MILJØPUNKT
INDRE BY & CHRISTIANSHAVN
AGENDA 21 · FOR ET BÆREDYGTIGT KBH

WPI

Evaluating Noise Pollution and Health Impacts from Cooling and Ventilation Systems

By Ally Wiesendanger [ME], Connor Piper [AREN], Jensen Gilbert [AE], and Nicholas DeBrito [ME]

April 30th, 2026

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

MILJØPUNKT
INDRE BY & CHRISTIANSHAVN
AGENDA 21 · FOR ET BÆREDYGTIGT KBH

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

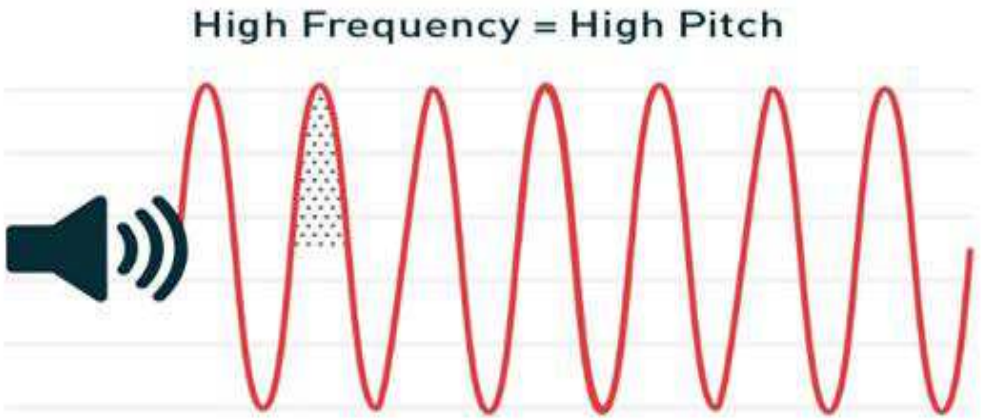
- Fans, compressors, motors
- Airflow in ducts

Spreads Through Nearby Structures

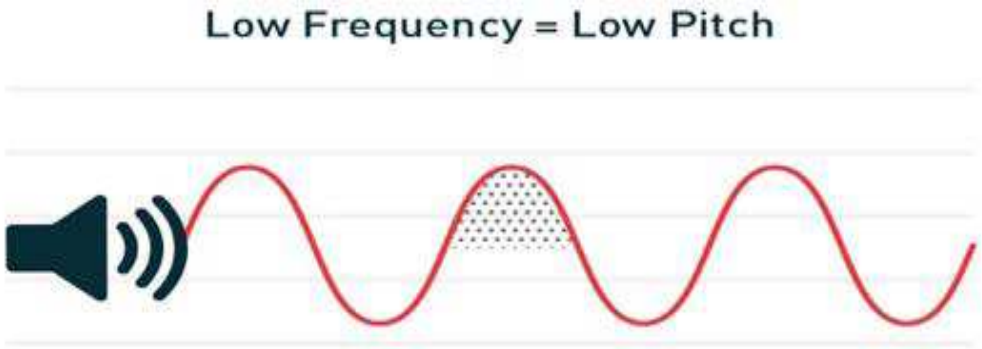
- Sounds propagate via vibration

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)



