	2.44	2.82	2.97		-
Maximum available supply air temperature with Heat Pump only(*)		No supply air heating				°C

### Hot water

		Test point 1	Test point 3	Test point 3	Test point 4	
Outside Air Temperature	T <sub>amb</sub>	-7	2	7	20	°C
Thermal Output Heat Pump for heating up storage tank.	P <sub>DHW heating up</sub>	3.13	3.19	3.83	6.30	kW
Thermal Output Heat Pump for reheating storage tank	P <sub>DHW reheating</sub>	2.75	2.71	3.26	4.64	kW
COP Heat Pump for heating up storage tank	COP <sub>DHW heating up</sub>	2.16	2.89	2.64	3.81	-
COP Heat Pump for reheating storage tank	COP <sub>DHW reheating</sub>	1.68	2.19	2.33	2.61	-
Average storage tank temperature		34.8				°C
Specific storage heat losses		1.84				W/K
Exhaust air addition (if applicable)		360				m <sup>3</sup> /h

## Measured values to be used in PHPP- recoCOMPACT 5kW VWL 59/5 230V (ID: 1325ch03) useful air flow rates 65 to 200 m<sup>3</sup>/h

### Heating

		Test point 1	Test point 3	Test point 3	Test point 4	
Outside Air Temperature	T <sub>amb</sub>	-7	2	7		°C
Thermal Output Heating Heat Pump	P <sub>WP,Heiz</sub>	4.64	6.26	6.54		kW
COP number Heating Heat Pump	COP <sub>Heiz</sub>	2.19	2.69	3.05		-
Maximum available supply air temperature with Heat Pump only(*)		No supply air heating				°C

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## Hot water

		Test point 1	Test point 3	Test point 3	Test point 4	
Outside Air Temperature	$T_{amb}$	-7	2	7	20	°C
Thermal Output Heat Pump for heating up storage tank.	$P_{DHW, heating\ up}$	0.96	1.95	2.47	4.38	kW
Thermal Output Heat Pump for reheating storage tank	$P_{DHW, reheating}$	0.60	1.66	2.10	3.33	kW
COP Heat Pump for heating up storage tank	$COP_{DHW, heating\ up}$	0.80	2.47	2.97	3.38	-
COP Heat Pump for reheating storage tank	$COP_{DHW, reheating}$	0.46	2.22	2.51	2.42	-
Average storage tank temperature		34.8				°C
Specific storage heat losses		1.84				W/K
Exhaust air addition (if applicable)		260				m <sup>3</sup> /h

## Measured values to be used in PHPP- recoCOMPACT 3kW VWL 39/5 230V (ID: 1326ch03) useful air flow rates 65 to 200 m<sup>3</sup>/h

## Heating

		Test point 1	Test point 3	Test point 3	Test point 4	
Outside Air Temperature	$T_{amb}$	-7	2	7		°C
Thermal Output Heating Heat Pump	$P_{WP, Heiz}$	2.75	3.75	4.82		kW
COP number Heating Heat Pump	$COP_{Heiz}$	2.02	2.70	3.40		-
Maximum available supply air temperature with Heat Pump only(*)		No supply air heating				°C

## Hot water

		Test point 1	Test point 3	Test point 3	Test point 4	
Outside Air Temperature	$T_{amb}$	-7	2	7	20	°C
Thermal Output Heat Pump for heating up storage tank.	$P_{DHW, heating\ up}$	0.96	1.95	2.47	4.38	kW
Thermal Output Heat Pump for reheating storage tank	$P_{DHW, reheating}$	0.60	1.66	2.10	3.33	kW
COP Heat Pump for heating up storage tank	$COP_{DHW, heating\ up}$	0.80	2.47	2.97	3.38	-
COP Heat Pump for reheating storage tank	$COP_{DHW, reheating}$	0.46	2.22	2.51	2.42	-
Average storage tank temperature		34.8				°C
Specific storage heat losses		1.84				W/K
Exhaust air addition (if applicable)		260				m <sup>3</sup> /h

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### Passive House comfort criterion

A minimum supply air temperature of 16.5 °C is maintained at an outdoor air temperature of -10 °C.

