

Evaluating Noise Pollution and Health Impacts from Cooling and Ventilation Systems

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Miljøpunkt Indre By & Christianshavn

- Improve quality of life
- Increase sustainability in the Inner City
- Influence legislation
- Three focus areas:
 - Healthy City
 - Green City
 - Circular City



Urban Noise Sources

Main Cooling and Ventilation Sources



Traffic



Construction



Social

Restaurants
Cafés
Events



Industrial



Neighborhood

Cooling and Ventilation Noise Pollution



Cooling and Ventilation Systems operate continuously



Primary Sources

- Fans, compressors, motors
- Airflow in ducts



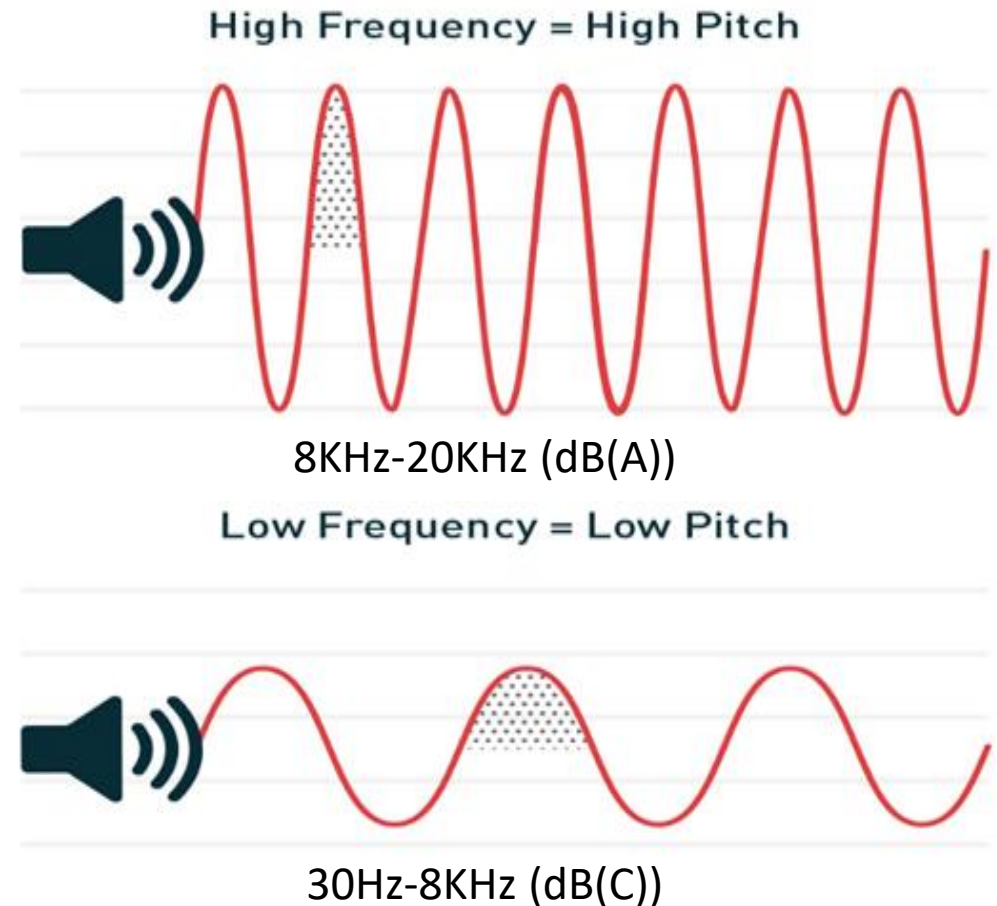
Spreads Through Nearby Structures

- Sounds propagate via vibration

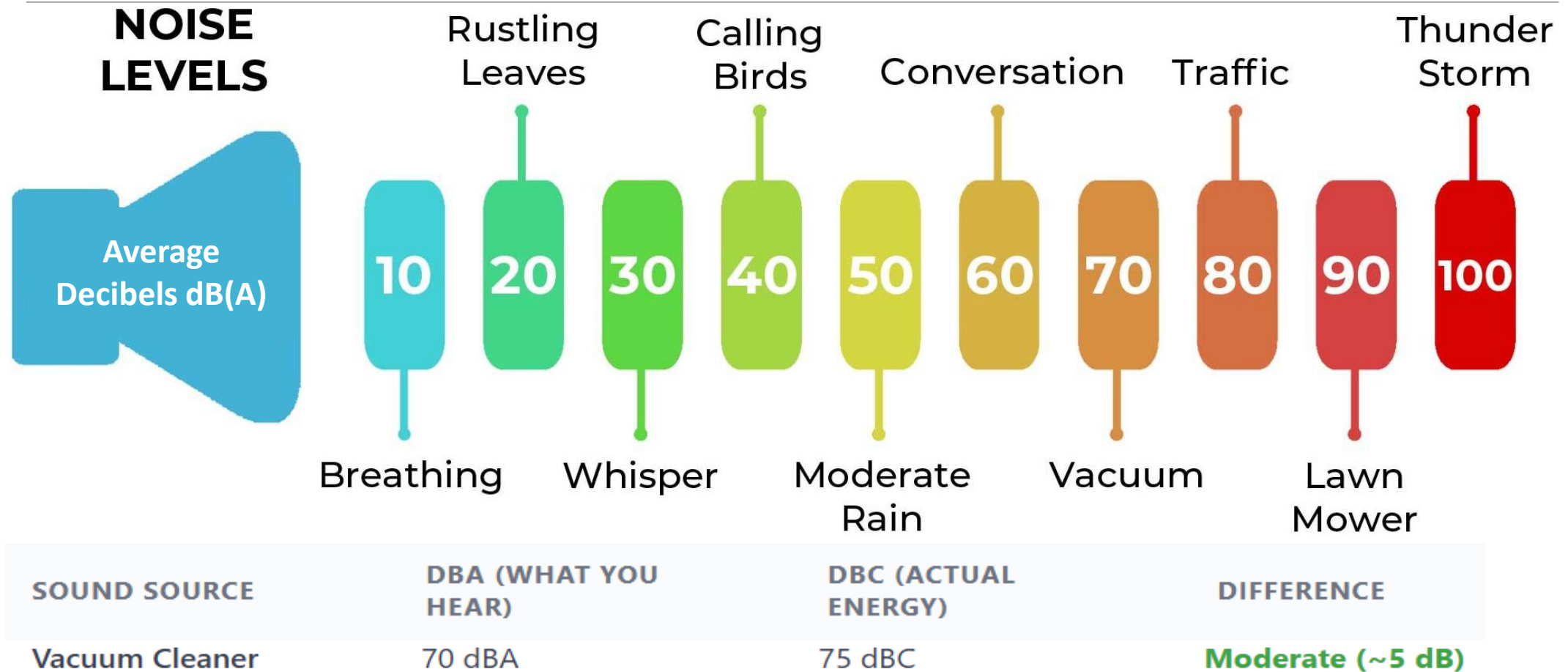


Measuring Noise

- Noise is determined by frequency and magnitude of sound waves
- Frequency:
 - Number of sound waves over time (Hz)
- Magnitude (dB)
 - A-weighted decibels dB(A)
 - C-weighted decibels dB(C)



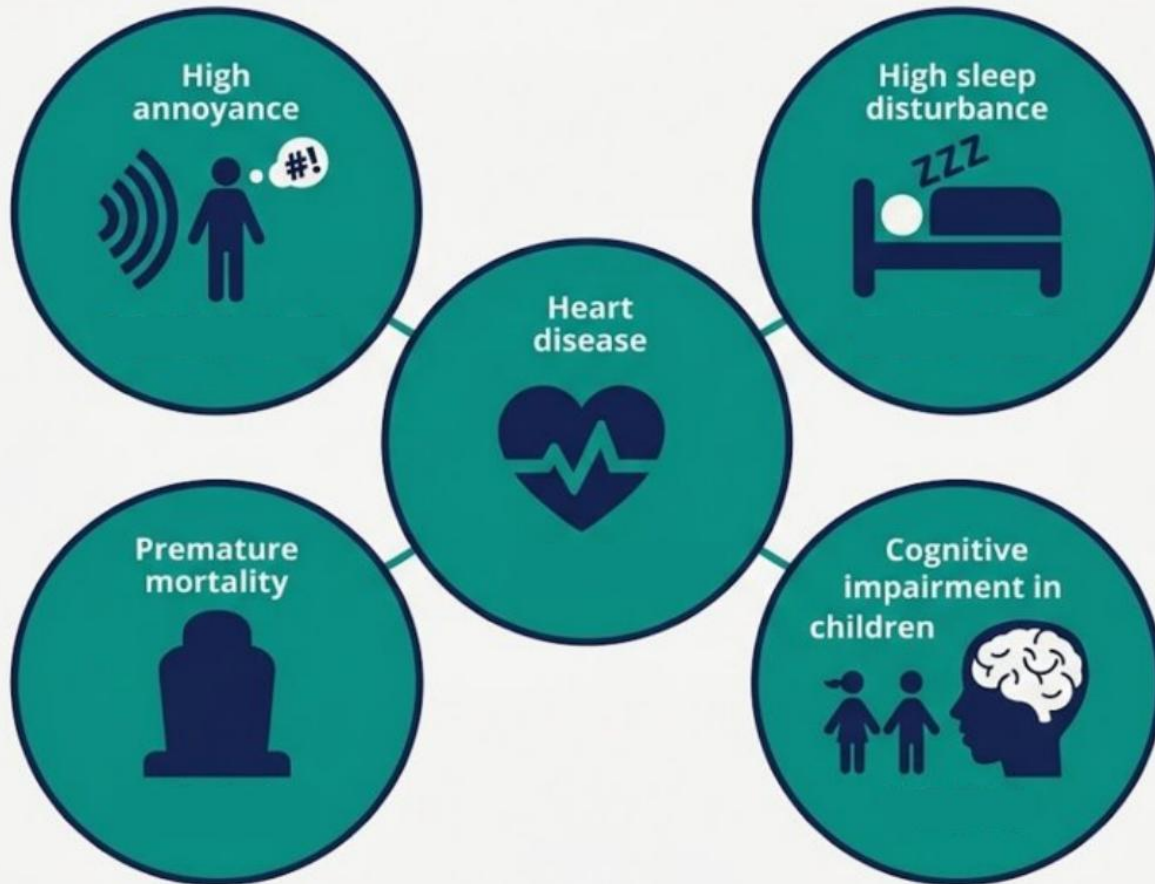
Perceived Loudness - dB(A) vs dB(C)



