AIR POLLUTION EMISSION AND POPULATION EXPOSURE ASSESSMENT OF THE UPDATE OF THE FINNISH ENERGY AND CLIMATE STRATEGY

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Contents of the presentation

- Background on the Finnish Energy and Climate Strategy update
- Environmental Impact Assessment of the Strategy
  - Background
  - Air pollution emissions
  - Population exposure to primary PM2.5
- Conclusions

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Update of the Finnish Energy and Climate Strategy

- Update of the 2008 Climate Strategy to integrate the impacts of
  - Economic recession
  - Industrial factory closings in Finland
  - Latest outlook on bioenergy potential in Finland
  - Extension to 2030 (However, the EIA at the moment only for 2020)
- Two scenarios
  - Baseline to fulfill agreed EU targets:
    - Generally 20/20/20
    - More specifically for Finland: renewables target 38 %, non-ETS emissions -16%
  - With-Additional-Measures (WAM) to additionally include measures to reach the non-ETS sector goal (-16%) and better anticipate 80% reduction by 2050 (differs very little from Baseline in 2020)
    - Traffic mode changes and ”eco-driving”
    - Stricter building energy regulation

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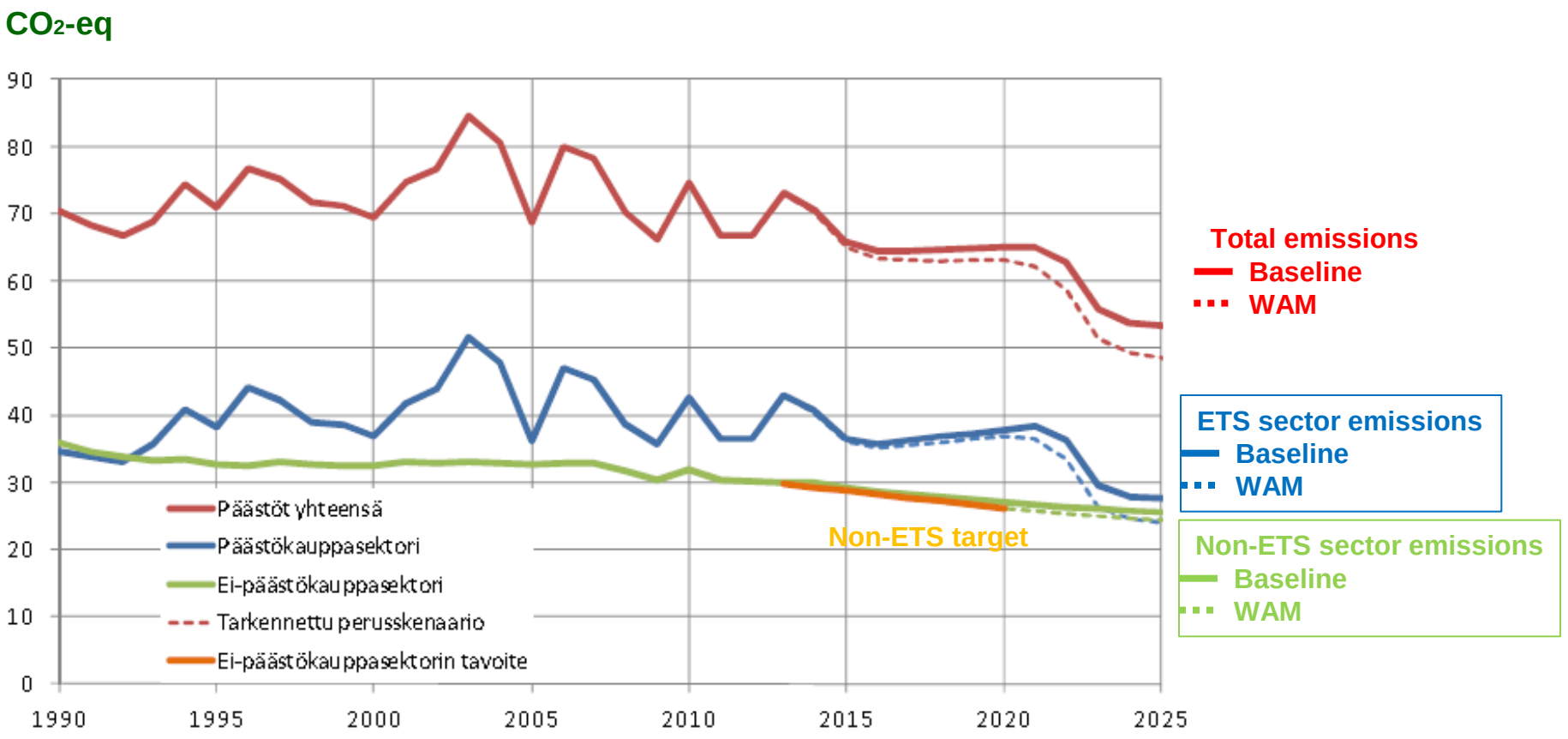
Update of the Finnish Energy and Climate Strategy



