Climate and Health Impacts of Residential Wood Combustion in Finland

Mikko Savolahti

Residential wood combustion (RWC) in Finland

- RWC has a prominent role in Finnish culture, and wood consumption has still been increasing in the last decades
- Wood is used mostly for heating
  - 66 PJ = 20% of all heating energy in 2017
  - 40% of heating energy in detached houses
  - ~70% of the fuelwood estimated to come from non-commercial sources

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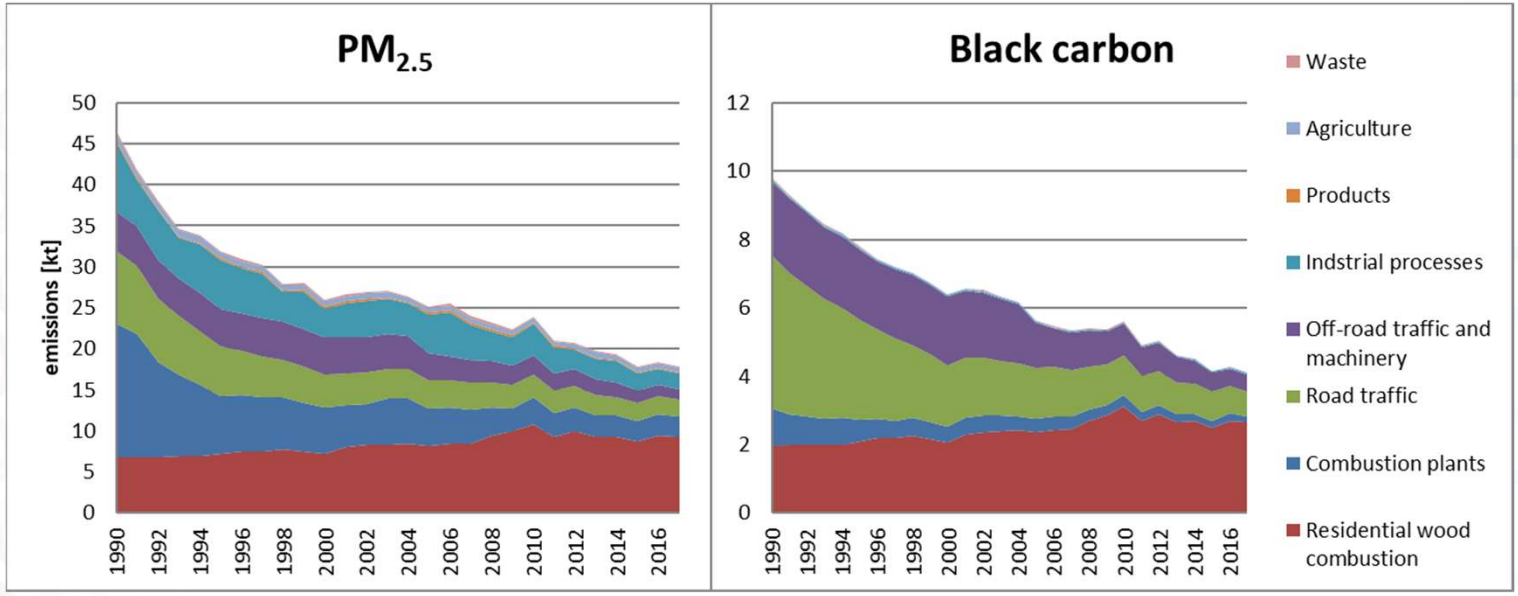
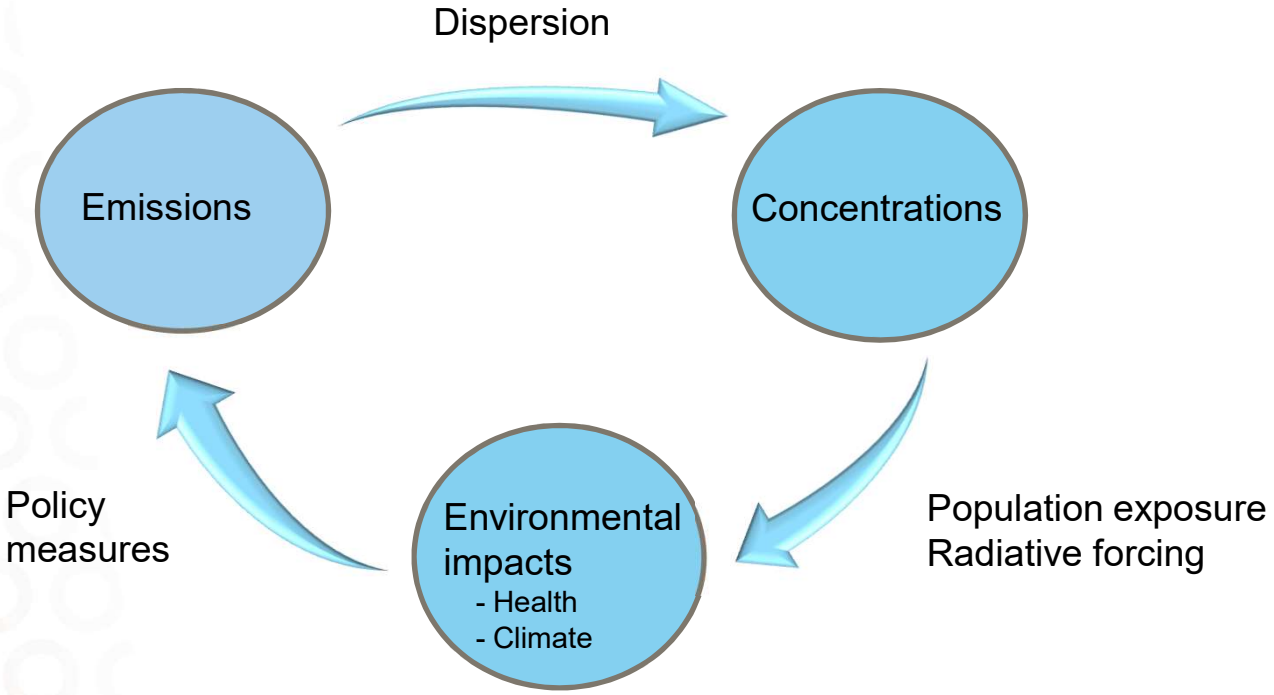
Motivation for the work