20 % of the EU population — one in five people — live in areas where noise levels are considered harmful to health



Impacts of environmental noise in Europe



Health Effects of Noise

- Constant state of alertness:
 - Increased cortisol
 - Low-quality sleep
 - Cardiovascular stress
- Increased risk of:
 - Hypertension
 - Heart disease
 - Heart failure

Goal

Support Miljøpunkt Indre By & Christianshavn in evaluating whether current Danish noise measurement standards adequately account for problematic low-frequency environmental noise in the Inner City district of Copenhagen.



Map of Inner City with neighborhoods.



Objectives

Objective 1: Assess Opinions

Talk to residents, the municipality, and noise experts

Ask about opinions on noise and legislation

Objective 2: Measure and Analyze

Measure cooling and ventilation systems

Compare to public annoyance

Objective 3: Present Findings and Educate

Present to Inner City Local Committee

Add materials to the sponsor's website



Main Results

- Current standards and regulations are based on A-weighted noise
 - Does not fully encompass the “feeling” of low-frequency noise
- A single, identifiable noise source is needed to resolve a complaint
 - If the source is unknown or from multiple places, action cannot be taken
- Municipality may have limited authority to act directly on certain measurements
 - Detailed noise assessments by external experts may be needed to ensure accuracy, which can extend the overall complaint process



Objective 1:

