IMPACTS AND REDUCTION POTENTIALS OF SHORT-LIVED CLIMATE FORCERS FROM FINNISH RESIDENTIAL WOOD COMBUSTION

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16th
IUAPPA Word Clean Air Congress
September 2013

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LIFE 09 ENV/FI/000572

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METEOROLOGISKA INSTITUTET
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IIASA

HELSINGIN YLIOPISTO

MACEB – Mitigation of Arctic warming by Controlling European Black carbon emissions

MACEB

A three year EU LIFE+ project aiming at quantifying the effect of black carbon emissions on Arctic climate.

Climate forcing

Besides CO_2, black carbon in air and snow is a cause to Arctic warming.

Outline

- Intro
  - What are short-lived climate forcers
  - Most important sources
  - Their role in climate change
- Measures for emission reduction in RWC
  - Technical measures
  - Nontechnical measures
- Reduction potential and costs by measure
- Conclusions

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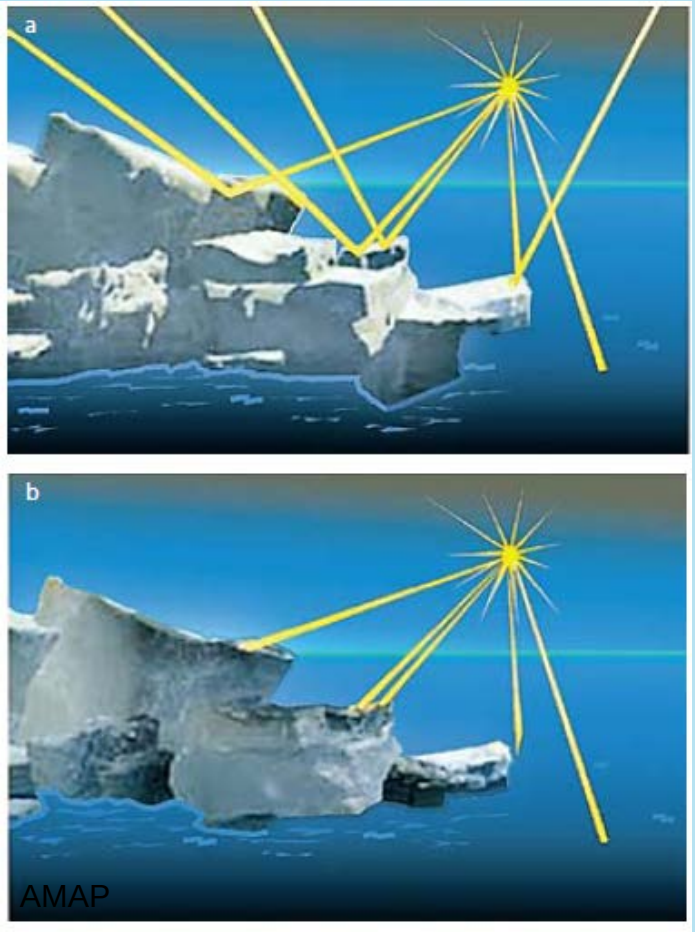
Short-lived climate forcers (SLCF)

- Black carbon (BC), Organic carbon (OC), CH4, VOC, CO
- Products of incomplete combustion
- Almost always co-emitted
- Short lifetime in the atmosphere
- Many are hazardous to health
- Can have warming or cooling effect