- Wood combustion has become the major source of particulate emissions in Finland and many European countries



Integrated Assessment Modeling



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Atmospheric Environment 140 (2016) 495–505

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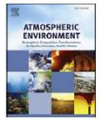

Black carbon and fine particle emissions in Finnish residential wood combustion: Emission projections, reduction measures and the impact of combustion practices

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Energy Policy 133 (2019) 110837

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Near-term climate impacts of Finnish residential wood combustion

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Chem. Phys., 19, 7743–7757, 2019
doi.org/10.5194/acp-19-7743-2019

Atmospheric Chemistry and Physics Open Access EGU

Climate impact of Finnish air pollutants and greenhouse gases using multiple emission metrics

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International Journal of *Environmental Research and Public Health*

MDPI

Article

Residential Wood Combustion in Finland: $PM_{2.5}$ Emissions and Health Impacts with and without Abatement Measures

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Emission inventories

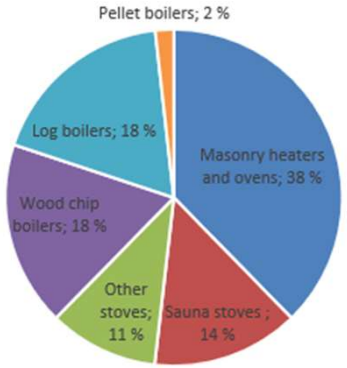
Activity
Fuel use, mileage, number of animals etc.

