EU RESHYVENT- INTERIM RESULTS

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ABSTRACT

Within the EU RESHYVENT project four demand controlled ventilation systems have been developed, each one for a specific application field. The scientific support work for the industries has been reported in a number of documents. A number of these reports will be published as AIVC Technotes after completion of the project.

KEYWORDS

Demand Controlled Hybrid ventilation, Sensor Technologies

INTRODUCTION

In January 2002 the EU RESHYVENT project started, a three-year project within the EU Fifth Framework Programme on the investigation and development of demand controlled hybrid ventilation systems in residential buildings. The project is a clustering of four industrial consortia with a multi-disciplinary scientific consortium. Each of these industrial consortia has developed a working prototype of a hybrid ventilation system, each one for a specific climate. A scientific group with 12 partners from research institutes, consultants and universities will carry out the scientific research work for the development of these systems. This paper gives a summary and update of the work carried out and the interim results so far.

INTERIM RESULTS OF THE EU RESHYVENT PROJECT

The scientific research work is organised in a number of work packages. The industrial partners can consult the work packages. It is the task of their scientific coaches to structure these questions, to identify the relevant work package and to match the questions with the scope of the work programme and the objectives of the work packages.
RESHYVENT has following work packages:

WP 1 State of art review - WP leader NBI, Norway
Within this work package an extended database is collected on all available literature and research work in the field of advanced ventilation (www.byggforsk.no/prosjekter/Reshyvent/) At his moment this database is not public accessible due to copyright matters.

WP 2 Market Support Unit - WP leader SWP, Sweden
Domestic ventilation systems are very different from country to country. There are many reasons for this, differences in building codes, traditions, user preferences and climate. In northern Europe most new dwellings are equipped with mechanical ventilation systems, while southern countries often rely on window airing. More and more mechanical ventilation systems also include heat recovery. The starting point is therefore very different. In some countries simply installing a ventilation system is an improvement, and the reference installation cost is then very low. In countries with mechanical ventilation systems a certain installation cost for ventilation is expected and accepted, however there is often a tendency to install inexpensive systems. The benefit of LCC analysis is being discussed, but rarely applied

in real projects. In the countries where mechanical ventilation systems have become more and more common usually a building code that more or less requires mechanical ventilation has been developed e.g. in France, the Netherlands, Norway and Sweden. For the Netherlands and Sweden mechanical ventilation systems were required for apartment buildings for several years, but not any more. Common ventilation market driving forces on the European market are IAQ, health, comfort and energy (i.e. energy performance regulations).
The existing European housing stock has a variety of ventilation systems. Most countries, apart from France, the Netherlands and to some extent Norway and Sweden, have a predominance of installed natural or passive stack ventilation systems.

WP 3 Renewables Integration Support Unit - WP leader Esbensen, Denmark
The integration of renewable energy technologies in the RESHYVENT project focuses and wind applications to substitute fossil fuel in the operation of hybrid ventilation systems. On the basis of existing renewable technologies this report gives an overview of the possibilities for integration of renewable into hybrid ventilation components. When integrating renewable in a system it is recommended that the Trias Energetica approach is followed to ensure that the use of conventional and renewable energy is optimised as much as possible. The method included tree steps: First the energy demand from the components is minimised as much as possible, secondly the remaining energy is supplied by renewable energy and third the remaining energy demand, if any, is supplied by conventional energy sources (fossil fuels). The third step includes optimisation of the efficiency of the conversion of fossil fuels. This report is focusing on step two the integration of renewable technology in hybrid ventilation systems. The following renewable applications have been described:
- Glazed balcony and sunspaces
- Solar air collector and solar wall
- PV systems
- PVT systems
- Wind cowls
- Wind turbines
- Solar chimneys

The described applications are all suitable in combination with a hybrid ventilation system, however whether the applications are feasible very much depends on the specific ventilation concept, location and urban environment. A rough overview of the characteristics, urban constraints and recommendations for the use of the different applications are shown in next table.

