



HOT AIR OR REAL SOLUTION? WHAT ROLE CAN DECENTRALIZED VENTILATION SYSTEMS PLAY? | 2021-06-09

eccee 2021 summer study

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Ventilation in single-family houses

Major problems with under-ventilation in Swedish single-family houses:

- 40 % of the Swedish stock of single-family houses is under-ventilated
- 15 % of the single-family house stock has at some point been investigated regarding moisture or mould problems
- Houses with natural ventilation (no mechanical ventilation system) that previously had an individual oil burner get even lower air flows when the boiler is replaced with a heat pump
- Upgrading all single-family houses' ventilation would increase the national energy demand by 5 TWh/year
 - May lead to increased electrical heating
 - Adding to already existing problems with lack of peak power and grid capacity



Technology development project – combined heating and ventilation system

Development of compact, combined heating and ventilation system for energy efficient new single-family houses in a Nordic climate

Project in several phases

- Feasibility study, 2014
- Technology procurement in two phases, 2015-2016
- Joint technology development, 2018
(Presented at eceee 2019 summer study)
- Verification of performance in real houses, 2020-2022



Decentralized ventilation – existing single-family houses

Existing detached houses also have a large need for new energy-efficient heating and ventilation systems that are cost-efficient, easy to install and adapted for existing buildings

- Ducting an obstacle to the installation of supply and exhaust air ventilation with heat recovery in existing single-family houses
- Decentralized ventilation systems - strong market in Germany
- No evaluations of heat recovery performance carried out for Nordic climates

Feasibility study aimed at:

Analyse the potential of decentralized systems and propose methods for testing, verifying and developing decentralized ventilation systems for the Nordic climate

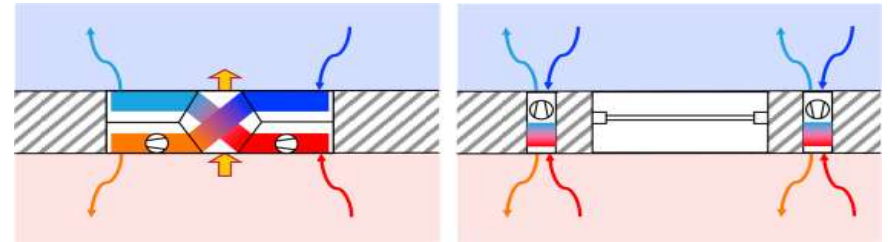
The results of the study should provide a basis for future work on this alternative ventilation solution

