

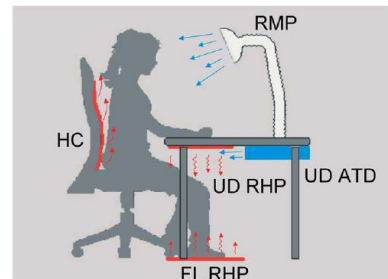
# Why is PECS not a mainstream product today?

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ASHRAE President 2017-18  
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1

## Personal Environmental Control Systems (PECS)

- Is systems that provide individual environmental quality (thermal comfort, IAQ, illumination, and acoustic) under personal control
- Has during the last 40 years been extensively studied by many researchers all over the world
- Almost all studies with persons (laboratory or some field studies) show the benefits of PECS regarding acceptable environmental conditions, better individual comfort, and the benefits of personal control
- Some studies show increased cognitive performance of users
- Very few systems installed and used in real buildings
- WHY



2

## Annex87 Literature Review Process – Selected Papers

Groups	No. of Papers	Criteria
Thermal	191	<ul style="list-style-type: none"> <li>Studies with human participants</li> <li>Reports at least one of the following: Thermal sensation / acceptability / comfort vote</li> </ul>
IAQ	111	<ul style="list-style-type: none"> <li>Reports at least one of the following: Perceived Air Quality / Contaminant Removal Efficiency</li> </ul>
Performance	13	<ul style="list-style-type: none"> <li>Reports results based on at least one of the following: Self-evaluated / Cognitive / Physical performance</li> </ul>
Health	86	<ul style="list-style-type: none"> <li>Reports results based on at least one of the following: SBS symptoms / Physiological measures</li> </ul>

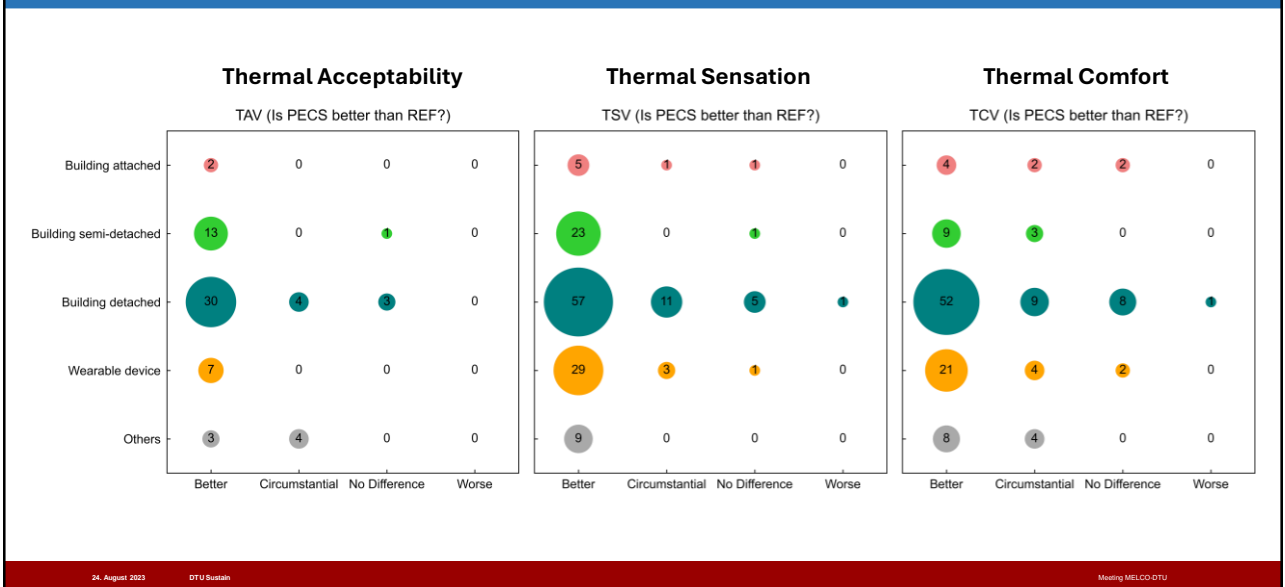
24 August 2023

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3

## Does PECS provide a better thermal environment?



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4

## Thermal Comfort

- Most research projects focus on thermal comfort with heating and cooling possibilities.
- Heating is much easier to implement than cooling.
- A person does not need to be heated but needs control of heat loss from the body