Concept	**Description**	**Urban constraints**	**Recommendations**
Glazed balconies	Existing or new balconies glazed for increase of the living area. Reduction of noise and for preheating of inlet air	Shadows and shelter in canyons	Recommend in open courtyards or at free exposed facades
Solar walls	Existing or new facades with glazing to improve the insulation level and for preheating of inlet air	Shadows and shelter in canyons	Recommend in open courtyards or at free exposed facades
Photovoltaics	Auxiliary energy for operation of fans and controls in a hybrid ventilation system	Very sensitive to shadows and shelter in canyons	Recommend in open courtyards, at free exposed facades facing south or at roofs
PVT systems	Integration in facade for production of auxiliary electricity and thermal energy for preheat of ventilation air	Very sensitive to shadows and shelter in canyons	Recommend in open courtyards or at free exposed facades

Wind cowls	Increase of wind induced flows in extracts	No constraints	Recommended at roofs
Wind turbines	Auxiliary electricity for fans and controls in the ventilation system	No constraints	Recommended at roofs
Solar chimneys	Increase of stack driven flows in extracts	No constraints	Recommended at roofs

WP 4 Standard and Regulations Support Unit - WP leader BBRI, Belgium
Work package 4 focuses on Standards and Regulations on Indoor Air Quality (task 4.1.) and Energy Performance (task 4.2.) in relation to ventilation. The general conclusions of WP4 task 4.1 are:

- Standards should determine test procedures / calculation methods without specifying requirements
- Regulations should determine requirements according to standardised test procedures / calculation methods
- Performance-oriented approaches instead of descriptive documents
- Standards on IAQ are no barriers for hybrid ventilation systems but have an impact on the conception of the components

The general conclusions of task 4.2. are:

- Calculation procedures can constitute a barrier to the application of hybrid ventilation systems.
- The specificity of such systems is not always taken into account in the standard calculation procedure (e.g. possibility to reduce the airflows).
- The evaluation of the benefits has to be determined by the so-called principle of equivalence. This requires an efficient and coherent framework allowing this assessment

WP5 Design parameters Support Unit - WP leader EMPA, Switzerland
Work package 5 has produced two reports: one Technical Report and a report on Parameters for Performance Assessment.
The Technical Report was originally aimed for the RESHYVENT participants, especially the participating industries but the information is of general interest for all manufacturers and designers of (hybrid) residential ventilation systems. The report gives detailed information on issues like wind pressure, thermal comfort evaluation by CFD simulation and input data, necessary to perform computer simulations for performance analyses of hybrid ventilation systems. This report will be published as an AIVC Technote.
The report on Parameters for Performance Assessment gives performance criteria, target levels and design constraints.

WP 6 Performance Assessment Support Unit - WP leader IDMEC, Portugal
The initial objective of this WP was to study the performance of different design options in hybrid ventilation systems for several climates, control strategies and occupancy schemes to support the industrial consortia (IC) with the development of their innovative systems. However, as the work started, the goals have been expanded to produce a tool that would evaluate new innovative ventilation products on the basis of the equivalence principle for satisfaction of regulations, norms and standards. This tool is an ideal platform, supported by scientists and industries, to assess and promote innovative energy efficient ventilation systems, necessary for the implementation of the EPD (Energy Performance of Buildings Directive. A graphical user interface tool has been developed to carry out simulations in Trnsys/Comis. A new subroutine type 101 for controllers has been written. Type 101 will allow the control of inlet grilles, exhaust valves and fans. It is possible to control 48 devices

(inlets, exhaust valves and fans). The inlet grids and exhaust valves can be regulated or auto regulated. If the inlet/valve is auto regulated the controller can have 1 to 4 levels of opening (besides closed) and reacts to one input signal, which can be for relative humidity, presence or CO2 concentration. There are two types of fan controller: ON/OFF fan ruled by a schedule that switches the fan position (0 or 1) or a proportional flow fan, (the fan speed rotation is a function of the inlet or exhaust airflow, depending on which is bigger).

WP 7 Control and Ventilation Strategies Support Unit - WP leader CSTB, France
The integration of natural ventilation and mechanical driving forces in a hybrid ventilation system requires development of new ventilation control strategies. The objective is to develop strategies for control of hybrid ventilation systems at any time and for a certain combination of internal pollutant, outdoor conditions and comfort requirements that ensure that the immediate demands to the indoor environment are fulfilled in the most energy efficient manner. The first work of the group showed that it was not possible to be exhaustive in the development of ventilation and control strategies. The final report draws up a panorama of the principles to take into consideration when developing ventilation and control strategies. The report contains three parts:
Part 1: Ventilation strategies for hybrid systems
Part 2: Hybrid ventilation control strategies
Part 3: Implementation of hybrid ventilation control strategies
The report gives a methodology to develop control strategies for hybrid ventilation together with examples of application. Particular strategies are developed with the Industrial Consortia who needed assistance. The work with the IC's is subjected to confidential reports.

