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Figure 1. Project structure – Topic "Q-Zones"



Figure 2. The "Q-Park" concept. Parks embedded in Q-Zones for ultra quiet park environment



Figure 4. Improved indoor hot-spot analysis. Hot-spot analysis means that indoor and outdoor noise data are weighted together to a total noise score value. More factors will also be considered in the improved noise score model.

¹ Methods both for outdoor and indoor hot-spot analysis will be elaborated



Figure 5. Hot-Spot analysis for the outdoor environment, e.g. in parks. Outdoors, the population density, equivalent and maximum sound levels as well as the low frequency content will be considered in the noise score value



Figure 6. Tyre-Road noise research - Project structure.





Figure 7. Reasons why tyre/road noise must be reduced for vehicles with electric driving. Driveline noise is reduced by 10 dB(A) for electric driving. This leads to a need for tyre/road noise reduction in order to take full benefit from the low driveline noise. The two red curves describe the difference in total noise emission between a normal gasoline fuelled passenger car (Volvo V70) and a hybrid electric car (Toyota Prius) during electric driving. Note that tyre/road noise dominates from 20 km/h and upwards for electric driving.



Figure 8. The concept of tyre hoods for reduction of tyre/road noise. Note: The silenced cooling air intake to keep tyre temperature down. The rubber stripes reduce the air gap to the road surface.

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Figure 9. Partial project structure. Environmental noise reduction. Note: Treatment of the low frequency aspects of environmental noise will be addressed.



Figure 10. Cities chosen for evaluation of Q-zones



| Figure 11. Estimated SRI as a | function of construction y | ear for Stockholm test site. |
|-------------------------------|----------------------------|------------------------------|
|-------------------------------|----------------------------|------------------------------|

| | Time | Linit | Stockholm | | |
|----------|--------------------------------------|-----------------------|------------|------------|------------|
| | Туре | Unit | Base-Case | S 3 | S 12 |
| | Noise Costs | [€ / a] | 6 680 812 | 6 472 338 | 5 915 540 |
| | Q-Zone Fees | [€ / a] | 0 | 0 | 0 |
| | Traffic Work (Q-Zone) | [No. Veh. km] | 19 442 | 9 809 | 4 811 |
| | Traffic Work (Test site - Q-Zone) | [No. Veh. km] | 86 969 | 73 046 | 62 940 |
| | Traffic Work (Summation) | [No. Veh. km] 106 411 | | 82 856 | 67 751 |
| | Traffic Costs (Q-Zone) | [€ / a] | 3 548 235 | 1 790 225 | 878 027 |
| Costs | Traffic Costs (Test site - Q-Zone) | [€ / a] | 15 871 817 | 13 330 918 | 11 486 496 |
| | Traffic Costs (Summation) | [€ / a] | 19 420 052 | 15 121 143 | 12 364 523 |
| | ∆ Noise Costs | [€ / a] | - | -208 474 | -765 272 |
| | ∆ Q-Zone Fees | [€ / a] | - | 0 | 0 |
| | ∆ Traffic Costs (Q-Zone) | [€ / a] | - | -1 758 009 | -2 670 208 |
| | ∆ Traffic Costs (Test site - Q-Zone) | [€ / a] | - | -2 540 899 | -4 385 321 |
| | ∆ Traffic Costs (Summation) | [€/a] - | | -4 298 908 | -7 055 529 |
| | HAP (Testsite, complete) | [No. Persons] | 5 098 | 4 996 | 4 708 |
| | Annoyed Park Visitors | [No. Persons] | 9 298 | 8 860 | 6 264 |
| | Capacity | [m2] | [m2] 802 | | 6914 |
| | % Capacity related to park area | [%] | [%] 2,4 | | 20,8 |
| Popofita | LDEN (Q-Zone) | [dB (A)] | 43,0 | 41,4 | 39,9 |
| beneilis | LDEN (Park) | [dB (A)] 49,9 | | 48,5 | 45,4 |
| | ∆ HAP (Testsite, complete) | [No. Persons] | - | -101 | -389 |
| | ∆ Annoyed Park Visitors | [No. Persons] | - | -438 | -3 033 |
| | ∆ LDEN (Q-Zone) | [dB (A)] | - | -1,6 | -3,1 |
| | ∆ LDEN (Park) | [dB (A)] | - | -1,4 | -4,5 |

 $\Delta = Sx - Base Case$

Figure 12. Cost benefit analysis for three scenarios for the Stockholm test-site.



Figure 13. Grid structure (3 x 3 m) with 120 microphones in a random pattern



Figure 14. Panoramic camera module with three cameras at -60, 0, and 60 degree



Figure 15. Object detection in real time: original video image showing two vehicles (upper left image), image analysis, foreground segmentation and object identification (upper right image), video morphing (lower left image), beamforming and calculation of source levels (lower right image)



Figure 16. Example of an Acoustical Fingerprint; Left: Front tire, smooth surface, low noise tires, Level [dB(A)] vs. speed and frequency; Right: Rear tire, smooth surface, low noise tires, Level [dB(A)] vs. speed and frequency



Figure 17. Measurement campaign with 5 different passenger cars (2 electric vehicles, 3 ICE cars) on test track using the developed modified head visor microphone array



Figure 18. Results from CPX measurements on Arvid Lindmansgatan, Gothenburg.