×

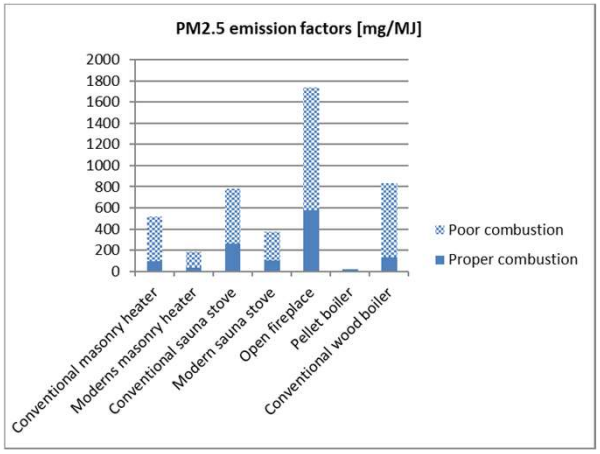
Emission factor

=

Annual emission



Wood consumption by appliance type



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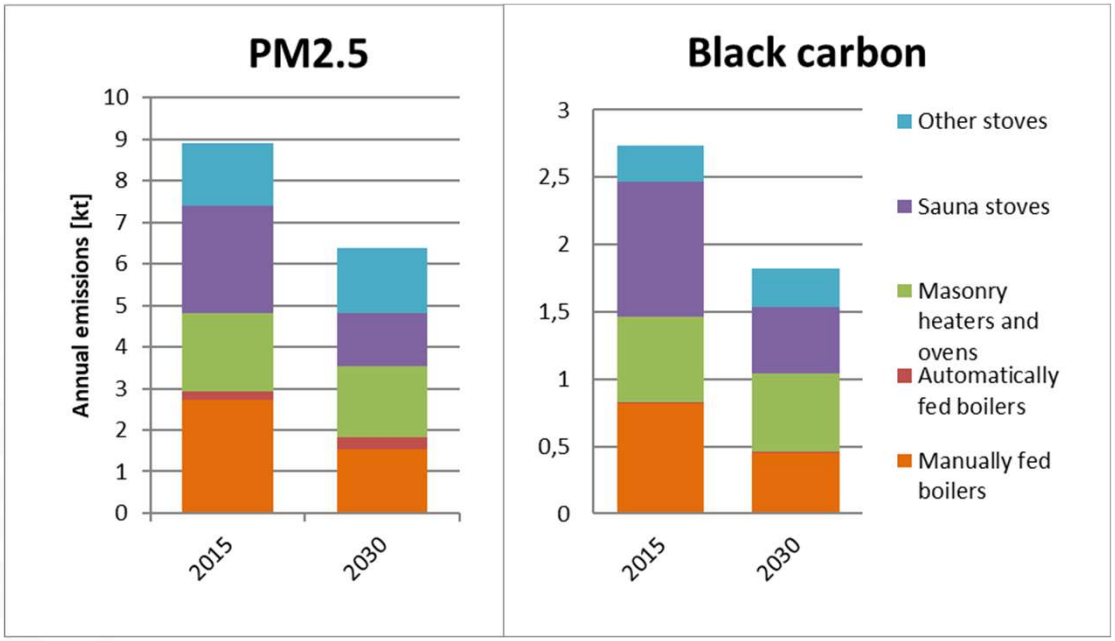
Estimated emissons



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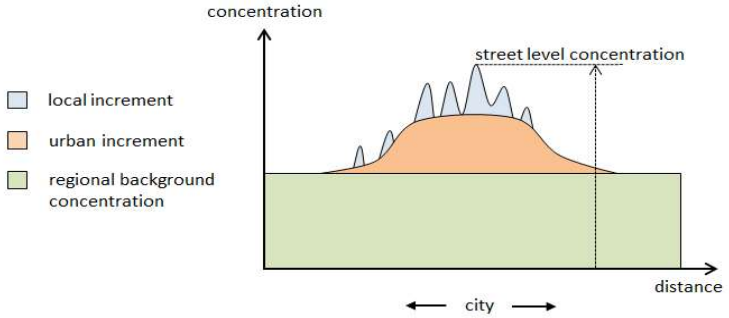
Health impacts of exposure to air pollution

- Exposure to air pollution can cause chronic inflammatory disases and acute symptoms
- Estimated to cause 6,5 million annual deaths globally and 2 000 in Finland
  - Fine particles ($PM_{2.5}$) the most harmful pollutant
- No safe threshold for $PM_{2.5}$ concentrations has been identified