### Efficiency criterion (heat recovery rate)

The effective dry heat recovery rate is measured at the test facility using balanced mass flows on the outdoor air/extract air side. The boundary conditions for the measurement should be taken from the documents relating to the testing procedure.

$$\eta_{HR,eff} = \frac{(\vartheta_{ETA} - \vartheta_{EHA}) + \frac{P_{el}}{\dot{m} \cdot c_p}}{(\vartheta_{ETA} - \vartheta_{ODA})}$$

The (dry) ventilation heating load (the house is the system boundary) can be calculated using  $\eta_{HR,eff}$  based on the formula  $\dot{V}_{supply\_air} \cdot (1 - \eta_{HR,eff}) \cdot 0.34 \cdot \Delta\vartheta$  (multiplied by the infiltration rate). The rates of heat recovery are usually greater if condensation occurs in the heat exchanger. Initially, this will not be taken into account on purpose.

For this device:

**recoCOMPACT 7kW  $\eta_{WRG,t,eff} = 83 \%$**

**recoCOMPACT 5kW  $\eta_{WRG,t,eff} = 87 \%$**

**recoCOMPACT 3kW  $\eta_{WRG,t,eff} = 87 \%$**

### Efficiency criterion (power consumption)

The overall electrical power consumption of the device including that for regulation, but without that for the frost protection heating, is tested at the test facility at an external pressure of 100Pa (50Pa for each of the pressure/intake sides).

For this device:

**recoCOMPACT 7kW - 0.34 Wh/m<sup>3</sup>**

**recoCOMPACT 5kW - 0.33 Wh/m<sup>3</sup>**

**recoCOMPACT 3kW - 0.33 Wh/m<sup>3</sup>**

### Air tightness and insulation

Before starting the thermodynamic test, the air tightness test should be carried out for under pressure as well as for over pressure. The leakage air flows must not be greater than 3 % of the average air flow volume of the operating range of the ventilation device.

The following result was obtained for the device:

**recoCOMPACT 7kW - Interne Leckagen: 2.46 %**

**recoCOMPACT 7kW - Externe Leckagen: 1.76 %**

**recoCOMPACT 5kW - Interne Leckagen: 2.48%**

**recoCOMPACT 5kW - Externe Leckagen: 1.81%**

**recoCOMPACT 3kW - Interne Leckagen: 2.48%**

**recoCOMPACT 3kW - Externe Leckagen: 1.81%**

This ventilation unit meets the airtightness requirements.

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### Adjustability

It must be possible to adjust the balance between the exhaust air flow rate and the outdoor air flow rate for all units.

- This unit is certified for air flow rates of **110 - 280 m<sup>3</sup>/h (recoCOMPACT 7kW)**, **110 - 280 m<sup>3</sup>/h (recoCOMPACT 5kW/3kW)**
- Balancing the air flow rates of the unit is possible
- The users should have at least have following possibilities for adjustment:
  - ✓ Switching the system on and off
  - ✓ Synchronized adjustment of the supply air and extract air flow to basic ventilation (= 70 %), standard ventilation (= 100 %) and increased ventilation (= 120 %) with clear readability of the set status.
  - ✓ Depending on the demand, the user can choose between 3 operating levels that can be set manually at the control unit of the operating element.
- The device being tested here has no switch for shutting down or standby-Modul. The device must be equipped with an additional external switch to separate the device from the electric circuit if required.
- After a power failure the device automatically continues to operate in the mode that was set before the power failure.

### Acoustical testing

In order to restrict the sound pressure level in the installation room, the sound power level should be restricted to 35 dB(A). With an equivalent room absorption area of 4 m<sup>2</sup> the amounts of sound power level and sound pressure level are nearly the same (the exact value of the sound pressure level in the specific installation room can be calculated with the help of the sound protection tool (download on [www.passivehouse.com](http://www.passivehouse.com))).