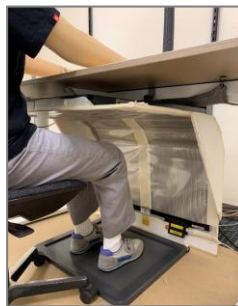
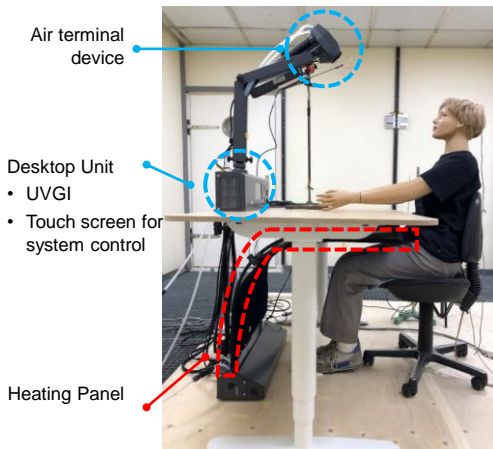
Palm warmer and a heated keyboard



Foot warmer

Cool hands and feet are mainly due to vasoconstriction and not low local temperature.

## Thermal Comfort and Radiant Panels



## Thermal Comfort and Cooling

Most common personal cooling device is personal fan

## Thermal Comfort and Clothing is that PECS

### PERSONAL CONTROL

Garment Description	Thermal Insulation clo	Change of Operative Temp. K
Sleeveless vest	<b>0,12</b>	<b>0,8</b>
Thin sweater	<b>0,20</b>	<b>1,3</b>
Light jacket	<b>0,25</b>	<b>1,6</b>
Normal jacket	<b>0,35</b>	<b>2,2</b>

## Thermal Comfort Chairs

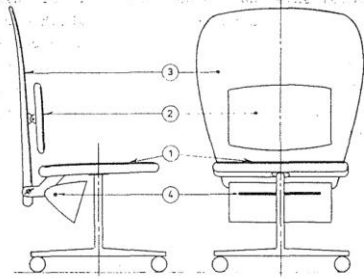


Fig. 6. Principle sketch for a heated chair. Each of the four elements can be controlled separately to a wanted effect.

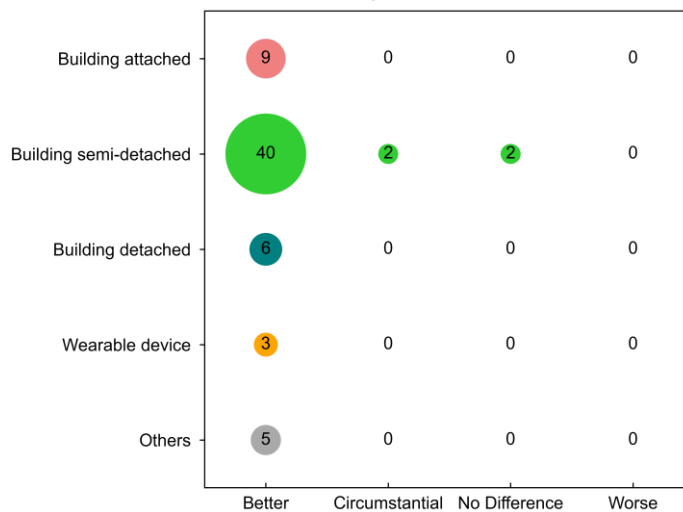
1. heating element in seat.
2. heating element in back
3. radiation heating element behind the back
4. radiation heating element for legs and feet

Madsen and Saxhof, 1979, DTU



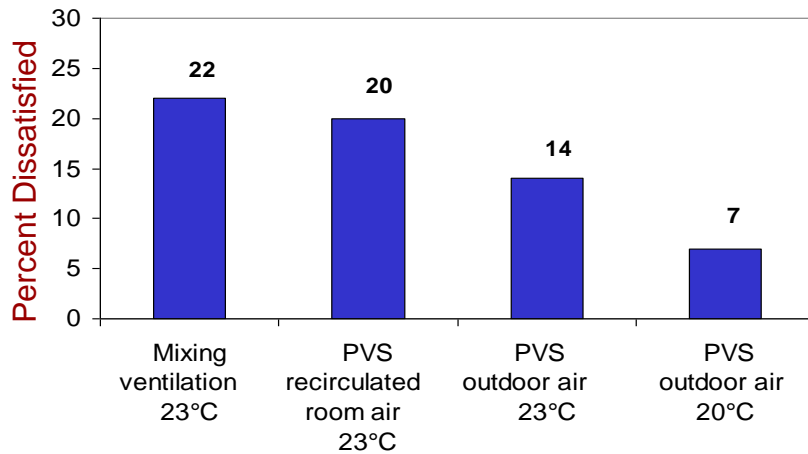
## Does PECS provide a better Indoor Air Quality (IAQ)?

