



Aalborg Universitet

AALBORG UNIVERSITY  
DENMARK

## 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

*Published in:*  
Environment and Health Perspectives

*Publication date:*  
2013

*Document Version*  
Accepted author manuscript, peer reviewed version

[Link to publication from Aalborg University](#)

*Citation for published version (APA):*  
Luis Teles de Carvalho, R., Jensen, O. M., da Cruz Tarelho, L. A., & Cabral da Silva, A. (2013). Scaling housing interventions for wood-burning stoves worldwide. *Environment and Health Perspectives*.  
<http://ehp.niehs.nih.gov/ehbasel13/o-4-16-01/>

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

### Take down policy

If you believe that this document breaches copyright please contact us at [vbn@aub.aau.dk](mailto:vbn@aub.aau.dk) providing details, and we will remove access to the work immediately and investigate your claim.



Environment and Health –  
Bridging South, North, East and West

Conference of ISEE, ISES and ISIAQ  
Basel, Switzerland 19 – 23 August 2013



# SCALLING HOUSE INTERVENTIONS FOR WOOD-BURNING STOVES WORLDWIDE

*HOUSEHOLD AIR POLLUTION AND RISK ASSESSMENT  
ENVIRONMENT AND HEALTH, BASEL, AUGUST 2013*

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

[RLC@SBI.AAU.DK](mailto:RLC@SBI.AAU.DK)

[LOWCARBONRETROFITTING.WORDPRESS.COM](http://LOWCARBONRETROFITTING.WORDPRESS.COM)



**DANISH BUILDING RESEARCH INSTITUTE**  
AALBORG UNIVERSITY COPENHAGEN



**cesam**

centro de estudos do ambiente e do mar  
universidade de aveiro

**FCT** Fundação para a Ciência e a Tecnologia

MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA

# 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)

Impacting on biodiversity

Low quality solid-fuels

Air pollution due to inadequate operation

Indoor confort

Impacts on human health, there is a global issue of **climate change**



**Running out of time – the 1990s at last**  
Emission levels of carbon dioxide from the transport sector have levelled off, after the sharp reductions that followed the economic crisis in 2008. ▶ Page 6

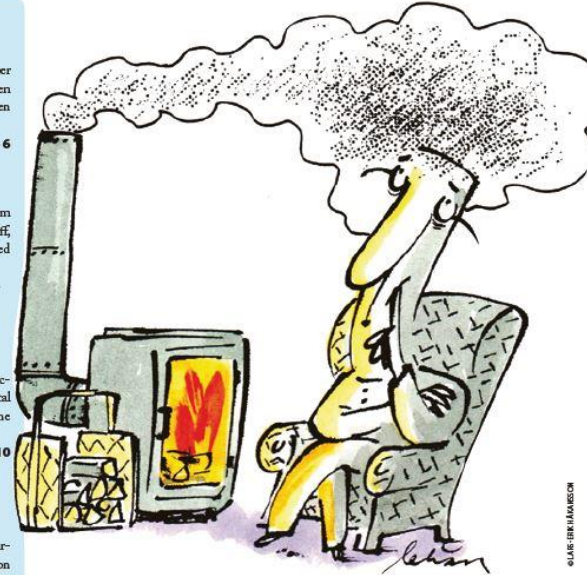
**Progress too slow**  
Emission levels of carbon dioxide from the transport sector have levelled off, after the sharp reductions that followed the economic crisis in 2008. ▶ Page 8

**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

**Scope for reducing ammonia emissions**  
By applying already known techniques and agricultural practices, the EU could reduce agricultural emissions of ammonia by more than 30 per cent. ▶ Page 16