Installation instructions must be provided which describe how the sound level can be kept below 25 dB(A) in living areas and below 30 dB(A) in functional areas. The following sound power levels have been determined :

#### recoCOMPACT 7kW (282 m<sup>3</sup>/h)

Geräteschall [dB(A)]	Kanalschall AU [dB(A)]	Kanalschall ZU [dB(A)]	Kanalschall AB [dB(A)]	Kanalschall FO [dB(A)]
58.2	47.6	66.1	44.1	65.9

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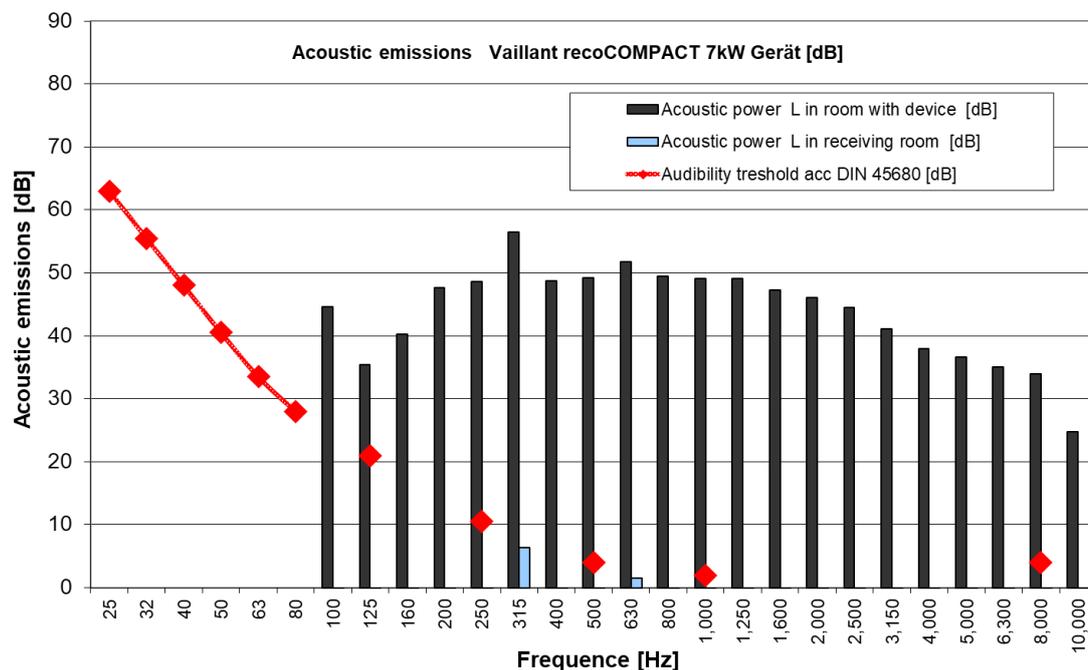


