



Reduction of Black Carbon Emissions from Residential Wood Combustion

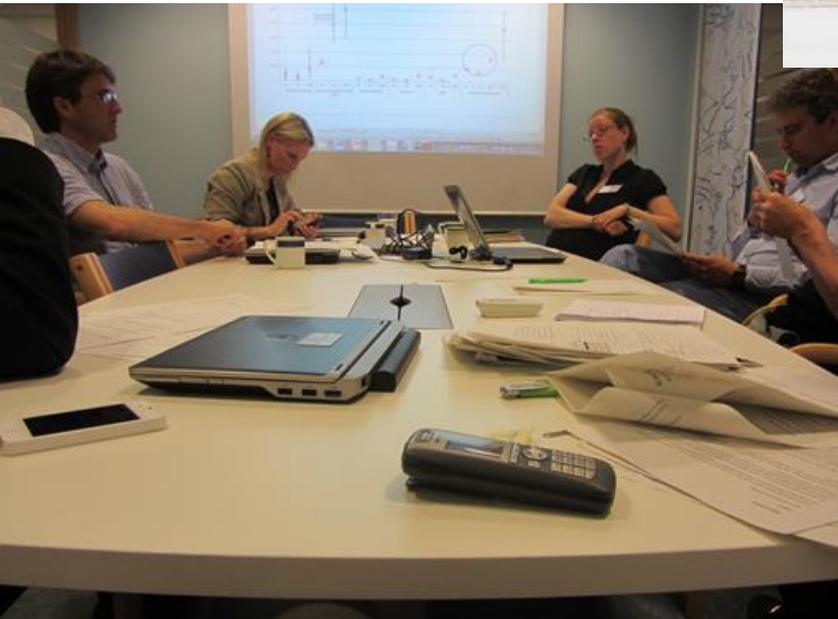
An ACAP Project co-lead by Norway and Finland



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Outline

- ▶ Project aims
- ▶ Participation
- ▶ Result highlights
 - ▶ Emission inventories
 - ▶ Measures and instruments
- ▶ Recommendations
- ▶ Discussion



Project aims

- ▶ Study existing data from the Arctic countries on emission factors, activity data and relevant measures for reduction of black carbon emissions
- ▶ Recommend possible measures, technologies and approaches to reduce black carbon from residential wood combustion.



ACAPWOOD participation

- ▶ Canada, Denmark, Finland, Norway, Sweden, USA
- ▶ A great thank you to the national experts who have contributed; questionnaires, workshop, comments, teleconferences