WP 8 Specifications and ToR for components and systems - WP leader TNO, the Netherlands
All research work carried out in the different work packages as well as the developments for the four specific hybrid ventilation systems (within WP 9) will be "translated" to generic terms and specifications. Ventilation industries and designers for development of hybrid ventilation systems can use these specifications. It gives information on:
- specifications and terms of references: components, systems and building
- solutions for different climates: generic and specific
- price reduction by optimisation of design and by scale enlargement

WP 10 Urban impact - WP leader NKUA, Greece
The objective of this work package is to assess the impact of the urban environment on the hybrid ventilation air flow process through experimental and computational procedures performed at a number of different configurations that affect the performance of natural and
The main parameters affecting the performance of natural and hybrid ventilation systems in urban canyons have been identified. A full report has been prepared. The main problem is the estimation of the wind speed in canyons. Using data from RESHYVENT and the EU URBVENT project a methodology has been developed to calculate the wind speed in canyons.
A literature study on the potential of natural and hybrid ventilation in urban canyons has been carried out. Reports on the impact of noise in canyons as well as on the potential use of renewables have been prepared. An important scientific work performed under this task was the experimental validation of the methodology to estimate the wind speed in canyons.
A literature study on the potential of natural and hybrid ventilation in urban canyons has been carried out. Reports on the impact of noise in canyons as well as on the potential use of renewables have been prepared.

An important scientific work performed under this task was the experimental validation of the methodology to estimate the wind speed in canyons. The main configurations that affect natural and hybrid ventilation in canyons have been identified. Specific configurations have been selected in order to perform experimental investigations.
Full experiments have been performed in two canyons and three buildings in Athens during Summer 2002 to indicate the impact of the urban environment on the natural and hybrid ventilation air flow process in urban canyons. The observed air flow characteristics and mechanisms driving the airflow as well as the estimated air changes rates for applied ventilation systems, is presented for these canyons.

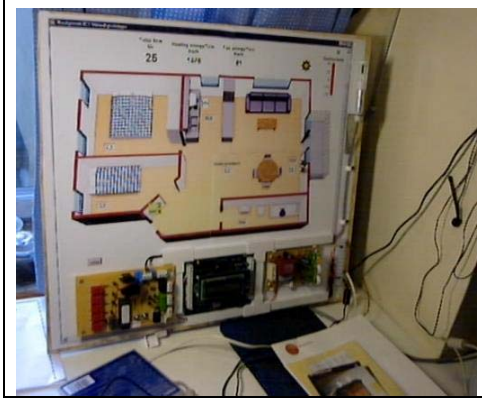
DEVELOPMENT OF A PROBABILISTIC APPROACH FOR PERFORMANCE ASSESSMENT OF INNOVATIVE VENTILATION SYSTEMS

The market uptake of innovative, energy efficient concepts in the building sector is to a large extent influenced by the stimuli found in building regulations. An increased number of countries and regions in Europe is implementing so-called Energy Performance Regulations (EPR). It is expected that more countries will follow this tendency. The new Energy Performance of Buildings Directive (EPBD) will surely enhance this development since it makes the application of an EPR mandatory for new buildings and for major renovations. If one is obliged to make an assessment of buildings in terms of energy performance, it is clear that one should be able to assess all kinds of building designs and of technologies. However, the present regulations clearly not cover all possible technologies. Among the technologies which are typically not covered by the standard procedures are innovative ventilation concepts, e.g. hybrid ventilation in dwellings.
Within the work packages 4, 5 6 and 7 a method for performance assessment of innovative ventilation systems is developed, based on a mixture of European measures and national actions, based on a probabilistic approach.

DEVELOPMENT OF FOUR HYBRID VENTILATION SYSTEMS

Within work package 9 the four industrial consortia actively participate with their scientific coaches on the development and construction of four hybrid ventilation concepts for four different European climate zones.

The Swedish concept
The Swedish concept addresses apartments in cold climates. As in these climates ventilation demand corresponds often with the heat demand the ventilation supply is integrated in a combined hybrid supply convector. Air collectors can preheat supply air.



