



Wirkungsstudie am Flughafen Kopenhagen

22. – 23. August 2019
Expertenanhörung UFP

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Copenhagen Airports **CPH**

Copenhagen Airport

- Copenhagen Airport is the main international Airport for Denmark
- 30. mill. Passengers
- 95% international
- 266.000 operations
- 2.400 employees in CPH
- 23.000 employees in total
- Approx. 200.000 Neighbors



→ Air Quality at Copenhagen Airports

1990
First report on Air Quality

2000
Monitoring LAQ:
NO
NO₂
O₃
SO₂
PM₁₀
PM_{2.5}
Benzene

2007
Air Quality on the apron project
- Following an Italian report: "Occupational exposure on airport personnel"

2010
Preliminary NERI report with results on ultrafine particles
- Strong reaction from unions and media

2012
ACI report: Ultrafine Particles at Airports

2014
Measurements and characterization of particles from aircrafts and vehicles
Final implementation of Stand policy

2016

2018
Update ACI report



1996-1997
EIA and Environmental approval for CPH
- demands on establishing Air Quality monitoring and conduct a survey on smell nuisance

2002
Report on "smell" and report on air pollution sources

2009
Change in monitoring programme from 3 to 2 stations
- NO_x and PM_{2.5} is now regulation

2011
CPH thorough survey on air pollution parameters (24 different VOC and 9 aldehydes) – all where within limit values
High amounts of ultrafine particles

2013
New emissions inventory and particle count inventory

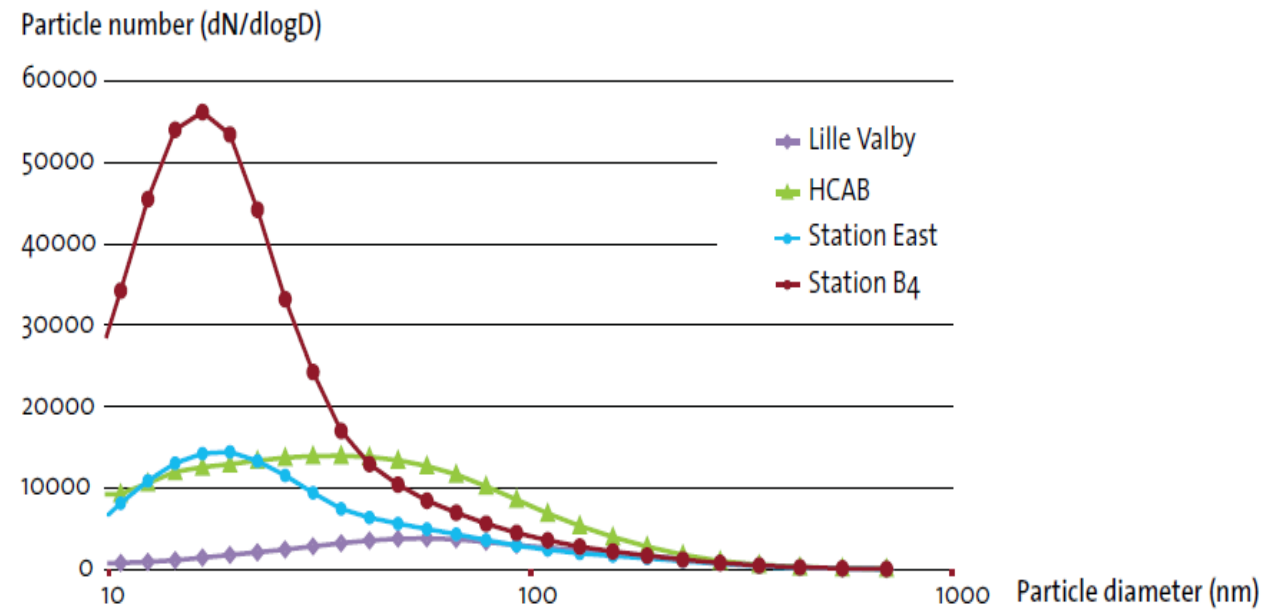
2015
NFA scrutiny and recommendations towards Force survey, 2014

2017
CPH CSR Strategy

2019
NFA scientific research on toxicity

The Challenge

- Handling personnel with cancer diagnosis – claimed to be related to exhaust from diesel engines
- High amounts of ultrafine particles
- No accept criteria for ultrafine particles



