

Indoor Particle Pollution from Residential Wood Stoves

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1 Introduction & Purpose

Small residential wood stoves are a well-known source to outdoor air pollution with fine particulate matter ($PM_{2.5}$), ultrafine particles ($PM_{0.1}$), and other key pollutants.

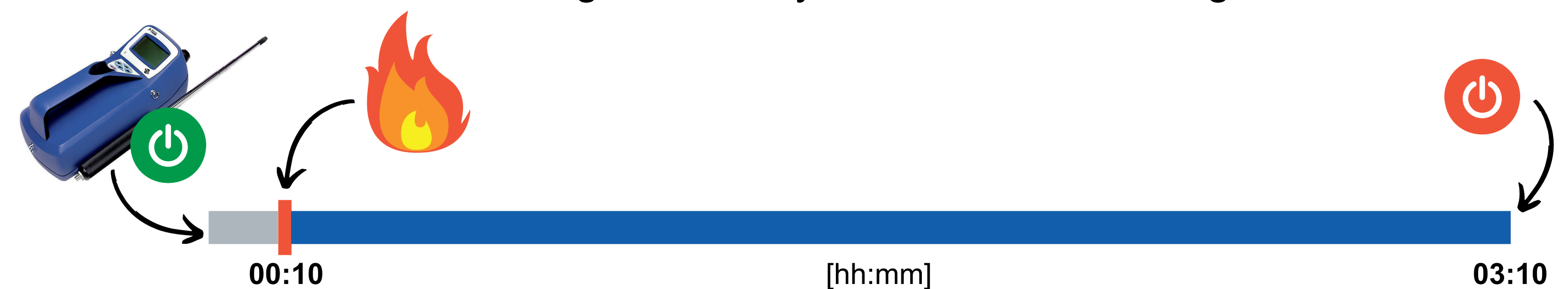
However, an increasing number of recent studies also document wood stoves as a significant source of indoor air pollution. Still, there is no legislative limits for indoor air pollution caused by new wood stoves. New technologies combining electrostatic precipitators with smoke extractors promise to reduce both outdoor and indoor air pollution from wood stoves. Studies confirm reduction in outdoor air pollution but not much documentation exists for indoor air pollution.

Purpose: To perform systematic measurements of indoor particle pollution primarily with $PM_{0.1}$, but also $PM_{2.5}$, from wood stoves and to investigate if electrostatic precipitators with smoke extractors reduce indoor particle pollution from wood stoves.

2 Methodology

Indoor particle pollution in 20 houses in Denmark with wood stoves was measured with newly calibrated P-Traks and DustTraks from TSI. Two of these houses had electrostatic precipitators with smoke extractors. In one house, measurements were conducted both before and after installing an electrostatic precipitator with a smoke extractor.

Background measurements were done for 10 minutes before igniting the wood stove. Pollution measurements were done for about three hours during the normal use of the wood stove (by the house owner). Indoor measurements were taken in a 2-4 meters distance from the wood stoves i.e. at locations where the residents would typically stay when the stove was in use, e.g. on nearby coffee table or dining table etc.



3 Results

This study confirms significant indoor air pollution with fine and ultrafine particles from some wood stoves and that the pollution can be caused by varying factors. The main findings are presented below.