Figure 19. Evaluation of macro economical noise costs.



Annoyance of traffic scenario

Figure 20. Ratings on the perceived annoyance of the presented traffic scenarios





Figure 21. Södermalm, Stockholm. Evaluation of the refined method for calculating number of HAP.



Figure 22. Distribution of visitors within the park



Figure 23. Distribution of % annoyed and % highly annoyed for the evaluated parks in Stockholm and Gothenburg.

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Figure 24. Q-Zone (test site) and the investigated park in Athens. The park is divided into two sections for evaluation (Park left and Park right)



Figure 25. Test site for measurements on facade noise insulation.

| Table 1. Dimensions for six different | ent measurement setups. |
|---------------------------------------|-------------------------|
|---------------------------------------|-------------------------|

| Setup | Inner sic Glass pane 1 [mm] | te (existing window) Cavity Glass pane [mm] 2 [mm] | | Cavity [mm] | Outer side Glass pane 3 [mm] |
|-------|-----------------------------------|--|---|--------------------|------------------------------------|
| 1 | 4 | 20 | 6 | - | - |
| 2 | 4 | 20 | 6 | 300 | 12 |
| 3 | 4 | 20 | 6 | 650 | 12 |
| 4 | 4 | 20 | 6 | 650MW ¹ | 12 |
| 5 | 4 | 20 | 6 | 1000 | 12 |
| 6 | 4 | 20 | 6 | 1300 | 12 |

Table 2. Noise reduction inside the building versus real frequency range.

| Frequency range | Concret H _b = | e barrier 6 [m] | Concrete-EPS-concrete barrier H _b = 6 [m] | |
|-----------------|-----------------------------|--------------------|---|------------|
| [Hz] | Η _b /λ [-] | IL [dB] | H _b /λ [-] | IL [dB] |
| 6.7 - 20 | 0.8 | 2 | 0.53 | 7 |
| 20 - 33.3 | 1.6 | 7 | 1.1 | 9 |
| 33.6 - 46.7 | 2.4 | 11 | 1.6 | 12 |
| 46.7 - 60 | 3.2 | 12 | 2.1 | 10 |

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Figure 26. CityHush logo



Figure 27. Front page of CityHush template for PowerPoint presentations.



Figure 28. Homepage of the CityHush website.

| and the second se | Dissemination |
|---|---|
| | Reducing transport noise in cities: Final CityHush event |
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| 1 Marrie | |
| Almat Crightash | Presentations PDP 's: (die Pdf-Station ond is der Anlage) |
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| | mad more! |
| | Reducing Transport Noise in Cities - First CityHush dissemination seminar Business 23 Management 2015 |
| | Contraction, 23 representation 2011 |

Figure 29. Page providing presentations given at CityHush dissemination events for download.

| | Interesting links |
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| I Partners | European Environmental Agency (EEA) is an agency of the European Union. Our fact is to provide sound, independent |
| 1 Discontration | edurmation on the environment. We are a major information source for those involved in developing, adopting, implementing and exploring environmental policy, and also the beneral public. Currents, the EEA has 32 member countries. |
| I interesting links | The news interaction attached in the |
| 1 Contact | Notes in the stag |
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Figure 30. Page with links to related projects at the CityHush website.

Table 3. List of relevant publications to disseminate CityHush results

| NAME OF MEDIA | TYPE OF MEDIA | COUNTRY | CONTACTS TO EDITORS? | WEBSITE |
|--|--|---------|-------------------------|---|
| New Scientist | Magazine | UK | no | http://www.newscientist.com/ |
| Acta Acoustica united with Acustica | Specialised scientific publication | EU | Yes | http://www.acta-acustica-united- with-acustica.com/ |
| Le Strade | Specialised scientific publication | Italy | No | http://fiaccola.it/lestrade.htm |
| Applied Acoustics | Specialised scientific publication | - | No | http://www.sciencedirect.com/scien ce/journal/0003682X |
| International Journal of Acoustics and Vibrations | Specialised scientific publication | UK | Yes | http://www.iiav.org |
| Plan | Publication of association of planners | Sweden | no | http://www.planering.org/plan.html |
| Ny Teknik | Engineers weekly newspaper | Sweden | no | http://www.nyteknik.se/ |
| Journal of Sound and Vibration | Refereed journal | UK | No | http://ees.elsevier.com/jsv/ |
| Journal of the Acoustical Society of America | Specialised scientific publication | US | Yes | http://asadl.org/jasa/ |

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CityHush USB-Cards





CityHush earplugs