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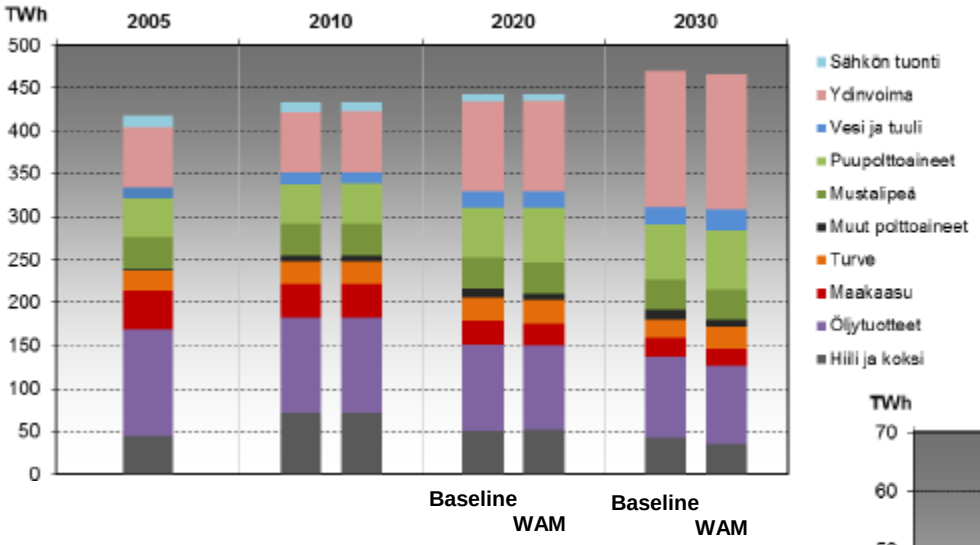
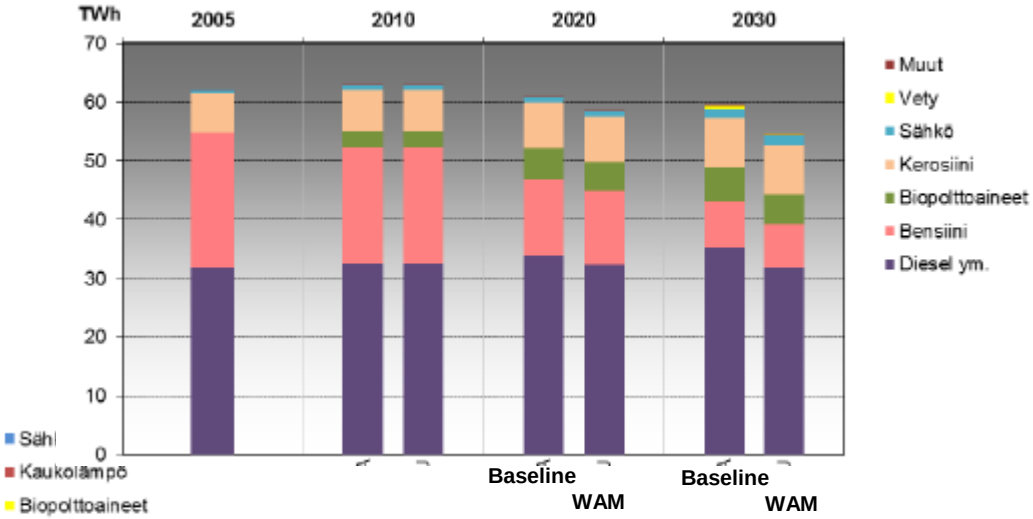
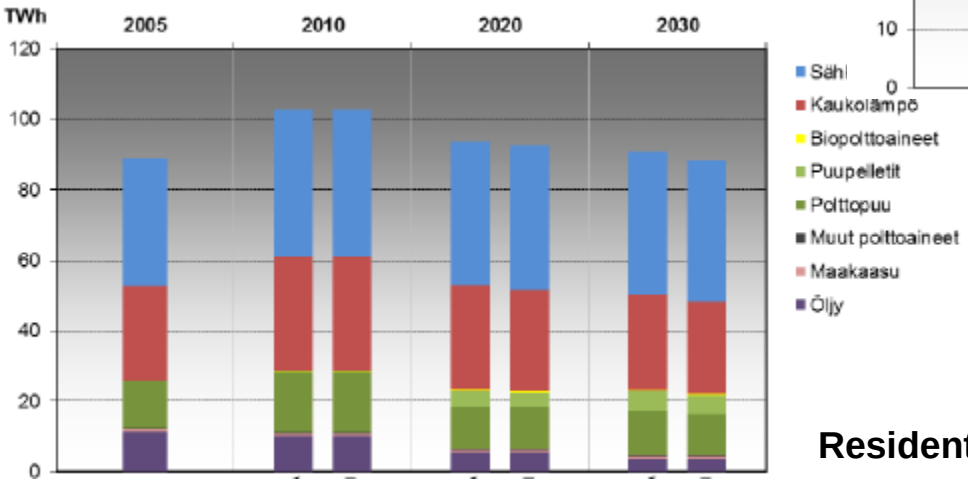
Update of the Finnish Energy and Climate Strategy



Total primary energy



Traffic primary energy



Residential heating primary energy

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EIA of the Energy and Climate Strategy

- Impacts of the Strategy on
  - Human health and welfare
  - Environment: soil, waters, air, flora, fauna, biodiversity
  - Urban structure, built environment, cultural heritage
  - Use of natural resources
  - Interactions between the above-mentioned
- Quantitative and qualitative assessments
- Most emphasis on:
  - Impacts on carbon sinks, e.g. carbon budgets of forest soils
  - Impacts on biodiversity
  - Life-cycle Impact Assessment (LCIA)
  - **Air pollution emissions and population exposure**