1 Hour Mean Ultrafine Particle Conc. in 20 Houses

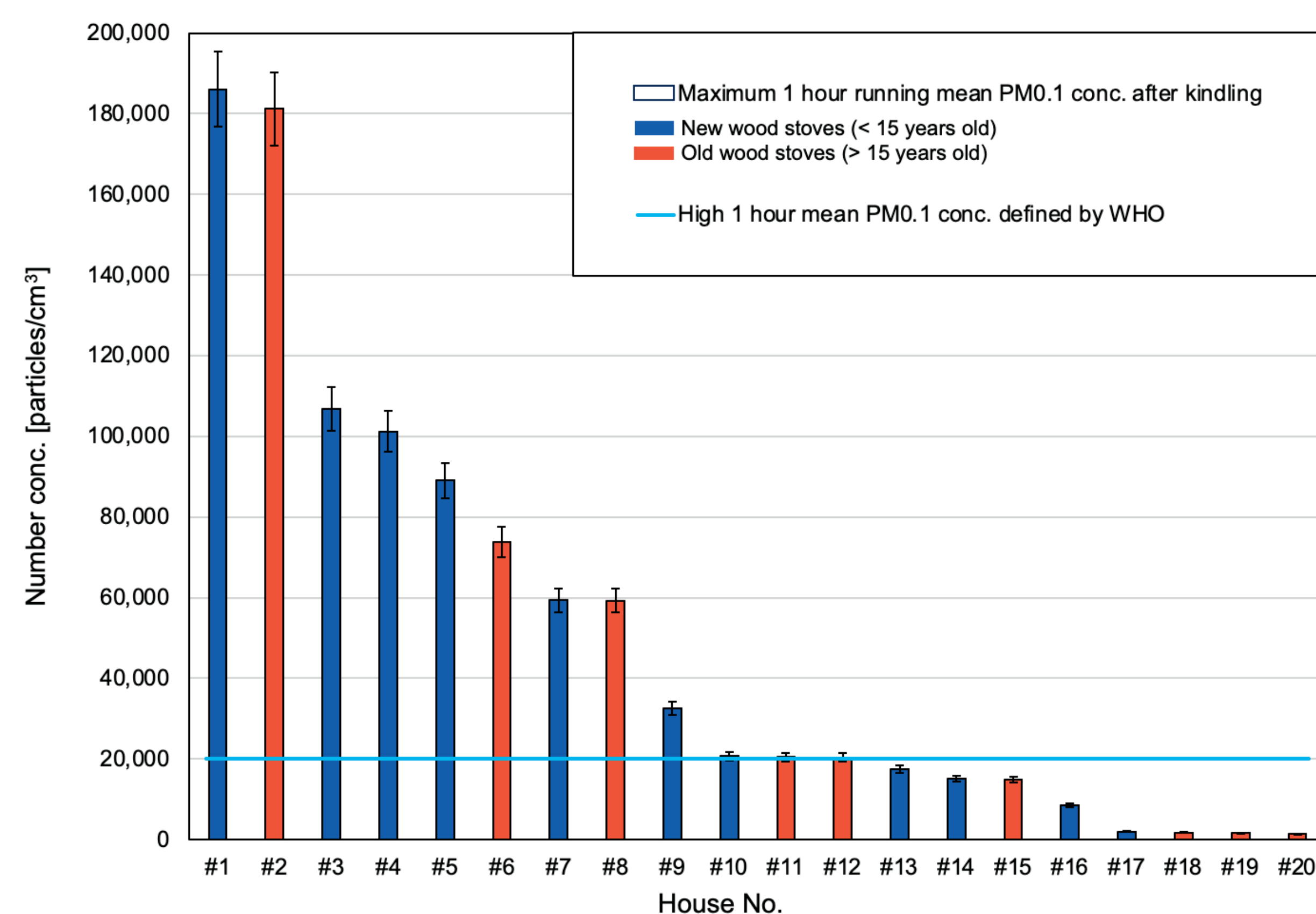


Fig. 1 Maximum 1 hour running mean of the measured $PM_{0.1}$ concentration in all houses.

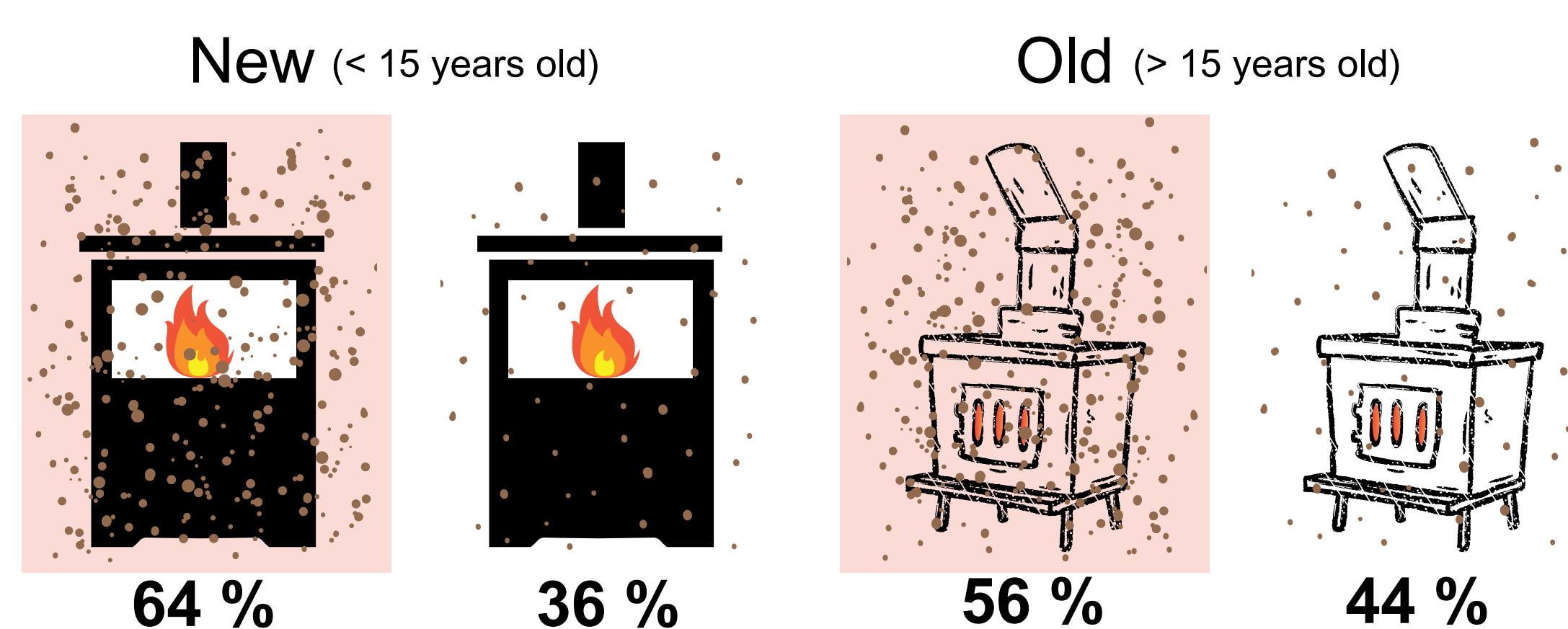


Fig. 2 Distribution by percentage of wood stoves emitting $PM_{0.1}$ concentrations of $> 20,000$ particles/ cm^3 and $< 20,000$ particles/ cm^3 on an hourly average in the groups new (< 15 y/o) and old (> 15 y/o). $> 20,000$ particles/ cm^3 on an hourly average are considered high levels.