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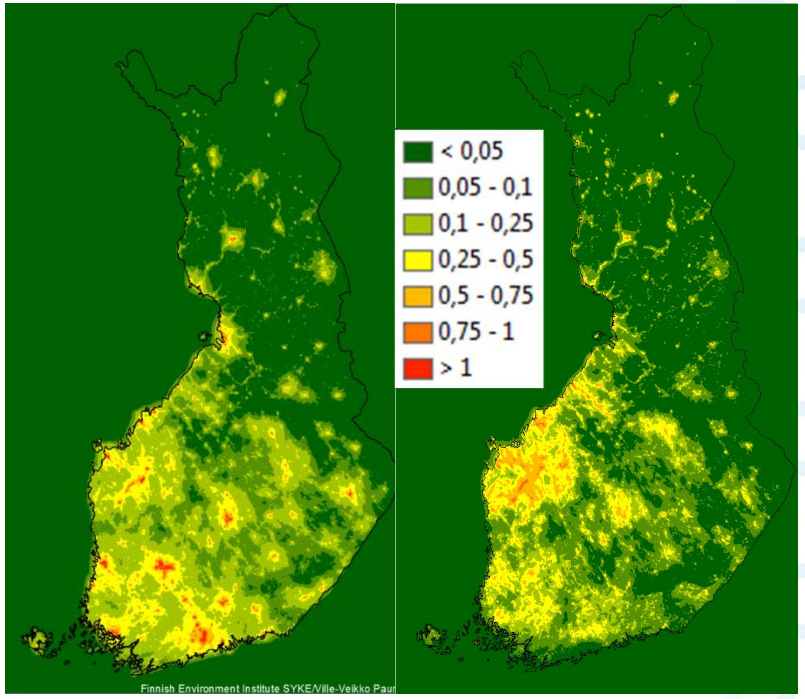
Health impacts of $PM_{2.5}$ emissions from residential wood combustion

- Concentrations modeled in a 250m x 250m grid
- Measured total concentrations in ambient air typically 5-10 µg/m^3
- RWC caused concentrations of 0,5-2 µg/m^3 in most towns
- Estimated to cause ~200 attributable deaths annually in Finland



PM2.5 concentrations from stoves

PM2.5 concentrations from boilers

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Residential wood combustion and climate

- Wood combustion has been promoted as a climate change mitigation measure, but it can't be viewed as climate neutral
- RWC is by far the largest source of black carbon emissions in Finland
- Wood combustion releases CO_2 into the atmosphere, reducing the carbon storage of the forest **and also it's ability to sequest carbon**
  - 1 ton of harvested C can reduce the carbon sink by 2 ton in a 25-year time frame[4]

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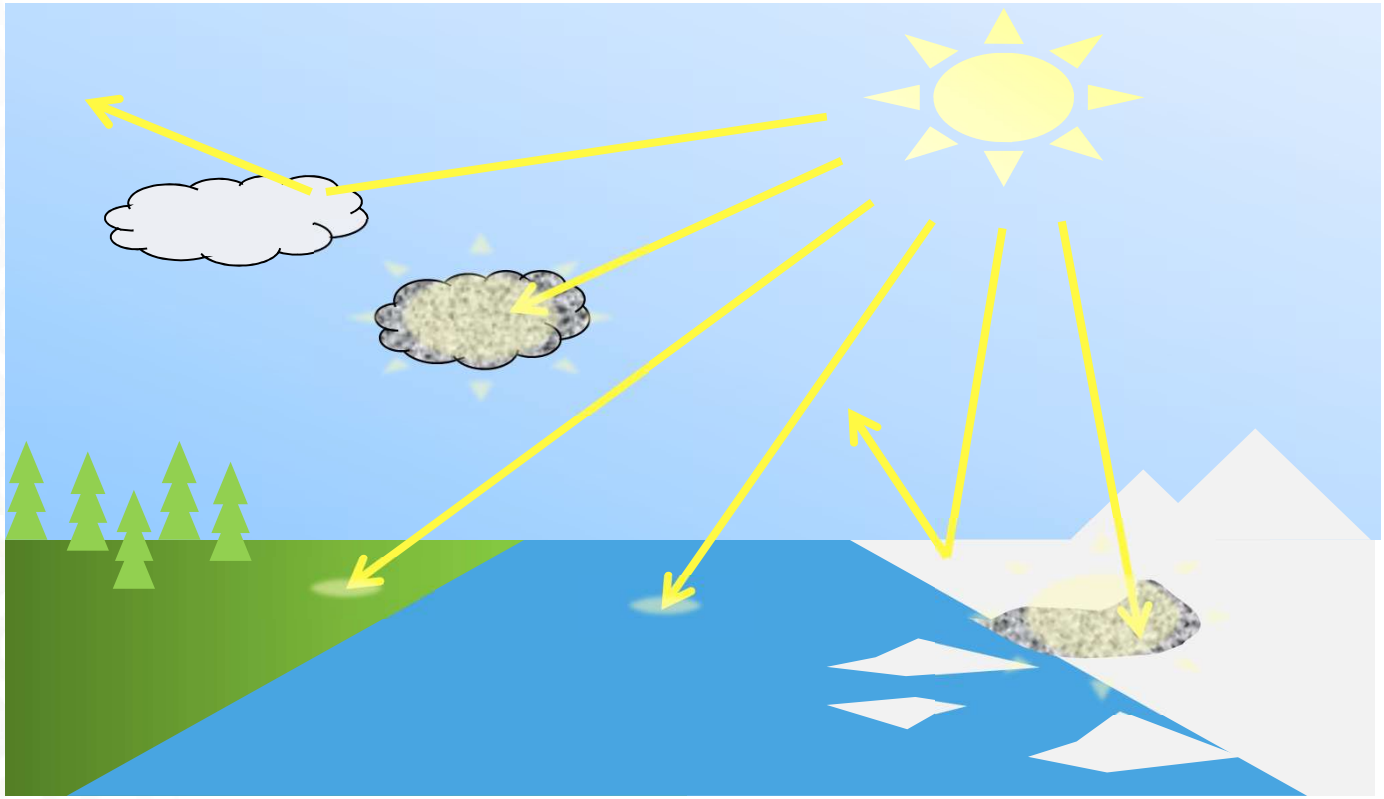
How black carbon emissions impact climate