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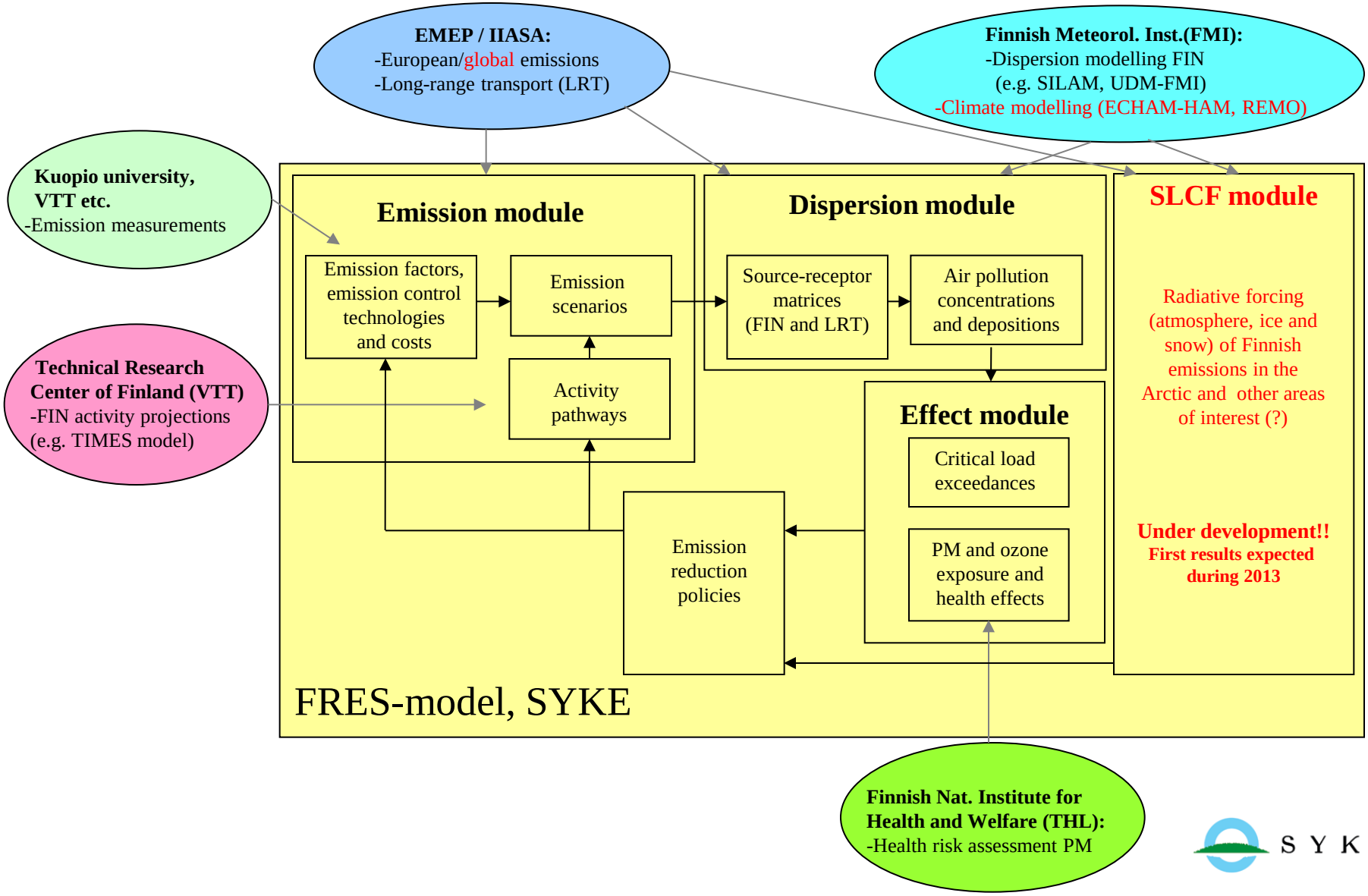
Finnish Regional Emission Scenario (FRES) model

Integrating policy analysis tool in the core of the Finnish Integrated Assessment Modeling (IAM) framework



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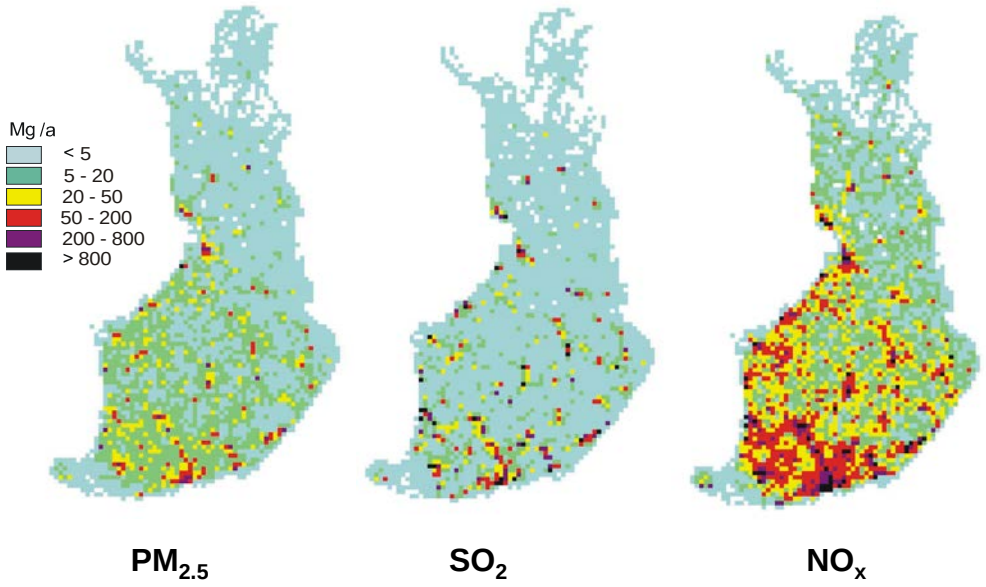
Finnish Regional Emission Scenario (FRES) model

www.environment.fi/syke/pm-modeling

- Anthropogenic emissions 1990, 2000, 2005, 2010, 2020, 2030, 2050 (several projections)
- Comprehensive and congruent calculation for primary PM and gases
  - primary PM (TSP, $PM_{10 - 2.5 - 1 - 0.1}$, chemical composition, incl. BC/OC/sulfates)
  - SO_2, NO_x, NH_3, NMVOCs
  - GHGs
- Abatement technologies and costs
- Aggregation: 154 sectors, 15 fuels (GAINS compatible)
- Large point sources (>200), small point sources (> 200), area emissions ($1 \times 1km^2$)
- Several emission heights
- Dispersion with s-r matrices ($10 \times 10km^2$ and $1 \times 1km^2$)
- LRT from EMEP
- Databases of population and critical loads



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Air pollution emissions and pop. exposure