Comparison of Ultrafine Particle Conc. Pre and Post Installation of Electrostatic Precipitator

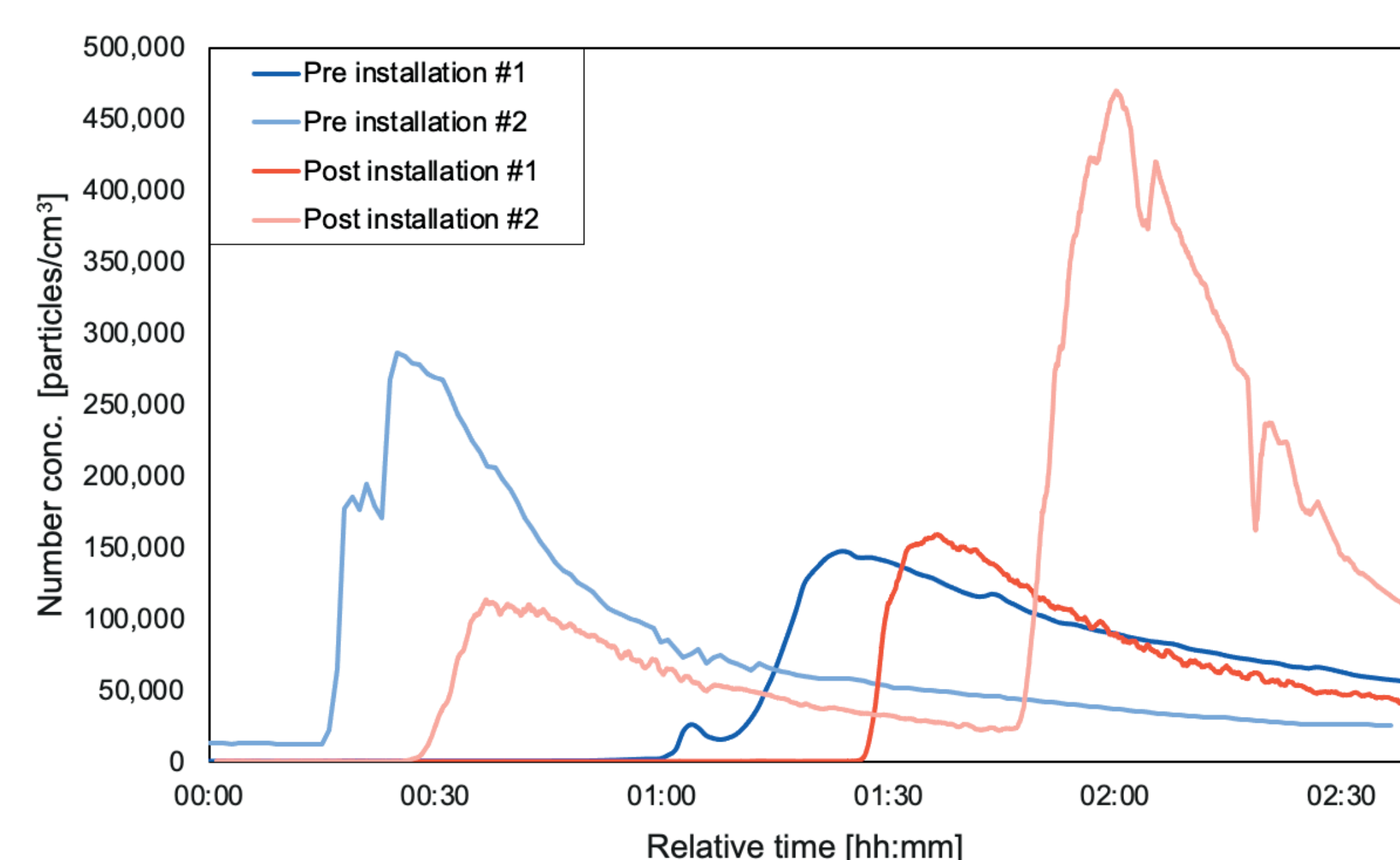


Fig. 3 $PM_{0.1}$ concentrations measured on 4 independent days in the same house. Two measurements are conducted before and two after installation of the electrostatic precipitator.

Take-Home Messages

- Small residential wood stoves can cause significant indoor air pollution with particulate matter.
- Electrostatic precipitators with smoke extractors were not found to reduce indoor particle pollution.
- New eco-labelled wood stoves were not found to pollute the indoor environment less than old wood stoves.

Acknowledgements

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