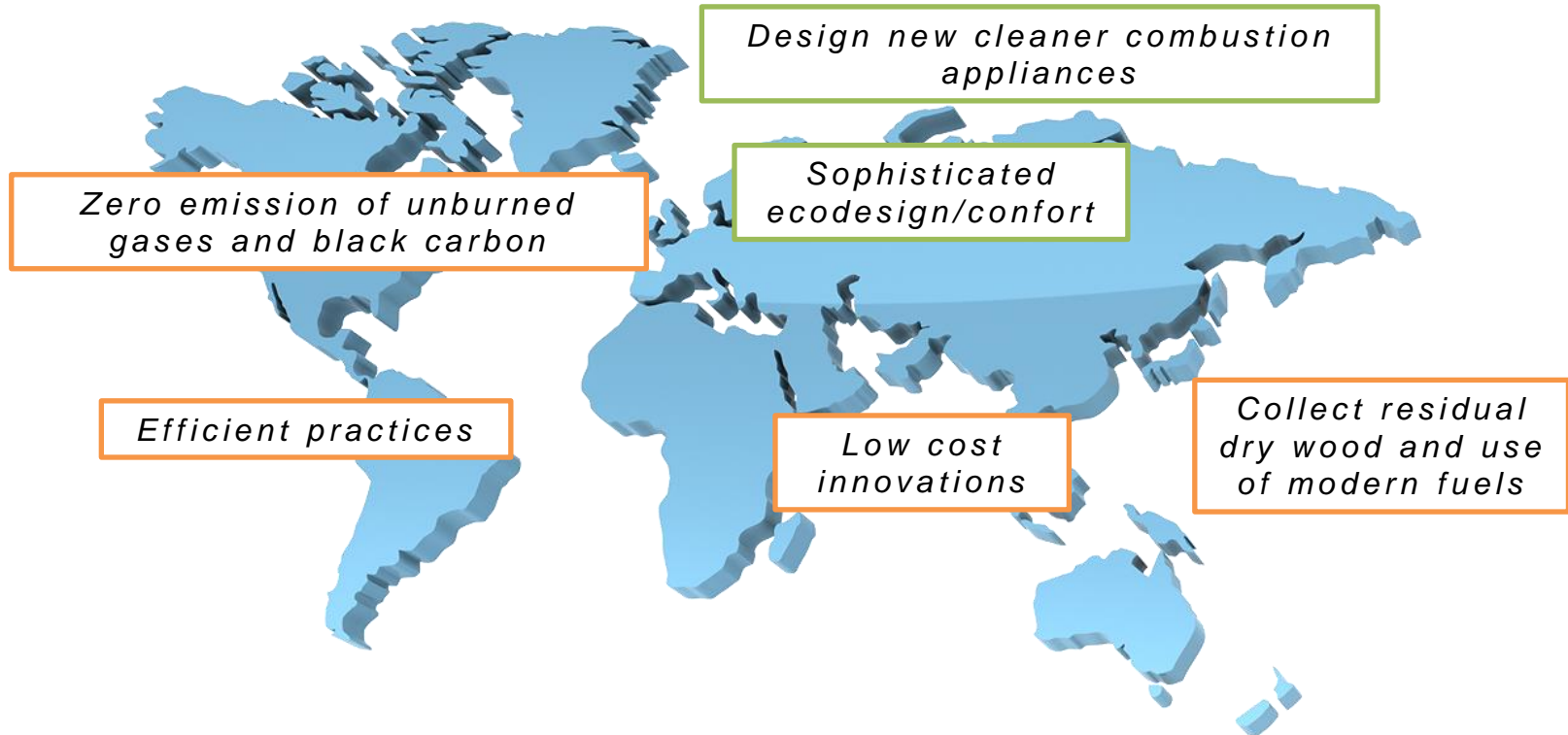
**Tailwind for wind**  
Wind power is coming of age. It supplies one-fourth of the world's electricity and



