

Thermal comfort in buildings with PV-powered thermoelectric surfaces for radiative cooling

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Outline

- **Introduction**
- **Thecla**
concept and hardware
- **Case study**
layout and results process
- **Results**
- **Conclusion and outlook**

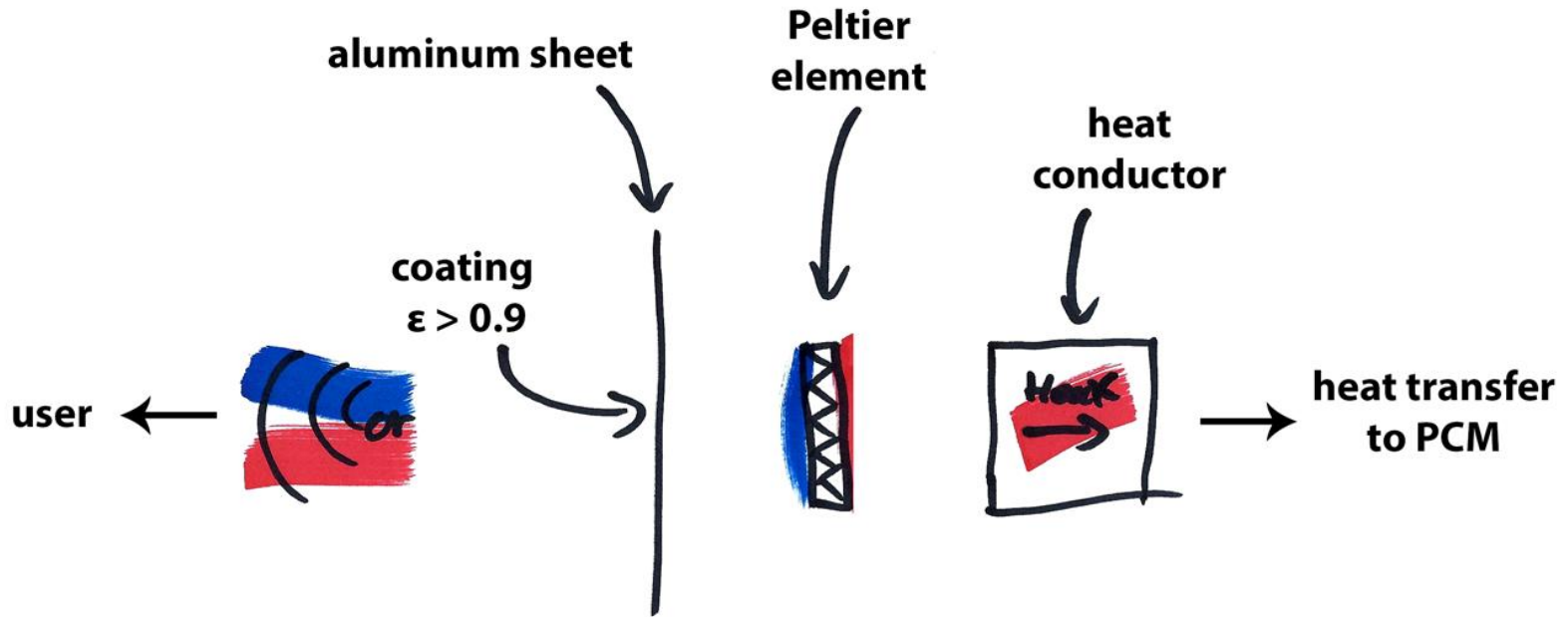
Introduction

- **Partial electricity consumption for space cooling in buildings**
 - In sub-tropical climates: 60 to 72 %
 - Climate change → Rising steadily ↑
- **Standard air-conditioning**
 - One single temperature per room
 - Dehumidification
 - Possible uncomfortable indoor conditions
 - Alternative: longwave radiation exchange

