

User Influence on Stove Performance

Sustainable Low Emission Stoves Workshop

hosted by IEA Bioenergy Task 32

Progetto Fuoco 2024, Verona

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Long History of Research on User Influence in Austria

- Schmidl, C. (2008). *Chemical characterisation of particulate matter (PM) emissions from biomass combustion sources. PhD Thesis, Vienna University of Technology*
- Several national and international projects between 2009 and 2023
 - New Stoves
 - Future Low Emission Stoves
 - BioCAT (FP7)
 - BeReal (FP7)
 - Clean Air
 - Clean Air II
 - ...
- Public initiatives on user training



*Cooking - the most traditional way of firewood use
(Photo credit: Pexels/Ponyo Sakana)*

Main topics covered

- How do users influence the performance of different wood heating appliances?
 - Which parameters can be influenced by users?
 - How large is their impact on emissions and efficiency?
- How can we „optimize“ the user influence?
 - by automation (reducing influencing factors)
 - by secondary measures (removing emissions which cannot be avoided, e.g. with filters, catalysts, ...)
 - **by training (with different approaches)**

Different training approaches (with scientific evaluation)

- Training at Home – Field Campaigns
- Training Events – Clean Air Trailer
- Training on your own
 - Fire Monitor App (Citizen Science)
 - Video Instructions / Brochures



Training @ home – Field measurements

- Field measurements at 15 sites
- Gaseous and particulate emission measurements
- „Real“ appliance and fuel
- Test concept:
 - User Operation
 - Instruction, Training
 - User Operation



Stove field measurement setup, or

*How to „get rid“ of free space
in your living room*



Challenge: finding users

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Training events – Clean Air Trailer



Data visualisation

Pressure and
temperature sensors

Gas analyser
(CO & O₂)

Training events – Clean Air Trailer



Still ongoing initiative in Styria
<https://www.ea-stmk.at/eag/cleanair-ii/>

Training on your own – User App and Video Instruction



FireMonitor App

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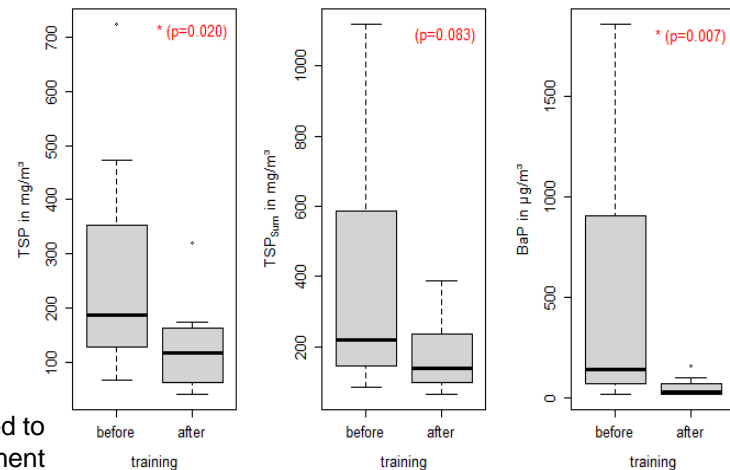
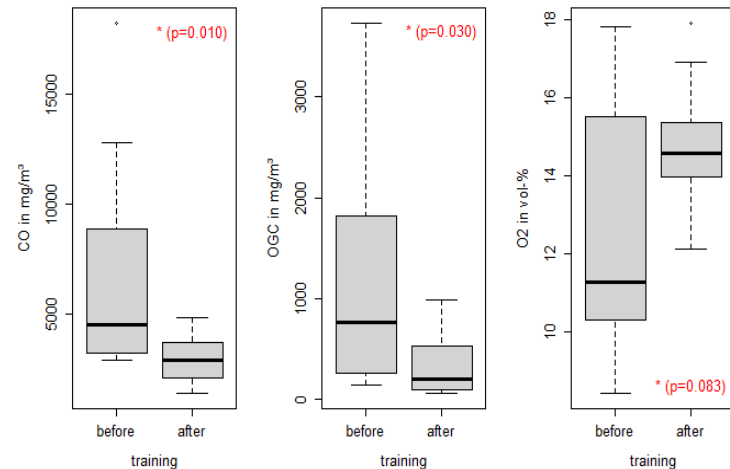
Video Instruction

Link to full video:

<https://www.youtube.com/watch?v=CXLYMvHSHr0>

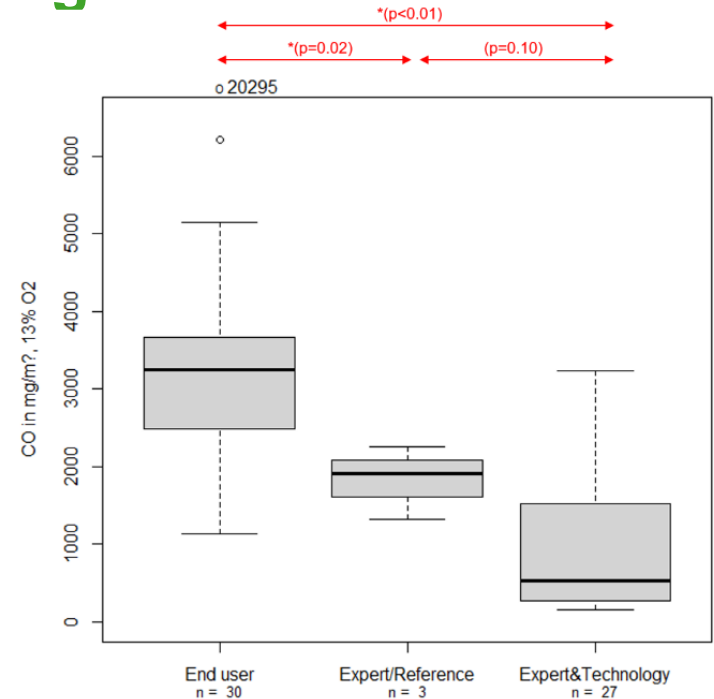
Deep-dive into results...

- Field measurement data (12 sites)
- Particles were measured hot and diluted (TSP_{sum})
- Effects (highly) significant:
 - Emission reduction
 - Lower variability
- Highest effect on Benzo[a]pyrene (BaP) ~ 70% reduction



Results from workshop training

- Measurements in workshops with Clean Air Trailer
- Only CO emissions were measured
- Technology = oxidation catalyst
- Positive effects from field measurements were confirmed
 - Statistically highly significant



Sturmlechner et al. (2024): submitted to Atmospheric Environment

Conclusions

- Users have the highest influence on wood stove performance
- User training significantly reduces emissions
 - Average reduction rates > 50% for all parameters measured
 - Maloperation (with extremely high emission) is avoided
- No „perfect“ training solution – different measures required?
 - Training events: personal contact, gamification, social (but limited reach)
 - Training @ home: use of own equipment (but high effort, limited reach)
 - Training videos and end user apps: highest reach/coverage (but impact unclear)
- Open question: Will the positive effect sustain after one training or does it require regular re-training?



Feedback after Training:

„I learned how to ignite a stove...“

„ ...more smokefree and clean ...“

„... less soot on the window...“

Thank you for your kind attention!

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