Decentralized ventilation systems with ceramic heat exchanger

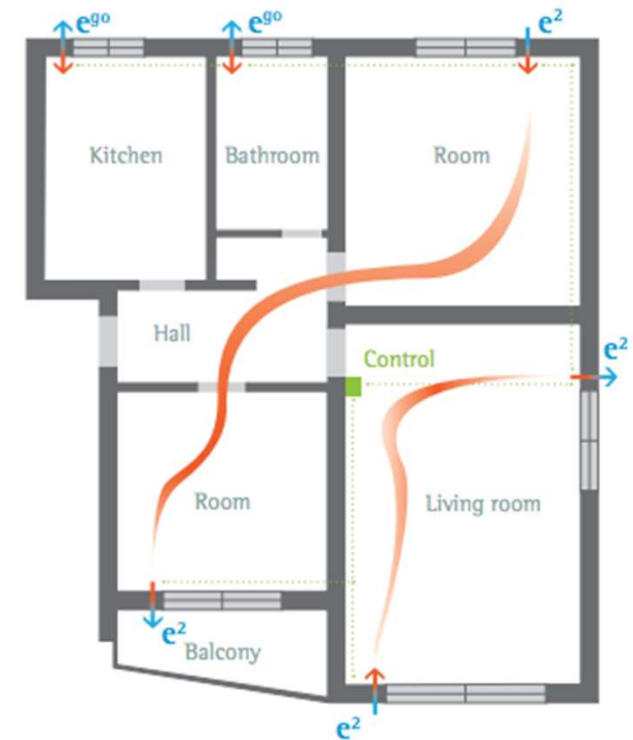
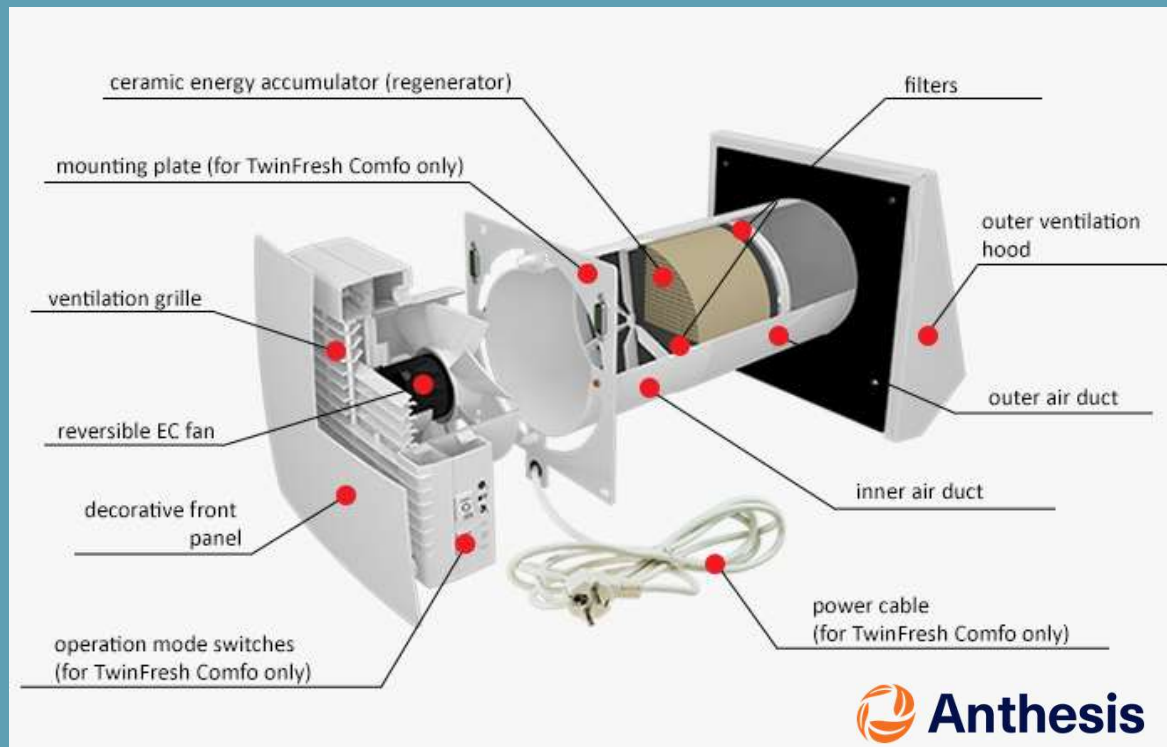
Decentralized ventilation systems are placed directly in the outer wall with a built-in fan that changes the flow direction between supply air and exhaust air. Heat from the exhaust air is stored in a ceramic material and then transferred to the supply air when the fan changes the flow direction

Pros:

- No ducting, easy to install and easy maintenance
- Low power demand
- Heat recovery (suppliers report values up to 90%)
- Can be installed in pairs to achieve balanced ventilation
- Can also be installed with wireless communication between devices



Decentralized ventilation systems with ceramic heat exchanger



Feasibility study methodology

The feasibility study has been carried out in three steps:

Market analysis

- What systems are available on the Swedish market?
- What tests have been carried out on these?
- Are the tests carried out in a Nordic climate?

Market intelligence survey of decentralised ventilation systems and studies and tests that have previously been carried out

Methods for testing and verifying system performance in a Nordic climate

The feasibility study was conducted by Agneta Persson and Sanna Börjeson, Anthesis, and Andreas Nyberg and Jennifer Mörck, Aktea

The study was conducted in collaboration with industry and academia. Dialogues were held with suppliers of the systems, and they provided information during the work.

