Scaling housing interventions for wood-burning stoves worldwide

Luis Teles de Carvalho, Ricardo; Jensen, Ole Michael; da Cruz Tarelho, Luís António; Cabral da Silva, Adeildo

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SCALING HOUSE INTERVENTIONS FOR WOOD-BURNING STOVES WORLDWIDE

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RICARDO L. T. CARVALHO, OLE M. JENSEN, LUÍS A. C. TARELHO, ADEILDO C. SILVA

RLC@SBI.AAU.DK
LOWCARBONRETROFITTING.WORDPRESS.COM
Domestic biomass combustion worldwide

We know that biomass burning can be carbon neutral when using dry local biomass performing lightning from top to down and operating the stove with primary and secondary air to burn volatile organic compounds.

A global issue...

Human health
- Epidemiological studies
- Associated to human exposure to air pollutants

Health of the globe
- Desforestation
- Energy consumption
- Air pollution/ climate change
Causes of inefficient biomass combustion (large increase on solid-fuel burning during the last years)

- **Air pollution due to inadequate operation**
- **Indoor confort**
- **Low quality solid-fuels**
- **Impacting on biodiversity**

**Impacts on human health, there is a global issue of climate change**
Appropriate domestic biomass use: What are the potential measures for GHGs mitigation?

- Design new cleaner combustion appliances
- Sophisticated ecodesign/confort
- Zero emission of unburned gases and black carbon
- Efficient practices
- Low cost innovations
- Collect residual dry wood and use of modern fuels
Practices and solid fuels worldwide

Developing regions
- Cooking
  - Firewood, straw, briquettes, shrubs
- Lighting
- Cooking, space heating/DWH
  - Charcoal, waste, briquettes, pellets, biogas, LPG

Developed regions
- Heating/cooyness
  - Firewood, pellets, natural gas, electricity

Low income (Asia, Africa, Latin America)

Middle income (Europe, Latin America and Australia/NZ)

High income (Northern Europe, US and Canada)
Overheating in low energy houses

new biomass stoves and EU labelling

Heating requirement (kW) for a sitting room at 50 m²

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Ole M. Jensen et al. Danish Building Research Institute, 2012
Magnitude of interventions in dwellings?

- **Developed Regions (mid income)**
  - Developed regions
  - Well developed regions

- **Developing regions**

- **High --x_i-- Levels of complexity----x_i--Low**

- **Global mitigation of air pollution**
  - Focusing on (ultra) fine particles and carbon
  - By improving thermal efficiency

- **High income**
  - Digital control and heat storage
  - Secondary air intake/outdoor primary air
  - \( \eta > 85\% \)
  - \( \eta > 80\% \)

- **Mid income**
  - \( \eta > 85\% \)

- **Low income**
  - \( \eta > 50-80\% \)

- **Modern fuels**
  - 4500 - 6000 €

- **Improved local solid fuels**
  - 400 - 4500 €
  - 100 - 400 €
Indoor climate measurements in low energy houses
guidance to scaling household interventions

Operating manually
Energy savings
Fine particle mitigation

Afshari, A. et al., 2011

Lightning stove

SBI – 23.09.2013
Testing efficient cooking stoves (Latin America)

Improved cooking stove Nina (Peru) have a thermal efficiency of 30% and new efficient wood cooking stove IDER (Brazil) saves 40% of solid-fuels.
Cataloging stoves in Latin America and Europe
Methodology for modelling mitigation measures impact

**Number of users for regions, stoves and solid fuels**

- Thermal mass/storage (appropriation and energy savings)
- Household’s real heating demand
- Stove heating supply (matching)
- Biomass consumption per hour
- Calorific power capacity/wet fraction of biomass

**Reference Scenario 2010**

- Domestic Biomass use 2030
- Appropriate heat demand Increasing $\eta$
- Best practices
  - High
  - Mid income
  - Low
- Emission factors
  - PM2.5
  - CO
  - TVOCs

**Potential savings/mitigation**

- PM2.5 emissions 2030 (g/kg)
Modelling/estimations energy savings and PM$_{2.5}$ emissions EU27 (*work in progress...*)

Scenario A: stable

![Graph showing emissions projections over years](image)
Modelling/estimations energy savings and PM$_{2.5}$ emissions in Latin America (work in progress…)?

Ricardo L.T. Carvalho
Scale up-grading biomass stoves until 2030
big changes with low cost innovations?

- Primary air in small chamber
- P-secondary air in small chamber
- P-tertiary outdoor air automation using modern fuels
- Solar/automatic heat exchange with filters
- Solar/automatic exhaust using modern fuels
- Automatic exhaust using modern fuels

Green: Developed regions
Orange: Developing regions

Years
2010 2015 2020 2030
Innovations (degree of complexity)
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QUESTIONS?

RICARDO L. T. CARVALHO, OLE M. JENSEN, LUÍS A. C. TARELHO, ADEILDO C. SILVA

rlc@sbi.aau.dk
lowcarbonretrofitting.wordpress.com