

A photograph of a wood stove chimney emitting smoke against a sunset sky over a snowy landscape. The sun is low on the horizon, casting a warm glow over the scene. The smoke is thick and dark, contrasting with the bright orange and yellow light of the setting sun. The foreground shows a snow-covered roof and the chimney structure.

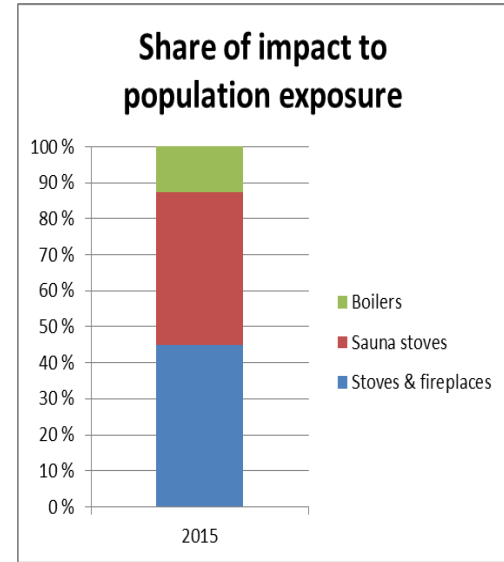
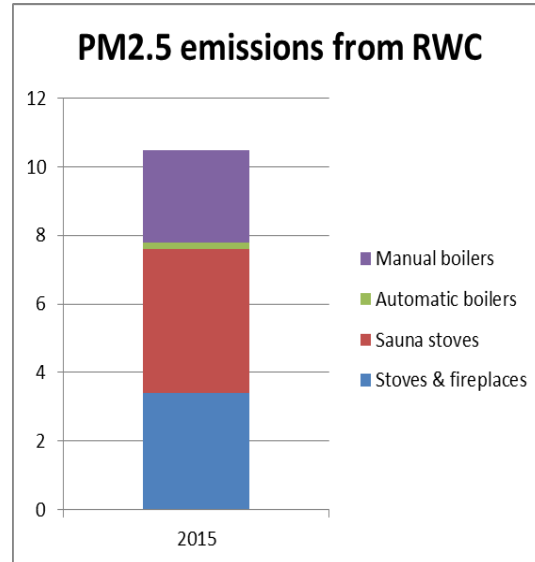
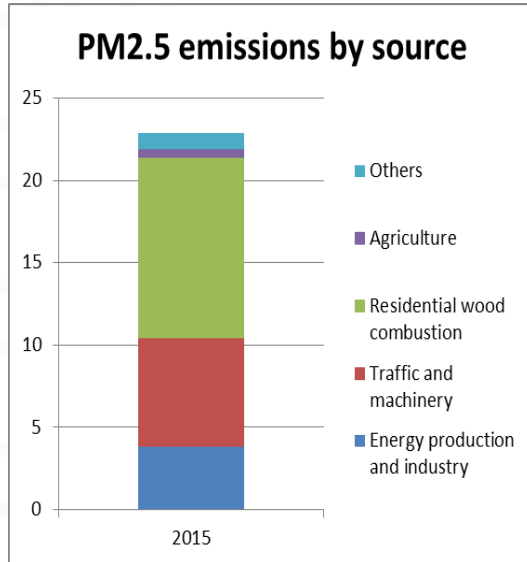
Better combustion practices can mitigate emissions from wood stoves

Mikko Savolahti

Finnish environment institute (SYKE)

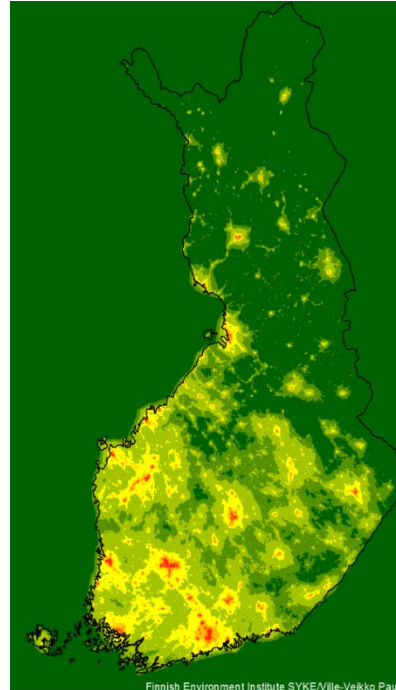
56th session of the Working Group on Strategies and Review, 22-25 May 2018, Geneva