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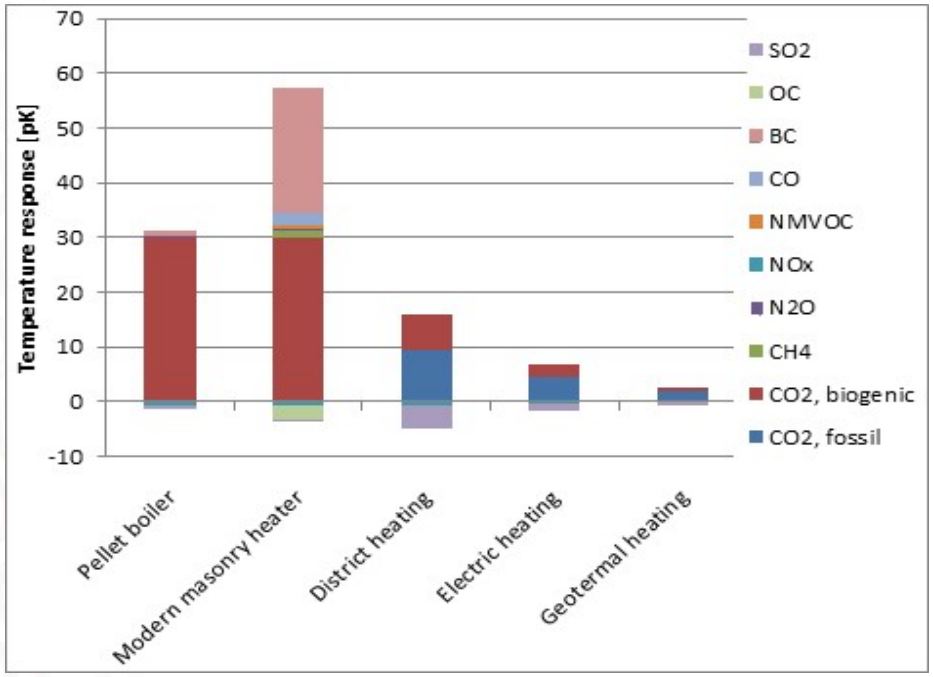
Climate impacts of different heating methods



Cumulative temperature response at the end of a 25 period due to emissions produced from heating a detached house

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Summary

- Residential wood combustion is the biggest source of fine particle and black carbon emissions in Finland
- It is the most important local contributor to air quality in many areas
- The magnitude of climate impacts is uncertain, but it seems that RWC is the least climate-friendly method to heat a house
- It has been more difficult to reduce emissions in RWC than in other sectors

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What should be done about it?