Figure 1: Acoustic emissions of unit body recoCOMPACT 7kW at air flow 280 m³/h

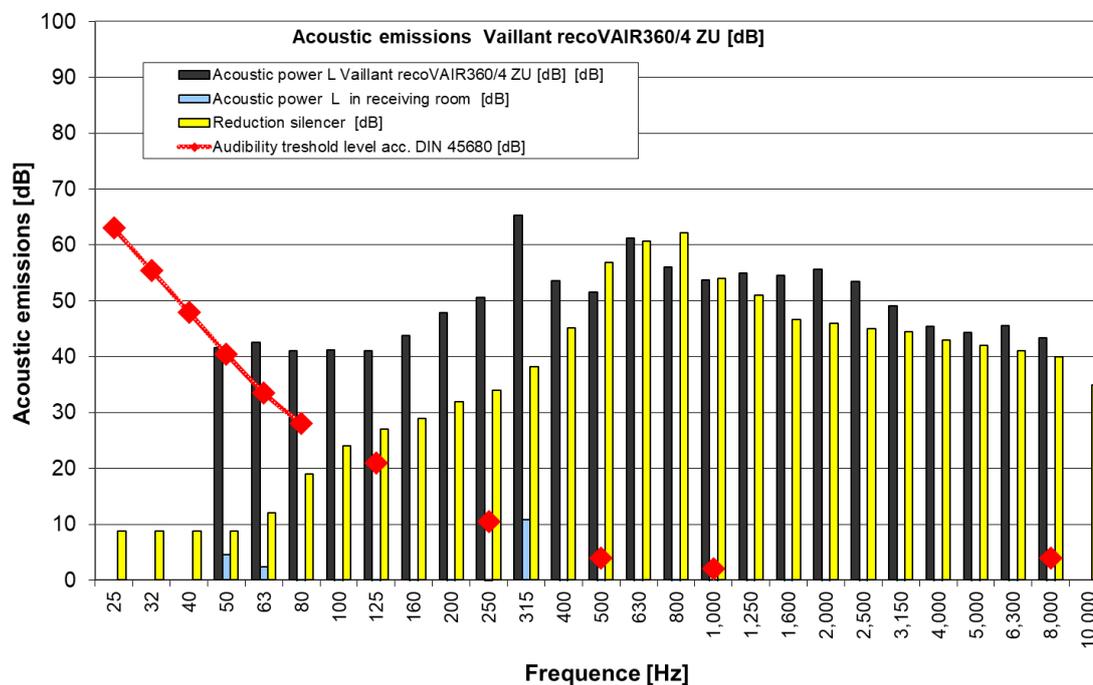


Figure 2: Acoustic emissions of supply duct recoCOMPACT 7kW at air flow 280 m³/h

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## recoCOMPACT 5kW (200 m³/h)

Geräteschall [dB(A)]	Kanalschall AU [dB(A)]	Kanalschall ZU [dB(A)]	Kanalschall AB [dB(A)]	Kanalschall FO [dB(A)]
51.6	40.8	59.4	38.7	59.3

## recoCOMPACT 3kW (200 m³/h)

Geräteschall [dB(A)]	Kanalschall AU [dB(A)]	Kanalschall ZU [dB(A)]	Kanalschall AB [dB(A)]	Kanalschall FO [dB(A)]
51.6	40.8	59.4	38.7	59.3