Survey Distribution & Interviews

Survey Distribution

Public Outreach

Sponsor Network

Flyers/Posters

Conducting Interviews

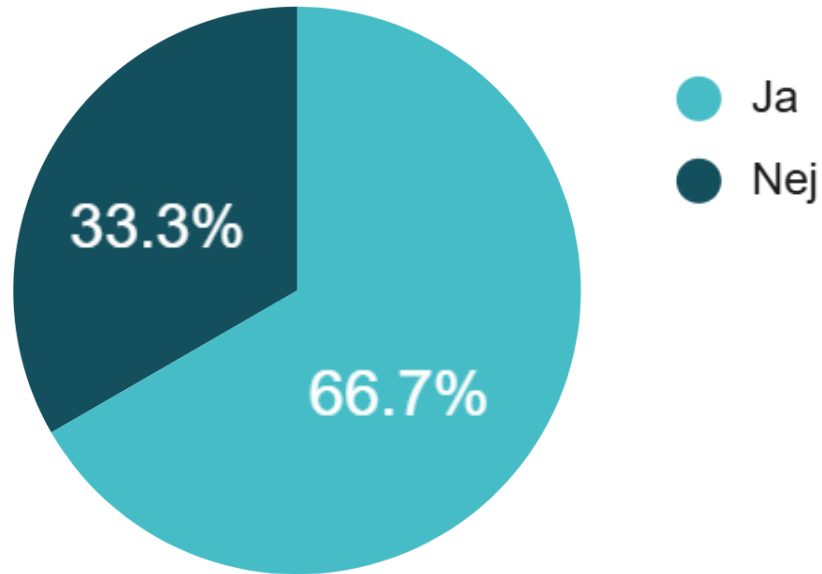
Noise Experts

Municipality

Public

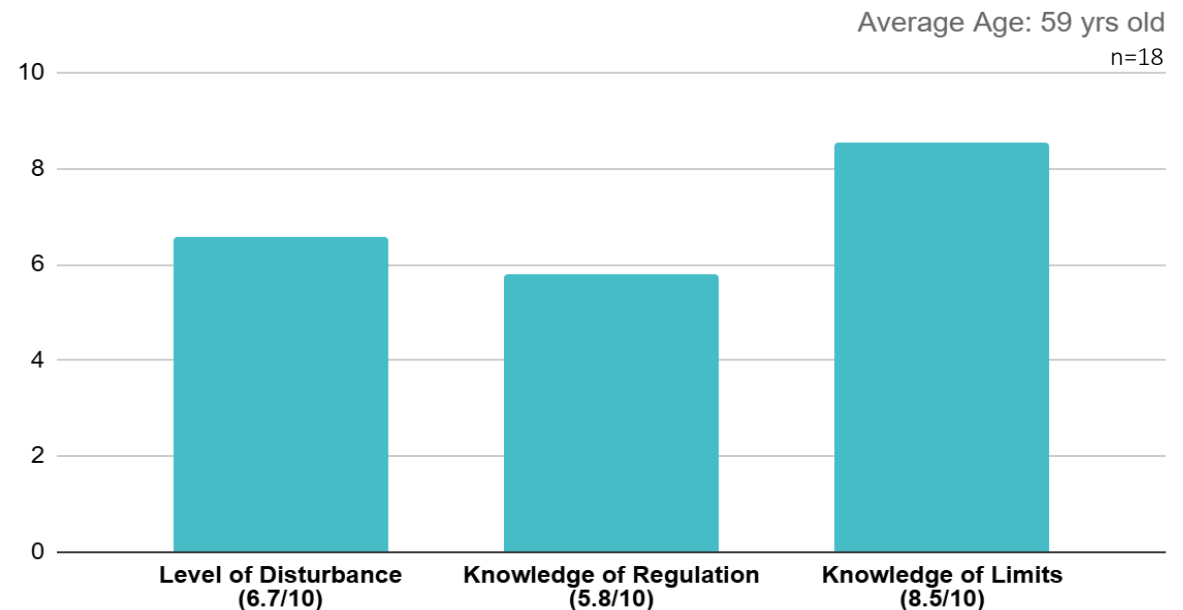
Objective 1: Survey Results

Have you ever complained about noise?



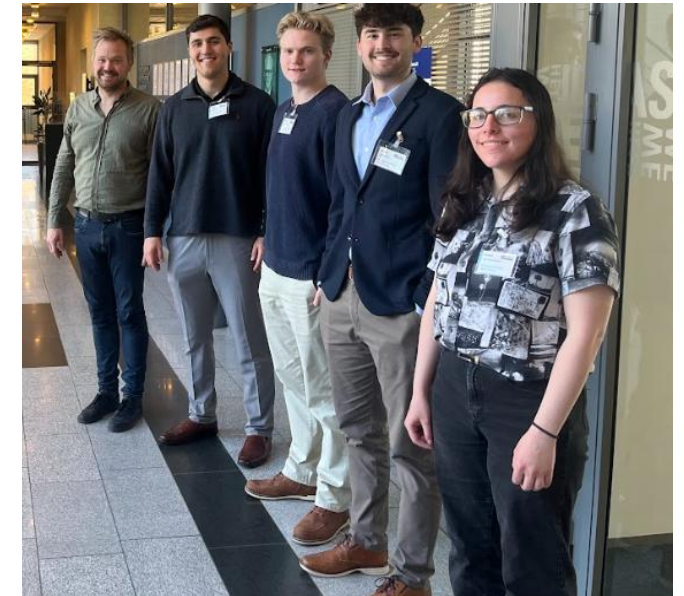
- 55% of the individuals who complained about the noise received no help from the municipality

- Based on **18** residents' responses:
- Types of noise noticed the most: transportation, construction, music/nightlife



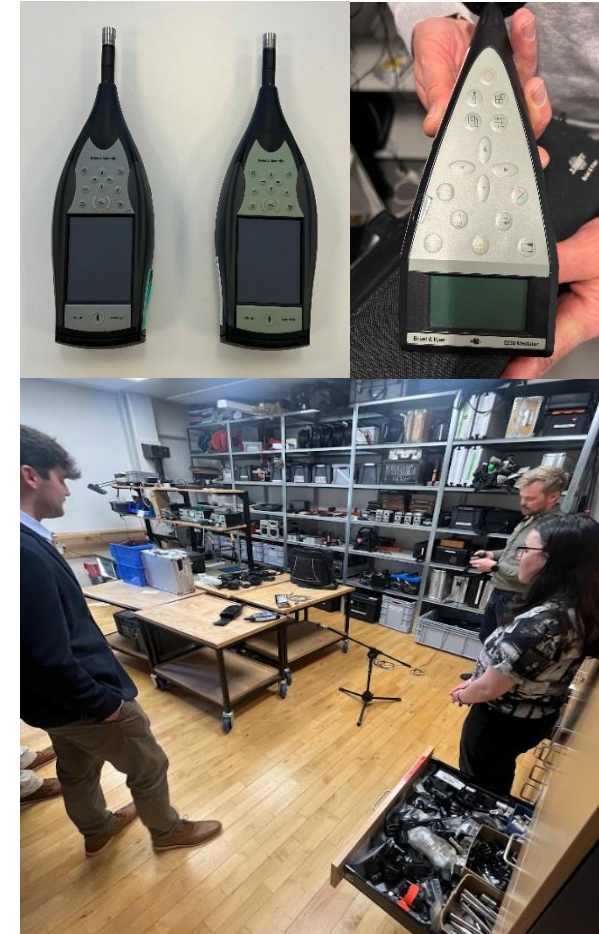
Objective 1: Regulatory Issues of Measuring Low-Frequency Noise

- Limited public awareness of noise standards
 - Especially for low-frequency noise
 - Misidentification of sources leads to dead ends with the Municipality
- Current regulations focus on A-weighted noise
 - Health studies focused on A-weighted noise
 - Redo studies using C-weighted noise to justify a change