Black carbon emission inventories -an important foundation for policy making

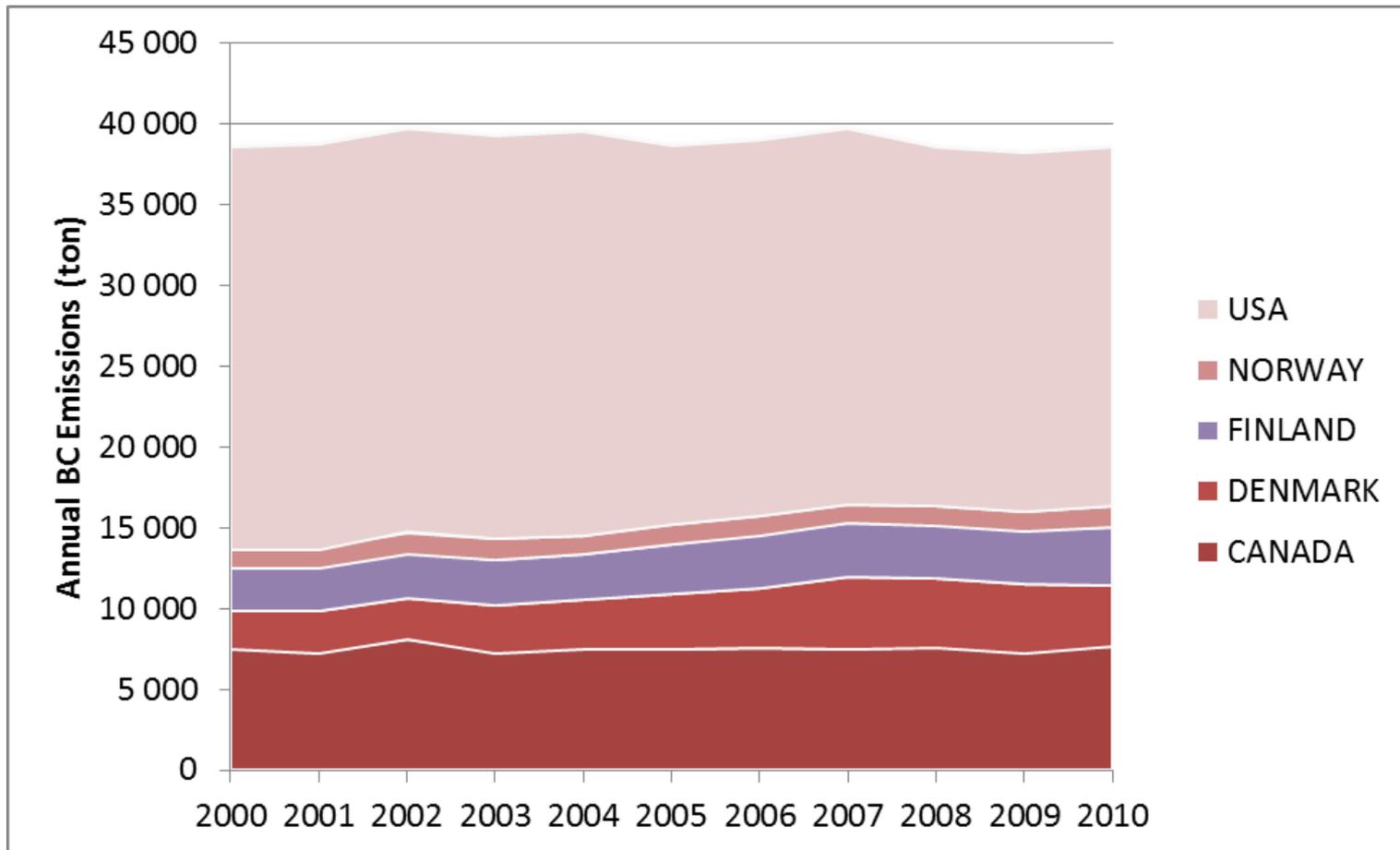
- ▶ All the six countries have national black carbon inventories that specify residential combustion.
- ▶ Table: residential wood combustion is an important source of BC emissions.

Country (inventory year)	Residential sector (%) of anthropogenic total BC (without open biomass burning)
Canada (2006)	14%
Denmark (2010)	59%
Finland (2010)	47%
Norway (2010)	26%
Sweden	n.a.
The United States (2005)	6%