Demo board of the Swedish hybrid ventilation system

Website of the Swedish system

Next to it, it is possible to preheat the air partly by a solar collector. The exhaust system is a fan assisted passive stack. Communication with the occupants via the internet about the energy performance of the system is one of the developments of the Swedish system.

The Dutch concept
The Dutch consortium is elaborating two concepts one for 2004 (ready at end of the project) and one for 2010. The 2004 concept is a fully hybrid demand controlled system with de-central supply from the facade and a coupled hybrid central mechanical extract. A characteristic development in this concept is an extreme low-resistance ductwork (< 2 Pa at 56 dm^3/s) based on the experiences and components developed within the EC TIPVENT project. A special fan is developed using 2 Watt at 56 dm^3/s at 20 Pa. This extreme low fan power is possible by a combination of the low pressure duct work and wind optimised cowls (<1 Pa at 56 dm^3s). Supply grilles are actively controlled with compensation for cross flow and infiltration. The advanced control system is being developed in close co-operation with WP7. The prototype is tested in 2003 in laboratory. In 2004 the system is build in a newly build test house at the by Brno University of Technology Czech Republic and will be extensively tested.

Demo board of the Dutch system

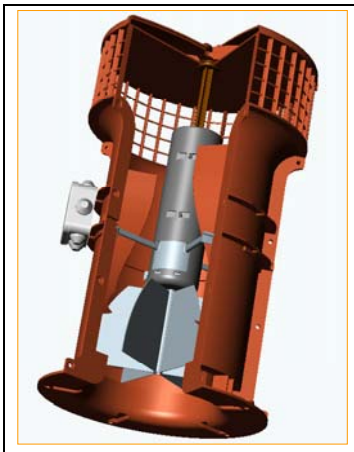

Exhaust chimney


Air inlets

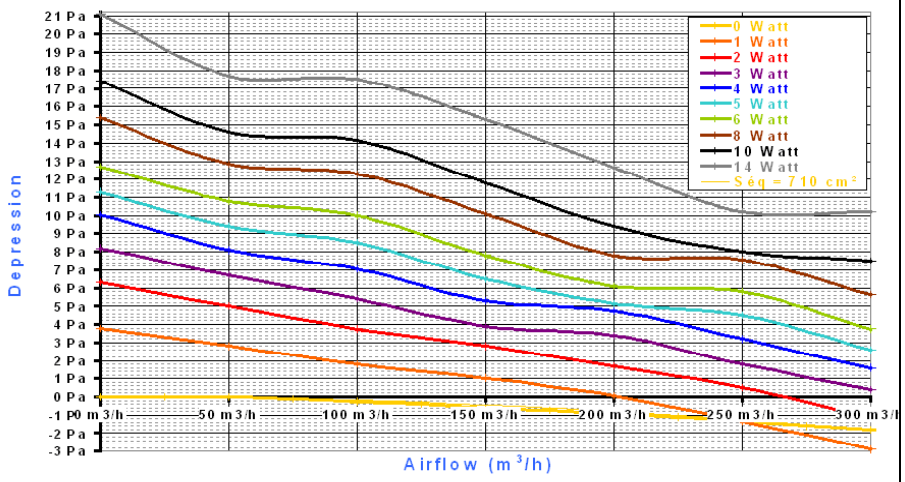

Demonstration house Brno Czech Republic

The French/Belgium concept
The French/Belgium consortium is working on the integration of renewables (i.e. PV application) in combination with hybrid ventilation. Like the Dutch concept, this concept is also based on a fully hybrid demand controlled system with de-central air supply from the facade and a coupled hybrid central mechanical extract. PV provides the auxiliary energy for the fan. There is special attention for the summer comfort en the application of free cooling during the night. A new development is a fan that can be used for combined natural and

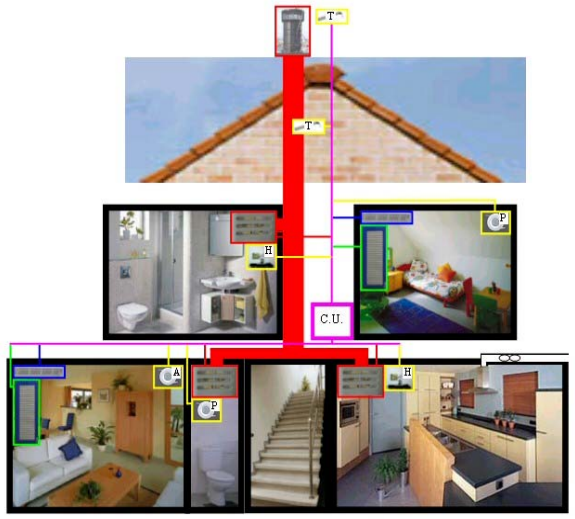
mechanical exhaust ventilation. The advanced controls for the system are being developed in close co-operation with WP7.