Objective 1: Technical Issues of Measuring Low-Frequency Noise

- Structural-borne vs. airborne noise
 - LFN primarily travels through vibrations through the building structure
 - Municipality does not measure structural-borne
 - Requires specific equipment to collect properly
- Combined noise sources can exceed limits despite individual compliance

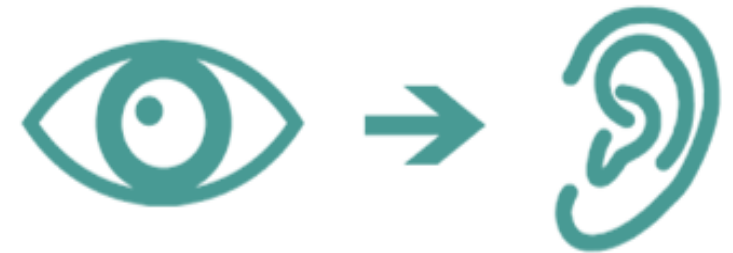


Objective 1:

Psychological Aspect of Noise

Noise Pollution

- Sources of noise can be more annoying if you see them as well as hear them



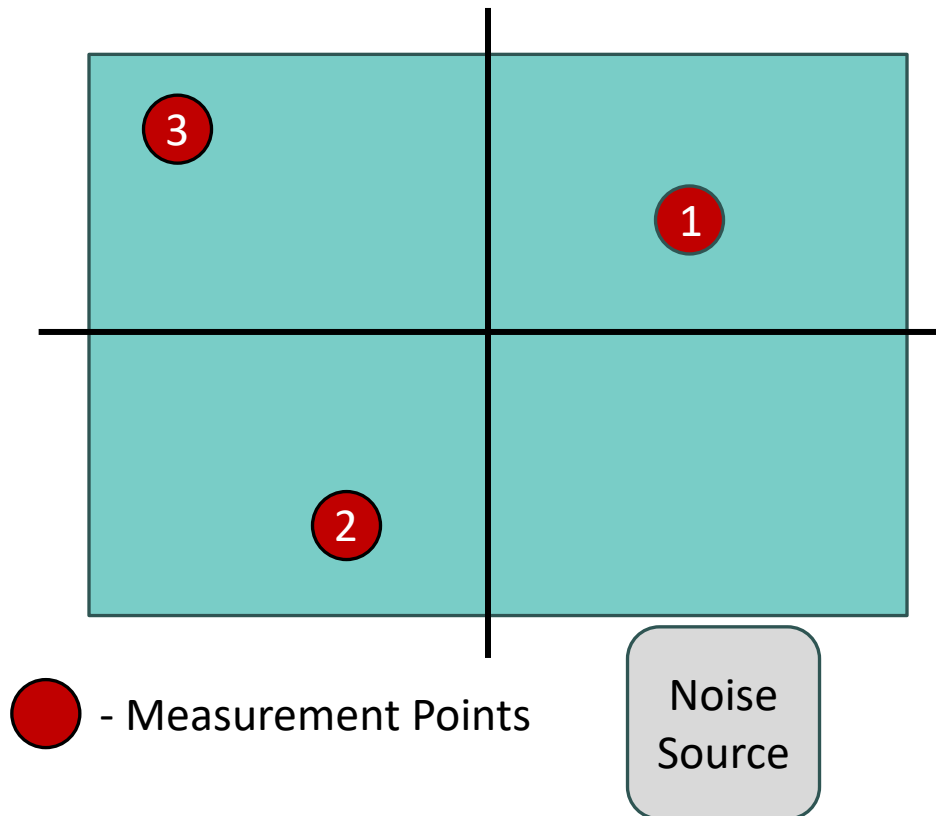
Measuring Noise Pollution

- Just having someone listen to complaints can be beneficial
- Even just measuring the source can be enough even if it leads to nothing being done