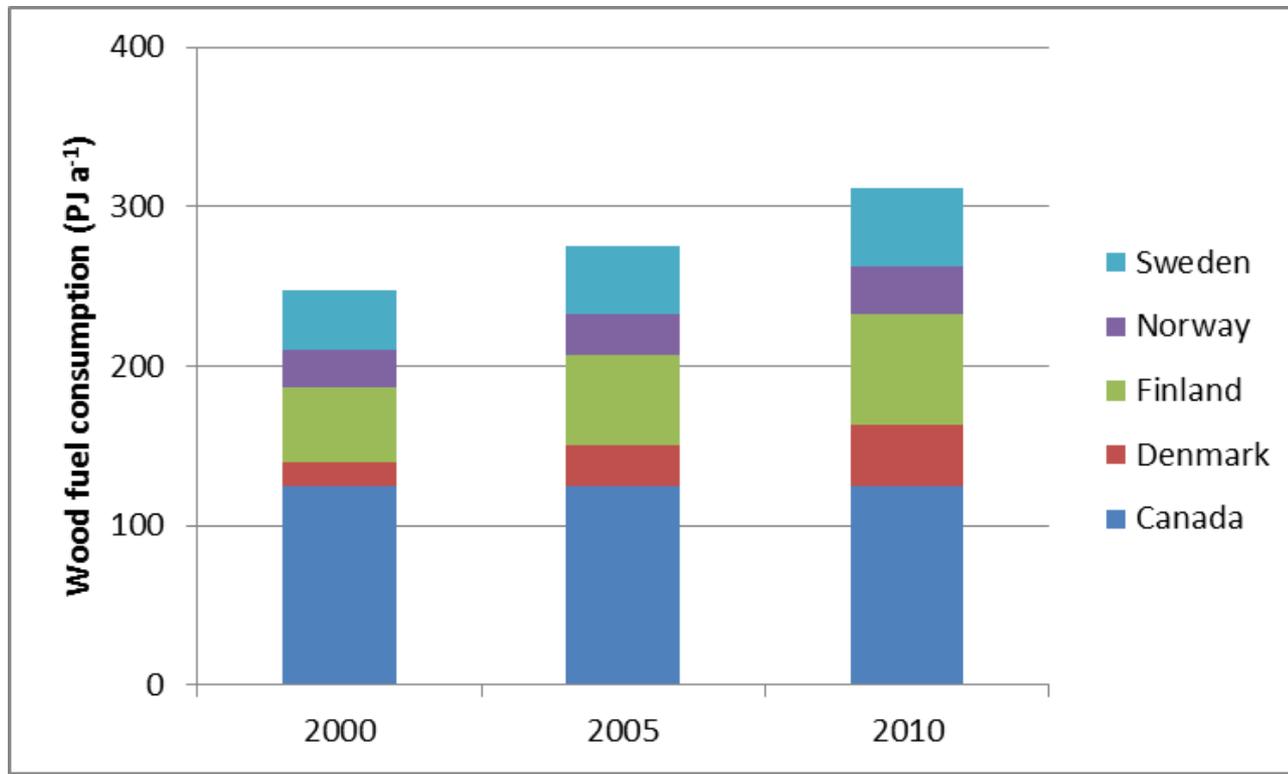
Black carbon emissions in 5 Arctic nations

- ▶ The last decade: relatively stable emissions



The wood use estimates

- ▶ Wood consumption estimates in all the six countries: periodic surveys, but frequency varies