CPH survey on air pollution parameters (24 different VOC and 9 aldehydes)
– all where within limit values

High amounts of UFPs compared to central Copenhagen streets

Behaviour



APU regulation

Engines in idle

**Stand policy
– PCA and
power**

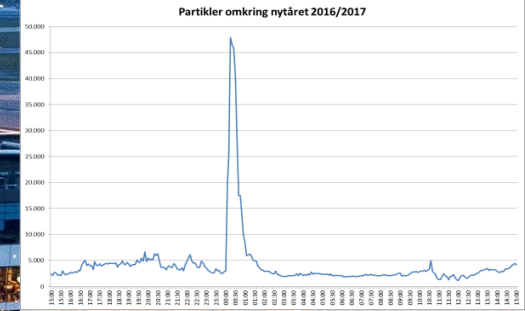
Ground Support Equipment



Green GSE

**Infrastructure
for Green GSE**

Research and analysis



Regulation

**Research
engagement**

**Robust
monitoring
scheme**

➔ **Copenhagen Airports Air Quality Program**

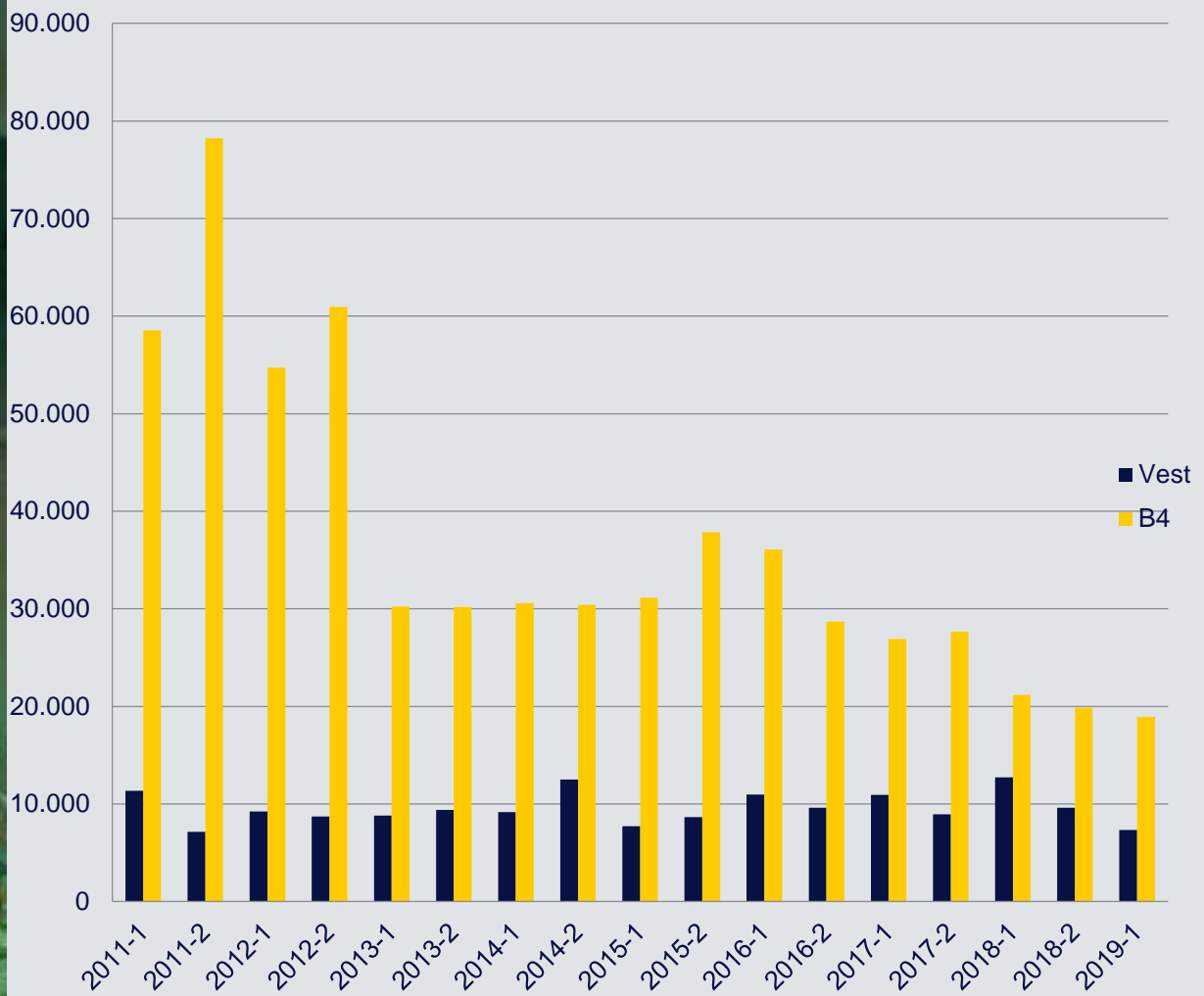
- Station West:**
- NO
 - NO_x
 - PM_{2.5}
 - UFP