Objective 2: Measurement Process

Example Measuring Setup

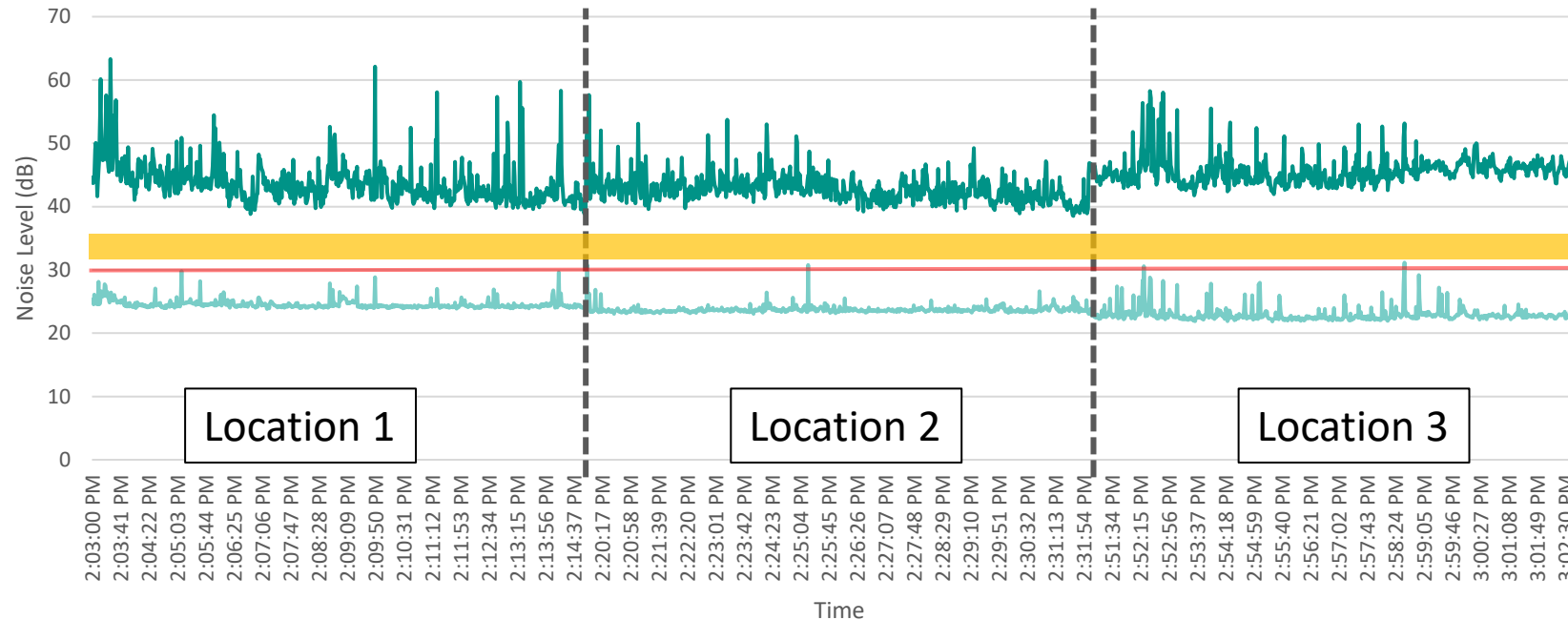


Danish Environmental Protection Agency
Guidance No. 9/1997:

- Three different measurement points
 - Away from the center of the room, walls, floor, ceiling, and other measurement points
- Constant noise: 10-20 minutes
- Intermittent noise: All day/overnight

Objective 2: Measurement Results – Office Kitchen