Example: Annual wood consumption in 5 Arctic nations, PJ energy input

The BC emission factors

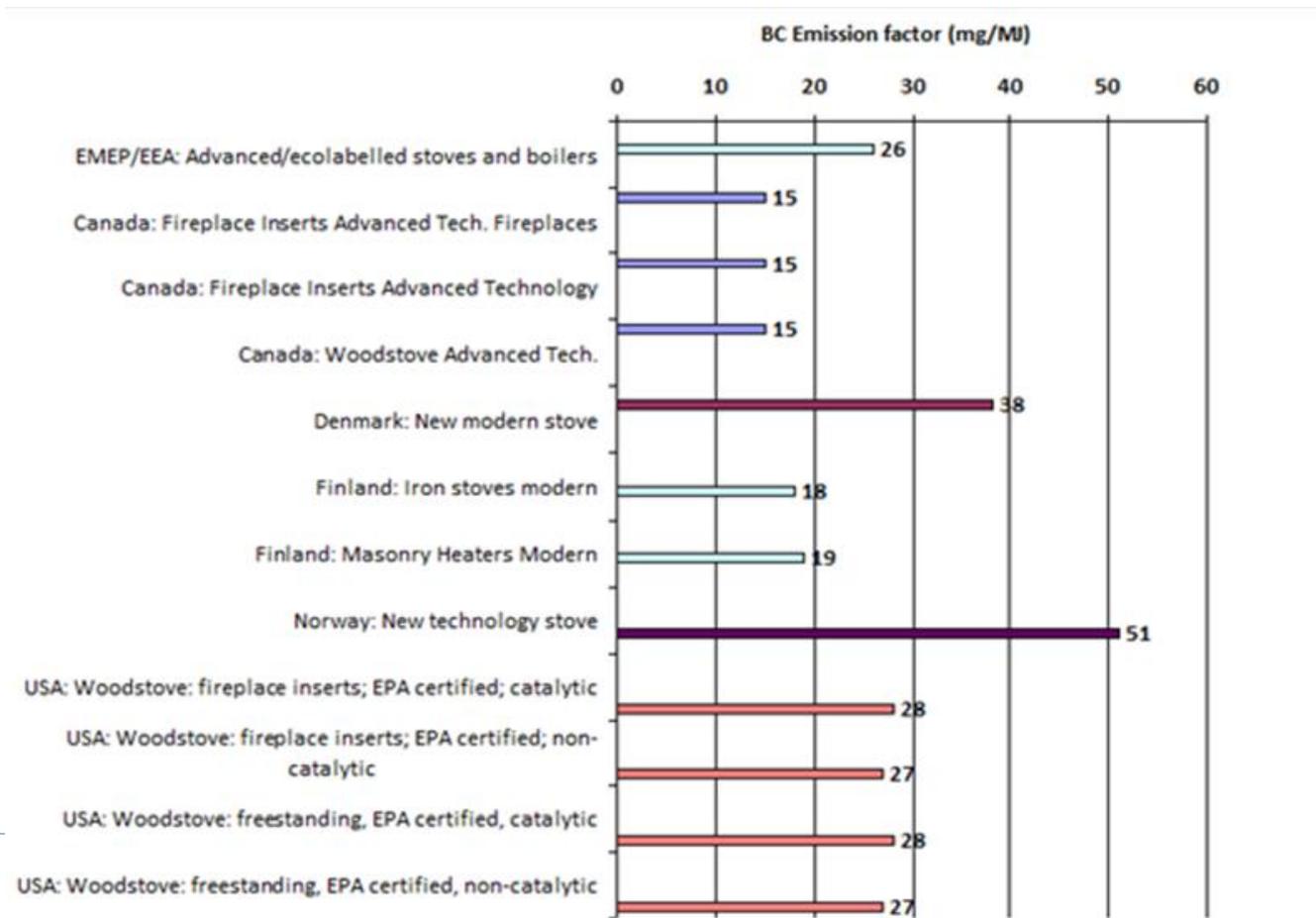
- ▶ BC emission factors have been established based on relatively few measurements and varying methods
- ▶ Black carbon assumed to be similar to elemental carbon
- ▶ The BC emission factors indicate significant potential for emission reductions if switching from old to advanced technologies
- ▶ BC is co-emitted with other pollutants, which should be also considered when assessing impacts of mitigation measures



The BC emission factor for similarly named technologies shows a relatively wide span