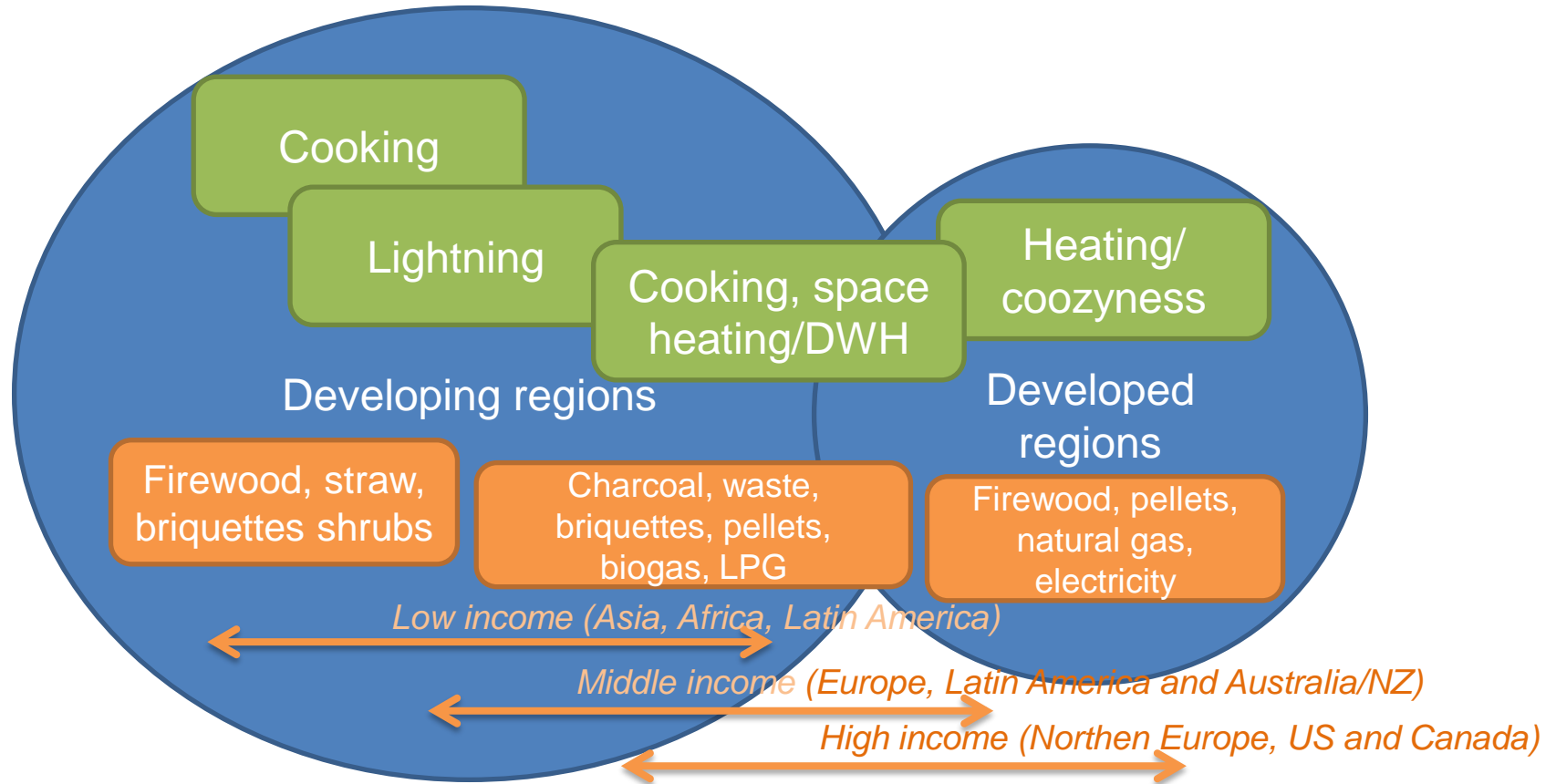
## Small chimneys – big emissions

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.

