DOCUMENTS IN THIS PACKET INCLUDE:

LETTERS FROM CITIZENS TO THE
MAYOR OR CITY COUNCIL

RESPONSES FROM STAFF TO LETTERS FROM CITIZENS

ITEMS FROM MAYOR AND COUNCIL MEMBERS

ITEMS FROM OTHER COMMITTEES AND AGENCIES

ITEMS FROM CITY, COUNTY, STATE, AND REGIONAL AGENCIES

Prepared for: 10/29/2018

Document dates: 10/10/2018 – 10/17/2018

Set 1

Note: Documents for every category may not have been received for packet reproduction in a given week.

Council, City

From: Ted O'Hanlon <tedohanlon@gmail.com>
Sent: Friday, October 12, 2018 3:32 PM
To: Council, City
Cc: Yurong Han; Lait, Jonathan; Leigh F. Prince
Subject: Consent Calendar, Oct. 15, 2018, Item #13

Dear Honorable Mayor and City Council Members:

On behalf of Golden Gate Homes, the owners of 567-595 Maybell Avenue, I write this email to encourage you to approve the Consent Calendar #13 on October 15, 2018 to defer Below Market Rate In-Lieu fees from Consent.

In support of this action, please consider:

- There is no project ready to utilize the fees and therefore no harm in deferring payment. There are proposed projects such as the PAH project at Wilton and a teacher housing proposal discussed in September 2018. However, based on our potential construction schedule proceeding immediately and plan to pay fees at final building permit inspection for the first of the 16 planned homes, the remaining 90% of fees will be paid in ample time should the funds be allocated to a project.
- If another project that might use the fees submits an application, even then it would be unlikely to receive required approvals prior to our first final building permit inspection, ensuring that the fees would still be timely and available even if deferred.
- The property was purchased for $22,000,000 in 2014 and has been carried by the owners 4 1/2 years through the entitlement process. At this juncture, the owners very much need to build and prepare homes for marketing and sale, rather than “paper” or approved homes to further fund construction allocations and move the project forward. Overall, there is a time value to money and the carrying cost, entitlement cycle and other soft costs add up.
- GGH is not trying to avoid payment of the fee. The request parallels other impact fee payment timing already executed by City Management and provided in the Municipal Code for items such as Parkland Dedication, Library, Community Centers, Traffic and Public Safety. There is a unique timing to this request as the BMR fee methodology changed over the course of this entitlement process from a percentage of gross sales to a flat rate calculated based on floor area.
- With annual fee increases, the City may collect more in fees if deferred.
- Similar to annual fee increases, also consider the most recent reported quarterly LAIF rate (the rate of return public agencies receive on their investments) of 1.9 percent. Therefore, the 3 percent premium that the owners will pay is significantly more and an additional fee enhancement for the City’s housing fund.

I will attend the City Council session and available to respond to questions as needed. We are optimistic this item can pass and we may proceed with building new homes in Palo Alto.

Best Regards
Ted

Ted O'Hanlon
Project & Development Consultant
tedohanlon@gmail.com
415.317.5070 mobile/text

Council, City

From: slevy@ccsce.com
Sent: Monday, October 15, 2018 11:04 AM
To: Council, City
Cc: Keene, James; Lait, Jonathan; Owen, Graham; Shikada, Ed
Subject: San Antonio housing pre screening

Dear Mayor and Council Members,

I have spent the last year going to meetings of the Committee to House the Bay Area (CASA) and SV@Home to hear their discussions about the obstacles to building more housing for low-income and all residents. I have also closely followed the housing work plan initiated at the request of council. Prior to that i served on the CAC where we discussed the city Housing Element.

Here is a summary of what i have learned.

1) Housing is expensive to build and costs are continuing to rise for a number of reasons--both for BMR and market rate units.

2) Projects must pencil out if they are going to get built. This is true for both non-profit and market rate developments. Perhaps the greatest public misunderstanding on this issue relates to the requirements of equity and lending partners. Often the public tends to blame developer profits instead for high rents.

Lenders require that rents cover debt service costs with a safety margin. This has nothing to do with developer or owner profits. It is a condition for getting loan financing, which is critical to most projects.

Equity partners require a a return on their investment that competes with other returns they can get with alternative investments.

Most if not all projects cannot go forward if they do not meet financing partner requirements.

3) Both of the above factors create the incentive and requirement for units that can command high rents for market rate projects. Non-profit developers must have costs low enough that their financing partners qualify for tax credit financing.

4) All parties (CASA, SV@Home and the city housing work plan) have identified cost and other barriers to building housing that must be addressed if our city or any city can meet its housing goals.

5) The above factors are why our Housing Element, while technically identifying sites that could house enough units to meet our housing goals to 2023, is not a plan for success AS FEW OF THE IDENTIFIED SITES ARE ECONOMICALLY VIABLE.

6) The above mean that zoning must change. The council has recognized this with the two recent overlay zones and the proposals for increased FAR and housing incentives in the housing work plan.

7) Costs such as fees and parking as well as density limits constrain our ability to have developers bring forth projects (market rate and BMR) that meet the requirement of their financing partners.

8) Finally, sites on which a meaningful amount of housing can be built are often rare and, therefore, precious if we are to meet our housing goals.

I hope you will keep these factors in mind as you do the pre screening Monday night on the San Antonio housing proposal.

The project provides a meaningful number of new units comparable to projects on the Wilton and VTA and some El Camino sites.

The project provides a mix of unit sizes

The project meets the BMR requirement

The project meets city standards for parking, which will be underground.

I do understand that in an ideal world the council was hoping to meet the Comp Plan goal with a minimum of new housing on San Antonio. But we do not live in Palo Alto with an excess of active housing proposals.

From my perspective as a resident this project will make a meaningful contribution to meeting our housing goals and give a welcoming signal that Palo Alto is open to new housing proposals for the council and community to review.

Stephen Levy

365 Forest Ave

and, Director

Center for Continuing Study of the California Econnomy

Council, City

From: Andrew Boone <nauboone@gmail.com>
Sent: Monday, October 15, 2018 12:55 PM
To: Council, City
Subject: Vote NO on $50 million for more car traffic

Dear Palo Alto City Council,

Please vote NO on the city's proposal to issue $50 million in bonds to finance the construction of a new car parking garage in the California Avenue business district. $50 million for 310 new car parking spaces is over $160,000 PER car parking space, an obscenely high cost for something that not only violates our General Plan and State Law but is simply fiscally reckless and harms the public.

This is $50 million, plus interest, that future city councils will not be able to spend on projects that would actually benefit the community. 310 new car parking spaces is especially inappropriate in a located that is one of the best-served by alternative modes of transportation – there is both a Caltrain station AND a VTA route 522 bus stop, and the area is accessible by one of the highest quality networks for walking and bicycling in the entire Bay Area.

Palo Alto's 2016 General Plan actually calls for REDUCING the number of car parking space in business district over time, and state Climate Change laws, including SB375, mandate the REDUCTION on greenhouse gas emissions from cars. Also Palo Alto residents do not want to have more car traffic, more car crashes, and a further degradation of the local environment for walking and bicycling. The more cars you put on the roads, the more you discourage people from walking and bicycling.

This project is an extremely bad idea in every possible way. We can get people to the California Avenue Business District in other ways than with more cars. And we MUST take action on Climate Change NOW not later – we must reduce emissions drastically as soon as possible. Vote NO on this bad project that harm Palo Altans and Planet Earth for generations to come.

- Andrew Boone

Council, City

From: herb <herb_borock@hotmail.com>
Sent: Monday, October 15, 2018 2:58 PM
To: Council, City; Clerk, City
Subject: (1) October 15, 2018, Council Meeting, Item #16: California Avenue Parking Garage; (2) Public Improvement Corporation Meeting, Item #1: Certain Actions With Respect to Certain Documents

Herb Borock
P. O. Box 632
Palo Alto, CA 94302

October 15, 2018

Palo Alto City Council
250 Hamilton Avenue
Palo Alto, CA 94301

OCTOBER 15, 2018, CITY COUNCIL MEETING, AGENDA ITEM #16
CALIFORNIA AVENUE PARKING GARAGE

OCTOBER 15, 2018, PUBLIC IMPROVEMENT CORPORATION MEETING, AGENDA ITEM #1
CERTAIN ACTIONS WITH RESPECT TO CERTAIN LEASE FINANCING DOCUMENTS

Dear City Council:

Please remove agenda item #16 from tonight's City Council agenda, and please cancel tonight's Public Improvement Corporation meeting, because the agenda item description for item #16 on the City Council agenda and the agenda description for the only item on the Public Improvement Corporation agenda fail to provide an adequate description of the subject to be discussed in violation of the Ralph M. Brown Act.

I have reviewed the publicly posted agenda after 11:00 am today and learned that there have been no revised agendas posted within 24 hours of the two meetings that correct the inadequate agenda item descriptions.

Agenda item #16 refers to the "California Avenue Parking Garage", but there is no parking garage on California Avenue that is the subject of the agenda item. Therefore, the public has no way of knowing the parking garage location by reading the agenda item description.

The only agenda item on the Public Improvement Corporation agenda refers to "Certain Lease Financing Documents" and "Certain Actions with Respect Thereto". Therefore, that agenda item description is similar to the issue considered by the California Office of the Attorney General in Opinion No. 89-903 issued January 9, 1990 that held:

"The adoption by the Midpeninsula Regional Open Space District of a resolution listing all parcels of real property larger than twenty acres within its planning area as the potential subject of negotiation for purchase would not satisfy the disclosure prerequisite for a closed session regarding the purchase of any one or more of such parcels."

Tonight's Public Improvement Corporation agenda description for agenda item #1 uses the vague word "certain" that gives even less information about the subject of the agenda item description than the agenda item description that the Opinion of the Attorney General found to be insufficient.

The Opinion's reasoning is independent of whether the meeting is a closed session or an open session, and is independent of whether the subject matter is real estate negotiation or is the construction and financing of a parking garage.

Who Benefits, Who Pays, and Where is the Money?

The purpose of building a parking garage in a commercial business district is to enrich investors, realtors, landlords, mortgage lenders, title companies, architects, planning consultants, and builders who benefit from the increasingly intensive use of land.

Consistent City of Palo Alto policy has been to require those who benefit from constructing such parking garages to pay for the garages by forming an assessment district to charge commercial property owners for the cost of the garage.

Exceptions are often included in the calculation of assessments to enable those in the assessment district to collectively pay less that the full cost of the garage.

The determination of the number of parking spaces for the commercial properties served by the garage often fails to account for the additional employees that need parking when more employees are crammed into a given space.

Residents become the victims of the under-estimation of parking spaces by having their neighborhood streets serve as parking lots for commercial district employees.

The victims are then required to pay for the parking garage itself by having City services cut to provide the funds to make up the shortfall in garage funding caused by the assessment process that is designed to generate less money than the garage costs.

Now staff wants to make the residents situation worse by not forming an assessment district that would require commercial property owners to agree

to fund the garage before you approve the construction and financing tonight.

Voters are being led to believe that the proposed tax on this November's ballot will pay for a long list of infrastructure projects, including new parking garages in two commercial business districts, that would require more money than the tax measure could possibly raise.

Now, when the election is still three weeks away and nobody knows if the voters will approve the tax measure, you are being asked by staff to take actions that are estimated to cost the City over $2.4 million a year for 30 years without staff including in its report (ID # 9689) the source of $39.5 million in garage costs before you even know how much the garage will actually cost.

Does staff really believe that your approval of the construction and financing of the garage before the election will increase the number of votes in favor of the tax measure on the ballot?

Distractions and Conclusions

Some people believe you should build housing on the site designated for a parking garage in the University Avenue Commercial District, while the same people ignore the debate about whether sites that could have more offices should instead be rezoned for exclusive residential use.

Other people believe you should focus on the design and location of bicycle lanes instead of addressing the root cause of traffic congestion and unsafe conditions which is too much development of offices; a lack of parking in commercial districts for the occupants of those offices; and the failure to require those who benefit financially from the garages to pay for them, while residents have to subsidize that development when their neighborhoods are turned into commercial parking lots and their services are cut to provide the funds needed for garages that are for someone else's financial enrichment.

When these agenda items return to you on agendas that include agenda item descriptions that comply with the Brown Act, I urge you to not be distracted by side issues, but rather focus on issues of benefit, costs, and funding sources that are the key issues in the garage construction and financing debate, and that are directly related to the key issues in this November's City Council election that include the amount and annual rate of development, the mix of development between residential and non-residential uses, the appropriate allocation of revenue raising measures between residents and businesses, and the equitable division of City expenses between infrastructure and services.

You should wait until after the November election results are certified in December before you act on these two agenda items.

Thank you for your consideration of these comments.

Sincerely

Herb Borock

Council, City

From: Neilson Buchanan <cnsbuchanan@yahoo.com>
Sent: Monday, October 15, 2018 2:35 PM
To: Carol Scott; Council, City
Subject: looks great
Attachments: EP.M letter to Council re Calif Ave Garage Oct 15 2018 buchanan edit.docx

send to city.council@cityofpaloalto.org

your subject line should read "Comments on California Ave Garage Oct 15 2015"

I made a few minor edits in red. Such letters dont have to be perfect. Too perfect does not seem genuine.

cc: your crew
rebsanders@gmail.com
fbalin@gmail.com

bc. the following people. your letter will not get into the packet tonight.
cory.wolbach@gmail.com
efilseth@gmail.com
adrianfine@gmail.com
tomforcouncil@gmail.com
patburt11@gmail.com
jguislin@gmail.com
cnsbuchanan@yahoo.com
nhbeamer@yahoo.com
welgreg@gmail.com

Neilson Buchanan
155 Bryant Street
Palo Alto, CA 94301

650 329-0484
650 537-9611 cell
cnsbuchanan@yahoo.com

Dear Council Members and City Staff,

As we approach the implementation phase of the plans for a new parking garage for the California Avenue area, I and my **my neighbors and I** neighbors would like to express our appreciation for your support for this project in its entirety with no shortcuts. As commercial activity and traffic has increased in this area, the need for parking has gone up with negative effects on the bordering residential neighborhoods until the enactment of the recent residential parking permit program.

We would now like to suggest as part of the process of actually constructing the garage that an agreement be reached that the number of commercial employee permits issued in Evergreen Park and Mayfield be reduced. This new garage is being funded by the taxpayers, and at least some of its benefits should flow back to the residents. We urge you to include, as part of the project's guidelines, a commitment not later than April 1, 2019, to reducing the negative effects of employee parking in residential neighborhoods such as traffic congestion, parking "bunching" on selected streets/blocks, and a lower quality of life.

Unfortunately, my neighbors and I hear rumors are that some[delete some] other City agencies are thinking of using the new garage as an excuse for permitting additional office space and housing projects that do not include sufficient parking for their needs. Deliberately increasing the demand for public parking spaces at the expense of the residential areas is not acceptable. It is contrary to the explicit statement in the Comp Plan. Businesses and developers should bear the cost of their construction projects. New projects should not be allowed to impose additional costs on residents, and should be precluded from purchasing permits in City lots and garages. We already have proof that requiring businesses to bear the costs of their own operations will not decrease interest in development in Palo Alto. Our experience with the College Terrace residential parking permit program has convincingly demonstrated that when businesses and developers know the rules, then can and will adapt.

Again, I thank you for your commitment to the construction of this garage to relieve the pressure for parking in the California Avenue area that has been created by many new construction projects and by changes in the workforce that now occupies many of the older buildings. Please continue to support the Comprehensive Plan commitment to encouraging commercial activity in the City, but not at the expense of residential neighborhoods.

Carol Scott
Resident of Evergreen Park

CITY OF PALO ALTO

City Council Meeting **#16**
10/15/2018
[X] Placed Before Meeting
[ ] Received at Meeting

City of Palo Alto
MEMORANDUM

TO: City Council

DATE: October 15, 2018

SUBJECT: Revised Resolution Authorizing the Delivery and Sale of Certificates of Participation (COPs) to Finance the Construction of the California Avenue Parking Garage (**CMR ID # 9689**)

Staff requests that the City Council adopt the revised resolution (Attachment A) approving, authorizing and directing execution of certain lease financing documents, approving a preliminary official statement, declaring the intention to reimburse expenditures, and authorizing and directing certain related actions, related to the issuance of the California Avenue Parking Garage Certificate of Participation (COP).

The staff report recommends that a competitive COP sale method be used whereby the bonds are advertised for sale. Any broker dealer or dealer bank may bid on the bonds at the designated date and time. The bonds are awarded to the bidder offering the lowest interest cost. The alternative, a negotiated sale, an underwriter is selected to purchase the bonds with the assistance of the City's Financial Advisor. The terms of the bonds are negotiated to meet the needs of the City. The attached resolution was updated to include language directing the City Manager to ultimately determine which sale method, competitive and/or negotiated, is in the best interest of the City. **Attachment A** is the final version of the revised resolution; **Attachment B** is the red-lined version to review the recommended change.

DEPARTMENT HEAD: Kiely S. Nose

Kiely Nose
Interim Director, Administrative Services/Chief Financial Officer

CITY MANAGER: James K. Keene Jr

James Keene
City Manager

Attachment A (Revised-Clean Version) City Resolution Approving, Authorizing & Directing Execution of Certain Lease Financing Documents

Attachment B (Revised-Red-Lined Version) City Resolution Approving, Authorizing & Directing Execution of Certain Lease Financing Documents

Attachment A (Revised-Clean Version)

RESOLUTION NO. _____

A RESOLUTION OF THE CITY OF PALO ALTO APPROVING, AUTHORIZING AND DIRECTING EXECUTION OF CERTAIN LEASE FINANCING DOCUMENTS, APPROVING A PRELIMINARY OFFICIAL STATEMENT, DECLARING THE INTENTION TO REIMBURSE EXPENDITURES, AND AUTHORIZING AND DIRECTING CERTAIN RELATED ACTIONS

WHEREAS, the City desires to finance the costs of acquiring and constructing a parking garage to be located at 350 Sherman Avenue (the "California Avenue Parking Garage");

WHEREAS, in order to finance the California Avenue Parking Garage, the City has determined to provide for the execution and delivery of City of Palo Alto 2018 Certificates of Participation (California Avenue Parking Garage) (the "Certificates");

WHEREAS, staff has recommended that the City cause the Certificates to be executed and delivered in a single series the interest on which would be exempt from taxation under federal tax law; however, in order to ensure that the financing is ultimately structured in the most cost-effective manner, the City Council wishes to delegate to the City Manager or a designee appointed by any such officer (e.g. Administrative Services Director) the final determination of whether it is desirable and in the City's best interest to have the City cause to be executed and delivered a second series of certificates of participation the interest on which would be subject to taxation under federal tax law;

WHEREAS, staff has recommended that the City cause the Certificates to be sold on a competitive basis; however, in order to ensure that the financing is ultimately structured in the most cost-effective manner, the City Council wishes to delegate to the City Manager or a designee appointed by the City Manager (e.g. Administrative Services Director) the final determination of whether it is desirable and in the City's best interest to sell one or more series of the Certificates on a negotiated basis;

WHEREAS, the City further proposes to lease a City asset, initially the Rinconada Library, located at 1213 Newell Road (or another property identified by staff) (the "Leased Property"), to the Palo Alto Public Improvement Corporation, a nonprofit public benefit corporation duly formed, organized, operating and acting pursuant to the laws of the State of California (the "Corporation"), under a Property Lease by and between the City, as lessor, and the Corporation, as lessee (the "Property Lease"), and to cause the Corporation to lease the Leased Property back to the City under a Lease Agreement, by and between the City, as lessee, and the Corporation, as lessor (the "Lease Agreement"), in consideration of the payment by the City of semi-annual lease payments (the "Lease Payments");

WHEREAS, as described in the Property Lease and the Lease Agreement, upon the construction and the substantial readiness of the California Avenue Parking Garage for use and occupancy by the City, as shall be evidenced by a certificate of completion delivered by the City, the California Avenue Parking Garage will be the Leased Property subject to the Property Lease and the Lease Agreement, and the Rinconada Library will be released;

WHEREAS, the City further proposes to cause the Corporation to assign its right to receive the Lease Payments to U.S. Bank National Association, as trustee (the "Trustee"), under an Assignment Agreement (the "Assignment Agreement"), by and between the Corporation and the Trustee, and in consideration of such assignment the Trustee has agreed

to execute and deliver the Certificates, each evidencing a direct, undivided fractional interest in the Lease Payments, in accordance with a Trust Agreement to be executed by and among the Trustee, the City and the Corporation (the "Trust Agreement");

WHEREAS, pursuant to the City's authorization, Quint & Thimmig LLP, as disclosure counsel to the City, has prepared and presented to the City a form of preliminary official statement containing information material to the offering and sale of the Certificates (the "Preliminary Official Statement");

WHEREAS, the documents described below have been filed with the City, the members of the City Council, with the aid of its staff, have reviewed said documents, and it is in the public interest and for the public benefit that the City authorize and direct execution of such documents;

WHEREAS, United States Income Tax Regulations section 1.150-2 provides generally that proceeds of tax-exempt obligations are not deemed to be expended when such proceeds are used for reimbursement of expenditures made prior to the date of issuance of such obligations unless certain procedures are followed, one of which is a requirement that prior to the payment of any such expenditure, the issuer declares an intention to reimburse such expenditure;

WHEREAS, it is in the public interest and for the public benefit that the City declares its official intent to reimburse expenditures related to the acquisition and construction of the California Avenue Parking Garage; and

WHEREAS, pursuant to Government Code Section 5852.1, which became effective on January 1, 2018 by the enactment of Senate Bill 450, certain information relating to the Certificates is set forth in Appendix A attached to this Resolution, and such information is hereby disclosed and made public.

NOW, THEREFORE, the Council of the City of Palo Alto does hereby **RESOLVE**, as follows:

1. The below-enumerated documents be and are hereby approved, and the Mayor, the City Manager, the Administrative Services Director or a designee appointed by any such officer (in each case, an "Authorized Officer") are hereby separately authorized and directed to execute said documents, with such changes, insertions and omissions as may be approved by such official, and the City Clerk is hereby authorized and directed to attest to such Authorized Officer's signature:

(a) the Property Lease, relating to the lease of the Leased Property by the City to the Corporation, by and between the City, as lessor, and the Corporation, as lessee;

(b) the Lease Agreement, relating to the lease of the Leased Property by the Corporation back to the City, between the Corporation, as lessor, and the City, as lessee;

(c) the Trust Agreement, by and among the Corporation, the City and the Trustee, relating to the execution and delivery of the Certificates, evidencing the fractional interests of the owners thereof in the Lease Payments to be made by the City under the Lease Agreement; and

(d) a continuing disclosure certificate under which the City will agree to provide certain information on a continuing basis.

2. The Council hereby authorizes the execution and delivery of the Certificates for the purpose of providing funds to finance the acquisition and construction of the California Avenue Parking Garage. The aggregate principal amount of the Certificates shall not exceed $50,000,000, the true interest cost of the Certificates may not exceed 5.0% and the Underwriter's discount may not exceed 1.5% of the principal amount of the Certificates.

3. The City Manager or a designee appointed by any such officer (e.g. Administrative Services Director) is hereby authorized and directed to determine whether it is desirable and in the City's best interest for the City to cause to be executed and delivered a second series of certificates of participation the interest on which would be subject to taxation under federal tax law to finance all or a portion of the California Avenue Parking Garage, either in lieu of or in addition to the tax-exempt series. If the City Manager or a designee appointed by any such officer determines that a second series should be executed and delivered, all references to the Certificates in this resolution shall refer to both series and the City Council hereby authorizes any necessary changes to the documents approved by this Resolution to reflect such second series.

4. The Council hereby authorizes and directs the competitive public sale of the Certificates. The Certificates shall be sold in accordance with the Official Notice of Sale in substantially the form on file with the City, together with any changes therein or additions thereto deemed advisable by an Authorized Officer. The Authorized Officers are hereby authorized and directed to accept the best bid for the sale of the Certificates, as determined in accordance with the Notice of Sale. Pursuant to Section 53692 of the Government Code, Jones Hall, as bond counsel, is hereby authorized and directed to cause a Notice of Intention, in form and substance acceptable to said firm, to be published in the manner required by applicable law.

The City Manager or a designee thereof (e.g. Administrative Services Director) is hereby authorized and directed, following consultation with the City's municipal advisor and bond counsel, to determine whether it is desirable and in the City's best interest for the City to sell the Certificates on a negotiated basis, to select an underwriter to purchase the Certificates and to negotiate a purchase contract with the underwriter. The Authorized Officers are hereby separately authorized and directed to execute a purchase agreement with the underwriter as long as the Certificates will meet the parameters set forth in Section 2.

5. Each Authorized Officer, the City Clerk and all other officials of the City are hereby authorized and directed to execute such other agreements, documents and certificates as may be necessary to effect the purposes of this resolution and the lease financing and refinancing herein authorized, and to revise the identity of the initial Leased Property as necessary in order to accomplish the purposes of this Resolution. Whenever in this resolution any officer of the City is authorized to execute or countersign any document or take any action, such execution, countersigning or action may be taken on behalf of such officer by any person designated by such officer to act on his or her behalf in the case such officer shall be absent or unavailable.

6. The City hereby approves the Preliminary Official Statement describing the Certificates, in the form on file with the Director of Administrative Services. The City's municipal advisor, PFM Financial Advisors LLC, is hereby authorized to distribute the Preliminary Official Statement in connection with the sale of the Certificates. An Authorized Officer is hereby

authorized and directed to (a) execute and deliver a certificate deeming the Preliminary Official Statement to be final as of its date within the meaning of Rule 15c2-12 of the Securities Exchange Act of 1934 and (b) approve any changes in or additions to cause such Preliminary Official Statement to be put in final form.

7. The Authorized Officers are separately authorized to approve corrections and additions to the Preliminary Official Statement by supplement or amendment thereto, or otherwise as appropriate, provided that any such corrections or additions shall be necessary to cause the information contained therein to conform with facts material to the Certificates, or to the proceedings of the City.

8. The Final Official Statement, when prepared, is approved for distribution by the purchaser of the Certificates in connection with the offering and sale of the Certificates.

9. The City hereby declares that it reasonably expects (i) to pay certain costs of acquiring and constructing the California Avenue Parking Garage prior to the date of execution and delivery of the Certificates, and (ii) to use a portion of the proceeds of the Certificates for reimbursement of expenditures related to the acquisition and construction of the California Avenue Parking Garage that are paid before the date of execution and delivery of the Certificates.

10. The Mayor, the City Manager and the Administrative Services Director are separately authorized and directed to cause the Preliminary Official Statement to be brought into the form of a final official statement (the "Final Official Statement") and to execute said Final Official Statement, dated as of the date of the sale of the Certificates, and the City Manager and Administrative Services Director are separately authorized and directed to execute a statement that the facts contained in the Final Official Statement, and any supplement or amendment thereto (which shall be deemed an original part thereof for the purpose of such statement) were, at the time of sale of the Certificates, true and correct in all material respects and that the Final Official Statement did not, on the date of sale of the Certificates, and does not, as of the date of delivery of the Certificates, contain any untrue statement of a material fact with respect to the City or omit to state material facts with respect to the City required to be stated where necessary to make any statement made therein not misleading in the light of the circumstances under which it was made. The Mayor, the City Manager or the Administrative Services Director shall take such further actions prior to the signing of the Final Official Statement as are deemed necessary or appropriate to verify the accuracy thereof.

11. The City hereby approves the selection of Jones Hall, A Professional Law Corporation, as bond counsel, Quint & Thimmig LLP, as disclosure counsel, and PFM Financial Advisors LLC, as financial advisor. Each Authorized Officer and other appropriate officials of the City are authorized to execute a professional services agreement with such firms in connection with the proposed financing, and the execution of such agreements on behalf of the City shall be conclusive evidence of such approval.

12. This resolution shall take effect immediately upon its adoption.

******

INTRODUCED AND PASSED: October 15, 2018

AYES:

NOES:

ABSENT:

ABSTENTIONS:

ATTEST:

_____
City Clerk

APPROVED AS TO FORM:
Jones Hall,
A Professional Law Corporation

By: _____
Christopher K. Lynch,
Jones Hall, A Professional Law Corporation
Bond Counsel

APPROVED:

_____
Mayor

_____
City Manager

_____
Director of Public Works

Director of Administrative Services

_____
City Attorney

APPENDIX A

Government Code Section 5852.1 Disclosure

The following information consists of estimates that have been provided by the City's municipal advisor which has been represented by such party to have been provided in good faith:

(A) True Interest Cost of the Certificates: All Tax-Exempt - 3.8354% and 75% Tax-Exempt and 25% Taxable - 3.9698%

(B) Finance Charge of the Certificates (Sum of all fees/charges paid to third parties): All Tax-Exempt - $410,485 and 75% Tax-Exempt and 25% Taxable -$417,385

(C) Net Proceeds to be Received (net of finance charges, reserves and capitalized interest, if any): $39,500,000.00

(D) Total Payment Amount Through Maturity: All Tax-Exempt - $72,441,083 and 75% Tax-Exempt and 25% Taxable -$73,548,855

The foregoing estimates constitute good faith estimates only. They assume either one series of tax-exempt bonds or two series of Certificates are sold, one tax-exempt (75% of the principal amount) and one taxable (25% of the principal amount). The principal amount of the Certificates, the true interest cost of the Certificates, the finance charges thereof, the amount of proceeds received therefrom and total payment amount with respect thereto may differ from such good faith estimates due to (a) the actual date of the sale of the Certificates being different than the date assumed for purposes of such estimates, (b) the actual principal amount of Certificates sold being different from the estimated amount used for purposes of such estimates, (c) the actual amortization of the Certificates being different than the amortization assumed for purposes of such estimates, (d) the actual market interest rates at the time of sale of the Certificates being different than those estimated for purposes of such estimates, (e) other market conditions, or (f) alterations in the City's financing plan (including the mix of tax-exempt and taxable Certificates), or a combination of such factors. The actual date of sale of the Certificates and the actual principal amount of Certificates sold will be determined by the City based on the timing of the need for proceeds of the Certificates and other factors. The actual interest rates borne by the Certificates will depend on market interest rates at the time of sale thereof. The actual amortization of the Certificates will also depend, in part, on market interest rates at the time of sale thereof. Market interest rates are affected by economic and other factors beyond the control of the City.

Attachment B (Revised-Red Lined Version)

RESOLUTION NO. _____

A RESOLUTION OF THE CITY OF PALO ALTO APPROVING, AUTHORIZING AND DIRECTING EXECUTION OF CERTAIN LEASE FINANCING DOCUMENTS, APPROVING A PRELIMINARY OFFICIAL STATEMENT, DECLARING THE INTENTION TO REIMBURSE EXPENDITURES, AND AUTHORIZING AND DIRECTING CERTAIN RELATED ACTIONS

WHEREAS, the City desires to finance the costs of acquiring and constructing a parking garage to be located at 350 Sherman Avenue (the "California Avenue Parking Garage");

WHEREAS, in order to finance the California Avenue Parking Garage, the City has determined to provide for the execution and delivery of City of Palo Alto 2018 Certificates of Participation (California Avenue Parking Garage) (the "Certificates");

WHEREAS, staff has recommended that the City cause the Certificates to be executed and delivered in a single series the interest on which would be exempt from taxation under federal tax law; however, in order to ensure that the financing is ultimately structured in the most cost-effective manner, the City Council wishes to delegate to the City Manager or a designee appointed by any such officer (e.g. Administrative Services Director) the final determination of whether it is desirable and in the City's best interest to have the City cause to be executed and delivered a second series of certificates of participation the interest on which would be subject to taxation under federal tax law;

WHEREAS, staff has recommended that the City cause the Certificates to be sold on a competitive basis; however, in order to ensure that the financing is ultimately structured in the most cost-effective manner, the City Council wishes to delegate to the City Manager or a designee appointed by the City Manager (e.g. Administrative Services Director) the final determination of whether it is desirable and in the City's best interest to sell one or more series of the Certificates on a negotiated basis;

WHEREAS, the City further proposes to lease a City asset, initially the Rinconada Library, located at 1213 Newell Road (or another property identified by staff) (the "Leased Property"), to the Palo Alto Public Improvement Corporation, a nonprofit public benefit corporation duly formed, organized, operating and acting pursuant to the laws of the State of California (the "Corporation"), under a Property Lease by and between the City, as lessor, and the Corporation, as lessee (the "Property Lease"), and to cause the Corporation to lease the Leased Property back to the City under a Lease Agreement, by and between the City, as lessee, and the Corporation, as lessor (the "Lease Agreement"), in consideration of the payment by the City of semi-annual lease payments (the "Lease Payments");

WHEREAS, as described in the Property Lease and the Lease Agreement, upon the construction and the substantial readiness of the California Avenue Parking Garage for use and occupancy by the City, as shall be evidenced by a certificate of completion delivered by the City, the California Avenue Parking Garage will be the Leased Property subject to the Property Lease and the Lease Agreement, and the Rinconada Library will be released;

WHEREAS, the City further proposes to cause the Corporation to assign its right to receive the Lease Payments to U.S. Bank National Association, as trustee (the "Trustee"), under an Assignment Agreement (the "Assignment Agreement"), by and between the Corporation and the Trustee, and in consideration of such assignment the Trustee has agreed

to execute and deliver the Certificates, each evidencing a direct, undivided fractional interest in the Lease Payments, in accordance with a Trust Agreement to be executed by and among the Trustee, the City and the Corporation (the "Trust Agreement");

WHEREAS, pursuant to the City's authorization, Quint & Thimmig LLP, as disclosure counsel to the City, has prepared and presented to the City a form of preliminary official statement containing information material to the offering and sale of the Certificates (the "Preliminary Official Statement");

WHEREAS, the documents described below have been filed with the City, the members of the City Council, with the aid of its staff, have reviewed said documents, and it is in the public interest and for the public benefit that the City authorize and direct execution of such documents;

WHEREAS, United States Income Tax Regulations section 1.150-2 provides generally that proceeds of tax-exempt obligations are not deemed to be expended when such proceeds are used for reimbursement of expenditures made prior to the date of issuance of such obligations unless certain procedures are followed, one of which is a requirement that prior to the payment of any such expenditure, the issuer declares an intention to reimburse such expenditure;

WHEREAS, it is in the public interest and for the public benefit that the City declares its official intent to reimburse expenditures related to the acquisition and construction of the California Avenue Parking Garage; and

WHEREAS, pursuant to Government Code Section 5852.1, which became effective on January 1, 2018 by the enactment of Senate Bill 450, certain information relating to the Certificates is set forth in Appendix A attached to this Resolution, and such information is hereby disclosed and made public.

NOW, THEREFORE, the Council of the City of Palo Alto does hereby **RESOLVE**, as follows:

1. The below-enumerated documents be and are hereby approved, and the Mayor, the City Manager, the Administrative Services Director or a designee appointed by any such officer (in each case, an "Authorized Officer") are hereby separately authorized and directed to execute said documents, with such changes, insertions and omissions as may be approved by such official, and the City Clerk is hereby authorized and directed to attest to such Authorized Officer's signature:

(a) the Property Lease, relating to the lease of the Leased Property by the City to the Corporation, by and between the City, as lessor, and the Corporation, as lessee;

(b) the Lease Agreement, relating to the lease of the Leased Property by the Corporation back to the City, between the Corporation, as lessor, and the City, as lessee;

(c) the Trust Agreement, by and among the Corporation, the City and the Trustee, relating to the execution and delivery of the Certificates, evidencing the fractional interests of the owners thereof in the Lease Payments to be made by the City under the Lease Agreement; and

(d) a continuing disclosure certificate under which the City will agree to provide certain information on a continuing basis.

2. The Council hereby authorizes the execution and delivery of the Certificates for the purpose of providing funds to finance the acquisition and construction of the California Avenue Parking Garage. The aggregate principal amount of the Certificates shall not exceed $50,000,000, the true interest cost of the Certificates may not exceed 5.0% and the Underwriter's discount may not exceed 1.5% of the principal amount of the Certificates.

3. The City Manager or a designee appointed by any such officer (e.g. Administrative Services Director) is hereby authorized and directed to determine whether it is desirable and in the City's best interest for the City to cause to be executed and delivered a second series of certificates of participation the interest on which would be subject to taxation under federal tax law to finance all or a portion of the California Avenue Parking Garage, either in lieu of or in addition to the tax-exempt series. If the City Manager or a designee appointed by any such officer determines that a second series should be executed and delivered, all references to the Certificates in this resolution shall refer to both series and the City Council hereby authorizes any necessary changes to the documents approved by this Resolution to reflect such second series.

4. The Council hereby authorizes and directs the competitive public sale of the Certificates. The Certificates shall be sold in accordance with the Official Notice of Sale in substantially the form on file with the City, together with any changes therein or additions thereto deemed advisable by an Authorized Officer. The Authorized Officers are hereby authorized and directed to accept the best bid for the sale of the Certificates, as determined in accordance with the Notice of Sale. Pursuant to Section 53692 of the Government Code, Jones Hall, as bond counsel, is hereby authorized and directed to cause a Notice of Intention, in form and substance acceptable to said firm, to be published in the manner required by applicable law.

The City Manager or a designee thereof (e.g. Administrative Services Director) is hereby authorized and directed, following consultation with the City's municipal advisor and bond counsel, to determine whether it is desirable and in the City's best interest for the City to sell the Certificates on a negotiated basis, to select an underwriter to purchase the Certificates and to negotiate a purchase contract with the underwriter. The Authorized Officers are hereby separately authorized and directed to execute a purchase agreement with the underwriter as long as the Certificates will meet the parameters set forth in Section 2.

5. Each Authorized Officer, the City Clerk and all other officials of the City are hereby authorized and directed to execute such other agreements, documents and certificates as may be necessary to effect the purposes of this resolution and the lease financing and refinancing herein authorized, and to revise the identity of the initial Leased Property as necessary in order to accomplish the purposes of this Resolution. Whenever in this resolution any officer of the City is authorized to execute or countersign any document or take any action, such execution, countersigning or action may be taken on behalf of such officer by any person designated by such officer to act on his or her behalf in the case such officer shall be absent or unavailable.

6. The City hereby approves the Preliminary Official Statement describing the Certificates, in the form on file with the Director of Administrative Services. The City's municipal advisor, PFM Financial Advisors LLC, is hereby authorized to distribute the Preliminary Official Statement in connection with the sale of the Certificates. An Authorized Officer is hereby

authorized and directed to (a) execute and deliver a certificate deeming the Preliminary Official Statement to be final as of its date within the meaning of Rule 15c2-12 of the Securities Exchange Act of 1934 and (b) approve any changes in or additions to cause such Preliminary Official Statement to be put in final form.

7. The Authorized Officers are separately authorized to approve corrections and additions to the Preliminary Official Statement by supplement or amendment thereto, or otherwise as appropriate, provided that any such corrections or additions shall be necessary to cause the information contained therein to conform with facts material to the Certificates, or to the proceedings of the City.

8. The Final Official Statement, when prepared, is approved for distribution by the purchaser of the Certificates in connection with the offering and sale of the Certificates.

9. The City hereby declares that it reasonably expects (i) to pay certain costs of acquiring and constructing the California Avenue Parking Garage prior to the date of execution and delivery of the Certificates, and (ii) to use a portion of the proceeds of the Certificates for reimbursement of expenditures related to the acquisition and construction of the California Avenue Parking Garage that are paid before the date of execution and delivery of the Certificates.

10. The Mayor, the City Manager and the Administrative Services Director are separately authorized and directed to cause the Preliminary Official Statement to be brought into the form of a final official statement (the "Final Official Statement") and to execute said Final Official Statement, dated as of the date of the sale of the Certificates, and the City Manager and Administrative Services Director are separately authorized and directed to execute a statement that the facts contained in the Final Official Statement, and any supplement or amendment thereto (which shall be deemed an original part thereof for the purpose of such statement) were, at the time of sale of the Certificates, true and correct in all material respects and that the Final Official Statement did not, on the date of sale of the Certificates, and does not, as of the date of delivery of the Certificates, contain any untrue statement of a material fact with respect to the City or omit to state material facts with respect to the City required to be stated where necessary to make any statement made therein not misleading in the light of the circumstances under which it was made. The Mayor, the City Manager or the Administrative Services Director shall take such further actions prior to the signing of the Final Official Statement as are deemed necessary or appropriate to verify the accuracy thereof.

11. The City hereby approves the selection of Jones Hall, A Professional Law Corporation, as bond counsel, Quint & Thimmig LLP, as disclosure counsel, and PFM Financial Advisors LLC, as financial advisor. Each Authorized Officer and other appropriate officials of the City are authorized to execute a professional services agreement with such firms in connection with the proposed financing, and the execution of such agreements on behalf of the City shall be conclusive evidence of such approval.

12. This resolution shall take effect immediately upon its adoption.

* * * * * *

INTRODUCED AND PASSED: October 15, 2018

AYES:

NOES:

ABSENT:

ABSTENTIONS:

ATTEST:

_____
City Clerk

APPROVED AS TO FORM:
Jones Hall,
A Professional Law Corporation

By: _____
Christopher K. Lynch,
Jones Hall, A Professional Law Corporation
Bond Counsel

APPROVED:

_____
Mayor

_____
City Manager

_____
Director of Public Works

Director of Administrative Services

_____
City Attorney

APPENDIX A

Government Code Section 5852.1 Disclosure

The following information consists of estimates that have been provided by the City's municipal advisor which has been represented by such party to have been provided in good faith:

(A) True Interest Cost of the Certificates: All Tax-Exempt - 3.8354% and 75% Tax-Exempt and 25% Taxable - 3.9698%

(B) Finance Charge of the Certificates (Sum of all fees/charges paid to third parties): All Tax-Exempt - $410,485 and 75% Tax-Exempt and 25% Taxable -$417,385

(C) Net Proceeds to be Received (net of finance charges, reserves and capitalized interest, if any): $39,500,000.00

(D) Total Payment Amount Through Maturity: All Tax-Exempt - $72,441,083 and 75% Tax-Exempt and 25% Taxable -$73,548,855

The foregoing estimates constitute good faith estimates only. They assume either one series of tax-exempt bonds or two series of Certificates are sold, one tax-exempt (75% of the principal amount) and one taxable (25% of the principal amount). The principal amount of the Certificates, the true interest cost of the Certificates, the finance charges thereof, the amount of proceeds received therefrom and total payment amount with respect thereto may differ from such good faith estimates due to (a) the actual date of the sale of the Certificates being different than the date assumed for purposes of such estimates, (b) the actual principal amount of Certificates sold being different from the estimated amount used for purposes of such estimates, (c) the actual amortization of the Certificates being different than the amortization assumed for purposes of such estimates, (d) the actual market interest rates at the time of sale of the Certificates being different than those estimated for purposes of such estimates, (e) other market conditions, or (f) alterations in the City's financing plan (including the mix of tax-exempt and taxable Certificates), or a combination of such factors. The actual date of sale of the Certificates and the actual principal amount of Certificates sold will be determined by the City based on the timing of the need for proceeds of the Certificates and other factors. The actual interest rates borne by the Certificates will depend on market interest rates at the time of sale thereof. The actual amortization of the Certificates will also depend, in part, on market interest rates at the time of sale thereof. Market interest rates are affected by economic and other factors beyond the control of the City.

CITY OF PALO ALTO

3

TO: **HONORABLE CITY COUNCIL**

FROM: **ED SHIKADA, ASSISTANT CITY MANAGER/UTILITIES GENERAL MANAGER**

DATE: **OCTOBER 16, 2018**

SUBJECT: **AGENDA ITEM 3 - UTILITIES ADVISORY COMMISSION RECOMMENDATION THAT THE FINANCE COMMITTEE RECOMMEND THAT THE CITY COUNCIL ADOPT A RESOLUTION APPROVING THE 2018 ELECTRIC INTEGRATED RESOURCE PLAN (EIRP), UPDATED RENEWABLE PORTFOLIO STANDARD PROCUREMENT PLAN AND ENFORCEMENT PROGRAM, AND RELATED DOCUMENTS**

This is an informational item to provide additional context for the discussion of the October 16, 2018 Finance Committee Agenda Item 3 (Utilities Advisory Commission Recommendation That the Finance Committee Recommend That the City Council Adopt a Resolution Approving the 2018 Electric Integrated Resource Plan (EIRP), Updated Renewable Portfolio Standard Procurement Plan and Enforcement Program, and Related Documents). The Utilities Advisory Commission's (UAC's) consideration of the EIRP and related documents occurred on October 3, 2018. The summary below of the UAC's discussion of this item, along with the attached excerpted minutes from that meeting, are provided in order to inform the Finance Committee's review and discussion of this material and ensure that Palo Alto can satisfy the statutory requirement to approve its 2018 EIRP by January 1, 2019.

COMMISSION REVIEW

On October 3, 2018, the UAC reviewed and discussed the full EIRP report and its appendices and related documents. Commissioners noted their appreciation for staff's work developing the EIRP and work plan. Commissioners also requested confirmation (which staff provided) that the EIRP lays out a series of future policy and strategic decisions that need to be made in the coming years, and that approval of the EIRP does not commit the City to any policy or strategic decisions. Commissioners made a point to note that the Western Base Resource hydroelectric contract is currently the lowest cost resource in the City's electric supply portfolio. And Commissioners emphasized the need to be realistic in our assumptions and goals (e.g., with

CITY OF
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respect to the rate of adoption of electric vehicles in the City by 2030) and to be forthright with the public (e.g., about our ability to supply our portfolio with carbon free electricity at all hours of the year).

Commissioners also asked for staff to provide periodic updates to the UAC on the new initiatives being undertaken through the work plan, and staff readily agreed to provide those. After this discussion, the UAC voted unanimously (6-0, Ballantine absent) to support the staff recommendation. Attach are the excerpted draft minutes of this meeting.

Ed Shikada
Assistant City Manager /
Utilities General Manager

CITY OF PALO ALTO

DRAFT

UTILITIES ADVISORY COMMISSION MEETING
EXCERPT OF MINUTES OF OCTOBER 3, 2018 REGULAR MEETING

UNFINISHED BUSINESS

ITEM 1: ACTION: Utilities Advisory Commission Recommendation that the Finance Committee Recommend that the City Council Adopt a Resolution to Approve the 2018 Electric Integrated Resource Plan (EIRP), Updated Renewable Portfolio Standard Procurement Plan and Enforcement Program, and Related Documents.

Jonathan Abendschein, Assistant Director of Resource Management, recalled that the Commission first heard staff's presentation in September. The Commission will have opportunities to discuss major strategic initiatives in the future.

Jim Stack, Senior Resource Planner, reported CPAU has been planning electric integrated resources (EIR) for many years, most recently under the framework of the Long-term Electric Acquisition Plan (LEAP), which was last updated in 2012. In 2015, SB 350 was passed and established new EIR planning requirements for large utilities like CPAU. SB 350 requires CPAU to submit an Electric Integrated Resource Plan (EIRP) to the California Energy Commission (CEC) every five years with the first one due in early 2019. SB 350 also established aggressive statewide targets related to renewables, greenhouse gas emissions, and energy efficiency. Staff is waiting for the CEC to establish regulations for the requirement to double energy efficiency levels by 2030. The CEC requires the completion of four standardized tables that will provide visibility into the actual details of supply and load forecasts to 2030. CPAU is also required to submit an updated version of its Renewable Portfolio Standards (RPS) Procurement Plan that reflects SB 350 changes to the renewables requirement. While CPAU is not required to submit an updated RPS Enforcement Program, staff updated the Enforcement Program and included it in the documentation. The EIRP details the state of the current (2018) supply portfolio, describes expectations for the 2030 portfolio, and discusses the major decisions to be made. The primary decision is whether to renew the Western Base Resource contract in 2025 for an additional 30-year period. The uncertainty around the decision is represented by the unknown carbon-neutral area of the 2025 portfolio. The EIRP does not discuss energy-efficiency program planning.

In response to Vice Chair Schwartz's query regarding whether staff was recommending elimination of the Western contract, Stack explained that the EIRP highlights the Western contract as an upcoming discussion. The EIRP's default scenario is contract renewal, but alternative options are explored in the EIRP.

Chair Danaher requested staff provide periodic updates on the process, contract issues, and analysis so that the Commission can be educated as the process moves forward.

Stack continued with the EIRP objective, strategies, and work plan. The EIRP objective is modeled after the Electric Utility's mission statement. The seven new initiatives listed in the work plan will be undertaken over the next few years. The California-Oregon Transmission Project (COTP) will return to the City's portfolio in 2024. Within the initiative for carbon accounting, staff is planning to address City communications with customers and the public regarding the portfolio's carbon content. CPAU could partner with external agencies such as Community Choice Aggregation (CCA) organizations.

Vice Chair Schwartz remarked that she could not imagine a partnership with a CCA that would benefit CPAU and questioned whether partnerships were specific to CCAs. Stack clarified that partnerships could include CCAs or other agencies. Staff could explore partnerships with CCAs for commodities trading or customer programs. Abendschein added that staff will look for opportunities to partner with CCAs.

Stack continued with next steps of presenting the EIRP and related documents to the Finance Committee and Council for review; submitting the required documents to the CEC early in 2019; and beginning work on the new initiatives listed in the work plan. Staff will provide periodic updates to the Commission regarding progress.

Commissioner Segal appreciated staff including communications to the community in the initiatives.

In reply to Commissioner Johnston's inquiry regarding the meaning of fully deliverable resources, Stack stated fully deliverable is not the same as dispatchable. Fully deliverable is a term used by the California Independent System Operator (CAISO) to describe resources that can be delivered reliably to customers during periods of high demand or congestion on the grid. Other resources can be counted as energy but not as capacity towards resource adequacy requirements; whereas, fully deliverable resources can be counted as capacity. In answer to Commissioner Johnston's question regarding the percentage of current supplies designated as fully deliverable, Stack advised that all resources with the exception of two solar projects are designated as fully deliverable. Staff is working with the developer to have the two solar projects qualified as fully deliverable. Commissioner Johnston commented that the supply chart shows the average cost is 5.9¢ per kilowatt hour (kWh) across the portfolio. The only resource below the average is the Western contract. Removing the Western contract from the portfolio will have a big impact on the overall cost. The EIRP does not detail portfolio rebalancing and replacing existing resources with resources that more closely match load. Staff will work on making the Western contract more favorable while concurrently identifying resources to replace the Western contract. Stack recalled that staff analyzed portfolio rebalancing earlier in the year and discussed the analysis with the UAC in more detail than was presented in the EIRP. Staff felt the analysis was not what the CEC wanted in the EIRP and did not include it.

Vice Chair Schwartz did not feel a goal of 90% adoption of electric vehicles (EV) was realistic as CPAU cannot control residents' behavior. Ed Shikada, Utilities General Manager, explained that the target came from the Sustainability and Climate Action Plan (S/CAP) and agreed to characterize it as an aspirational goal. Staff's efforts will focus on facilitating market adoption of EVs. Vice Chair Schwartz believed that the cost of incentives would be enormous. Chair Danaher noted the projection for the cost of EVs to decrease by 2025. Vice Chair Schwartz stated the goal is unrealistic even if EV costs decrease. If EV adoption is part of the plan, then staff has to include incentives or set a realistic goal. Chair Danaher clarified that the goal does not indicate whether adoption of EVs pertains to new cars or the City fleet. Charging networks are one component of a plan to incentivize EV adoption. Abendschein advised that the list of goals was taken from other City documents. When the S/CAP returns for discussion, the Commission can discuss the goal of 90% adoption of EVs. Stack added that the EIRP assumes 40% of residential customers will adopt EVs. Chair Danaher commented that 40% was the percentage of new electric and hybrid vehicles in Palo Alto. Schwartz expressed that a goal of 40% is ambitious without providing incentives.

In answer to Vice Chair Schwartz's query regarding whether the power supply charts reflect actual purchases, Stack responded no, the charts reflect net purchases, not gross purchases. Vice Chair Schwartz felt the 2018 chart is misleading in that it reflects no thermal purchases. Stack advised that the carbon accounting discussion would include the question of how to accurately reflect purchases. Vice Chair Schwartz suggested the EIRP include a discussion of time-varying rates enabled by advanced metering infrastructure (AMI) because AMI can provide price signals to incentivize desired behaviors, which would justify the Finance Committee's support for investing in AMI. Stack reported a discussion of time-varying rates is included in the Distributed Energy Resources (DER) Plan. Abendschein added that the EIRP pertains

to supply. The distributed resources needed to substitute for electric supply are acknowledged in the EIRP, but the details are in the DER Plan. Vice Chair Schwartz was referring to varying rates as providing incentives for people to use less energy. A large portion of the population needs a financial reason to use electricity at specific times. In reply to Vice Chair Schwartz's inquiry regarding the percentage of the population participating in the Residential Energy Assistance Program (REAP), Abendschein answered a fairly low percentage. He could provide the exact percentage at a later time.

Vice Chair Schwartz suggested CPAU offers electricity at lower rates than PG&E because 40% of PG&E customers participate in PG&E's care plan. She wanted to know the resources that could replace Western hydroelectric power. She wanted staff to explain fully and realistically the idea of carbon-neutral resources so that the City Council and the public can understand the need for investment.

In response to Commissioner Forssell's suggestion that the EIRP essentially provides a strategy to answer a set of specified questions, Abendschein concurred that the EIRP is a problem statement, an acknowledgement of the strategic questions for staff to focus on in the next several years. In reply to Commissioner Forssell's question of whether the Western contract projections are placeholders for carbon-neutral energy to be determined rather than a commitment to continue the contract, Stack replied that the projections are placeholders rather than a commitment. The default scenario assumes the continuation of the Western contract. Commissioner Forssell commended staff for identifying key issues and questions and ways to think about them.

Chair Danaher related that the EIRP content is meant to comply with regulatory requirements and to identify areas of future work. At some point, staff should integrate some of the issues with the Commission's calendar. Chair Danaher acknowledged Vice Chair Schwartz's point about staff tracking and reporting fossil fuel purchases.

ACTION: Vice Chair Schwartz moved that the Utilities Advisory Commission (1) finds that the 2018 EIRP report is not a project as defined in Public Resources Code 21065 and, therefore, California Environmental Quality Act (CEQA) review is not required and (2) recommends that the Finance Committee recommend that the City Council adopt a Resolution to approve the 2018 Electric Integrated Resource Plan (EIRP), Updated Renewable Portfolio Standard Procurement Plan and Enforcement Program, and related documents. Commissioner Johnston seconded the motion. The motion carried 6-0 with Chair Danaher, Vice Chair Schwartz, and Commissioners Forssell, Johnston, Segal, and Trumbull voting yes, and Commissioner Ballantine absent.

Rail Committee – October 17, 2018 – David Shen, North Old Palo Alto group, CAP member

Distinguished Rail Committee and Staff,

I am Dave Shen, representing the North Old Palo Alto group and a member of the CAP.

A few comments at this juncture:

As we move into discussion about South PA, I'd like to reaffirm some points in support of the residents of South PA.

Lowered rail is the preferred option and a short trench for both Meadow and Charleston would be most acceptable for a variety of reasons, especially for those whose backyards border on the tracks. Raising the rail for any reason would not be a pleasant nor acceptable prospect.

I would like to emphasize that getting to a resolution on whether a 2% grade were possible or not is critical in determining the short trench's full viability. Whatever we can do to expedite this decision would be a good thing.

As we look across Palo Alto at traffic as a system, it is also critical that we perform traffic studies properly and to dispel any further use of old, outdated data in support of one option or another. I am disheartened to sit in these meetings to hear others throw out data in support of one idea or another but knowing the source it has been taken out of context or of questionable validity for the topic. Naive listeners will naively trust the data presented without knowing the details. Can we do better in this era of fake news and fake data?

As we look further into traffic studies, I advocate strongly for additional studies that include solutions. In our discussions with Josh Mello, former chief transportation officer, he had some very interesting options for the reconstruction of the Embarcadero underpass which would substantially improve traffic flow as well as reduce it through surrounding neighborhoods. I do not want to see these options forgotten in our analyses. I would also like to advocate caution as we present the first traffic study results which will be without solutions. When we present them, I would like to see us remind the viewers that this is part of the initial development process and that solutions are still being explored.

Lastly, I advocate for doing whatever we can to speed up. I know this is a tough thing to say in the face of resources but Caltrain development is not slowing down and it is likely that we will experience a time when our construction timeline is simply not going to match up with their timelines. I for one would like to see the construction period be minimized as much as possible. Sparing the residents even one less month of traffic and safety hell would be a win in my book.

Thank you.

CITY OF PALO ALTO
OFFICE OF THE CITY MANAGER
250 Hamilton Avenue, 7th Floor
Palo Alto, CA 94301
650.329.2392

Rail
~~COUNCIL~~ MEETING
10/17/18
[ ] Placed Before Meeting
[x] Received at Meeting

Caltrain
1250 San Carlos Ave
San Carlos

DRAFT

City of Palo Alto staff, community, and elected officials are actively working to identify a preferred solution for our four at grade crossings. While we are making progress there are several recurring technical questions that we need answered by Caltrain for the City and community to be able to evaluate the feasibility of alternatives under consideration. The questions are generally: what are the economic, engineering, and regulatory constraints that impact our grade separation options? We need clarity about current constraints, and how and where Caltrain might be flexible with design criteria exceptions? Specifically, the questions City staff, community and consulting team have are as follows:

1. Under what conditions would Caltrain accept a grade variance from 1% to 2% grade, and what would the approval process be?
2. Under what conditions would Caltrain accept a variance to the existing vertical clearance for poles and wires, and what would the approval process be?
3. How are grade separation design criteria and constraints likely to change in the future?
4. What should the City of Palo Alto assume regarding freight on the Caltrain right of way in the future?
5. What is Caltrain's position on a shoofly (temporary routing around construction sites), and criteria that would be an important in the City's evaluation of alternatives (e.g. trench for East Meadow Ave and Charleston Road alternative)

The City of Palo Alto appreciates your attention to these questions and looks forward to receiving answers and clarification to these questions, so that we can effectively and efficiently proceed with our community focused effort to define a preferred solution for our four at grade crossings.

Thank you,

Good morning, I'm Lee Langhammer Law, and I've been a PA resident for 30+ years. I'm here today to voice my support for the shallow trench or any lowered rail option for the Charleston/Meadow crossings and to staunchly oppose any and all raised rail options.

The decision made on this issue will irrevocably alter the city and its quality of life for decades. If we truly embrace being green, being innovative, and being a pedestrian/bicyclist/family-friendly community, then we have to make sure our solutions match these values.

To date nearly 600 of us have already gone on record to support lowered rail; countless others have done the same on Nextdoor and other media -- PLEASE LISTEN & HEED THIS CALL. These same numbers have strongly OPPOSED raised rail options that are completely out of scale for residential neighborhoods.

Many of us have seen the pretty pictures of raised rail being circulated showing dreamy, idealistic scenes of the space beneath the massive cement structures they require. But no pictures have shown up reflecting the trash, weeds, graffiti, beer bottles, shopping carts, tents, and other even worse elements that typically take over these spaces as they have in SF and Oakland. Why would PA be any different?
[What guarantees would PA get about what happens to such space and the safeguards we'd need to protect property values?]

I'm asking you to please take action right now, this week --

- To obtain Caltrain's approval of a 2% grade and an 18.5 ft clearance enabling forward movement on desired solutions
- To restore the tunnel/trench option for South PA and approve its detailed analysis
- To consolidate the raised rail options to just one for study

Thank you very much for all your hard work and for your deliberation.

Council, City

From: pol1@rosenblums.us
Sent: Saturday, October 13, 2018 2:45 PM
To: Council, City
Subject: Rail Committee Agenda Item 1 October 17th 2018

Members of the Rail Committee:
I have long been an advocate for the city wide tunnel option because I believe it offers the best outcome for the long term future of Palo Alto. There would be complete east west connectivity with the railroad right of way no longer blocking views or minimizing the number of cross connections. I do not accept the position that any option for grade separation that does not make the situation worse is acceptable, For a community with our values and wealth it should be possible to come up with a more fitting solution such as Berkeley was able to do with their BART tunnel. Financing is the main issue and needs to be looked at seriously with all options on the table. This has not been done. I outright reject any option that allows the rail bed to rise above ground level as this requires the construction of a long dirt wall which would further separate the east and west sides of our city with an even more visually imposing physical barrier with NO likelihood of improved east-west connectivity.
For this reason, I urge you all to put the alternative of rail on raised pylons (viaduct) as one of the alternatives on our list. To me it is the second best alternative to a bored tunnel as it allows full east-west connectivity, allowing passage under the tracks as deemed suitable by future traffic studies and our Comprehensive Plan. The area under the tracks could become a green space or developed commercially.
As has been pointed out many times by Nadia Naik in the past and Council Member Wolbach recently, we need to do some serious investigation into the issue of freight traffic on the right of way. This has extremely serious cost and noise issues associated with any chosen solutions. If it were possible to buy out the freight option, this might offer a very cost effective solution.

Stephen Rosenblum
Santa Rita Ave, Palo Alto

Council, City

From: gmahany@aol.com
Sent: Monday, October 15, 2018 9:25 AM
To: Council, City
Subject: rail noise mitigation
Attachments: RAIL SYSTEM NOISE AND VIBRATION CONTROL.pdf; IPOL-TRAN_ET(2012)474533_EN-one.pdf

Hello Rail Committee
Please find attached the some information on how noise from railroad trains and tracks are generated and how to muffle that noise.

RAIL SYSTEM NOISE AND VIBRATION CONTROL

George Paul Wilson

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Abstract

Control of noise and vibration emitted by steel wheel and rail transportation systems has a long history of designs and techniques, some of which were dismal failures and some which worked very well. Many of the early efforts had a valid technical base for the design, however, there were also many based on intuition or ideas with great expectations, but which had no real technical basis. In the last four decades the technology and materials used for rail noise and vibration control, particularly for the control of groundborne vibration from rail systems, has developed and benefited from thoughtful technical analyses and application of simple engineering principles. These also were not always successful in all respects but provided for a continuing development of the technology with ever-improving success and performance. Included in this presentation are a review of the development of rail noise and vibration control systems, including the lightweight, undamped concrete floating slab track for reduction of groundborne noise and vibration, and of the development of structurally integrated sound barriers with absorption materials for control of airborne sound. The presentation includes anecdotes and discussion of some of the unexpected results from new design installations, an outline of design progress and application extensions, and review of the concepts and designs which are successful and currently in use by rail systems located in many different parts of the world.

Introduction

There has been impressive progress over the last 40 years in the development of rail system noise and vibration control technology and designs. Design criteria for rail system noise and vibration were once either not considered or treated as a secondary item but the importance as a major design parameter is now recognized by new system designers. Sometimes there is still resistance to incorporation of non-revenue producing features in the rail system design, but as each new generation of project managers and designers become educated, there is acceptance of the need for incorporation of noise and vibration control in the overall system design.

In the mid-60's when I began work with assessment and control of noise and vibration from rail systems there were three new rail transit systems in design development: the San Francisco Bay Area Rapid Transit District, BART; the National Capital Transportation Agency, now the Washington, D.C. Metro; WMATA, and the Baltimore Region Rapid Transit District, BRRT. These were the first major new rail transit facilities that had been considered in the United States since the 1930's. In Toronto, Canada the TTC Yonge Subway was opened in 1954 and was the first subway to be built in North America since the beginning of WWII. This was the first North American system to use resilient rail fixation on concrete. Extensions were opened in the period from 1963-1968 and with 34 kilometers total it became the catalyst for resurgence of rail or fixed-guideway transit on the North American continent.

Because of the negative image created in the U.S. by the very noisy steel elevated structures in Chicago and New York, new transit system planners did have concerns about noise and vibration. As a result, studies and surveys were commissioned to develop information which could be used to set new facility design criteria. One of these surveys completed for the Washington, D.C. Metro, by the Office of Research and Experiment, ORE, of the International Railway Union, UIC, asked ORE members to rank order operational problems. The result was almost universal ranking of (1) vandalism and (2) noise and vibration as the two top priority problems.

Partly as a result of the survey, but also because of the general concern regarding patron exposure to noise and vibration and the effects on adjacent communities, a large number of measurement programs and research studies were completed in the 1960's and '70's. One survey by ORE published in 1981 listed 192 separate reports produced or published during the period from about 1965 to 1979 on various aspects of rail system noise and vibration, including standards or regulations and exposure or annoyance assessment.

The studies and experiments with rail system noise and vibration included a number of trial installations of resilient rail fixation designs and floating slab track for reduction of the ground and structure-borne noise. Examples include the Paris Metro in coordination with the Regional Express Line, RER, and the French National Railway, SNCF, installing a number of test tracks with of various rail fastener designs and floating track slab. German railways also were experimenting with resilient rail fixation on concrete. In Vienna, floating track slabs supported on continuous glass fiber panels were installed in an effort to reduce groundborne noise from streetcar lines. In Toronto several trial installations of floating slab track using polystyrene foam boards as the isolation media were installed. The Paris Metro installations provided valuable information on

performance of various resilient track fixation systems. The continuously supported track slabs in Vienna and Toronto were not successful.

Much of the concern relative to noise and vibration in new rail systems was with respect to the in-vehicle noise and ride quality. These were perceived as affecting the attractiveness of public transit to the patrons and, therefore, directly related to revenue. This made in-vehicle noise and ride quality very important design parameters. Thus, many of the early studies were confined to in-vehicle noise and vibration assessments, development of appropriate criteria and development of procedures for improving the design of vehicles, waystructures and track to control the vehicle interior noise and ride quality. Similar importance was placed on control of noise in new station facilities, resulting in application of acoustical absorption materials both to control noise in the stations and to improve intelligibility of public address systems.

The technology and design procedures for control of in-vehicle noise and ride quality had a long history of development prior to the startup of the new system designs in the 1960's and 70's. This background coupled with the results of the various interior noise and ride quality studies commissioned by the new systems for identifying the best practices resulted in a relatively well defined set of criteria, design procedures, technology and materials for control of car interior noise and ride quality. Control of noise and reverberation in stations was also studied and then included on architectural design.

However, rail fixation technology was relatively poorly developed and, in many cases, traditional ballast and sleeper track or wood sleepers cast-in-concrete were still considered the primary design choice because of the long experience and known characteristics. There was limited experience with ballastless resilient rail fixation and floating slab track so these were considered unproved technology, viewed with caution and required both persuasion and demonstration of their potential to induce adoption.

The many studies which showed potential benefit to noise and vibration control, and which demonstrated operational safety and potential for reduced maintenance costs did result in adoption of resilient rail fixation. Further development followed including the light weight undamped floating slab concept. This presentation is a review of the designs developed and implemented for reduction of ground and structure-borne noise from the rail systems and the control of wayside airborne noise from surface and viaduct guideways.

Following the initial successes with the then new rail fixation technology, the work on development of improved and more effective noise and vibration control technology for the rail systems continued throughout the 1980's and 90's. In some cases this was a continuing effort to reduce costs and/or improve performance. However, it was also due to the imposition of more and more restrictive wayside noise and vibration requirements. Generally the same car interior noise and station platform noise criteria as were developed early on continue to be used. But as more and more cities or jurisdictions adopted restrictive environmental controls it has become an increasing requirement that new rail transit systems provide extensive vibration and noise control. One of the most graphic examples is the requirement for very low wayside noise and vibration by the Hong Kong Environmental Protection Department, EPD, as part of its overall program to reduce future outdoor noise levels in one of the noisiest cities in the world.

Track Fixation Developments

In evaluating and developing new or existing technology regarding the noise and vibration generated, it is extremely important that all aspects contributing to the noise and vibration be considered. There are numerous instances in the literature presenting glowing results which were in fact due to change of two or multiple parameters rather than the item being studied or evaluated. For example, considering the wayside noise from trains operating on at-grade or viaduct guideway, the principle noise sources are the propulsion system, including the motors and gearing, the wheel/rail system and auxiliary equipment such as air conditioners. At higher speeds, the propulsion system noise usually predominates, unless the wheels and rail are in poor condition. At medium speeds the wheel/rail noise usually predominates, but may be affected by auxiliary equipment noise. At low speeds or stopped, the auxiliary equipment noise dominates. Application of mechanical service brakes can also result in dominant noise. Thus, all of these factors must be considered when assessing the wayside noise.

Factors which affect the structure-radiated noise from a viaduct or the groundborne noise and vibration from at-grade and subway installations are primarily the guideway deck and girder construction, the rail fixation system and the dynamics of the vehicle bogie, principally the unsprung weight and the primary suspension resonance frequency. In several instances a change in the bogie dynamics resulted in erroneous evaluation of the effect of rail fastener changes which were being evaluated because the bogie dynamics change created a larger more dominant effect. Evaluation of the rail fastener performance without knowledge or recognition of the bogie change resulted in erroneous conclusions.

The high ranking of noise and vibration as an operational problem did result in the three new U.S. systems and the Toronto system commissioning studies intended to extend the existing knowledge and develop new technology for reduction of ground and structure-borne noise and vibration. The objectives of the studies included developing appropriate acceptability criteria. Feasibility and installation costs were also items of substantial concern.

One of the significant factors at the time was the success of the TTC system introducing resilient direct

fixation in place of the conventional ballast and sleeper track or wood sleepers cast in concrete as used in subways built in the 1920's and 30's. The original motivation for the TTC introduction of resilient direct fixation rail fastener on concrete trackbed was to increase durability and life of the rail installation. The improvement in noise and vibration performance was an unexpected benefit.

In addition to the studies and research projects commissioned by the three U.S. projects, the Paris Metro extensive research program on direct fixation rail fasteners, resiliently supported ties (STEDEF system) and floating track slab as a means for reduction of wayside noise and vibration from subways provided valuable data and insights. Paris Metro also had a parallel program of refurbishing old subway lines via changing from steel wheels to pneumatic rubber tires as a means to improve the overall noise and vibration performance and other operational aspects. Although marketed in other countries as a quiet system, the pneumatic rubber tire system was never adopted by Paris Metro as a feature for new installations, and was used only for renovation of older subways.

One of the studies initiated by the BRRT was an evaluation of pneumatic rubber tire systems compared to steel wheel and rail to determine whether or not there was sufficient noise and vibration benefit to justify adoption of pneumatic rubber tire rather than steel wheel technology. The evaluation included the Transit Expressway vehicles on a test track in Pittsburgh, Pennsylvania and the Paris Metro rubber tired lines. The result of the study was the finding that, when compared on an equal train speed and equal passenger carrying capacity, the rubber tire system created the same or greater noise levels in the vehicle and at the wayside for surface guideways. The only benefit was reduced groundborne vibration and noise. It was concluded that in fact well maintained steel wheel and rail systems were potentially quieter with regard to airborne noise than can be expected for a pneumatic rubber tire system for equal operating conditions.

Much of the early work on development of rail fixation methods which would reduce the noise and vibration compared to either standard ballast and tie track or wood sleepers embedded in concrete, as used for most systems installed prior to the 1960's, was concentrated on the development of resilient rail fixation fasteners (baseplates). As part of its technology development program, the San Francisco BART system during the design development period constructed a test track and obtained three "laboratory" cars for assessment of various aspects of the transit technology, including noise and vibration. The test track included ballast and tie and viaduct with concrete girders and decks.

Figure 1 presents drawings of the three basic types of resilient rail fasteners used for fixing the rail directly to concrete roadbed with a low profile device: (1) the unbonded elastomer pad under a flat rail baseplate, (2) the bonded assembly with flat top and bottom plates and (3) the elliptical shaped bonded fastener with elastomer in shear rather than compression. The first type with unbonded flat elastomer was the type used in Toronto, and was the type investigated during the Paris Metro testing. Early experience showed the need for steel springs at the anchor bolts to prevent fatigue failure of the bolts. To eliminate the need for anchor bolt springs, the bonded fastener configuration evolved and a number of this type were included in the BART test track evaluations. There were many versions of the unbonded and bonded types of rail fasteners that were developed and which were evaluated for noise and vibration characteristics, both wayside noise and structure-borne noise. Figure 2 is a photograph showing the experimental setup for measuring wayside noise and ground vibration at the BART test track in 1966.

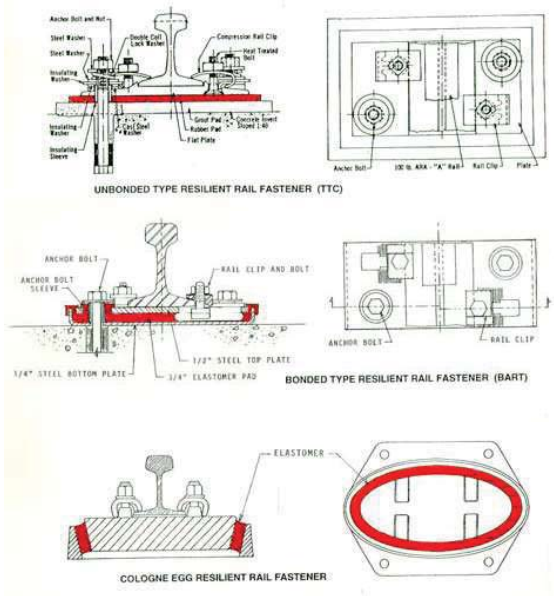

Figure 1 Three basic types of resilient direct fixation rail fasteners, unbonded, bonded and Cologne Egg

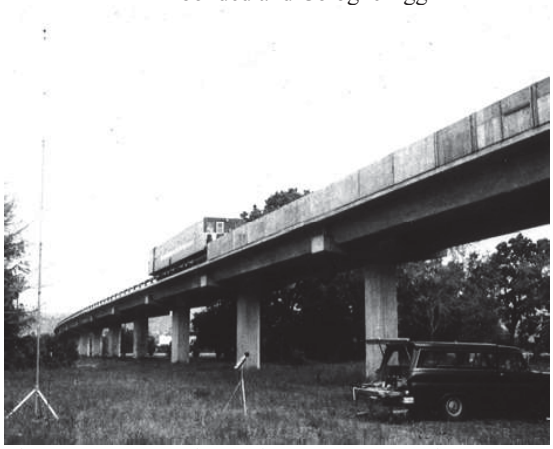

Figure 2 Photo of BART Test Track concrete viaduct and trial sound barrier wall

The requirements for rail support safety and durability resulted in rejection of many configurations developed by various manufacturers. Many candidates that had promising noise and vibration performance failed the 3 or 5 million cycle alternating vertical and lateral load test imposed. Also, providing for limited lateral rail deflection reduced the vibration and noise control effectiveness, eliminating further submissions.

In addition to resilient rail fastenings, resilient wheels of various types have been one of the features considered for transit vehicles for reduction of noise and vibration. Figure 3 shows the main types of resilient wheels which have been considered and which were included in the testing at the BART test track. Note that the PCC type wheel is a super-resilient design which has been used since the 1930's on streetcars for general noise reduction, particularly reduction of wheel squeal noise. This was particularly important with streetcars because of the short radius curves. With modern rail transit systems, limiting the minimum radius to about 200-250 m avoids wheel squeal. Thus, there is little benefit from use of resilient wheels on heavy rail transit. In general, while there have been experimental installations, all of the modern rail transit systems use solid steel wheels or non-resilient aluminum centered wheels with steel tires. For heavy rail transit systems with shorter radius curves the wheel squeal is generally controlled using ring-dampers on the wheels rather than resilient wheels. In contrast, most modern light rail systems do have resilient wheels, not the PCC super-resilient type, but a resilient insert type such as the Bochum wheel.

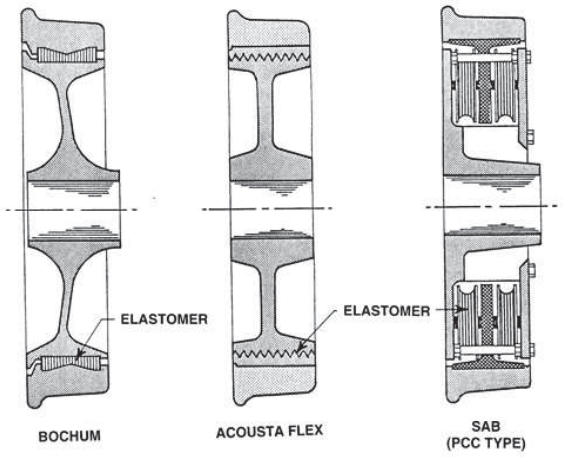

Figure 3 Three types of resilient wheels tested for application to rail transit

Because resilient wheels were one of the parameters being tested via the "laboratory" cars at the BART test track, many of the initial tests on the effectiveness of different types of resilient rail fasteners were inconclusive and in fact incorrect. This occurred because the particular laboratory vehicle used for all of the initial rail fastener tests at the concrete aerial structure was equipped at the time with the SAB (PCC) type resilient wheels. This wheel had resilience that was far greater than that of any of the rail fasteners, resulting in the measurements showing essentially no difference regardless of the stiffness or other characteristics of the rail fastener. The result of this evaluation was selection of a relatively stiff resilient fastener, about 75 kN/mm for the BART viaduct and subway installations. When later tests with standard steel wheels revealed the error in the early conclusions, the result was identification that a rail fastener stiffness in the range of 17 to 22 kN/mm was about the optimum compromise between maintenance of rail stability and minimizing structure-borne noise radiated from viaduct or transmitted from subways.

At the BART system concrete viaducts, the stiff fastener did result in some low frequency noise radiated from the structure but it was barely audible and did not increase the total A-weighted wayside noise level from the trains. Systems constructed later have used the softer fasteners with the result that there is lower radiation of noise from the viaduct structures and use of sound barrier walls is more effective in controlling wayside noise.

Figure 4 BART concrete viaduct with sound barrier wall

Most of the noise control provisions of the initial 112 kilometer BART system were concentrated on control of noise at the vehicle via specified maximum noise levels for the propulsion system and auxiliary equipment and because wayside noise was not considered an important parameter beyond the provisions of continuous welded

rail and concrete aerial structure. There was only one small section of sound barrier wall. Figure 4 is a photo showing the sound barrier wall applied to the BART viaduct, a modification which resulted in about 6 dBA reduction of wayside noise.

The Metropolitan Atlanta Rapid Transit, MARTA, system followed the design of the three earlier U.S. systems and as a result incorporated more of the provisions for control of noise and vibration. Figure 5 is a photo of a MARTA steel girder and concrete deck aerial structure on which the softer variety of rail fasteners and the sound barrier wall were used extensively to reduce wayside noise from the viaducts. In this case, because the design requirements for safety walks on the outside edges of the viaduct deck made the deck much wider with resulting increased noise radiation, it was essential that the softer direct fixation fasteners be used in order to allow sound barrier walls to produce the expected noise reduction. Without the softer version of the rail fastener, the structural radiation from the MARTA aerial structure would have been a dominant source of noise. Constrained layer damping was used on the steel girders to give approximately the same noise radiation as for concrete girders along noise sensitive sections of trackway, including all sections with sound barrier wall. At locations where the viaduct girders do not have the constrained layer damping, there is significant noise radiation from the steel girders. The MARTA sound barriers provided 8-9 dBA reduction of wayside noise.

Figure 5 MARTA double track concrete deck with damped steel girder and sound barrier wall

There has been continuing development of new configurations and versions of the resilient rail fasteners. The major variation from the flat plate rail fasteners, as shown on Figure 1, was the introduction in about 1979 of the elliptical-shaped "Cologne Egg" fastener which places the elastomer in shear for vertical load and compression for lateral loads. This allows for a much softer rail support while maintaining the rail stability required for safe operation of the rail vehicles. The Cologne Egg type fasteners can have a vertical stiffness in the range of 9 to 13 kN/mm, which is of significant benefit in reducing structure-borne radiation from viaduct structures with steel girder and in reduction of groundborne vibration and noise from subway or at-grade rail installations.

The basic limitations on rail support lateral stiffness and/or rail lateral deflections limit the lower range of stiffness which can be achieved with the flat plate type of rail fastener, either the bonded or non-bonded configuration. Thus, there is a practical limit to the reduction of groundborne noise and vibration from at-grade and subway installations of flat plate type of rail fasteners. As it turns out, the minimum practical stiffness results in groundborne vibration and noise similar to that resulting from ballast and tie track. Because of the characteristics of the Cologne Egg type fastener, the result is a reduction by 6 to 8 dB of the groundborne vibration and noise for frequencies above about 40 Hz. In many cases, this is sufficient to achieve satisfactory results, particularly for new rail facilities placed adjacent to non-noise-sensitive land uses.

An alternative design which also provides about 6-8 dB greater reduction of groundborne noise for frequencies above about 40-50 Hz is the resiliently supported or booted double tie. This is the STEDEF design which was included in the early Paris Metro studies and has been used at some locations where the additional reduction was considered adequate, particularly before the Cologne Egg gained acceptance. The resilient double tie system, now called Low Vibration Track, is not low profile, requiring a second pour of concrete to embed the ties, but does have the advantage of reduced radiation of airborne noise from the rail because of the stiff fixation to the concrete tie mass.

Floating Slab Track

There are may instances where the control of ground and structure-borne noise levels achieved by resilient rail fasteners, or the alternative Cologne Egg or Low Vibration Track, are not low enough for satisfactory or acceptable results. Adjacent land uses which are noise sensitive, such as residential, school or performing arts facilities, and in some cases even commercial facilities such as office or court buildings may require a higher degree of noise reduction. In these instances the practical alternative is a fully vibration isolated or floating track slab design.

As a part of the noise and vibration assessments performed for the new U.S. transit systems, measurements were made of the groundborne noise and vibration at various locations in buildings near the existing subways in Toronto and at other existing transit systems such as those in Philadelphia and Chicago. Further, information from the Paris Metro and other studies in the literature were used along with the measurement results to develop a basis for projecting the

expected groundborne noise at locations along the Washington, D.C. Metro routes to determine whether or not mitigation was needed. This same procedure was used for subsequent evaluations and projections with a continuing growth of the database as new systems went into operation providing opportunities for additional measurements.

The initial assessments indicated several locations along the WMATA route where mitigation beyond that which could be provided with resilient rail fasteners was necessary. Initially, the planners and consultants for the system thought that a floating slab track type of mitigation would be needed at stations, but not in other locations. An objective analysis showed that there were many locations requiring added mitigation but only a few instances where track through stations needed the mitigation.

Identifying the need for mitigation at the WMATA system subways motivated the development of the initial light weight loading slab configuration. There had previously been a successful floating slab type of installation at the Barbican Scheme site in the City of London where residential development, an Arts Center and several buildings sensitive to noise were located close to an underground railway. When the railway was realigned, a slab bridge deck type of design was developed, a design which required substantial increase in depth of the subway tunnel, along with the installation of a complex system of crossbeams on rubber bearings under the ends of 10 m length concrete bridge decks with a damping layer and ballasted track on top. The design incorporated lateral bearings for lateral restraint without reduction of the isolation affect. The stiffness of the natural rubber bearings was tuned to about 6 Hz, considering the mass of the bridge deck and the ballasted track. A similar system was installed some years lateral on the London Heathrow transit line. This type of design was very complex and expensive so that there was strong motivation to develop an alternative design which would be effective and of much lower cost, including minimum depth to minimize additional cost in excavating the subway tunnel.

One of the factors which had discouraged prior development of a light weight floating track slab system was the perception that damping was needed to prevent amplification of the wheel/rail interface vibration forces at the natural frequency of the floating slab on the resilient bearings. The Barbican and Heathrow slabs had heavy damping layers in addition to the ballast to accomplish damping of the floating track assembly.

After an analysis of the type of forces applied by a moving rail vehicle to the trackbed and the supporting structure, it was identified that the forces are random impact-like forces and moving or non-stationary relative to the support system. Therefore, it was concluded that the response would be more similar to the response of a spring mass system to an impulse or impact force than that due to steady-state excitation, which is the more familiar type of analysis. This conclusion led to the estimate of 2 to 3 dB amplification factor for a lightly damped floating slab track system rather than the 15 to 20 dB amplification that would be expected for steady-state excitation of the same system.

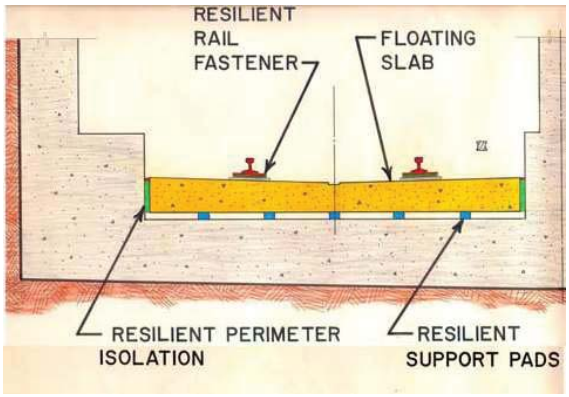

Figure 6 Cross-section of continuous floating slab design developed for WMATA

Figure 6 presents a cross-section of the light weight floating slab design developed from the analysis which indicated that the moving random excitation would create the effect of a damped single-degree-of-freedom system. For the WMATA system continuous cast-in-place floating slabs using a sheet metal form or shutter left in place were constructed. Stationary steady-state tests of an initial installation did indicate an amplification factor of 15 to 17 dB at the design resonance frequency, but that for frequencies of concern in the groundborne noise there was substantial reduction.

This design did achieve the goal of low profile while retaining enough mass to achieve the 15 to 20 dB of groundborne noise reduction needed at some locations. The added depth for box-section tunnels was small, 300 mm, and the design was adaptable to round tunnels without increasing the tunnel diameter.

A significant part of the development of the design was the determination of the appropriate elastomer for the floating slab. To this end there were several requirements that limited the design. One was an imposed limit of 3 mm for rail deflection. Another was a limit of 300 mm for the total depth of the slab and resilient pads, at least for the initial installations. A third limit was the need to have natural frequency low enough to provide the groundborne noise reduction required and low enough to avoid interaction with the vehicle bogie primarily resonance frequency. These requirements taken together indicated that natural rubber was the best selection for the elastomer. With natural rubber the ratio of dynamic-to-static stiffness is the minimum, allowing for a ratio less than 1.4. Most synthetic elastomers, including Neoprene, have a ratio of 2.0 to 2.5, resulting in substantially greater rail deflection for a given resonance frequency. Natural rubber was also known and demonstrated to have a long service life and can be

formulated to have very low creep under compressive load.

Through correspondence in 1972 with the Malaysian Rubber Bureau in the U.K., a formulation specifically tailored for floating slab track was developed and has subsequently been used as the specified elastomer with great success. Some of the earliest installations have been in service for nearly 30 years and show no signs of deterioration or change in mechanical properties. There are many older installations of natural rubber bearings used for vibration isolation applications or other purposes which demonstrate the expectation of very long life. One of the oldest is the Victorian Railway's viaduct between the Flinders Street and Spencer Street Stations in Melbourne where the installation completed in 1891 is still in service. The rubber isolation pads between the viaduct structure and the supporting piers are still in excellent condition and functioning to minimize vibration transmitted from the trains to the stone and brick piers.

With the selection of elastomer, the design of the WMATA floating slabs was determined, including the decision to cast-in-situ continuous slabs with pinned moment connections between individual sections as the concrete was poured. While these floating slabs were successful in reducing the groundborne noise and vibration, they also radiated airborne noise due to bending waves in the continuous slabs. For standard track the low frequency radiated noise was a barely noticeable addition to the noise generated by the train propulsion equipment. However, at special trackwork, the noise was thunderous, audible in the cars and at station platforms where a crossover was located near the station. The main problem encountered was that for some sections the contractors were allowed to substitute polyurethane elastomer pads for the natural rubber pads. The polyurethane pads turned out to be hydroscopic and lost their mechanical stiffness when exposed to water. The failed pads had to be replaced, a process which was difficult and expensive due to the continuous poured-in-place slab configuration.

In 1974 the TTC opened a new Yonge Street Extension with only the resilient rail fasteners for mitigation. This line went further into residential areas than previous lines and resulted in a huge amount of complaints about groundborne noise and vibration. This led to extensive research and development programs both to improve the existing new line and to identify better mitigation for future new subway lines. One of the TTC track engineers proposed precast concrete sections as a lower cost alternative to the continuous floating slab. The configuration proposed also provided for access and easy replacement of the isolation pads. With revisions to optimize the acoustical performance, the design was developed into what is known as the double-tie or discontinuous floating slab track.

Figure 7 is a plan view showing the typical 1.5 m length segments for the floating slab. The side pads and end pads provide for complete isolation with mechanical retention and to accommodate lateral loadings. Figure 8 is a photo of the double-tie floating slab system before installation of the rail fasteners and rail. This configuration essentially eliminates the airborne noise radiated from the slab as an addition to train noise heard by the patrons, provided that the resilient rail fastener has sufficient resilience to control transmission of higher frequency vibration from the rail to the slab. At the TTC system, the noise radiated from the slabs is at or below the train noise level at the same frequencies and is not noticeable either on station platforms or in the cars. At some other more recent installations where the rail fastening is too stiff, there is noticeable noise radiation from the slabs. In one instance, the rail was fastened directly to the slabs, resulting in very high noise level radiated into the cars and very poor groundborne noise control performance.

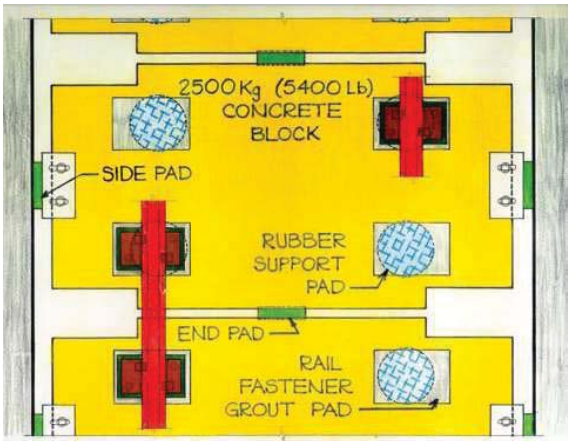

Figure 7 TTC double-tie discontinuous floating slab design - 1500 mm length precast concrete blocks

Figure 8 Photo of TTC double-tie system in subway - before installation of the rail fasteners and rail.

The earliest installations in Toronto, with the natural rubber bearing pads as specified, have now been in service for 28 years without any evidence of deterioration of the rubber pads. Further, there has been no added or special maintenance required or created by the floating slabs. The success of the design has led to the adoption by a number of rail transit facilities where mitigation of groundborne noise has been necessary. These include the MARTA system in Atlanta and the transit facilities in Los Angeles, Buffalo and recent extensions of the BART system. Other notable applications are at the Hong Kong Mass Transit Railway and at the Canary Wharf in London, U.K.

Another early installation of the double tie concept floating slab was at the Melbourne Underground Loop, MURLA, subway. The four lines of the Loop are in close proximity to a number of noise sensitive facilities. Therefore, an extensive study was completed by Victorian Railways over the period from 1973 through 1978. This study included a trial installation at the Jolimont Cutting to provide in-service testing and evaluation of the proposed floating slab track system. While the intermediate mitigation of resilient booted tie system would have been adequate at some locations, it was not adequate at others. To avoid the complication of multiple transitions and multiple types of trackwork to be maintained, it was determined the entire Loop network would be the double-tie floating slab. The system was completed and opened in 1981.

Recent Developments

The new extensions of the Hong Kong MTRC and the new line constructed for the Kowloon Canton Railway Corporation, KCRC, have required creative combinations of structure-borne noise control and sound barrier technology. The environmental requirements for these new facilities are among the most restrictive in the world. At first it was thought that achieving the design goal of 64 dBA at 25 m for a train at 140 km/hr would require a covered viaduct with floating slab track. However, using the floating slab track design principles developed and refined from experience with each new system combined with a new approach to sound barrier wall design enabled creating an overall design achieving the low wayside noise level without a complete cover over the guideway.

The overall design approach for the 21 km KCRC viaduct was the use of concrete guideway and girders, floating slab track to minimize structure-borne noise radiation from the guideway and integral sound barriers, soft rail fasteners to minimize noise radiation from the floating track slabs, sound barrier walls with sound absorption and an undercar/under-walkway sound absorptive plenum to supplement the sound barrier walls. The overall design also required low noise performance for the vehicle propulsion and auxiliary equipment. For example, a typical roof-mounted air conditioner could by itself exceed the overall wayside noise allowance, since the AC unit noise would not be mitigated by a sound barrier wall.

Figure 9 is a representation of the KCRC viaduct final design showing the elements included for control of wayside noise, the all-concrete structure, the floating slab track, the sound barrier wall with absorption and the under-walkway plenum with absorption to minimize noise transmitted to the walkway-to-car gap to the sound barrier wall and thence to the wayside. Figure 10 is a photo of the completed viaduct and Figure 11 is a close-up photo showing the floating slab segments with the soft Cologne Egg type rail fastener. Trains began running on this facility in 2004 and the wayside noise measured was 64 dBA L_{eqmax} at 25 m for an 8-car train at 140 km/hr.

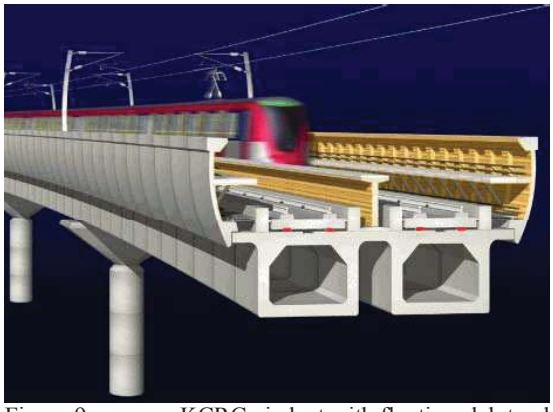

Figure 9 KCRC viaduct with floating slab track, absorptive sound barrier wall and under walkway absorptive plenum

Figure 10 Photo of KCRC viaduct completed

The fact that the new KCRC viaduct was designed and constructed to successfully control the wayside noise without need for complete cover over the trackway demonstrates that the principles, procedures and materials which have been developed do accomplish the acoustical design goals. The design represented in Figure 9 was based entirely on empirical and analytical

design analysis without construction of a test track or test section to demonstrate the performance.

Figure 11 Close-up view of KCRC viaduct floating slabs with low stiffness rail fasteners

Summary

Through the application of simple vibration isolation design principles with careful attention to the entire complex system affected by individual noise and vibration control features, it has been found possible to greatly reduce both the wayside airborne noise from viaduct structures and the groundborne noise and vibration from subway and at-grade rail installations. The principles applied to viaducts can also, of course, be applied to bridges. With attention to the design factors which affect structure-radiated noise, it has been possible to reduce the unmitigated wayside noise from the range of 84 to 87 L_{Aeqmax} at 15 m for 130 km/hr train on a concrete viaduct structure to 65-67 L_{Aeqmax} for the same conditions but with mitigation.

Through development of light weight, undamped floating slab systems which take into account the vehicle bogie dynamics, the trackway or subway structure mass and the surrounding geology characteristics, it is now possible to install new rail systems in very close proximity to noise sensitive land uses without the impact of low frequency rumbling noise which has traditionally been associated with rail system subway trains. For example, initial operations of the TTC Spadina line, which opened in 1978, resulted in complaints from only two houses and it turned out these were due to problems with flat wheels during the initial operations. After the flat wheel problems were corrected, there were no further complaints and it was reported that trains in a tunnel only 3 m from houses were only occasionally audible.

With the technology and materials now available for rail system noise and vibration control, it is possible to install new facilities in locations or along alignments which in the past would have been considered unfavorable because of the noise and vibration impacts. Even with the more restrictive standards now imposed by many jurisdictions, the transit system planners and designers have less limitations regarding selection of alignments for new transit facilities. Of course, there still remains the problem of convincing the neighbors of a potential new facility that the wayside noise and vibration will be satisfactory and acceptable in the community.

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ANNEX III: COMPARISON OF COVERAGE OF BOGIES FROM DIFFERENT MODERN ROLLING STOCK EQUIPMENT on page165

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DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT B
STRUCTURAL AND COHESION POLICIES

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REDUCING RAILWAY NOISE POLLUTION

STUDY

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This document was requested by the European Parliament's Committee on Transport and Tourism.

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STUDY

Abstract

12 million EU inhabitants are affected by railway noise during the day and 9 million during the night. This study lists measures, funding and regulations to reduce it. The introduction of modern rolling stock will lower noise most significantly. In the short run, the replacement of cast iron by composite brake blocks on rail freight cars is most important. Developing a regulation scheme for a staged process towards low-noise rolling stock is the heart of a rail noise abatement strategy.

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LIST OF ABBREVIATIONS

AEA	AEA Technology Rail BV, Netherlands
BIMSchV	Bundes-Immissions-Schutz-Verordnung (Traffic Noise Ordinance of Germany)
BMVIT	Bundesministerium für Verkehr, Innovation und Technologie (Federal Minister for Transport, Innovation and Technology of Austria)
BS	British Standard
BVU	Beratergruppe Verkehr + Umwelt (Consultants for Transport + Environment)
CER	Community of European Railway and Infrastructure Companies
DB	German Rail (Deutsche Bahn)
DEFRA	Department for Environment, Food and Rural Affairs of UK
DG	Directorate-General of the European Commission
DG ENTR	Directorate-General Entreprise and Industry
DG ENV	Directorate-General Environment
DG Research	Directorate-General Research
DG TREN	Directorate-General Transport and Energy
DIR	Directive
EC	European Council
ECML	East Coast Main Line
EEA	European Environment Agency
EMU	Electric multiple unit
EP	European Parliament
ERFA	European Rail Freight Association
ETC LUSI	European Topic Centre on Land Use and Spatial Information
EU	European Union
FM	Friction modifier
FS	National railway of Italy - Trenitalia (former Ferrovia dello Stato)
K-block	Composite brake block

L_{DAY}	Average Noise Level Index day time
L_{DEN}	Average Noise Level Index total day
LL-block	Low-low brake block
L_{NIGHT}	Average Noise Level Index night time
NDTAC	Noise Depending Track Access Charge
ÖBB	Österreichische Bundesbahn (Federal Railway of Austria)
PPG	Planning Policy Guidance
RENFE	Spanish Railways (Red Nacional de Ferrocarriles Españoles)
RFI	Italian railway infrastructure management company - (Rete Ferroviaria Italiana)
SBB	Swiss Federal Railway (Schweizer Bundesbahn)
STIB	Municiple Public transportation company of Brussels (Société des transport intercommunaux de Bruxelles
TAC	Track Access Charge
TOC	Train Operating Company
TOR	Top of Rail
TSI	Technical Specification for Interoperability
UIC	International Union of Railways (Union Internationale des Chemins de Fer)
UIP	International Union of Private Wagons (Union Internationale des Wagons Privé)
UIRR	International Union of combined Road-Rail transport companies (Union internationale des sociétés de transport combiné Rail-Route)
UITP	International Assosiation of Public Transport
UNIFE	Association of the European Rail Industry
VDV	Association of German Transport Companies (Verband Deutscher Verkehrsunternehmen)
VPI	German Association of private wagon owners (Vereinigung der Privatgüterwagen-Interessenten)
WCML	West Coast Main Line
WHO	World Health Organisation

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EXECUTIVE SUMMARY

According to Member State reports compiled by the European Environment Agency (EEA) in 2010, railway noise affects about 12 million EU inhabitants at day time, with a noise exposure above 55 dB(A), and about 9 million at night time, with a noise exposure above 50 dB(A). In fact, the real figures are undoubtedly higher since the EEA's European noise mapping initiative concentrates on agglomerations with over 250,000 inhabitants and on main railway lines with over 60,000 trains per year. The railway noise problem is concentrated in central Europe, where the majority of the affected citizens live and the volume of rail freight transport is highest (primarily Germany, Italy and Switzerland, but traffic density is high also in Poland, Austria, the Netherlands and France, and noise mapping indicates that significant population is affected in Belgium and Luxembourg).

Noise is an annoying phenomenon, contaminating the environment and adversely affecting the health of people exposed to high ambient noise levels above 70 dB(A) – or even less. The discussion about railway noise has become very important in several European countries as railway transport increases and plays a more important role in greening transportation. For implementing the sustainability goals formulated in the EC 2011 Transport White Paper and the Greening of Transport package, the environmental impact (carbon, energy, noise, etc.) of railway operations needs to be minimised to maintain rail's position as a green transport mode – and thereby promote a modal shift to rail, to reduce the environmental impact of transport overall.

In order to analyse the noise situation in Europe, following current EC legislation, the Member States have to provide noise maps and noise action plans. Noise action plans describe the measures taken to lower environmental noise for identified affected inhabitants. However, legal conditions differ widely across Europe as Member States have different limits or threshold limits for environmental noise emissions, and usually these limits are tested only when building new infrastructure or during major redevelopment.

In general, three different sources of railway noise are identified:

- Engine noise
- Rolling noise
- Aerodynamic noise.

Railway noise is largely a problem of freight trains and trains containing older wagons or engines, and is a particularly severe problem during the night. Rolling noise is generally higher from poorly maintained rail vehicles, and from trains running on poorly maintained infrastructure. Aerodynamic noise is particularly relevant for high speed lines where, in most cases, noise limiting measures like noise barriers are implemented; noise barriers reduce the impact of rolling noise, but are usually too low to have any effect on noise originating at the pantograph. Engine noise is most relevant at lower speeds up to about 30 km/h, rolling noise above 30 km/h and aerodynamic noise dominates above 200 km/h. The most important noise source is rolling noise, which affects all kinds of train.

To reduce railway noise pollution, passive measures at the place of disturbance can be distinguished from active measures at the noise source. The most important passive methods used to reduce the impact of railway noise on the environment are noise protection walls and insulating windows, and for the most part action plans and

investments of the Member States concentrate on these methods. However, they are only locally effective, requiring huge investments to protect wider parts of railway networks.

In contrast, source-driven measures lower noise across the whole railway system if they are widely introduced. As an example, the problem of noisy rail freight cars can be reduced by the replacement of cast iron brake blocks by composite brake blocks. This is currently being investigated by the railway industry and would affect about 370,000 old freight wagons. Also, wheel absorbers, aerodynamic design of pantographs and noise insulation of traction equipment (e.g., locomotive engines) are measures to reduce noise at source. According to the current Technical Standard for Interoperability (TSI Noise), rolling stock which was introduced since the year 2000 (including engines and passenger coaches or passenger power cars) are required to lower noise emissions by about 10 dB(A) compared to the equipment of the 1960s and 1970s.

In the authors' opinion, noise should ideally be reduced at the source because these measures have a network-wide effect. Where track infrastructure causes increased noise levels (e.g., structure-radiated noise from viaducts or curve squeal in narrow radius curves), or where the local environment is particularly sensitive to noise (e.g., areas of natural beauty or urban environments with residences very close to the railway line) then additional trackside noise mitigation measures may be necessary. Such measures include friction modifiers, rail dampers, floating (or isolated) slab tracks and of course noise bunds and barriers in various heights. Vehicles and track should all be maintained to eliminate unnecessary sources of noise, e.g., corrugation.

Retrofitting of existing rail freight cars with composite K- or (if approved) LL-brake blocks is the most cost-effective measure on the vehicle side. Additional measures on the vehicle side are wheel absorbers, vehicle-mounted friction modifiers (most effective in urban or sub-urban networks) and (for high-speed trains) aerodynamically optimised pantographs (e.g., shielding or coating). These measures are effective network-wide. Additional research could be made for modified wheel constructions as they are very effective but experiences with accidents lead to reluctance to use new wheel constructions replacing mono block types.

On the infrastructure side, friction modifiers, rail dampers and slab track are cost-effective measures for reducing noise. In densely populated environments and highly trafficked railway sections, the use of noise barriers or coverings cannot be avoided. However, if there is a wide introduction of vehicle-related measures, the number of noise barriers or covers can shrink significantly.

Additionally, wheels and rails need frequent monitoring and maintenance to reduce noise. The surface quality of wheels and rails is a key factor determining rolling noise and deteriorates naturally over time; severely damaged surfaces (out of round wheels or corrugated tracks) are a major noise source.

The European Parliament and European Commission try to encourage the Member States to take more action to reduce railway noise, e.g., by introducing noise-dependent track pricing schemes. Such economic incentives (rail track charging differentiated according to noise emissions) can help to:

- stimulate the use of low-noise technology for the rolling stock;
- foster the use of routes which avoid hot spots for noise;
- foster noise-reducing operational routines and speeds in sensitive areas.

On the regulative side, the Japanese top-runner scheme[1] is an example to come to a long term reduction of noise. The TSI Noise is an appropriate basis for noise regulation in the medium and long term. Presently, the standards for noise emissions are valid for new or modified vehicles only. In the medium and long-term view the TSI can become compulsory for all vehicles. The noise levels in TSI Noise should also be lowered from time to time according to technical development similar to the Japanese example.

In principle, there are three approaches to a noise-dependent track pricing, and each can be configured as a mix of bonus and penalty components:

1. The train-related noise emissions can be measured at critical points in densely populated areas and/or low distances to residential zones and then allocated to the trains causing the noise. The noise mark-up for the track charge then would vary with the local noise level and eventually with the noise exposure of the residential population.

2. The wagons can be classified into noise categories and charged with a noise mark-up or granted with a bonus according to the noise category. The train operator would pay the charge to, or get the bonus from, the infrastructure manager, and pass the bill or grant the bonus to the car owner or operator.

3. Trains can be classified on the basis of the rail car types from which they are composed. In the case of freight trains, the emission category of a train could vary with every change of the train composition in marshalling yards.

The first approach would directly correspond to the polluter-pays principle, but causes high transaction costs for implementation and control. The second approach is the most simple and easy to implement, but neglects the nature of rail noise; a high percentage of noise-reduced cars is required in order to achieve a substantial reduction of train-related emissions. The third approach does not require a sophisticated payment system but needs a functioning (eventually international) information system for wagon control.

The charging schemes can be embedded into appropriate legislative regulations to set a clear framework for long-term activities to reduce railway noise. The following instruments for regulation are possible:

- Limits for stationary and pass-by noise for freight wagons and locomotives;

- Operation and maintenance rules;

- Noise-limiting technology for new rolling stock according to the Japanese top-runner scheme. This scheme aims at reducing energy consumption and climate impact by dynamic setting of emission targets on the basis of current best practice (“top runners’ performance”);

- Retrofitting programmes for vehicles currently in service (phased obligation schedule).

[1] This scheme aims at reducing energy consumption and climate impact by dynamic setting of emission targets on the basis of current best practice (“top runners’ performance”).

Noise depending track access charges (NDTAC) should be introduced to encourage the vehicle owners to invest in noise reduction measures. At the first stage they should focus on rail freight wagons but the scheme can include other vehicles or measures later or focus on noise limits without regard to measure to reach the limit.

Importantly, NDTAC should be realised so that no burdens for competitiveness for the rail sector appear. Investment and higher operational costs should be covered. NDTAC should be harmonised in the Member States and each vehicle operating in a national network should be included (also foreign vehicles). To meet the fact that significant noise reductions are only to be achieved if trains are completely equipped with low noise equipment, the NDTAC should favour trains which are nearly fully equiped with these vehicles. To avoid losses in competitiveness lower TAC for low noise vehicles a substantial part should be financed by the Member States. To motivate an early switch to low noise vehicles or retrofitting of existing freight cars also direct funding of investments should be considered for a few years.

Summary of recommendations

As rail freight wagons commonly travel across wider international distances, it is essential to harmonise noise legislation policies across Europe. As a result the authors recommend focusing on the following actions:

- Retrofitting the existing freight wagon fleet with low noise braking systems especially by replacing the cast iron by composite brake blocks as the most important and effective first step of source related noise reduction measures.

- Establishing funding schemes to cover the retrofitting and additional operating costs of the new noise reduction technologies to avoid a reduction of the rail sector's competitiveness; a substantial part of costs should be covered by the Member States, since quieter trains will reduce the need for, and therefore the cost of, infrastructure noise mitigation measures.

- Introducing rail track charging systems which differentiate the train charges according to the noise category of a train. The noise classification of a train should be determined by the wagon with the highest noise emission level.

- Making activities concerning NDTAC or noise limit regulation depending on the same actions in road transport to avoid losses of competitiveness for the rail sector.

- Making noise limits by TSI Noise ([TSI Noise 2011] also compulsory for existing rolling stock 10 or 12 years after introduction of funding schemes and noise limits for new rolling stock.

- Adjusting limits of TSI Noise in a phased process for a medium and long-run future to foster the development of new noise reduction technologies.

- Monitoring and maintenance of noise development due to abrasion to assure low noise levels also during operation over long periods.

1. DEFINITIONS AND EFFECTS OF NOISE

KEY FINDINGS

- Noise is **sound which is unwelcome** but the annoyingness depends on the individual.
- Noise can be **harmful.**
- The **noise pressure level** is measured in **dB(A)** (deci Bel) with a logarithmic scale.
- **10 dB(A)** increase of noise represents a **ten-fold increase** of noise pressure.
- A change of **3 dB(A) is detectable by the human ear**, with it representing a **doubling of noise pressure.**
- Local **resistance against railway noise increases** especially in Central Europe where most rail freight transport is realised.
- The majority of rail transport is realised in **France, Germany and Poland.**

1.1. Noise and railway noise

Noise is sound that is unwelcome, because of its volume or structure, and can be harmful. Since not everyone responds equally to sounds and the perception is dependent on constitution and mood, noise also contains a subjective component. Therefore, there is no fixed value at which a sound is perceived as noise.

Rail noise is sound emissions arising from the operation of trains and trams. There are a wide variety of sources and causes of rail noise, such as locomotives accelerating, freight wagons braking, squeal noise in curves, vibration from rail corrugation and out-of-round wheels, vehicle coupling in shunting yards, and even the pantographs of high-speed trains.

1.2. Measurement of noise

Sound is vibrations in the air around us causing our eardrum to vibrate. The human ear is sensitive to frequencies in the range 20 Hz – 20 kHz. These vibrations in the air cause pressure changes, and the change in pressure is called sound pressure. Sound, and therefore noise, is measured by measuring the sound pressure. How loud we perceive the sound depends on sound pressure level and duration, but also on frequency and bandwidth. Psychology also affects our perception and tolerance of sound. Besides sound pressure level, the duration of the sound, the time of day, the composition and frequency of the sound must be considered in the assessment of noise. Also, the tonality ("squeak") and impulsiveness ("hammer") play a role.

The measurement of sound pressure level, usually referred to as volume, has the physical unit Bel. Normally the term decibel (dB) (i.e., one tenth of a Bel) is used. The additive (A)

behind the unit dB expresses that the noise measurement is A-weighted (a filter defined by IEC 61672:2003 norm), i.e., tuned to the perception of the human ear.

While the human ear can perceive an increase in sound volume as sound energy increases, the relationship is logarithmic. If two identical 10 dB noise sources are placed together, the perceived increase is not a doubling of the volume but rather a 3 dB increase. If ten such noise sources were placed together, the increase would be 10 dB – multiplying the sound energy (and thus the real exposure) by a factor of ten, multiplies the perceived sound volume by a factor of two.

As such, a sound level increase from 45 dB to 55 dB may not look like much on paper, but it represents a ten-fold increase in sound energy and its impact on human health. Humans are usually able to sense a change of 3 dB in sound level, which corresponds to a factor-of-two change in sound energy, but that is about the limit of sensitivity. Measures to reduce noise levels by less than 3 dB would, by themselves, be of no real value.

Sound can also be transmitted as vibration through the ground and directly into the body, and this is also a form of noise pollution.

Three standard measures of average sound pressure level, defined by ISO 1996-2:1987, are L_{day}, $L_{evening}$ and L_{night}, where day is typically 07.00 – 19.00, evening is 19.00 – 23.00, and night is 23.00 – 07.00; these are long-term average A-weighted measurements of all days, evenings and nights, respectively, over the course of a year. L_{den} is a weighted average of these three, adding 5 dB(A) to $L_{evening}$ and 10 dB(A) to L_{night}; this is defined in Annex 1 of European Commission Directive 2002/49/EC. The UK uses also $L_{Aeq,16h}$ which is an average of L_{day} and $L_{evening}$.

1.3. Effects of noise

The faintest audible sound is at 0 dB(A); the pain threshold is about 120 dB(A). If it is louder than 120 dB(A), there is a risk of injury. At a detonated blast of 150 dB(A) the eardrum can rupture.

Noise exposure during sleep such as night flight noise is regarded as particularly critical. So night noise causes health hazards already at individual levels below 45 dB(A), if the difference between the individual level and the background noise is more than 3 dB.

Noise above 55 dB(A) is considered as noise pollution. If noise above this level lasts for an extended period of time, the efficiency and well-being of a person will be reduced. Noise in the range 65 to 75 dB(A) causes stress to the body. This can lead to arterial hypertension (high blood pressure), cardiovascular disease and myocardial infarction (heart attack). Noise can also provide for a reduction of gastric secretion and be the cause of stomach ulcers [WHO JRC 2011].

In the workplace, above 85 dB(A), a contractor is responsible to ensure his employees have suitable hearing protection available. If the noise level is over 90 dB(A), employees must wear hearing protection.

1.4. Results of noise mapping

According to Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise, all Member States have to provide noise maps and noise action plans (for details see section 2.2 on page 29).

The report on the implementation of Directive 2002/49/EC [EC 2011] summarises the number of affected people by environmental noise in the first round of strategic noise mapping (see Table 1).

Table 1: Affected people by environmental noise according to first round of noise mapping

SECTION	NUMBER OF AFFECTED PEOPLE BY NOISE LEVELS ABOVE 55 DB(A) L_{DEN} [MILLION]	NUMBER OF AFFECTED PEOPLE BY NOISE LEVELS ABOVE 50 DB(A) L_{NIGHT} [MILLION]
Agglomerations > 250,000 inhabitants		
All roads	55.8	40.1
All railways	6.3	4.5
Industrial zones	3.3	1.8
Important infrastructures outside agglomerations		
Main roads	34	25.4
Main railways	5.4	4.5
Main airports	1	0.3

Source: EC 2011, Table 2.

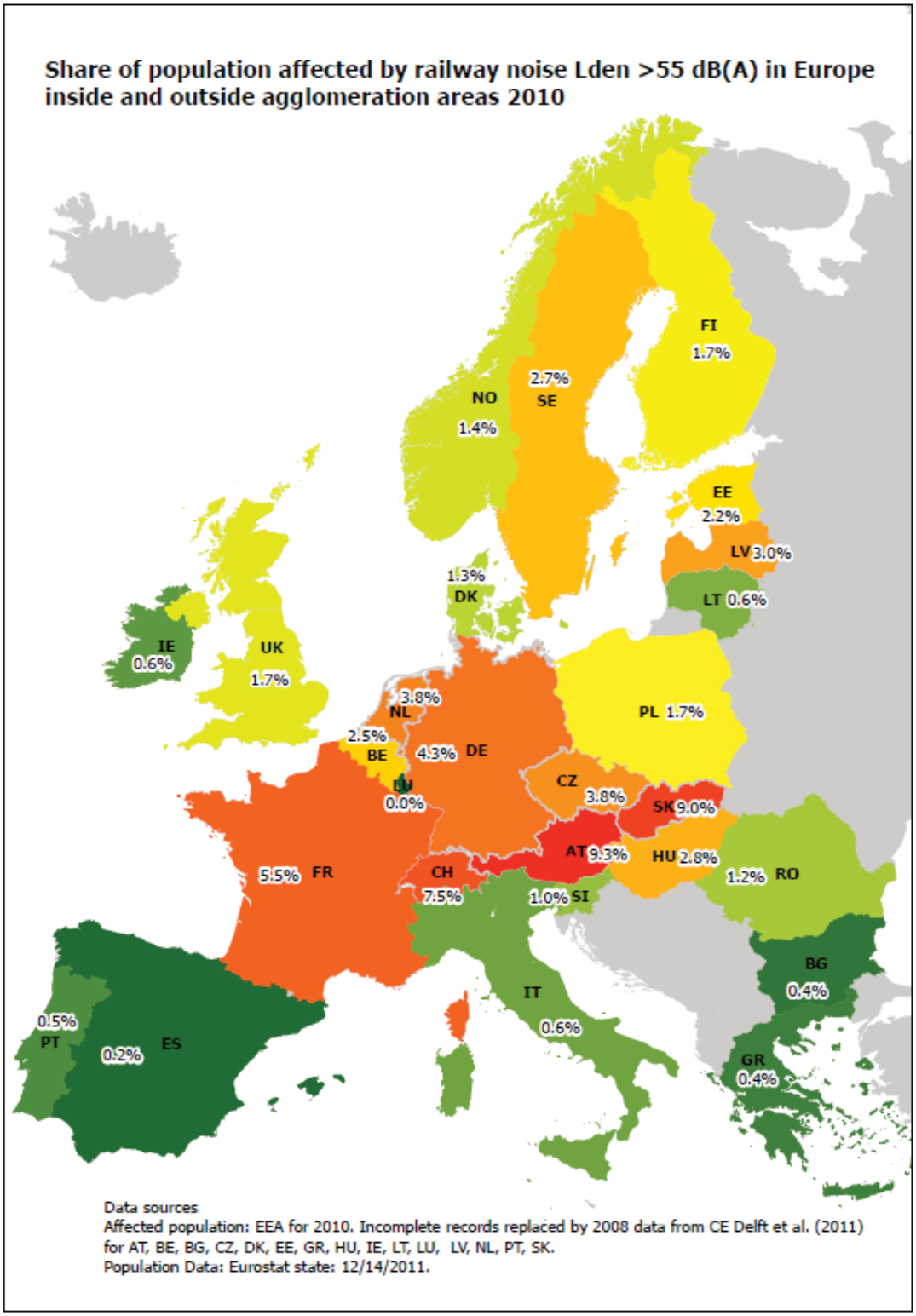
The European Environment Agency (EEA) and the European Topic Centre on Land Use and Spatial Information (ETC LUSI) publishes noise maps on the internet according to Directive 2002/49/EG. The maps are available at [NOISE 2011]. The maps present the population in each country affected by rail noise (distinguishing agglomerations from main lines outside agglomerations). Also, affected population by industry, main road traffic and aviation can be identified. A spreadsheet[2] shows detailed and aggregated figures according to data sent until 30 June 2010. In Annex I of this study (pages 120 - 121) the results of noise mapping for the rail sector are shown for all countries inside and outside agglomerations.

According to EEA data, the following states in Europe are mostly affected by railway noise according to the share of their population that is affected by railway noise with more than 55 dB(A) L_{DEN}: Austria (9.3%), Slovakia (9.0%), Switzerland (7.5%), France (5.5%), Germany (4.3%), Czech Republic (3.8%), the Netherlands (3.8%) and Latvia (3.0%) (see Figure 1).

The following Figure 1 shows the share of affected people in each European country according to the figures delivered by the states to fulfil the requirements of Directive 2002/49/EC.

[2] Summary of noise exposure data – file name is “END_DF4_Results_101005_ETCLUSI_inclBG&SW.xls”

Figure 1: Share of people affected by railway noise in each European country according to EEA data



Source: Figure elaborated by the authors with EEA data.

Analysing the figures in Annex I, it can be seen that about 85% of people affected by railway noise (over 55 dB(A) L_{DEN} or 50 dB(A) L_{NIGHT}) are located in the following six countries in Europe: Germany, France, UK, Austria, Poland and Switzerland. About 60% are located in Germany and France.

If only areas outside agglomerations are considered the figures change significantly. In this case the six countries mentioned above represent 89% of affected people. The share of people affected in agglomerations and outside agglomerations differ very much between the countries. In Germany about 75% of affected people live outside agglomerations whereas in Poland this share is 0 (Switzerland: 15%, Austria: 59%, the UK: 17%, France: 44%).

Although the number of people affected by rail noise is about eight times smaller than that affected by road transport noise, the total number remains high. In total 11.8 million inhabitants are affected by railway noise during the day (L_{DEN}) and 9 million are affected at night time (L_{NIGHT}). The limit in noise mapping remains much higher than the recommendations from WHO (see Table 2 page 24).

1.5. Environmental groups and affected inhabitants

On 7 May 2011, about 1,000 protesters came together in Rüdesheim to protest against the rail noise in their hometowns along the middle Rhine Valley. They carried banners demanding a speed limit of 50 km/h in settlement areas and a ban on night trains, word-playing with the “Deutsche Bahn” as “TaliBahn” and blocking the railway line for 40 minutes. The protests were organised not only by a number of local initiatives, but also by communities and district administrations.

The main discussion is currently about freight trains as they are identified as the main source of noise, and they mostly operate at night.

A recent survey [Schreckenberg et al. 2011] showed that 45% of the inhabitants along the middle Rhine region are highly annoyed by rail noise, compared to only 13% by road noise. The reason is easy to understand: The topography forces the trains to pass through a narrow valley between Koblenz and Bingen. Four tracks, two on either side of the Rhine, cause unbearable noise disturbances in the ears of the inhabitants. Noise maps published recently show noise levels (L_{DEN}) above 65 and 70 dB(A). These extremes are caused by 400 trains per day, oncoming trains, old infrastructure, and noise reflections on the steep valley and on the water. Additionally, the EU plans for a European freight corridor from Rotterdam to Basel will double the number of freight trains of presently 150 per day to 300 per day. Further protests are expected. Further details concerning the Rhine axis will be elaborated in Section 4.2.1, page 85.

Figure 2: Protests in Rüdesheim May 2011, noise map Loreley L_{DEN}

This is not the only protest at the Rhine against rail noise. The plans to increase capacities on the upper Rhine valley caused massive protests from Offenburg to Basel, where presently around 10 local action groups are active. In Offenburg, 45,840 objections were made against the infrastructure plans of Deutsche Bahn, and finally the planning was not approved by the regional administration. As a result, DB started negotiations about a rail tunnel under Offenburg and an alignment with the motorway. In other towns, groups protest against the visual impact of “ugly noise protection barriers” and demand a covered deep-level track near settlements.

The local action groups are supported by a number of environmental NGOs that operate on a national or international level. The wide range of demands concerning rail noise may be summarised as follows:

- Freight trains should bypass settlement areas or be guided through deep-level tracks, tunnels or fully enclosed tracks.
- Equal priorities for noise reduction on existing tracks and new construction projects are required.
- Regarding the legal framework, the equivalent continuous sound pressure level should be complemented by a maximum level measurement combined with frequencies (in other words, peak sound levels and noise frequencies should be considered, not just averaged sound levels).
- Set noise emissions ceilings on railway tracks, in relation to land use and population density. Reduction of the permitted night time noise level to 45 dB(A).
- Introduce protection against vibrations into relevant laws and regulations.
- Set a speed limit of 50 km/h for trains in settlement areas.
- Revise the noise standards for new railway rolling stock (TSI Noise).
- Establish a binding framework for the use of market-based instruments to ensure the polluters pay for their noise costs, including road charges and a framework for rail track access charges which will create an incentive for fast and prioritised retrofitting of rail wagons with quiet brake blocks.

Figure 3: Upper Rhine Valley: Plans for Weil am Rhein and protests in Offenburg

Analyses of transportation data from EUROSTAT show that in 2009 almost 27% of the total rail transportation volume in Europe affected Germany. This underlines the importance of central Europe as a transit region as well as an industrial region and presents the reason why the discussion, or even the battle, concerning noise is the strongest in Germany. Poland in the second place has a share of rail freight volume of 12% and France in the third place has 9%. Concerning passenger transport, Germany has a 20% share and France 21%.

Analyses of the noise mapping results show that the problem is most severe in France, Belgium, Luxembourg, the Netherlands, Austria and Switzerland.

These two aspects are the reason why data, comments, available studies and national policy activities concentrate mostly on central Europe and, there, especially on the German speaking countries and the Netherlands. Regarding the main rail transportation axes in Europe, Germany, Austria and Switzerland are affected by a large volume of transit transportation. This will even rise according to transportation volume forecasts.

The future development of rail freight transport will potentially extend noise problems to other countries through which the TEN-T Corridors pass and which will see rising rail transportation volumes. However, the measures to reduce railway noise which are proposed in this study can help to prevent problems in corridors where transportation will rise in future.

2. LEGAL FRAMEWORK

KEY FINDINGS

- WHO recommends **environmental noise limits between 32 and 42 dB(A) at night** to avoid risks for health.
- About **1 million years of healthy life** are lost every year in the EU due to noise reasons.
- National noise **limits or thresholds differ very much** between the Member States and exceed the WHO recommendations.
- Noise limits are mostly **only binding for new build infrastructure.**
- **Directive 2002/49/EC** requests the Member States to provide **noise maps** and **noise action plans**. This has been fulfilled for the first round of noise mapping which covers main railways, roads, airports and agglomerations. The second round (realised until 30 June 2012) will include smaller railways, roads, airports and agglomerations.
- **12 million** inhabitants are affected by railway noise above 55 dB(A) at day time and **9 million** inhabitants are affected by railway noise above 50 dB(A) at night time (major infrastructure and agglomerations).
- The **Recast** of the first railway package will request the Member States to **introduce noise depending track access charges** to compensate investments for noise reduction measures for railway operating companies.
- The **TSI Noise** sets noise limits for new rolling stock.

The reader can find an overview about all identified and analysed regulation schemes in Annex IV.

2.1. General recommendations, limits and thresholds for environmental noise

In this section some recommendations and thresholds for environmental noise will be introduced.

2.1.1. WHO recommendations on environmental noise

WHO published in 2011 a study about the burdens of disease from environmental noise [WHO JRC 2011]. The study used a quantitative risk assessment approach for the estimation. One result of the study is that, about 1 million years of healthy life are lost in the EU every year due to noise reasons.

Already in 2009 the WHO working group for preparing guidelines for exposure to noise during sleep published recommendations for thresholds of environmental noise levels [WHO 2009]. The recommendations are shown in Table 2.

Table 2: Thresholds for environmental noise at night time to avoid health risks according to WHO recommendation

EFFECT		INDICATOR	THRESHOLD [DB(A)]
Biological effects	Change in cardiovascular activity	see footnote 3[3]	see footnote 3
	EEG awakening	$L_{Amax,inside}$	35
	Motility, onset of motility	$L_{Amax,inside}$	32
	Changes in duration of various, in sleep structure and fragmentation of sleep	$L_{Amax,inside}$	35
Sleep quality	Waking up in the night and/or too early in the morning	$L_{Amax,inside}$	42
	Prolongation of the sleep inception period, difficulty getting to sleep	see footnote 3	see footnote 3
	Sleep fragmentation, reduced sleeping time	see footnote 3	see footnote 3
	Increased average motility when sleeping	$L_{Amax,inside}$	42
Well-being	Self-reported sleep disturbance	$L_{Amax,inside}$	42
	Use of sleeping pills, etc.	$L_{Amax,inside}$	40
Medical conditions	Environmental insomnia[4]	$L_{Amax,inside}$	42

Source: WHO 2009, page XII.

According to the recent UIC study [CE Delft et al. 2011], the social costs of transportation noise are estimated at about 35 billion Euro across the EU plus Switzerland and Norway in 2008, of which about 90% are related to passenger cars and trucks. The costs of rail noise amounts to 953 million Euro or 6% of total noise costs and distributes rather evenly to passenger and freight traffic.

2.1.2. Limits or recommendations for maximum noise limits in the Member States

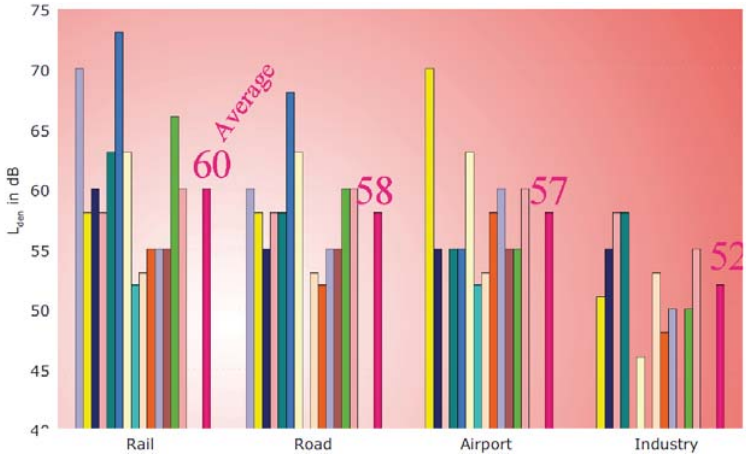
The European Environment Agency published a comparison of L_{DEN} limits of 14 Member States[5] in November 2010 [EEA 11/2010].

[3] Although the effect has been shown to occur or a plausible biological pathway could be constructed, indicators or threshold levels could not be determined.

[4] Note that "environmental insomnia" is the result of diagnosis by a medical professional whilst "self-reported sleep disturbance" is essentially the same, but reported in the context of a social survey. Number of questions and exact wording may differ.

[5] The EEA report does not specify which 14 Member States provided the information.

Figure 4: L_{DEN} planning values for residential area (as reported by 14 Member States)



Source: EEA 11/2010, page 22.

A standardisation might be useful in order to avoid health risks at the same level in every Member State and to balance competitiveness of all industrial sectors (including transport) as all Member States have to meet the same conditions.

The figures required as well as recommended by Member States are often much higher than the recommendations of the WHO. Some national limits or recommendations for environmental noise are introduced as examples below.

Table 3 shows recommendations for values of threshold for action plans for environmental noise reduction according to the German Federal Environment Agency (Umweltbundesamt) (2006). These figures are not obligations so that the residents cannot claim any specific mitigation measures from these recommendations, if they are affected by environmental noise above these limits. Introduction of measures is a voluntary measure by public bodies.

Table 3: German Federal Environment Agency recommendations of thresholds for action planning

TARGET OF ACTION	PERIOD	L_{DEN}	L_{NIGHT}
Avoiding health risks	Short-term	65 dB(A)	55 dB(A)
Lowering of large disturbances	Middle-term	60 dB(A)	50 dB(A)
Avoiding of large disturbances	Long-term	55 dB(A)	45 dB(A)

Source: 16. BIMSchV 2006.

On the other hand, the levels introduced by German Federal Emission Regulation (Bundesimmissionsschutzverordnung) are required for new built or modified transportation infrastructures; environmental noise levels have to fall below the values mentioned in [16. BImSchV 2006].

Table 4: German maximum environmental noise levels for new built or modified transportation infrastructures

	L_{DEN}	L_{NIGHT}
Near hospitals, schools, sanatoriums	57 dB(A)	47 dB(A)
Pure residential areas and small colonies	59 dB(A)	49 dB(A)
In central areas, villages or mixed areas	64 dB(A)	54 dB(A)
In industrial areas	69 dB(A)	59 dB(A)

Source: 16. BIMSchV 2006.

In comparison to the German legislation the following table presents the Austrian limits or thresholds for noise reduction action planning.

Table 5: Austrian values of thresholds for action planning

TARGET OF ACTION	L_{DEN}	L_{NIGHT}
Road traffic	60 dB	50 dB
Air traffic	65 dB	55 dB
Rail traffic	70 dB	60 dB
Industrial areas	55 dB	50 dB

Source: Bundes-LärmV 2006.

Finally, the British Standard 8233:1999 "Sound insulation and noise reduction for buildings – Code of practice" [BS 8233:1999] states noise limits in the UK for indoor noise caused by environmental noise.

Table 6: UK values of thresholds for indoor noise caused by environmental noise

CRITERION	TYPICAL SITUATION	DESIGN RANGE	
		Good noise level	Reasonable noise level
Reasonable industrial working conditions	Heavy engineering	70 dB(A)	80 dB(A)
	Light engineering	65 dB(A)	75 dB(A)
	Garages, warehouses	65 dB(A)	75 dB(A)
Reasonable speech or telephone communications	Department store	50 dB(A)	55 dB(A)
	Cafeteria, canteen, kitchen	50 dB(A)	55 dB(A)
	Wash-room, toilet	45 dB(A)	55 dB(A)
	Corridor	45 dB(A)	55 dB(A)
Reasonable conditions for	Library, cellular office, museum	40 dB(A)	50 dB(A)

study and work requiring concentration	Staff room	35 dB(A)	45 dB(A)
	Meeting room, executive office	35 dB(A)	40 dB(A)
Reasonable listening conditions	Classroom	35 dB(A)	40 dB(A)
	Church, lecture theatre, cinema	30 dB(A)	35 dB(A)
	Concert hall, theatre	25 dB(A)	30 dB(A)
	Recording studio	20 dB(A)	25 dB(A)
Reasonable resting/sleeping conditions	Living rooms	30 dB(A)	40 dB(A)
	Bedrooms	30 dB(A)	35 dB(A)

Source: BS 8233:1999, page 19.

British standards give acceptable noise levels for properties, and requirements for noise insulation. However, there are no relevant formal limit values in force in England with regard to environmental noise from railways. The Noise Insulation Regulations, defined in British Standard; Sound insulation and noise reduction for buildings [BS 8233:1999], define a threshold level as part of the eligibility criteria. Furthermore, there are guideline levels to be found in Planning Policy Guidance that provides guidance on land use with respect to noise from railways.

Environmental impact is considered as part of the planning permission process for construction, etc., in the UK. Planning Policy Guidance 24 [PPG 24 2006]: “Planning and Noise” provides guidance to local authorities in England on how to minimise noise impact (The Scottish Office issues Planning Advice Note 56 “Planning and Noise” with similar categorisation of noise levels.). [PPG 24 2006] defines exposure categories for residential development. These categories define action depending on noise level categories.

Table 7: Noise exposure categories for dwellings

CATEGORY	DESCRIPTION
A	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level.
B	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

Source: PPG 24 2006, Annex 1.

Noise levels corresponding to the categories are shown in Table 8.

Table 8: Noise levels corresponding to exposure categories for dwellings

NOISE SOURCE	NOISE EXPOSURE CATEGORIES			
	A	B	C	D
Road traffic				
07.00 – 23.00	<55	55 – 63	63 – 72	>72
23.00 – 7.00	<45	45 - 57	57 - 66	>66
Rail traffic				
07.00 – 23.00	<55	55 – 66	66 – 74	>74
23.00 – 7.00	<45	45 - 59	59 - 66	>66
Air traffic[6]				
07.00 – 23.00	<55	55 – 66	66 – 72	>72
23.00 – 7.00	<48	48 - 57	57 - 66	>66
Mixed sources				
07.00 – 23.00	<55	55 – 63	63 – 72	>72
23.00 – 7.00	<45	45 - 57	57 - 66	>66

Source: PPG 24 2006, Annex 1.

Sweden has decided long-term goals for noise limits in 1997. Indoor levels should not exceed 30 dB(A) (L_{DEN}) and 45 dB(A) L_{NIGHT}. Outdoor levels should not exceed 55 dB(A) L_{DEN} and 70 dB(A) as a maximum on a patio [Blidberg 2011].

According to Royal Decree 1367/2007 in Spain, noise action plans are to be made according to the following table [Sierra 2011].

Table 9: Spanish values of thresholds for action planning

TIME FOR ACTION	Situation	L_{DAY}	$L_{EVENING}$	L_{NIGHT}	L_{MAX}
Up to 2020	Existing	65	65	55	-
Now	New	60	60	50	85

Source: Sierra 2011.

Bedrooms in houses located in the 60/60/50 noise contour have to meet 40 dB(A) L_{DAY}, 40 dB(A) $L_{EVENING}$ and 30dB(A) L_{NIGHT}.

Thresholds for noise action planning differ between countries. The differences are even in classifying noise protection areas. In Germany, action plans which lead to a maximum level of noise in defined areas are only required for new built and modified infrastructures.

[6] Aircraft noise: daytime values accord with the contour values adopted by the Department for Transport which relate to levels measured 1.2m above open ground. For the same amount of noise energy, contour values can be up to 2 dB(A) higher than those of other sources because of ground reflection effects.

Austria requires noise action planning for certain environmental noise levels, depending on the source of noise. UK recommendations do not require any action, except in the workplace or for new built and modified infrastructures, and levels depend on use of the rooms; local authorities have a number of legislative powers to control noise emission. Mostly the obliged figures are based on the highest level of the German Federal Environment Agency recommendations.

These examples of legislation rules or national recommendations differ from the WHO recommendation and are often only relevant for new or modified infrastructure.

The result of this comparison shows that reducing environmental noise is a very important action for the environment/health of the population. Many people are affected by rail noise that exceeds the lowest level the WHO Recommendation according to [WHO 2009] demands.

2.2. Environmental Noise Directive 2002/49/EC

The Environmental Noise Directive [Dir. 2002/49/EC] has the following aim[7]:

- "Monitoring the environmental problem; by requiring competent authorities in Member States to draw up "strategic noise maps" for major roads, railways, airports and agglomerations, using harmonised noise indicators L_{DEN} (day-evening-night equivalent level) and L_{NIGHT} (night equivalent level). These maps will be used to assess the number of people annoyed and sleep-disturbed respectively throughout Europe"

- "Informing and consulting the public about noise exposure, its effects, and the measures considered to address noise, in line with the principles of the UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, known as the Aarhus Convention, and signed on June 25, 1998.

- "Addressing local noise issues by requiring competent authorities to draw up action plans to reduce noise where necessary and maintain environmental noise quality where it is good. The Directive does not set any limit value, nor does it prescribe the measures to be used in the action plans, which remain at the discretion of the competent authorities."

- "Developing a long-term EU strategy, which includes objectives to reduce the number of people affected by noise in the longer term, and provides a framework for developing existing Community policy on noise reduction from source. With this respect, the Commission has made a declaration concerning the provisions laid down in article 1.2 with regard to the preparation of legislation relating to sources of noise."

According to the Directive 2002/49/EG, all Member States have to provide noise maps and action plans for noise reduction.

The Report from the Commission to the European Parliament and the Council on the implementation of the Directive on environmental noise in accordance with Article 11 of

[7] Expressions coming from http://ec.europa.eu/environment/noise/directive.htm, last visited 14 September 2011.

Directive 2002/49/EC from 1 June 2011 [EC 2011] shows the current status of implementation of the Directive in the Member States.

2.2.1. Status of implementation of Directive 2002/49/EG

The Directive is implemented in all Member States since October 2007 according to [EC 2011]. The 14[8] Member States which did not transpose by 18 July 2004 achieved that by October 2007. According to the EEA Study "Laying the foundations for greener transport" [EEA 7/2011] the data provided is 96% complete in mid 2011. In fact [EEA 7/2011] confirms many aspects concerning limits and the potential risks and limits to avoid risks as the WHO did in its two studies [WHO 2009] and [WHO JRC 2011]. The road map of the Directive is represented in [EC 2011] as follows.

Table 10: Road map for implementation of Directive 2002/49/EG

IMPLEMENTATION DEADLINE	ISSUE	REFERENCE DIRECTIVE 2002/49/EC	UPDATES
30 June 2005	Information on major roads, major railways, major airports and agglomerations according to the upper thresholds, designated by MS and concerned by 1st round of mapping	Art. 7-1	Mandatory every 5 years
18 July 2005	Establishment of competent bodies for strategic noise maps, action plans and data collection	Art. 4-2	Possible at any time
18 July 2005	Noise limit values in force or planned and associated information	Art. 5-4	Possible at any time
30 June 2007	Strategic noise maps for major roads, railways, airports and agglomerations according to the upper thresholds[9]	Art. 7-1	
18 July 2008	Action plans for major roads, railways, airports and agglomerations	Art. 8-1	Mandatory every 5 years
31 December 2008	Information on major roads, major railways, major airports and agglomerations according to the lower thresholds, designated by MS and concerned by 2nd round of mapping	Art. 7-2	Possible at any time
30 June 2012	Strategic noise maps for major roads, railways, airports and agglomerations according to the lower thresholds[10]	Art. 7-2	Mandatory every 5 years

Source: EC 2011, page 4.

[8] AT, BE, CZ, DE, EL, FI, FR, IE, IT, LU, PT, SE, SL, UK.
[9] Upper thresholds are agglomerations > 250.000 inhabitants, roads > 6 millions of vehicles per year and railways > 60.000 trains per year.
[10] Lower thresholds are all agglomerations > 100.000 inhabitants, roads > 3 millions of vehicles per year and railways > 30.000 trains per year.

Additional to the information shown in Table 10 according to [EC 2011] the Directive 2002/49/EC [Dir. 2002/49/EC] defines one more step.

In the first round of noise mapping and action plans only big agglomerations and intensive frequented transportation infrastructure is concerned. The second round also concerns smaller agglomerations and transportation infrastructures.

Table 11: Additional steps in noise mapping according to [Dir. 2002/49/EC]

IMPLEMENTATION DEADLINE	ISSUE	REFERENCE	UPDATES
18 July 2013	Action plans for all roads, railways, airports and agglomerations where limits are exceeded	Art. 8-2	Mandatory every 5 years

Source: Dir. 2002/49/EC.

Concerning noise mapping the following table shows details for the first and second rounds of noise mapping.

Table 12: Schedule for noise mapping and noise reduction planning

ACTION	AGGLOMERATIONS > 250.000 INHABITANTS AND MAIN RAIL LINES > 60.000 TRAINS / YEAR	AGGLOMERATIONS AND MAIN RAIL LINES > 30.000 TRAINS / YEAR
Announcement of railway lines and agglomerations which belong to categories mentioned	June, 30th 2005 (must be updated every 5 years)	December, 31st 2008 (must be updated every 5 years)
Elaboration of noise maps	June, 30th 2007	June 30th 2012 (must be updated every 5 years)
Action plans for noise reduction	July, 18th 2008	July, 18th 2013 (must be updated every 5 years)

Source: Dir. 2002/49/EC.

Table 13 shows the details of the current status of implementation.

Table 13: Status of implementation of Directive 2002/49/EG

CASE	DESCRIPTION	FULL IMPLEMENTATION	PART IMPLEMENTATION
Indication of noise indices and limits	Member States shall indicate their national legal environmental noise limits or recommendations. A European wide noise level was not introduced.	Limits by 19 Member States (AT, BG, BE, CZ, DK, EE, ES, FR, DE, EL, IT, LV, LT, LU, NL, PL, PT, SL, SI); currently reviewed in 3 Member States (LT, LV, RO); recommendations by 4 Member States (FI, IE, SE, UK)	
Strategic noise maps	The Member States have to provide noise maps for main transport infrastructure and agglomerations. They must be updated frequently (5 years) and the update shall indicate the situation in the year before the update.	12 Member States (BG, CZ, EE, HU, IE, LT, LV, LU, PL, PT, SI, UK)	11 Member States reported completely with a few omissions (AT, BE, CY, DK, FI, DE, NL, RO, ES, SE, SK) 3 Member States reported only for part of the sources of noise (FR, EL, IT) 1 Member State did not report (MT)

Source: EC 2011

The range of limits and recommendations for environmental noise differ very much between the Member States. Only four of them considered health care orientated limits (EE, LU, PT, SL and the administration of Brussels in BE).

2.2.2. Noise action plans

Several studies by UIC (see [UIC 2010]) and CER together with UIC (see [CER UIC 2007]) and additional surveys by the authors lead to an overview of the existing noise abatement actions in the Member States and also in other European countries. All data available are presented in Table 14.

Table 14: Actions by European Countries for noise abatement on railways where data are available

COUNTRY	ACTIONS	SOURCE
Austria	• Very important topic in particular in urban and mountainous areas • Noise maps since 1993; environmental noise plans implementing DIR 2002/49/EC (www.laerminfo.at) • 250,000 people exposed to excessive rail noise • Complex national and state legislation • 1.7 million sq. m [m^2] noise barriers constructed along 803 track-km, 2/3 of the planned construction works are completed • Most of the highly affected inhabitants are protected against noise, annually some 10-15,000 new protected citizens • Financial means amount to €16 – 25 million p.a.; 50% of the costs are covered by ÖBB and 50% by the federal states and the community; equipment of new tracks 100% funding by ÖBB • Equipment of 4,500 out of 31,000 wagons from Rail Cargo Austria and Rail Cargo Hungary with K-block brakes through new units. Retrofitting and noise related access charges are not foreseen • Participation at UIC-Project EuropeTrain for testing LL-block brakes	Interviews with country representatives in September 2011
	• Until 2009 450 km of noise barriers for € 355 million	[UIC 2010]
	• Critique to noise action plans: lag of new ways to deal with noise, no concrete specification	[Justice and Environment 2009a]
Belgium	• Regional noise legislation, no national legislation existent • Flanders, Brussels: noise limits • Wallonia: no limits • No programme by SNCB; however protection for new or upgraded lines	[CER UIC 2007]
Bulgaria	• Only interest in composite brake blocks for noise reduction	Interview with Bulgarian railway operator (BDZEAD) in September 2011
Cyprus	• Since 1951 there is no railway line in Cyprus in effect. So rail noise is no problem for Cyprus	http://en.wikipedia.org/wiki/Cyprus_Government_Railway

COUNTRY	ACTIONS	SOURCE
Czech Republic	• Noise abatement compulsory for new railway lines • Upgrading of existing lines with noise barriers • Action plans for END (Directive 2002/49/EC) will form framework of noise abatement programmes • Pilot project with LL brake blocks	[CER UIC 2007]
	• Until 2010 about 115 km of noise barriers	[UIC 2010]
	• Critique to noise action plans: merely containing only measures which have been planned anyway; no estimate of costs and deadlines	[Justice and Environment 2009a]
Denmark	• Few noise barriers in Denmark: 58 km • Passive noise abatement strategy, mostly done at houses	[CER UIC 2007]
	• Research and Testing programmes for optimisation of track construction, acoustic rail grinding, noise partnership with the inhabitants and noise communication management • Until 2009 46 km noise barriers, windows in 8,300 houses, total costs 65 million €	[UIC 2010]
	• Up to 2013 22,100 dwellings will be protected by noise screens and/or offered grant to improved sound insulation • Offer of grant to improved sound insulation of 17,700 dwellings, of which 4.650 dwellings (~26%) have got improved sound insulation. • Intensified grinding of rails on all main railway sections (2009 –2014) Target: Less fluctuation in rail smoothness and reduced noise • Tests of rail dampers on a short section - effect 2,7 dB(2007) • Project Optimized Railway Superstructure (2009 –2014): Survey on influence of different rail pads on noise and vibration at Holmstrup (2010-2011)	[Blumensaadt 2011]
Estonia	• TSI Noise is transformed into national law. • Noise action plans for the City of Tallinn (May 2009) and for major road links (Dec. 2008) have been established. These are not legally binding and are not referring to rail transport. Road measures including noise barriers only. • Provisions by the Tallinn noise action plan to be taken until 2013: o Technical measures at noise sources o Selection of quieter sources o Reduction of sound transmission (e.g. tramway speed reduction)	[Justice and Environment 2009a] [Justice and Environment 2009b]

COUNTRY	ACTIONS	SOURCE
	• Estonian legislation has delayed the deadline for preparing noise maps beyond 30.6.2007 and action plans. This constitutes a conflict with EC legal provisions	
France	• Noise protection for new or upgraded lines • implement noise control at hot spots – mostly noise barriers and noise protection windows – track absorbers homologated • research projects	[CER UIC 2007]
	• Combined optimisation of rail and wheel dampers. Homologation of wheel dampers (STARDAMP project) • Noise plan with € 193 million for noise barriers and rail dampers	[UIC 2010]
Finland	• Noise abatement package being considered by parliament, no retrofitting Problem of noisy Russian freight wagons	[CER UIC 2007]
	• Some noise barriers	[UIC 2010]
	• For the 7 agglomerations, Finnish Transport Agency (FTA) has contracted with the city authorities to include the main roads and railways in their assessments, paying a part of their costs • The total cost for FTA will be about € 800,000, about € 1.50 per probable noise zone inhabitant (cost with roads!) • Experiences with low height barrier come to a reduction of about 10 dB(A)	[Pokolainen 2011]
Germany	• Strong political pressure from citizen's groups and associations • Long-term goal of German railway DB: cut rail noise emissions 2000 -2020 by half, i.e., a noise reduction of 10 dB(A). Costs: € 2.3 m, with € 100 m p.a. duration of programme expected at 25 years • Noise differentiated track access charges will be introduced in December 2012. Wagon holders will receive a bonus financed by 50% through government. The bonus will be paid through a fund that is financed equally by increased track charges and the Noise Protection Programme of the German government • 180,000 wagons are eligible to be retrofitted with new brakes. Costs amount to € 300 m. Number of wagons presently retrofitted: 6,350 • Programme "Quiet Rhine" started that will retrofit 1,150 wagons with new brakes • Voluntary noise remediation programme for existing tracks of the federal railways • Research project "silent train on real track"	Interviews with representatives from DB and national authorities in September 2011

COUNTRY	ACTIONS	SOURCE
	testing innovative vehicle-side technologies • Research programme "silent track" testing track dampers and low noise barriers with funding from the Economic Stimulus Package II • Acoustic rail grinding programme on-going	
	• Testing innovative infrastructure measures: Rail dampers, friction modifiers, low height barriers, absorbers for steel bridges, under sleeper pads • Work on realistic rail/wheel contact: improvement of wheel/rail contact, wheel vibrations and acoustic optimisation of pavement • € 100 million per year, total costs of 2.3 billion until 2030 including noise barriers and windows • Most activities are related to infrastructure side measures • Retrofitting up to 5,000 freight wagons with K- and LL-blocks up from the year 2009 • Definition of a practical approach for the use of LL-blocks • Definition and pre-evaluation of noise differentiated track access charging models	[UIC 2010]
	• In fact, Germany currently invests significant money in noise protection walls in the Konjunkturpaket 2[11]	Additional information by the authors
Hungary	• The national law obligates noise protection on new or modernised railways	[CER UIC 2007]
	• Action plans are not binding and have no implication for national budget rules • Good public involvement in action plan design by establishment of noise committees	[Justice and Environment 2009a]
Greece	• The density of railway lines in Greece is very small. 60% of all railway kilometres belong to one single connection between Thessaloniki and Athens (1565 km). A very small percentage of all Greece inhabitants is affected by railway noise	http://www.griechenland-travel.com/eisenbahn.htm
Ireland	In the Dublin area traffic is the major noise source, but railways do not have a major impact on overall noise levels. Major measures: Promoting walking, cycling, public transport and quieter motor vehicles	[Dublin City 2008]
	Outside agglomerations 23 km of track are above 60,000 passages p.a., but without affecting	[King et al. 2009]

[11] « Konjunkturpaket 2 » (Economic Stimulus Package II) is an extra investment programme of the German government following the recent economic crisis 2008/2009 to support the building industry.

COUNTRY	ACTIONS	SOURCE
	population with L_{DEN}>55 dB(A)	
Italy	• Strict noise legislation including existing lines • action plans • implementation until 2020 • measures to be considered on about 8000 km • costs about € 6.8 billion • legislation does not allow retrofitting	[CER UIC 2007]
	• Measurements of all assets (rolling stock) for noise emissions – example: modification of software of the ETR 500 High Speed trains to lower ventilation and cooling noise • Most measures indeed concentrate on noise barriers and insolating windows • Development of cast iron brake blocks for freight wagons	Answer from Trenitalia (FS) on authors survey in September 2011
	• For the next 15 years on about 3,675 km of existing lines noise barriers and building insulation is foreseen with a budget of about 8.31 billion € (9,025 single actions)	Answer from RFI on authors survey in September 2011
Latvia	• Strategic Noise Mapping was completed in 2008 including only major road sections. It can thus be concluded that rail noise does not play a significant role in Latvia	[EIONET 2011]
Lithuania	• Detailed information on noise action plans have not been available; Communications from the Ministry for Transport and Communications only mention noise reduction programmes for road and air transport • But modal shifts to rail by a cooperation between Lithuanian Railways (JSC) and CargoBeamer (Germany) on combined transport is expected to reduce noise pollution from road haulage	[SUMIN 2011]
Luxembourg	Luxemburg has submitted a draft Noise Action Plan to the EC, which is not accessible to the public	[EIONET 2011]
Malta	• Since 1931 there is no railway line in Malta in effect. So rail noise is no problem for Malta	http://de.wikipedia.org/wiki/Schienenverkehr_auf_Malta
Netherlands	• Noise abatement legislation since 1987 • Introduction of noise differentiated track access charges in 2008. The bonus is fixed at € 0.04/ wagon-km and is applied to both passenger and freight vehicles with a maximum of € 4,800 over two years. The bonus is granted on a system of self-declaration • Noise Innovation Programme: Launching of numerous studies and pilot projects to test composite brake blocks • Noisy trains will be prohibited starting in 2015	[CER UIC 2007]

COUNTRY	ACTIONS	SOURCE
	• Target noise reduction: 10 – 12 dB(A) • Also measures for shunting yards are planned	
	• € 430 million for noise barriers, windows and rail dampers • Lubrication, removing of rail joints, noise barriers and window insulation in shunting yards • Research projects for friction modifiers against curve squeal, influencing rail roughness • Monitoring noise ceilings and capacity management	[UIC 2010]
Norway	• Rail grinding planned but not yet implemented, noise from freight terminals, tonal noise from accelerating and decelerating trains • Passive noise abatement strategy, mostly done at houses	[UIC 2010] [CER UIC 2007]
Romania[12]	• National noise action plans in preparation since 2008	[CER UIC 2007]
Poland	• Environmental law includes noise abatement • track grinding • noise barriers (50 km), • noise protection windows on new and upgraded lines	[CER UIC 2007]
Portugal	• Noise protection is obligated on all railway lines • Nearly all freight cars are equipped with LL-blocks (no need of admittance of these cars in other countries as Portugal has broad gauge track and so there is no exchange of wagons with the other European countries) • More than 50 km of noise protection walls and in future more are planned	[CER UIC 2007]
Slovak Republic	Action plans are considered very vague and general and not binding and have no implication for national budget rules	[Justice and Environment 2009a]
	To date only Action Plans for road transport have been submitted to the EC	[EIONET 2011]
Slovenia	Action plans are considered very vague and general and not binding and have no implication for national budget rules	[Justice and Environment 2009a]
Spain	• Directive 2002/49/EC is completely implemented in national legislation and for major railway lines and agglomerations noise maps are existing, second phase of noise	Interview with the RENFE in December 2011

[12] According to an Interview with the Romanian Railway Authority there are no problems with noise in this country.

COUNTRY	ACTIONS	SOURCE
	mapping will be fulfilled in 2013 • Currently 62% of rail freight transport is done with low noise wagons (equipped with composite brake blocks) • 32% of all freight wagons are already equipped with composite brake blocks (30,58% K- and 1,37% LL-blocks, as well as Portugal Spain has broad gauge) • Equipment of freight wagons with K- or LL-blocks goes on (600 expected for 2012) • 95% of passenger rolling stock is already equipped with disc brakes and new rolling stock will only have disc brakes	
Sweden	• According to Sweden´s noise mapping: problems also outside of mapping areas; noise mitigation measures such as rail grinding, rail dampers and low height barriers are being studied • Passive noise abatement strategy, mostly done at houses	[CER UIC 2007]
	• Noise abatement programme including insulated windows and local barriers for good acoustic indoor environment and noise protected patio area	[UIC 2010]
	• Sweden also favors retrofitting braking systems of existing rail cars but serious problems are still not solved concerning the braking performance in severe winter conditions	[Blidberg 2011]
Switzerland	• Noise legislation enacted 1987 • Noise differentiated track access charges introduced in 2010 using a bonus system for low-noise wagons • railway noise abatement largely financed through road traffic • specific legislation for railway noise: • – retrofitting of all Swiss rolling stock until 2014 (direct subsidies) – noise barriers with cost-benefit restriction – noise protection windows	[CER UIC 2007]
	• The total national freight wagon fleet will be equipped with composite breaks which lower rolling noise (for details see Section 3.3). The programme is financed by the government which shifts earning from road pricing to the rail sector. Also a noise-dependent track price system has already been introduced and is currently in discussion for enhancements • A cost benefit analysis should show which additional measures will be taken: rail grinding, stand by noise, rail dampers and	[UIC 2010]

COUNTRY	ACTIONS	SOURCE
	steel bridges are among the issues studied • By 2009 111 km of noise barriers and windows, and by 2015 300 km of noise barriers are planned for € 1 billion • Switzerland publishes very detailed information about the status of rail noise abatement and the approach for private persons to gather funding for noise insulating windows for instance (see www.laerm-sbb.ch)	
United Kingdom	• Strict planning policy requires new railway developments to consider noise impact during construction and operation	[CER UIC 2007]
	• British Standards give acceptable noise levels for properties and requirements for noise insulation • Most (approximately 75%) of UK freight wagons have disc brakes or composite brake blocks • The UK uses a variety of noise mitigating technologies including noise barriers, rail lubricators and friction modifiers, rail absorbers, and, usually in tunnels, resilient baseplates and floating slab track • DEFRA (Department for Environment, Food and Rural Affairs) is responsible for the UK's noise mapping and noise action plans • The UK has identified a number of Important Areas for the relevant transport authorities to focus on, as well as a subset of First Priority Locations and a timeline for implementation	Interviews held by partners in September 2011
	• Long-term strategy: Framework for noise abatement incorporating infrastructure provider (NetworkRail) and train operators • Concentration on night time noise and integration of transport and land use planning	[AEA et al. 2004]

Source: Different sources; see column SOURCE.

Reports have been suspended for Greece, Malta and Cyprus due to marginality or non-existence of rail networks.

Switzerland and Norway are mentioned as non-member countries as they are also members of UIC as the concerned railway organisation.

UIC (in [UIC 2010]) also mentions an initiative by the group of **The Netherlands, Germany, Switzerland and Italy** ([UIC 2010], page 25). In the Rotterdam - Genoa project, the governments of the states mentioned analysed possibilities to promote retrofitting of freight cars with low noise equipment (particularly composite brakes). The study finally recommended harmonised solutions for bonus systems (not only along the corridors) and to avoid penalty systems.

By the end of 2005, in Europe 1,000 km of noise barriers have been built and approximately 60,000 buildings have been endowed with noise protection windows. The measures resulted in noise protection for about 1,250,000 citizens. The measures comprised annual investments of 150–200 million Euros. The estimated total costs for infrastructure measures are estimated at up to € 10 billion.

Most national activities and investments so far concentrate on infrastructure: noise barriers, rail damping and friction modifiers. Many countries and projects also concentrate or integrate source driven measures like wheel dampers or composite brake blocks.

Interviews conducted with rail industry representatives from DB and ÖBB suggest that noise bonus regulations shall be unique across Europe to increase the incentives for wagon owners and operators to retrofit old rolling stock and to minimise market distortions among rail transportation companies.

2.3. Recast of the First Railway Package

The First Railway Package consists of Directives 2001/12/EC (amending Council Directive 91/440/EEC on the development of the Community's railways), 2001/13/EC (amending Council Directive 95/18/EC on the licensing of railway undertakings) and 2001/14/EC (on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification). This was designed to open the international freight market by setting out the conditions for licensing freight operators in Europe, to define the roles of the infrastructure managers and railway undertakings, and to set out a policy for capacity allocation and infrastructure charging.

The Second Railway Package includes the Railway Safety Directive (Directives 2004/49/EC and 2008/110/EC) and EC Regulations 881/2004 and 1335/2008 which required the establishment of national safety authorities and investigatory bodies who report to the European Railway Agency, responsible for rail safety and interoperability as well as drafting legislation for a harmonised European rail system. The Second Package also includes the Interoperability Directive (2008/57/EC) which defines how the Technical Standards for Interoperability (TSIs) should be developed, e.g., TSI Noise relating to "'rolling stock – noise' of the trans-European conventional rail system", Commission Decision 2011/229/EU (see Section 2.4, page 42).

The Third Railway Package focuses on opening up international passenger services to competition within Europe, and includes Directive 2007/58/EC (amending Council Directive 91/440/EEC on the development of the Community's railways and Directive 2001/14/EC on

the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure).

On September 17th 2010, the European Commission delivered a proposal for a Recast of the First Railway Package [COM(2010) 475]. Article 7 of Dir. 2001/14/EC covers “Principles of charging”. Noise is not mentioned explicitly in Dir. 2001/14/EC, but the directive allows infrastructure charges to be modified based on environmental impact. This enables Member States to introduce noise-dependent track access charges if this is introduced also for competitive transportation modes or the total turnaround for infrastructure companies does not rise. Article 31 of the proposed Recast, based on Article 7 of Dir. 2001/14/EC, explicitly allows differentiation of track access charges based on the noise emission characteristics of the rolling stock if the same is introduced for road transport.

2.4. TSI Noise

The basis for all subsystems (infrastructure, energy, control-command and signalling, operation and traffic management, telematics applications, rolling stock and maintenance) of the railway system are the “European Railway Technical Specifications for Interoperability (TSIs)”. The elaboration of TSIs is introduced in Directive 2008/57/EC. The European Railway Agency (ERA) is responsible for the coordination of development of the TSIs. For this, ERA organises working groups for the different subsystems which consist of experts and authorities. The ERA pays attention that all relevant stakeholders are represented in the working groups.

All TSIs are directly valid for each Member State for new build or modified subsystems. If exceptions must be made, the Member States have to declare this precisely. General exceptions are only possible for underground, tram and regional rail systems; infrastructures / networks which are separate from the rail network and are only used for local and urban transport; private rail infrastructure and vehicles which are only used on the private infrastructure which is only used for freight transport for the owner; infrastructures and vehicles which are only for local use or historical and touristic uses.

The new European Railway Technical Specification for Interoperability (TSI) for Noise (TSI Noise), document No. 2011/229/EU (published on April, 4th 2011) defines maximum noise levels for rolling stock [TSI Noise 2011]. This TSI is part of the subsystem rolling stock. It replaces the version of 2006 [TSI Noise 2006]. Maximum noise levels are defined for stationary and for pass-by noise on defined rail reference tracks and at defined speed. For engines, starting noise levels and interior noise within the driver's cab are also defined where applicable. Interior noise within the driver's cab is not relevant for this study. Details are presented in Annex II. According to Directive 2008/57/EG these limits are directly valid for new build vehicles.

Pass-by noise is defined at a distance of 7.5 metres from track centre line and 1.2 metres above upper surface of the rail. Details about the reference track are to be found in the TSI Noise. The reference track is defined by its roughness and its dynamic behaviour (described by the vertical and lateral track decay rates).

In Commission Decision of 30 May 2002 concerning the technical specification for interoperability relating to the rolling stock subsystem of the trans-European high-speed rail system referred to in Article 6(1) of Directive 96/48/EC (2002/735/EC) noise limits were set to rolling stock of high speed trains [Com 2002/735/C].

2.5. Measuring and computing of railway noise

2.5.1. Legislation according to Environmental Noise Directive

The EU Directive 2002/49/EC demands in its Annex 1 the following formula to calculate the relevant day-evening-night level (on the basis of measured noise levels):

$$L_{den} = 10\lg\frac{1}{24}\left(12*10^{\frac{L_{day}}{10}} + 4*10^{\frac{L_{evening}+5}{10}} + 8*10^{\frac{L_{night}+10}{10}}\right)$$

in which:

- L_{day} is the A-weighted long-term average sound level as defined in [ISO 1996-2: 1987], determined over all the day periods of a year,
- $L_{evening}$ is the A-weighted long-term average sound level as defined in [ISO 1996-2: 1987], determined over all the evening periods of a year,
- L_{night} is the A-weighted long-term average sound level as defined in [ISO 1996-2: 1987], determined over all the night periods of a year,
- L_{den} is the average noise level for a period of 24 hours (day, evening and night)

and in which:

- the day is 12 hours, the evening four hours and the night eight hours. The Member States may shorten the evening period by one or two hours and lengthen the day and/or the night period accordingly, provided that this choice is the same for all the sources and that they provide the Commission with information on any systematic difference from the default option,
- the start of the day (and consequently the start of the evening and the start of the night) shall be chosen by the Member State (that choice shall be the same for noise from all sources); the default values are 07.00 to 19.00, 19.00 to 23.00 and 23.00 to 07.00 local time,
- a year is a relevant year as regards the emission of sound and an average year as regards the meteorological circumstances; and in which: the incident sound is considered, which means that no account is taken of the sound that is reflected at the façade of the dwelling under consideration (as a general rule, this implies a 3 dB correction in case of measurement) (see [EC 2002], Annex I).

Noise indicators can also be computed (necessary for predictions). Directive 2009/49/EG defines in its Annex II computing methods which have to be used if the Member States have no own legislative computing method which is adapted to Annex I of the directive. For railway noise the calculation method of the Netherlands is prescribed („Reken- en Meetvoorschrift Railverkeerslawaai '96, Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 20th November 1996“) [ReMR 1996].

The calculation scheme defines nine train categories where noise levels for pass by of one of these trains are indicated. Together with the total number of trains of one type, the averages L_{DEN} and L_{NIGHT} level can be calculated. Supplement factors are indicated for different types of bridges.

Germany for example has its own calculation scheme. They use the "Preliminary calculation method for the environmental noise at railways" (Vorläufige Berechnungsmethode für den Umgebungslärm an Schienenwegen) – VBUSch 2006" [VBUSch 2006] for calculations for noise mapping.

All calculations schemes are very complex and exceed the scope of this study, but all schemes classify trains into classes. For each class an emission factor must be calculated and the addition of all factors is done with a logarithmic function.

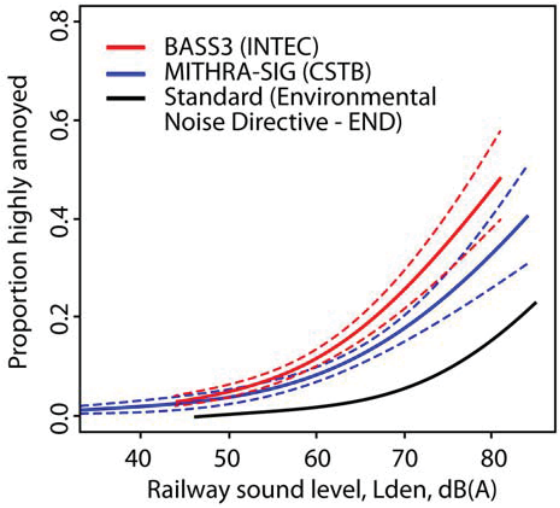
There are currently two main discussions about the calculation schemes - the different results of different schemes and the rail bonus in calculation. Both aspects will be discussed in the following sections.

2.5.2. Different results of different computing schemes

The Dutch scheme uses nine train type categories where the indicators mentioned in the German scheme are already integrated in general calculation factors for the train category.

The calculation in Germany has a common factor for all train types, modified by individual bonus or penalty factors according to indicators, whereas the Dutch calculation scheme has already defined global calculation factors for train categories. So calculation results can differ according to the scheme used; Lercher elaborated an example of these differences in ALPNAP project [ALPNAP 2007-2]. Figure 5 which comes from the ALPNAP project [ALPNAP 2007-2] shows an example of the result of different calculation methods for people annoyed by railway noise. The figure compares BASS3 (INTEC)[13], the MITHRA-SIG[14] and the Standard set by the Environmental Noise Directive.

Figure 5: Comparison of noise calculation methods in ALPNAP project



Source: ALPNAP 2007-2, page 124.

Clearly there would be value in a European calculation (and measuring) standard to make noise effects on the population more comparable.

[13] BASS3 is an implementation of ISO 9613 (acoustics - Attenuation of sound during propagation outdoors) by INTEC-University of Gent.

[14] MITHRA-SIG is an implementation of the French standard method NMPB (Méthode de Prevision du Bruit des Routes).

2.5.3. Rail noise bonus discussion

In former, and in some current, calculation or measuring methods (see German Schall 03, for example) a general bonus for rail noise is included. These incentives transfer measured or calculated environmental noise emissions into a balanced value. Railway noise is often seen as less annoying than other noise sources. Amongst others this is accounted due to more times without noise emissions at all. The general discount is between 3 and 10 dB in different countries [ZEUS Möhler 2010].

Recently, several studies analysed whether this discount is suitable and eligible. The study "Lärmbonus bei der Bahn?" (Noise bonus for rail?) [ZEUS Möhler 2010] by Möhler + Partner München; ZEUS GmbH, Hagen, analysed several studies for the German Federal Environment Agency (Umweltbundesamt).

The following table shows the suitability of railway noise incentives according to analysed studies:

Table 15: Analysis of studies about the eligibility of rail noise incentives

ELIGIBILITY OF RAIL NOISE DISCOUNT	TYPE OF STUDY		
	Case studies	Laboratory studies	Total
Yes for a general rail noise bonus	2	6	8
Different kinds of bonus or penalty	6	0	6
No for a general rail noise bonus	0	5	5
Neutral concerning rail noise bonus	1	1	2
Total	9	12	21

Source: Zeus Möhler 2010, page 49.

About 8 out of 21 studies came to the result that a rail noise bonus is eligible. 11 of the 21 studies came to the result that either the incentives have to be variable (for example depending on time, area influenced, noise level; even a penalty should be included), or the rail noise bonus is not eligible. 2 of the studies remain neutral. If only case studies are considered, only 2 of 9 studies agreed that a general rail noise bonus was acceptable, whereas 6 studies suggested a variable noise bonus/penalty system was necessary. The authors of that study also identified mistakes in the studies considered. The rail noise bonus/penalty must be further elaborated, especially considering the current modal split in transportation and the effects of noise at night (interruption of quiet phases), or different noise levels, for instance.

ZEUS GmbH and Möhler+Partner published an article about a census concerning the annoyance by rail and road noise at different times of day (Daytime-related harassment by road and rail traffic noise – Method and empirical results / Tageszeitsbezogene Belästigung durch Straßen- und Schienenverkehrslärm - Methode und empirische Ergebnisse) [ZEUS Möhler 2005]. The authors questioned people about their feeling of harassment from railway and road noise. The most important result is that during the evening and night the noise coming from railways harassed more than at during the day. This would justify a rail noise penalty at evening and night time.

As a result of the ALPNAP[15] project, Lercher et al. studied the use of sleeping pills by people affected by rail noise [Lercher et al. 2007]:

- Use of sleeping pills is increasing already at low levels of railway noise from 50 dB(A) upwards.
- The environment noise level of 60 dB(A) at night which leads to the necessity of action plans is considerably too high.

This leads to the general result that a rail noise bonus is not justifiable both at evening and night time but only eligible during the day and not in the night.

[15] ALPNAP = Monitoring and Minimisation of Traffic-Induced Noise and Air Pollution Along Major Alpine Transport Routes, see http://www.alpnap.org (last visit June, 30th 2011).

3. RAIL NOISE – SOURCES AND PREVENTION MEASURES

KEY FINDINGS

- **Main source** of railway noise is **rolling noise** coming from rail freight wagons.
- **Of minor importance** is engine noise (at lower speeds) and aerodynamic noise (high speed trains).
- Locally also squeal noise can be important.
- Rolling stock which is introduced from the year 2000 on is about **10 dB(A) less noisy** then rolling stock from the 1960s and 1970s.
- Against each source of noise an **enormous number of measures** has been developed in the last years.
- **Rolling noise and wheel noise** can be reduced by **composite brake blocks** (freight wagons), **resilient wheels** or **wheel dampers.**
- **Rail noise** can be reduced by rail dampers, resilient track pads and combinations with noise barriers of different heights.
- Track side or vehicle side **lubrication systems can avoid squeal noise** and are well introduced in tram way systems.
- **The most efficient measure to achieve network wide noise reduction is the retrofitting of freight cars with composite brake blocks.**

This chapter will identify the main sources of railway noise and measures to prevent or to protect from it.

3.1. Sources of railway noise

Many studies and publications exist concerning sources of rail noise. The Working Group Railway Noise of the European Commission published its Position Paper on the European strategies and priorities for railway noise abatement in 2003 [EC 2003]. The International Union of Railways (UIC) published its “Environmental Noise Directive Development of Action Plans for Railways” in April 2008 [UIC 2008].

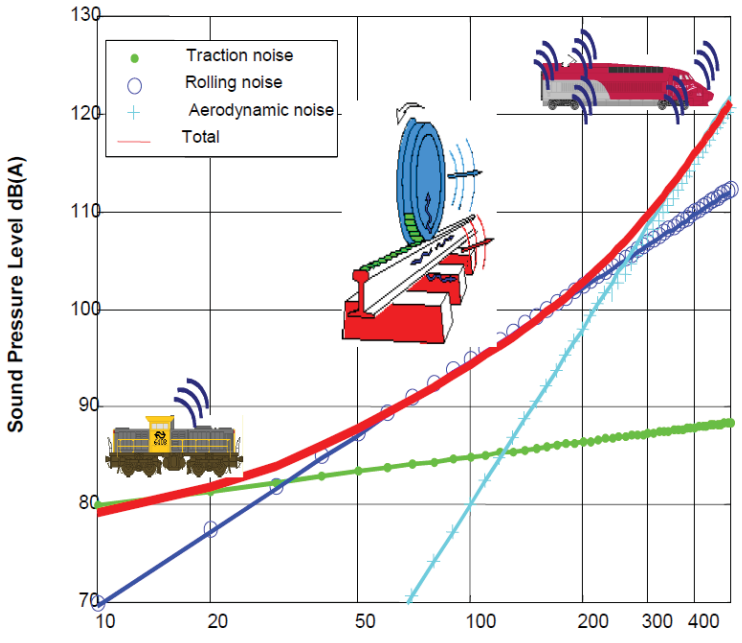
Both studies (and others, see, e.g., the comprehensive review given by [Thompson and Gautier 2006]) identify the following sources for railway noise:

- Rolling noise
- Power equipment noise
- Aerodynamic noise.

The severity and relative proportions of these noise sources depend on train speed. At low speed, power equipment noise is the dominant source, whereas at medium speed the

dominant source is rolling noise. Only at very high speed does the aerodynamic noise become an important factor. This effect is illustrated in the following figure.

Figure 6: Sources of railway noise according to train speed



Source: UIC 2008, page 7.

This figure shows that between 30 and 200 km/h rolling noise is the dominant source. This is also the speed range which affects most people living near railway tracks. Low speed is only to be found in shunting yards, near stations or on factory railways. Speeds of more than 200 km per hour are only to be found on high speed lines.

The range between 30 and 200 km/h applies to most other railway lines. Mostly these are older lines built in a time where noise protection was not obligatory. Currently these lines have the right of continuance. There is mostly no obligation to invest in noise protection measures but according to Directive 2002/49/EC, many states in Europe already introduce actions to lower environmental railway noise. The speed range between 30 and 200 km/h is also the speed where freight trains operate (about 100 km/h). Many sources identify freight trains as the noisiest trains and they mostly operate outside high-speed lines. The following table shows the importance of noise sources, depending on train type.

Table 16: Importance of noise sources

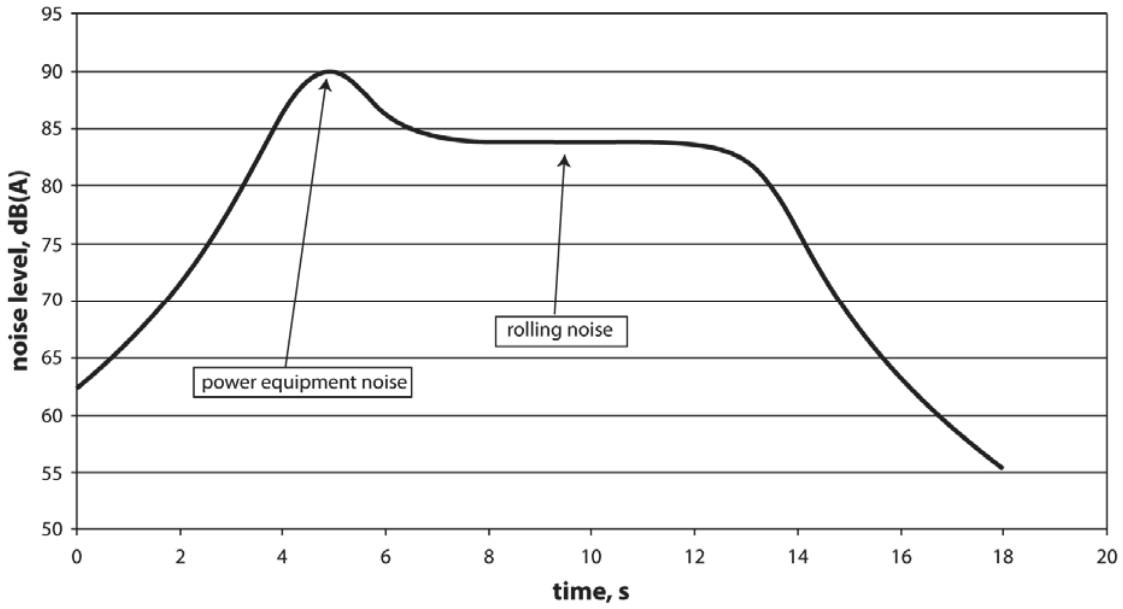
ACTION	ROLLING NOISE	POWER EQUIPMENT NOISE	AERODYNAMIC NOISE
Freight trains	++	+	Not relevant
High speed trains	++	+	++
Intercity or other long distance trains	++	+	Not relevant
City railways (tram)	++	+	Not relevant

Source: EC 2003, page 18.

The table confirms the importance of rolling noise. [EC 2003] considers that passenger trains are already quieter as they are equipped with disc brakes. This measure was not introduced for noise reduction but to enhance performance at speeds above 140 km/h.

The following figure shows the effect of power equipment noise (here a diesel hydraulic engine, built 1968 to 1979, German type 218), when a train passes. The engine noise has a large influence at the beginning of the train passage, but after a few seconds the main influence is the rolling noise.

Figure 7: Development of noise sources while train passing



Source: UIC 2008, page 13.

Concerning shunting yards: there were no reports identified which elaborate this aspect in detail. However, noise sources from shunting yards include:

- Engine noise from shunting engines
  especially many acceleration and braking phases must be considered
- Rolling noise from the wagons
  (especially in the train splitting siding zone behind the hump)
- Brake noise
  - Incoming trains
  - Braking of shunting engines
  - Braking of wagons by hump retarders (one of the loudest noise sources)
  - Testing of brakes of ready trains
- Noise from shunting impacts

Most shunting yards are located outside housing areas and their number has dropped over the years. Single wagon transport has even been abandoned in some countries. On the other hand, single wagon transport is still important and may play an important role in modal shift. There was no literature found concerning noise from shunting yards. Other shunting areas are mostly industrial railways where industrial noise protection rules must be met. Here railway noise is treated together with other noise aspects and is part of the total noise measurement or calculation for industrial plants.

Engine noise is relevant at lower speeds and so mostly near stations. This concerns especially acceleration noise when engines (especially diesel engines) work at high power drain (high motor speed, high inverter and converter noise).

Summary:

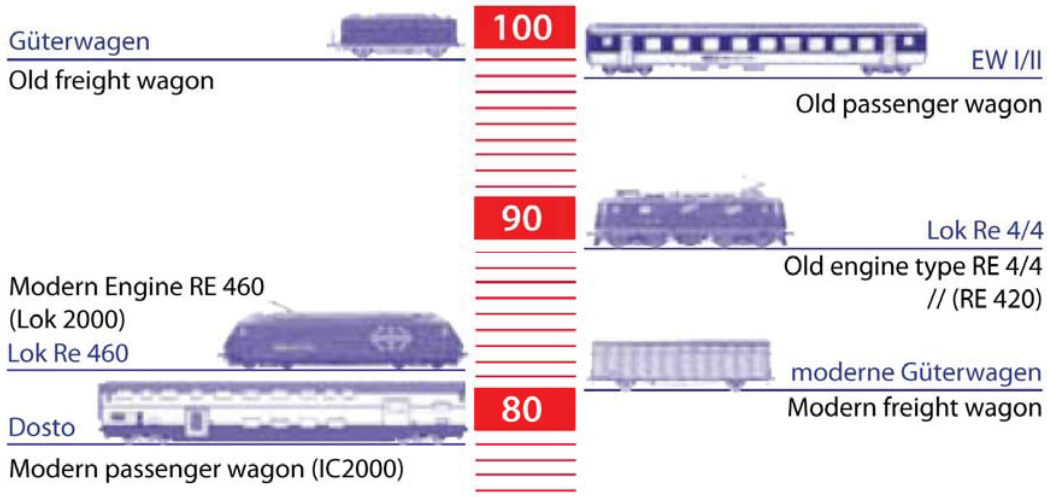
- **The most important source of noise is rolling noise, as this is relevant for both freight and passenger trains.**
- **Aerodynamic noise, especially from pantographs, is very important for high-speed trains.**

3.2. Noise emissions in relation to rolling stock

For existing wagons and engines no changes need to be made according to TSI Noise [TSI 2011]. Only in the case of renewal or upgrading of the wagon or engine is there the need for a new authorisation (to be defined by the national authority); the noise levels must be met with the new authorisation.

The following examples show the development of noise emissions concerning engines and wagons in the past. Since the year 2000, many new vehicles have been introduced all over Europe in freight and in passenger transport. In its brochure “Ruhe bitte” (silent please) [SBB 2011], Schweizer Bundesbahn (SBB – Swiss Federal Railway) showed how pass-by noise differs between old and new rolling stock. The following figure shows the changes between old stock (designed in the 1970s, or earlier) and new rolling stock (designed at the end of the 1990s). For each of the vehicle types, the noise emission measured according to TSI Noise is shown.

Figure 8: Noise emission development of Swiss rolling stock



Source: SBB 2011.

The engine Re 460 (also known as Lok 2000) is still one of the quietest engines and was the quietest vehicle of all trains until the introduction of the IC2000 passenger double deck coaches. Detailed photographs of the modern Swiss rolling stock show that the bogies are well covered by the whole engine body (Annex III).

The TSI Noise demands a maximum pass-by level of 85 dB(A) for electric engines and of 80 dB(A) for passenger wagons at 80 km/h. The Swiss examples are already below the noise level of current European legislation. This is even more interesting as the Lok 2000 was introduced in 1991 and the IC 2000 passenger cars were introduced in 1997.

[Mather 2006] presented an analysis of sources of noise in comparison with the TSI Noise. This shows the current performance of rail vehicles in comparison with the demands of the TSI. The results are shown in the following tables.

Table 17: Maximum and realised noise emissions of existing high speed trains

SPEED	MAXIMUM NOISE EMISSION ACCORDING TSI NOISE	CURRENT EMISSION OF GERMAN HIGH SPEED TRAINS	DIFFERENCE
250 km/h	87 dB(A)	87 – 94 dB(A)	0 – 7 dB(A)
300 km/h	91 dB(A)	91 – 95 dB(A)	0 – 4 dB(A)
320 km/h	92 dB(A)	92 – 96 dB(A)	0 – 4 dB(A)

Source: Mather 2006.

Table 18: Maximum and realised noise emissions of new freight wagons

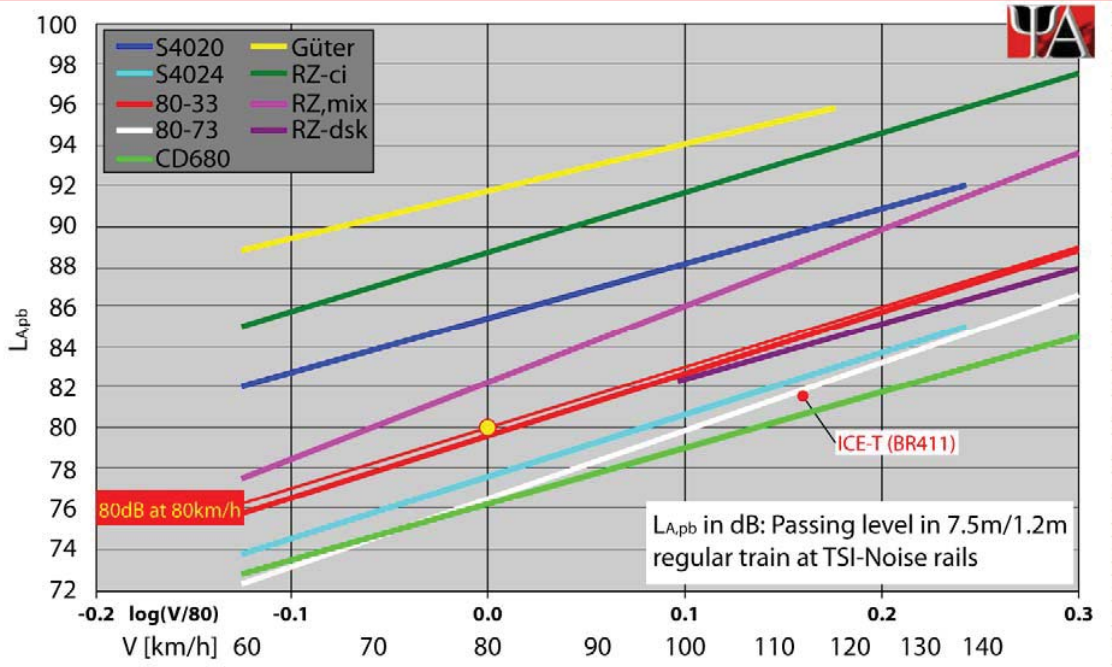
AXLES PER WAGON LENGTH	MAXIMUM NOISE EMISSION ACCORDING TSI	CURRENT EMISSION OF WAGONS	DIFFERENCE
0.15 axles per metre (new car / retrofit car)	82 dB(A) – 84 dB(A)	92 / 94 dB(A)	8 – 12 dB(A)
0.15 – 0.275 (new car / retrofit car)	83 dB(A) – 85 dB(A)	91 – 95 dB(A)	6 – 12 dB(A)
> 0.275 axles per metre (new car / retrofit car)	85 – 87 dB(A)	92 – 96 dB(A)	5 – 11 dB(A)

Source: Mather 2006.

The result is that most actions are still to realise at rail freight wagons and less on passenger trains and modern engines.

Bukovnik, in a presentation about development and measures in rail noise abatement, gives a comparison of old and new rolling stock [Bukovnik 2010]. The following figure shows the effect of new self-propelled vehicles for suburban railways. The vehicle type 4020, built between 1978 and 1987, is - at all speeds - about 8 – 10 dB(A) noisier than the type 4024 (Bombardier electric Talent) built since 2006. At 80 km/h, type 4024 meets or goes below TSI recommendations.

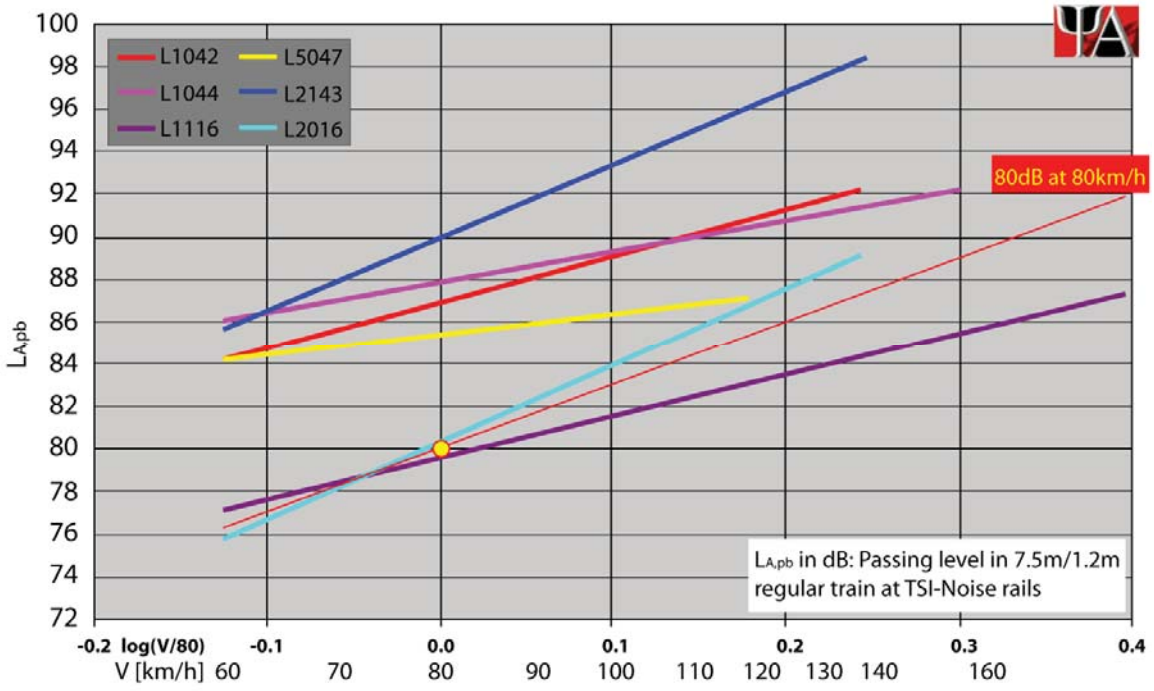
Figure 9: Noise levels of Austrian self-propelled rail vehicles



Source: Bukovnik 2010.

Similar to self-propelled passenger trains, the following figures show pass-by noise emissions of diesel and electric engines. Red lines show electric and blue lines show diesel engines.

Figure 10: Noise levels of Austrian rail engines



Source: Bukovnik 2010.

L1042 and L1044 are old electric engines, designed between 1963 and 1995. L1116 (Taurus) is a new electric engine built since 2000. L2123 is an old diesel engine built between 1964 and 1977; L2016 (Eurorunner) is a new diesel engine built since 2002. A reduction of about 8-10 dB(A) has been realised. With 80 dB(A) at a speed of 80 km/h the new engines are much below the TSI recommendation of 85 B(A).

This shows that the introduction of new rolling stock can lower noise in a big range. Halving of noise was realised since the 1960s and 1970s. Nevertheless there are also negative examples of new rolling stock that may even be noisier than the old equipment. Many sources recognise the modern Class 66 engine as well as the Blue Tiger engine as being as noisy as engines from the 1960s. Both engines were constructed in the 1990s and built since 1998. The great breakthrough to lower noise of engines came according to this since the beginning of the 21st century.

Nevertheless the noise emissions of about 80 dB(A) for new and modernised rolling stock do not lead to a reduction of noise below the WHO levels. Also the levels of the example countries cannot be met with the new rolling stock. But the reduction at the source can lower the additional needs for local noise protection as they can be less extensive or avoided in regions where people live far away from railway lines. There quieter rolling stock can lower the noise measured at far distance to an applicable level.

Summary:

- **Rolling stock introduced since the year 2000 is about 10 dB(A) less noisy in comparison with equipment from the 1960s and 1970s.**
- **So the replacement of old equipment with new ones helps to reduce rail noise.**

3.3. Measures to avoid railway noise

Sources of railway noise can be divided into the following aspects:

- Roughness-Induced Rolling Noise
- Wheel Noise
- Rail Noise
- Squeal Noise
- High Speed Trains
- Other Sources of Noise

The mitigation methods studied or already realised in demonstrators or practice will be introduced with the source of noise.

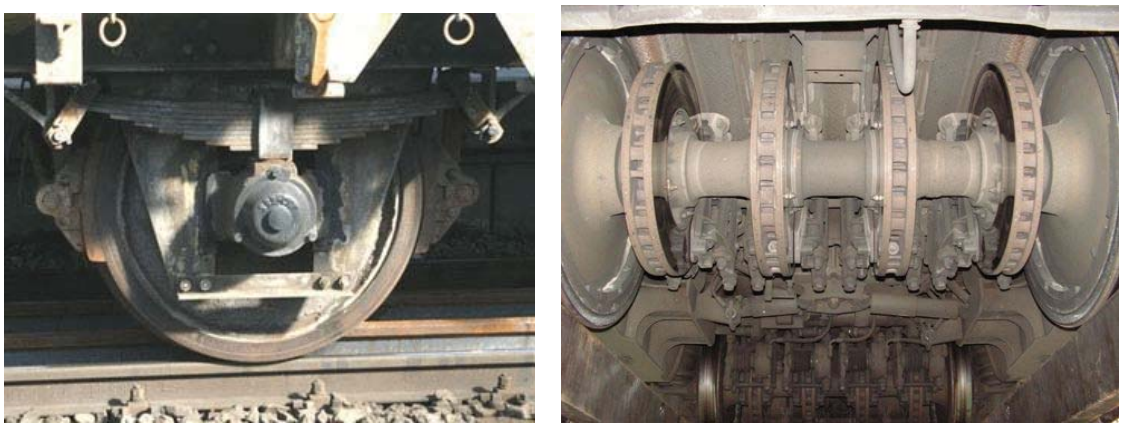
3.3.1. Roughness-Induced Rolling Noise

A major, unavoidable source of noise is wheel and rail roughness. Rail corrugation (which causes intense ground vibration and can increase noise level by 20 dB [CER UIC 2007]) and wheel flats (regular thuds) are extreme versions of this, but poor rail or wheel surface condition should be avoided. Regular grinding of rails and turning of wheels helps to minimise noise. Special ‘acoustic’ grinding can reduce noise levels by about 3 dB [Thompson 2008-1]; grinding strategies to reduce noise levels were studied in the MONA project [Thompson and Gautier 2006].

Both Speno and Schweerbau offer general purpose grinding, which can reduce noise levels by 10-12 dB, and special acoustic grinding, which can achieve a further 3-4 dB reduction [Licitra 2006]. UIC's 2007 report on the state of the art [CER UIC 2007] states that poorly maintained track increases noise levels, so that track renewal can achieve about 10 dB noise reduction, and acoustic grinding can achieve a further 1-3 dB.

Cast iron tread brakes, which are very common in European freight vehicles, tend to induce a corrugation in the wheels which increases noise levels significantly [Thompson and Gautier 2006]. By contrast, disc brakes, which are prevalent in passenger vehicles, are typically about 8 dB quieter [Hemsworth 2006]. The difference between tread brakes and disc brakes is shown in Figure 11. With tread brakes, the brake blocks press against the wheel directly on the running surface (the tread), i.e., the wheel surface which is in contact with the rail; whereas with disc brakes an extra disc is placed on the axle and brake blocks press against this to brake the vehicle. Because tread brakes, particularly with cast iron blocks, damage the wheel, the running surface becomes rough and can develop out-of-roundness, increasing the rolling noise.

Figure 11: Comparison of tread and disc brakes



Source: Hemsworth 2006.

Disc brakes are very expensive and can only be introduced with new freight wagons or expensive retrofitting of existing wagons (the whole bogie needs to be changed). The EU Project EuroSabot (1996-1999) looked into possibilities for retrofitting vehicles with a low-noise replacement for cast iron brake blocks [EUROSABOT 2011], [Hemsworth 2006], [Thompson and Gautier 2006]. This started the quest for composite brake blocks with friction characteristics similar to cast iron brake blocks, and suitable for retrofit; these are called 'LL-blocks'. 'K-blocks' are composite brake blocks used in new vehicle designs.

The advantage of LL-blocks is that the braking system of the wagon does not need to be modified, whereas for K-blocks there is additional effort necessary besides changing the blocks. This is because LL-blocks have similar friction characteristics to conventional cast-iron blocks, whereas K-blocks have a higher coefficient (2.5 times higher).

Both types (K- and LL-blocks) reduce noise levels by 8-10 dB; life cycle costs for K-blocks are similar to life cycle costs for cast iron brake blocks; life cycle costs for LL-blocks are still to be determined [CER UIC 2007] concerning operation costs. Concerning K-blocks, some manufacturers or wagon owners recently detected higher costs due to higher wheel wear [Gilliam 2008] and [Saabel 2011].

The EU Project Euro Rolling Silently (2002-2005) developed three prototype LL-blocks. By 2009, two LL-block types (IB 116* and Jurid 777) were reportedly safe for use in Europe [Dörsch 2009]. ICER Brakes S.A. sell organic LL-blocks which reduce noise by 8 dB compared to cast iron brake blocks [Licitra 2006]; organic LL-blocks are also produced by the Federal-Mogul Corporation.

However, although the new composite LL-blocks are effective at reducing noise, there are still problems to be solved before they can be implemented across Europe. In tests with LL-blocks, the wheels' equivalent conicity increases over time, affecting the dynamic stability of the vehicles. To address this, a consortium of brake manufacturers and vehicle operators has established the EuropeTrain project ([EuropeTrain]) which is using a real train travelling around Europe to speed up testing of LL-blocks.

If the LL-block could be introduced and certified the migration would be relatively easy, simply replacing the existing cast iron blocks by LL-blocks. Concerning the accreditation of LL blocks, Mr Lochman from CER expects certification by the end of the year 2011 and the beginning of introduction mid-2012, whereas Mr Pennekamp, Mr Fleckstein, Mr Mather and Mr Theis from DB expect certification sometime during 2012.[16] As a result, the authors of this study expect certification by the end of 2012, which is more practical.

In addition to EuropeTrain, the following two composite brake projects are being conducted in Europe: Leiser Rhein includes the retrofitting of vehicles, especially in the Rhine Valley, and LäGiV develops improved K-and LL-blocks.

Summary:

- **Roughness of rails and wheels, especially corrugation in rails and out-of-round wheels, is a major cause of rail noise and needs to be monitored and controlled. Infrastructure managers and train operators already have maintenance programmes to control rail and wheel quality, and infrastructure managers use axle load checkpoints to monitor passing traffic and detect severely damaged wheels. Tolerances may need to be tightened to improve quality and reduce noise, requiring additional maintenance.**

- **The use of composite brake blocks rather than cast iron brake blocks will significantly improve the wheel running contact surface and reduce noise levels. Retrofitting existing wagons with composite brake blocks is possible, and the use of LL-blocks in particular (requiring the least effort and cost to retrofit) is currently being investigated by UIC's EuropeTrain consortium. There are still questions about the long-term degradation and the life cycle costs of the new LL-blocks that are holding up widespread implementation.**

3.3.2. Wheel Noise

The EU Project Silent Freight (1996-1999) looked at possibilities of reducing noise emission from wheels [Dörsch 2009], [Hemsworth 2006], [Thompson and Gautier 2006]:

- ring dampers reduce noise by 6 dB;

[16] These statements are the results of interviews held by the project team in July 2011.

- perforation of the wheel is ineffective;
- wheel-tuned absorbers reduce noise by up to 7 dB;
- wheel web shields reduce noise by up to 9 dB.

The following figures illustrate the systems.

Figure 12: Ring damped and perforated wheel

Source: Hemsworth 2006.

Figure 13: Wheel-tuned absorbers

Source: Hemsworth 2006.

Figure 14: Wheel web shields

Source: Hemsworth 2006.

Further noise reduction can be achieved through the use of a bogie shroud [Hemsworth 2006].

Fundamental redesign of the wheel to reduce noise is difficult due to the need to fit with existing tread braking systems and the need to dissipate the heat generated during braking. Reducing the wheel diameter makes the wheel more susceptible to wheel-rail roughness interaction and can increase noise levels. The RONA project (wheel optimisation for high-speed lines) developed a new wheel design, JR13, which reduced noise levels by about 3 dB. The RONA project also developed a wheel, Alu4, with a thick aluminium web and wheel dampers, with a predicted noise reduction of 12 dB. However, following the Eschede derailment in 1998[17], caused by a broken tyre, the industry has been wary of multi-material wheels. Other incidences with broken axles on freight wagons or ICE trains[18] will make innovations of wheels and axles more difficult. The EU Project HIPERWHEEL (2000-2004) tested a constrained layer damping treatment on the ETR500 high speed train in Italy and measured a noise reduction of 4-5 dB between 200 and 300 km/h (see [Thompson and Gautier 2006]).

Lucchini[19] offers a range of special low-noise damped wheels. *Syope* is a constrained layer damping treatment; *Galene* uses tuned absorbers to reduce squeal noise for trams; *Hypno* is a friction damping steel design for tread-braked freight wagon wheels. Valdunes[20] also integrates damping systems into wheels, for example, using damping rings to reduce squeal noise by 10-15 dB (see [Licitra 2006]).

Heathcote Industrial Plastics offers constrained layer dampers which eliminate squeal noise and reduce under-vehicle noise by up to 30 dB. GHH offers wheel absorbers (5-15 dB noise reduction) and damping rings. VSG Vibration Absorbers offers wheel vibration absorbers (10-30 dB noise level reduction at squeal noise peak frequencies). Schrey & Veit offers wheel absorbers which almost completely eliminate squeal noise, and reduce the noise level by 8 dB if squeal does occur (see UIC Curve Squeal Project WP3 [Müller et al. 2003]).

Summary:

- **Resilient wheels can reduce noise and improve ride quality, and can be very effective at reducing squeal noise in tight curves. A variety of technologies are available and in use in high-speed and metro applications.**
- **Following the Eschede disaster in 1998, there is still a reluctance to use non-monoblock wheels in high-speed rail vehicles.**

3.3.3. Rail Noise

Rail dampers – steel masses embedded in an elastomer, fixed to the rail web – were developed in the 1990s by ERRI in the OFWHAT (Optimized Freight Wheels and Track)

[17] At Eschede the broken separate tyre caused the high-speed ICE train to derail at a switch. The rear bogie of one carriage followed the turnout on to a parallel track, and the carriage subsequently hit bridge supports. The bridge collapsed onto the train and the following cars crashed into the broken bridge and cars. 101 people died and a further 88 sustained injuries. The separate tyre technique was only used with ICE trains to solve a primary damping problem with this train type whereas other high speed trains only use full monoblock wheels.

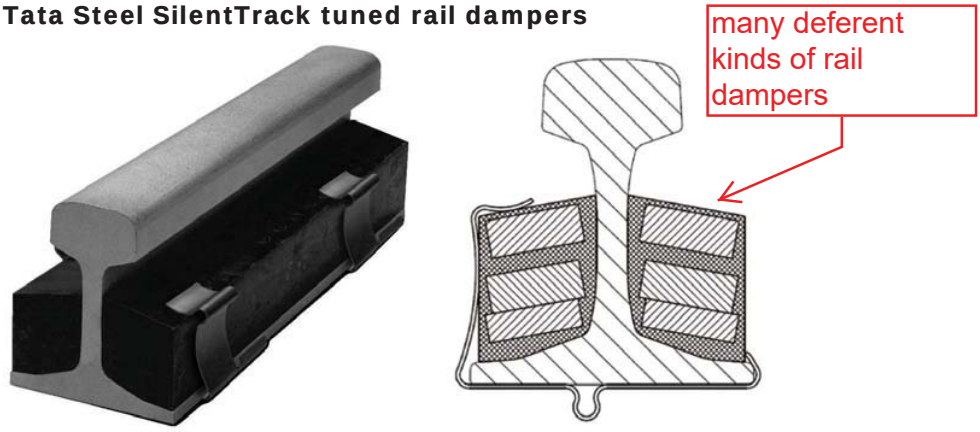
[18] Breaking of an axle of an ICE3-train in Cologne on 9 July 2008; freight train derailment in Viareggio (Italy) 30 June 2009.

[19] Lucchini RS [http://www.lucchinirs.it/] is an Italian company which produces high-speed wheelsets; this is separate from the Russian-owned steel manufacturer Lucchini.

[20] Valdunes [http://www.ghh-valdunes.com/] is a major European wheelset manufacturer based in Germany, France and Belgium.

project and SNCF in the VONA project (low-noise track designs for high-speed lines) [Thompson and Gautier 2006]. The EU Project Silent Track (1997-2000) developed these rail dampers further; the new design reduced noise by 6 dB [EUROSABOT 2011], [Hemsworth 2006], [Thompson and Gautier 2006]. The Dutch IPG project[21] tested rail dampers and found the silent track dampers and also the Schrey and Veit (S&V) VICON-ASMA 5RQ absorber to be effective, reducing noise levels by 3 dB [Thompson 2008-2]. Further testing of rail dampers is presented by van den Dool [van den Dool 2007].

Figure 15: Tata Steel SilentTrack tuned rail dampers



Source: Tata Steel; images from product brochure.

Tata Steel offers the 'SilentTrack' tuned rail damper system (see Figure 15), with a noise reduction of 3-7 dB. The rubber at both sides of the metal rail causes the noise reduction. Over 200 km of SilentTrack are in operational use around the world, including the Netherlands, Germany and the UK.

Trackside barriers can also be used to reduce noise levels [Hemsworth 2006], [Thompson and Gautier 2006], but rail dampers can make barriers and screens unnecessary [van den Dool 2007].

The VONA project also developed optimised rail pads which reduced noise levels by 3-4 dB [Thompson and Gautier 2006]. Rail pads were also developed in the Silent Track project, reducing noise levels by 2 dB.

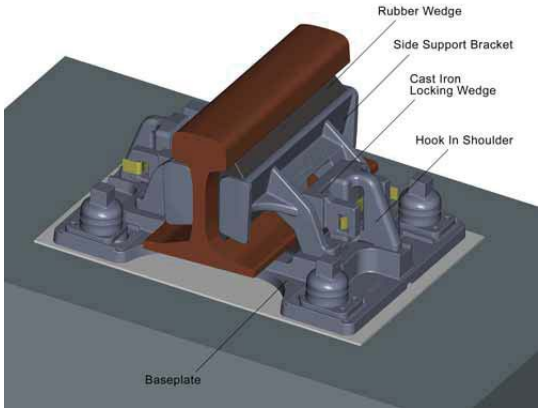
Saargummi and CDM offer a range of resilient rail pads designed to damp noise and vibration; CDM and Getzner Werkstoffe offer under-sleeper pads and ballast mats and a range of solutions for slab track and embedded track systems [Licitra 2006].

Pandrol's VANGUARD uses resilient padding to attenuate noise, but also supports the rail at the web to prevent rail roll. This system is used in the London Underground (Victoria Line) and the Channel Tunnel Rail Link, for example, and recently in the new development of Belgrade Central where vibration reduction was a key consideration. When tested in Hong Kong's MTRCL test track on plain slab track, the VANGUARD system reduced average noise levels by 7.3dB in the 20Hz-500Hz range; and by 13dB in the 40Hz-80Hz range. These tests showed even greater noise reduction was possible by using the VANGUARD on an Isolated Slab Track (IST); IST has a rubber ballast mat and is easier to install than floating slab track, but is not as effective.

[21] Innovatieprogramma geluid (IPG) voor weg- & spoorverkeer [http://www.innovatieprogrammageluid.nl/].

Figure 16: Left: Saargummi rail pad; Right: Pandrol Vanguard resilient web support

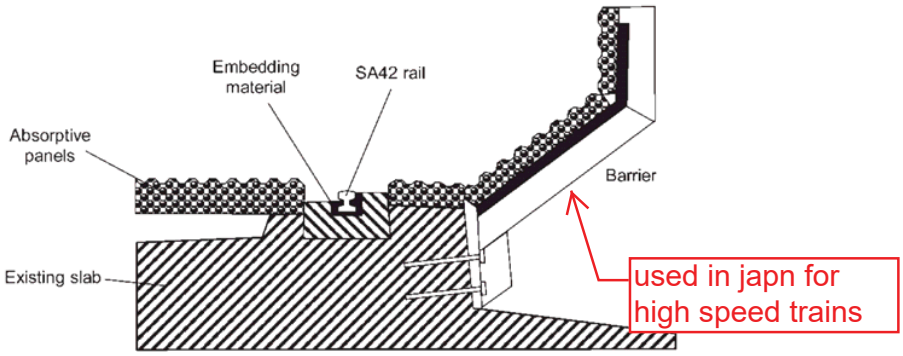
Source: Licitra 2006



Source: Pandrol Vanguard; product brochure

The Silent Track project developed a new rail section with a narrower fit, along with a new fastening system and a new twin-block sleeper design; this reduced noise levels by 3 dB. The Dutch project Quiet Rail Traffic (STV) developed a new, smaller rail section, SA42, for slab track (see Figure 17); the rail is continuously supported by a stiff embedding material, and this acts as a damping mechanism. The noise reduction compared to slab track with UIC 54 rails is 5 dB. Barriers at the side of the track, with a height of 0.7 m, further reduced noise levels by 6 dB (see [Thompson and Gautier 2006]).

Figure 17: Slab track section SA42 from Quiet Rail Traffic project



Source: Thompson and Gautier 2006.

The Edilon Corkelast embedded rail system, which provides a noise reduction of 5 dB, has been implemented in the rail steel bridge over the Arno in Pisa [Licitra 2006].

Balfour Beatty Embedded Rail System (BBERS) has been shown in a test in Medina, Spain, to reduce noise level by 2 dB or more, compared to ballasted track [InnoTrack D2.3.3].

Summary:

- **Noise and ground-borne vibration are a major concern in urban areas, and bridges and underground railways require special measures. Resilient rail pads are a common solution, but for locations where a greater level of damping is required then floating or isolated slab track is a possibility, or under-sleeper pads and ballast mats for ballasted track; an alternative to**

rail pads is a more advanced resilient rail support system such as VANGUARD.

- **Resilient rail support solutions interact with each other and also with resilient wheel technologies, and the whole system needs to be considered and modelled in order to minimise noise and vibration in the required frequency range.**

- **Noise barriers have a large on-going maintenance cost, have a high visual impact and create problems for track access. Rail dampers can be tuned to the local needs of the railway and left in place for the life of the track; these can be an effective alternative to noise barriers.**

3.3.4. Squeal Noise and Friction Modifiers

Squeal noise is the high pitch noise (2-4 kHz) sometimes emitted when vehicles are curving. This is caused by lateral stick-slip behaviour of the contact between the wheel and rail exciting high-frequency resonances in the rail and wheel. Many wheel and rail damper solutions target squeal noise.

Friction modifiers are used to change the interaction of wheel and rail to prevent squeal noise and corrugation. As of 2005, UIC's position on friction modifiers was that there is no optimal solution. Friction modifiers can be lubricants, e.g., greases, designed to reduce friction to 0.2 or less, and usually applied to the gauge face of the high rail in curves where the wheel flange often makes contact, creating a grinding sound and high levels of wear. Lubrication is primarily used to reduce wear, and is not desirable on the top of the railhead where high levels of friction are required for traction (train acceleration and braking). Top-of-rail (TOR) friction modifiers (FM) control friction to be in the range 0.3-0.35. To prevent squeal noise, friction modifiers need to have 'positive friction' characteristics, so that friction increases when the wheel slips. TOR FM can also be effective at reducing short-pitch corrugation (a major noise source) on the low rail in curves, and has been used successfully in the Heathrow Express to combat corrugation[22].

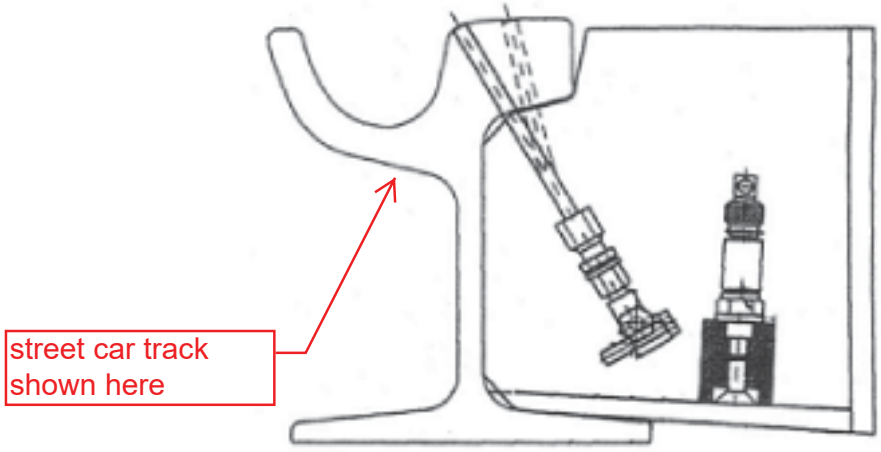
Alternatively, special asymmetric rail sections can be used to prevent squeal ('Anti-Squeal Profile'), and the track layout can be adjusted to avoid dynamic conditions of the vehicle which cause squeal noise. Special surface layers or coatings can be designed with special friction characteristics, such as Duroc AB's particle-impregnated rail surface. Based on laboratory tests, this layer has a low coefficient of friction when dry, and is also effective at reducing rail wear, and even the corresponding wheel wear is relatively smooth (see [Hiensch et al. 2007]).

The EU Project Q-City (2005-2009) tested vehicle and track lubricators for squeal noise suppression. On-board lubrication was tested in the Antwerp network and found to be effective at reducing squeal noise, and for a relatively low cost. A wayside lubrication system was tested at the STIB depot; the wayside lubrication was very effective, decreasing squeal noise by at least 16 dB. In general, electric power is required on site for wayside lubricators, and access to hydraulics for maintenance may be difficult in urban

[22] M. Chestney, N. Dadkah and D. Eadie (2009) The Effect of Top of Rail Friction Control on a European Passenger System: The Heathrow Express Experience, 8th International Conference on Contact Mechanics and Wear of Rail/Wheel Systems (CM2009), Firenze, Italy. [For a summary of this, and a general look at TOR FM, see also: http://www.therailengineer.com/railtex2011/Day-2-No-06-Kevin-Portec.pdf].

environments (see [Q-City 2009]). These techniques, indeed, are only tested for municipal railways (light rail, underground systems).

Figure 18: Principle of way-side lubrication systems for friction modifying



Source: Q-City 2009.

The particular through-hole lubricator prototype developed by Lion Oil was found to be unreliable (see Figure 18). The figure shows the injection device to lubricate the rail-wheel-contact area. Other similar systems are on the market, and the annexes of [Q-City 2009] give quotations for: (A) Clicomatic rail through-hole grease lubrication system; (B) FluiLub rail lubrication systems (vehicle-mounted and track-based).

ELPA d.o.o. offer another through-hole wayside application for suppressing squeal noise, both in curves and during braking (particularly useful at marshalling yards) [ELPA], [Licitra 2006]. The ELPA system uses an environmentally friendly composite friction modifier.

Other track-based rail lubrication / friction management systems are: Portec trackside Friction Management System (5-15 dB noise reduction); Schreck-Mieves Electronic Rail lubrication; and KLS Lubriquip. Other on-board friction management systems: REBS (rail lubrication, 20-28 dB reduction at 2500 Hz, and wheel-flange lubrication); TracGlide (rail lubrication); Vogel AG (wheel-flange lubrication); Kelsan/Lubriquip (wheel-side, 2-7 dB reduction); Barnt Green Birmingham (water spray); SBB (water spray) (see UIC Curve Squeal Project WP 3 [Müller et al. 2003]).

Summary:

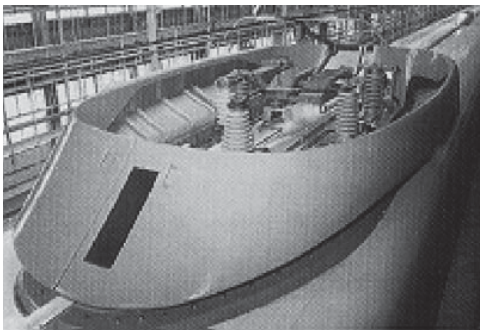
- **Gauge-face lubrication is the traditional means for controlling wear of the high rail in narrow-radius curves, which has a secondary effect of reducing noise levels, including squeal noise in some cases. The main technological developments in this area focus on the applicators.**

- **Top-of-rail friction modifiers are a relatively new extension of this technology, and are used to prevent corrugation of low rails and squeal noise in curves, as well as brake squeal in shunting yards.**

3.3.5. High-Speed Trains

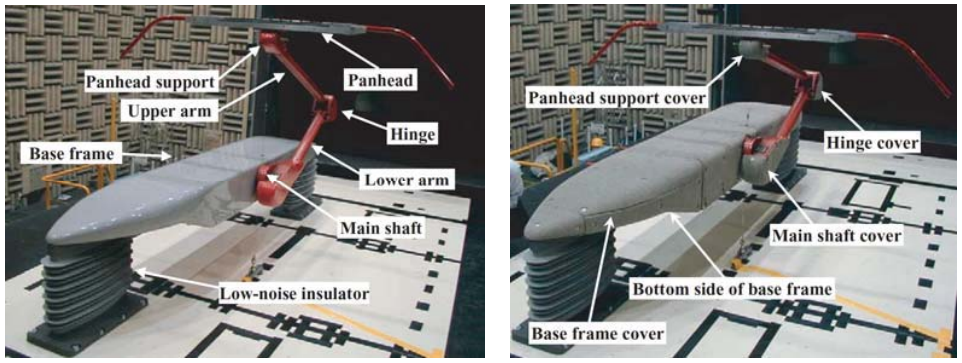
Aerodynamic noise becomes significant at high speed (over 200 km/h) reaching a noise level similar to rolling noise. For electric trains, pantograph noise is also significant at high speed. Pantographs and the leading bogie are the two main sources of aerodynamic noise. Pantographs can be shielded (see Figure 19) and/or carefully shaped, and thereby achieve noise reductions of 5-10 dB in each case (see [Talotte 2000], [Talotte et al. 2003]). [Sueki et al. 2009] have shown that porous covers can reduce aerodynamic noise of pantographs.

Figure 19: Shield of pantograph of Japanese Shinkansen Series 700



Source: Talotte 2000.

Figure 20: Porous coating of pantographs



Source: Sueki et al. 2009.

Vibrations caused by vehicle-track interaction travel through the ground at a speed that depends on the ground type; propagation is slower in softer soil. If train speed exceeds the ground vibration propagation speed, then this creates a ground-borne vibration 'boom', analogous to a sonic boom when aircraft break through the sound barrier. In practice this means there is a threshold train speed above which ground vibration increases sharply. For peat and clay soils, this critical speed can be as low as 150 km/h, but bogie spacing and axle spacing also influence the critical speed [Madshus and Kaynia 2000].

Concerning high speed trains on high speed lines, often ballast-less tracks are used. As this superstructure is a hard soil the noise can increase due to the hard concrete plate, low absorption of noise and strong transference. The normal solution is to cover the ballast-less tracks with dampers.

Summary:

- **Pantographs are generally higher than noise barriers, and for high-speed trains these are a major source of noise. Rather than making noise barriers**

even higher or all-enclosing, an alternative approach is to focus on aerodynamic design and new materials.

3.3.6. Other Sources of Noise

Other sources of noise include locomotive exhaust, traction motors, cooling fans, bridges and train horns [Talotte et al. 2003]. Resilient baseplates are effective at reducing bridge noise (the Pandrol VIPA system reduced noise by 6 dB in one study [Wang et al. 2000]). Schrey & Veit (S&V) also offer a tuned absorber system for railway steel bridges [Licitra 2006] with also approximately 6 dB noise level reduction.

It should be noted, finally, that poor or infrequent maintenance can cause increased noise levels, particularly from components with moving parts, e.g., bearings, vehicle suspension.

3.3.7. Other options to reduce noise

Other options, such as speed limits and land-use planning, are rejected in [UIC 2008]. Speed limits need to be substantial (50 km/h) to have a considerable noise impact and thus "are not compatible with the operation of a commercially competitive railway" (although the benefits of speed reduction should be considered on a case-by-case basis). Land-use planning measures are of little effect, since further than 50 metres from the source "noise level is insensitive to even medium changes in distance".

The redirection of trains is not always suitable. In some cases there may be alternative lines, but here also people can be affected. So this solution may only be a shift of the problem. In some cases, for example the Rhine axis, there are no (realistic) alternatives.

3.4. Result for main reduction measures

The following table shows a summary of measures, effects and costs, collected from the different sources.

Table 19: Measures, effects and costs

MEASURE	AVOIDED SOURCE OF NOISE	IMPACT (LOCAL, NETWORK WIDE)	EFFECT	COSTS / UNIT[23]
K-blocks	Rolling noise	network wide	Up to 8 dB(A) – 10 dB(A)	4,000 – 10,000 € per wagon[24]
LL-blocks	Rolling noise	network wide	Up to 8 dB(A) – 10 dB(A)	500 – 2,000 € per wagon[25]
General grinding of bad track	Rolling noise	local	10 – 12 dB(A) (up to 20 dB(A) at very bad tracks)	Shall be established in normal maintenance

[23] Cost information comes from [UIC 2008] page 25.
[24] Retrofit, for new wagons there are no additional costs; additional operating cost still to be analysed.
[25] Retrofit, for new wagons there are no additional costs; additional operating cost still to be analysed.

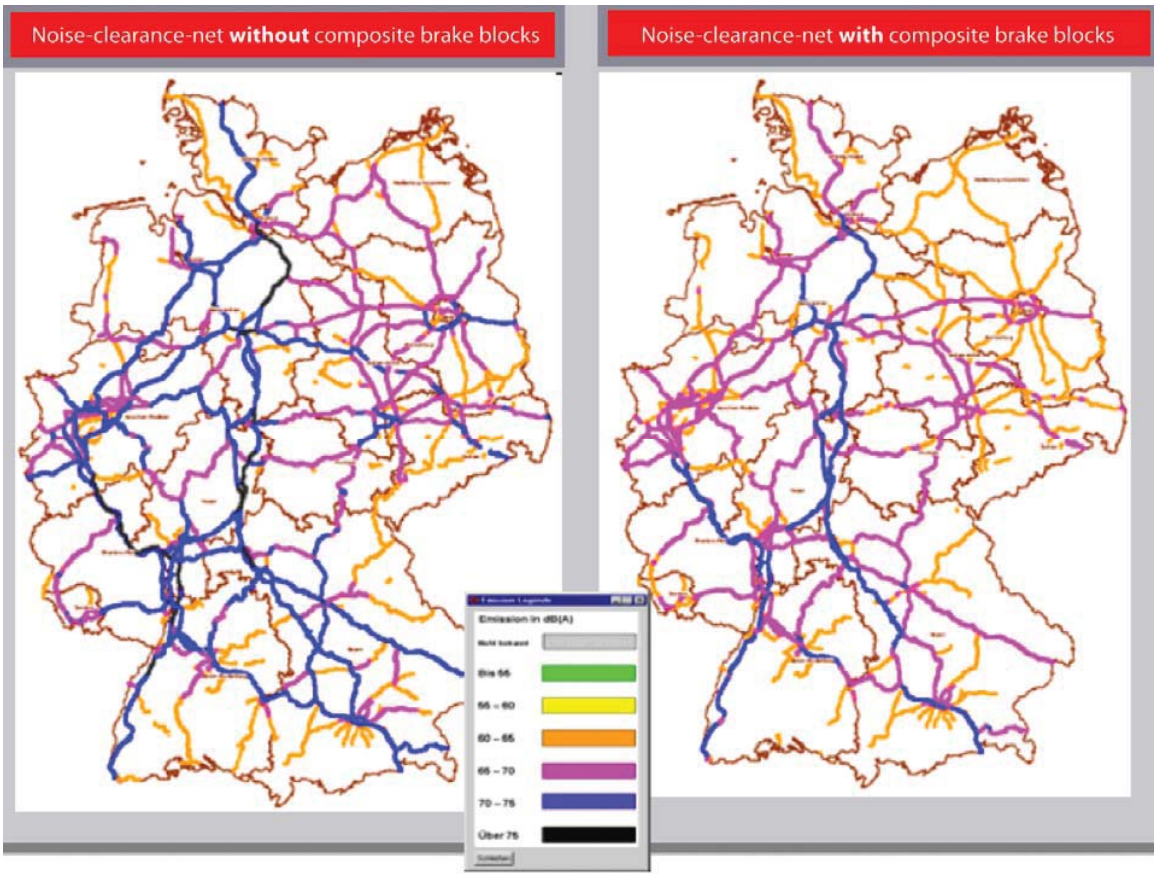
MEASURE	AVOIDED SOURCE OF NOISE	IMPACT (LOCAL, NETWORK WIDE)	EFFECT	COSTS / UNIT[23]
Special acoustic grinding	Rolling noise	local	1 – 4 dB(A) (depending on local rail roughness conditions), mostly around 2 dB(A) attended	
Disc brakes	Rolling noise	network wide	10 dB(A)	Meanwhile mostly established in passenger cars
Wheel-tuned absorbers	Wheel noise	network wide	2 – 7 dB(A)	3,000 – 8,000 € per wheel → (24,000 – 64,000 per 4-axle wagon)
Bogie Shrouds together with low height barriers	Wheel noise	local	8 – 10 dB(A)	
Rail dampers	Rail Noise	local	3 – 7 dB(A) (mostly around 3 dB(A) attended)	300 – 400 € per metre (two rails)
Slab tracks	Rail noise	local	5 dB(A)	
Rail pads	Rail Noise	local	3 – 4 dB(A)	
Different measures to lower squeal noise	Squeal noise	local	Up to 20 dB(A) depending on local conditions	
Shielding of pantographs	High speed trains	Global but only at high speed up from 200 km/h	5 – 10 dB(A)	
Barriers 2 meter high	All sources	local	10 dB(A)	1,000 €/m
Barriers 3 – 4 meter high	All sources	Local	15 dB(A)	1,350 €/m (3 metres high) 1,700 €/m (4 metres high)
Insulated windows	All sources	In house only	10 – 30 dB(A)	3,000 – 8,000 € per house (4 windows)

Source: Elaborated by the authors from different sources.

Deutsche Bahn has published two graphs in its Statement for Noise Reduction [DB 2010] Figure 21 shows, on the left, the current noise levels on German railway lines; and, on the right, the results of a simulation with the assumption that composite brake blocks for rail freight wagons have been introduced. The graphs show that the network affected by high noise emissions will shrink by introducing modified tread brake blocks. Fewer lines will be affected by noise levels between 70 – 75 dB(A) and 65 – 70 dB(A). Nevertheless, there are many lines which will remain affected by these noise levels.

However, the introduction of low noise wagons with the help of composite blocks lowers the number and length of rail sections where local (expensive) measures must be taken.

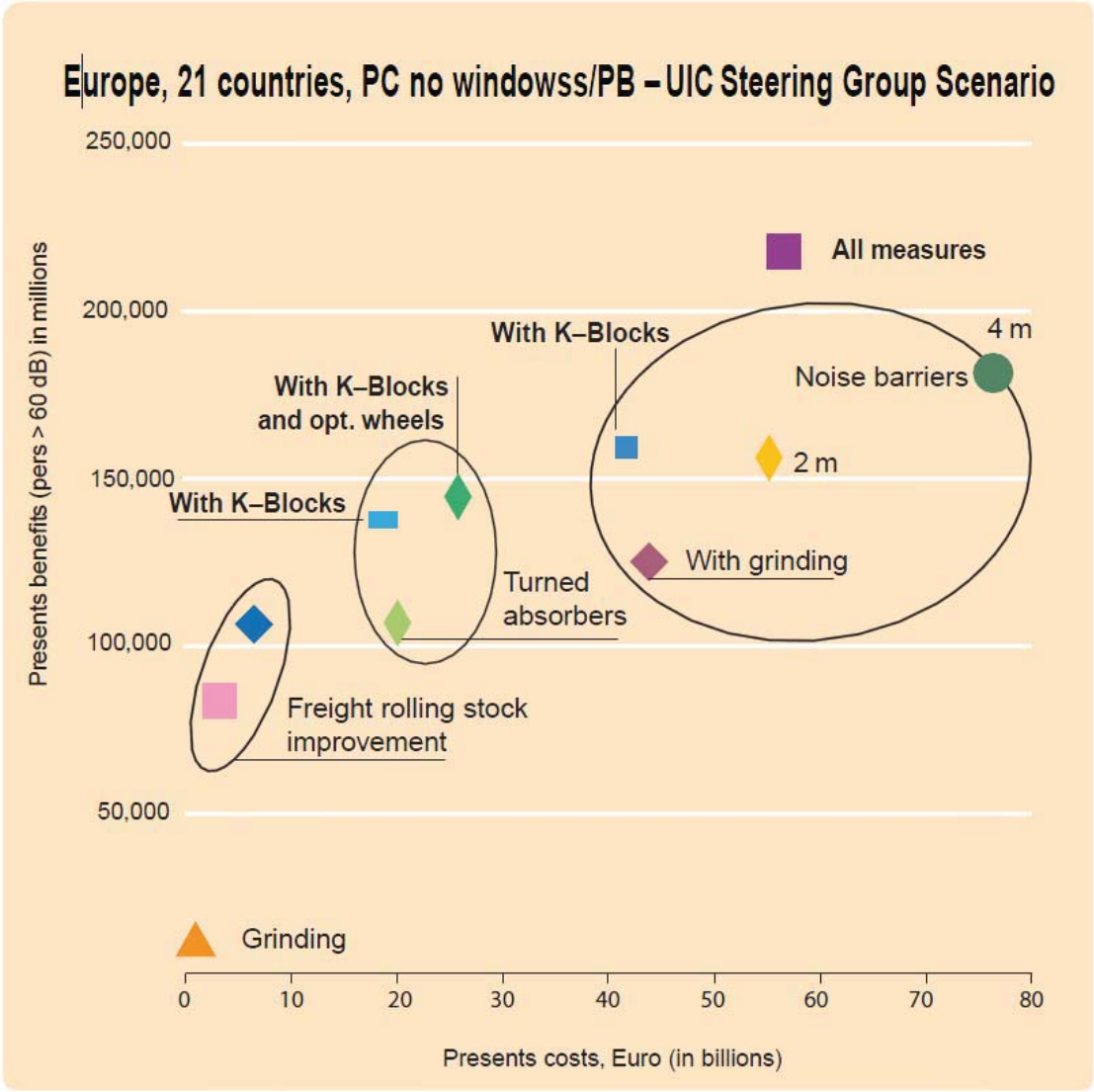
Figure 21: Shift of noise levels on German railway lines due to introduction of composite iron soles for rail freight wagons



Source: DB 2010, page 3.

The UIC published in its report “Railway Noise in Europe – A 2010 report on the state of the art” a diagram where the costs and benefits of different measures and combinations are presented [UIC 2010]. Figure 22 represents the main result of the STAIRRs Project (funded by the EU 5th Framework Programme). The graph shows that the most cost effective measure to lower railway noise is the retrofitting of freight wagons with composite blocks. It costs about 5–10 billion Euro and lowers noise for about 100 million people. The combination of composite blocks with rail-tuned absorbers will raise costs up to 20–40 million and affect 100–150 million people. In comparison, noise barriers (without any changes in vehicle technology) will cost about 80 billion Euro and affect about 180 million people. As a result, the introduction of composite brakes saves a considerable amount of money in comparison with noise abatement only realised by noise barriers.

Figure 22: Cost benefit analysis of measures to reduce noise in STAIRRS project

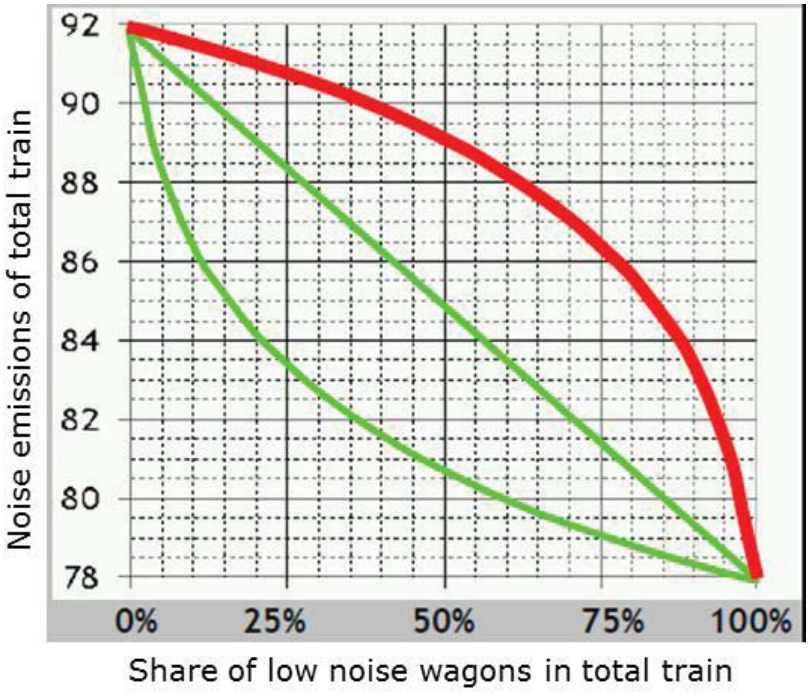


Source: UIC 2010, page 15.

Concerning the equipping of freight wagons with composite blocks: The noise reduction effect of a complete train depends in a logarithmic form on the number of wagons equipped with composite blocks. This effect is illustrated by [Bukovnik 2010].

The red line in Figure 23 is the relevant one. It shows the effect of the total noise emission (y-axis) of a train in which a certain share of wagons is equipped with low noise brakes (x-axis). The assumption for Figure 23 is that wagons equipped with composite brakes cause noise emissions of 78 dB(A), whereas the others cause emissions of 92 dB(A). The figure shows that noise reduction for a whole train follows the share of noise-reduced wagons and is disproportionately low until about 75% of the wagons have composite brakes, and after that the total noise decreases faster.

Figure 23: Effect on total noise according to share of wagons equipped with K- or LL-blocks



Source: Bukovnik 2010.

If 50% of the wagons were equipped with composite blocks the total noise would only be reduced to a noise level of 89 dB(A) (21% of total possible lowering). Only if about 98% of wagons were equipped would a total level of 80 dB(A) (86% of possible lowering) be reached. This means that the lead time until significant noise reduction is achieved will be very long if the modified wagons are introduced by normal replacing of old wagons by new ones after the normal operation time of a wagon (about 40 years).

To achieve a significant and noticeable effect, a large share of wagons has to be equipped with K- or LL-blocks as soon as possible. LL-blocks can be completely introduced according to the normal operational lives of blocks (which in some cases is less than one year as normally – operation time for cast iron blocks is about 60,000 km, whereas wagons for combined transport run about 100,000 km per year). K-blocks can be introduced in about 6–8 years providing the possibility for wagon owners to modify the braking system with the general inspection.

Conclusion:

Regarding the costs and the associated effects, and current experience of noise measures, the authors conclude that:

- Noise should ideally be reduced at the source because these measures have a network-wide effect.
- **A relatively cheap way to reduce noise on freight routes is to retrofit braking systems of rail freight wagons with composite brake blocks as quickly as possible.**
    - Freight trains are currently identified as the noisiest trains.
    - Most freight trains operate at night which is the most sensitive time of day.
    - Most passenger trains already have disc brakes due to higher speeds and enhanced comfort for passengers, so these trains are quieter than freight trains.
    - Wheel dampers are very expensive and cause additional efforts for maintenance but can significantly reduce noise emission.
- In case of high-speed trains, advanced pantograph designs should be considered, especially for routes through noise-sensitive areas where noise bunds and barriers shield against rolling noise but may not shield pantograph noise.
- Where track infrastructure causes increased noise levels (e.g., structure-radiated noise from viaducts or curve squeal in narrow radius curves), or where the local environment is particularly sensitive to noise (e.g., urban environments with residences very close to the railway line (especially agglomerations) or areas of natural beauty) then additional trackside noise mitigation measures may be necessary.
    - Rail-tuned absorbers can be effective against curve squeal and rolling noise, reducing noise levels typically by 3-7 dB(A). These can be a low-cost solution which avoids visually intrusive noise barriers.
    - Noise bunds and barriers can be effective against noise propagation, but can create problems for track access and have high on-going maintenance costs.
    - Curve squeal and corrugation of the low rail can be prevented using top-of-rail friction modifiers.
- In the long term, new wheel concepts can be introduced, but these need more research and testing before they can be introduced especially into high speed vehicles.
- In dense populated areas with high frequencies of trains, noise protection walls or insulating windows still need to be introduced. Their number could shrink in case of well introduced source related measures or modified tracks.

3.5. Number of rail freight wagons to be retrofitted

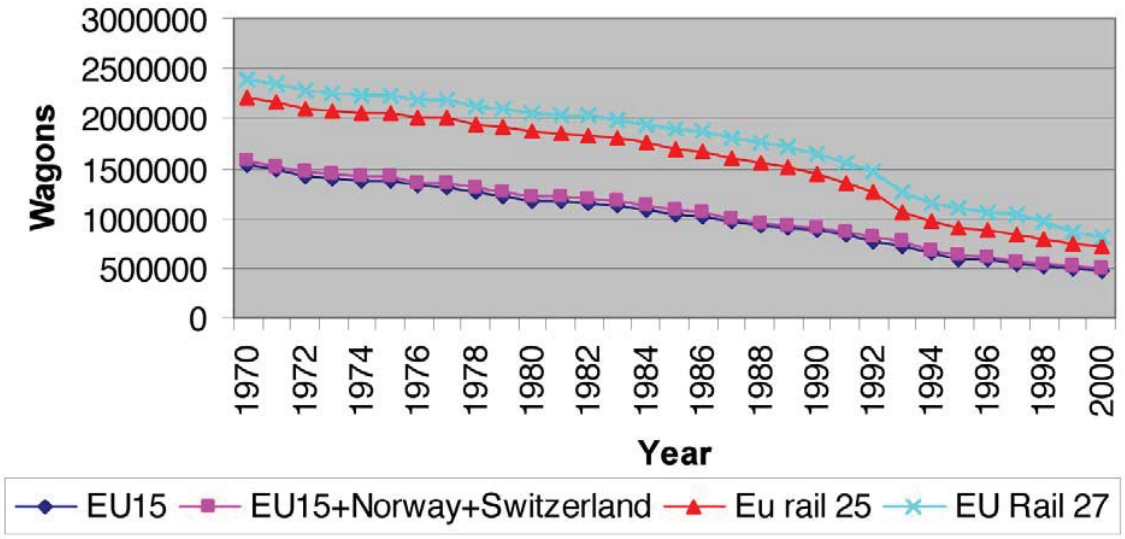
To identify the value of retrofitting freight cars with composite brake blocks, an analysis of the age structure of the fleet must be done. One question is the number of wagons it is worth retrofitting. Another is the number of wagons that will be replaced by new ones in the near future, since these are not worth retrofitting.

Unfortunately the only study available concerning the freight wagon fleet is from the year 2004 [AEA et al. 2004]. The figures from that report will be updated by some recent reports or news from European railways, wagon owners and wagon manufacturers.

The AEA study mentions on page 38, that Trenitalia has made a detailed survey of the European fleet in the year 2000. If a retrofitting programme had begun in 2005, the retrofitting would have affected 650,000 wagons out of 1.2 million.

In general, the AEA study points out that determining the size of the fleet is very difficult due to the lack of data from some countries. Also, the authors did not get data from each of the railway companies or countries because the number and age of freight cars is often confidential for competition reasons. The estimated total number of freight cars in Europe is given in Figure 24. The age structure of the total fleet of the year 2000 is presented in Table 20.

Figure 24: Estimated number of freight cars



Source: AEA et al. 2004, page 39.

Table 20: Age structure of freight wagon fleet in the year 2000

Building year	Share
Before 1970	10%
Between 1970 and 1980	46%
Between 1980 and 1990	22%
after 1990	10%

Source: AEA et al. 2004, page 42.

To update the figures given in the AEA-study, the authors have made additional analyses using other sources.

Recent documents from VDV, UIC and others indicate that in Europe 600,000 rail cars still exist or are relevant for noise reduction programmes. The UIC indicates a total number of 600,000 old wagons to be retrofitted [UIC 2009]. Also VDV together with VPI, DB Schenker

and DB Netz indicate 600,000 wagons where retrofitting must be checked [VDV et al. 2010].

For retrofitting activities the railway alliances UIC, CER, UIRR, ERFA, EIM and UIP together answered a Consultation document of the Commissions Services [UIC et al. 2007]. Their statements concerning the worth of retrofitting focus on the number of years a retrofitted wagon will be used. This is about 4–6 years (one revision cycle) but realistically 10 years. The normal durability of a freight wagon is about 40 years, so the oldest wagons to be retrofitted may be about 30 years old. According to the figures mentioned in Table 20, only 264,000 of the fleet of the year 2000 are valid for retrofitting (only the categories up from the year 1980). General figures about the total number of wagons currently operating in Europe are 600,000 or 650,000. The difference between the wagons up to 30 years and the highest number of wagons in operation makes 386,000 wagons which either have been built since the year 2000 or before 1980. Estimating that the normal life time of freight wagons is 40 years, almost 80% of wagons produced between 1970 and 1980 are still in use. That makes about 300,000 wagons. So about 86,000 wagons must have been produced since the year 2000. Together with the fleet worth retrofitting, from between the years 1980 and 2000, this makes a total of 350,000 wagons.

An interview with Mr Kerth from VDV by the authors came to an estimate of 350,000 to 370,000 wagons to be retrofitted. Also KCW indicates a total number of 370,000 freight cars to be retrofitted [KCW 2009].

Summary:

- **Although the exact number is not known, a reasonable estimate is that there are currently 370,000 freight wagons suitable for retrofitting with composite brake blocks.**

4. CASE STUDIES

KEY FINDINGS

- This section describes some general noise situations in regions and rail sections and effects of realised or proposed measures to lower / avoid noise.
- On the **Rhine Axis** the situation on the currently realised/planned upgraded line **between Karlsruhe and Basel** and the existing line in the narrow Rhine Valley between **Bingen and Koblenz** is described. A **simulation** of the introduction of noise barriers on the one hand and of composite brake blocks on the other hand is made.
- For **alpine regions** general findings from a research project on noise are represented.
- For the **Inn Valley in Austria** the current situation, development of rail transport and the intensive activities of Austria concerning the **installation of noise protection walls** are described.
- For the **Fréjus Corridor between France and Italy** the noise situation is described.
- For the **UK activities** and noise situations for the new built projects **Thameslink** and the **two High Speed Lines** are represented.

This chapter is divided into two main sections. Section 4.1 on page 71 describes selected regions or countries and includes some general local aspects of noise emission and noise spreading in mountain areas. Section 4.2 on page 83 analyses selected railway lines in more detail. The effects of sample measures which are described in Section 3.3 on page 53 are calculated.

4.1. General descriptions of environmental railway noise in selected areas or countries

4.1.1. Rhine Axis

The Rhine Axis beginning at the ARA ports and ending in Basel with the continuance via Gotthard and Lötschberg to north Italy represents one of the most important freight corridors.

The main areas where the discussions about railway noise are currently the strongest are the section between Bingen and Koblenz and the new build “Rheintalbahn” between Karlsruhe and Basel. The section Bingen – Koblenz is the narrowest section of the Rhine Axis where railway lines are located on both sides of the Rhine. The rail track follows the river with many sharp turns. The section Bingen – Koblenz will be described in Section 4.2.1 on page 84. This section focuses on the Rheintalbahn.

In 1993 the first sections of two extra tracks between Karlsruhe and Basel were introduced for operation on the "Rheintalbahn". In the following years more and more sections got into operation. They are mostly located next to the existing railway line but also some of the new sections are constructed next to the motorway A5 (example: bypass Freiburg for freight trains) or use completely new corridors (like the Rastatt tunnel or the Katzenberg tunnel). The sections between Rastatt and Offenburg are in operation. The sections Karlsruhe – Rastatt and Offenburg – Basel are still in planning or partly under construction. There are many objections against the project especially due to noise pollution reasons.

BMU and Intraplan Consult published a prediction about numbers of trains between Offenburg and Basel. The study firstly comes to the result that about 1,300,000 people are living in the affected area of the railway[26] line ([BVU INTRAPLAN 2008], page 11).

The following table gives the result of predicted numbers of trains for sample sections (rural and urban areas).

Table 21: Prediction of numbers of trains on Rheintalbahn

SECTION (SAMPLES)	TRAIN TYPE	2007	2015	2025
Denzlingen – Freiburg (agglomeration)	Long distance trains	66	76	78
	Regional trains	124	152	190
	Freight trains	160	286	304
	Share of freight trains	47%	56%	53%
Müllheim – Auggen (rural area)	Long distance trains	66	76	78
	Regional trains	50	76	76
	Freight trains	160	280	304
	Share of freight trains	58%	65%	66%

Source: BVU INTRAPLAN 2008, page 38.

The predictions for regional trains as well as for long distance trains come from existing planning for extensions of public transport services.

The figures show that in the corridor the number of freight trains will rise about 100% in all sections. In the Freiburg agglomeration, the number of regional trains also will rise. The share of freight and passenger trains differs between agglomeration and rural areas. In agglomerations the share of freight trains is about 50% whereas in rural areas the share will rise up to 66%. So the influence on total noise is different.

The share of trains during day and night time for 2015 is shown in the following table.

[26] Cities of Freiburg, Ortenaukreis, Landkreise Breisgau-Hochschwarzwald, Emmendingen and Lörrach.

Table 22: Share of numbers of trains on Rheintalbahn between day and night time

SECTION (SAMPLES)	TRAIN TYPE	DAY (6 – 22 H)	NIGHT (22 – 6 H)
Denzlingen – Freiburg (agglomeration)	Long Distance trains	60	16
	Regional trains	132	20
	Freight trains	129	155
	Share of freight trains	40%	81%
Müllheim – Auggen (rural area)	Long Distance trains	60	16
	Regional trains	64	12
	Freight trains	125	155
	Share of freight trains	50%	85%

Source: BVU INTRAPLAN 2008, page 39.

At night the share of freight trains rises from 40 / 50% up to 81 / 85%. Almost 55% of freight trains are operated at night. As night time is a period with a higher sensitivity to noise this is important.

The figures show that a concentration on measures to reduce noise at the source - for freight wagons, as the first step - is an important measure to reduce or avoid extra railway noise.

The current situation is represented by the noise action plans of the cities of Freiburg and Offenburg. In its noise action plan the city of Freiburg published the number of inhabitants affected by railway noise.

Table 23: Affected inhabitants of railway noise in Freiburg

L_{DEN}		L_{NIGHT}	
Noise level [dB(A)]	Affected inhabitants	Noise level [dB(A)]	Affected inhabitants
		> 45 – 50	32,820
> 55 – 60	22,820	> 50 – 55	19,020
> 60 – 65	8,950	> 55 – 60	7,530
> 65 – 70	4,380	> 60 – 65	3,820
> 70 – 75	2,680	> 65 – 70	2,410
> 75	2,340	> 70	1,880
Total	41,170	Total	67,480

Source: Freiburg 2009, page 5.

According to the noise action plan, Deutsche Bahn is currently installing about 9 – 10 km of noise protection walls and noise protection windows in about 1,500 apartments. The target of Deutsche Bahn is to meet the emission levels of 70/72/75 dB(A) at day time and 60/62/65 dB(A) at night time (residential zones / mixed zones / industrial zones).

In the noise action plan of the city of Offenburg [Offenburg 2009] the number of inhabitants affected by railway noise is published as follows.

Table 23: Affected inhabitants of railway noise in Offenburg

L_{DEN}		L_{NIGHT}	
Noise level [dB(A)]	**Affected inhabitants**	**Noise level [dB(A)]**	**Affected inhabitants**
> 55 – 60	7,150	> 50 – 55	5,890
> 60 – 65	2,910	> 55 – 60	2,310
> 65 – 70	920	> 60 – 65	770
> 70 – 75	450	> 65 – 70	410
> 75	450	> 70	410
Total	11,880	Total	9,790
Total above 70	900	Total above 60	1,590

Source: Offenburg 2009, page 6.

Actions for environmental railway noise mostly consider the building of a freight train tunnel for the next section of the new Rheintalbahn and noise action plans in special areas.

Concerning the new built areas and sections of the third and fourth track, mostly noise protection walls are foreseen. Discussions with the neighbours are often made due to different opinions of calculation about the associated noise emissions and the resulting number, length and height of noise protection walls. Especially the difference between the calculation scheme for noise mapping according to Directive 2002/49/EB [VBUSch 2006] and for new build infrastructure [Schall 2003] (for details see Section 2.5 on page 43) is currently in discussion. The rail noise bonus which is still valid for German infrastructure caused many struggles.

In Offenburg the planning foresees to build the new tracks along a new corridor through the city. Noise emissions will affect many people. Alternatives like a tunnel solution are presented by citizens´ initiatives. As this solution is very expensive it is refused by the building owner. The current plans of the building owner were refused by the planning and authorisation body (Regierungspräsident Freiburg) as they were not finished and could not meet legal checks.

In Rastatt a tunnel already was planned but it was adjourned indefinitely at the beginning of 2010. Local action groups are struggling against this as noise pollution in Rastatt is expected. The Federal Ministry of Transport, Building and Urban Development argues that Rastatt is not a bottleneck and the building activities have to concentrate on the section Offenburg – Basel.

In fact, for high frequency railway lines and, especially for construction of new railways, the citizens become more and more aware of noise items. This must be kept in mind for all planning.

4.1.2. Alpine regions

4.1.2.1. General aspects

This section provides general aspects concerning railway noise in Alpine and mountain regions and presents details about two railway corridors in the Alps.

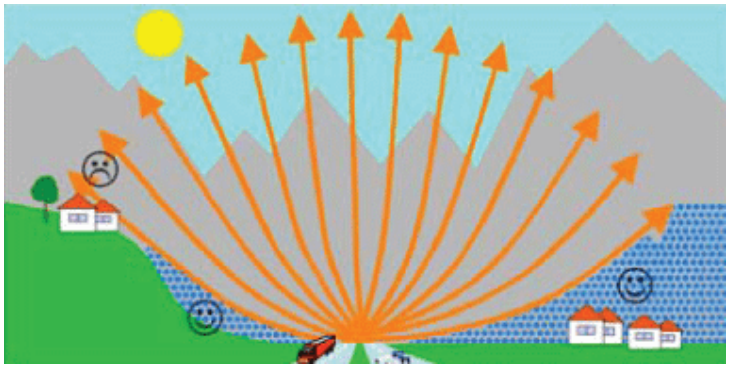
Important and interesting aspects about noise impacts in alpine regions come from the ALPNAP project.

ALPNAP has been a European research project [ALPNAP 2007-2] funded by INTERREG IIIB in ERDF Funds. The main target was to develop exact but also practical calculation methods for air and noise pollution prediction. As there is a gap between difficult scientific calculation and practical approach (easy formulas and assumption methods), the project aimed at the development of methods that were acceptable and sufficiently precise.

The project partners made many measurements for pollution and environmental noise emissions in defined areas like the Brenner corridor with Inn Valley and Edige/Etsch valley and the Fréjus corridor with Maurienne valley and Susa valley.

Concerning environmental noise (in general) one important result of the project is that the spread of noise depends on weather conditions and time of day. Examples are shown in the following figures.

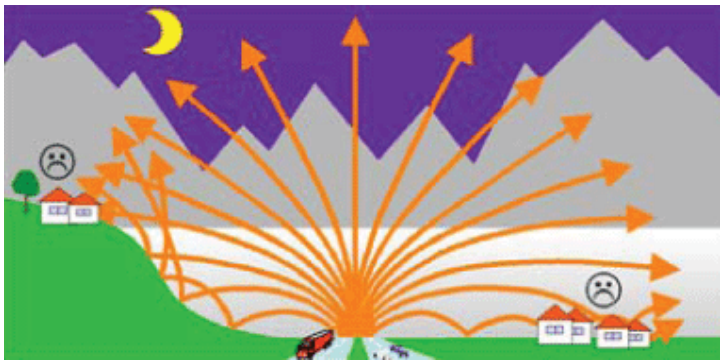
Figure 25: Direction of sound spreading (sound rays) during day



Source: ALPNAP 2007-1, page 10.

During the day, the temperature decreases with height and the sound is refracted upward. In the dotted blue areas (“acoustical shadow zones”) on the valley bottom the noise is reduced significantly because the upward refracted sound rays cannot reach there.

Figure 26: Direction of sound spreading (sound rays) during night



Source: ALPNAP 2007-1, page 10.

During the night, the temperature increases with height in an inversion layer (shown grey) and the sound is refracted downward. Acoustical shadow zones do not appear. Instead the sound is reflected at the ground.

Wind speeds and wind directions have an impact on environmental noise. Also, in valleys reflections can spread environmental noise up to high altitudes. Mostly low frequencies are spread very wide as higher frequencies are well absorbed by air.

The most severe problem for transportation and its emissions in mountain areas is that transportation infrastructure (both rail and road) as well as residential or industrial zones are concentrated in (partly narrow) valleys. So all sources of noise are located very close together.

Noise in mountain regions is even more annoying or economically harmful as the area is used for tourism which is an important employment factor.

The figures above also show one important incident for protection measures. As noise in valleys can spread up to very high altitudes where also inhabitants can be affected by noise, protection walls have a lower influence on noise reduction.

4.1.2.2. Alpine regions - The Inn Valley

The Inn Valley between Kufstein and Innsbruck is the major access line to the Brenner railway line where a tunnel has been planned for a long time. The Inn Valley was examined in the ALPNAP project and will become more important for freight trains when the Brenner tunnel is opened. An estimation of future rail traffic was made.

In the year 2005, 40 regional passenger trains, 16 long distance passenger trains, ([Kummer et al. 2006], page 24) and about 100 freight and RoLa-trains are operating on the Brenner line. Taking into account the rise of freight trains - about 4.3% per year between 1999 and 2005 - a total rise of about 52% is expected for 2015. ÖBB (Austrian Federal Railway) expects 186 freight trains in 2016 ([Kummer et al. 2006], page 25). Passenger trains will remain at about 46 regional and 26 long distance trains. This shows that freight trains have a share of 64 to 68%. So they have the majority on the Brenner line which affects the Inn Valley.

Austria may be considered as good practice regarding rail noise abatement. More than 12 years ago noise emission inventories were compiled and on this basis plans for the implementation and financing of noise abatement measures along railway lines were developed. In recent years, the annual financial means amounted to some 30 million Euros. It is expected to spend the same amount in the years to come as well. The costs are carried 50% by the Austrian railways ÖBB and the remaining 50% by the federal states and the community [ÖBB - BMVIT 2008].

Through this programme, Austria has realised considerably more protection measures as foreseen in the first phase of the EU Noise Directive 2002/49/EC. In 2008, the programme had achieved the following results:

Table 24: Results of the Austrian rail noise abatement programme

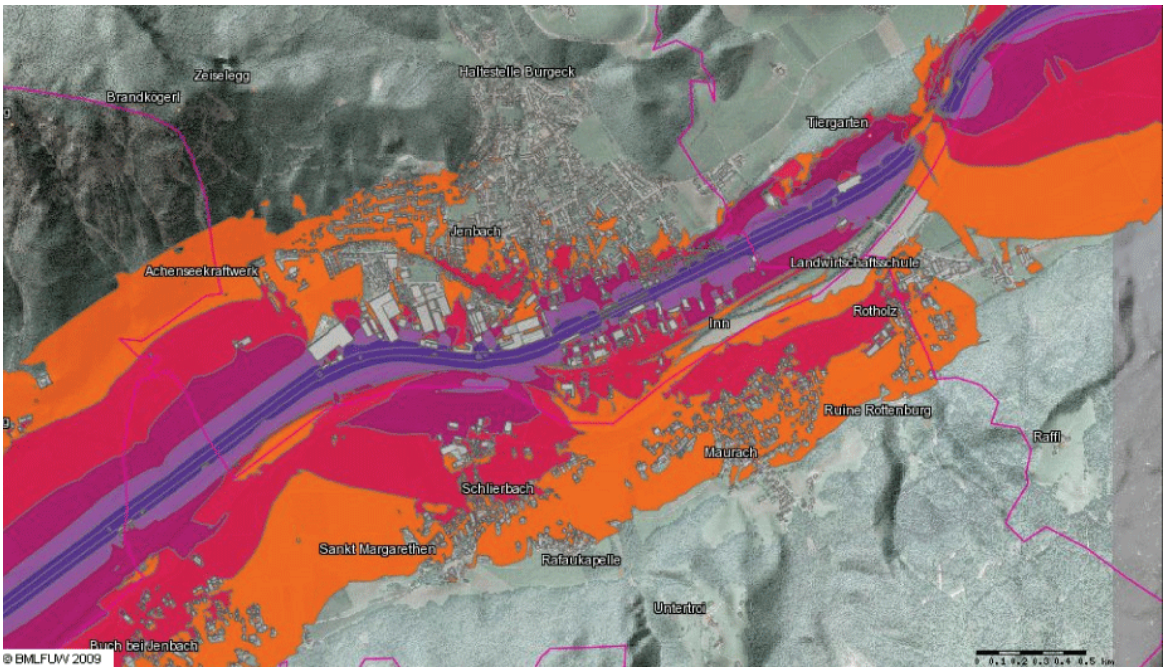
ACTION	FIGURES
Planning in communities	236
Implementation in communities	185
Inhabitants covered in plans	250,280
Inhabitants benefitting from implementation	183,603
Noise barriers [m^2]	1,263,706
Length of noise barriers [m]	413,016

Source: ÖBB – BMVIT 2008.

In 2008, 72% of the citizens covered in the plans benefited from noise protection measures. Since then, the size of the rail noise barriers has increased to some 1.7 million sq. m [m^2]; in 2011 two thirds of the planned construction works are completed and most of the severely affected inhabitants are protected against noise. Through the continuation of the programme, 10–15,000 additional citizens annually will be protected against rail noise.

The effects of noise barriers in the mountainous Inn Valley can be seen on the map below, where the inhabitants of the small town of Jenbach are protected against high noise levels that show up in the unprotected outskirts of the settlement. However, the map shows as well the effects of noise reflection from the adjacent mountains.

Figure 27: Impacts of noise protection barriers in Jenbach, Inn Valley, Austria



Source: Austrian Noise mapping, http://gis.lebensministerium.at/geoinfo).

4.1.2.3. Alpine regions – The Fréjus line

The Fréjus line is the rail freight corridor between France and Italy. Additional to this it is part of the planned high speed and rail freight corridor between Lyon and Turin.

The Frésjus-Coridor, especially the Susa (between City of Susa and Modane) and the Maurienne Valley (between Modane and Aiguebelle), was also examined in the ALPNAP project. For the Fréjus line the numbers of daily trains on the Italian side (Susa Valley) of the total line are published in [ALPNAP 2007-2] on page 241. The table is represented below.

Table 25: Example of railway traffic data in the Susa Valley; Number of trains for an average workday

SECTION	TYPE OF TRAIN	DAY	EVENING	NIGHT	SPEED [KM/H]
Borgone Susa – Bussoleno	Regional	35	14	3	120
	International	3	3	0	130
	Freight	21	11	13	85
	Goods	49	23	29	95
Bussoleno – Susa	Regional	18	7	3	120
	International	0	0	0	130
	Freight	0	0	0	85
	Goods	0	0	0	95

SECTION	TYPE OF TRAIN	DAY	EVENING	NIGHT	SPEED [KM/H]
Bussoleno – Salbertrand	Regional	9	4	0	110
	International	2	2	0	110
	Freight	11	5	6	75
	Goods	24	12	14	85
Salbertrand – Bardonecchia	Regional	17	7	0	110
	International	3	3	0	110
	Freight	21	11	13	75
	Goods	49	23	29	85
Bardonecchia – Modane	Regional	1	0	0	75
	International	3	2	0	75
	Freight	21	11	13	70
	Goods	49	23	29	70

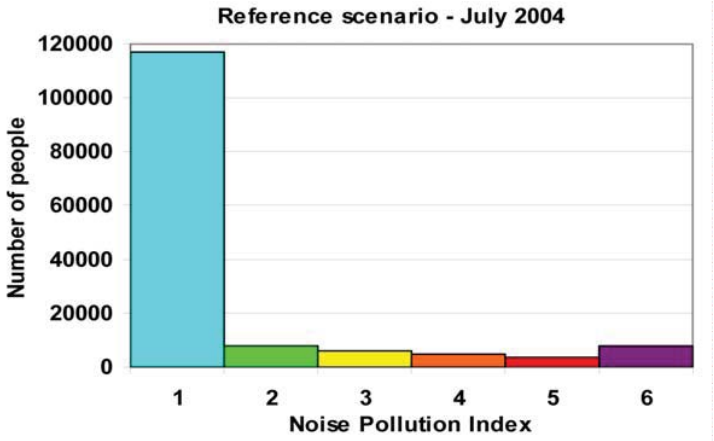
Source: ALPNAP 2007-2, page 241.

Here freight and goods trains have the majority on the main line, especially at night (as in the Inn Valley) and in the sections between Bussoleno and Modane. The share of freight trains is higher than on the Brenner line / in the Inn Valley.

The study has already shown that rolling noise is the most important environment noise source from trains at speeds between 30 and 200 km/h and that freight trains are the noisiest trains. Considering this, the most important starting point to lower noise, particularly in mountain areas, is to avoid rolling noise directly at the original source (contact zone of rail and wheel).

For the Fréjus Corridor the ALPNAP project produced a noise pollution index which shows the number of people which are affected by a certain noise pollution index (see Figure 28). The meaning of the indices is declared in Figure 29 and Figure 30.

Figure 28: Noise pollution in the Fréjus Corridor



Source: ALPNAP 2007-2, page 288.

The noise pollution index defined by ALPNAP project is represented in the following figures:

Figure 29: Noise pollution index (NPI) due to simultaneous exposure to rail and road sources

	$L_{den\text{-}railway}$ (dB)						
$L_{den\text{-}road}$ (dB)	45	50	55	60	65	70	75
45	1	1	1	2	3	4	5
50	1	1	2	2	3	4	5
55	2	2	2	2	3	4	5
60	3	3	3	3	3	4	5
65	4	4	4	4	4	4	5
70	5	5	5	5	5	5	5
75	6	6	6	6	6	6	6

Source: ALPNAP 2007-2, page 154.

Figure 30: Interpretation of the NPI values

NPI value	Exposure to noise
1	Very low
2	Low
3	Moderate
4	Pronounced
5	High
6	Very high

Source: ALPNAP 2007-2, page 154.

The NPI shows the exposure to noise in dependence of the L_{DEN} noise level caused by both road and rail traffic.

Although train traffic is high in the Fréjus-Corridor, about 30,000 out of 146,000 people (see [Alpnap 2007-2] page 286) are affected by NPI levels higher than 1.

An interesting result of the ALPNAP Study is that a modal shift from road to rail will lead to an increase of people affected by NPI 5 to NPI 6. The reason is that the motorways in the Fréjus-Corridor are already well equipped with noise protection walls in populated areas in comparison with the railway lines.

There are many protests against the project of a high speed railway line between Turin and Lyon especially concerning the affected valleys. In detail the high-speed line will consist of about 200 km new build railway lines including the new Mont-Cenis-Base-Tunnel (56 km). This tunnel will completely pass by the Susa-Valley between Modane and Susa. On the Italian side the Bussoleno-Tunnel will directly follow the Mont-Cenis-Base-Tunnel (12 km) so only a short part of the railway line will remain outside in the area of Susa. On the French side also two long tunnels (Bolledonne Tunnel, (20 km) and Chartreuse Tunnel (20km – freight trains only) are foreseen passing by big parts of the Maurienne-Valley

[Transalpine]. With all these tunnels only short parts of the new line remain uncovered in the Valleys.

Protests against this project concern air pollution (due to excavations of asbestos and uranium), general threats for the nature of the valleys and disturbances due to building works (15 – 20 years). During the building phase economic losses due to shrinking of tourism in the affected areas are expected. Noise is also mentioned in some of the publications but is not a main aspect of the protests. Most relevant are disturbances during the building phase.

4.1.3. United Kingdom

The UK uses a variety of noise mitigating technologies including noise barriers, rail lubricators and friction modifiers, rail-tuned absorbers, and, usually in tunnels, resilient base plates and floating slab track. Approximately 75% of the UK freight wagon fleet has disc brakes or composite tread brakes instead of the noisier cast-iron tread-braked wheels.

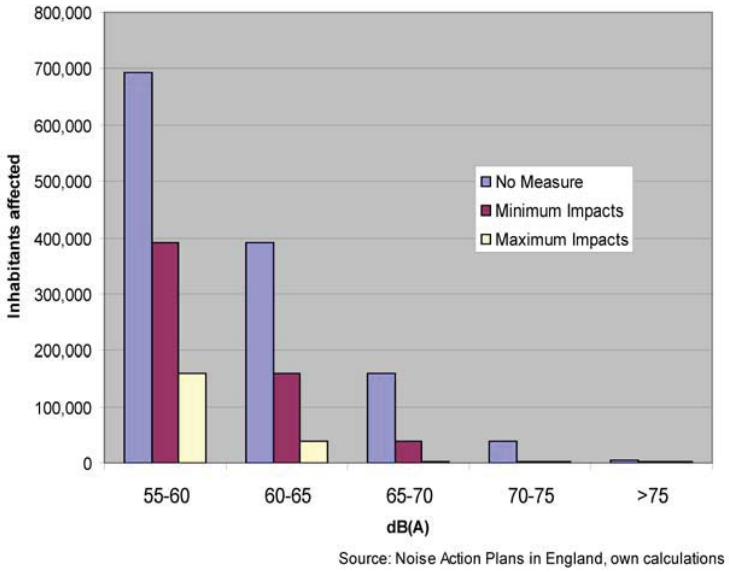
In England[27], 23 Noise Action Plans were designed to address the management of noise issues and effects in agglomerations. According to these plans, 1.3 million inhabitants of agglomerations are affected by rail noise; of these, 68% live in Greater London. Outside agglomerations, only 4,000 inhabitants are included in Noise Action Plans.

The theoretical study in this section estimates the potential impact of building noise barriers with 2m height along all railway lines in English agglomerations. It is assumed that noise barriers reduce the noise levels by 5–10 dB(A). Due to these rough assumptions, only the magnitude of the impact may be estimated. The number of affected inhabitants would decrease by 54–84%. This implies that in English agglomerations only 200,000 to 600,000 inhabitants would be affected by rail noise, compared to 1.3 million without noise protection measures. Figure 31 shows the range of impacts of noise barriers in English agglomerations.

The environmental cost of rail noise in English agglomerations may be estimated at 144 million Euros per year. These costs would be reduced through the implementation of noise barriers by annually 86 to 126 million Euros.

[27] UK not including Scotland, Wales and Northern Ireland.

Figure 31: Effects of rail noise barriers on the number of inhabitants of agglomerations in England



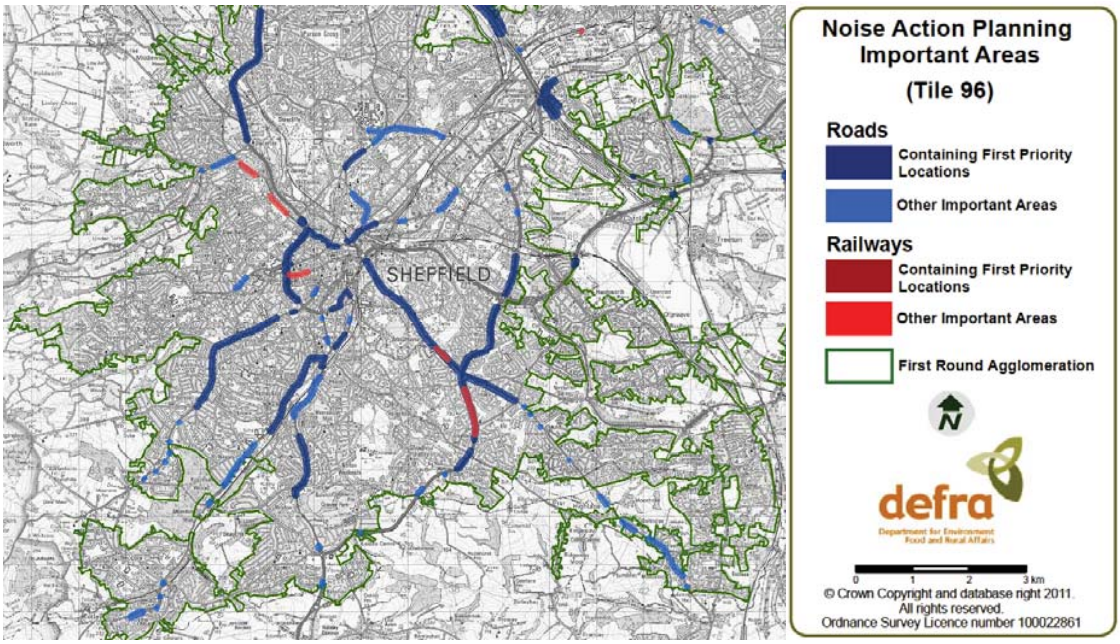
Source: calculation by the authors according to Noise Action Plans in England.

For rail noise protection in England it has been decided that the important areas with respect to noise from major railways will be where the 1% of the population that are affected by the highest noise levels from major railways are located according to the results of the strategic noise mapping ("Important Areas"; see Figure 32). In addition, those locations where the $L_{Aeq,18h}$ is at least 73 dB(A) according to the results of the strategic noise mapping have been identified as "First Priority Locations". The following timeline for railways was developed:

April 2010 – Oct 2011	Relevant rail authorities investigate Important Areas (giving priority to those that contain First Priority Locations)
April 2011 onwards	Relevant rail authorities implement any actions or secure budget for actions
April 2012 onwards	Relevant rail authorities investigate remaining Important Areas and implement any actions or secure budget for actions

An example of Important Areas arising from the English Noise Action Planning is given in Figure 32.

Figure 32: Important Areas, Noise Action Plan for Sheffield, England



Source: DEFRA 2010.

4.2. Detailed analysis of selected sections

This section describes effects of noise reduction measures for selected sections of the rail network. Assessments for effects of noise reductions are made with the use of defined measures from Section 3.3 on page 53).

The authors made a general analysis of the sections as detailed examinations in real situations were not possible. Some generalisations have been made. For example, noise barriers were assumed to be built in each location where inhabitants are affected, not taking into account if this will be technically feasible or whether installations already exist. Therefore, a range of noise impacts of the different measures had to be defined as given in Table 26. These figures were again adapted to the local conditions, i.e., used rolling stock, number of trains and share of train types (long distance, regional, freight trains). For replacement of cast iron by composite block brakes or equipment of freight cars with wheel absorbers, a 100% endowment of all relevant wagons is assumed.

Calculations were made with the actual state and the if-case (if-case = the measure is introduced completely in the section).

Table 26: Range of noise reduction

MEASURE	MIN REDUCTION	MAX REDUCTION
Composite brake blocks on freight wagons	8 dB(A)	10 dB(A)
Noise barriers (2m high)	5 dB(A)	10 dB(A)
Wheel absorbers	2 dB(A)	7 dB(A)
Rail tuned absorbers	3 dB(A)	7 dB(A)

Source: own summary according to section 3.3.

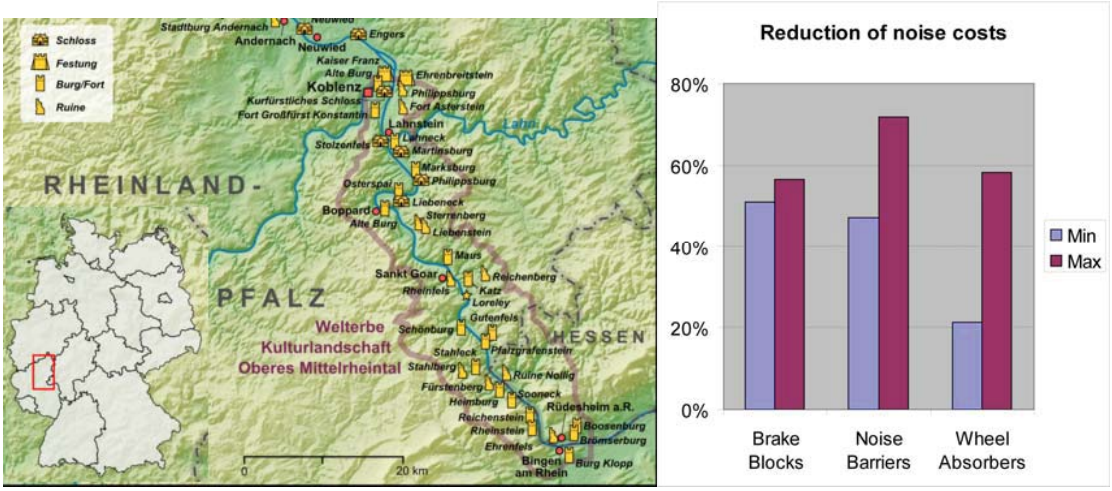
The following elaboration also includes an assumption of noise reduction effects by reduction of external rail noise costs. For cost calculation the same method was applied as the study "External Costs of Transport in Europe 2008" commissioned by the International Railway Union (UIC) in 2011 [CE Delft et al. 2011]. The study quantifies the monetary impacts of steady noise exposure of people at different levels by a review of European studies of housing prices and assesses additional medical costs by the increased risk of cardiac infarctions based on latest epidemiological research. The resulting non-linear noise exposure cost function is then applied to national statistics on noise affected inhabitants by 5 dB(A) L_{DEN} noise classes.

4.2.1. The Rhine Axis section Koblenz – Bingen

The selected section between Koblenz and Bingen represents an area in a narrow valley with high frequency railway lines on one of the main European transportation corridors (see also Section 4.1.1 on page 71).

The location of the section is given in Figure 33. The valley has four tracks, two on each river bank. The essential data and results of the assessment are given in Table 27.

Figure 33: Section Koblenz - Bingen, impacts of measures



Source: Own calculation by the authors.

In this section of the Rhine Valley, nearly 68,000 people are affected by rail noise above 55 dB(A). Rail noise causes damages in the order of 11 million Euros per year. However, these may be reduced significantly: The strongest impacts are achieved through the construction of noise barriers. If - theoretically - the whole valley were protected, only 17,000–36,000 inhabitants will still be affected afterwards and the environmental costs will be reduced by 47%–72% (Figure 33). However, this would imply considerable costs, as well as strong visual intrusions. If new brake blocks were implemented, the environmental costs could be reduced by 51-57%. The lower value is due to the fact that passenger trains are not affected by this measure. Wheel absorbers reduce environmental costs by 21-58%.

Table 27: Impacts of noise reduction measures in the Middle Rhine Valley

ITEM	VALUE
No of freight trains / day (both directions)	265
No of passenger trains / day (both directions)	157
No of remaining inhabitants affected by rail noise (>55dB(A))	
Without measures	67,550
With noise protection barriers	16,850 – 36,200
With low-noise brake blocks (K and LL)	28,985 – 32,907
With wheel noise absorbers	28,460 – 55,010
Remaining annual external rail noise costs [million €]	
Without measures	10.7
With noise protection barriers	4.4 – 8.4
With low-noise brake blocks (K and LL)	4.6 – 5.2
With wheel noise absorbers	4.4 – 8.4

Source: Own calculation by the authors.

4.2.2. United Kingdom section Thameslink near Blackfriars in London

In order to have an example about a railway line in a dense populated agglomeration with a large frequency of trains per hour, Thameslink was chosen as a case study. Rail noise of railway lines in metropolises by nature affects a lot of people. So it is very important to find good solutions for inner-city lines. Thameslink is considered to be a good example because it represents an area with dense population and a planned extension of traffic.

Thameslink runs through the heart of London, crossing the River Thames at Blackfriars Bridge, operating along a 225km route between Bedford in the north and Brighton on the south coast. The service stops at King's Cross / St Pancras International, Luton Airport and Gatwick Airport, and an offshoot (the Wimbledon Loop) passes through south-west London. An estimated 75000 people every day use Thameslink to get in and out of London.

Thameslink 2000 is a £5.5bn programme[28] to increase service capacity and frequency on the Thameslink route, with longer trains and eventually new rolling stock. The route from St Pancras to London Bridge is being upgraded, and Blackfriars station is being rebuilt to

[28] Thameslink 2000 Programme website: http://www.thameslinkprogramme.co.uk/.

span the river, with a new entrance on the south bank; the station will be ready for 12-car trains by December 2011, and completed in time for the 2012 Olympics. The Thameslink 2000 project was originally proposed in 1991, and, following a public inquiry in 2005, planning permission was finally granted in 2006.

As a result of the public inquiry, many of the relevant documents are available to the public through the Inquiry's website[29] or on request.

As part of the Environmental Impact Assessment, Temple Environmental consultants Ltd produced the 'Noise & Vibration Specialist Report' in June 2004 [Thameslink 2004], and the 'Blackfriars Noise Assessment Report' in 2005 [Thameslink 2005]. These reports include calculations and predictions of rail noise, using ISVR's NORBERT[30] model, and make recommendations regarding the use of noise mitigation technologies.

One of the goals of the Thameslink programme is to run 24 trains per hour, each way, between Blackfriars and St Pancras Midland Road; and 18 trains per hour, each way, between Blackfriars and London Bridge. Blackfriars Railway Bridge is a steel decked bridge across the Thames (see Figure 34 and Figure 35) with ballasted track. In 2004, the traffic across the bridge during the day was 233 Thameslink trains and 133 other trains; during the night, the traffic was 39 Thameslink trains and 11 other trains. The target is to increase this to 672 Thameslink trains and 70 other trains during the day, and 74 Thameslink trains during the night.

Figure 34: Left: View of Blackfriars Railway Bridge from the south bank. Right: First Capital Connect Class 319 EMU.

Source: Thameslink 2005.

In addition to increasing the number of trains, capacity will be further increased by replacing 8-car trains with 12-car trains during peak hours; during off-peak hours, 4-car trains will be replaced by 8-car trains. To some extent the increase in noise from the additional traffic will be offset by the introduction of quieter rolling stock. In 2004, Thameslink operated Class 319 EMUs primarily, and have since acquired all Class 319 vehicles still operational[31]. These are disc-braked; the last of the Class 421 and 423 EMUs with cast iron tread brakes were phased out during 2004. The Class 319 fleet was manufactured during 1987-90. First Capital Connect (who took over the Thameslink franchise in 2006) have recently acquired 23 Class 377/5 EMU 4-car trains (Electrostars),

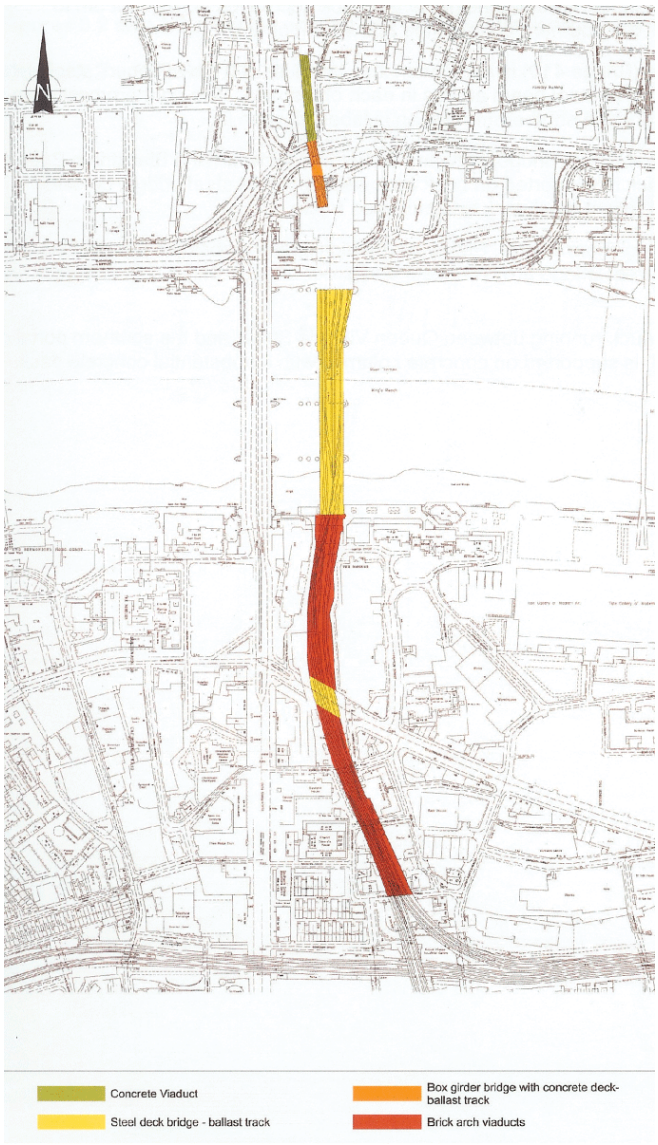
[29] Thameslink 2000 Public Inquiry website: http://www.tl2000inquiry.org.uk/.

[30] ISVR's NORBERT model calculates structural radiation of bridge noise using a detailed model of track and bridge structure, rail roughness and rolling stock type. (Thompson, D.J., Jones, C.J.C., Bewes, O.G., 2005, 'NORBERT – Software for Predicting the Noise of Railway Bridges and Elevated Structures, Version 2.0,' ISVR Contract Report, CR 05.12; also see David Herron, 2009, 'Vibration of railway bridges in the audible frequency range,' Thesis submitted for Engineering Doctorate, University of Southampton.)

[31] The Class 319 is a dual-voltage EMU, and therefore able to operate both north of the River Thames, which uses a 25kV AC overhead supply, and south of the river, which uses a 750V DC third rail.

manufactured in 2008-09. The train noise correction for the Class 377/5 is 8.4 dB(A), compared to 11.3 dB(A) for the Class 319.

Figure 35: **Overview of viaducts / bridges near Blackfriars station**



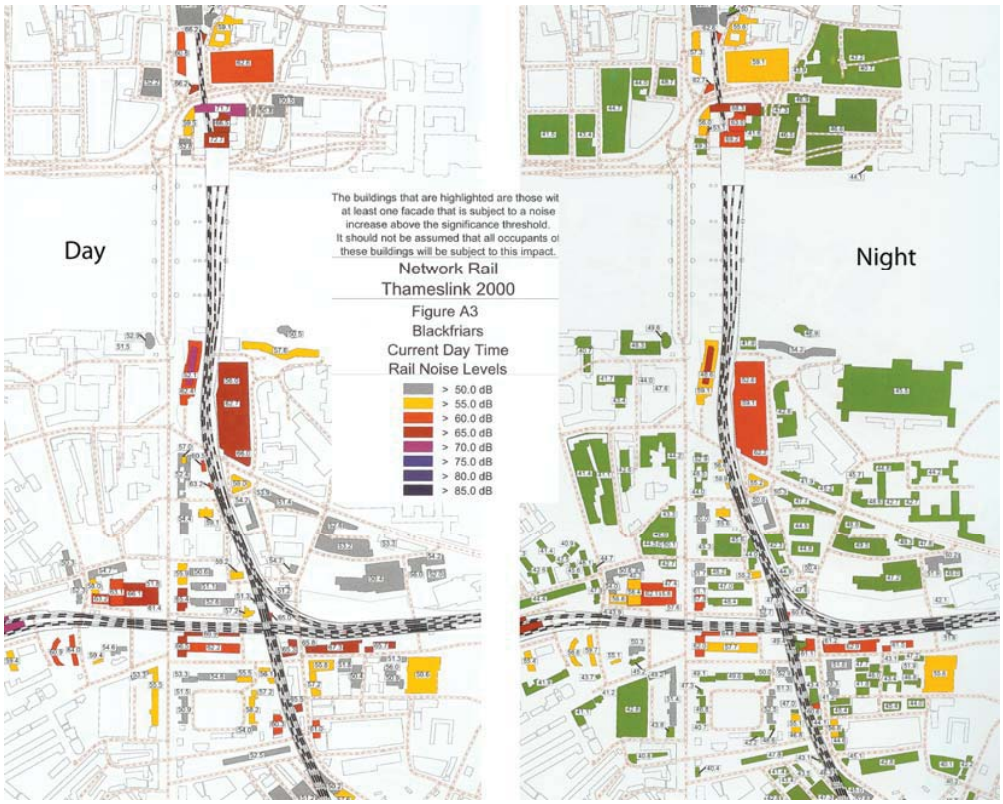
Source: Thameslink 2005.

Regarding further rolling stock noise mitigation measures:

- wheel dampers may provide a cost-effective means of reducing curve squeal and flange contact noise;
- for vehicle mounted lubricators or wheel dampers Network Rail will work with TOCs and other stakeholders to install them to the existing rolling stock where it is found that such measures are reasonably practicable.

However, the EMUs are disc-braked and there is little scope to reduce rolling noise; future design innovations in the suspension systems are not expected to reduce ground borne noise and vibration; and, in general, train speed is not an effective means of vibration reduction.

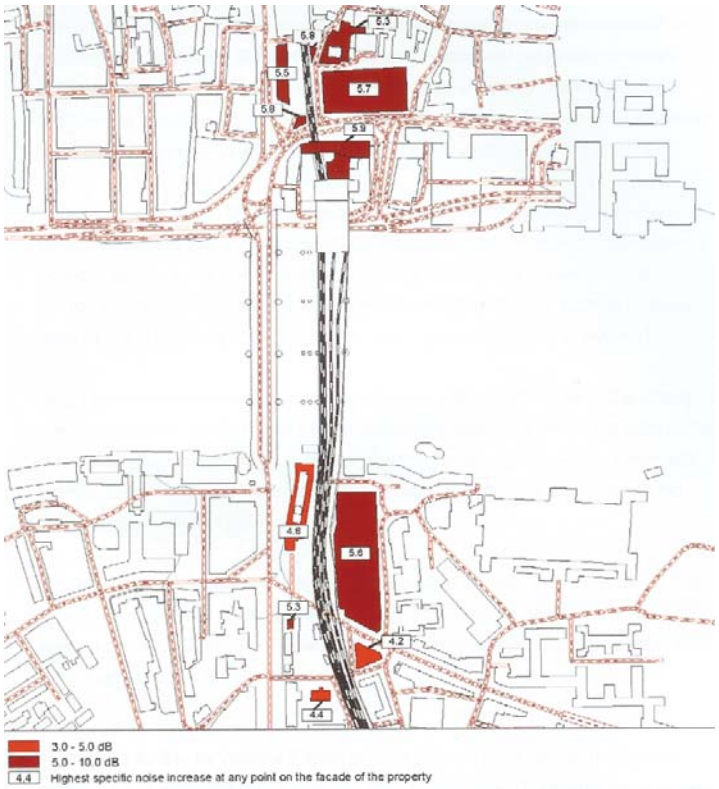
Figure 36: Measured noise levels in Blackfriars area



Source: Thameslink 2004.

Noise level projections for 2026, with or without the Thameslink upgrade, were used to assess the impact of noise on local properties. The Thameslink programme was predicted to reduce the number of affected residential properties from 44 to 24, and the number of non-residential properties from 14 to 8. In either case, the majority of these impacts are either slight or moderate. The reason why so few properties are affected is that, even close to the railway, rail noise does not dominate over the ambient noise level. Predicted noise level increases near Blackfriars Railway Bridge are shown in Figure 37.

Figure 37: **Predicted noise increase by 2026 at nearby facades as a result of daytime railway operation**



Source: Thameslink 2004.

One distinctive source of noise at Blackfriars is the jointed track, which gives rise to the characteristic 'pounding' noise. Removal of joints will reduce the noise level by about 3.1 dB(A), and will significantly improve the subjective impression of the bridge noise. Regarding track renewals and remodelling between Blackfriars and London Bridge:

- All jointed track will be removed as far as practical where track is renewed and replaced with Continuously Welded Rail or Long Welded Rail. Any unnecessary Switches and Crossings (S&Cs) will be removed and joints to remaining S&Cs will be welded. All new or replacement expansion joints will be scarfed.

Another source of noise, about 6 dB(A), is flange contact on the curve south of the bridge (Falcon Point). As part of the renewal programme, this section will be replaced with modern track to a high specification, avoiding sudden changes in curvature at rail joints. Where necessary, flange lubricators will be installed or replaced.

Network Rail has a regular inspection and maintenance programme, and is committed to removing any corrugation. In addition, vehicles are monitored for wheel flats. No significant benefit in noise level is expected from imposing more frequent grinding or an enhanced wheel set maintenance regime.

Where effective and safe, Network Rail is willing to use rail dampers[32]. However, rail damping is not effective when used with stiff rail pads. In the Blackfriars area (in 2005), the rail was supported on stiff pads or no pads at all. Rail dampers would not have affected the bridge noise component, and only a 0.8 dB(A) reduction would have been achieved in the direct rolling noise.

Noise barriers are a visual intrusion, particularly since they are a target for graffiti; they have a high cost, and cause problems for track access. Their effectiveness depends on their absorption properties, their height, and the proximity of the barrier to the noise source and/or to the receiver. At Blackfriars, noise barriers will not be particularly effective since the railway is multiple-track, and many of the affected properties overlook the track. However, the new station roof will incorporate sound absorbent material which will help to increase the noise attenuation provided by the barriers, and a new Vitreous enamel clad Bridge 412 enclosure will shield 1 Puddle Dock.

A variety of noise mitigating trackforms were considered for reducing noise levels around the Blackfriars Railway Bridge, including ballast mats (which can be problematic for maintenance and tamping), resilient baseplates, booted sleepers, and Pandrol's VANGUARD (which clamps the rail around the web and under the head, as well as under the foot) on ballasted track; and slab track with soft rail pads or baseplates. While these track designs reduce noise levels significantly when compared with the reference design, they do not provide any meaningful reduction in overall train noise levels. At Falcon Point, railway noise is expected to reduce by 3–4 dB at the upper floors closest to the Bridge. This benefit would affect some 6 dwellings. The cost will be disproportionately high in relation to the scale of the potential benefit. There is no justification to install resilient baseplates on Blackfriars Railway Bridge.

4.2.3. Noise Impact of High Speed Lines in the UK

The East Coast Mainline (ECML) operates between Edinburgh and London King's Cross and the West Coast Mainline (WCML) operates between Glasgow and London Euston. The lines are rated for 200 km/h for the most part, and even for 225 km/h in places. However, UK legislation requires in-cab signalling for train speeds over 200 km/h, which has prevented operation at 225 km/h on these lines. Currently the only line in the UK operating at speeds over 200 km/h is High Speed 1 (HS1). High Speed 2 (HS2) is currently in the early planning stages and is expected to start operation in 2025.

4.2.3.1. High speed 1 (HS1)

High Speed 1 is the route from London to the Channel Tunnel which started operation in 2007. After leaving St Pancras, the line crosses the ECML and immediately enters a tunnel which passes underneath London for 20 km (line speed for this stretch is 230 km/h, but other tunnels on the route have a speed limit of 270 km/h); the bridge across the ECML to the tunnel entrance is fully enclosed by a tube with acoustic grey cladding to shield the local environment from noise (although this is not completely effective). Pandrol's VANGUARD and a variety of other noise mitigation technologies are implemented along the route: noise bunds and barriers (including low barriers on viaducts), Sateba booted sleeper track system (Slab track SAT SB12), and GERB's floating slab track (also used in London's Docklands Light Railway).

[32] Blackfriars Station will be the first site in the UK to install Tata Steel's SilentTrack noise damping system – this is scheduled for February 2012.

There is no noise map for HS1, but there are a few comments on noise in the written evidence in the Transport Committee HS2 report:

- 'experience in Kent and elsewhere shows how the noise footprint of HSR trains can be mitigated'
- 'the experience of HS1 is that fears expressed before its construction have mostly not been realised'
- 'it would appear from the lack of complaints related to HS1 operation that the noise impact can be overrated by objectors at the planning stage'
- 'HS1's impact has been masked to some extent by the route passing close to existing busy roads'

Overall, HS1 has been a positive development with very few complaints about noise.

4.2.3.2. High Speed 2 (HS2)

This section refers to the Tenth Report of Session 2010-12 of the House of Commons Transport Committee, regarding High Speed Rail (HSR), specifically High Speed 2 (HS2), and associated written evidence. HS2 is planned for 2025.

Remit:
'HS2 Ltd was established as a Government company to examine the case and develop proposals for a new high-speed railway line between London and the West Midlands, and potentially beyond. Its remit was to identify a route between London and the West Midlands with the primary aims of increasing passenger capacity on the corridor and optimising journey times. It was a requirement of the remit that the route should include an interchange between HS2, the Great Western Main Line and Crossrail, with convenient access to Heathrow.'

Proposal:
'HS2 Ltd has proposed a London – West Midlands route that avoids any significant demolition of property except for the Euston station area; about half the route would be in deep cutting or tunnel, to reduce noise and visual intrusion on adjacent areas.' The proposal focuses on 400 km/h high speed rail route. This is expected to free up capacity on the West Coast Mainline and allow greater rail freight utilisation.

Noise Issues:
No Environmental Impact Assessment has been carried out for HS2, and none is planned until after the current consultation exercise. An Appraisal of Sustainability (AoS) has been published which includes a technical report on noise and vibration.

Following England's Noise Action Plan and the Noise Insulation (Railways and Other Guided Transport Systems) Regulations, the noise measure LAeq,18h (noise averaged over the period 06.00–24.00) has been used as the primary indicator of noise level, with an imposed limit of 73 dB – since noise levels higher than this would make the route a 'First Priority Location', i.e., an immediate target for noise mitigation.

While such a strategy might be acceptable for already noisy areas, part of the proposed route runs through an Area of Natural Beauty (AONB) where the environmental impact of the railway is a major concern. Consequently, there has been fierce opposition to HS2 along this section of the route, including complaints about noise levels:

- 'Acceptable' noise levels do not follow WHO guidelines or English Planning Permission (PPG24) guidelines. The latter would limit noise levels to 66 dB, or even less considering the rural environment. The former recommends that peak noise levels be considered, not just the average, and for high speed trains the difference between these is large.