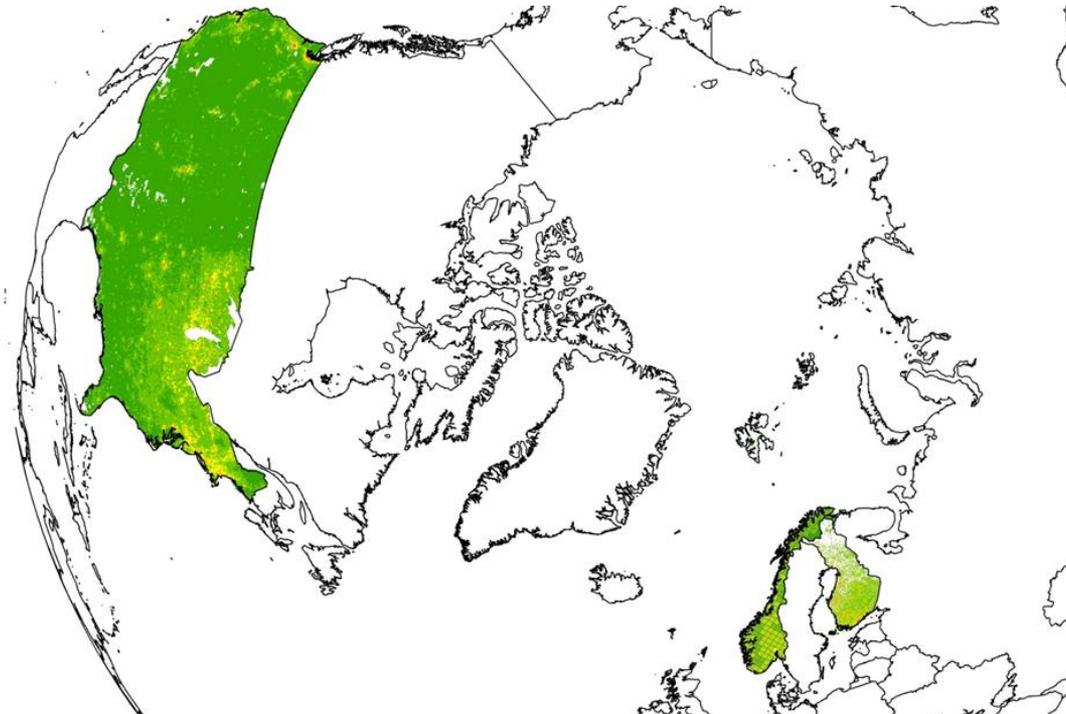
Unanswered question:

- ▶ Because of different methods to determine emission factors or differences in actual emissions?



Emissions – spatial distribution

- ▶ Spatial distribution of the emission data is a cornerstone for robust impact analyses of BC
- ▶ Four participating countries have high resolution spatially distributed residential sector BC emissions (but all have PM2.5)