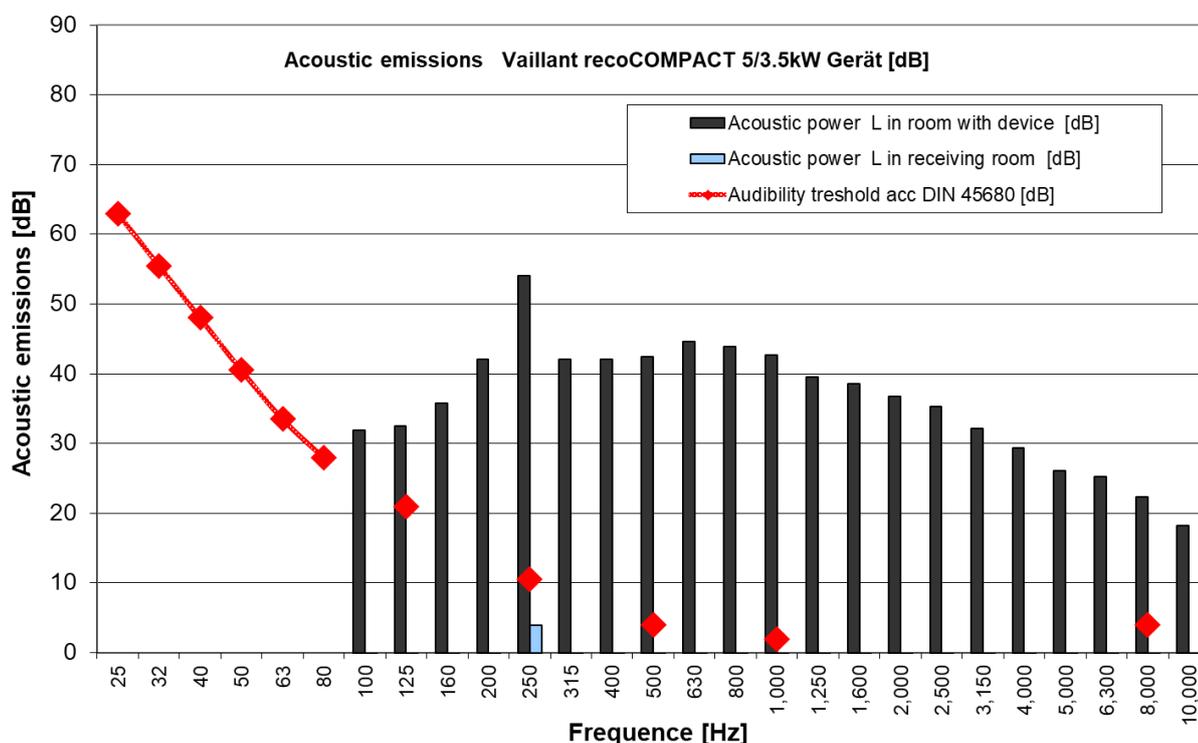
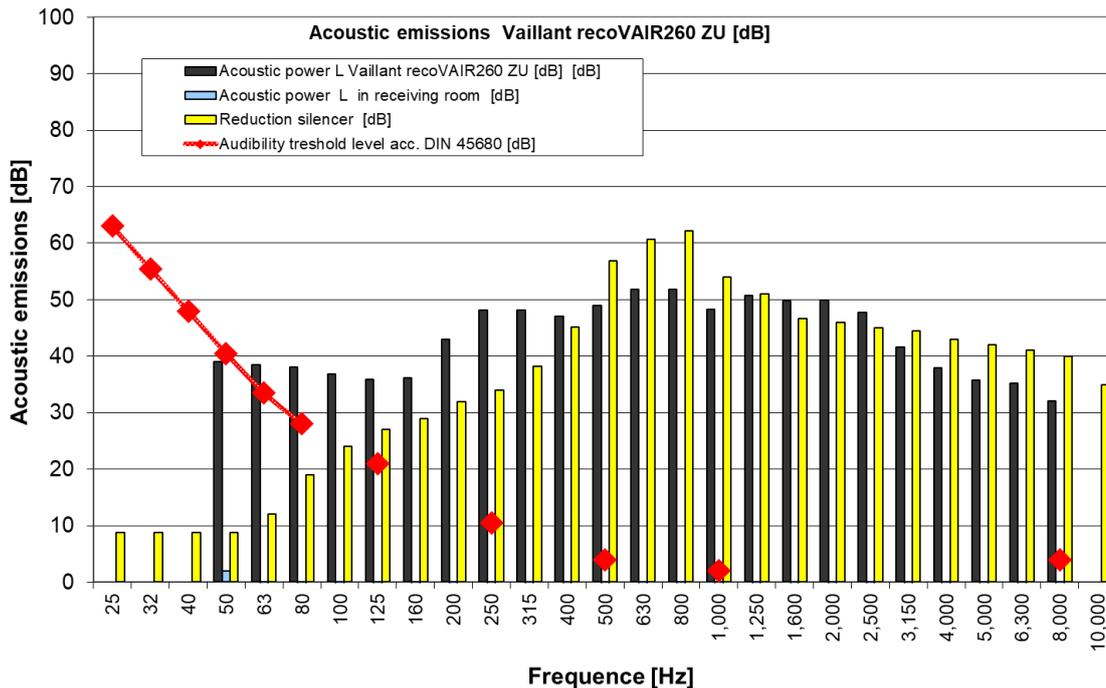


Figure 3: Acoustic emissions of unit body recoCOMPACT 5/3kW at air flow 200 m³/h

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**Figure 4: Acoustic emissions of supply duct recoCOMPACT 5/3kW at air flow 200 m<sup>3</sup>/h**

- The sound level of the unit exceeds the limit value of 35 dB(A). Therefore the unit should be installed so that it is acoustically separated from living areas.
- Silencers are recommended by the manufacturer for complying with the required sound level in the supply air and extract air rooms. Detailed information about these can be found in the full report. Dimensioning of a suitable silencer is required for the specific project on the basis of the measured sound intensity level.

### Indoor air hygiene

Inspection and cleaning of the central device including the heat exchanger is simple. The filter can be replaced by the user himself/herself (no specialist required). The unit is equipped with following filter qualities:

- ✓ Outdoor Air filter F7
- ✓ Extract Air filter G4

The Unit can be alternatively equipped with a filter of class F9 for the outdoor air.