Residential wood combustion and PM2.5 emissions in Finland

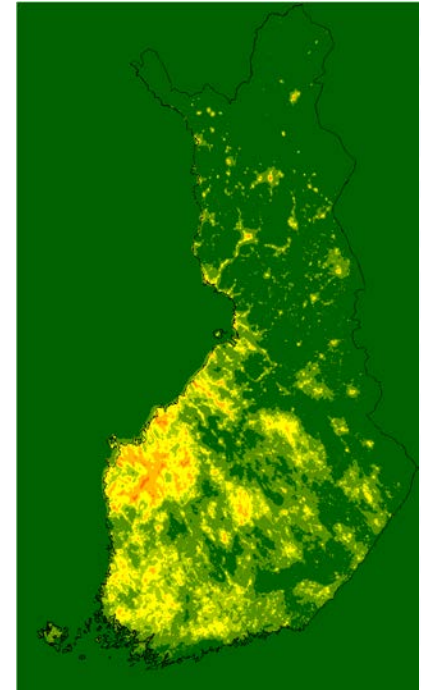


Modelling the population exposure

- 250m x 250m grid
- Spatial allocation of emissions by
 - Building register, degree of urbanization, climate conditions



PM2.5 concentrations from stoves



PM2.5 concentrations from boilers

Impact of poor combustion practices

- Emissions from a typical Finnish stove can be 6 x higher with poor combustion practices
 - Tissari et al. 2008. Fine particle and gaseous emissions from normal and smouldering wood combustion in conventional masonry heater

Estimation for the share of smouldering combustion in the use of Finnish stoves

User profiles	Share of users	Share of smouldering combustion
Good use of heater	55 %	0 %
Decent use of heater	30 %	10 %
Poor use of heater	15 %	50 %
Total share of smouldering combustion for wood-fired room heaters		10.5%

Emission factors

PM2.5 emission factors from stoves [mg/MJ]*	Normal combustion	Coefficient for smouldering combustion	Applied emission factor (10,5% poor combustion)
Open fireplaces and other	578	2	638
Kitchen range	48	2	53
Conventional masonry heaters	93	5.4	136
Modern masonry heaters	33	5.4	48
Masonry ovens	43	2	48
Sauna stoves	389	3	470
Modern sauna stoves	194	3	235
Wood stoves	77	5.6	113
Modern wood stoves	49	5.6	72

*Emissions measured over the whole heating cycle, using a dilution tunnel for the flue gases



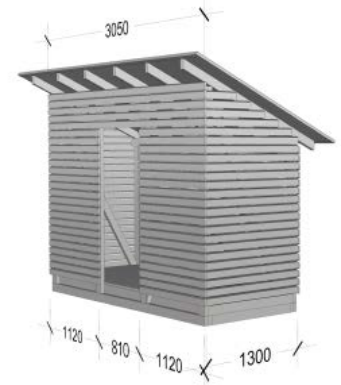
Informational campaigns carried out by Helsinki Region Environmental Services Authority HSY



Guide to burning wood



Chimney sweeps' advice to better use of stove



"Urban woodshead"



Efficiency of informational campaigns

1/2

- "Urban woodshead": 47% of woodshead owners had been reached, of which 89% said that they had "become more conscious of their wood storing methods"
- No measurements available for the impact of information to actual emission or concentration levels



Efficiency of informational campaigns

2/2

- Sensitivity study: the assumed impact of infocampaign: total share of smouldering combustion reduced by 5 - 50%
 - Would decrease total annual emissions by 1 – 7% (70 – 700 t in 2015)
- Best case: 60% of "decent" and "poor" users manage to improve their profile



Costs and cost-efficiency

- Cost per household €0,31 (including production, printing and distribution of information leaflets, arrangements for lecturers and the payments for experts involved)

Measures, PM2.5 reduction potentials and costs in 2030

Measure	Reduction potential (total RWC emissions)	Cost M€/a	Cost efficiency (reduced emissions)	Cost efficiency (reduced health impacts)
Ecodesign	- 6 %	14		
Legislation for sauna stoves	- 20 %	22		
Informational campaign	< - 8 %	0.3		
ESPs to boilers and banning the use of log boilers without an accumulator tank	- 17 %	44		



Conclusions

- Poor combustion practices increase particulate emissions
 - Significance in the big picture uncertain, but safe to assume that it's relevant
- Informational campaigns can reach people well
 - Can also increase general awareness harmful health impacts and possibly decrease recreational use in urban areas
 - Difficult to quantify the impact on behavior
- Modelled emission reduction potential moderate, but seems very cost efficient
 - Can be targeted to problem areas, increasing cost-efficiency even further
 - True reduction potential could be higher?
- Can be implemented immediately, unlike technical measures



Thanks!

Contact:

mikko.savolahti@ymparisto.fi

+358 29 5251595

Finnish Environment Institute SYKE

Savolahti et al. 2016. [Black carbon and fine particle emissions in Finnish residential wood combustion: Emission projections, reduction measures and the impact of combustion practices](#)