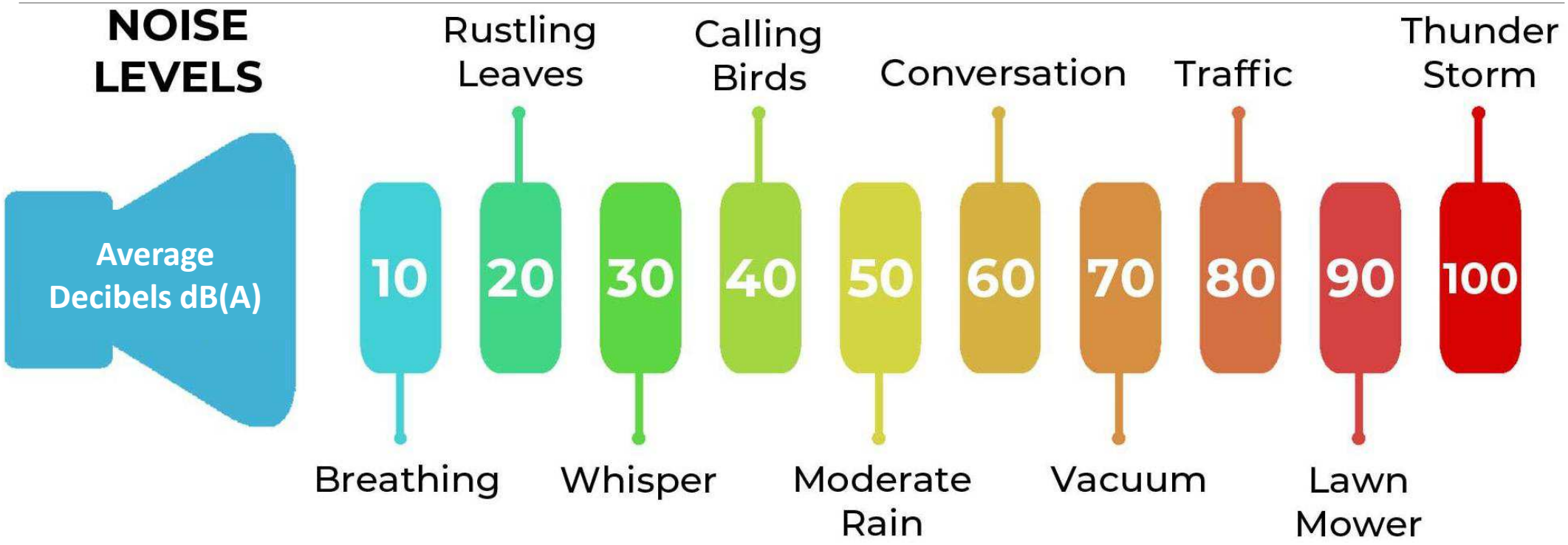
8KHz-20KHz (dB(A))



30Hz-8KHz (dB(C))

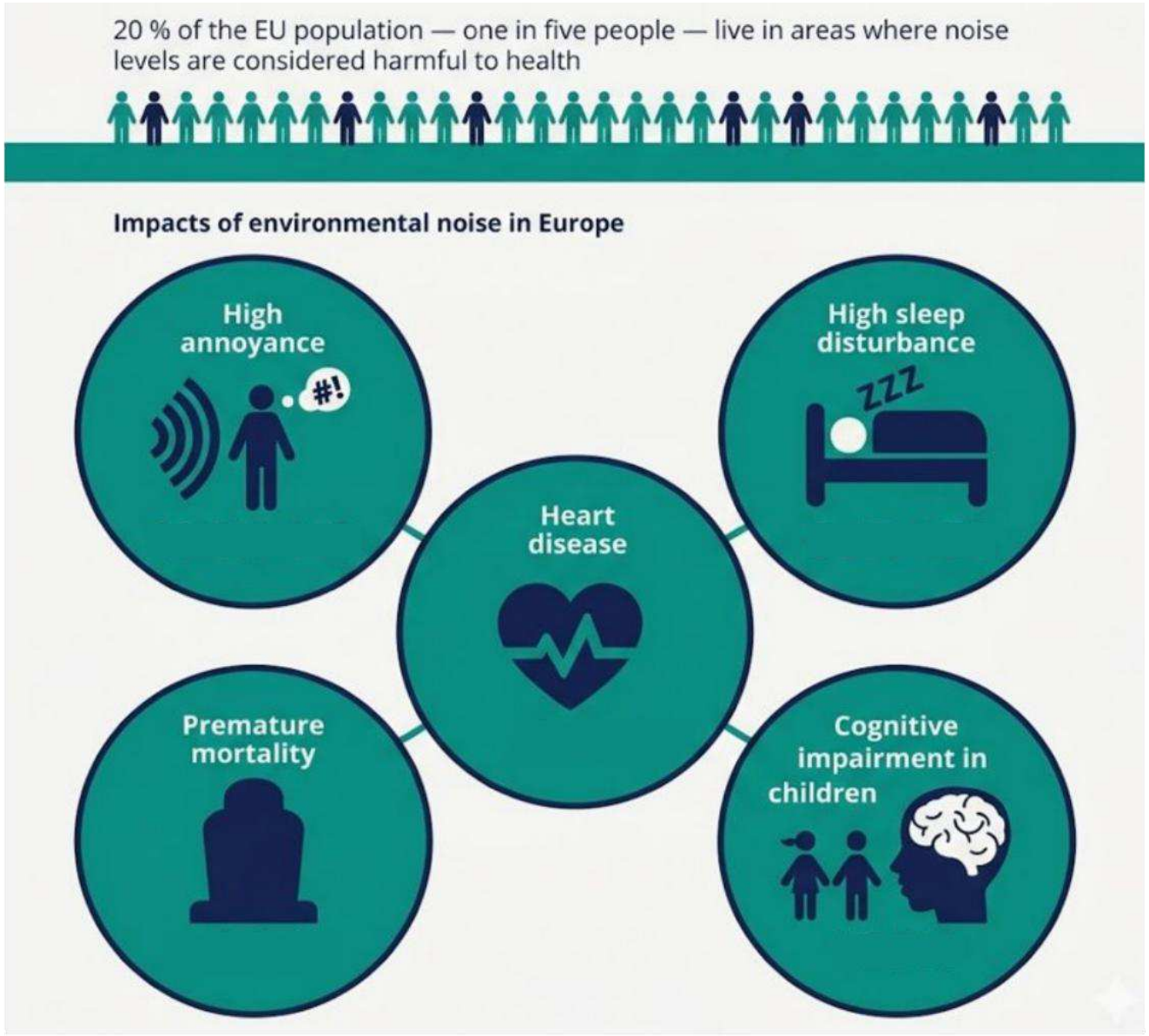
High and Low Frequency Waves (How Acoustic Foam Effects Sound Waves: Holland| SoundFix, n.d.)