If the device is not operated during the summer, the filter should be replaced before the next operation.

Filter replacement is recommended after an interval of 12 months.

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### Frost protection

Appropriate measures should be taken to ensure prevention of icing over of the heat exchanger and freezing up of hydraulic post-heater coils during extreme winter temperatures (-15°C). The regular functioning of the device should be permanently ensured during uninterrupted operation of the frost protection circuit (there is no interrupt circuit for outdoor air in the Passive House, as the heating loads caused by the forced infiltration would become too high). If heater coils for hot water are used, a suitable frost protection circuit should ensure prevention of frost damage to these heater coils. In the process, the possibility of failure of the pre-heating coils and extract air fans must also be taken into consideration.

- Frost protection circuit for the heat exchanger:
  - ✓ The built-in frost protection strategy of the device is suitable for passive houses.
  - ✓ The device can be optionally (as accessories) equipped with an electrical heater coil with a heating power of 1500 W (recoCOMPACT 7kW) respectively 1000 W (recoCOMPACT 5/3kW). During the investigation, the heating coil was installed. For use in Passive Houses, it is absolutely necessary to use it, in order to ensure continuous supply of fresh air. This strategy depends on the outdoor air and adjusts upon the temperature of -3°C behind the heating coil.
  - ✓ If the heating power of the heater coil is not enough at a very cold day, an additional frost protection strategy will work. This additional strategy depends on the temperature of the exhaust air. If the temperature of exhaust air is under 5 °C, the supply air ventilator will be shut down. After the temperature of exhaust air is over 8 °C, the supply air ventilator will be again turned on.
- Frost protection circuit for downstream hydraulic heater coils:
  - ✓ In order to protect a downstream hydraulic supply air heater, an undershooting of 5°C supply air temperature leads to a shutdown of the unit.

It should be noted that cold air can also lead to freezing up of stationary fans due to free circulation; this can only be ruled out if the air duct is closed (by means of a shut-off flap).

**Assessment of the heat pump:** The seasonal performance factor (SPF) of the system installed in the reference building and the primary energy consumption for the reference building without use of a ground heat exchanger are:

**recoCOMPACT 7kW:** SPF (without SHX) = 2.1, PE-value (without SHX)= 36.1 kWh/m<sup>2</sup>a. (Figure 5)

**recoCOMPACT 5kW:** SPF (without SHX) = 1.4, PE-value (without SHX)= 47.1 kWh/m<sup>2</sup>a. (Figure 6)

**recoCOMPACT 3kW:** SPF (without SHX) = 1.4, PE-value (without SHX)= 48.7 kWh/m<sup>2</sup>a. (Figure 7)

This unit recoCOMPACT 7kW can be used in Passive Houses with an air flow rate between 110 m<sup>3</sup>/h and 280 m<sup>3</sup>/h, based on an air flow rate of 30 m<sup>3</sup>/h/person and a heating load of 12 W/m<sup>2</sup>. The characteristics of ventilation unit set the operational range of recoCOMPACT 7kW. The limit for PE-value was not exceeded.

The outdoor air intake temperatures are raised when a ground heat exchanger is used. Better performance values are obtained as a result.