Results: Market analys

Seven types of decentralized ventilation systems with ceramic recycling on the Swedish market



A challenge with the systems highlighted by both suppliers and researchers who have investigated the systems is disturbing noise levels

- There is a risk that users in practice will reduce the airflow in the units
- No possibility to install decentralized systems in spaces that is not disturbed by high noise levels (such as basements and attics), since the systems are installed in the façade

Results: Market analys

Major lack of knowledge of how the systems should be tested

- It is not clear what standards or methods the systems should be evaluated against when the products are launched in Sweden.
- The tests carried out on the systems have mainly been carried out by German suppliers
- No common standardized method for evaluating decentralized ventilation systems (room ventilation only)
- Suppliers refer to different measurement methods when accounting for the performance of their units
- There is a need for development of comparable measurement methods

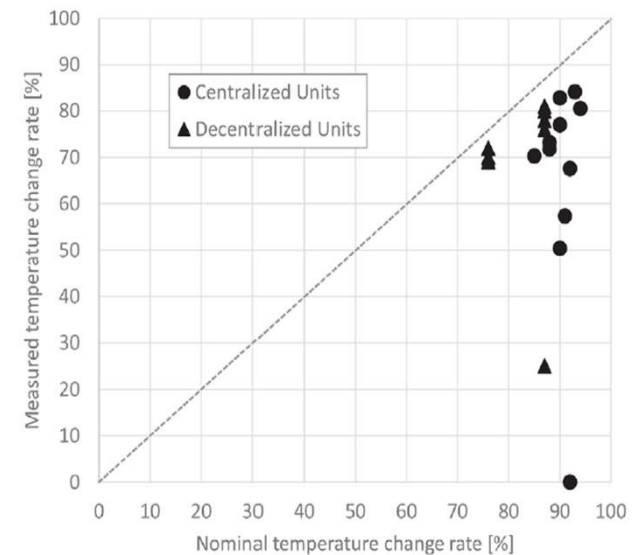
EN 13141-8:2014, is the only test standard adapted to decentralized systems

A significant weakness of this standard is that it is developed for the assessment of units intended for individual rooms and thus does not take into account the entire system solution

Results: Market intelligence

Three research studies of decentralized ventilation systems were studied. They show that under 'normal' operating conditions, systems can achieve $\eta \approx 70\%$ on average

- Actual η significantly lower than the nominal η reported by manufacturers and suppliers
- However, decentralized ventilation systems may have the potential to be an energy and cost-effective ventilation option in cases where supply and exhaust air ventilation with heat recovery solutions with ducting are technically difficult to install, are too costly or are inappropriate for other reasons



Monitored heat exchange rate in operation compared to the nominal efficiency

The 2013-2014 heating, field tests 20 centralised and 60 decentralized ventilation systems for detached and apartment buildings

Purpose: Monitoring the actual energy performance of the systems in a real environment

Source: Merzkirch et al 2016

Results: Verifying methods

An evidence-based study of how decentralized ventilation systems work in a Nordic climate is needed

- The products need to be tested both in a laboratory and by simulation of the Nordic climate
- Also interesting to test the products in a standardized real case with a Nordic climate and compare between laboratory results and results in real houses

The following aspects of the decentralized ventilation units need to be further studied in testing and verification:

- Capacity (airflow and temperature efficiency) at different pressure conditions against the appliance
- Function if filters are clogged (not regularly changed)
- Air distribution at different fan positions and air mixing in the room
- Function if muffler is mounted
- Noise level

Proposed continued work

Several areas where decentralized ventilation systems need to be further studied have been identified

There is also a need for technology development in order for the systems to be an attractive solution for existing single-family houses in a Nordic climate:

- Can these systems provide a single-family house with its entire ventilation needs?
- Disturbing noise levels – how to handle?
- Risk of increased moisture load in the construction of the houses?

By initiating a project where the decentralized systems are properly evaluated, it can be clarified how the systems work under real conditions in the Nordic climate, taking into account the ventilation balance of the dwelling



Proposed continued work

There is also a need to develop alternative ventilation solutions that, e.g. could be installed on the outside of the façade and that do not require a complex installation

- Installations on the outside of the façade would most likely reduce noise problems, but at the same time present other challenges such as design and weather resistance
- Technology procurement: Allocate funds to conduct a feasibility study on how a technology procurement of ventilation systems adapted for existing single-family houses in a Nordic climate can be designed and implemented



Photo: Mikael Damkier



Thank you for your attention!

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