# Appropriate domestic biomass use: *What are the potential measures for GHGs mitigation?*



# Practices and solid fuels worldwide



# Overheating in low energy houses

## *new biomass stoves and EU labelling*

Heating requirement (kW) for at sitting room at 50 m<sup>2</sup>

Outdoor temperature (kW)	BR 1961	BR 1977	BR 1985	BR 1995	BR 2006	BR 2010
10 °C	2,1	1,9	1,3	1,3	1,2	1,0
5 °C	3,1	2,8	1,9	1,9	1,8	1,5
0 °C	4,2	3,7	2,5	2,6	2,3	2,0
-5 °C	5,2	4,7	3,1	3,2	2,9	2,5
-10 °C	6,2	5,6	3,8	3,8	3,5	3,0

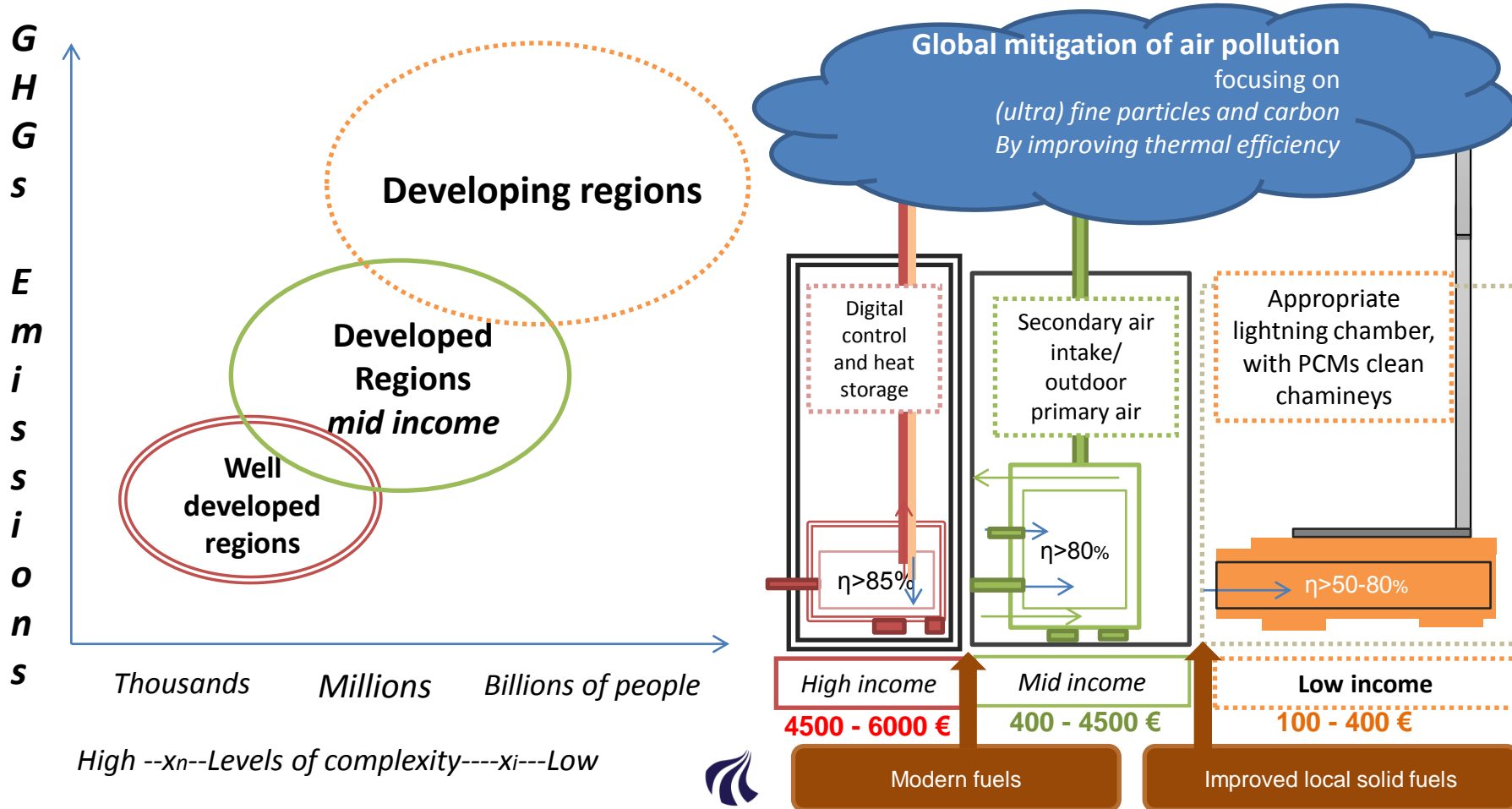


*Ole M. Jensen et al. Danish Building Research Institute, 2012*





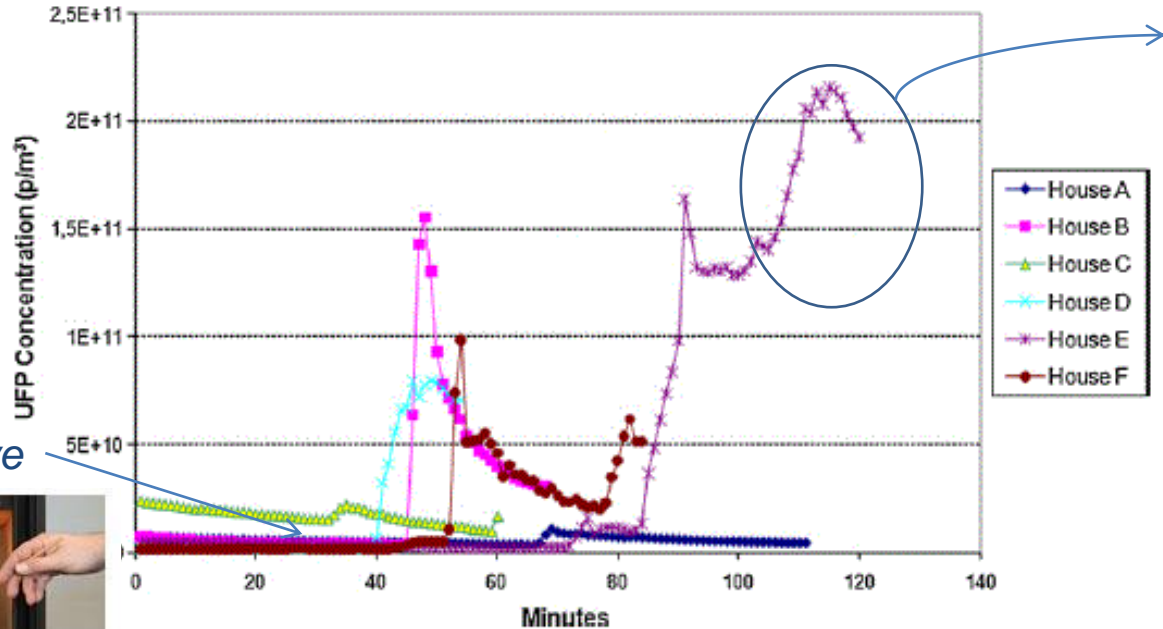
# Magnitude of interventions in dwellings?





# Indoor climate measurements in low energy houses

## *guidance to scaling household interventions*



*Operating manually*



*Energy savings  
Fine particle mitigation*

*Lightning stove*



*Afshari, A. et al., 2011*



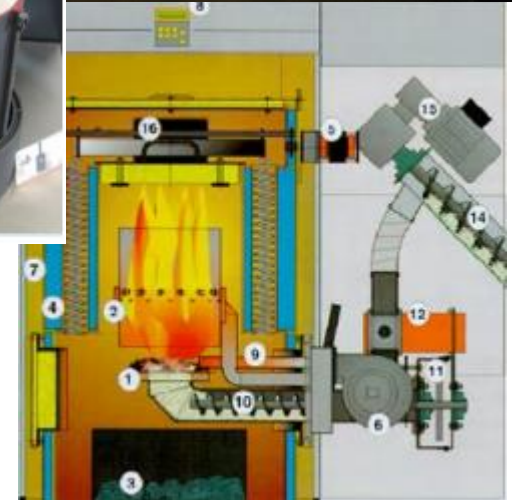
# Testing efficient cooking stoves (Latin America)



