



Climat et environnement

Klimaat en milieu

CleanAirBouw

Filter application as air quality improvement strategy for particulate matter

L. Corneillie, K. De Jonge, J. Laverge



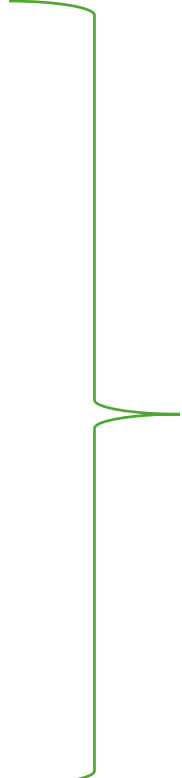
AVEC LE SOUTIEN DU FONDS EUROPÉEN DE DÉVELOPPEMENT RÉGIONAL
MET STEUN VAN HET EUROPEES FONDS VOOR REGIONALE ONTWIKKELING

Context

- Pandemic
- Increasing use of air cleaners
- Multiple test standards used
- Inconsistencies in type, technology, duration and pollutants

Knowledge gaps and challenges

- Small set of pollutants
- High concentrations
- Small test chambers
- Fixed conditions



Uncertainty in
real-life performance

Simulation model

- Air cleaner with filter
- Particulate matter (PM)
 - Particles suspended in air
 - Toxic
- Dynamic simulations using Modelica
- 3-bedroom apartment



Floorplan of the reference apartment (Source: De Jonge, 2023).

Simulation studies

Base scenario

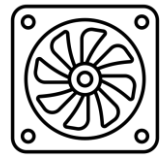
Category A

Category B

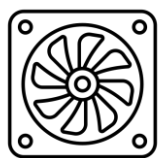
Category C

Category D

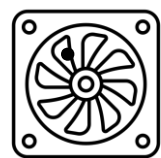
1.



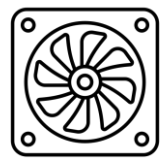
2.



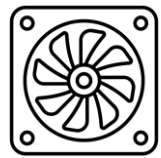
3



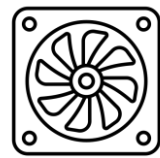
4.



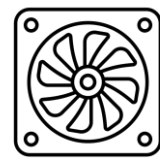
5.



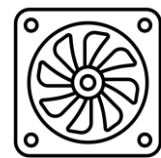
6.



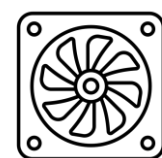
7.



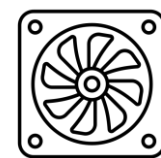
8.



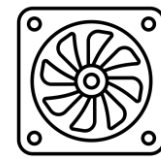
9.



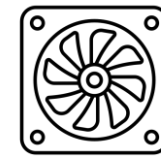
10.



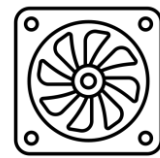
11.



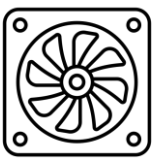
12.



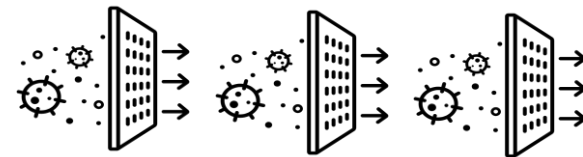
13.



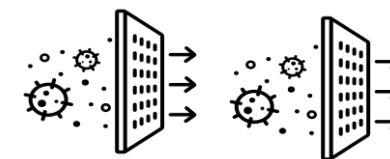
14.



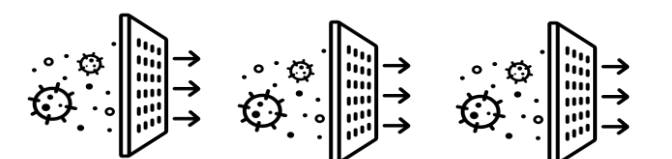
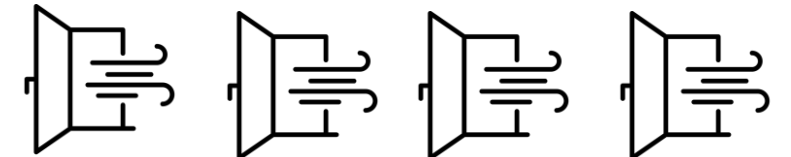
Urban Traffic Rural



Coarse Fine HEPA



Coarse HEPA



Coarse HEPA HEPA



Simulation studies

Base scenario



Simulation studies

Base
scenario

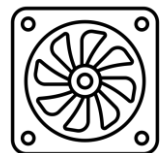
Category A

Category B

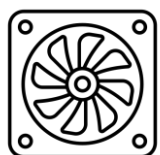
Category C

Category D

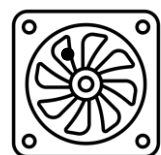
1.



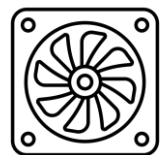
2.



3.



4.

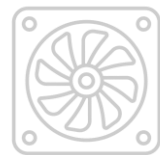


Urban Traffic Rural

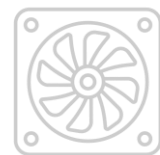
5.



6.

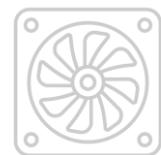


7.

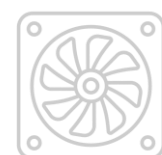


Coarse Fine HEPA

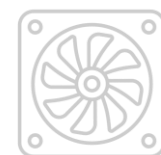
8.



9.

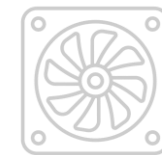


10.

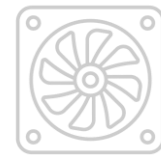


Coarse HEPA

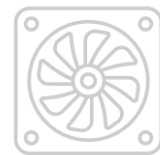
11.



12.



13.



14.



Coarse HEPA HEPA



Simulation studies

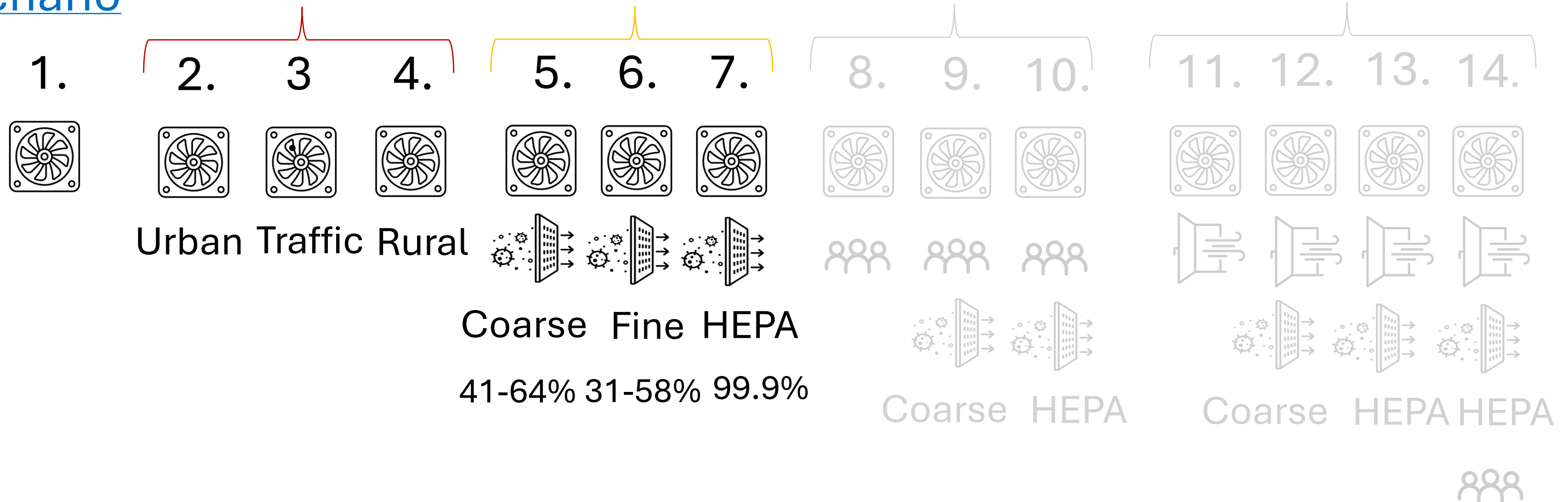
Base scenario

Category A

Category B

Category C

Category D



Simulation studies

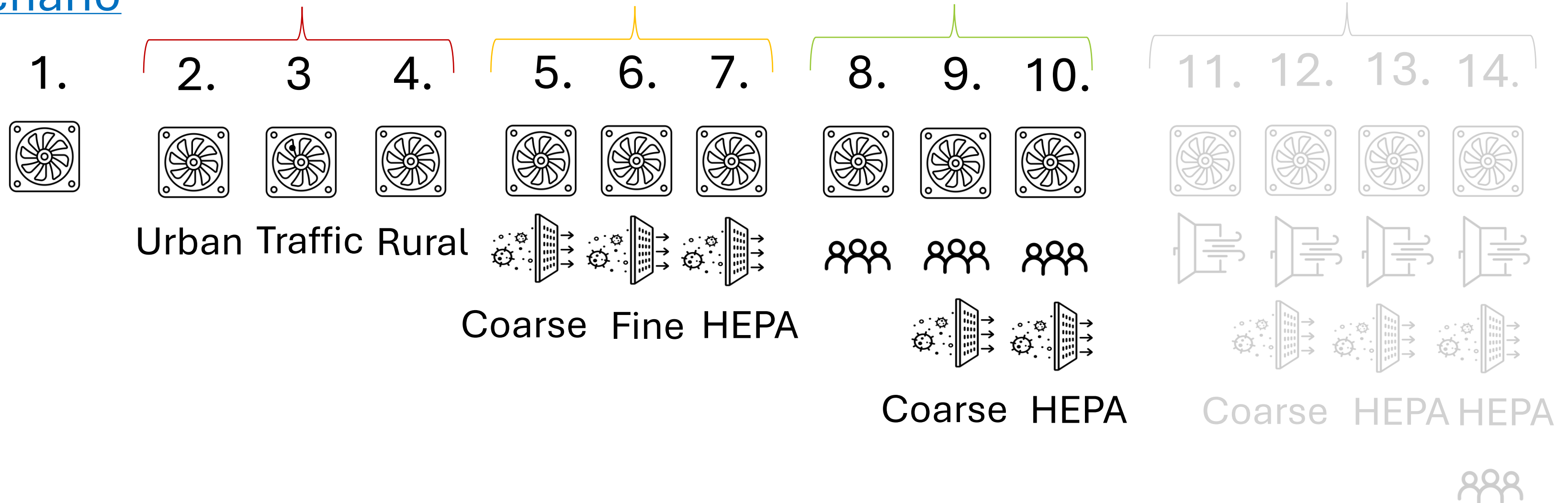
Base scenario

Category A

Category B

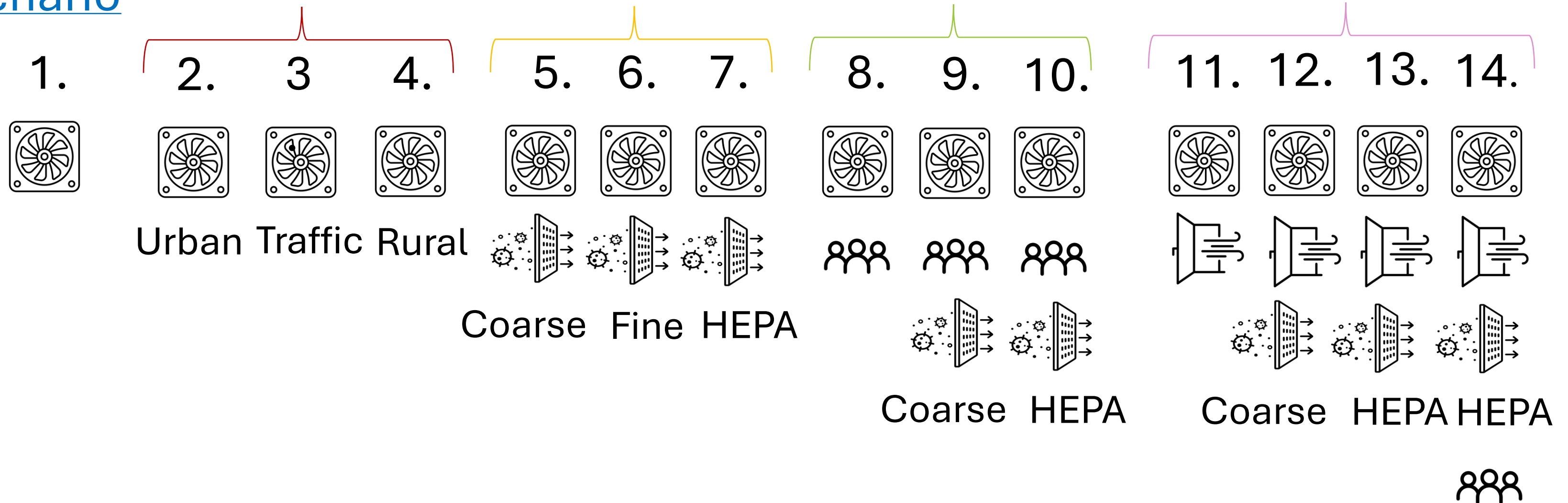
Category C

Category D



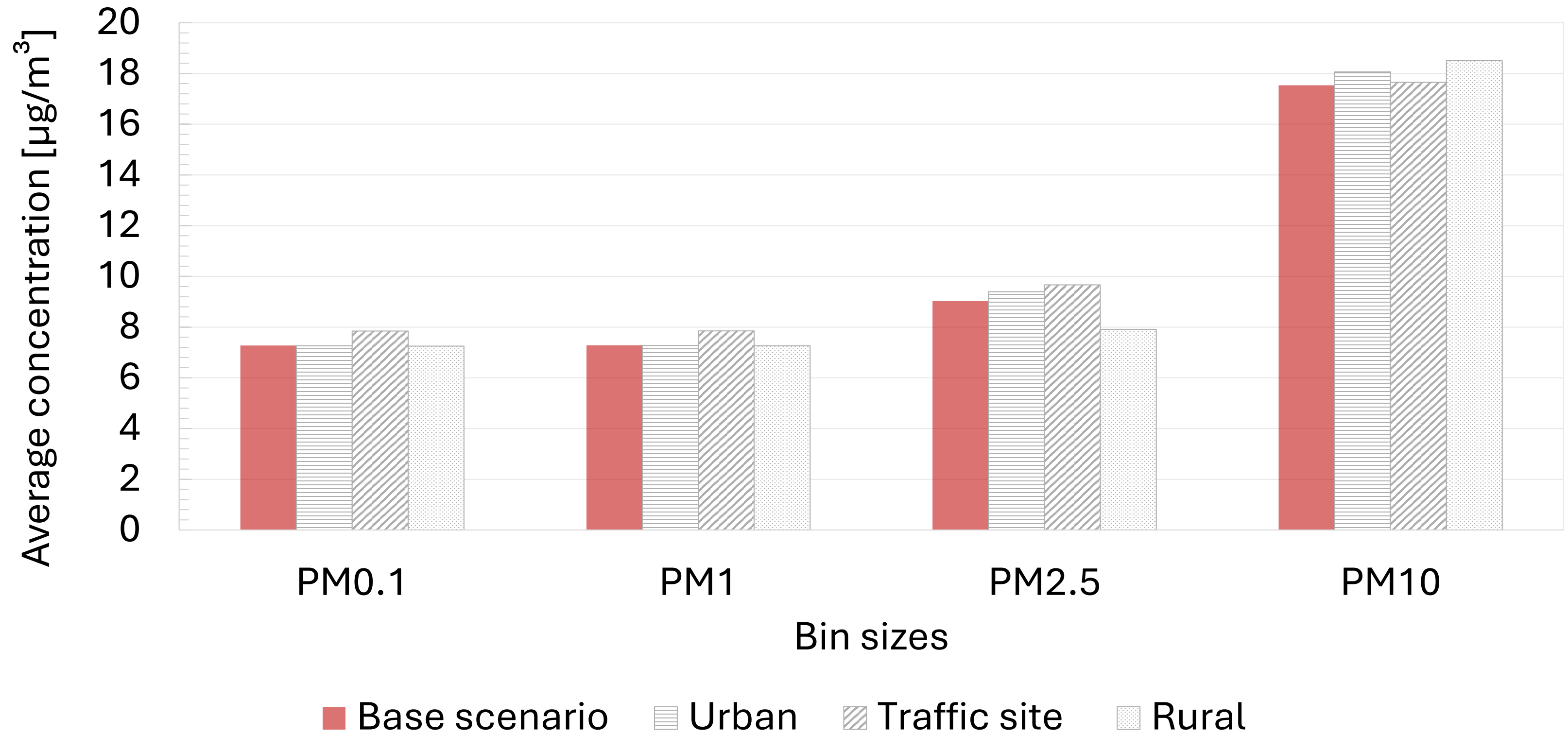
Simulation studies

Base scenario

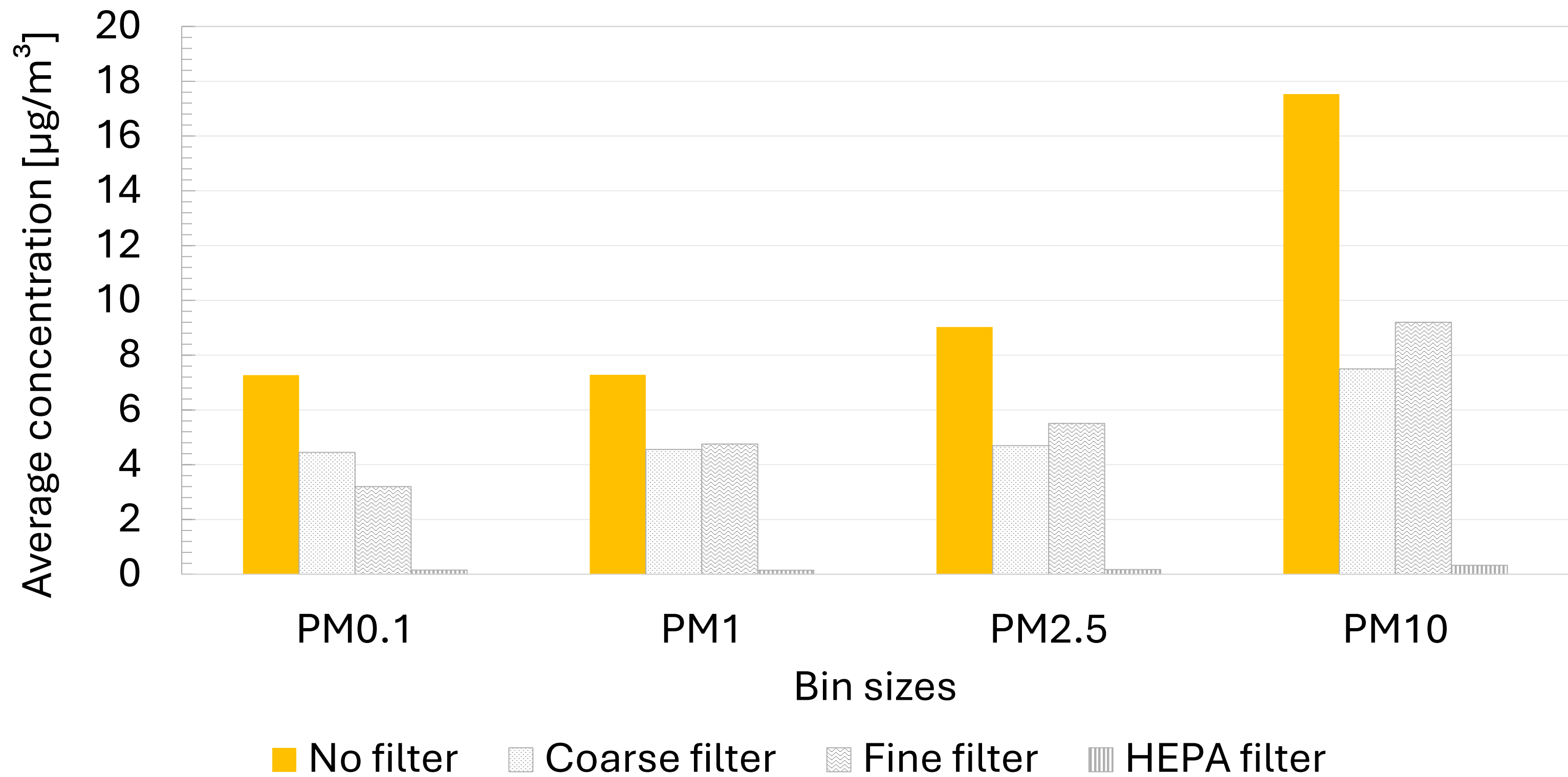


Annual average Vilvoorde	PM0.1	PM1	PM2.5	PM10
	$\mu\text{g}/\text{m}^3$			
TARGET VALUE WHO	3	4	5	15
Bedroom 1	7.25	7.25	9.06	17.64
Bedroom 2	7.27	7.27	9.01	17.72
Bedroom 3	7.24	7.24	9.06	17.59
Living	7.15	7.15	8.89	17.32
Hall	7.27	7.27	9.06	17.50
Kitchen	7.24	7.27	8.91	17.43
Bathroom	7.21	7.24	8.88	17.63
Toilet	7.51	7.51	9.31	17.93
Service room	7.31	7.31	9.08	17.66

Average PM concentration in each room in Vilvoorde in 2023.

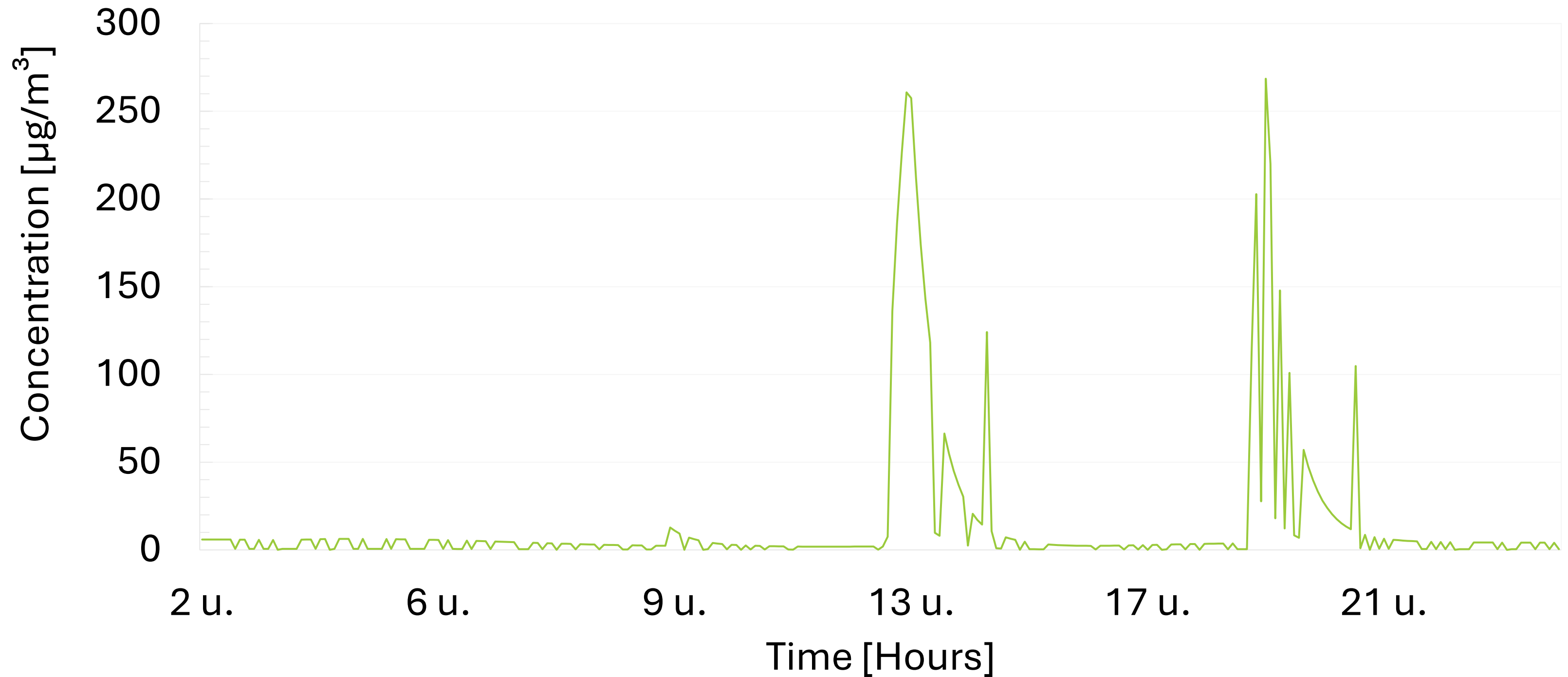


Difference in average indoor PM concentration per bin size.

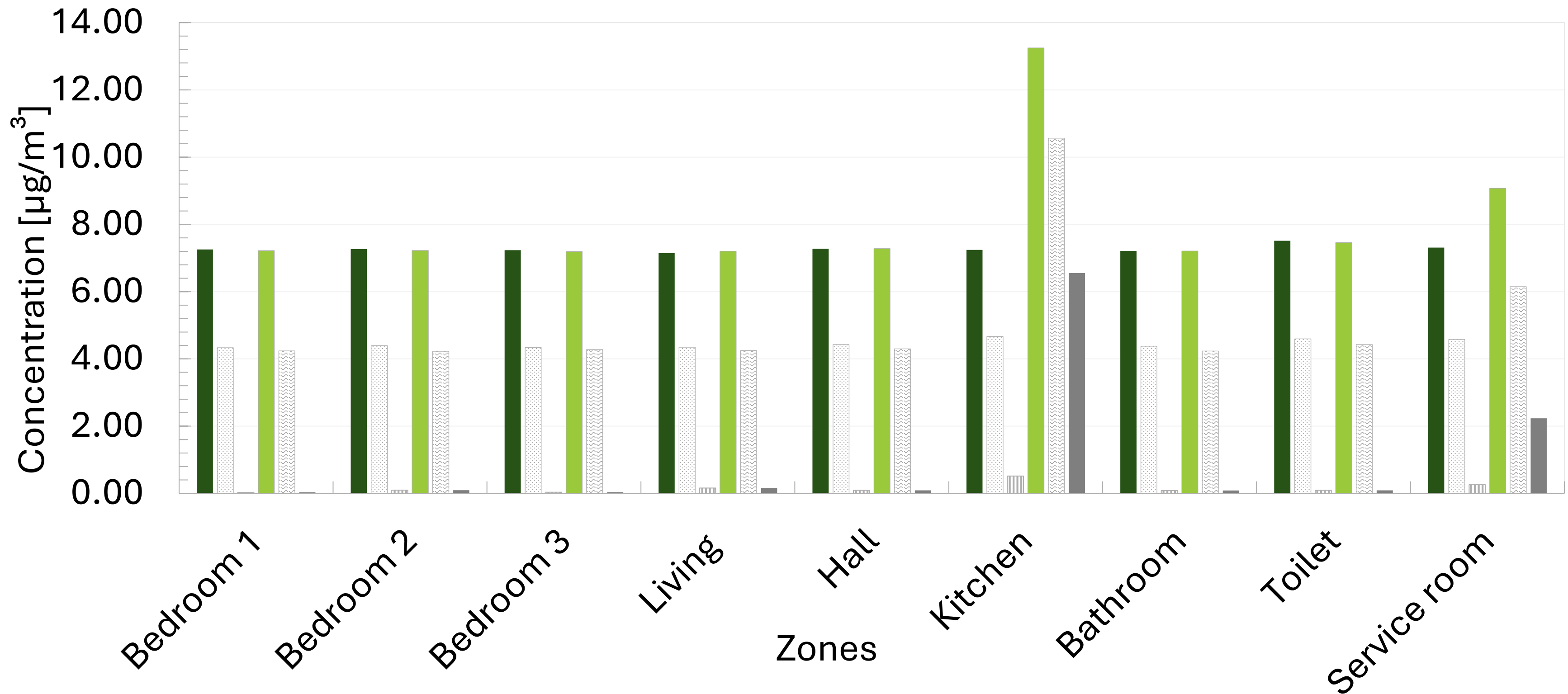


Average indoor concentration for various filters.

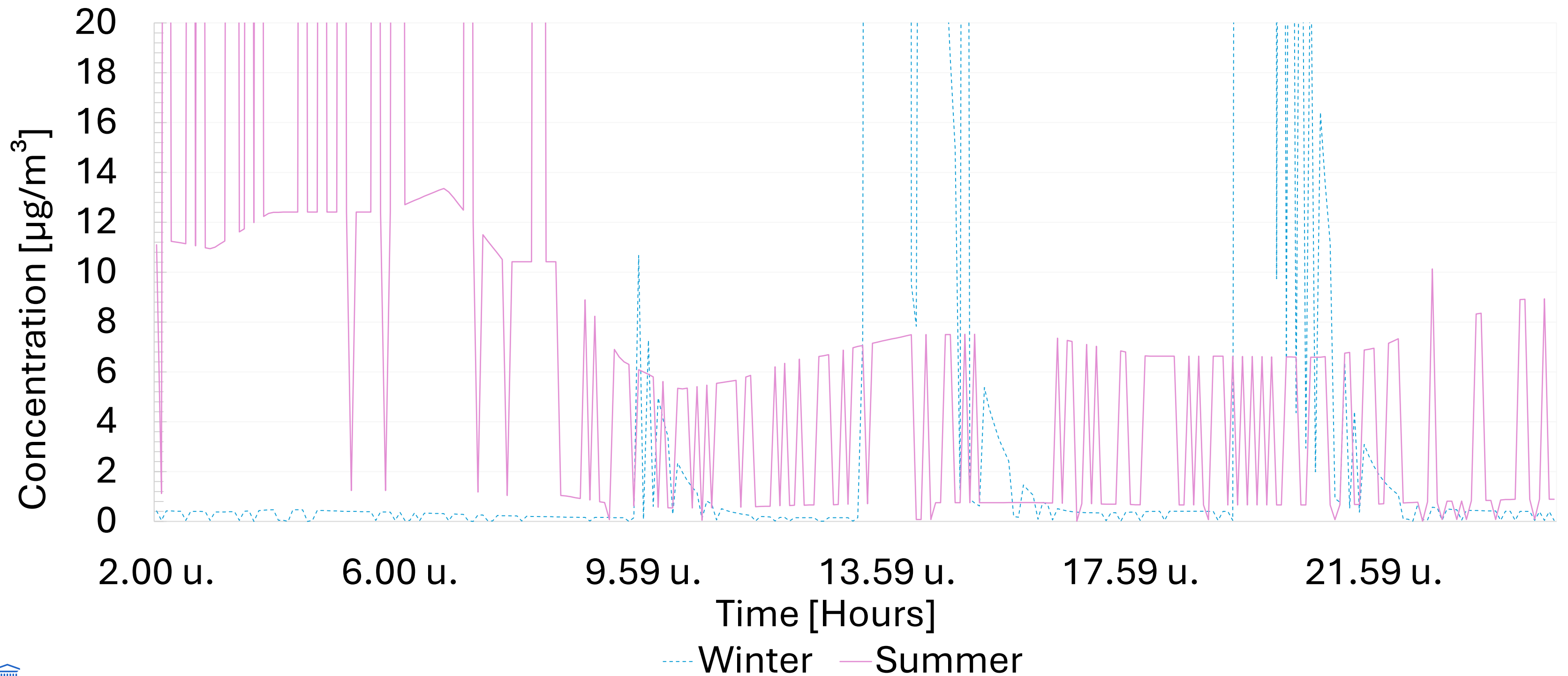
Indoor PM : cooking



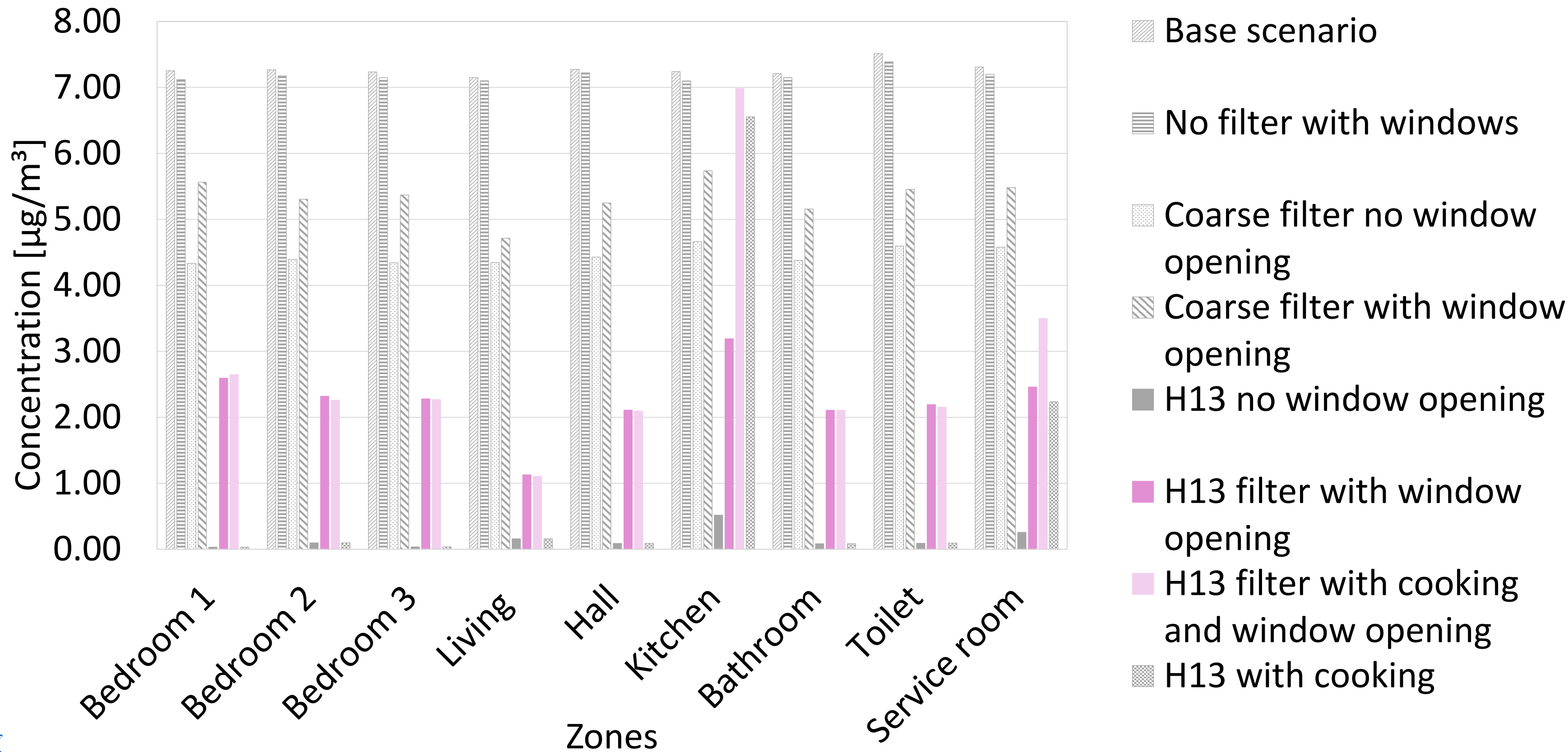
PM0.1 concentration in the kitchen on a Sunday.



Window use

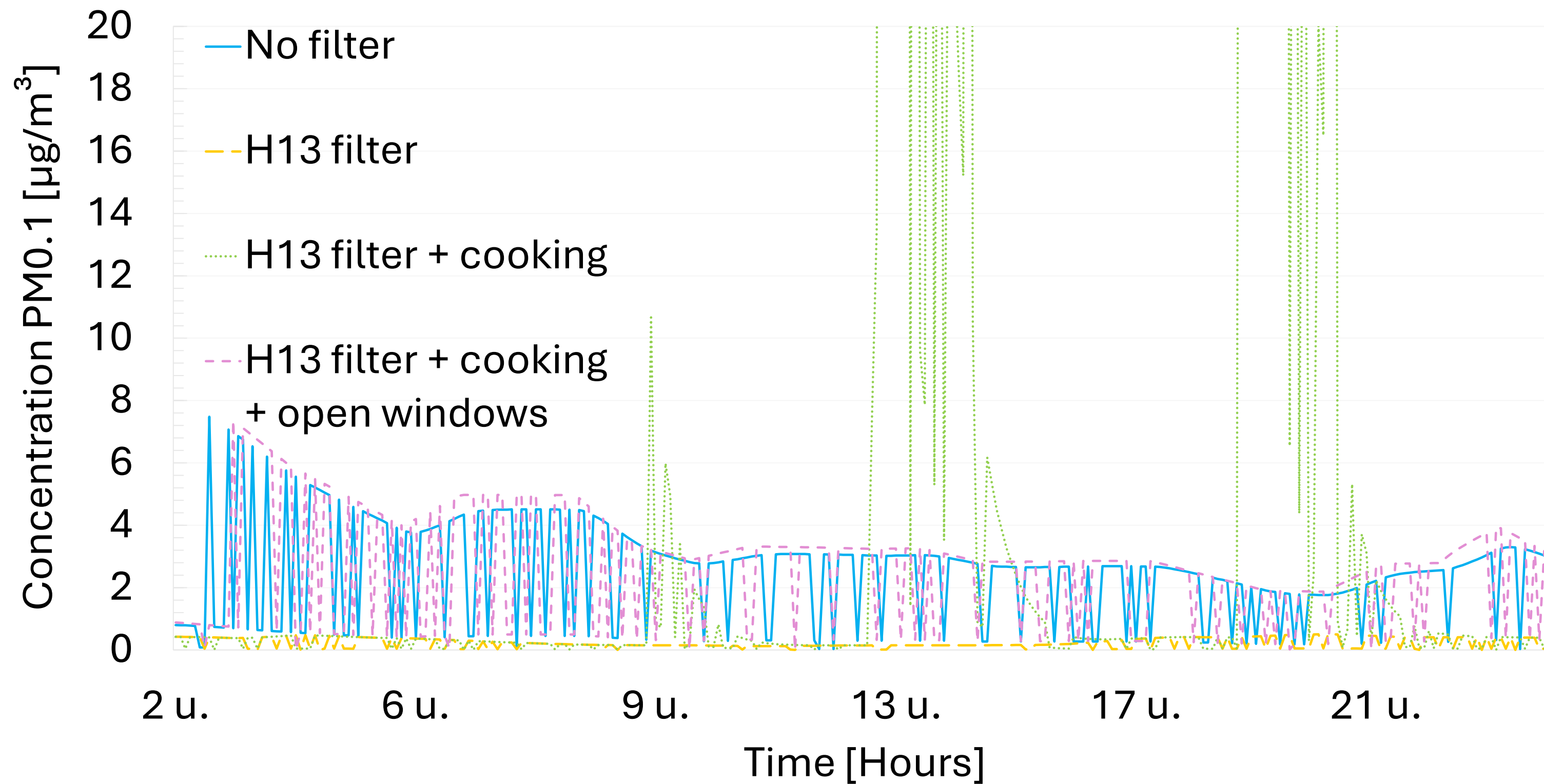


Daily concentration of PM_{0.1} in the kitchen when a HEPA filter is present, and windows are opened.

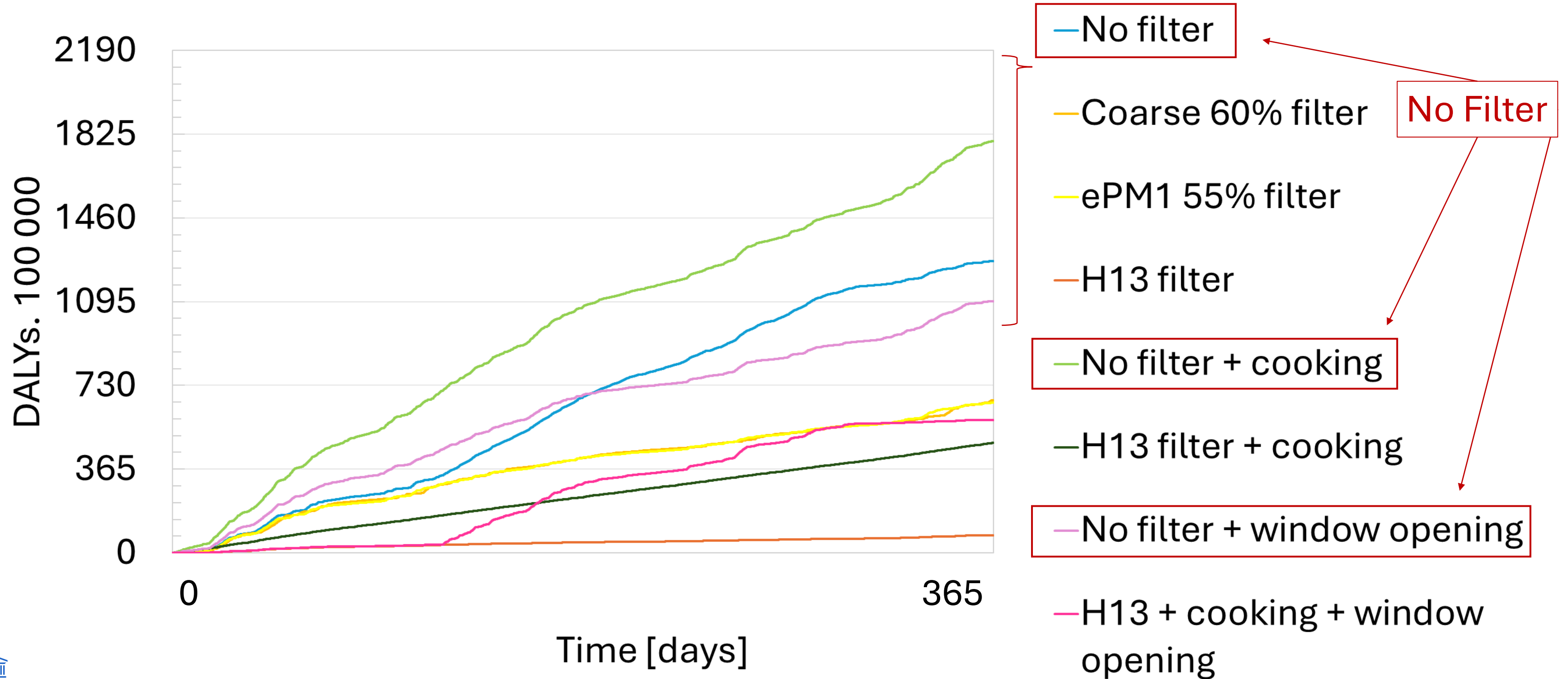


Average concentration PM0,1 in different scenarios.

Summary

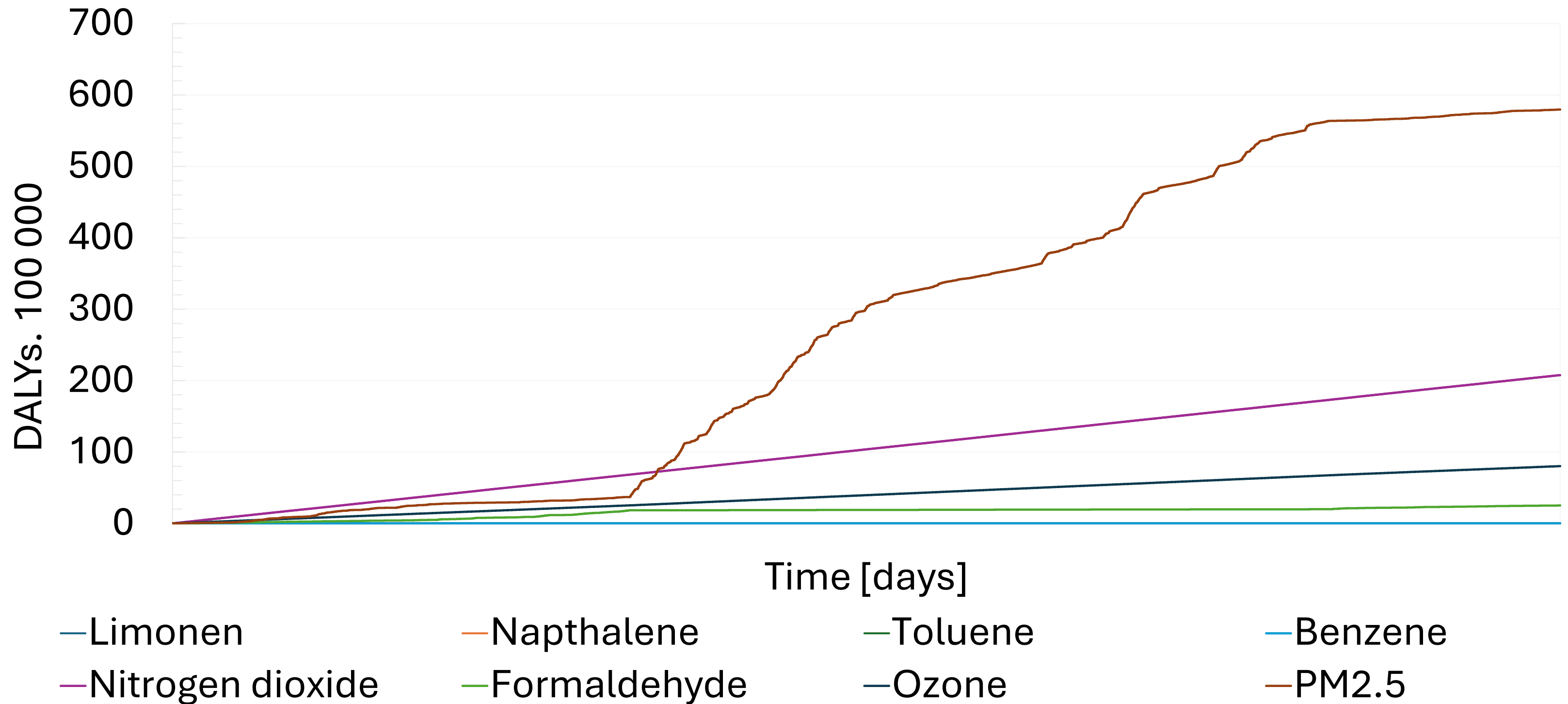


Quantification of health effects



Number of DALYs for PM2.5 in the kitchen.

Quantification of health effects



Number of DALYs for other pollutants per 100 000 people in the kitchen.