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



SOUND SOURCE	DBA (WHAT YOU HEAR)	DBC (ACTUAL ENERGY)	DIFFERENCE
Vacuum Cleaner	70 dBA	75 dBC	Moderate (~5 dB)

Blake, J. *Best Sound Level Meter (That Actually Records Data)*. Acoustic Nature. https://acousticnature.com/journal/best-sound-level-meter-for-recording
Ray, M. (2026, March 9). *dBA vs dBC: Which One Should You Use?* https://realtimesoundmeter.org/blog/dba-vs-dbc



Health Effects of Noise

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

European Environmental Agency. (2020, October 15). *Noise pollution*. https://www.eea.europa.eu/en/analysis/maps-and-charts/noise-pollution

Map of Inner City with neighborhoods.

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.

Bydelsplan | Indre By Lokaludvalg. (n.d.) https://indrebylokaludvalg.kk.dk/om-lokaludvalget/lokaludvalgets-arbejde/bydelsplan

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

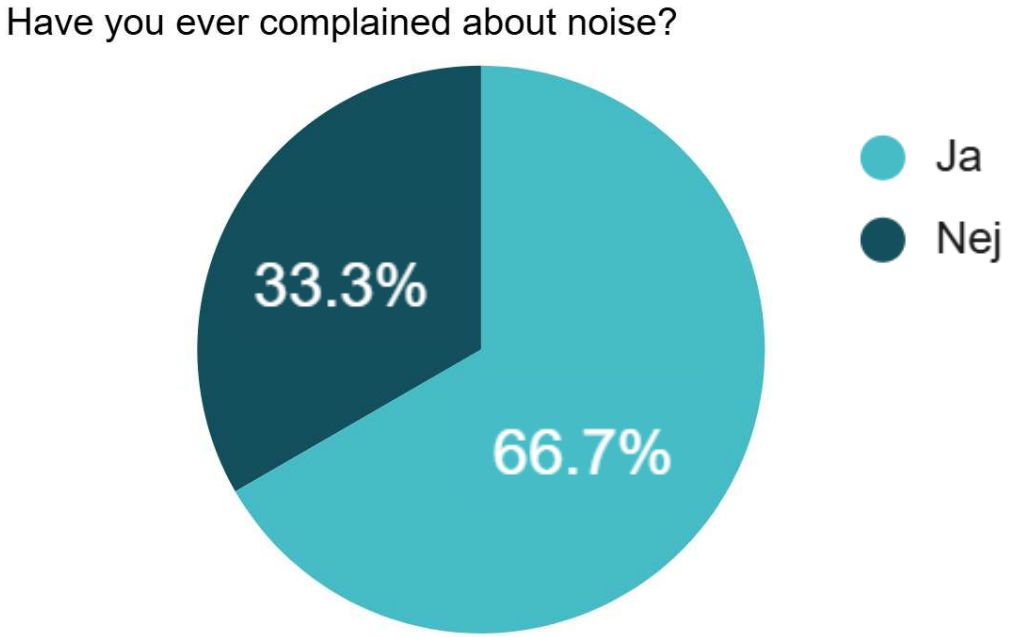
Survey Distribution

- Public Outreach
- Sponsor Network
- Flyers/Posters

Conducting Interviews

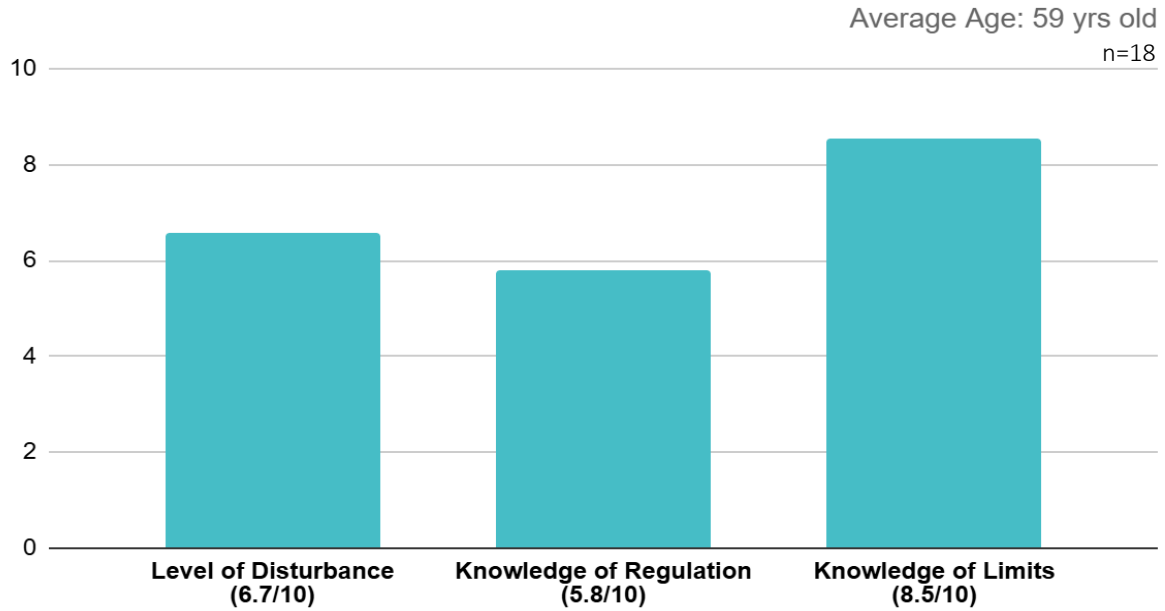
- Noise Experts
- Municipality
- Public

Objective 1:
Survey Results



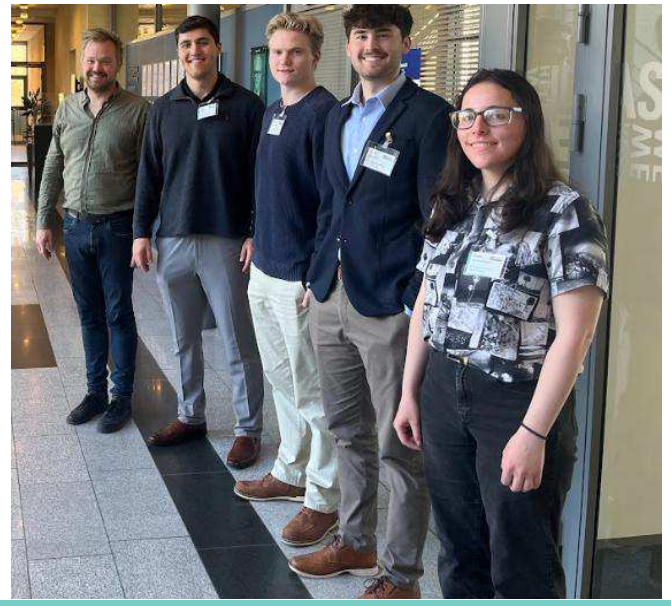
- **55%** of the individuals who complained about the noise received no help from the municipality

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



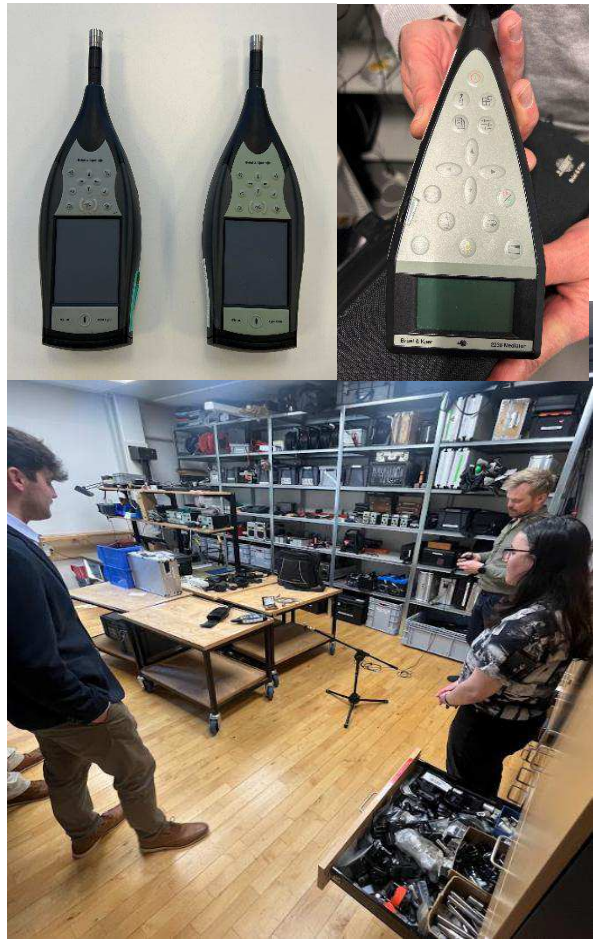
Objective 1:
Regulatory Issues of Measuring Low-Frequency Noise