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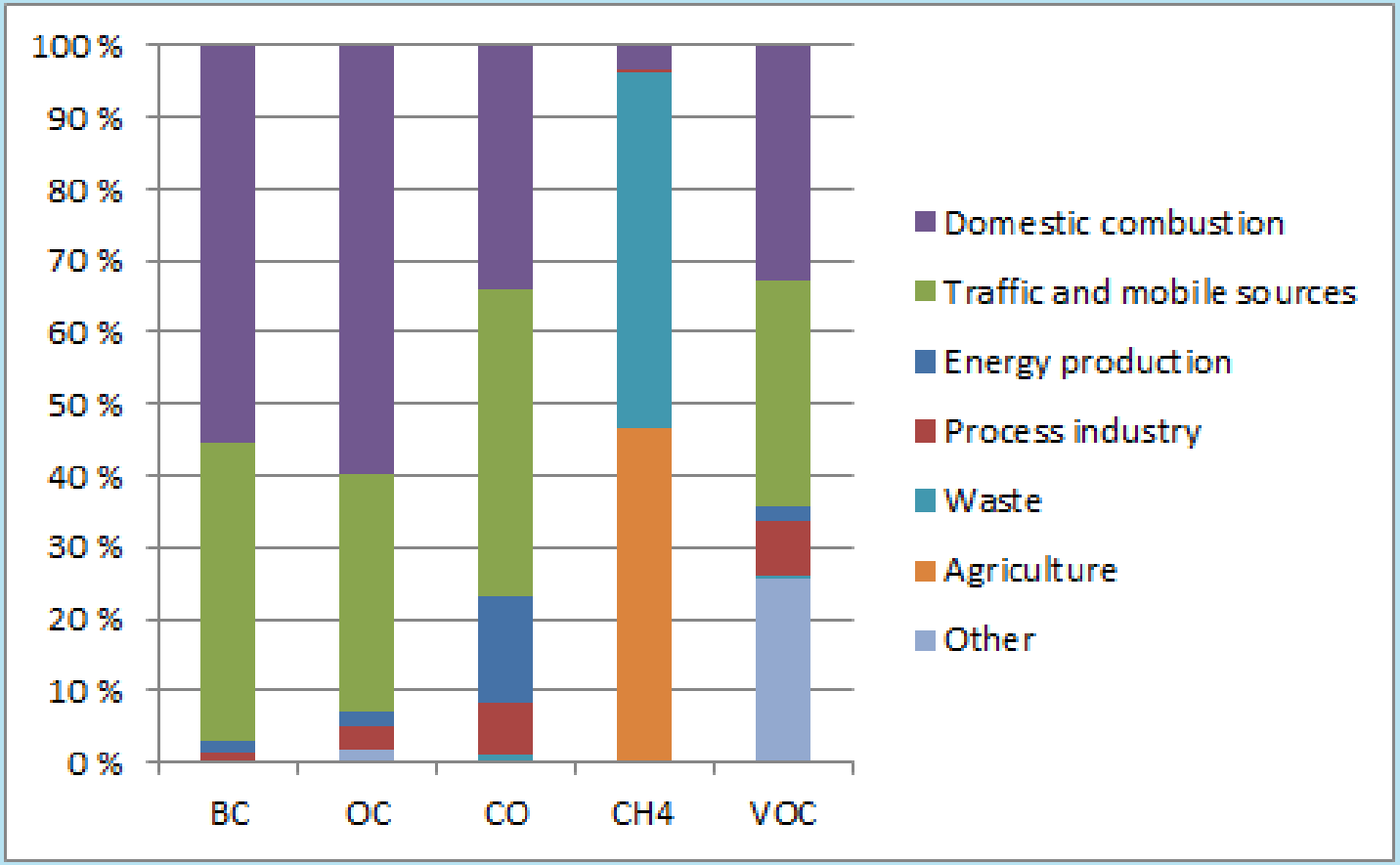
Sources of short-lived climate forcers



Sources of studied SLCFs in Finland (2010)

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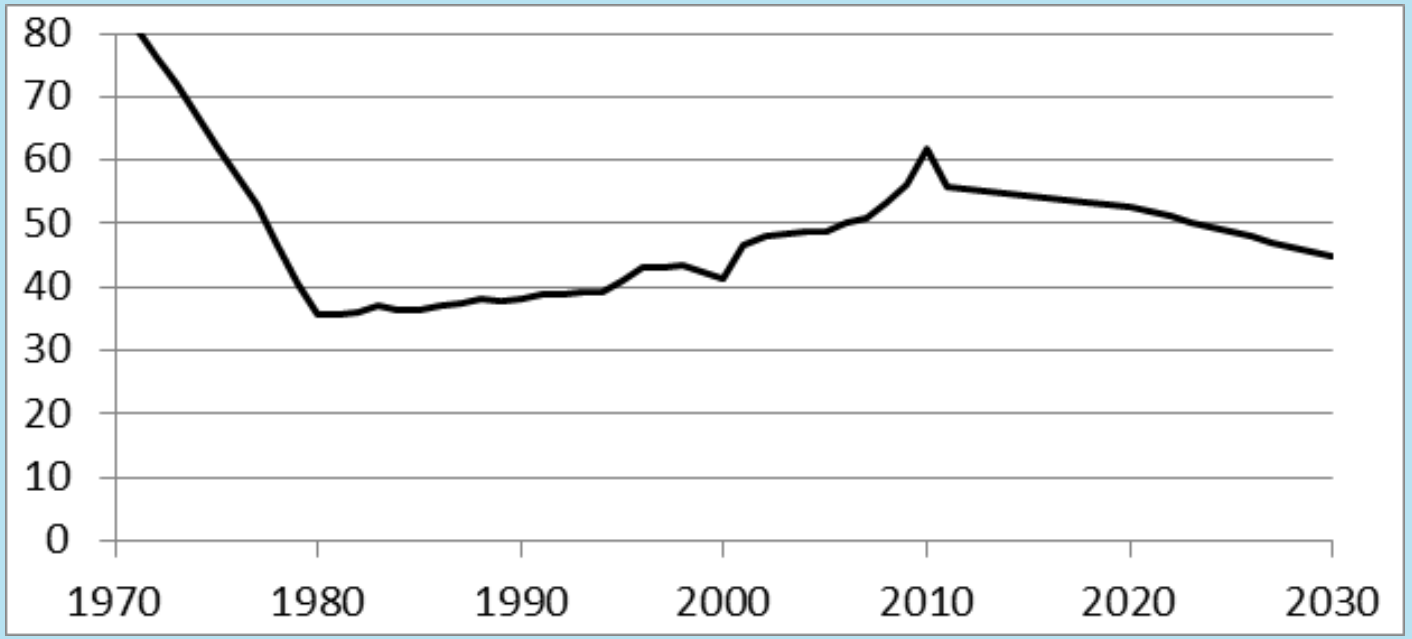
Residential wood combustion in Finland