Emissions of

- SO_2
- NOx
- Black carbon (BC)
- Primary PM2.5

Population exposure of primary PM2.5

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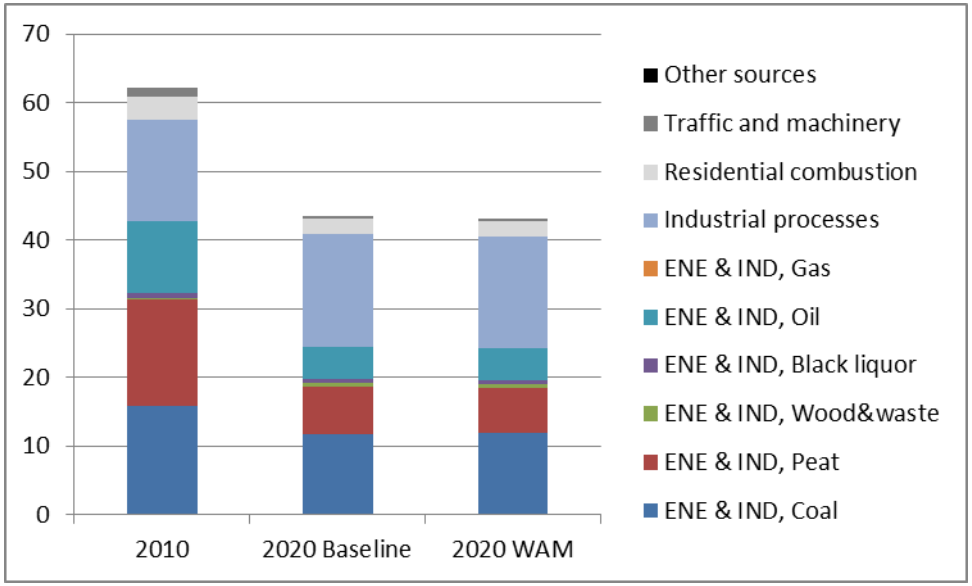
Air pollution emissions, SO2 (ktons/a)

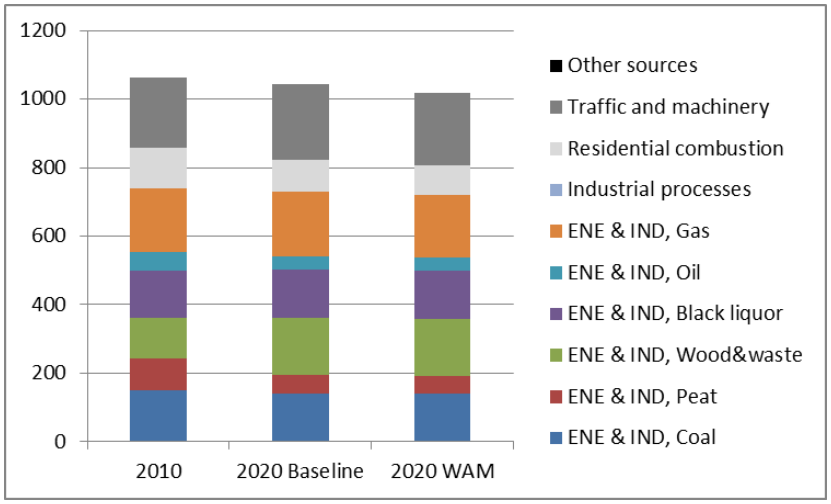
Emissions decrease from 2010 due to

- Lesser use of peat, oil and coal
- IE directive

Very little difference between Baseline and WAM



Primary energy use of fuels (PJ/a)



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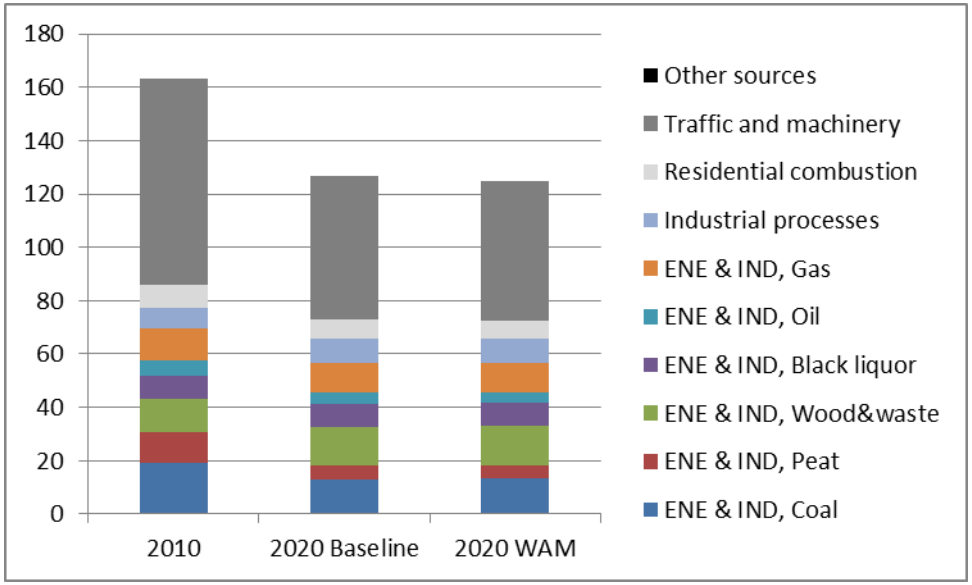
Air pollution emissions, NOx (ktons/a)

Emissions decrease from 2010 due to

- Traffic car fleet renewal
- Lesser use of peat, oil and coal
- IE directive

Very little difference between Baseline and WAM



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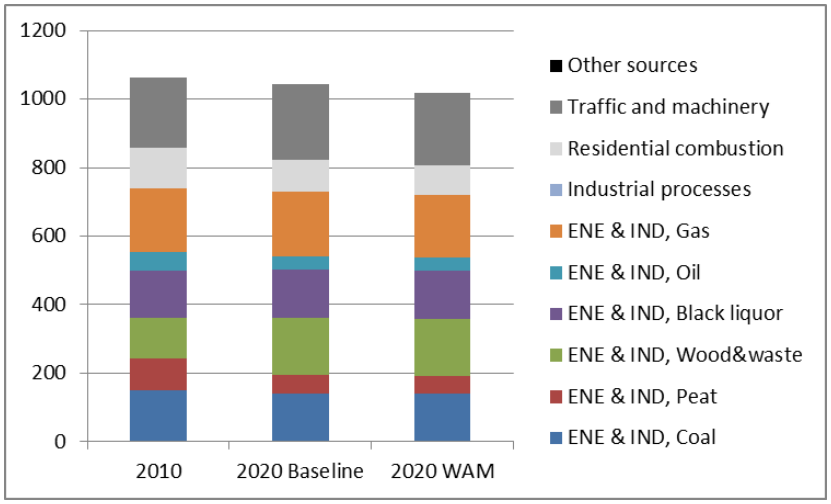