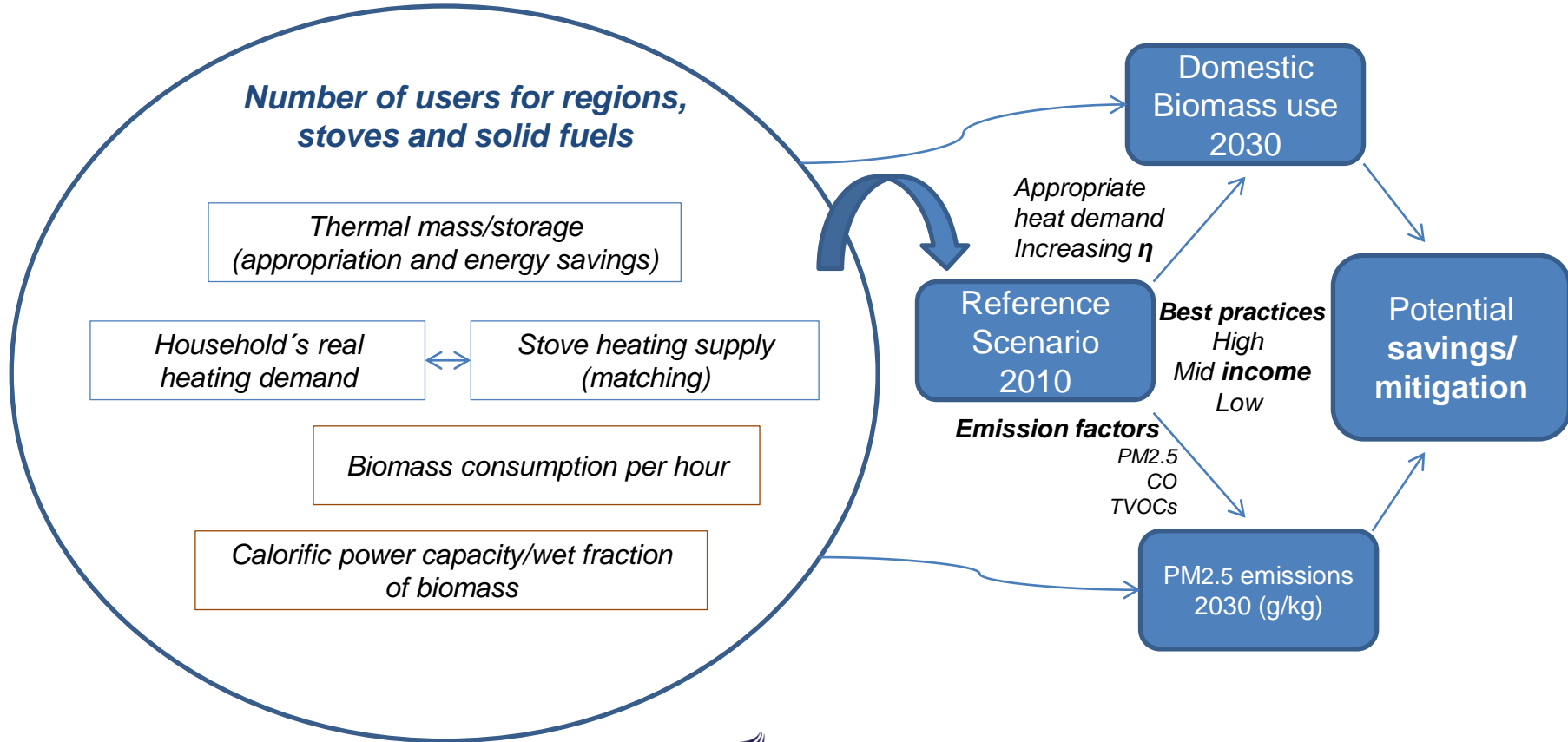
*Improved cooking stove Nina (Peru) have a thermal efficiency of 30% and new efficient wood cooking stove IDER (Brazil) saves 40% of solid-fuels*