A-Weighted vs. C-Weighted Measurements Over 12 Minute Increments
(3 Locations, Indoors, No Ventilation Running)



— 30 dB(A) Limit Value

— LAeq — LCeq

Approximate
dB(C) Limit Range

	Noise Level (dB)
Average C-Weighted	44.052
Average A-Weighted	23.716

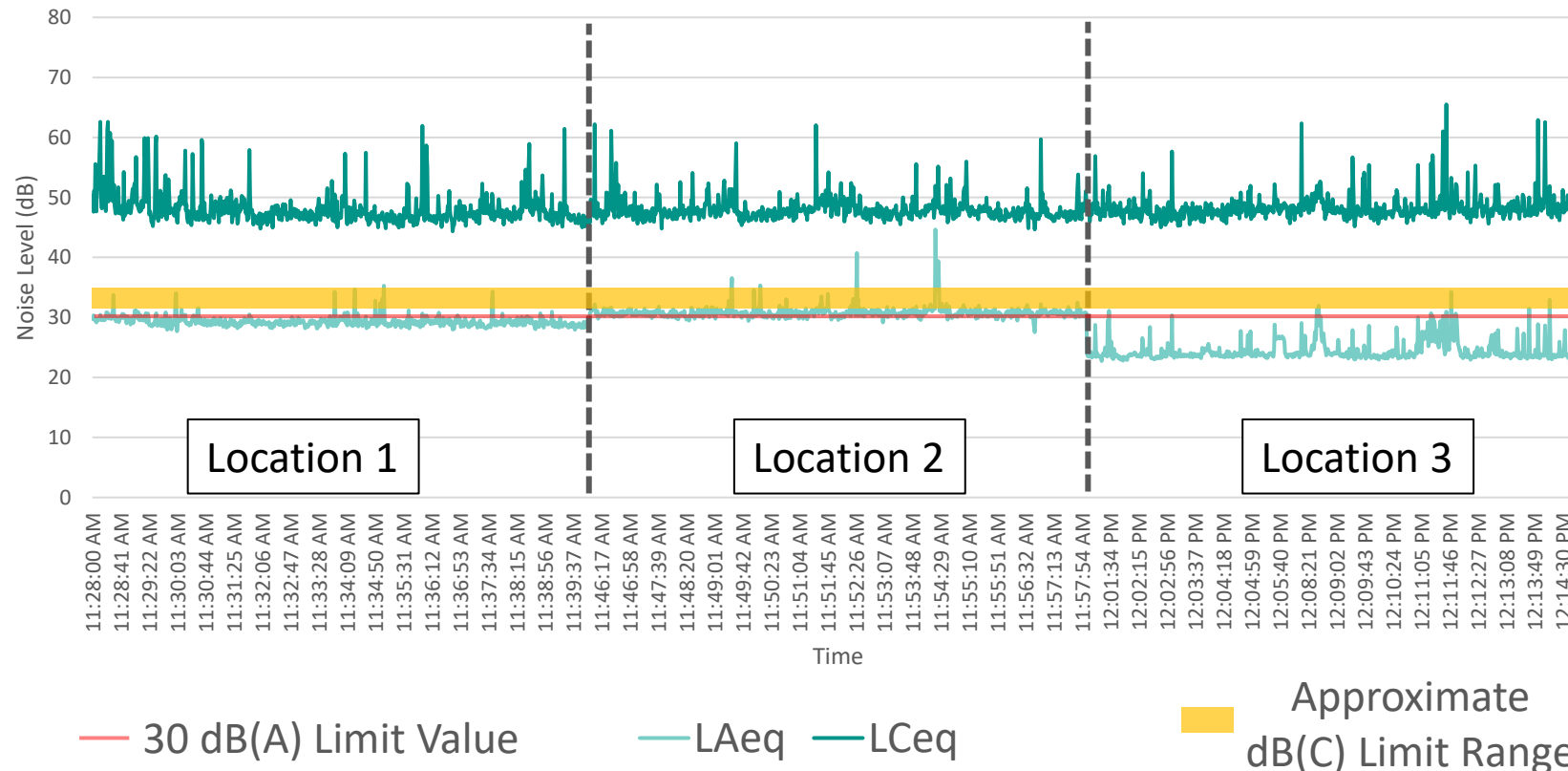
Location	Time Period	Limit Value
Living room	07:00–22:00	30 dB(A)
Living room	22:00–07:00	25 dB(A)
Living room	Night (max level)	40 dB(A)
Office premises	All day	40 dB(A)