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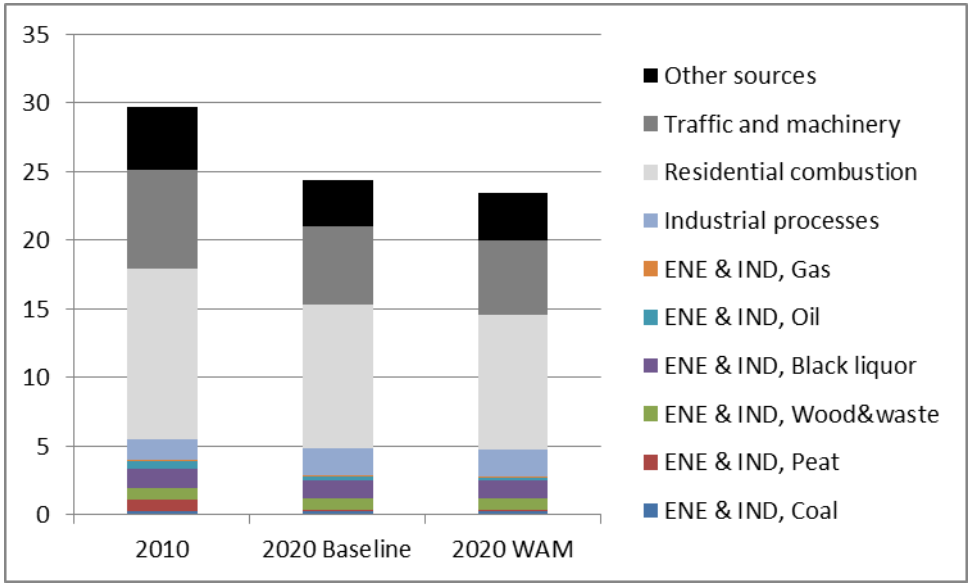
Air pollution emissions, PM2.5 (ktons/a)

Emissions decrease from 2010 due to

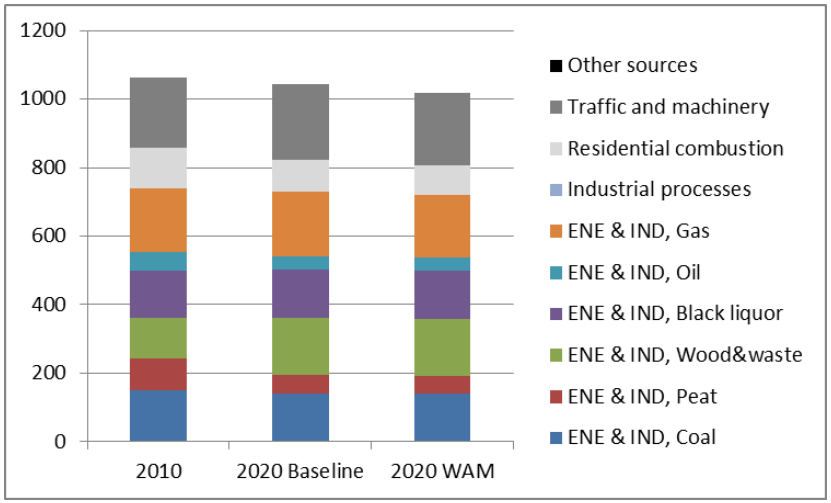
- Traffic car fleet renewal
- Wood stove stock renewal
- IE directive (+ national legislation) to energy plants < 50 MW

Slight decrease from Baseline to WAM

- Less traffic fuel consumption due to measures on traffic mode changes and ”eco-driving”
- Less house heating need due to stricter building regulation



Primary energy use of fuels (PJ/a)



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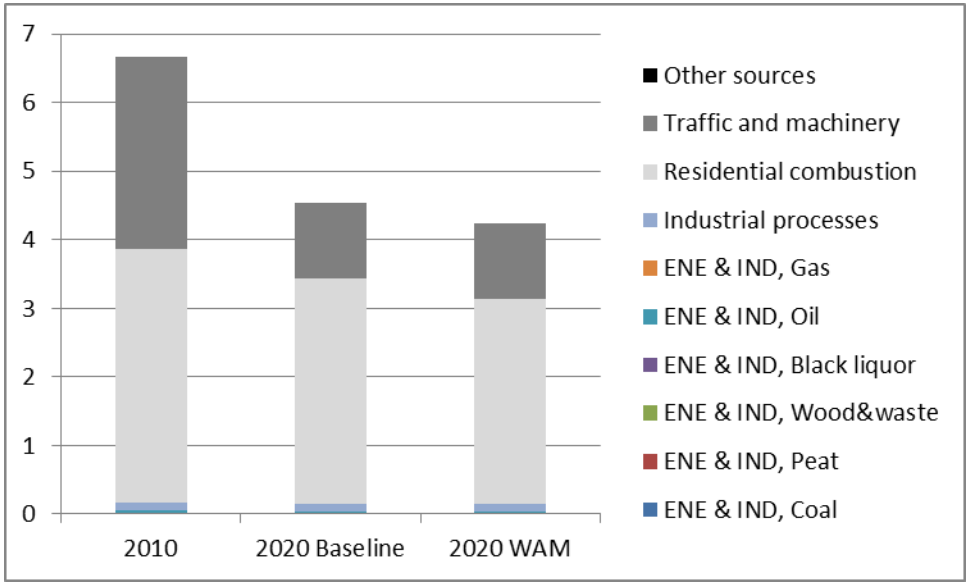
Air pollution emissions, BC (ktons/a)