# Cataloging stoves in Latin America and Europe



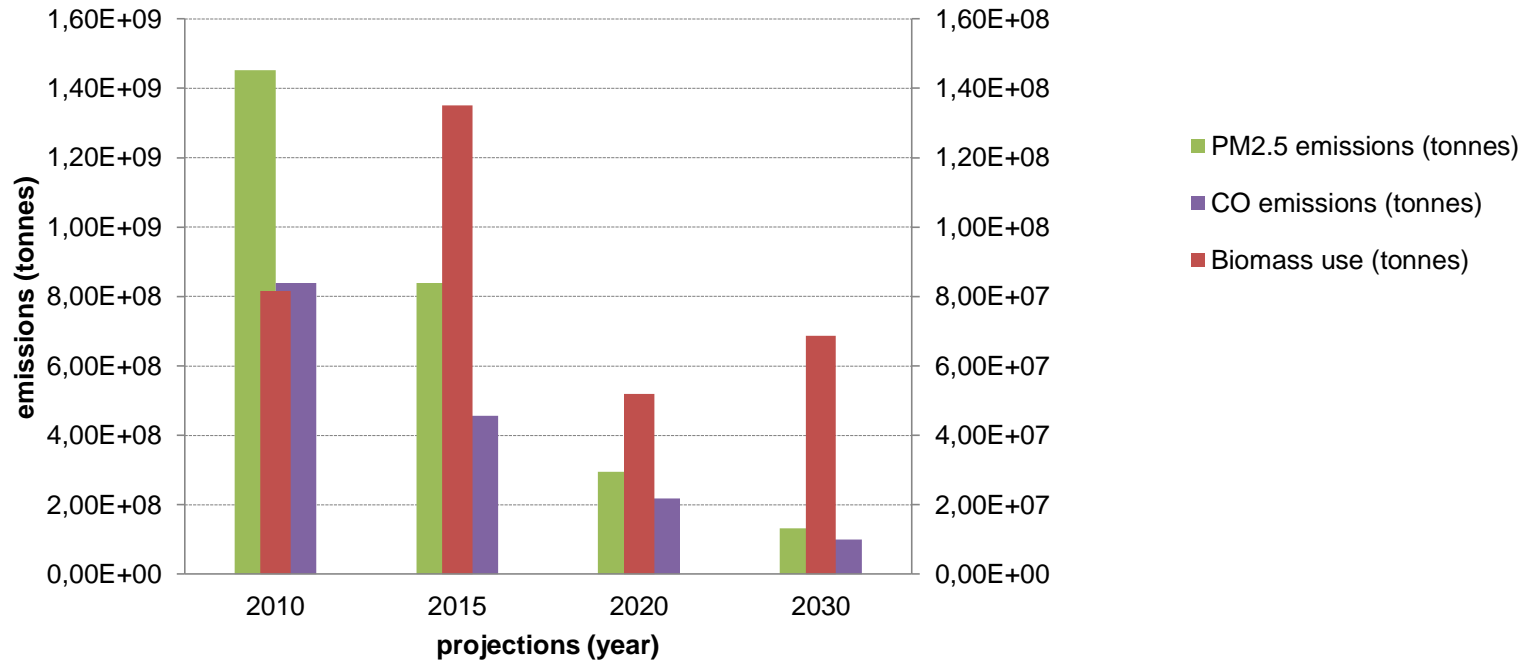
# Methodology for modelling mitigation measures impact





