Indoor air pollution caused by wood-burning in Brazilian and Danish dwellings

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INDOOR AIR POLLUTION CAUSED BY WOOD-BURNING IN BRAZILIAN AND DANISH HOUSEHOLDS

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Domestic wood combustion worldwide

low-cost stoves in low carbon dwellings

Biomass burning can be carbon neutral when performed under optimal lightning and operating conditions

Many different practices by more than 3 billion people worldwide representing one of the major causes of respiratory diseases such as asma and alergies with more than 4 million permature deaths each year, in both developing and developing countries (UNDP, 2011)

Human health
Epidemological studies
Associated to human exposure to air pollutants

Sustainability of the globe

- *Desforestation*
- *Energy consumption*
- *Air pollution*

Inefficient residential biomass combustion

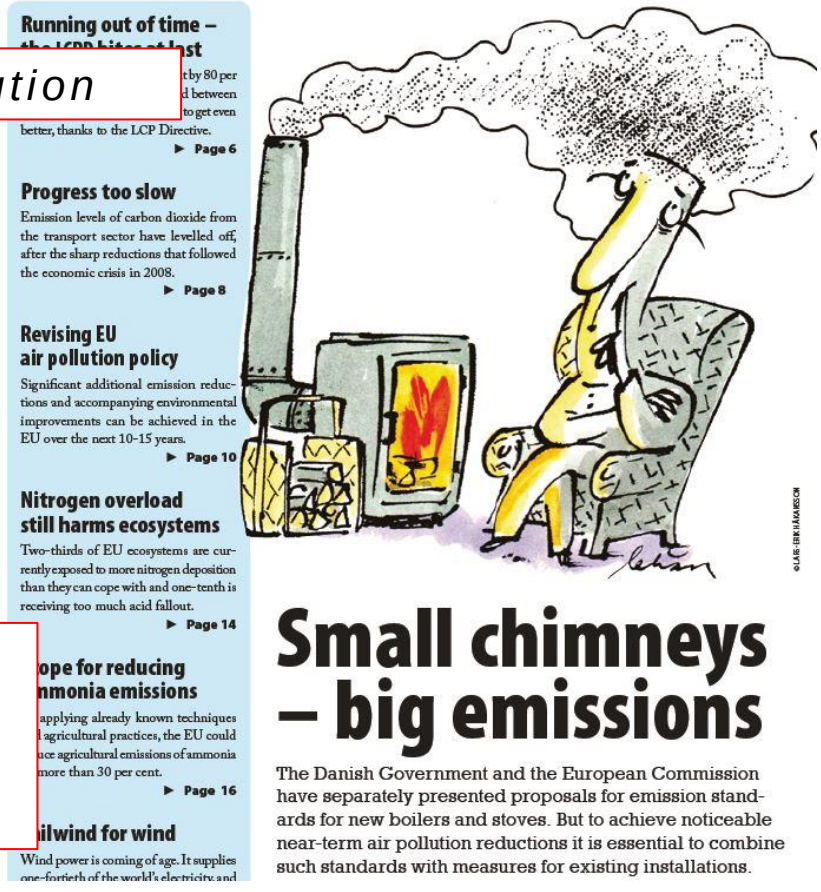
Air pollution

Deforestation

Overheating

Indoor air pollution

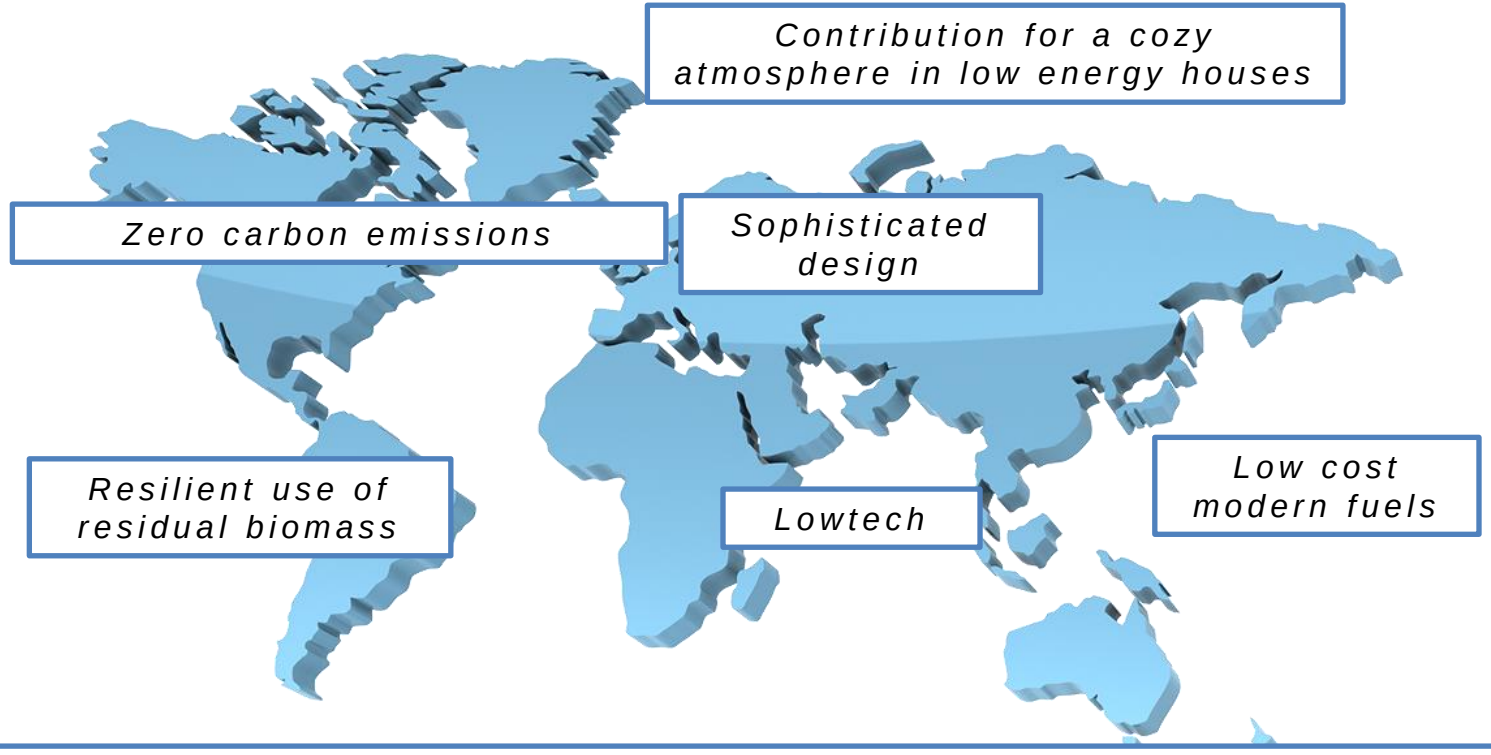
Respiratory diseases such pneumonia by inhalation of fine particles and carbon monoxide as well as high indoor temperatures



Running out of time –
Progress too slow
Emission levels of carbon dioxide from the transport sector have levelled off, after the sharp reductions that followed the economic crisis in 2008.
► Page 8
Revising EU air pollution policy
Significant additional emission reductions and accompanying environmental improvements can be achieved in the EU over the next 10-15 years.
► Page 10
Nitrogen overload still harms ecosystems
Two-thirds of EU ecosystems are currently exposed to more nitrogen deposition than they can cope with and one-tenth is receiving too much acid fallout.
► Page 14
Small chimneys – big emissions
The Danish Government and the European Commission have separately presented proposals for emission standards for new boilers and stoves. But to achieve noticeable near-term air pollution reductions it is essential to combine such standards with measures for existing installations.

Air Pollution & Climate Secretariat, 2013

Appropriate domestic biomass use:
What is the potential for the mitigation of GHG emissions?



What is the potential/magnitude of the mitigation measures by implementing certain practices including technological innovations and modern fuels in biomass stoves?