- 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

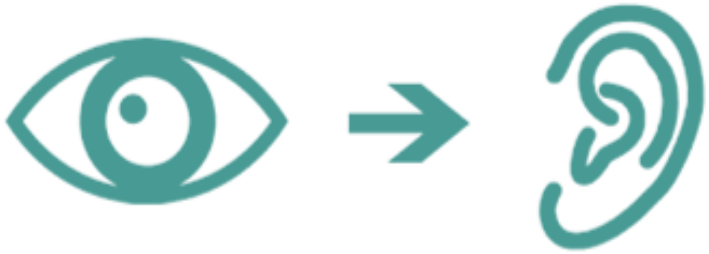
- Structural-borne vs. airborne noise
  - LFN primarily travels through vibrations through the building structure
  - Municipality does not measure structural-borne
  - Requires specific equipment to collect properly
- Combined noise sources can exceed limits despite individual compliance



Objective 1:
Psychological Aspect of Noise

Noise Pollution

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

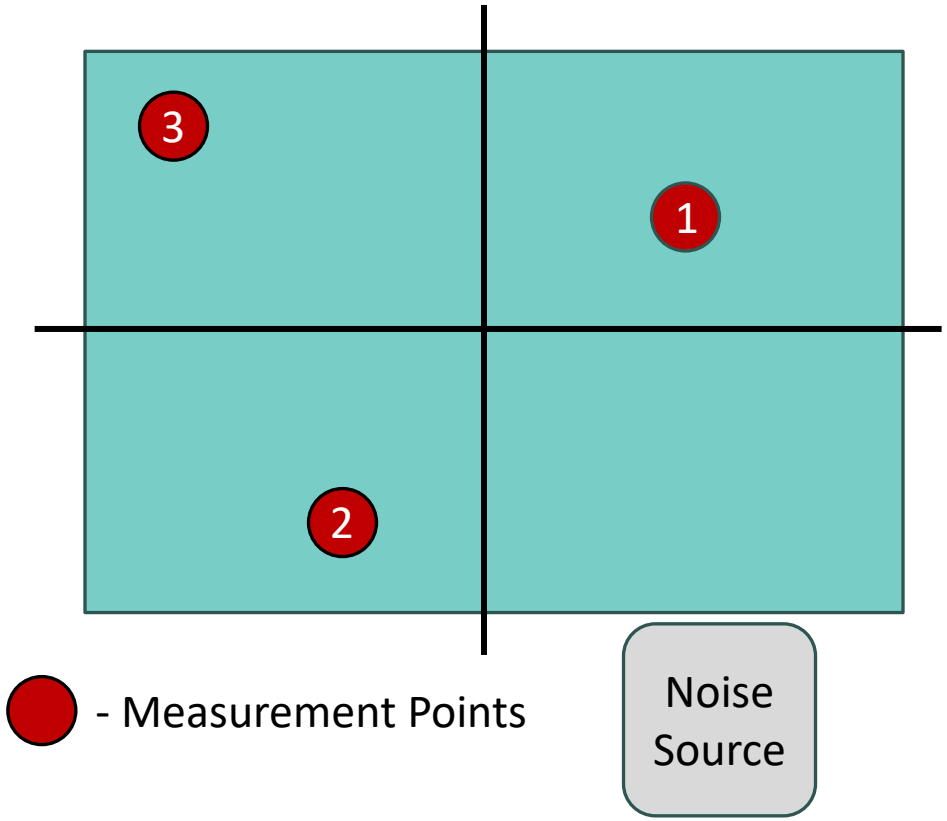


Measuring Noise Pollution

- 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

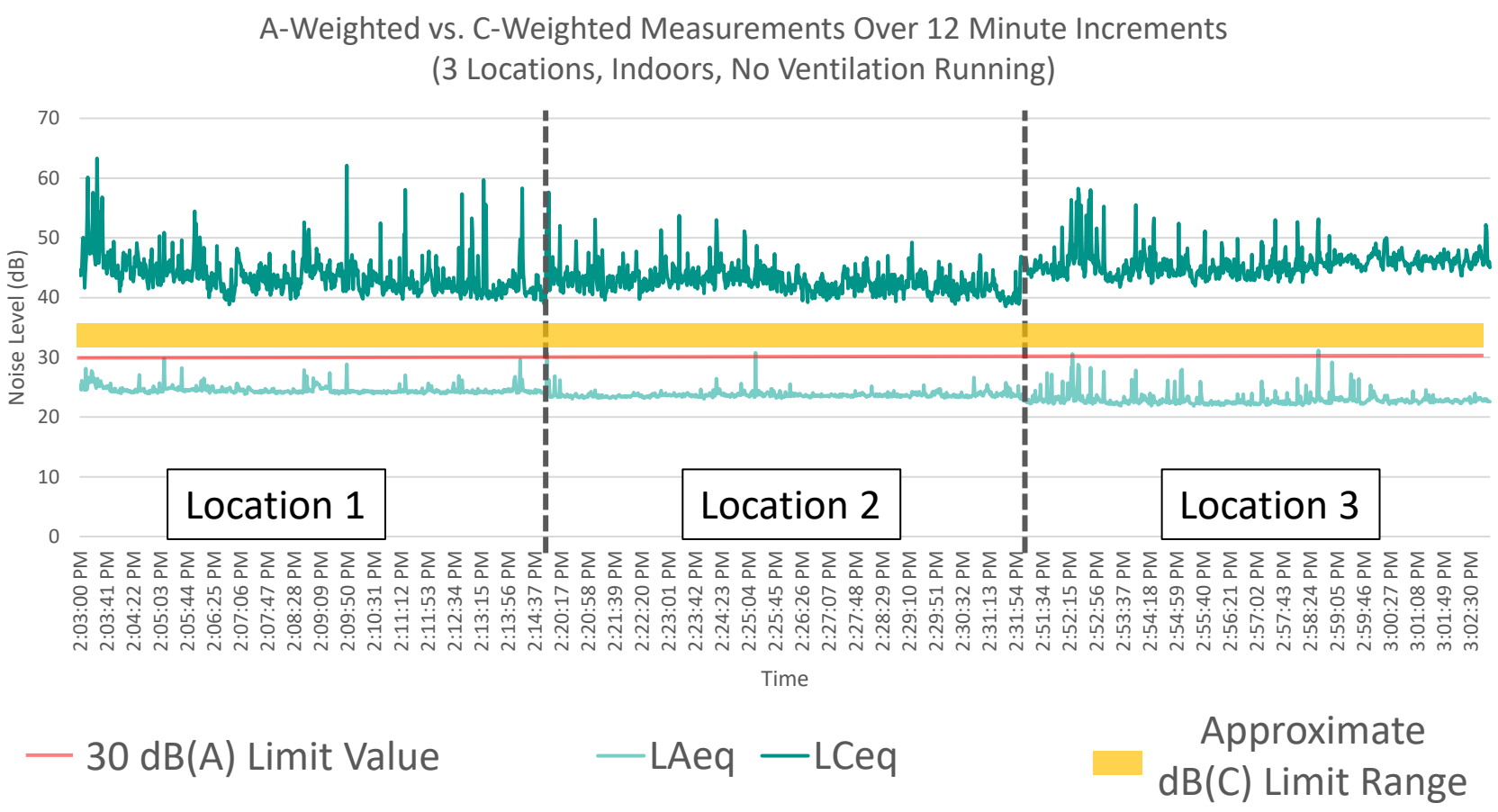
Example Measuring Setup



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

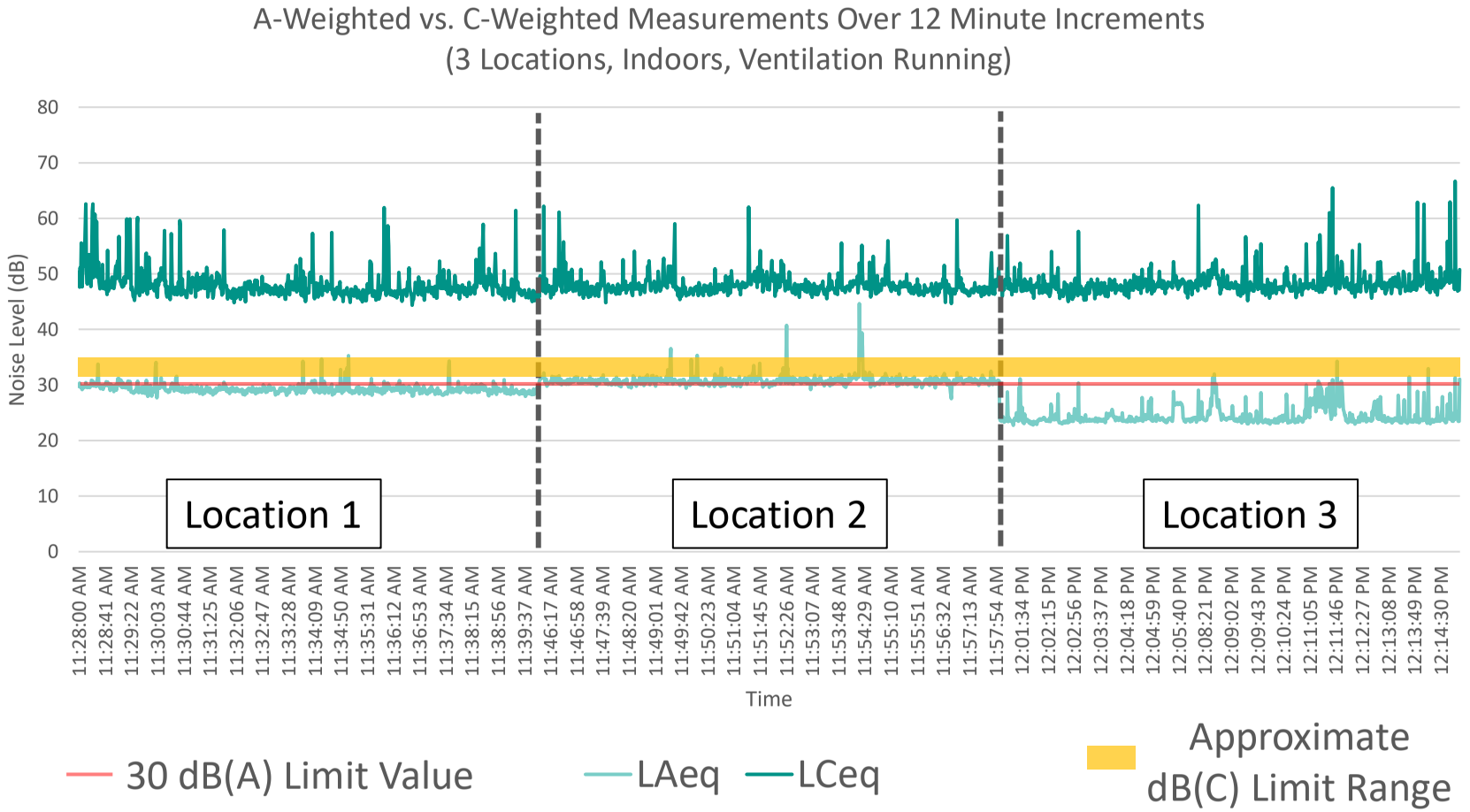


	Noise Level (dB)