Spatially distributed BC emissions from FI, NO and the US

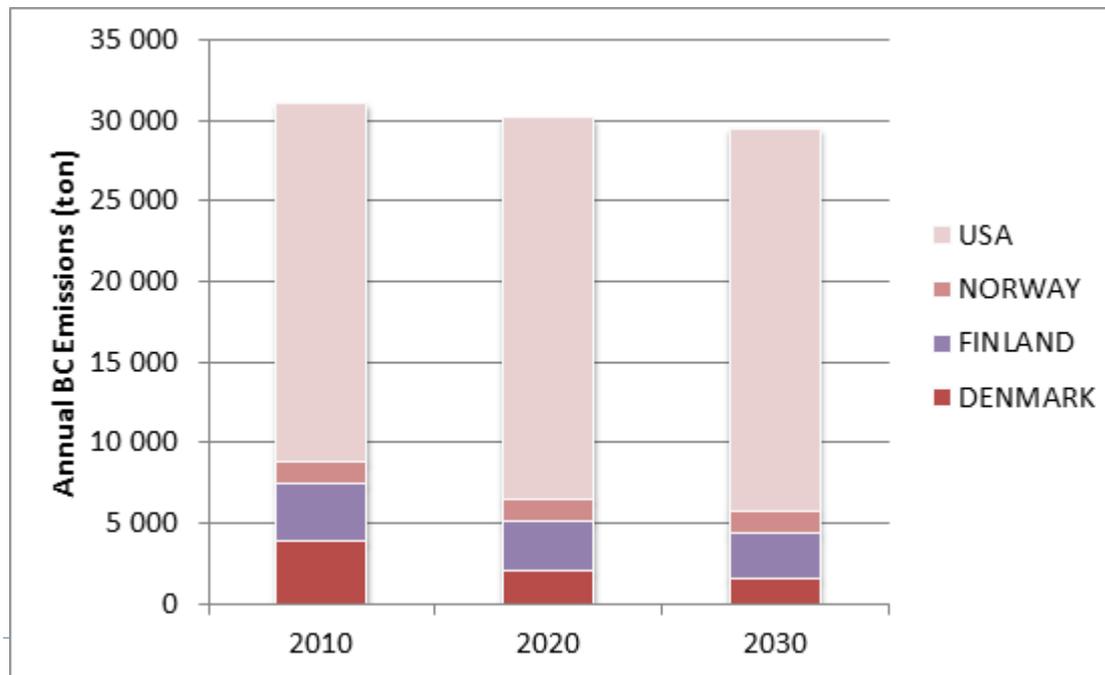
Robustness of the emission inventories

- ▶ Nearly all the components of the inventories have some degree of uncertainty.
 - ▶ Wood consumption; public surveys, extrapolation, assumptions on humidity and heat value.
 - ▶ determination of BC emission factors; varying measurement protocols and methods.
- ▶ Robust BC emission inventories and projections are a fundament for understanding the structure of emissions as well as planning and targeting future policies to reduce emissions



BC emission reduction strategies for wood combustion

- ▶ Emission projections show only slight reduction
- ▶ Wood consumption is expected to continue to be important
- ➔ climate effect (all though magnitude uncertain) and health impact makes policy for further reductions highly relevant



Measures and instruments in use in the Arctic countries

- ▶ With current knowledge, the most feasible way to reduce BC is significant PM reductions
- ▶ Many factors influence BC emissions (stove, chimney, fuel, operation...) → mix of instruments and measures needed in effective policy
- ▶ The report gives an overview of measures and instruments in use → menu to learn from for countries





Recommendations

Two «menus»:

- Countries
- Arctic region



Recommendations:

Countries could consider:

- ▶ National Action Plans → prioritise and decide efficient policy mix
- ▶ Emission limits new stoves; implement or make stricter
- ▶ National and regional change-out programs
- ▶ Stove inspections and maintenance
- ▶ End-user information campaigns
- ▶ Fuel wood guidance and information
- ▶ Advocating stoves with heat storage
- ▶ Transition from wood stoves to pellet



Recommendations:

The Arctic countries as a region could...

- ▶ **Consider to encourage consensus on BC measurement methods and emission limits;** CEN and the Eco Design directive are relevant arenas
 - ▶ **Consider to encourage common BC reporting guidelines;** CLRTAP Gothenburg Protocol is a natural arena. AC-countries active promoters?
 - ▶ Methods of measurement:
 - ▶ Methodologies for collecting wood consumption data
 - ▶ Technology categories;
 - ▶ Black carbon emission factors
 - ▶ **Consider to make an outreach strategy to members, observers, others** → encourage actions to reduce BC emission
 - ▶ **Consider to develop regional guidelines/tool box for developing national action plans**
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Recommendations:

The Arctic region could cont...

- ▶ **Consider to facilitate information sharing;** e.g. through online platform on on-going work
 - ▶ task forces under the Arctic Council,
 - ▶ projects under the Nordic Council,
 - ▶ reporting requirements under the Convention on Long Range Air Pollution,
 - ▶ directives from the EU
 - ▶ case studies and experiences from individual countries
 - ▶ ...
- ▶ **Consider shared research efforts to close knowledge gaps.**
- ▶ **Consider to cooperate on demonstration projects,** e.g:
 - ▶ Effect of technology replacement and assessment of methodology for emission measurements and modeling
 - ▶ Effect of regular maintenance of stoves and boilers
 - ▶ Effect of technology choices



For discussion

- A) Consider and approve the report, including recommendations

- B) As far as time allows: Consider and decide on the follow up of the report, based on the recommendations