- Station B4:**
- UFP
 - NO
 - NO_x

- Station East:**
- NO
 - NO_x
 - PM_{2.5}



Døgngennemsnit pr. halvår



➔ Research and analysis

Cohort Study

- Research from Bispebjerg Hospital and National Institute of Public Health, University of Southern Denmark (Research produced 2011 – 2016)
- Financed by The Fund for Working Environment Research under the Danish Ministry of Employment and Copenhagen Airports
- Purpose: Investigate the correlation between outdoor work in an airport and a number of specified diseases
- Total Cohort approx. 70.000 males
- 6,500 persons working airside in the airport from 1985 to 2013

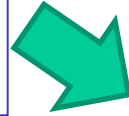




En undersøgelse af
helbredsskader ved luftforurening
og tungt løftearbejde
hos bagageportører i lufthavnen



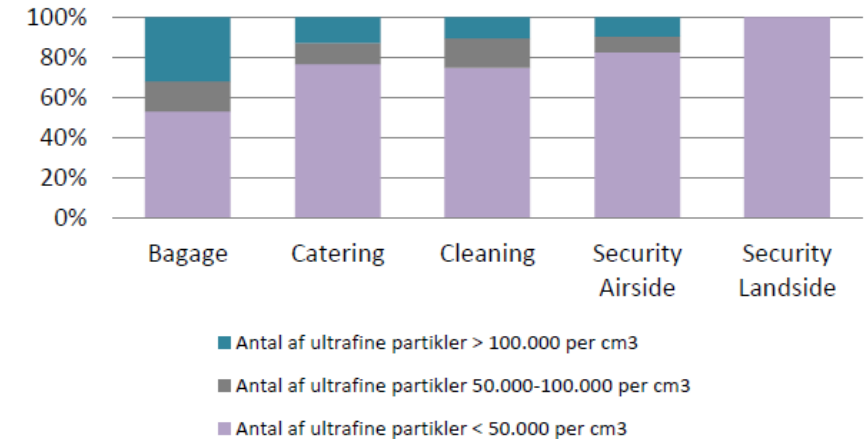
Styregruppemøde den 3. december 2012.
Overlæge Charlotte Brauer, charlotte.brauer@regionh.dk
Arbejds- og Miljømedicinsk Afdeling, Bispebjerg Hospital



Personal Monitoring



Procentvis fordeling af ophold i lav, mellem og høj
koncentration af ultrafine partikler



■ Antal af ultrafine partikler > 100.000 per cm³
■ Antal af ultrafine partikler 50.000-100.000 per cm³
■ Antal af ultrafine partikler < 50.000 per cm³



Occupational Exposure to Ultrafine Particles among Airport Employees - Combining Personal Monitoring and Global Positioning System

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Abstract

Background: Exposure to ultrafine particles (UFP) has been linked to cardiovascular and lung diseases. Combustion of jet fuel and diesel powered handling equipment emit UFP resulting in potentially high exposure levels among employees working at airports. High levels of UFP have been reported at several airports, especially on the apron, but knowledge on individual exposure profiles among different occupational groups working at an airport is lacking.

Purpose: The aim of this study was to compare personal exposure to UFP among five different occupational groups working at Copenhagen Airport (CPH).

Method: 30 employees from five different occupational groups (baggage handlers, catering drivers, cleaning staff and airside and landside security) at CPH were instructed to wear a personal monitor of particle number concentration in real time and a GPS device. The measurements were carried out on 8 days distributed over two weeks in October 2012. The overall differences between the groups were assessed using linear mixed model.