Danish Building Research Institute, 2012

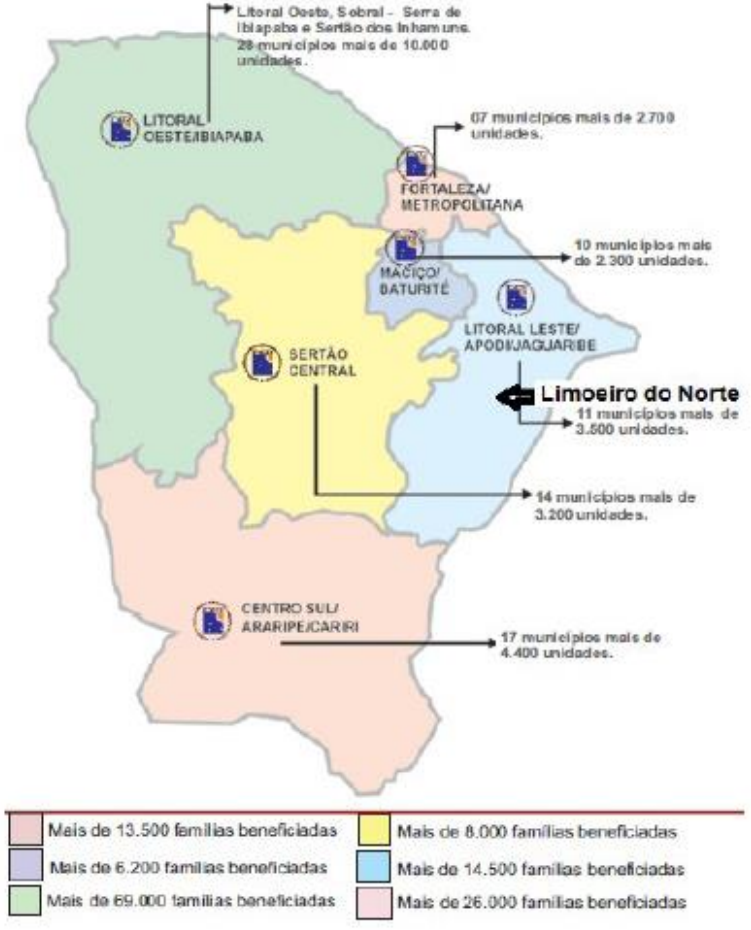
Indoor wood smoke in developing regions

- ***Latin America, África and Asia are among the developing regions where domestic wood combustion is very popular (3 billion people worldwide)***
- ***In Brazil*** around 27,2% of the residential energy consumption is associated to the use of wood logs for cooking/heating (cold regions) (BEN, 2013)
- Ineficient domestion biomass burning practices causes overheating and indoor contamination by unburned gases associated to the uncompleted wood combustion in rural housing of northeast Brazil

New efficient combustion chambers have been being developed worldwide in order to optimize the complete biomass combustion towards the reduction of black carbon emissions indoors and outdoors

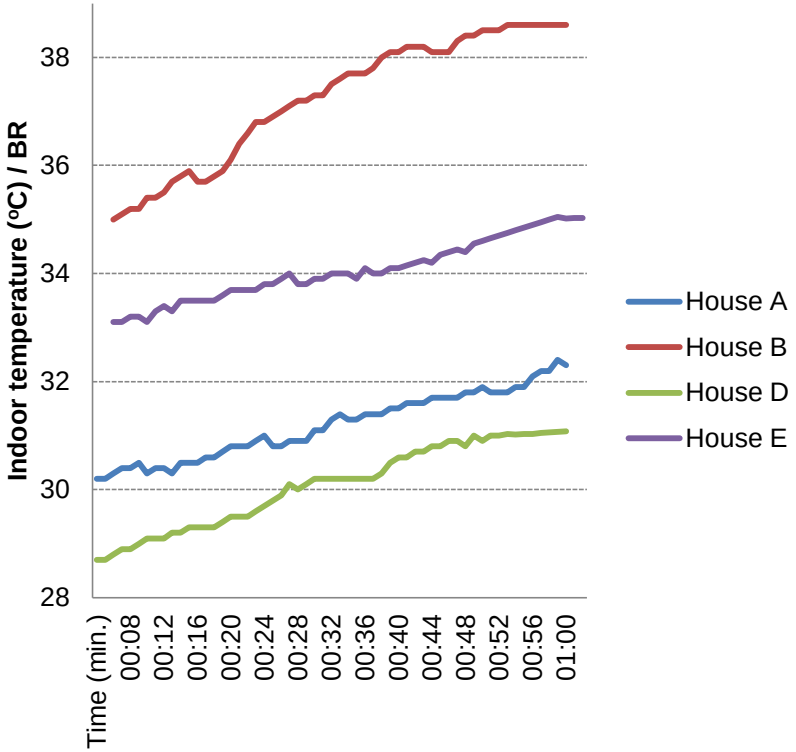
Wood heating as a resilient practice towards a cozy atmosphere?