Emissions decrease from 2010 due to

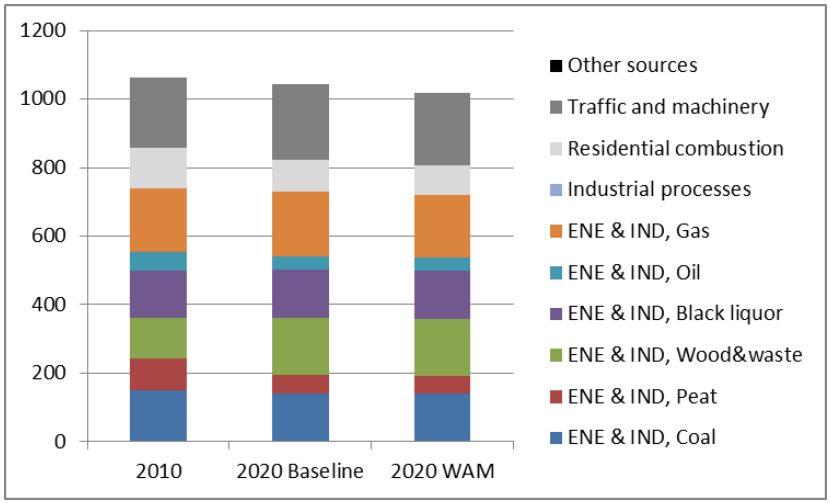
- Traffic car fleet renewal
- Wood stove stock renewal

Slight decrease from Baseline to WAM

- Less traffic fuel consumption due to measures on traffic mode changes and ”eco-driving”
- Less house heating need due to stricter building regulation



Primary energy use of fuels (PJ/a)



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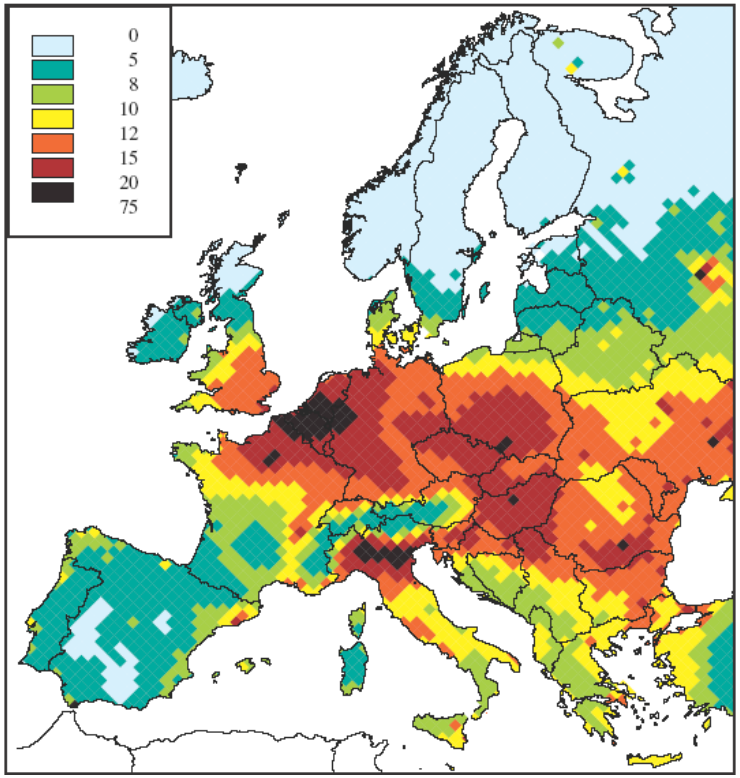
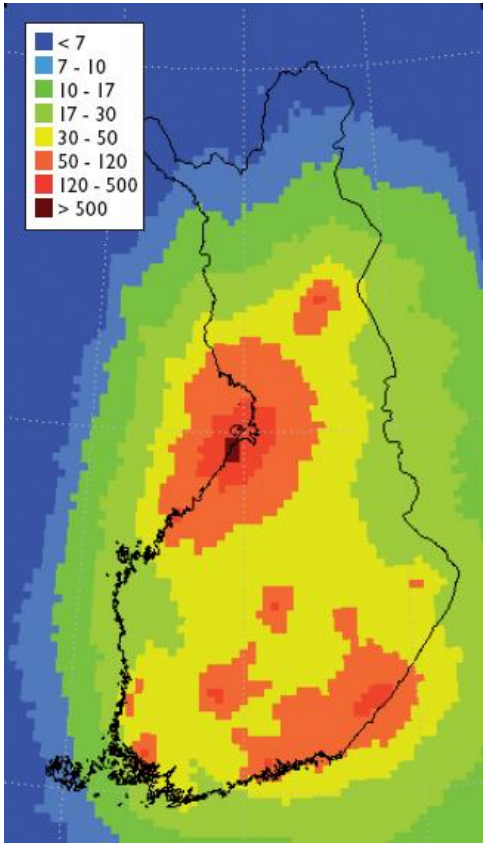
Primary PM dispersion in FRES

1. Long-range transport impacts with EMEP 50 km resolution – Not used in this
2. Finnish high-stack PM emissions with 10 km resolution
3. Finnish near-ground PM emissions with 1 km resolution