Results: Data showed significant differences in exposure levels among the groups when adjusted for variation within individuals and for effect of time and date ($p < 0.01$). Baggage handlers were exposed to 7 times higher average concentrations (geometric mean, GM: 37×10^3 UFP/cm³, 95% CI: $25-55 \times 10^3$ UFP/cm³) than employees mainly working indoors (GM: 5×10^3 UFP/cm³, 95% CI: $2-11 \times 10^3$ UFP/cm³). Furthermore, catering drivers, cleaning staff and airside security were exposed to intermediate concentrations (GM: 12 to 20×10^3 UFP/cm³).

Conclusion: The study demonstrates a strong gradient of exposure to UFP in ambient air across occupational groups of airport employees.

Citation: Møller KL, Thygesen LC, Schipperijn J, Loft S, Bonde JP, et al. (2014) Occupational Exposure to Ultrafine Particles among Airport Employees - Combining Personal Monitoring and Global Positioning System. PLoS ONE 9(9): e106671. doi:10.1371/journal.pone.0106671

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Competing Interests: The authors have declared that no competing interests exist.
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Measurements indicate that it is possible to divide employees into 3 groups related to amount of exposure

Cohort Study

Conclusions

- No sign of increased risk related to working airside and ischemic heart disease, cerebrovascular disease (stroke), COPD (chronic obstructive pulmonary disease) or Asthma
- The statistical data is too small to get valid information on Lung- and Bladder cancer
- This is the first study of its kind
- The scientists recommends further research

Slutrapport til Arbejds miljøforskningsfonden, projekt nr. 22-2011-09

Helbredsskader og partikelforurening i Københavns Lufthavn, Kastrup.




RESEARCH

Open Access

Airport emission particles: exposure characterization and toxicity following intratracheal instillation in mice