# Modelling/estimations energy savings and PM<sub>2.5</sub> emissions EU27 *(work in progress...)*

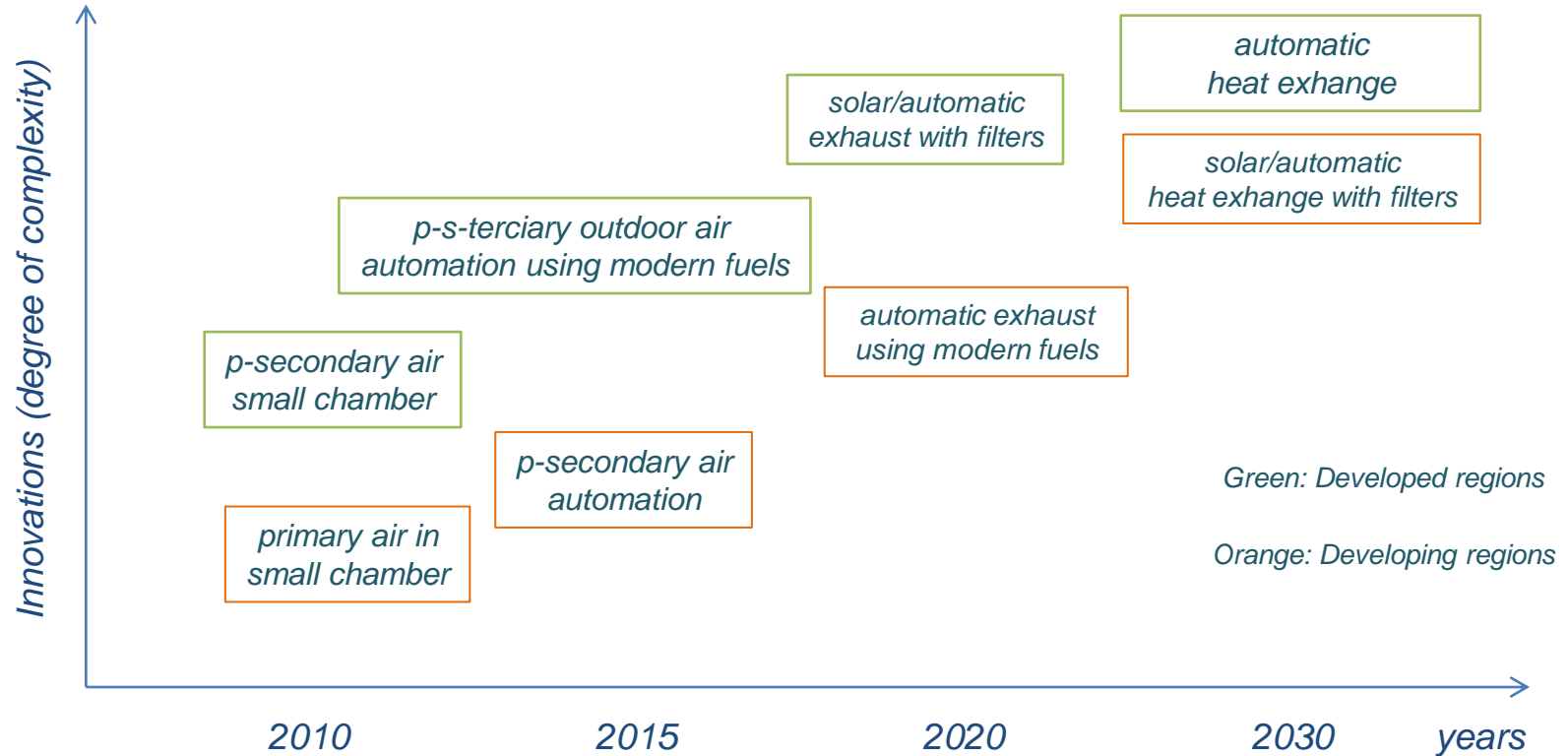
## Scenario A: stable



Modelling/estimations energy savings and PM<sub>2.5</sub> emissions in Latin America *(work in progress...)??*

# Scale up-grading biomass stoves until 2030

## *big changes with low cost innovations?*







Environment and Health –  
Bridging South, North, East and West

Conference of ISEE, ISES and ISIAQ  
Basel, Switzerland 19 – 23 August 2013



# SCALLING HOUSE INTERVENTIONS FOR WOOD-BURNING STOVES WORLDWIDE

## QUESTIONS?

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

[RLC@SBI.AAU.DK](mailto:RLC@SBI.AAU.DK)

[LOWCARBONRETROFITTING.WORDPRESS.COM](http://LOWCARBONRETROFITTING.WORDPRESS.COM)



**DANISH BUILDING RESEARCH INSTITUTE**  
AALBORG UNIVERSITY COPENHAGEN



**cesam**

centro de estudos do ambiente e do mar  
universidade de aveiro

**FCT** Fundação para a Ciência e a Tecnologia

MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA