

# Enhancing Air Quality: Investigating Filter Lifespan and Byproducts in Air Purification Solutions

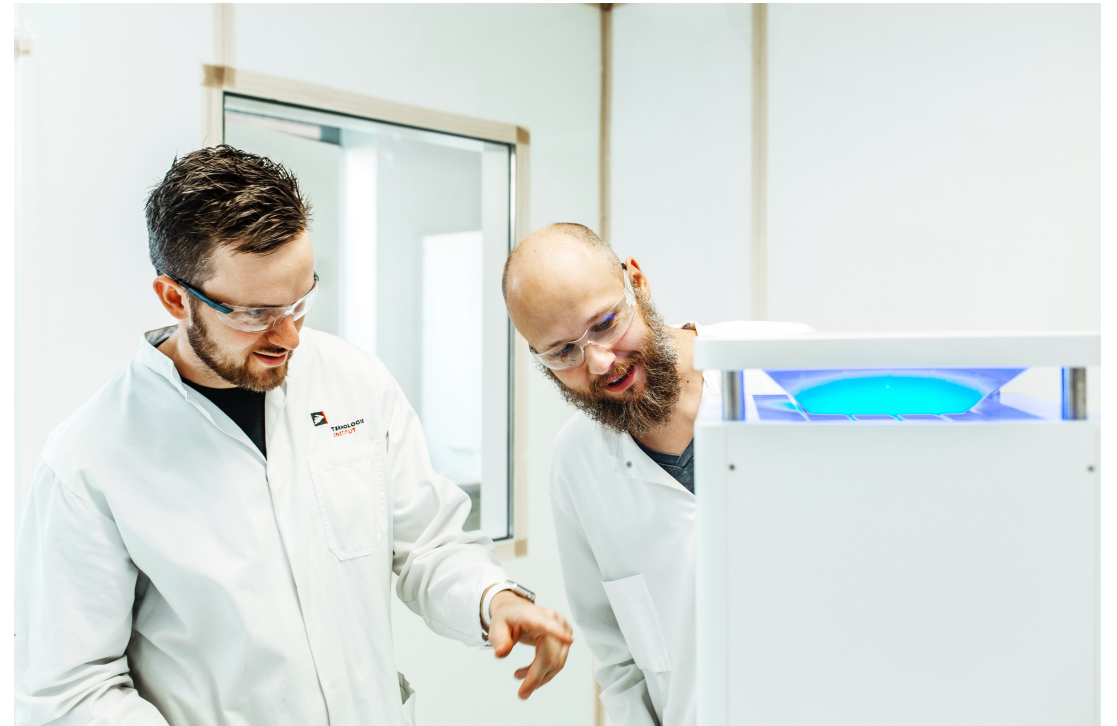
Freja Rydahl Rasmussen, M.Sc. Atmospheric Chemistry

Danish Technological Institute, Air and Sensor Technology

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# Background

- We spent 90 % of our time indoors
- Mobile air purifiers are increasing in popularity and are used in many work-place scenarios
- Currently, no European standard exists, however, it is on its way, and thus knowledge on the subject is needed
- Technologies:
  - Particle Filter (HEPA, EPA, etc.)
  - Active Carbon filters
  - Ionization, UV-C, PCO
- Recommendations when it comes to filter change (from 1 month to 1 year)



# Project Aims

- To study the various concerns regarding air purifiers including
  - Life span of particle filters
  - Life span/capacity of active carbon filters
  - Off-gassing from active carbon filters
  - Byproducts from selected technologies (Ionization, PCO, and UV-C)
- A total of 16 air purifiers was investigated
- The project will contribute to:
  - Understanding filter life span
  - Enhancing safety for consumers when using air purifiers
  - Help with better regulation and standardization



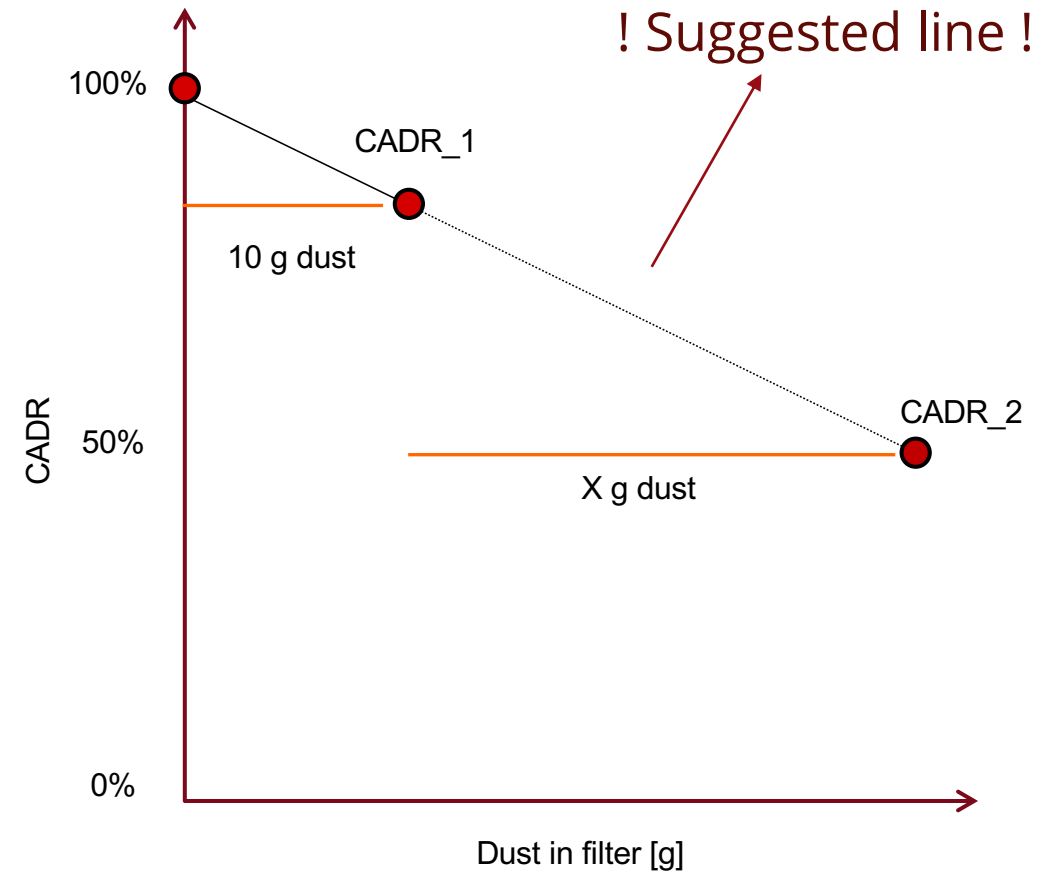
# Life span of particle filters





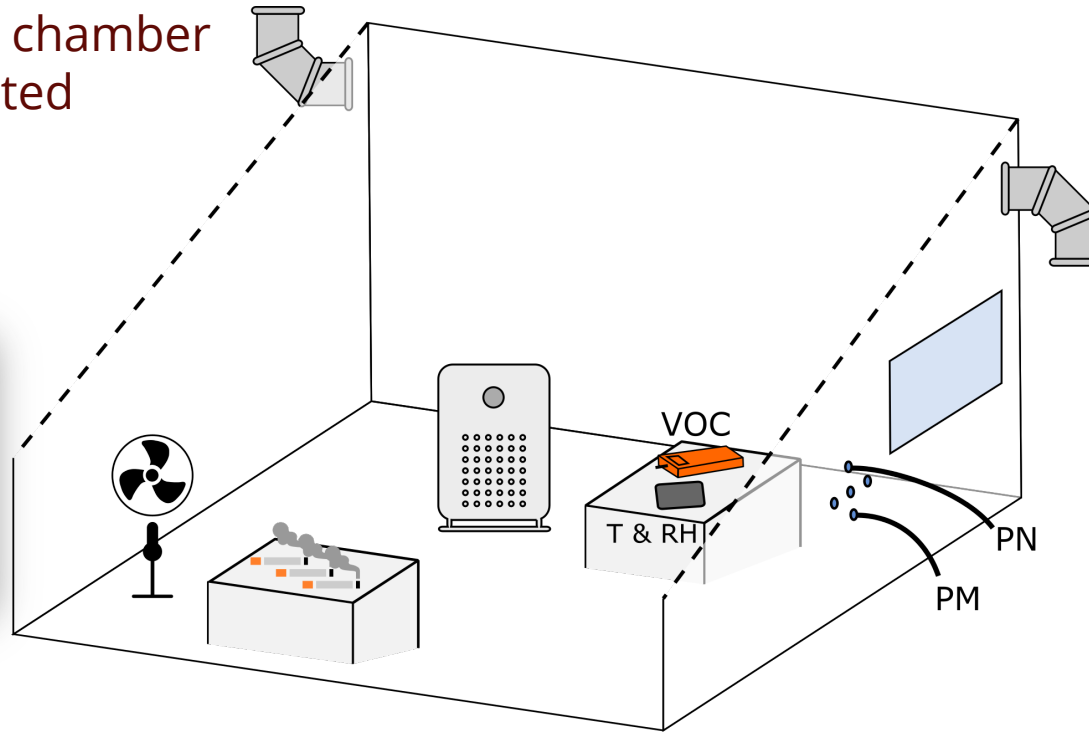
# The Idea

- The efficiency of an air purifier is given as Clean Air Delivery Rate (CADR, m<sup>3</sup>/h)
- Filter lifespan is estimated to be at the point where CADR is reduced by 50%
- The filter lifespan is depended on how much pollution/particles are captured by the filter
- The challenge was to get as many particles as possible on the filter during a short time-period.



# CADR test

20 m<sup>3</sup> test chamber  
Teflon coated



Particle number  
TSI Nanoscan SMPS

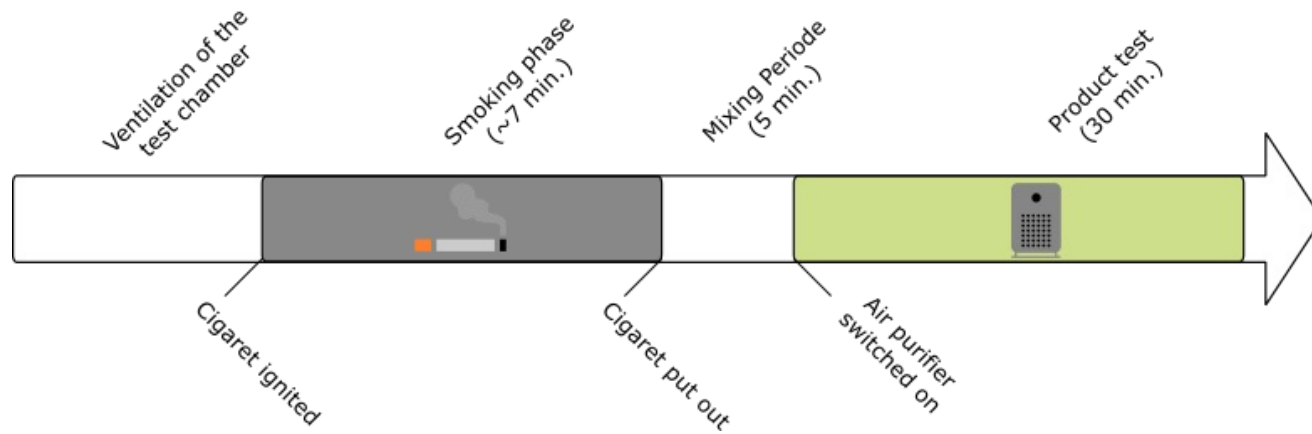


PM2.5  
TSI Dusttrak



TVOC  
Ion Science Tiger

Smoking "robot"



# Filling the filters - Test Setup



A2 fine dust used  
Particle size range: 0.97-176  $\mu\text{m}$



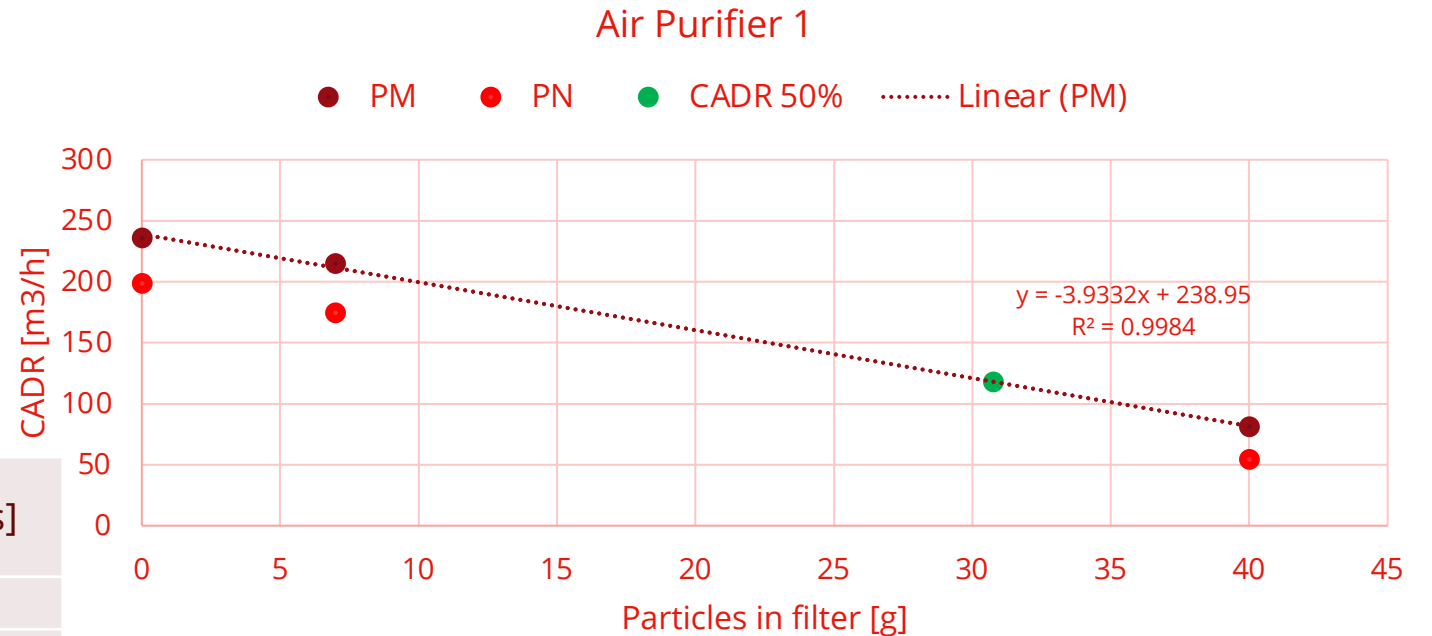


# Life span of particle filters

Assumptions:

- Constant CADR
- Constant pollution

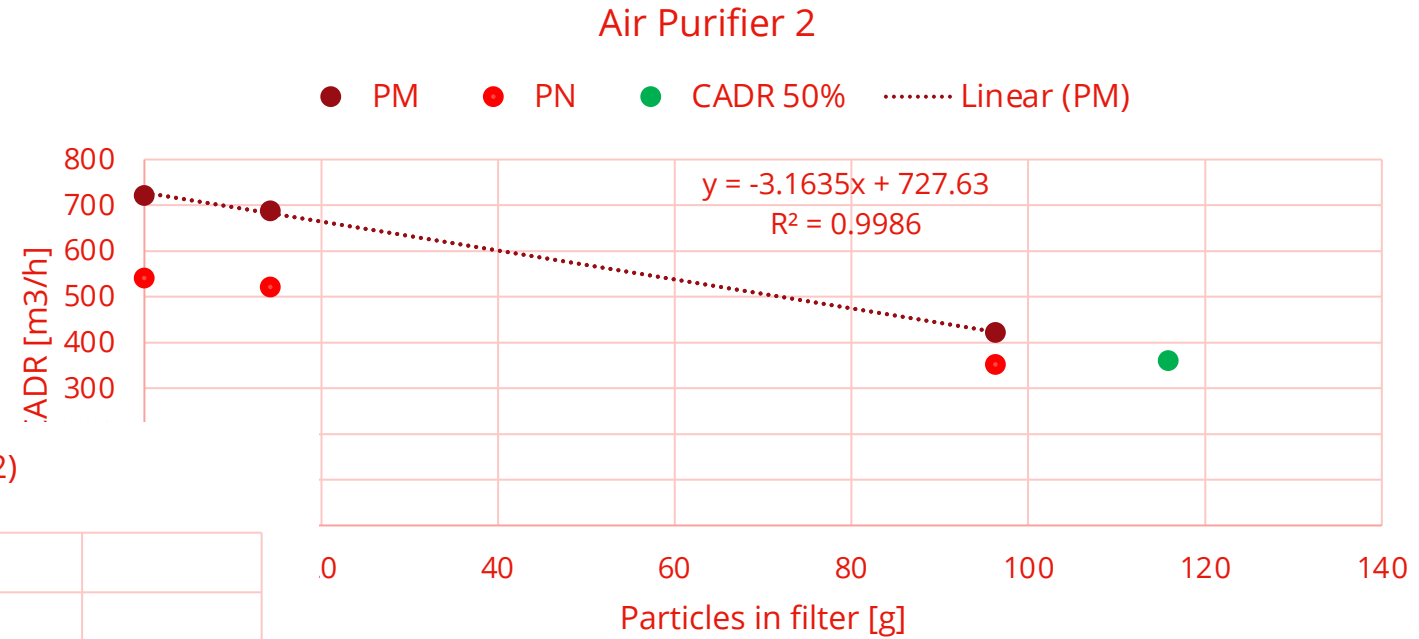
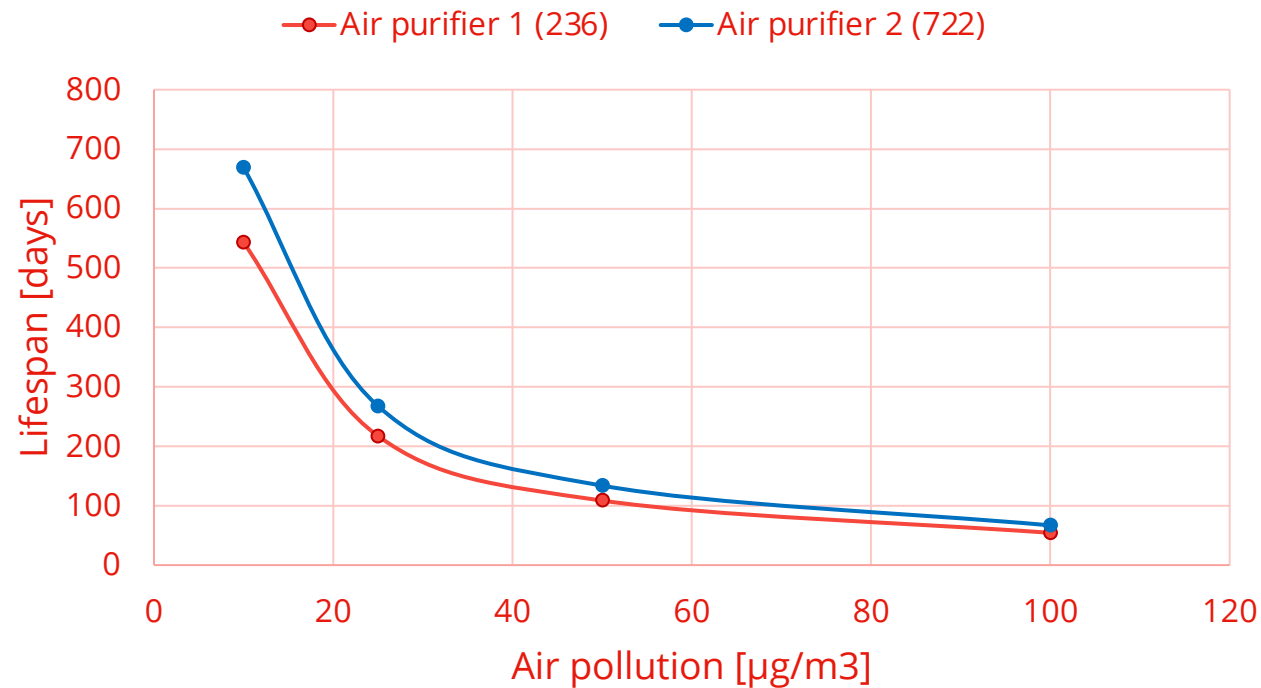
Assumed Air Pollution experienced by air purifier in real life [ $\mu\text{g}/\text{m}^3$ ]	Lifespan [days]
10	543
25	217
50	109
100	54
500	11
1000	5



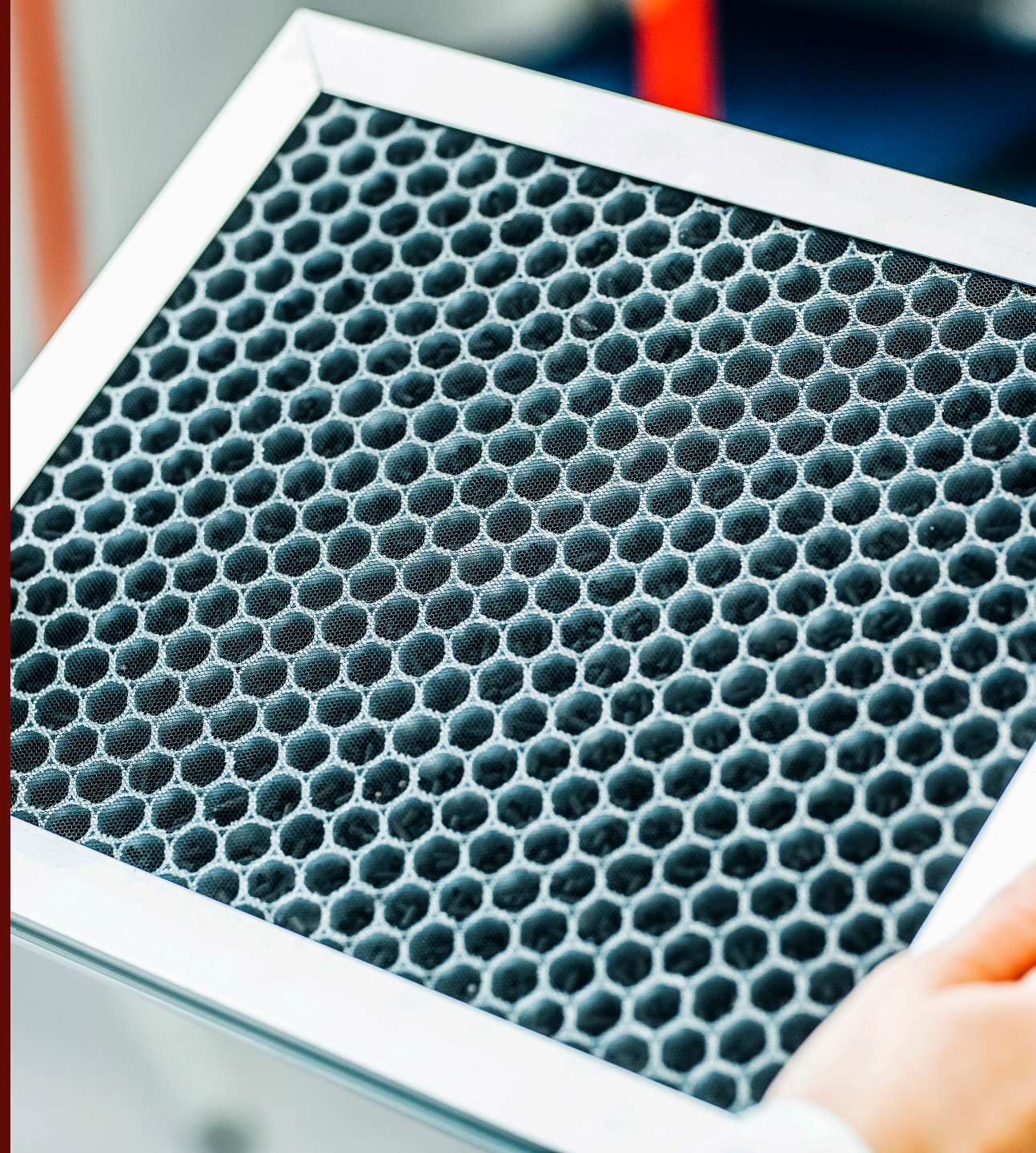
$$\text{Lifespan}(\text{days}) = \frac{\text{Maximum filter gain}(\mu\text{g})}{\text{Mass of particles through air purifier}(\mu\text{g}/\text{day})}$$

# Life span of particle filters

Assumed Air Pollution experienced by air purifier in real life [ $\mu\text{g}/\text{m}^3$ ]	Lifespan [days]
10	669
25	268



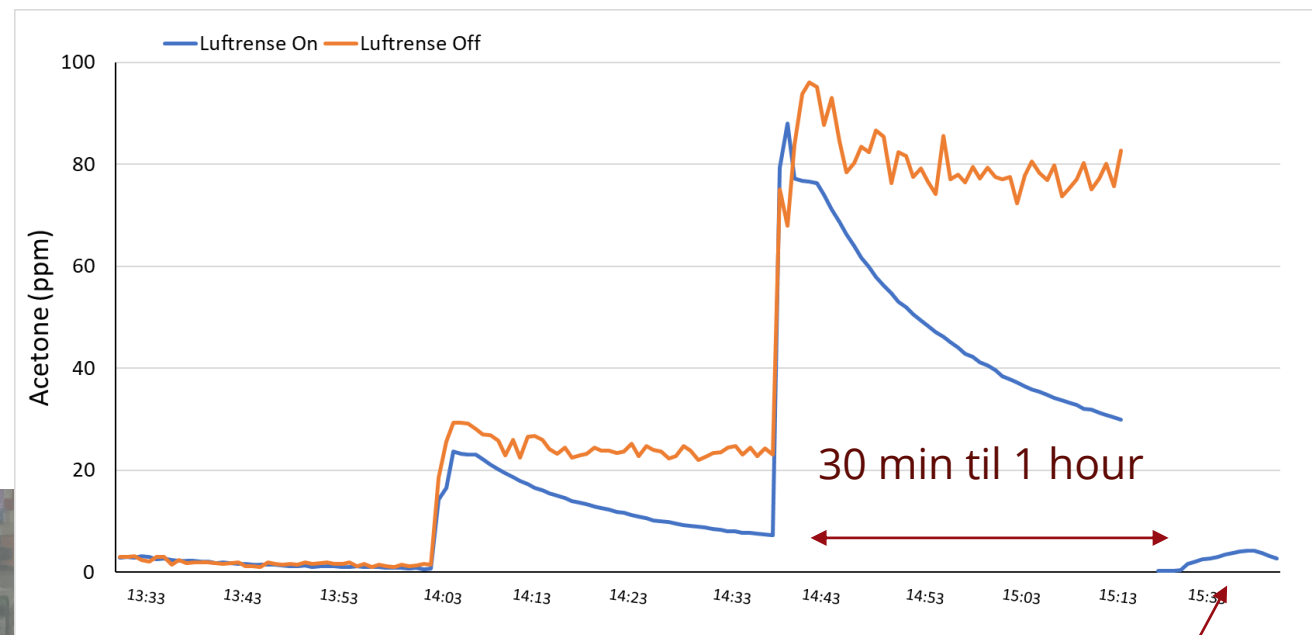
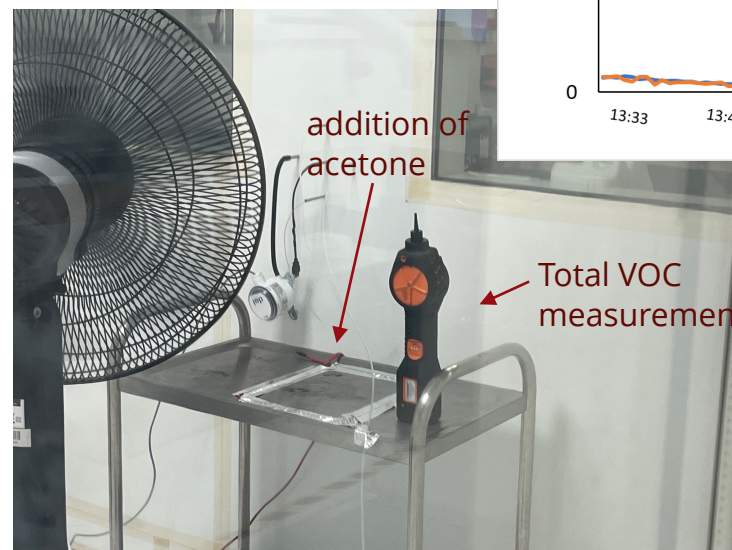
# Off-gassing from active carbon filters