- Get the right information about the environmental impacts of wood combustion
- People should be provided with easy and affordable access to more environmentally friendly ways to produce heating energy => **combustion** of **any fuel** causes emissions
- If wood combustion is the only convenient method in a given situation, up-to-date appliances should be used and attention paid to proper combustion practices.

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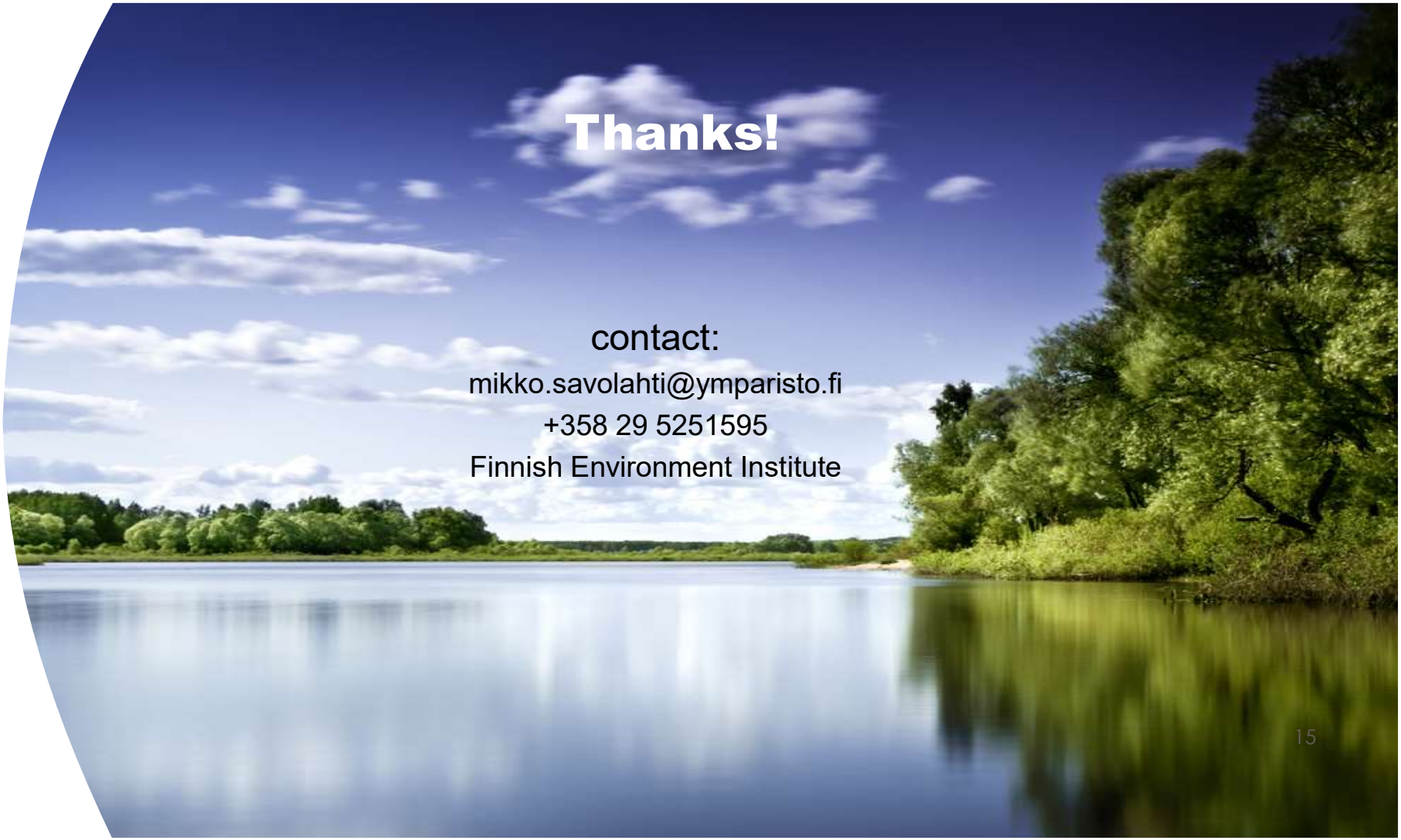
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