Thecla

- **ThermoElectric Cooling partition with Active heat storage**





Case study

- **Setup**
 - Single workplace in office
 - 27 – 29 °C ambient temperature
 - Thecla approx. 30 – 40 cm from seated subject
- **Structure**
 - 80 min total, including acclimatization
 - Cooling power set to 0 %, 50 %, 100 %, 0 % for 20 min each

period	1	2	3	4
duration	20 min	20 min	20 min	20 min
cooling power	0 %	50 %	100 %	0 %

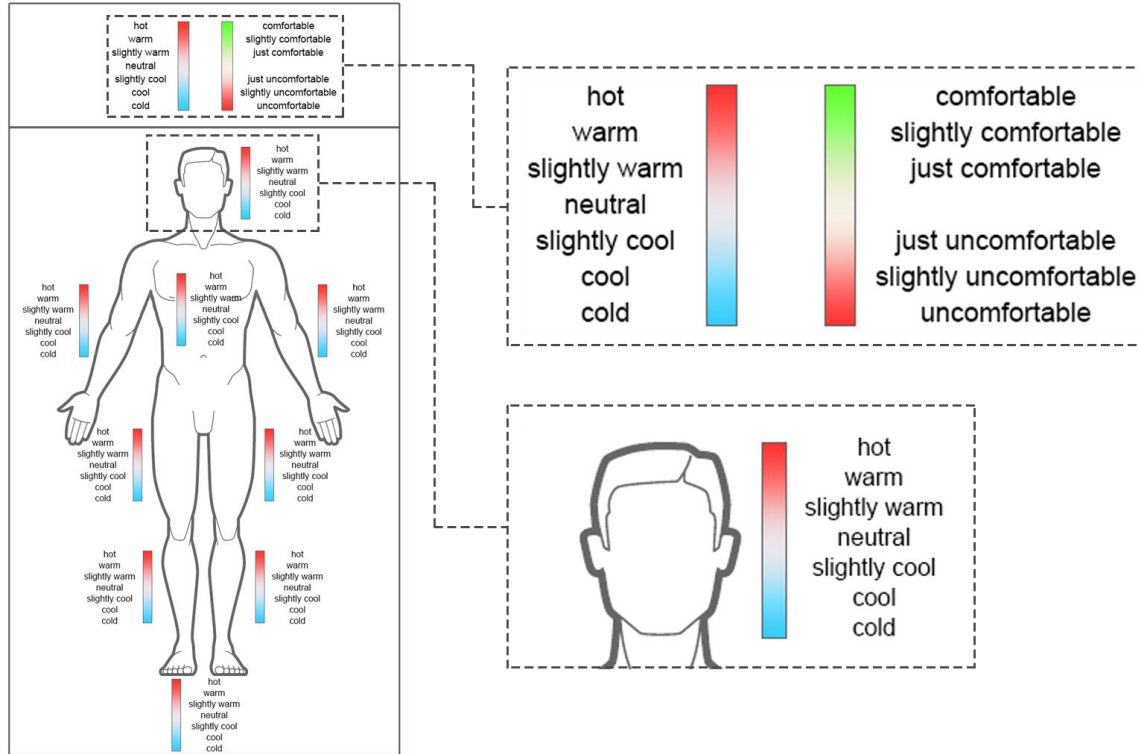
Case study



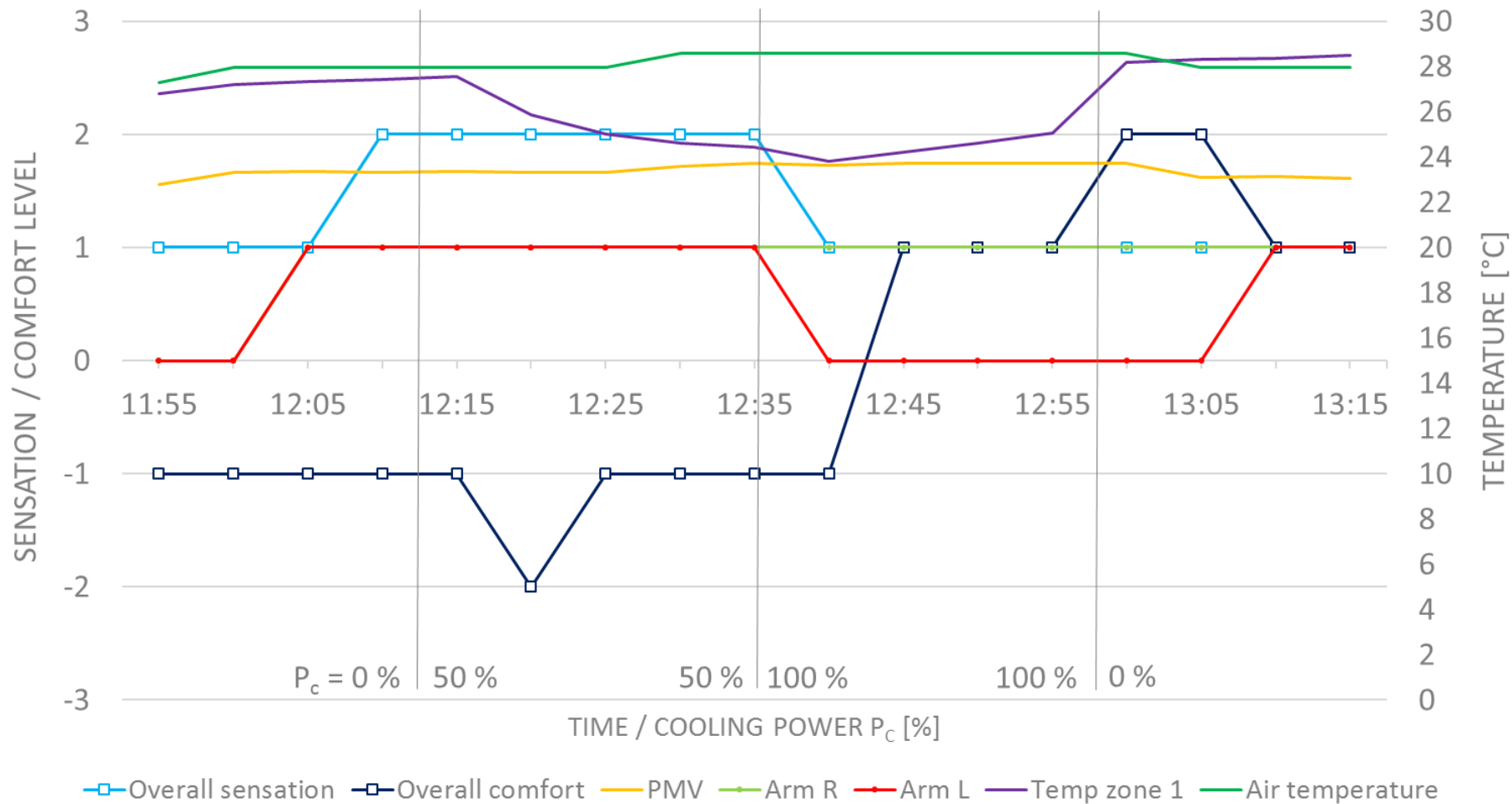
Case study

- **Data recorded**
 - Ambient conditions: air temperature, air velocity, rel. humidity, globe temperature, Thecla surface temperature
 - Subjects' voting every 5 min: overall thermal sensation and thermal comfort + local thermal sensation for body parts on 7 / 6 point ASHRAE scale
- Preliminary study: 7 participants