# Test setup

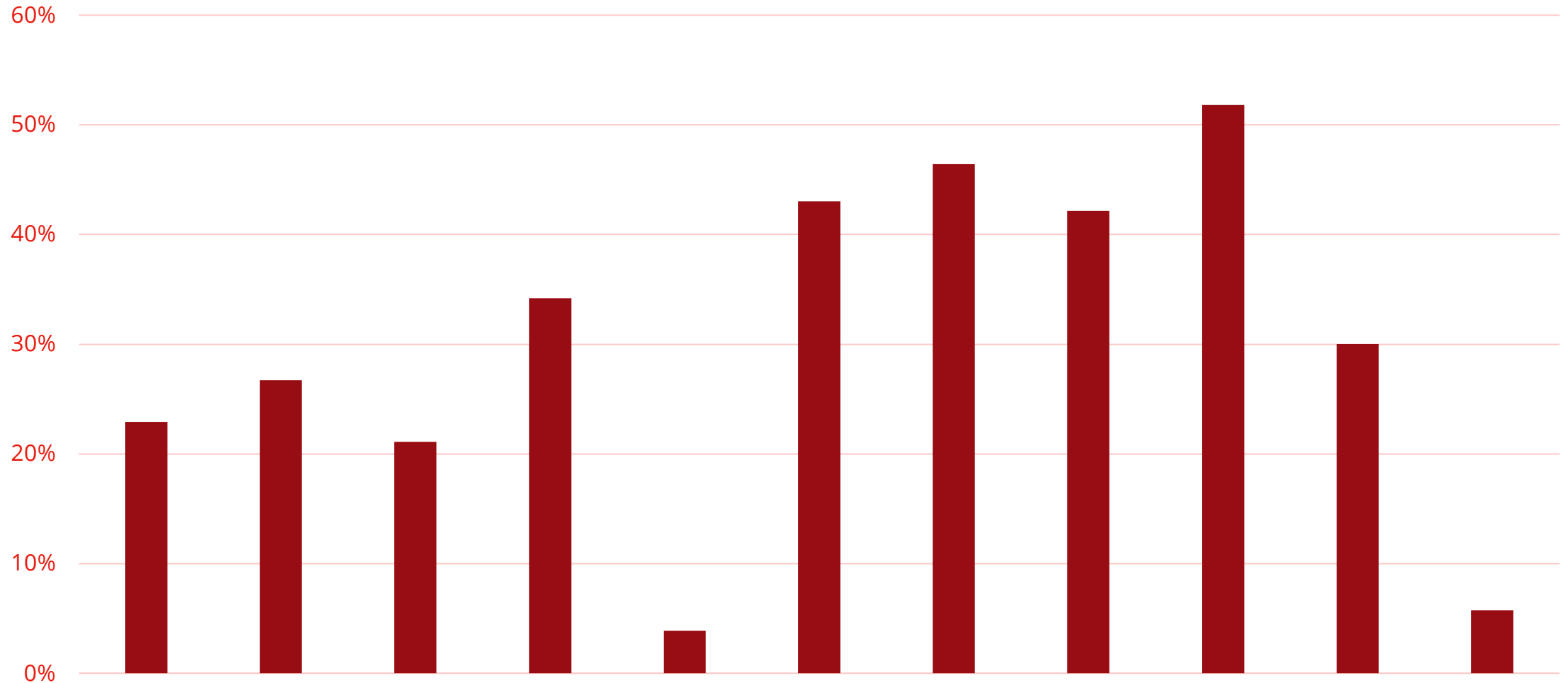
- Acetone was used as a test gas.
- Three concentrations were used: 5, 20 and 50 ppm



Off-gassing

Acetone measurement  
ND-IR

# Results off-gassing (acetone)



# Preliminary Conclusions

- For two air purifiers the lifespan of the particle filter was found to vary depending on the air pollution in the room.
- Filter life span is difficult to estimate, and some assumptions needs to be made.
- All products with active carbon filters off-gasses to some degree
  - However, experimental setup is very important as this will change depending on type of gas, room size, concentration of the gas, and duration.

## Outlook

- Looking into byproducts formed with different type of gasses (and also a mixture of gasses)
- Publish our results to give consumers and manufacturers guidelines for lifespan and byproducts through the Danish Consumer Council.





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# Thank you for your attention!

The team:

Naja Villadsen, Nathalia  
Thygesen Vechi, Camilla  
Jessen, Stig Koust, Freja  
Rydahl Rasmussen

Christel Søgaard Kirkeby  
(From The Danish Consumer  
Council TÆNK)