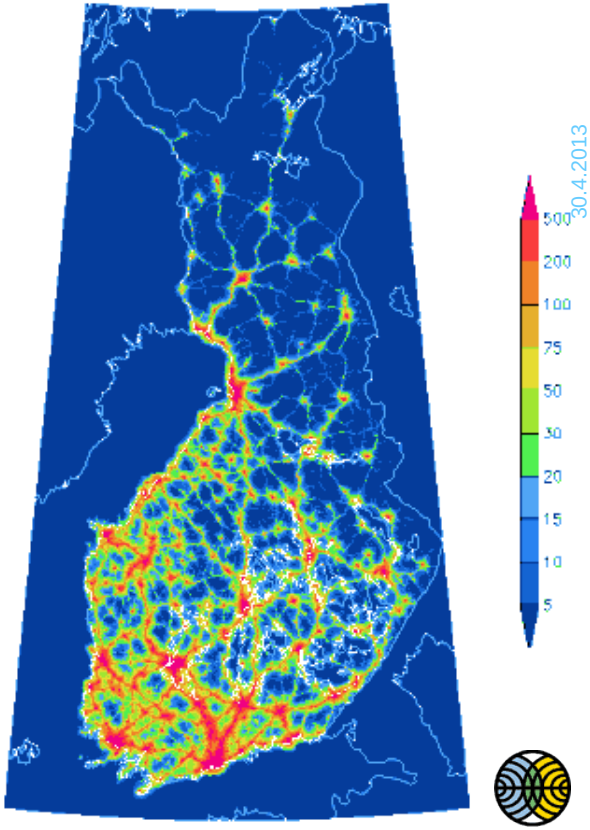
1. EMEP source-receptor matrices (SRM) 50 x 50 km



2. Lagrangian SILAM based SRM 10 x 10 km



3. Gaussian UDM-FMI based SRM 1 x 1 km



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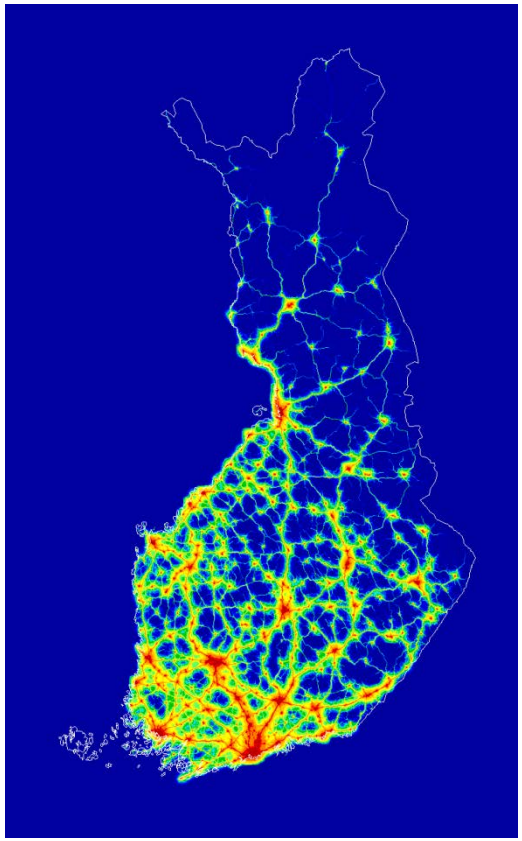
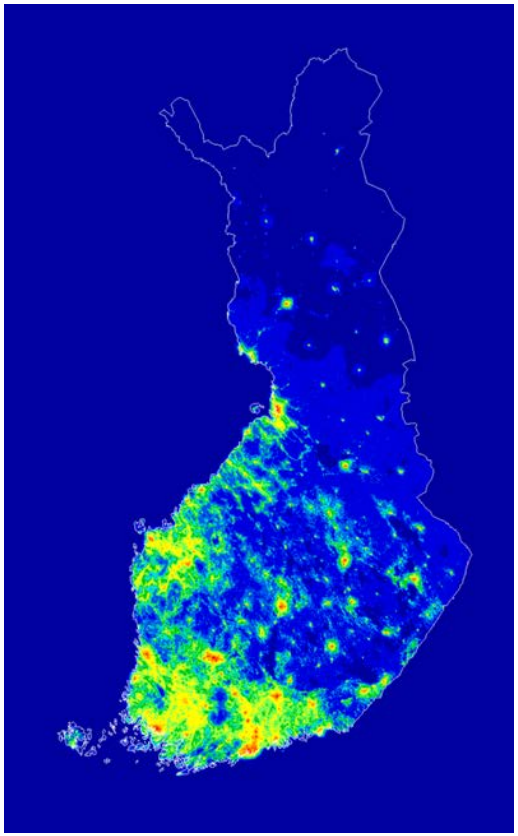
Primary PM2.5 concentrations

Primary PM2.5 SRMs at 1 x 1 km resolution were applied to Finnish near ground emissions

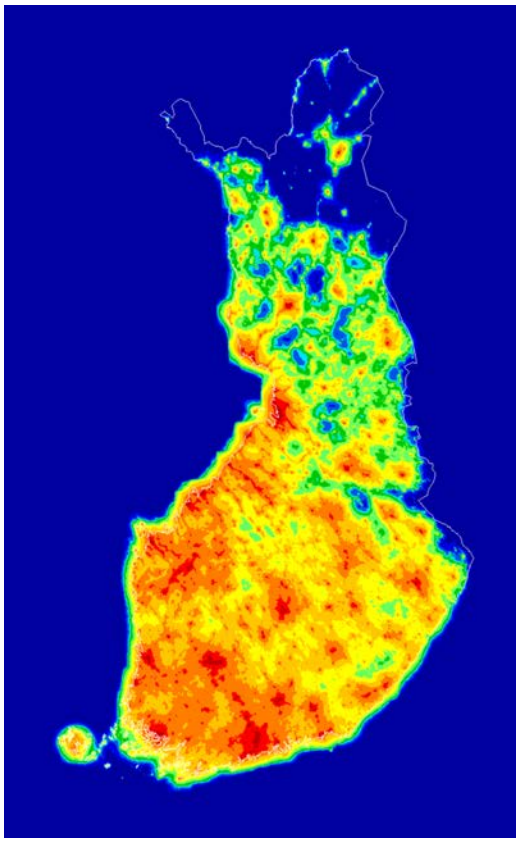
Modelled primary PM2.5 concentrations in 2020 Baseline (ng/m3)