**recoCOMPACT 7kW:** SPF (with SHX) = 2.7, PE-value (with SHX)= 34.6 kWh/m<sup>2</sup>a.

**recoCOMPACT 5kW:** SPF (with SHX) = 1.9, PE-value (with SHX)= 36.6 kWh/m<sup>2</sup>a.

**recoCOMPACT 3kW:** SPF (with SHX) = 1.9, PE-value (with SHX)= 34.6 kWh/m<sup>2</sup>a.

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03ud Vaillant 7kW

Lüftg mit EWT:  $\eta_{a^*} = 0.73$  PE [kWh/m<sup>2</sup>a] = 34.55

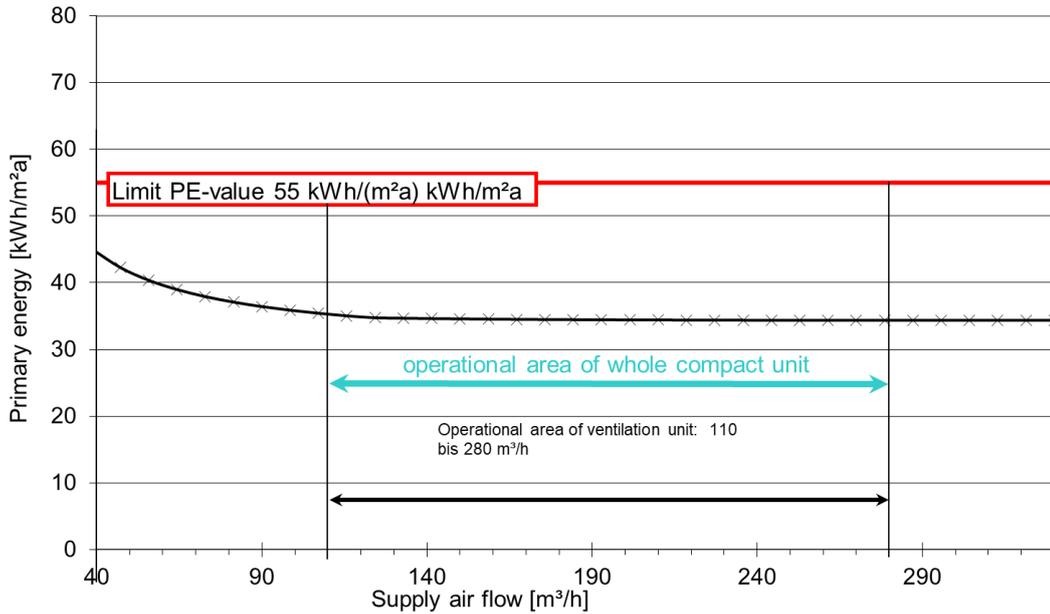


Figure 5: Operational range of recoCOMPACT 7kW (without SHX)