Residential wood combustion in Finland [PJ/a]

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Climate impact of SLCFs

GWP factors used (GAINS)

Pollutant	GWP20	GWP100
BC	2200	680
OC	-240	-69
CH4	72	25
CO	4.5	1.9
VOC	12	3.4

Global warming potentials of Finnish emissions

	2010		2020		2030	
	GWP 20	GWP 100	GWP 20	GWP 100	GWP 20	GWP 100
Finnish reported GHGs under UNFCCC	88	75	74	63	53	45
SLCFs from RWC	8.8	2.9	7	2.3	5.5	1.8

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Measures to reduce emissions 1/2

Technical measures

- More advanced combustion technology
  - Modern boilers and stoves with better mixing of air and fuel
  - Heat storage tanks for boilers
  - Pellets
- Flue gas cleaning
  - Electrostatic precipitators
  - Catalysts

Schleicher et al. 2011

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Measures to reduce emissions 2/2

Non-technical measures

- Influencing the combustion habits of stove users
  - Information campaign

www.hengitysliitto.fi

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Calcultating the effects and costs of emission reduction measures

Parameters in FRES model

- Emission factors (BC, OC, CO, CH4 & VOC) for different heaters
  - 9 stove gategories, 5 boiler types
  - Reduction efficiencys of ESPs
- Average lifetime of appliances
- Costs (equipment, fuel, maintenance, education)
- Profile of combustion practises

	Share of profile	Share of SC
Accomplished user	25 %	0 %
Average user	60 %	5 %
Problem user	15 %	50 %
Average over profiles		**10.5%**

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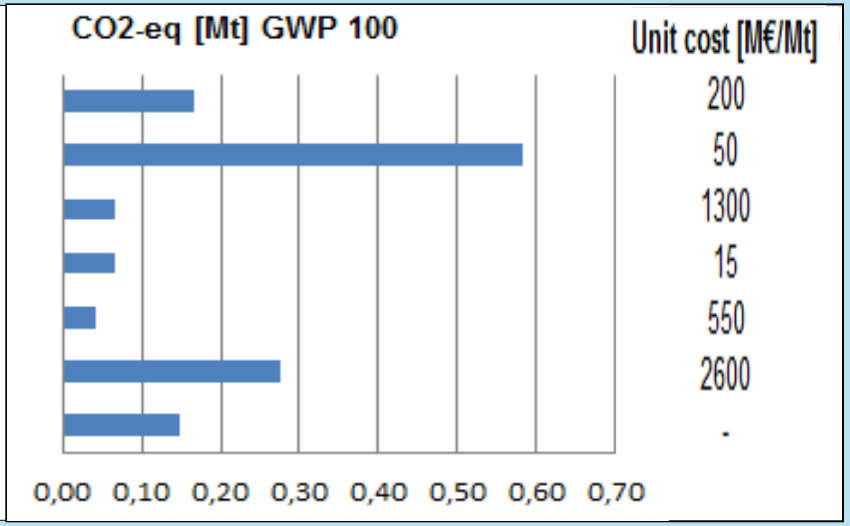
Results

Effects of single measures implemented on baseline

	CO2-eq [Mt] GWP 100	Unit cost [M€/Mt]
Ecodesign requirements	0,10	200
Only modern sauna stoves on the market	0,60	50
Acceleration of masonry heater stock renewal	0,05	1300
Installing heat storage tanks to old log boilers	0,05	15
Installing ESPs to boilers	0,03	550
Installing ESPs to stoves	0,25	2600
Good combustion practises in all stoves	0,15	-