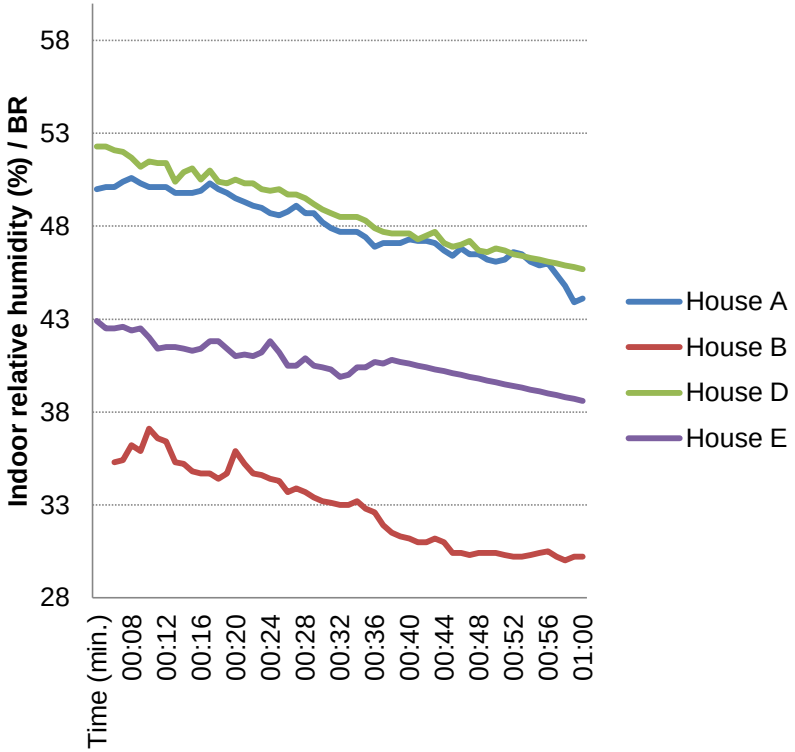
Large-scale wood-burning stove program in CE-Brasil/Latin America



Indoor climate in rural households (Brazil)

…when using an improved efficient mass stove?