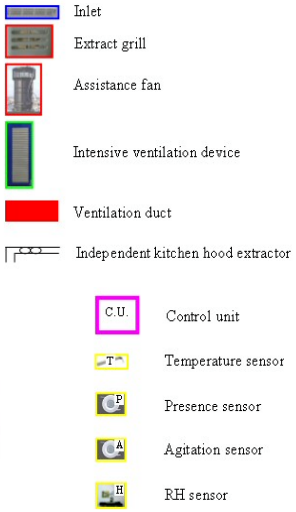


Fan for combined natural and mechanical exhaust. Power consumption 2W
No pressure losses when the fan is off.



Characteristics of the fan

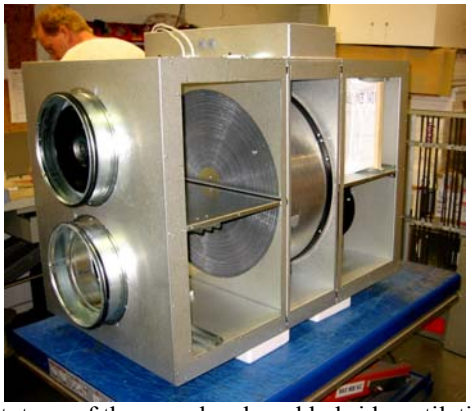




Various components of the ventilation system

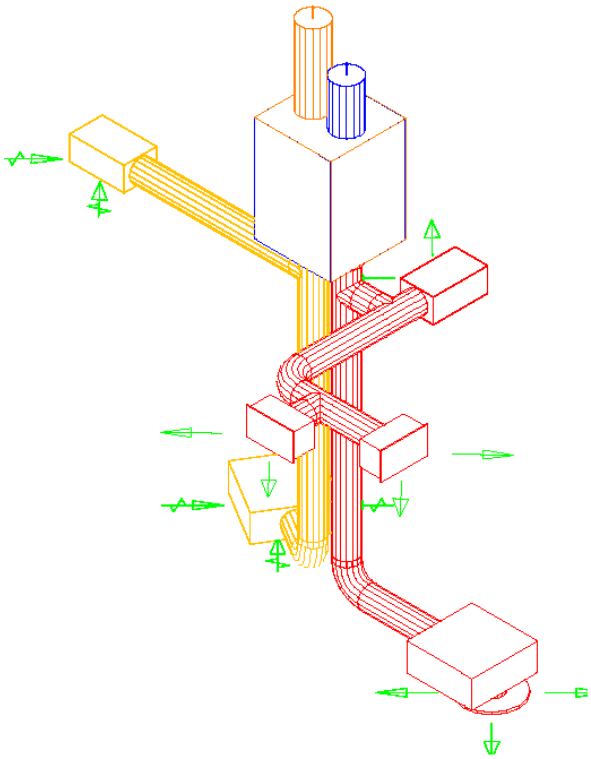
The Norwegian concept

The Norwegian concept is being developed for extreme cold climates. For these conditions heat recovery is necessary for preheating and to recover energy.
The Norwegian concept is entirely different from the others. The combination of hybrid (natural) ventilation with heat recovery is innovative. A supply system with low-pressure ducts is used. The heat recovery system exists of a rotary heat exchanger. Special attention is being paid to develop and optimise the outlet with wind vane and the air inlet on top of the roof. The system can be equipped with CO_2-sensors as well as with R.H.-sensors. The system will be build in four demonstration houses in several configurations and will be extensively monitored and tested under occupied circumstances.



Prototype of the new developed hybrid ventilation unit with heat recovery.

Test houses with the Norwegian hybrid ventilation system.



Scheme of the optimised duct system

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