Case study



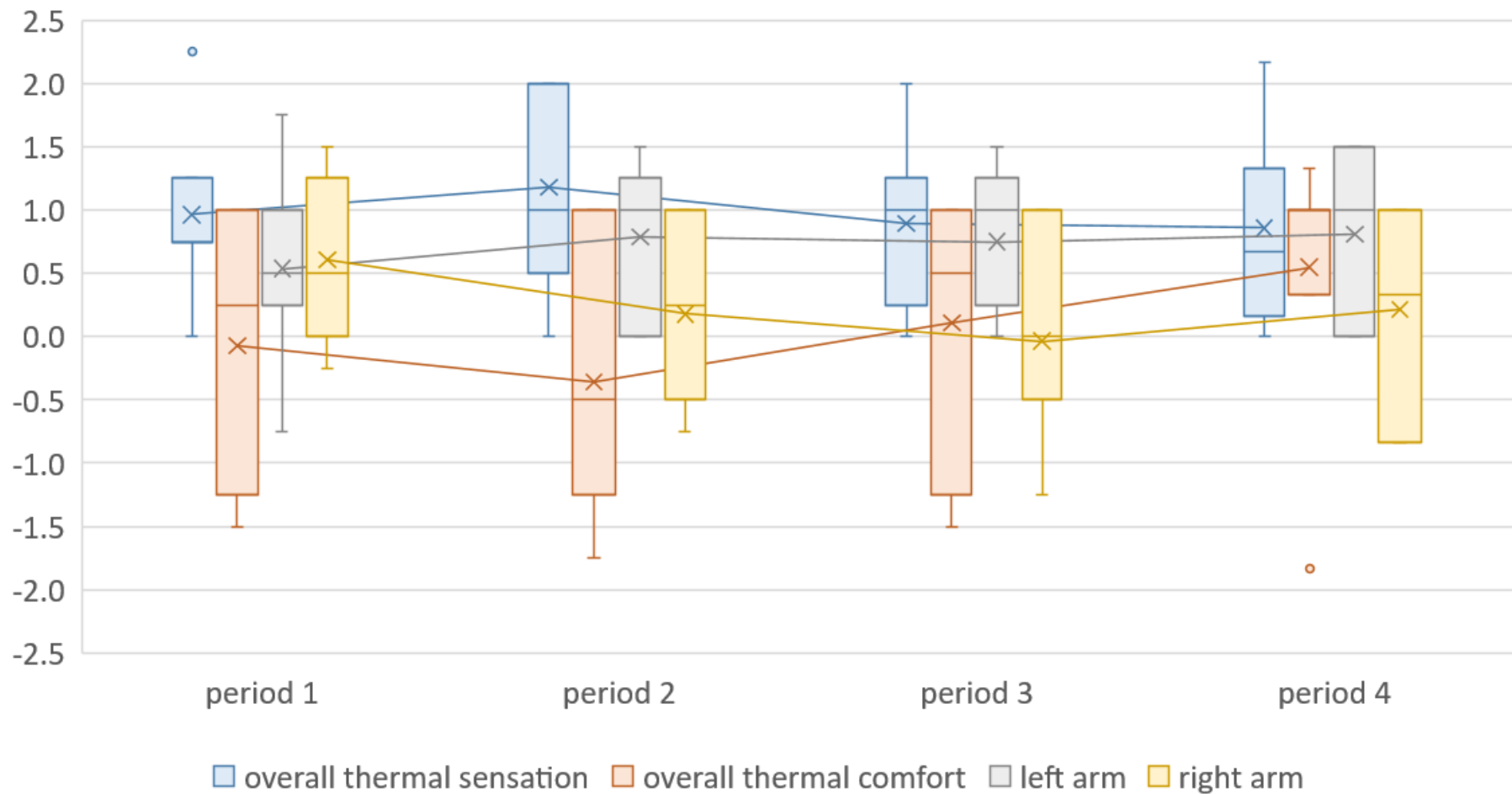
Thecla case study 1 | 02.12.2016 | Participant #7



Results

- **Results summary**
 - Average Thecla surface temperature: 25 / 23 °C
at 50 / 100 % cooling power
- **Cooling effects**
 - Overall thermal sensation: - 0.40
 - Overall thermal comfort: + 0.15 to + 0.55
 - Left arm thermal sensation: ± 0.00
 - Right arm thermal sensation: - 0.25 to - 0.66

Thecla case study 1 | 03.12.2016 | Summary of results



Conclusion and outlook

- **Conclusion**
 - Successful conceptual proof
 - Demonstration of cooling effect when using Thecla
- **Outlook**
 - Extended human subject study
 - Implementation of PCM heat storage
 - Connection to building HVAC systems
 - Determination of influence on building energy efficiency

Thank you for your attention!

**PATENT
PENDING**

Next step...