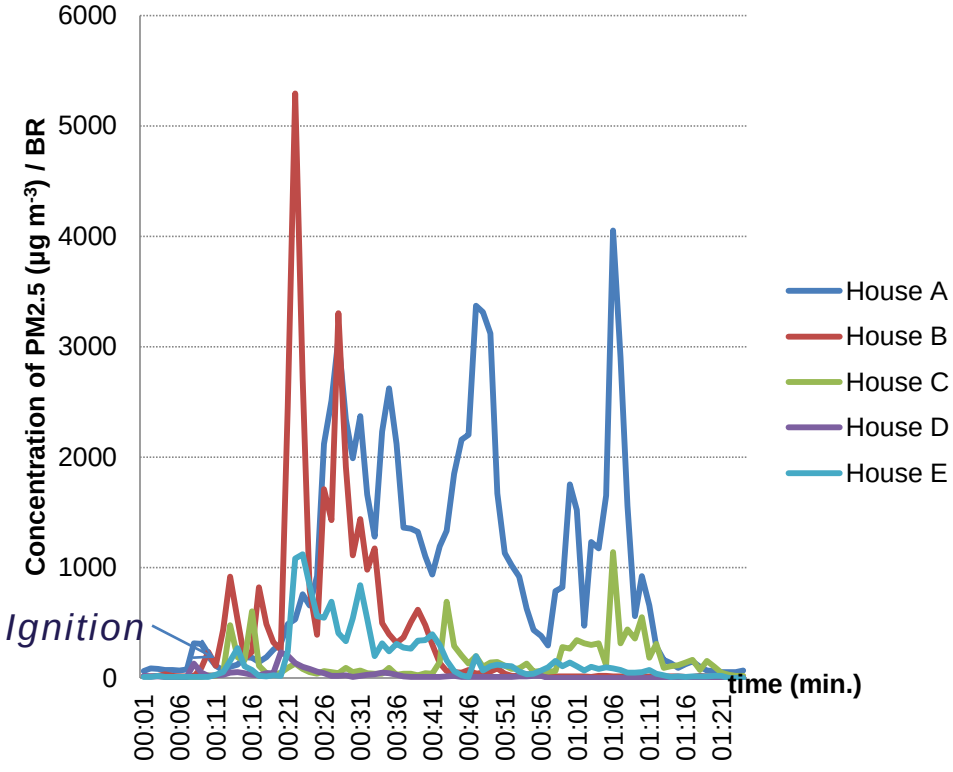


Mean outdoor temperature 33-35 oC and RH 40-51%

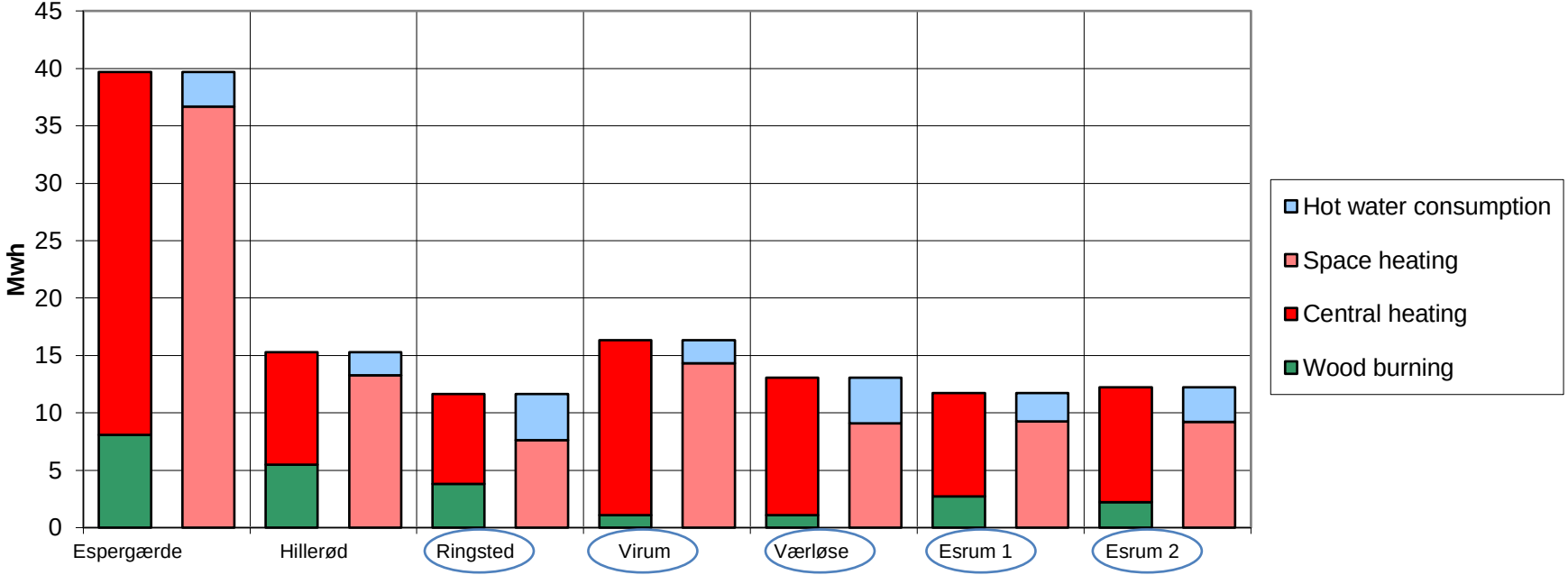
Fine particles in rural households (Brazil)

kitchens of developing regions in northeast Brazil

- House B with a lower ventilation rate in a closed kitchen with no wind brise reaveled an higher indoor concentration of fine particles
- The stove chaminey exhaust at the house A presented was not working properly due to lacks of cleaning, inadequate installations and the stove walls were leaking the flue gas due to breaks on the brick walls caused by very high temperatures in the brick walls
- Soft wood promotes indoor smoke and a short-term combustion