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Sauna stoves

www.rakentaja.fi

www.harvia.fi

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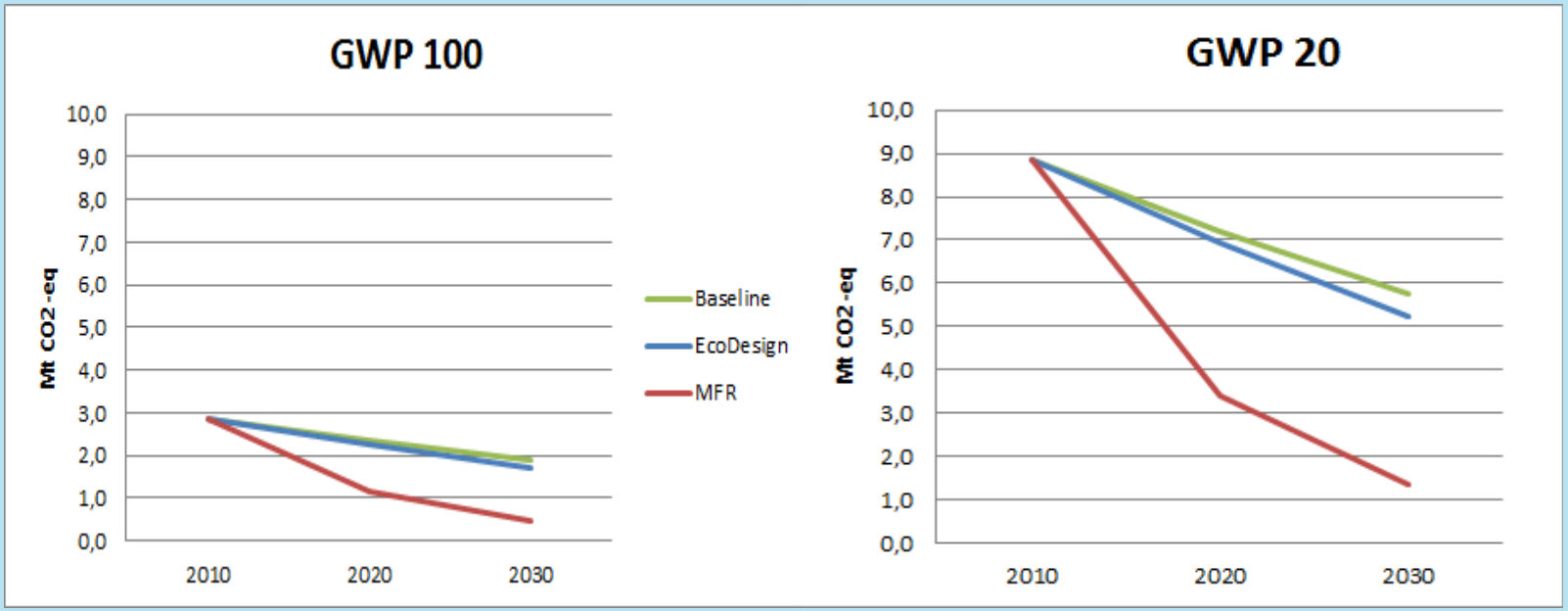
Cumulative effects of measures



- Effects of other measures in the National Energy Strategy
  - Traffic planning to increase the energy efficiency of transportation 0,6 Mt CO2-eq
  - Incresing the energy efficiency of housing to save (fossil) heating fuel 0,3 Mt CO2-eq

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Stove user behaviour

- Knowledge on current operation practices is lacking
- Operation practices are shown to have significant impact on particle emissions and chemical composition (Frey et al. 2009, Schmidl et al. 2011, Lenz et al. 2008)
- Effects of campaign uncertain, but possible to estimate
  - Reduction potential
  - Unit costs of reductions

Assumed effect of campaign	Unit cost [M€/Mt CO2-eq]	CO2-eq [Mt] GWP 100
SC decreases 10.5% -> 10%	54,8	0,01
SC decreases 10.5% -> 5%	4,8	0,08
SC decreases 10.5% -> 0%	1,7	0,22

* Cost estimation based on a local information campaign by Helsinki Region Environmental Services Authority

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Conclusions

- RWC sector is the major source for many SLCFs in Finland
- Significant climate impacts in addition to detrimental health effects
- Notable reduction potential
- Activity has been increasing
- Ecodesign has relatively minor effect in the near future
- Other measures possible
  - National legislation for sauna stoves
  - Information campaigns (targetting problem areas)
  - New technology (Flue gas cleaning, pellets etc.)

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Thanks for your interest

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