Limit values for building-transmitted noise measured indoors in living spaces/office spaces, from “Cooling and ventilation regulations in Copenhagen, Appendix 2.”



Objective 2: Measurement Results – Office Kitchen

A-Weighted vs. C-Weighted Measurements Over 12 Minute Increments
(3 Locations, Indoors, Ventilation Running)



No Ventilation Running

	Noise Level (dB)
Average C-Weighted	44.052
Average A-Weighted	23.716

Ventilation Running

	Noise Level (dB)
Average C-Weighted	48.122
Average A-Weighted	28.187

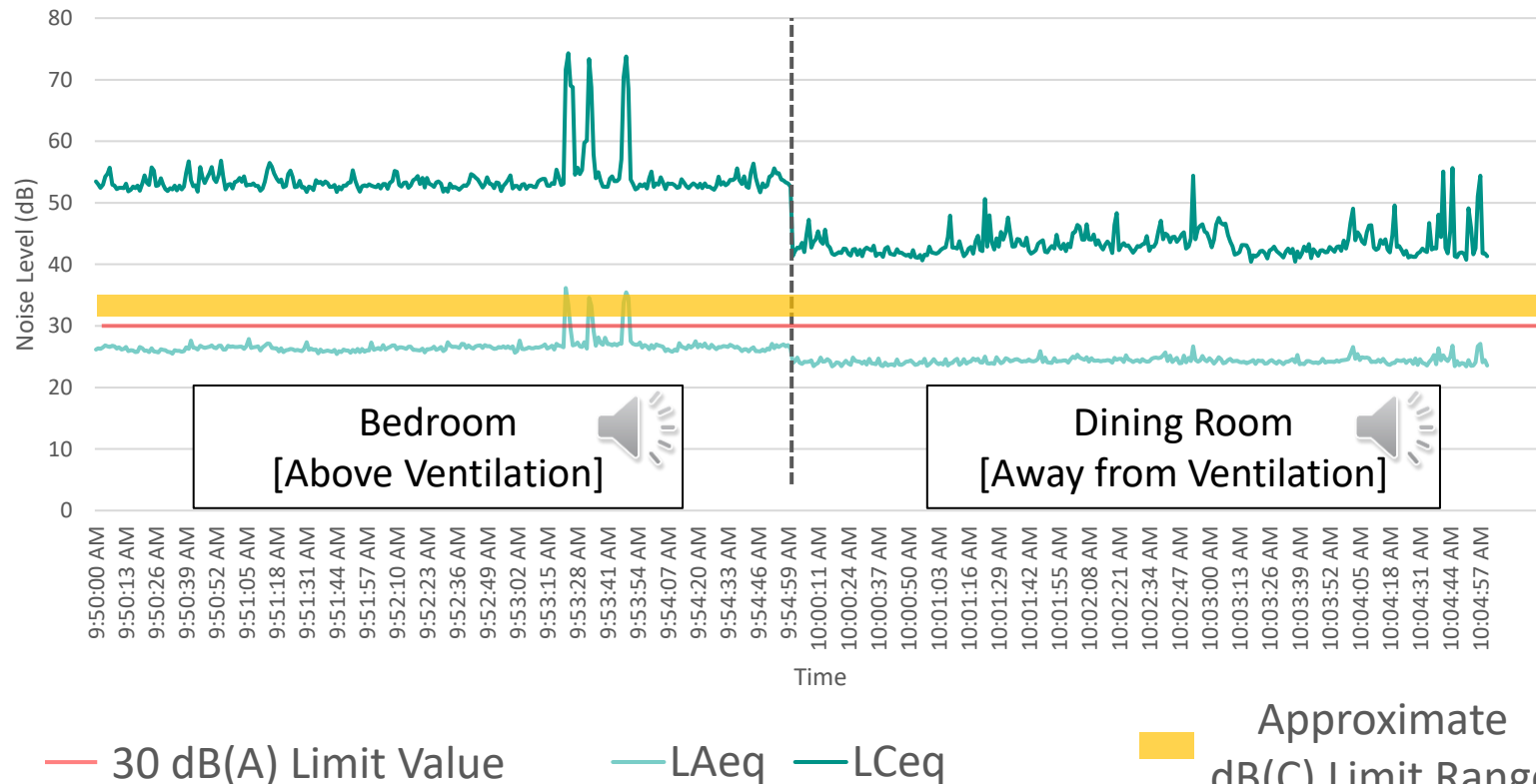
Overall Change

	Noise Level (dB)
Average C-Weighted	4.070
Average A-Weighted	4.471

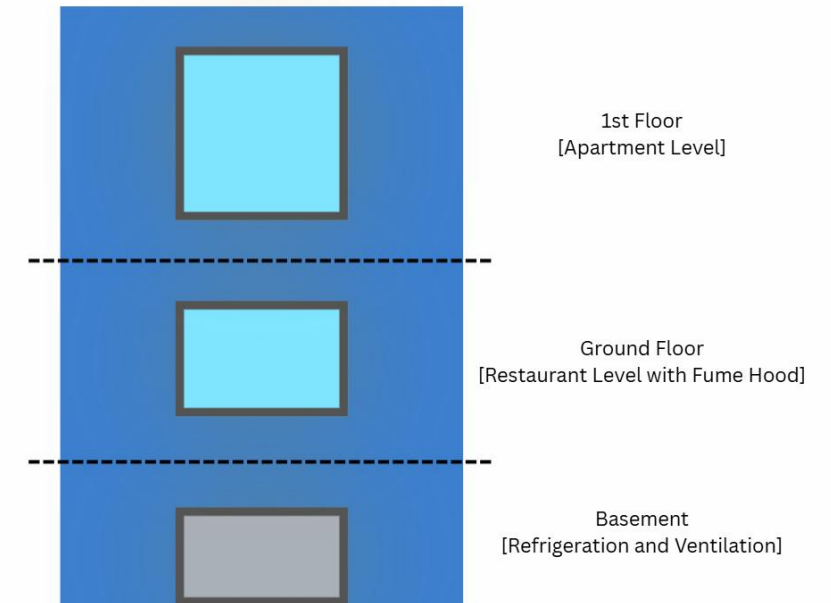
Objective 2:

Measurement Results – Survey Respondent

A-Weighted vs. C-Weighted Measurements Over 5 Minute Increments
(Indoors, Ventilation Running)



	Noise Level (dB)
Average Bedroom C-Weighted	53.876
Average Dining Room C-Weighted	43.350
Average Bedroom A-Weighted	26.655
Average Dining Room A-Weighted	24.322



Objective 3: Committee Presentation & Sponsor's Website



- Committee Presentation
 - Presented findings to stakeholders in the community
 - Requested recommendations on next steps in the project cycle
 - Particularly interested in the health aspect of noise
- Compiled findings on sponsor's website
 - Includes report, presentations, data, and audio recordings for reference

Recommendations:

Legislative Changes & Public Awareness



Legislative:

National Health Law (2027)

Include LFN & compounding noise



Municipality:

Measure with C-weighting

Data collection



Public:

Learn about health risks

Define and identify LFN



Businesses:

Proper installation and maintenance

Understand their systems' impact

Low-Frequency Noise

Summary

Low-Frequency Noise Issues

Health Impacts

- Increased cortisol, depression, anxiety, and heart problems
- Lower quality sleep

Technical Issues of Measuring LFN

- LFN is primarily structural borne
- LFN is better captured with C-weighting

Compounding Noise

- Multiple sources in the legal limit combine over the regulations

Current Legislation and Health Studies

- Done in A-weighting
- Would need to be redone with C-weighting

Public's Perspective

- Difficult in identifying and describing LFN sources

Municipality does not fully capture low-frequency noise in initial measurements

Thank you for your time!

Questions?

MILJØPUNKT

INDRE BY & CHRISTIANSHAVN

AGENDA 21 · FOR ET BÆREDYGTIGT KBH



WPI