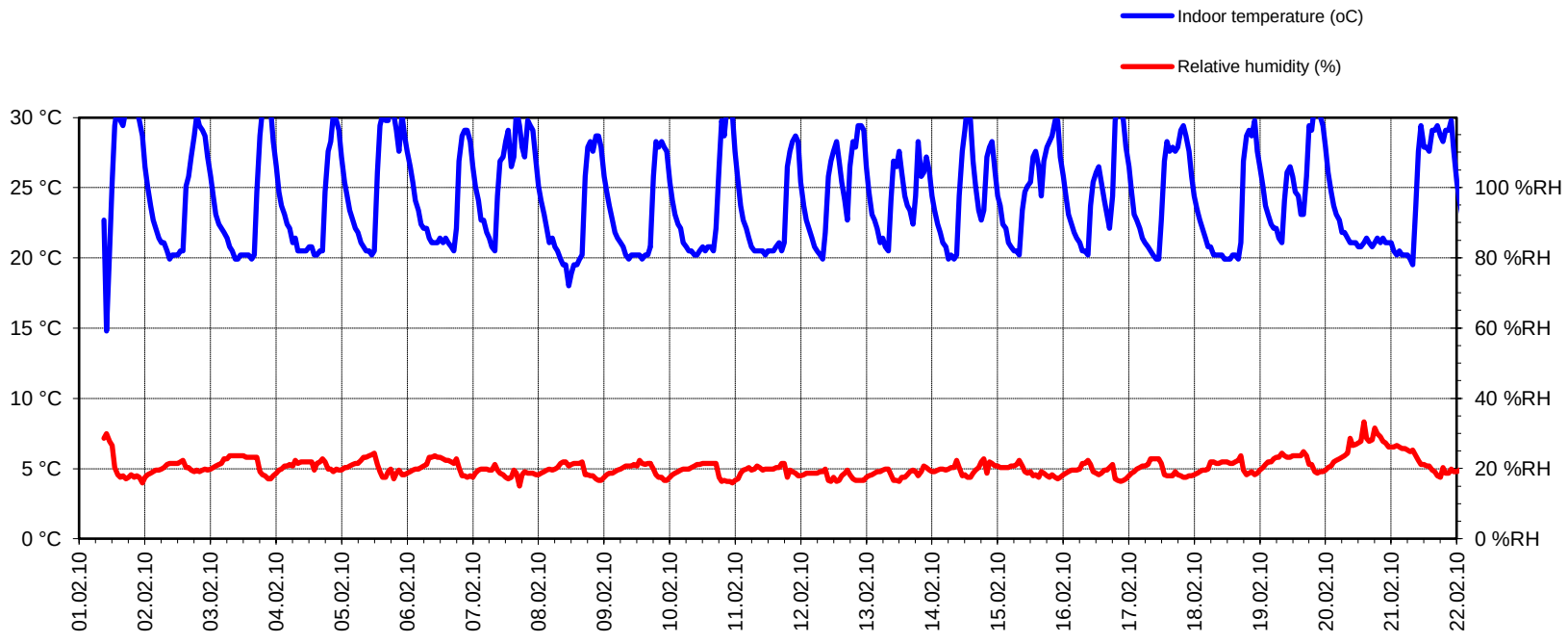
Field studies in single-family households in CPH (Denmark)



R.L.T. Carvalho, 2013

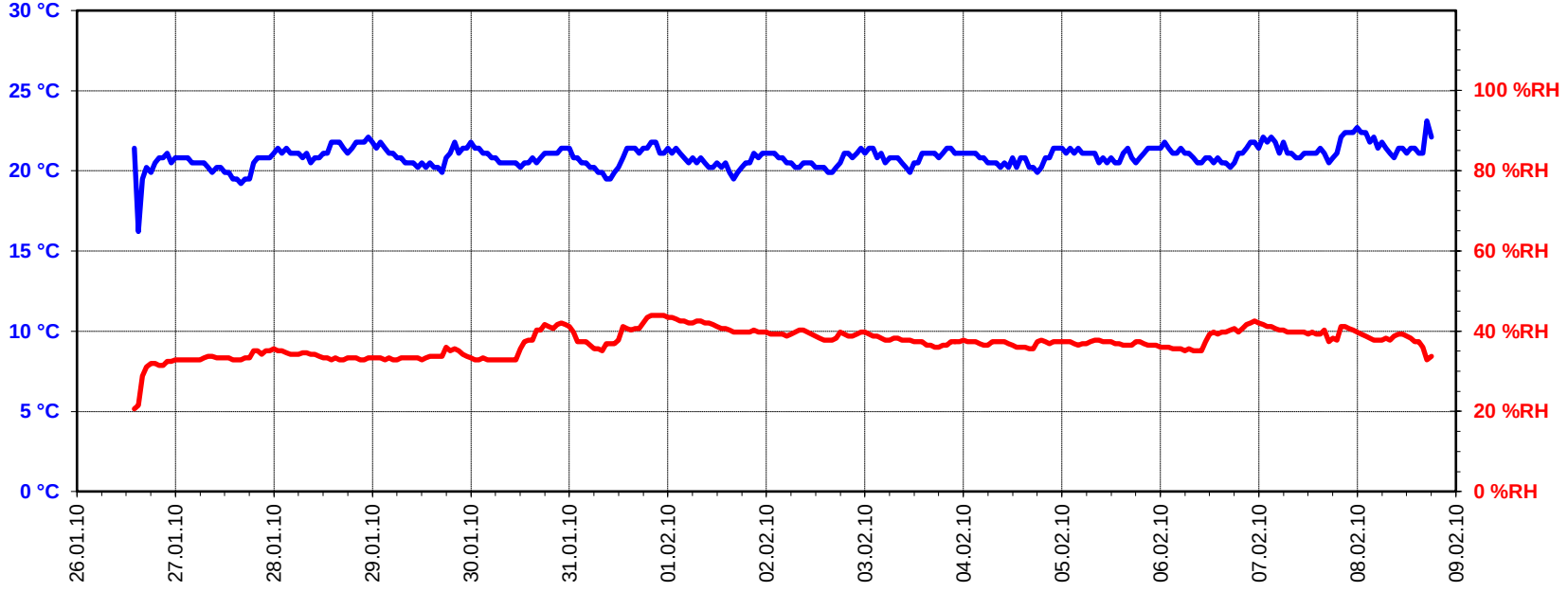
Indoor climate in a low energy house (Denmark)