04ud Vaillant 5kW

Lüftg mit EWT:  $\eta_{a^*} = 0$  PE [kWh/m<sup>2</sup>a] = 47.08

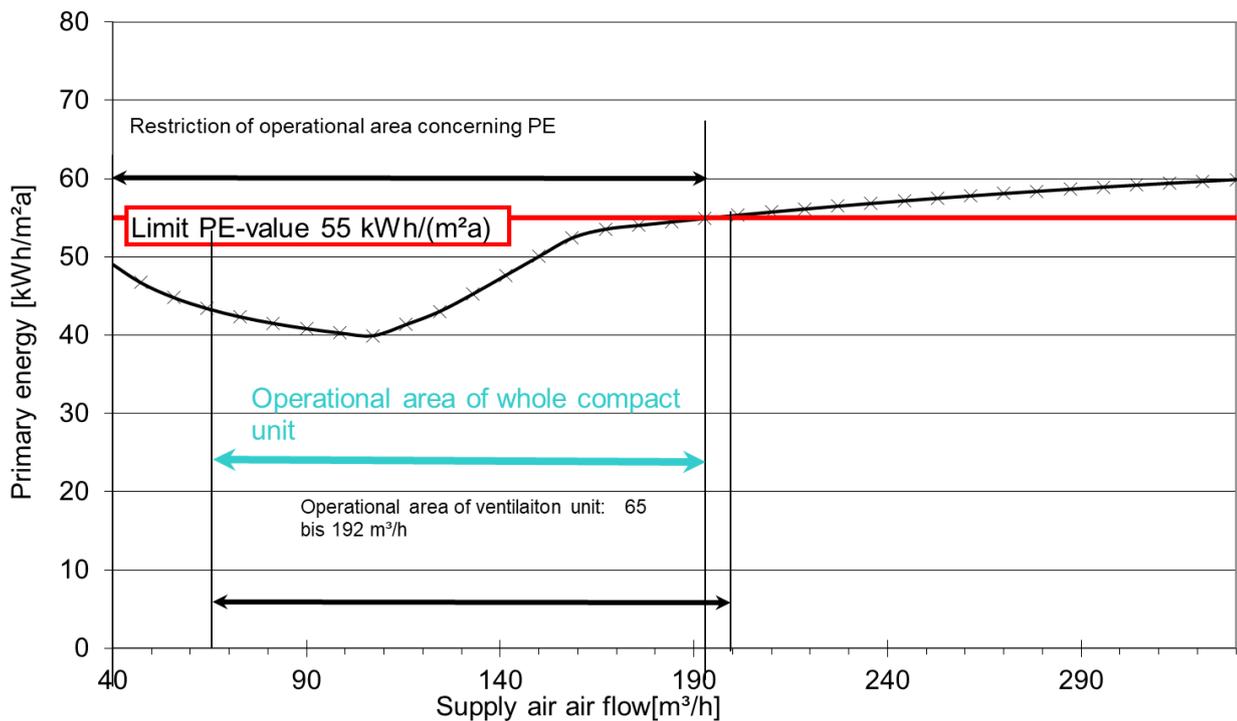


Figure 6: Operational range of recoCOMPACT 5kW (without SHX)

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05ud Vaillant 3kW

Lüftg mit EWT:  $\eta_{a^*} = 0$  PE [kWh/m<sup>2</sup>a] = 48.66

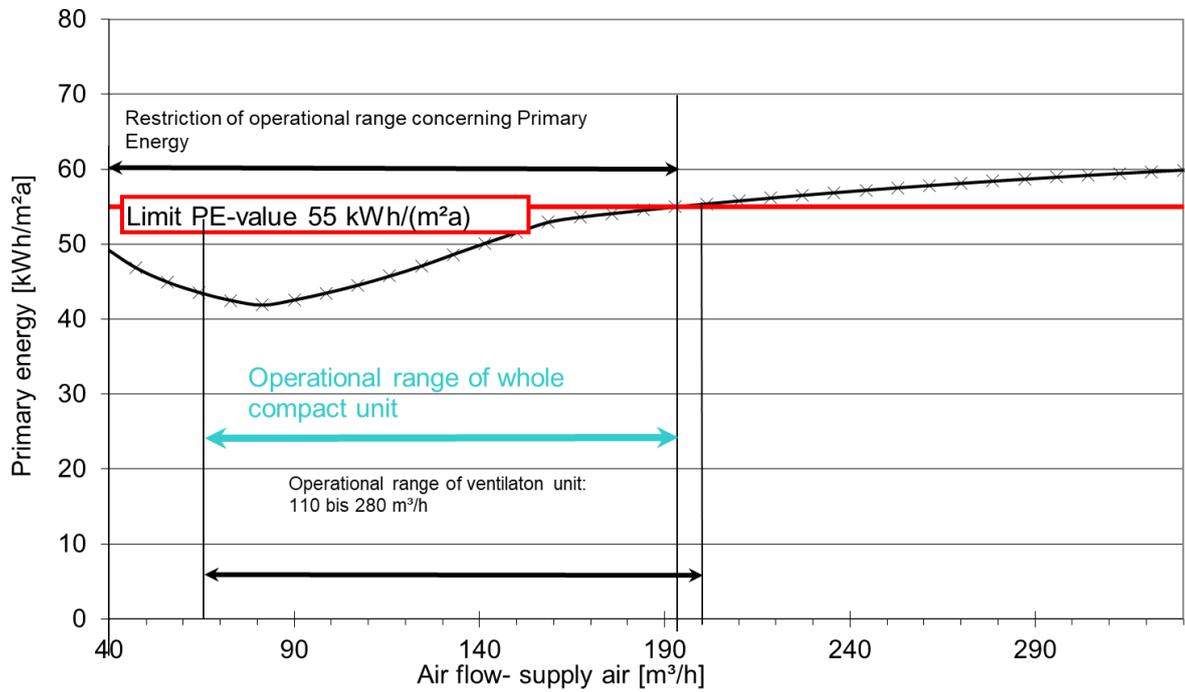


Figure 7: Operational range of recoCOMPACT 3kW (without SHX)

## Abbreviations

- AU/ODA = Outdoor air
- FO/EHA = Exhaust air
- ZU/SUP = Supply air
- AB/ ETA = Extract air