Road traffic



Machinery



Residential wood combustion

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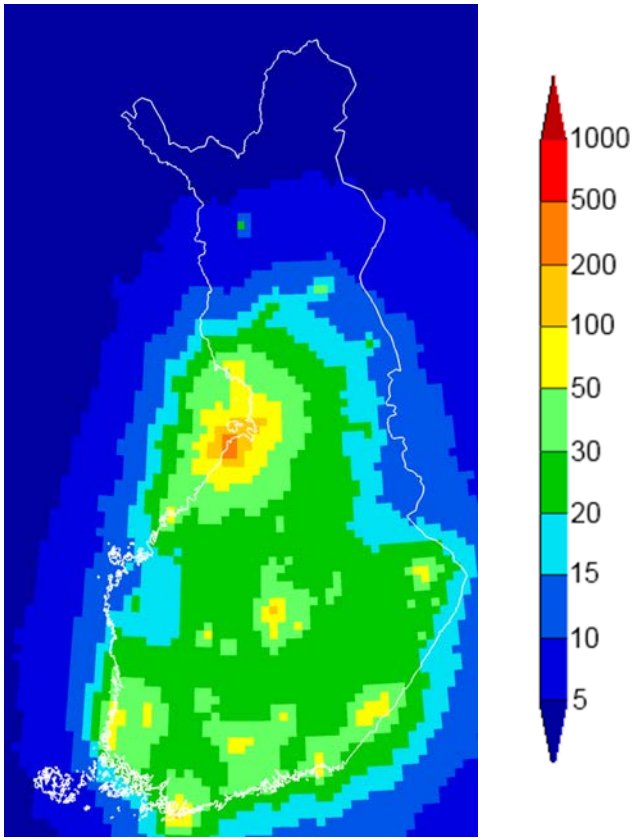
Primary PM2.5 concentrations

Primary PM2.5 SRMs at 10 x 10 km resolution were applied to Finnish high stack emissions

Modelled primary PM2.5 concentrations in 2020 Baseline (ng/m3)



Energy production,
industry and processes

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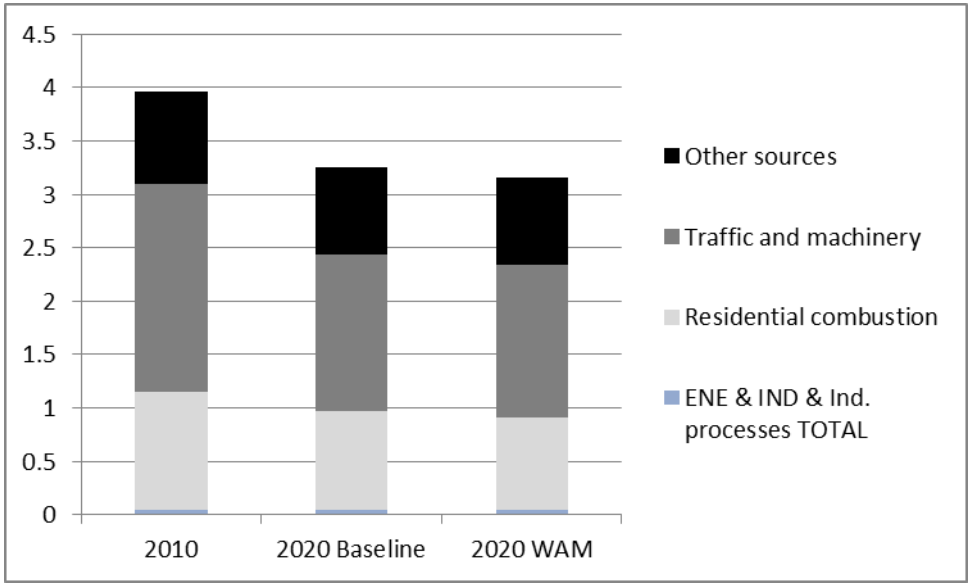
Population exposure to primary PM2.5 (µg/m3)

Population exposure decrease from 2010 due to

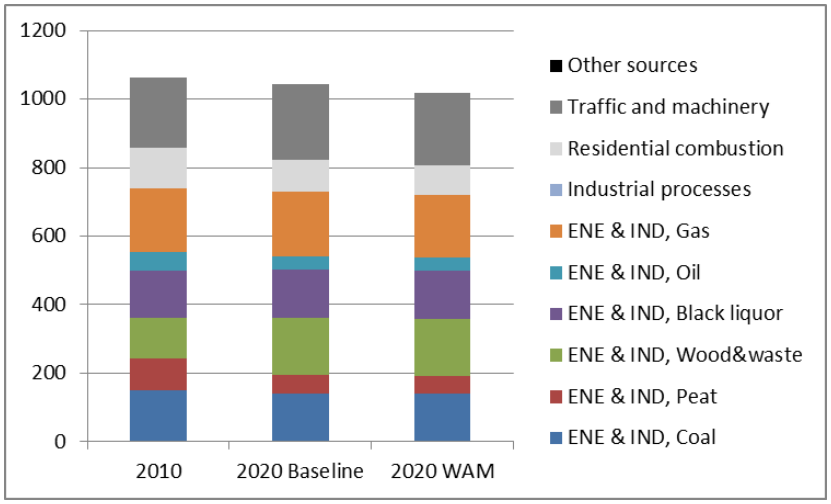
- Traffic car fleet renewal
- Wood stove stock renewal

Slight decrease from Baseline to WAM

- Less traffic fuel consumption due to measures on traffic mode changes and ”eco-driving”
- Less house heating need due to stricter building regulation



Primary energy use of fuels (PJ/a)



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Conclusions

- The strategy scenarios rather conservative and industry driven. Challenging to get to a -80% pathway by 2050
- Air pollution study demonstrates decrease in emissions and population exposure from 2010 to 2020 thanks to emission legislation and cleaner fuels
- Baseline - WAM scenario comparison demonstrates positive impacts of traffic- and residential-related NTMs (e.g. traffic mode changes, ”eco-driving”, stricter building efficiency regulations) on the emissions and population exposure to PM2.5 and BC
- Potential trade-offs from residential wood heating
  - Increased population exposure and negative health impacts from urban emissions
  - Increased climate impacts from winter-time BC emissions (especially through snow albedo effects)

Thank You

www.environment.fi/syke/pm-modeling

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