…using a certified wood cast-iron stove…



Indoor climate in a Danish single family house (class B)

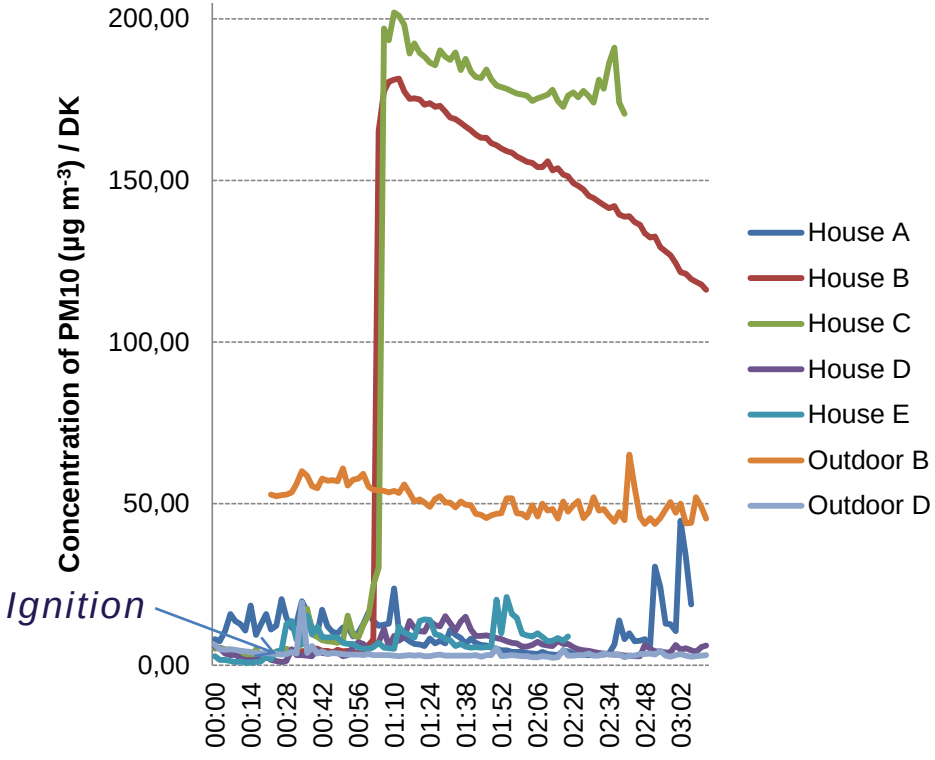
…using a wood mansory stove…



Inhalable particles in low energy households (Denmark)

- House B and C with a lower ventilation rate and higher air-tighness using Swan labelled cast-iron stoves, respectively, reaveled indoor concentrations of PM_{10} over 150 µg m^{-3} during periods larger than 1 hour

  (air-exchange rate 33-58 m^3h^{-1})
- Hard wood promotes a long-term combustion for more than 1 hour/cycle
- Even the expert in lightning was not able to mitigate high emission of inhalable particles in class A single-family houses



Conclusions findings worldwide

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QUESTIONS?

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