Does PECS provide better IAQ than REF?



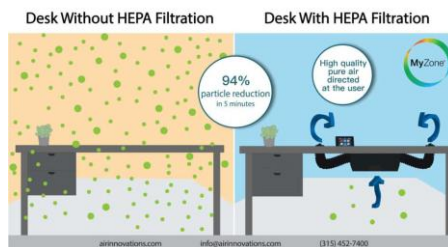
## Personalized Ventilation: Human Response

Subjects dissatisfied with perceived air quality

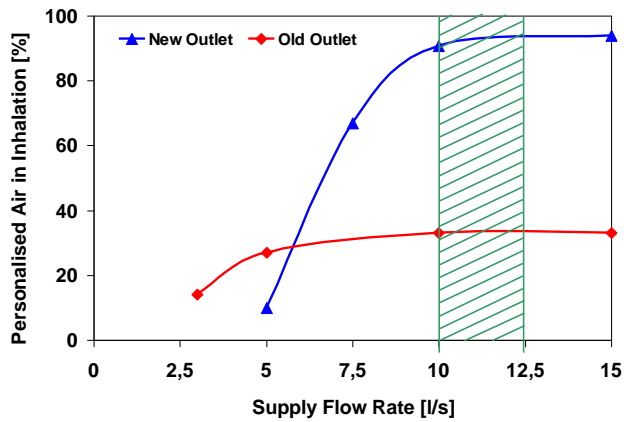


## Indoor Air Quality and Personal Ventilation

- Outside air directly
- Outside air conditioned
- Recirculated room air with filtration/air cleaning



## Performance of Air Supply Devices



$V_e = (10 - 20)$



$V_e = (1.5 - 2.5)$



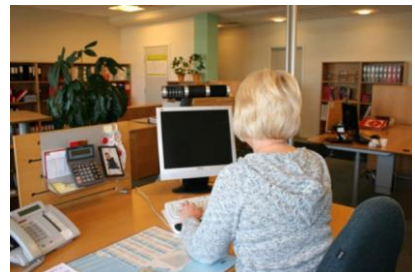
Round Movable Panel



(a)