Average C-Weighted	44.052
Average A-Weighted	23.716

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

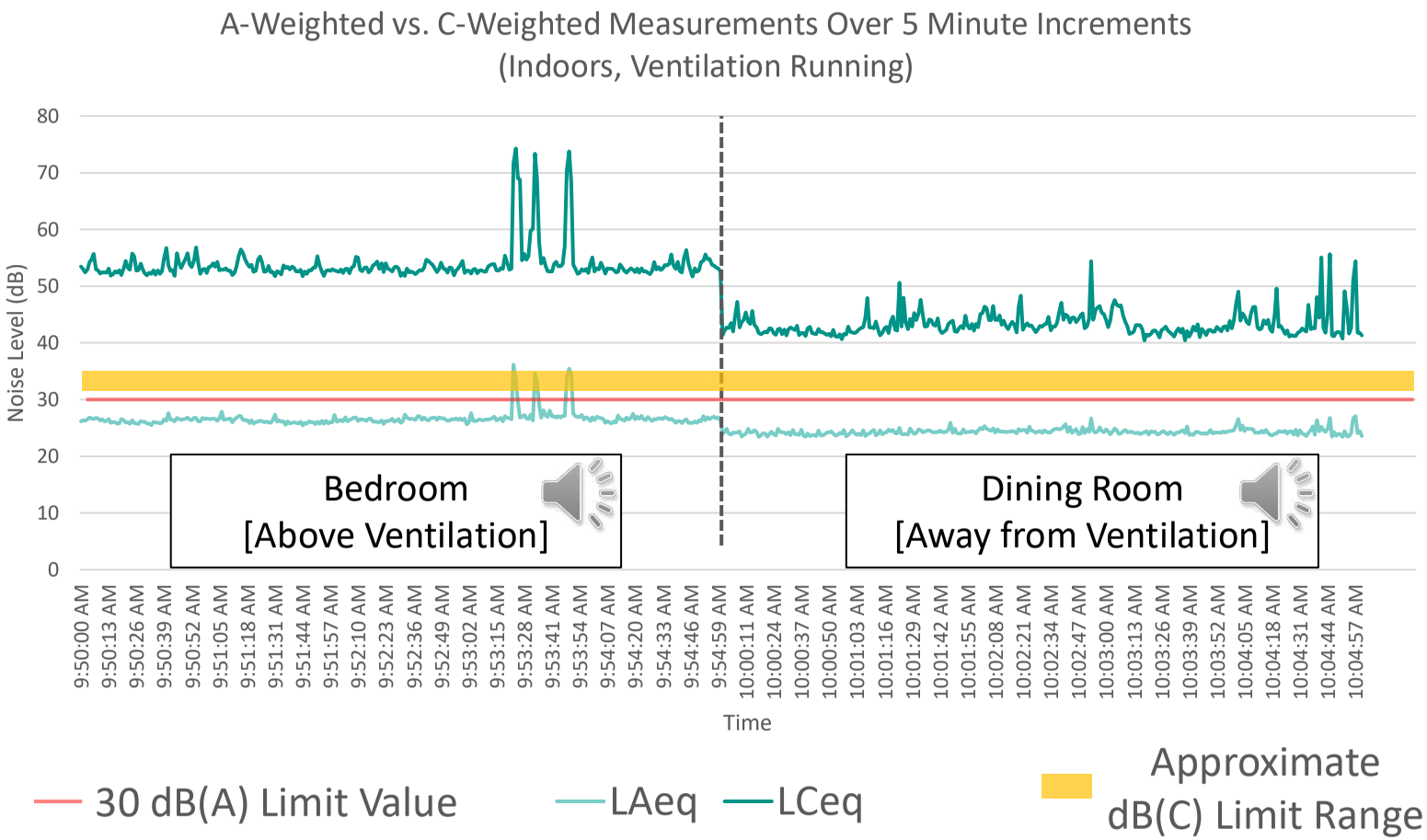


No Ventilation Running	
	Noise Level (dB)
Average C-Weighted	44.052
Average A-Weighted	23.716

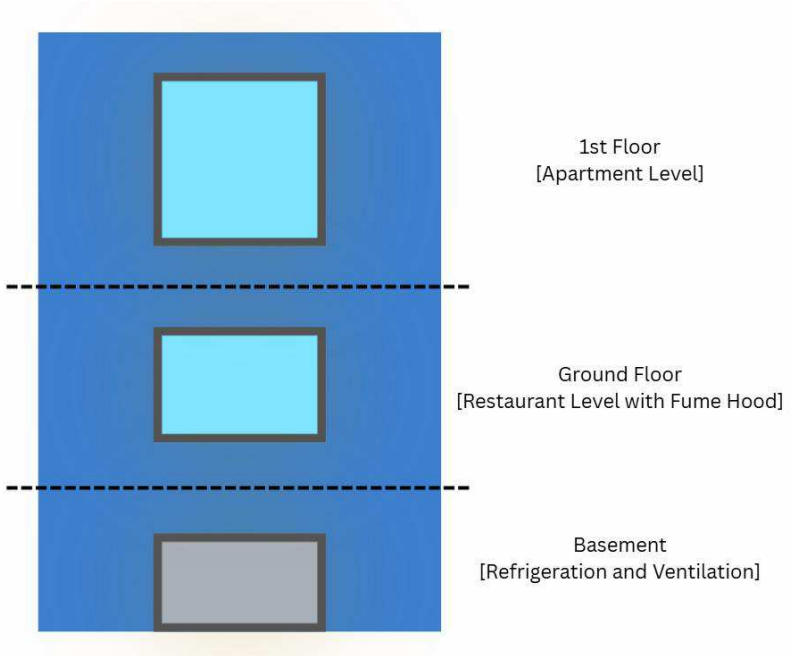
Ventilation Running	
	Noise Level (dB)
Average C-Weighted	48.122
Average A-Weighted	28.187

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

Objective 2:
Measurement Results – Survey Respondent



	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

MILJØPUNKT
INDRE BY & CHRISTIANSHAVN
AGENDA 21 · FOR ET BÆREDYGTIGT KBH

WPI

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

MILJØPUNKT
INDRE BY & CHRISTIANSHAVN
AGENDA 21 · FOR ET BÆREDYGTIGT KBH

WPI

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