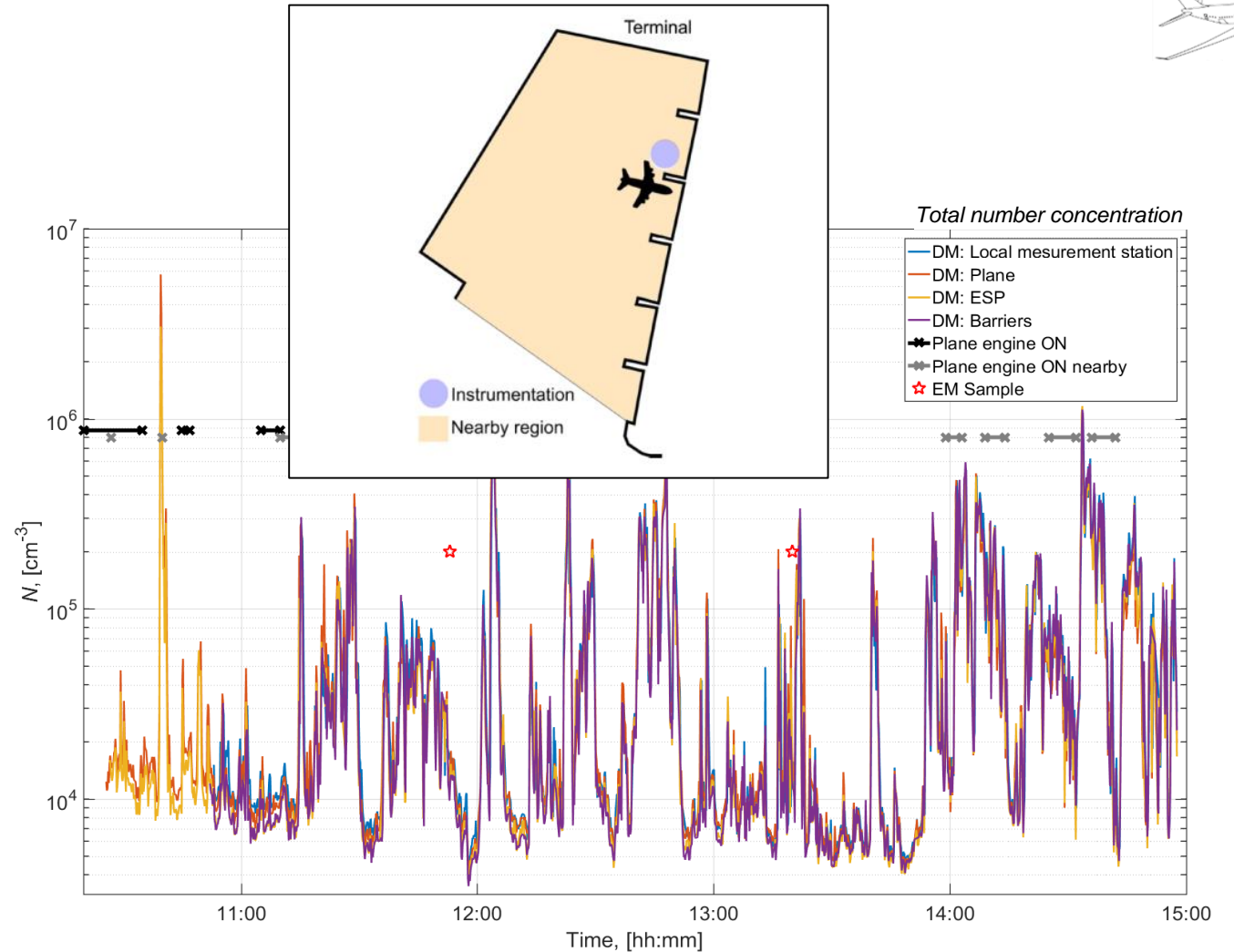


Katja Maria Bendtsen¹, Anders Brostrøm^{1,2}, Antti Joonas Koivisto¹, Ismo Koponen^{1,3}, Trine Berthing¹, Nicolas Bertram¹, Kirsten Inga Kling², Miikka Dal Maso⁴, Oskari Kangasniemi⁴, Mikko Poikkimäki⁴, Katrin Loeschner⁵, Per Axel Clausen¹, Henrik Wolff⁶, Keld Alstrup Jensen¹, Anne Thoustrup Saber¹ and Ulla Vogel^{1,7*} 

Exposure measuring

Large Commercial Airport

- Instruments reached their upper limit
- Predominant particle size <300 nm
- Two main size distributions: <20 nm and around 140 nm
- A lot of very small size particulates when aircrafts were operating nearby
- No dedicated workplace exposure measurements were conducted



Instrumentation

Electrical Low Pressure Impactor (ELPI): Real-time particle monitoring

Four DiSCminis: Particle number concentration, mean particle size and lung-deposited surface area (LDSA)

Nanoscan: size-dependent particle number measurements

Optical Particle Counter (OPC)



Summary

1) Particulates were similar to diesel exhaust particulates both physical and chemical:

- Very small carbon particulates
- Tar
- Metals

2) The measured levels of exposure were significant high:

- Based upon epidemiological studies
- Based upon EU's threshold limit value at $50 \mu\text{g}/\text{m}^3$

3) Aircraft emission particulates caused:

- Inflammation in lungs
- Acute phase response
- At same level as two different diesel exhaust particulates and Carbon Black



Conclusions

The study suggests that jet engine particles have similar physicochemical properties and toxicity as diesel exhaust particles.

Both particulates from the commercial and non-commercial airport resembles two different diesel exhaust reference particulates and Carbon Black

Given the results in this study and further resemblance between JEP and diesel exhaust particles as well as the dose-response relationship between diesel exhaust exposure and lung cancer, the observed occupational exposure to jet engine emissions at the two airfields should be minimized.

➤ First study of the toxicity from aircraft-emissions particulates – needs further research

Zusammenfassung

- Zeitweise sehr hohe Anzahl von ultrafeinstaub am Flughafen Kopenhagen
- Kohorten Studie
 - Keine anzeige für höher Risiko an Herz Infarkten, Schlaganfall, COPD oder Asthma
 - Zu glaubwürdige Informationen über Lungen und Blasen krebs sind die statistische daten zu niedrig
- Toxikologische Studie
 - Den Ruß von Strahltriebwerke hat ähnliche physikalische/Chemikalischen Eigenschaften und Toxikologie wie Partikeln von Diesel Ruß
- Beide Studien empfehlen noch mehr Untersuchungen





→ Mange tak!