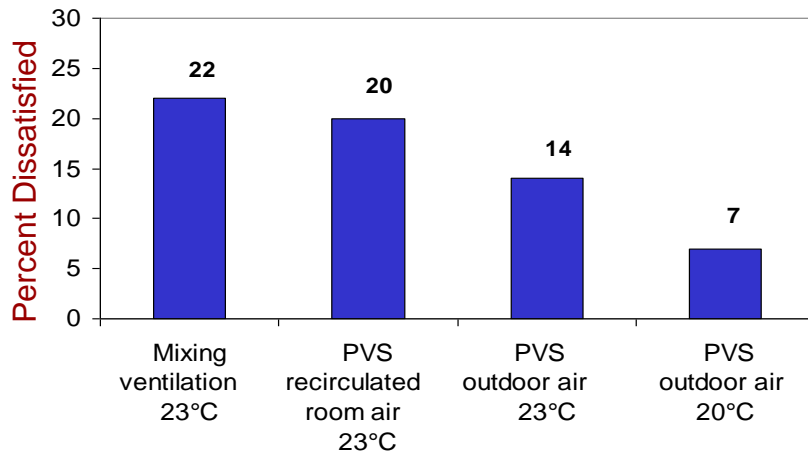
Melikov 2016

Headset  
Clean  
PV air  
Nozzle  
Air supply  
tube

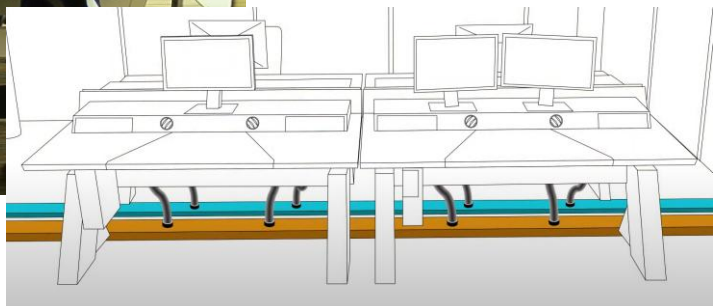
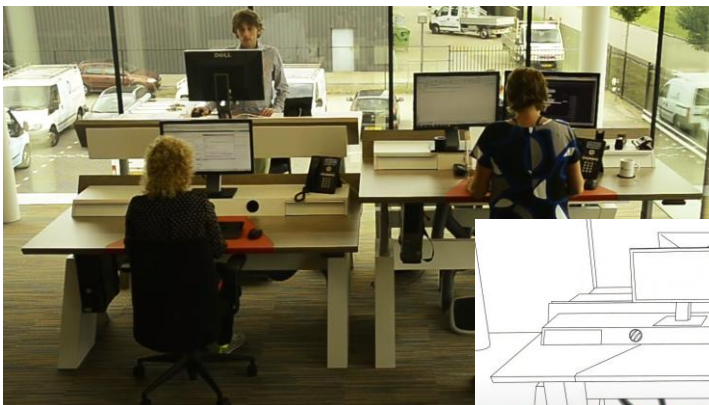


## Personalized Ventilation: Human Response

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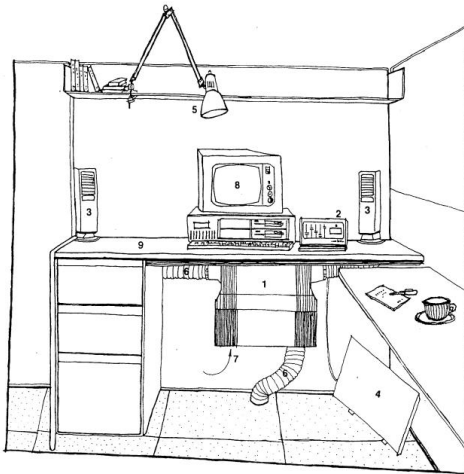


## PECS Products



Van Delft Groep: JEP!  
<https://www.youtube.com/watch?v=FchH4V08OoA>

## All Inclusive PECS are needed



- 1 PEM supply module
- 2 PEM control panel
- 3 PEM supply nozzle
- 4 radiant heating panel
- 5 task light
- 6 flexible supply duct
- 7 recirculated room air
- 8 personal computer
- 9 desk

Bauman et al., 1998

## Lighting and Acoustic

- Most common PECS is a desk lamp
  - Daylight control
  - Light therapy
- Acoustic
  - System noise at high air velocities
  - Masking noise in landscape offices

## Who is producing/selling PECS

- HVAC-manufactures
  - Installation of PECS is after the building and HVAC installations is finished
  - HVAC manufacturers may not focus on the design
- Furniture manufacturer and office supplies
  - Has little knowledge on IEQ
  - Design issues are very important
  - Installed after building and HVAC is finished

## How big is the market?

- PECS requires that people have a more or less fixed workplace
  - Landscape offices
  - Banks
  - Call centres
  - Control centres
- Residential market
  - People are in many companies now working at home 2-3 days a week
  - Companies may therefore cut down on office space
  - Companies may then be responsible for the working conditions at home
  - Would this open a new market?

## Costs?

- Costs are certainly a factor
  - You still need a second general system to condition the space
  - Even if scaled down the total HVAC costs may increase.
- Can increased productivity/performance compensate for the increased costs?
- Can possible energy savings compensate for the increased costs?

## Interaction between main HVAC system and PECS

- In most case where you have PECS you also have a general room conditioning system
- Optimal performance can only be obtained if the general system and PECS communicate with each other

## Future Activities should focus on these issues

- PECS shows the highest performance on Indoor Environmental Quality
- Why not a mainstream HVAC-product?
  - Too expensive?
  - No design guidelines?
  - No standard criteria and testing methods?
  - Energy performance?
  - Installation issues?
  - Operation together with the general ambient system?
- Annex 87 should help bring PECS to market by solving some of these issues.



**The presentation is the opinion of the presenter and not of Annex 87, which are and will in the coming years work with the issue of market penetration**

# Questions

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