- Concern over the visual impact of noise barriers, coupled with the concern that these will not block aerodynamic noise from pantographs. In addition, in the noise prediction modelling, pantograph noise has been modelled as a noise source at rail track height, which is not appropriate and underestimates the noise impact. (The AoS assumes a 3 dB reduction in noise emissions based on improved noise control measures in future rolling stock, and notes the importance of mitigating the source of aerodynamic noise. 100 km of 2–3 metre high noise barriers are included in the model.)

- The noise impact from the ground-borne Raleigh shock wave of high-speed trains travelling at 400 km/h over flood plains, soft alluvial ground, etc., has not been considered, nor has the cost of mitigation measures against this.

- The number of trains used in the noise modelling is 432 per day, but the potential train throughput could be up to 576 trains. The system needs to be modelled at full operational capacity, otherwise noise regulations will put a severe constraint on route utilisation.

- Noise modelling has been carried out for a maximum speed of 360 km/h, even in places where the design speed is higher.

In summary, the HS2 assessment of noise levels both uses an arguably too-high definition of acceptable noise level, and underestimates noise levels arising from pantographs, ground-borne shock waves and full system capacity. This highlights the need for a full Environmental Impact Assessment and a clearer remit on noise and vibration levels in the AONB.

The strongest arguments against HS2 can be countered by lowering the line speed from 400 km/h to, e.g., 240 km/h in sensitive areas. Although this will increase journey time, and weakens the economic case for HS2, it will significantly reduce the environmental impact of construction and of operational noise and energy requirements. A lower design speed also allows the route to follow the existing M1 motorway, further reducing environmental impact.

5. EVALUATION

KEY FINDINGS

- There are different possibilities for financial support and regulative activities to foster the introduction of noise reduction measures.
- **Noise depending track access charges** are one possibility next to direct support for low noise measures.
- Noise depending track access charges shall bear in mind that **relevant noise reduction effects** are only coming from **trains which are (nearly) completely equipped** with low noise rolling stock and that noise reduction measures may cause **extra operative costs** (next to investment cost).
- Regulation can focus on the **TSI Noise** where noise limits for new rolling stock are regulated. They **shall be compulsory for existing rolling stock** after about 10 – 12 years and **lowered from time to time** according to latest technical possibilities.
- Currently **Switzerland** and the **Netherlands** have introduced noise depending track access charges, **Germany** is planning to introduce them at the end of the year 2012.
- **Competitiveness of rail transport** in comparison with other transportation means must be borne in mind in all activities, so all financial and regulative measures shall not burden the rail sector.

This chapter describes and evaluates different methods for financial support of noise reduction measures with the focus on promoting the retrofitting of freight wagons with new braking systems. This is currently the most important discussion. Regulation possibilities are also discussed.

5.1. Economic incentives

Economic incentives through rail track charging differentiated according to noise emissions can help to:

- stimulate the use of low-noise technology for the rolling stock,
- foster the use of routes which avoid hot spots for noise and
- foster noise-reducing operational routines and speeds in sensitive areas.

In general, there are two possibilities for the design of mark-ups for noise emissions: First, the mark-ups can be added to the rail infrastructure charges of high noise polluters while low noise polluters would be free of additional charges. In this case revenues are generated which can be used for subsidising noise abatement investments for railway cars.[33] Second, the mark-ups can be designed in a way that they are neutral with respect to the total burdens from rail track charging, i.e., additional charges would be levied on high noise

[33] We discount the option to allocate the revenues to the infrastructure manager, because they do not reflect infrastructure costs.

polluters while low noise polluters would receive a bonus. Penalty and bonus payments would balance after aggregation. This scheme would be comparable to the charging scheme for heavy goods vehicles on motorways according to Directive 2006/38/EC (variant of differentiating the charges on the base of EURO emissions standards).

The recast of Railway Directive 2001/14/EC foresees the differentiation of rail track charges according to noise (see [Com(2010) 475] Article 31. There are several options to be analysed:

- Differentiation of rail track charges according to measured noise emissions (see Section 5.1.1);
- Differentiation of charges for wagons according to their noise classification (see Section 5.1.2);
- Differentiation of charges for trains according to the composition of wagons (see Section 5.1.3);
- Bonus payments for new and retrofitted cars (see Section 5.1.4);
- Combined bonus systems (see Section 5.1.5).

5.1.1. Differentiation of rail track charges according to measured noise emissions

The object of charging would be the train. The train-related noise emissions would have to be measured at critical points in densely populated areas and/or low distances to residential zones and then allocated to the train. The noise mark-up for the track charge then would vary with the noise level, eventually in a progressive way.

Such a scheme would perfectly implement the polluter-pays principle. It works independently from the car or wheel technology and cannot be manipulated by wrong classification or changing electronic identification plates. However, it would require many measurement posts or gentries alongside the tracks and a complex information, payment and administration system. As a result, the implementation cost of such a system could be very high.[34]

As the charge will be paid initially by the train operator, the question is open how the train operator (the railway enterprise) will pass on the costs to the cars' owners/operators or to the shippers.

5.1.2. Differentiation of charges for wagons according to their noise classification

The simplest way to differentiate track charges according to noise is to classify the wagons into noise categories and charge each wagon separately with a noise mark-up. The train operator would pay the charge to the infrastructure manager and send the bill to the car owner or operator.

[34] Some form of infrastructure for dynamic measurement and reporting of vehicle noise may be necessary anyway to reflect changes in the vehicle's status, e.g., wheel out-of-roundness, which significantly affect noise levels; this could be coupled with existing trackside measuring stations. Higher-than-expected noise levels may indicate an urgent need for vehicle maintenance.

This scheme presupposes the introduction of noise standards for rail wagons (comparable to EURO categories for road vehicles) and a rail-car-based km charge. While the technology of charging, control and monitoring can be kept simple there is one serious caveat: The noise emission curve is shaped in a strictly concave way ("diminishing marginal noise emissions") with increasing share of low noise cars. This means that a 50% share of low noise cars in a train will lead to a noise reduction of only 1.5 dB(A) compared with a high noise train, so that the exposed population will hardly notice the progress. The share of low noise cars should be very high to achieve a significant noise reduction of a train. If, for instance, 100% of freight cars are equipped with silent brakes the noise reduction can be as much as 10 dB(A), which implies cutting noise by half.[35]

In conclusion, this scheme is simple to implement, but does not fully reflect the polluter-pays principle, i.e., a train composed of 50% low noise cars would pay reduced charges for 50% of the cars although the noise reduction is negligible. There is a risk, furthermore, that identification plates (e.g., RFIDs) are manipulated to get wagons classified in favourable categories.

5.1.3. Differentiation of charges for trains according to the composition of wagons

To avoid the caveats mentioned in Section 5.1.2 on page 94, an alternative is to classify the trains instead of the wagons. In this case, the trains will be classified on the basis of the rail car types from which they are composed. This presupposes the introduction of noise standards for rail wagons (as in 5.1.2 on page 94) and, in addition, the classification of trains on the basis of the expected noise emissions.

In the case of freight trains, the problem arises that the emission category of a train would vary with every change of the train composition in marshalling yards (single wagon traffic). Indeed, the problem is that only block trains which do not change wagon types from start to end can be easily classified. In single wagon transport, this classifying is much more difficult as train composition changes with every shunting activity. If charging followed the polluter-pays principle, then adding a few high-noise cars to a low-noise train would imply a very high mark-up for the train, while adding a low-noise car to a high-noise train would not lead to a change of the train charge. This will not be accepted by the market players (i.e.: investment in low noise cars will not pay if these cars are often integrated in high noise trains), so such a scheme should be modified in a more pragmatic way.

Nevertheless, the problem remains that the railway undertaking would have to charge the car owners/operators/shippers, accordingly.

5.1.4. Bonus payments for new and retrofitted cars

Against the background of the manifold problems of noise-related rail track charging and the possible second round effect of losing market share to road transport, if the noise charges are really high but lead to the desired noise reduction, the easiest way to come to low noise technologies is to pay public subsidies for new low-noise cars and for retrofitting used cars. Certainly this is the approach which will be most readily accepted by the market players.

[35] Because of the logarithmic scale of the noise curve, details see Section 3.4 and Figure 23

While this burden should not fall on the tax payer, nevertheless this instrument can be an element of an overall strategy to introduce an incentive-based system and to achieve a high rate of penetration within a short period of time – much shorter than the lifetime of railway cars, which can be estimated at about 40 years.

5.1.5. Combined bonus systems

Whenever charging schemes are considered, companies worry about higher costs and the possibility of losing market shares to the road transport mode. This is a relevant argument, in particular in a political environment which aims at increasing rail freight market shares for environmental reasons and to meet climate challenges.

Public financial assistance should be given in the initial phase of a charging scheme with noise mark-ups. This could be implemented by a bonus payment for the purchase of new cars which are equipped with noise reducing technology, and/or for retrofitting used cars.

5.1.6. Current status of track charges

As the European Commission has decided on 27 September 2011 to allow charging for emissions of road vehicles (see Directive 2011/76/EU of the European Parliament and of the Council of 27 September 2011, amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures, as published OJEU L 269 on 14.10.11 [Dir. 2011/76/EU]) the way is also free for track charges according to noise emissions on railways without regard for total earning of the infrastructure company (see Recast of Railway Directive 2001/14/EC in [Com(2010) 475] Article 31).

The European Commission established a working group in 2011 to harmonise and implement Trace Access Charge systems including noise depending instruments. The recommendations from this study shall be considered by this group.

UIC has published (in [UIC 2010]) an overview about the current status of noise abatement legislation in different countries. The Netherlands and Switzerland already have track charges with a noise bonus and penalty. Since 2002, Switzerland has granted a bonus for all wagons which are equipped with low noise brakes of 0.01 CHF (0.0075 €, exchange rate November 2010) per axle-kilometre. The bonus is financed by the state, as well as the retrofitting programme of all Swiss wagons. The Netherlands grants a bonus of 0.04 € per wagon kilometre for all low noise wagons. The bonus is granted for two years up to a total maximum of 4,800 € per wagon.

In Germany, a system will be introduced in 2012 in which a bonus will be granted only to single freight wagons which are newly retrofitted with low noise equipment like composite brake blocks after the introduction of the bonus scheme. Furthermore, a bonus is planned for whole freight trains which consist of only low noise wagons. In this second part of the bonus scheme, new and recently retrofitted wagons are also considered. Both parts of the bonus will be realised as a discount on the track charge according to wagon kilometres. This will be granted directly from the infrastructure company to the wagon owner.

In Switzerland there is a discussion about modifying the existing system. Both the German and Swiss plans include a funding of owners of low-noise freight cars. The funding will be organised and calculated by the infrastructure companies. They rely on the owner notifying

which freight cars are low-noise. The funding depends on axle-kilometres in both countries. There are also discussions about the costs for the implementation and operation of the accounting system. For VDV (in [KCW 2011]), KCW calculated the operating costs for different kinds of funding systems for low-noise freight wagons. Funding for new wagons which are equipped with LL-blocks (if they are admitted) is currently being discussed.

In detail, Germany plans to fund retrofitted freight cars with 0.0028 € per axle-kilometre on German tracks up to a total of 1,688 € per axle. The total comes from estimated investment costs of about 2,120 € per axle minus 432 € as opportunity saving for replacement of an old cast iron block by a new one. The costs for the bonus will be covered 50% by the German state and 50% by a general increase of track prices for all freight trains.

In a study for the European Commission, KCW proposes a funding of 0.008 € per axle-kilometre for K-block equipped wagons and 0.0025 € per axle-kilometre for LL-block equipped wagons [KCW 2009]. The figures mentioned are for a funding period of 8 years. For a potential funding period of 12 years the figures are 0.0045 € per axle-kilometre for K-blocks and 0.002 € for LL-blocks.

Irmhild Saabel from WASCOSA AG held a presentation at Forum Güterwagen (forum freight wagons) in May 2011 about costs coming from K-blocks [Saabel 2011]. The total costs for blocks and wheels increase by a factor of 1.5 to 2.6. Although K-blocks have a life cycle of about 110,000 to 130,000 km, the wheels need reprofiling each 120,000 to 310,000 km (instead of 450,000 to 500,000 km) and have a life cycle of about only 360,000 to 1,140,000 km (instead of 2,700,000 to 3,500,000 km). Also Mr Gilliam from the AAE reports higher operating costs, from first experiences, caused by abrasion of wheels with modified blocks[36].

Costs for railway undertakings or wagon owners, related to composite brake blocks, arise not only from investment but also from operating.

To harmonise NDTAC on an EU-wide scale in 2011, the Commission established an expert group under the DERC Committee [Rapacz 2011].

- The main aim: to discuss and propose practical solutions on how to harmonise NDTAC schemes across Member States, focusing on financial aspects.
- The result of the work of the group could be a set of guidelines for the Member States on NDTAC harmonisation / implementing measure adopted by the Commission on the basis of the recast.
- The group is to be restarted in 2012, following the recast developments.

[36] Early trials with composite tread brakes in the UK in the 1970s–80s found similar results.

5.2. Analysis of regulation possibilities

The number of regulations on railway noise in the EU Member States is large. A brief overview of the national noise measures is listed in Annex IV.

In 2003, the Working Group on Railway Noise of the European Commission [EC 2003] was of the opinion that "a solution to the major railway noise issues is possible within 10 years if the proposals are implemented as a cost-effective combination of the instruments described".

The most relevant standardisation issues for railway rolling stock have been formulated in the TSI documents (Technical Specifications for Interoperability). In the latest TSI Noise [TSI Noise 2011], the following regulations for noise emissions of rail vehicles are defined:

- Limits for stationary and pass-by noise for freight wagons and locomotives (for details see Annex II of this study),
- Operation and maintenance rules,
- Application to new rolling stock, and
- Retrofitting programmes.

While the rail noise problem is well understood and the technical possibilities are clearly described in the European Commission documents, a timetable for introducing new noise standards – comparable to the Euro standards for HGVs – is missing until now. However, because rail cars are clustered tightly (i.e., grouped as trains), the equipping of rail cars with low noise technology is only effective if a large proportion of the cars use this technology (see Section 1.2 on page 15).

Retrofitting the current freight fleet with composite brake blocks will be a slow process since a charging scheme is required that creates an incentive to retrofit without increasing the overall cost of rail freight transport relative to other transport modes. The planned funding in Germany (see Section 5.1.6 on page 96) is not attractive enough for a part of wagon owners, since a negative impact on railway transport costs would be inevitable.

Therefore, developing a regulation scheme for a staged process towards low-noise rolling stock must be the heart of a noise abatement strategy for railways. The economic instruments developed in Section 5.1 on page 93 then would serve as incentive engines, for instance as a motivation for top runners to start early with retrofitting or purchasing new noise-reduced cars and for the followers to reduce their costs.

5.2.1. Regulating technology for noise emissions?

Currently the discussion focuses on the braking system of rail cars. Most noise in railway operations is caused by rough running surfaces of wheels and tracks. If both can be kept smooth, noise can be reduced significantly [CER UIC 2007]. The conventional cast-iron brake blocks cause a fast deterioration of wheels and rough wheel surfaces and high noise levels are a consequence. If this braking technology can be exchanged by modern composite brake blocks the noise emissions can be reduced by up to 10 dB(A).

Retrofitting with composite brake blocks targets brake noise and elevated rolling noise, but there are other sources of noise, locations which require an even greater noise reduction

than can be gained by retrofitting alone, and there are many railway vehicles which do not have cast-iron tread brakes. Noise reduction can also be achieved by rail- and wheel-tuned absorbers and other technical measures. Furthermore, technological development may yield new technologies in the next years to come. This brings up the question whether the regulation towards a particular noise reduction technology makes sense. In any case, the regulation should allow for alternative technologies if they have proved to achieve at least the same reduction performance. The Japanese Top-runner scheme gives an example for an incentive compatible regulation scheme. The current best technology is set as a standard in the medium term (e.g.: 5–7 years).

An alternative way of regulation consists of setting upper limits for local noise emissions. Directive 2002/49/EC gives the basic definitions of indicators, methods of measurement and mapping of exposed population. The Member States are obliged to identify hot spots where noise limits are exceeded and to prepare action plans not later than July 2013. The national legislation for noise control is well developed for new investments which lead to additional traffic and noise production. The big challenge remaining is the noise protection of population alongside existing railway tracks. In principle it would be possible to prepare a noise directive comparable to the Air Quality Directives 1999/30 and 2008/50, which limit the local concentration of exhaust emissions like NOx and PM. Analogously, a noise quality directive could limit the noise levels alongside the tracks at maximum thresholds, depending on the environment and the exposed population.

The advantage of emission dependent regulation is that the industry is free to find the best technologies to meet the limit values set. A disadvantage is that it will take some time to achieve a consensus of the Member States on noise limit values. After the painful experiences gained with the introduction of Directive 1999/30 (Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air) one can expect that the Member States will check such values carefully to avoid massive investments in their transport infrastructure for noise abatement.

Therefore, the most promising way for the medium term future is to start from the platform of TSIs and the Recast of the Railway Packages (see [TSI Noise 2011] and [Com(2010) 475]). This can be formulated in a way that the expected noise reduction is clearly defined while the technology used is not specified in detail, leaving options open for technological progress.

5.2.2. Regulation authorities

The European Railway Agency (ERA), established in 2006 in Valenciennes following the second railway package, is responsible for TSIs and can take responsibility for developing the appropriate noise regulation for railway cars as well. This regulation can be controlled by the national railway regulation authorities – following the first railway package the establishment of national railway regulators is obligatory for each Member State.

From this follows that the existing national bodies can be involved in the control of rail noise emissions more intensively and with the necessary administrative power. A close coordination with the road and air transport regulators is necessary to avoid market distortions stemming from unbalanced regulation.

5.3. Analysis of stakeholder remarks on economic incentives and regulation

Since it is not possible to reflect the position of each railway stakeholder in Europe within this framework, the position of the International Railway Union (UIC) is provided. UIC makes frequent statements of the issue which generally acknowledge the need for noise reduction measures. UIC favours the following strategies [UIC 2010]:

- Reduce the noise of all new freight vehicles by introducing TSI limit values.
- Promote the retrofitting of existing freight vehicles with composite brake blocks.
- Build noise barriers and install noise insulated windows.
- Pursue further solutions in special cases such as acoustic rail grinding, rail absorbers, wheel absorbers, friction modification against curve squeal, etc. The precondition is regular maintenance.

UIC considers LL-brake blocks to be a “promising noise reduction measure; however they still require further improvement before they can be used on a large scale in Europe”.

Other options, such as speed limits and land-use planning are rejected [UIC 2008]. Speed limits need to be substantial (50 km/h) to have a considerable noise impact and thus “are not compatible with the operation of a commercially competitive railway”. Land-use planning measures are of little effect, since at distances further than 50 metres from the source “noise level is insensitive to even medium changes in distance”.

UIC's main concern is that noise reduction measures might burden the railways in a manner that the competition with the road sector is distorted. The burden may be created either through high investment costs or excessive administrative tasks. “Due to fierce competition, wagon owners do not have sufficient resources to finance the retrofitting of their fleet. Any incentive system should neither weaken the overall market share of the freight sector nor disadvantage any freight market player” [UIC 2011].

Therefore, the cost efficiency of the measures (see Section 5.1 on page 93) is a major UIC decision criterion. For example, the retrofitting with composite brake blocks is considered as more efficient than the construction of noise barriers. UIC argues that an incentive scheme should be developed, where public funds for retrofitting are diverted from the railway network operators to the wagon owners. Additionally, UIC criticises the above-mentioned studies commissioned by the EU [PWC 2007] and [KCW et al. 2009] for its “too low cost assumptions related to the use of composite brake blocks. These assumptions combined with too high an estimate of the average annual mileage may lead to a differential track access charge which is insufficient for promoting retrofitting.”

Since direct funding does not take into account the wagon mileage, [UIC 2011] proposes a bonus system combined with access charges: “national authorities should fund the retrofitting of freight wagons by means of a noise reduction bonus … [which] would be granted based on the mileage travelled on lines of the respective national networks. The bonus would compensate the investment costs as well as the additional operating, transaction and administrative costs.”

In an interview with the authors in July 2011, Mr Kerth from VDV mentioned that the total costs for retrofitting are about 0.008 € per axle-km if the additional operating costs and financing costs are included in the calculation. Currently, the interest of the wagon owners in retrofitting existing wagons due to this funding scheme is very low. A problem for the rail sector can also rise because part of the financing of the bonus system will be financed by an increase of track prices for the total freight train sector. This increase also affects existing wagons which are already equipped with composite brake blocks. The press release of VDV and VPI concerning the financing of the bonus from July 5th 2011 announces the 50% share of the rail sector as unfair [VDV VPI 2011]. It is the first time a transportation mode would be burdened by costs for noise and it would only fund recently retrofitted wagons, while existing low-noise or new-build wagons have to carry the increased track prices.

In general, the planned funding scheme in Germany is accepted by the rail sector as it is a direct funding of wagon owners and the system is not too complicated. The implementation costs seem to be acceptable (see the elaborations in [KCW 2011]). Nevertheless, many details still have to be clarified and agreed, such as the size of the bonus and its financing. Also the inclusion of additional operating costs is still in discussion. If they are included, this could lead to a lower share of the German state as this part of the funding is limited to 152 million Euros per year [VDV-2011-2]. VDV expects only 15% share of costs will be carried by the Germany state if the additional operating costs remain to the rail sector.

UIC, CER, UIRR, ERFA, EIM and UIP comment in their position paper on a Consultation document of the Commission concerning rail noise abatement measures in 2007 [UIC et al. 2007]. In this respect they point out that the funding scheme should not burden the rail freight sector with additional costs and the funding and monitoring scheme should not be cost-intensive itself.

6. CONCLUSIONS

Reducing railway noise is an important activity for the environment and citizens' health in Europe and for the acceptance of the railways as a driving force for ecological and economic development of Europe. Therefore, the acceptance of railways by citizens living near railway lines, especially the main rail freight corridors, is vital.

In freight corridors, the number of trains will increase, and so noise for the citizens will increase as well. Therefore, measures to reduce noise levels are essential to prevent health risks and to have the acceptance of the neighbours. Without this acceptance, the risk remains that the increase of capacity on main railway lines will be inhibited for a long period of time, which will cause losses for the rail sector and for the total economy.

6.1. Recommendations of measures

The recommendations cover the following three main aspects, considering the revival of the rail sector as one of the most important measures for greening transportation and meeting climate change targets:

- identifying effective technical measures;
- providing effective regulation and economic incentive schemes which do not distort competition with other transportation modes;
- funding the necessary investments.

Technical Measures

On the technical side, the noise reduction measures focus on two pillars: vehicle-related measures and infrastructure-related measures.

There are several **vehicle-related** measures:

LL-blocks: One of the main sources of railway noise is freight wagons, particularly those with cast-iron tread-brake blocks. The cast-iron blocks damage the running surface of the wheels, making the surface rough and increasing the noise level at the wheel-rail interface. High-speed trains and passenger trains use disc brakes rather than tread brakes; new vehicles can be fitted with composite tread brake blocks (K-blocks), but these are not suitable for retrofitting. There are still about 370,000 freight wagons with cast iron brakes which are worth being retrofitted in Europe, and finding a cost-effective composite brake block replacement (LL-blocks) for retrofitting is a priority for many railway operators. The current estimate for retrofitting the 370,000 freight wagons is between 2.2 and 4.2 billion Euros, but the impact of LL-blocks on wheelset maintenance costs is yet to be established.

Noise can also be a problem on railways with no freight traffic, so other vehicle-related measures are important:

- **Wheel absorbers** are used to reduce rolling noise and can be effective against curve squeal. A range of wheel noise absorption technologies and products have been developed. The interaction of wheel noise absorbers and any track noise absorbers needs to be considered for optimum system performance.

- A number of **modified wheels** have been developed in recent years but the accident with an ICE in Eschede in 1998 has left the industry wary of modified wheels for high-speed trains. However, these developments have had significant noise reduction potential and it is worth continuing research in this area.

- Vehicle-mounted top-of-rail **friction modifiers** (TOR FM) or flange lubrication systems can be used to combat curve squeal (as well as to reduce wear). A range of technologies and products are available. These are appropriate for closed systems where the vehicles are regularly monitored and maintained, such as local commuter networks; urban systems also have tighter curves and consequently more problems with curve squeal.

- Pantograph noise is a problem with high-speed electric trains, particularly since the pantograph is usually higher than noise barriers, if present. **Aerodynamic designs** like shielding or **special materials** like porous coating of pantographs can be used to reduce aerodynamic noise.

Additionally, new rolling stock, introduced since the year 2000, already have lower noise emissions by 10 dB(A) in comparison with equipment produced in the 1960s and 1970s. This shows the importance of replacing old rolling stock as soon as possible.

The effectiveness of vehicle-related measures has the best cost-benefit ratio. So the introduction of composite brakes on freight wagons should be approached with the highest priority. Other measures can be done complementarily.

A wide variety of **infrastructure-related** technologies have been developed to combat noise and vibration. Mostly these fall into three categories:

- Noise barriers and bunds are usually large earth mounds creating an artificial cutting for the railway; these require several metres of land to the side of the railway which is not normally an option for existing railways or urban environments. **Noise barriers**, on the other hand, are suitable for existing railways and urban environments, but to be effective they need to be at least two metres high. Noise barriers have a poor visual impact, especially since they are a target for graffiti; they create problems for track access and incur a high on-going maintenance cost. Special acoustic enclosures are sometimes used to surround the railway above as well as at the sides.

- Track-side lubricators are a traditional method of reducing curve squeal (as well as reducing wear) and **friction modifiers** are used also to reduce brake squeal (in shunting yards, for example). Top-of-rail friction modifiers (TOR FM) are also effective at reducing corrugation (a major noise source) on the low rail in curves.

- Resilient track forms and technologies include: floating slab track, ballast mats, resilient base plates, rail pads of various stiffnesses, rail clips that clamp the web under the railhead, tuned **rail dampers**, and booted sleepers. Tunnels under urban environments, such as the Channel Tunnel Rail Link and Crossrail in London, are targets for such technologies. (As noted earlier, the interaction of wheel noise absorbers and track noise absorbers needs to be considered for optimum system performance.)

Additional considerations:

- Wheels and rails need to be monitored so that (a) out-of-round wheels (and especially wheels with flats) can be turned, and (b) corrugated rails can be ground. Out-of-round wheels and corrugated rails are a source of increased rail noise, as well as a cause of increased wheel-rail forces and consequent damage.

- Track geometry and substructure should be designed and maintained to avoid sudden changes in direction or stiffness, both of which increase noise emission, wheel-rail forces and consequent damage.

- Rail joints should be avoided (insulated rail joints are an exception) and continuously welded rail used instead; expansion joints should be scarfed.

Large infrastructure-related investments have already been made in several countries, including Sweden, Denmark, The Netherlands, Germany, Poland, Czech Republic, France, Switzerland, Austria, Italy and Portugal. These measures are necessary, particularly in densely populated areas. Noise-reducing infrastructure-related measures are usually introduced with new construction or major redevelopment of railway links according to new standards where these measures are a requirement, whereas for the existing infrastructure there is no obligation to lower noise.

Intelligent combinations of vehicle- and infrastructure-related measures help to bring rail noise down to long-term sustainability levels for a reasonable cost. The analyses of this study show that infrastructure-related measures can be reduced if effective vehicle-related measures are also taken. Therefore, a fast retrofit of the existing freight wagon fleet is the most urgent action to be taken.

Regulation and economic incentive schemes

International examples such as the Japanese top-runner scheme[37] underline that a sound **regulation scheme** is the heart of any successful pollution reduction strategy. This holds in particular for noise, because an effective reduction of noise through vehicle-related measures presupposes that almost all internationally operating rail wagons are equipped with low-noise technology.

The TSI Noise is an appropriate basis for noise regulation in the medium and long term. Presently, the standards for noise emissions are valid for new or modified vehicles only. In the medium and long-term view the TSI can become compulsory for all vehicles. The time schedule for validation of the noise levels for all vehicles should be long enough to allow for an adjustment of technology without major additional investment costs. We propose a time period of 10–12 years, which covers 1–2 revision cycles and is half of the normal life time of rolling stock (a quarter for freight wagons). The noise levels in TSI Noise should also be lowered from time to time according to technical development.

Economic incentive schemes consist of charging and bonus/penalty systems. Rail track charging is an important element of an incentive-compatible penetration strategy for low-noise rail technology. The principles and request for introducing noise emissions into the track access charging system are formulated in the Recast of the First Railway Package (proposed in 2010) and can be implemented by the Member States as the revision of

[37] This scheme aims at reducing energy consumption and climate impact by dynamic setting of emission targets on the basis of current best practice ("top runners' performance").

Directive 2006/38/EC (Eurovignette) has been adopted on 27 September 2011 (see [Dir. 2011/76/EU]) as the existing Directive 2001//14/EC already allows NDTAC if the same is allowed for other transportation means. The Directive 2011/76/EU allows for mark-ups reflecting environmental costs (including noise) for HGVs on motorways and highways. This means that in the future a balance can be found between road and rail pricing for noise emissions which does not disturb competition between the transport modes. It is important to take into consideration that a substantial noise reduction requires that a large proportion of rail cars are equipped with modern technology. This suggests that lower tariffs should be offered only to trains which consist entirely of noise-reduced cars. Such a system can be implemented without installing further electronic devices in the rail cars, if an effective reporting system is established. The example of the proposed German rail track charging and retrofit-funding scheme shows that this requirement can be fulfilled. This underlines that the transaction cost of a noise-differentiated charging system can be held low, which is an important argument, because many objections against the introduction of such systems are based on the presumed high transaction costs.

Further alternative or complementary incentives can be introduced through bonus/penalty systems. In particular, in the transitory phase, bonus payments can motivate the rail car operators to switch to new technology as early as possible. The railway companies will call for wide use of this instrument if the state pays for the bonus. From the viewpoint of setting incentives right, at least a part of financial contributions should be covered by the rail car owners/operators.

Funding schemes

After assessing the best combinations of technical and economic measures, the financial implications have to be considered and the impacts on stakeholders have to be analysed. In our view, the adjustment of braking systems is the most urgent and promising strategy, complemented by infrastructure-related measures at noise hot-spots. There are different funding sources, which have to be developed for these measures.

Infrastructure-related measures are financed by the state and/or the rail infrastructure managers. In the latter case, the additional costs for the infrastructure managers are passed on to the railway undertakings through the rail track charges. This implies that the state will have to cover a substantial part of the infrastructure-related costs if the competitive balance between road and rail is not to be affected.[38]

Vehicle-related measures have to be financed by the car owners/operators in the long term. In the short and medium term, subsidies by the state or the European Union, for instance bonus payments for retrofitting, can accelerate the change of technology. Member States will have to decide on the magnitudes of bonus payments and the method of refinancing. In this context it is crucially important that the territoriality principle will be fully applied with the rail track charging system, which means that retrofitted rail cars get a lower tariff regardless of which country they have been licensed in and where the owner/operator is located.

The vehicle-related funding scheme should be a limited programme for some years (e.g., 10 years) and should focus on retrofitting existing vehicles. Existing low-noise vehicles can also be included if the cost of the noise-reduction measure can be verified (former

[38] Note that the mark-ups for noise, as suggested by the Commission, are rather low for HGVs on motorways and freeways and the Member States are not obliged to implement them.

retrofitting without funding of the measure, price differences between normal and low noise vehicle of the same type).

Funding and regulation schemes should be harmonised in the EU to minimise distortions of competition as many freight transport companies are operating internationally, carrying a high share of freight rail cars cross-border. “Noise leakages” should be avoided, which could occur if noisy freight cars, registered in a “low noise cost” country, are operating in “high noise cost” countries. Therefore a common regulation scheme is necessary, accompanied by a widely harmonised system of pricing and funding. Variations from this general rule could only be accepted to the positive side, i.e., to motivate top runners to start early with appropriate actions. In this context, the trade-off between low noise policy and competition policy could be more balanced in favour of low noise in the medium-term. The reason is that rail freight as a whole may lose market share in the medium term if the noise problems cannot be solved appropriately, and the resistance of the affected population might impede full capacity utilisation and the removal of capacity bottlenecks.

6.2. Recommendations for parliamentarian activities

To support and accelerate the introduction of noise reduction measures, the European Parliament could – in the second reading of the Recast of First Railway Package – only accept the Recast if the following issues are fulfilled:

- Including an obligation for a harmonisation of charging of railway noise in all Member States within a reasonable short time period.

- Integrate the dependence of the introduction of Noise Depending Track Access Charges (NDTAC) from the same introduction in road transport.

- Including an obligation to create “Noise Depending Track Access Charges (NDTAC)” for the introduction and use of noise reducing measures in each Member State according to the levels in TSI Noise (COMM. DEC. 2011/229/EU).

    - The NDTAC could include funding / covering of higher operational costs if the noise reduction measure causes extra costs.
    - The NDTAC could also include a significant special bonus for trains which are completely equipped with noise reduction measures (in addition to funding of individual equipment of single rolling stock units).

- Including an obligation for the infrastructure managers to maintain the infrastructure in a way to avoid noise caused by poor infrastructure conditions (rail roughness).

Additional to this, the European Parliament could request the European Commission:

- Creates an European Funding Scheme for vehicle-related noise-reduction measures, and to motivate Member States to introduce noise-reduction funding for internationally operating rolling stock.

- Modifies the latest TSI Noise, introduced with Commission Decision (2011/229/EC) of 4 April 2011, so that the maximum noise levels are also obligatory for existing rolling stock about 10–12 years after introduction of the modification of TSI Noise.

- Lowers the maximum noise levels introduced by TSI Noise in a staged process for the long-term future, with adjusted obligations for new and existing rolling stock (top runner scheme).

To harmonise the competitiveness between rail and road sectors, the European Parliament could request the European Commission:

- Prepares a Directive for a network-wide regulation and charging of lorry noise, at least for the TEN-T roads (comprehensive network) – eventually embedded in a concept of full internalisation of external costs under explicit consideration of noise-reduction targets, extending the optional noise-related motorway charging as in Directive 2011/76/EU.

To lower noise at hot spots which cannot be solved by the introduction of vehicle-related measures, the European Parliament could:

- Observe the introduction and fulfilment of noise action plans concerning hot spots in rail and road sectors.

- Include noise-reduction measures at noise hot spots of the TEN-T (comprehensive network including existing links and nodes) into the EU funding facilities (in particular the Connecting Europe Facility).

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ANNEX I: ENVIRONMENTAL NOISE EMISSIONS IN MEMBER STATES AND AGGLOMERATIONS

		Rail noise outside agglomerations									
		Nr of people exposed to different noise bands (Lden) [dB(A)]					Nr of people exposed to different noise bands (Lnight) [dB(A)]				
Country	***km***	*55-59*	*60-64*	*65-69*	*70-74*	*>75*	*50-55*	*55-59*	*60-64*	*65-69*	*>70*
Austria		217,300	121,700	47,900	16,900	7,500	194,200	98,900	36,700	13,300	5,600
Belgium		33,300	19,700	16,100	13,400	3,900	25,700	17,200	15,000	7,500	1,800
Czech Republic	270	13,300	2,600	1,100	300	0	6,700	2,000	800	200	0
Denmark	1,776	20,200	5,500	1,900	1,200	100	12,100	3,300	1,600	800	0
Finland		15,100	5,900	2,300	200	0	8,800	4,000	800	0	0
France	1,435	624,200	420,000	250,300	139,500	105,200	519,600	348,400	207,100	112,900	70,000
Germany	17,282	1,588,700	693,400	218,200	87,900	58,000	1,392,500	547,600	175,700	73,100	44,800
Hungary	32	0	0	0	0	0	0	0	0	0	0
Ireland	58	0	0	0	0	0	0	0	0	0	0
Italy	591	89,900	61,900	37,300	33,000	24,800	87,000	67,300	35,600	31,300	25,400
Luxembourg	20	100	100	0	0	0	100	0	0	0	0
Norway		4,500	2,600	2,000	700	900	3,600	2,100	1,300	500	600
Poland	16	900	200	100	0	0	700	100	100	0	0
Portugal	115	21,200	11,600	8,000	7,200	4,400	14,900	9,400	7,500	5,500	1,100
Romania		3,900	1,000	0	0	0	5,500	3,400	700	0	0
Slovenia	68	5,600	2,600	1,100	400	300	4,700	2,400	1,000	400	300
Spain	742	45,700	23,500	11,000	1,600	0	34,900	19,300	6,000	500	0
Sweden		58,100	33,800	12,300	4,800	1,700	43,900	21,200	7,700	2,500	1,200
Switzerland		39,500	23,600	12,500	8,800	3,800	30,400	16,700	10,700	6,100	2,400
United Kingdom		80,800	50,300	32,500	14,100	2,100	56,400	36,400	18,500	3,800	100
Total general		2,862,300	1,480,000	654,600	330,000	212,700	2,441,700	1,199,700	526,800	258,400	153,300
Total EU 27		2,818,300	1,453,800	640,100	320,500	208,000	2,407,700	1,180,900	514,800	251,800	150,300

		Rail noise in agglomerations									
		Nr of people exposed to different noise bands (Lden)					Nr of people exposed to different noise bands (Lnight)				
Country	Inhabi-tants	55-59	60-64	65-69	70-74	>75	50-55	55-59	60-64	65-69	>70
Austria	1,610,578	107,000	81,100	57,900	35,500	9,500	101,900	76,700	41,900	28,800	4,100
Bulgaria	2,084,000	18,400	5,800	500	100	0	16,300	6,100	200	0	0
Czech Republic	1,852,955	74,800	59,500	65,900	14,500	0	63,300	69,800	32,000	400	0
Denmark	1,071,714	19,400	7,400	2,600	1,000	100	12,500	4,900	1,500	600	0
Estonia	401,140	10,600	6,900	3,500	900	0	9,000	5,700	2,500	300	0
Finland	560,905	27,500	25,400	16,700	200	0	27,600	21,500	2,000	0	0
France	13,664,912	1,488,600	208,800	117,700	63,500	43,000	1,426,900	148,200	63,700	34,300	12,800
Germany	17,265,322	478,300	246,700	122,400	31,400	5,700	393,800	194,400	75,800	16,700	3,300
Hungary	2,065,230	132,500	50,600	19,600	7,900	1,200	110,700	40,900	16,400	6,000	700
Ireland	1,150,000	10,600	6,800	2,800	500	0	7,700	3,500	1,400	100	0
Italy	4,190,684	34,000	30,900	24,800	6,400	1,400	34,500	37,800	19,500	4,600	2,100
Latvia	806,993	28,400	20,100	6,300	800	100	25,500	9,400	4,700	400	0
Lithuania	932,847	9,100	5,000	1,100	300	0	8,600	2,800	800	200	0
Netherlands	5,026,059	118,600	60,700	25,000	8,800	1,000	94,100	40,800	12,700	4,100	1,200
Norway	822,800	19,200	15,500	16,000	4,900	0	18,300	18,100	7,900	600	0
Poland	7,446,365	323,600	197,900	98,100	38,500	6,900	191,800	108,100	37,300	700	100
Romania	4,079,364	135,700	90,700	15,700	1,300	100	184,200	111,700	44,600	4,800	200
Slovakia	528,129	95,100	67,600	38,500	16,600	3,700	92,300	54,200	32,900	8,700	2,600
Slovenia	266,251	6,700	3,500	900	0	0	5,800	2,300	500	200	0
Spain	8,116,104	16,300	7,200	1,300	500	0	9,700	2,900	1,000	200	0
Sweden	1,548,886	84,900	37,800	13,400	5,400	1,500	56,300	22,100	7,100	2,800	300
Switzerland	5,300,000	182,700	126,600	98,500	62,300	25,900	156,100	107,700	85,000	41,600	16,900
United Kingdom	25,613,309	395,500	291,400	157,900	46,800	6,000	321,000	193,700	69,600	14,000	2,200
Total general	106,404,547	3,817,500	1,653,900	907,100	348,100	106,100	3,367,900	1,283,300	561,000	170,100	46,500
Total EU 27	105,581,747	3,615,600	1,511,800	792,600	280,900	80,200	3,193,500	1,157,500	468,100	127,900	29,600

Source: ETC 2010.

ANNEX II: MAXIMUM NOISE LEVELS OF ROLLING STOCK ACCORDING TO TSI NOISE

Table 1: Limiting values LpAeq,Tp for the pass-by noise of freight wagons

Wagons	LpAeq, Tp in dB
New wagons with an average number of axles per unit length (apl) up to 0,15 m^{-1} at 80 km/h	82
Renewed or upgraded wagons according Article 20 of Directive 2008/57/EC with an average number of axles per unit length (apl) up to 0,15 m^{-1} at 80 km/h	84
New wagons with an average number of axles per unit length (apl) higher than 0,15 m^{-1} up to 0,275 m^{-1} at 80 km/h	83
Renewed or upgraded wagons according Article 20 of Directive 2008/57/EC with an average number of axles per unit length (apl) higher than 0,15 m^{-1} up to 0,275 m^{-1} at 80 km/h	85
New wagons with an average number of axles per unit length (apl) higher than 0,275 m^{-1} at 80 km/h	85
Renewed or upgraded wagons according Article 20 of Directive 2008/57/EC with an average number of axles per unit length (apl) higher than 0,275 m^{-1} at 80 km/h	87

Table 2: Limiting value LpAeq,T for the stationary noise of freight wagons

Wagons	LpAeq, Tp in dB
All freight wagons	65

Table 3: Limiting values LpAeq,T for the stationary noise of electric locomotives, diesel locomotives, OTMs, EMUs, DMUs and coaches

Wagons	LpAeq, Tp in dB
Electric locomotives and OTMs with electric traction	75
Diesel locomotives and OTMs with diesel traction	75
EMUs	68
DMUs	73
Coaches	65

Table 4: Limiting values LpAFmax for the starting noise of electric locomotives, diesel locomotives, OTMs, EMUs and DMUs

Vehicle	$LpAF_{max}$ in dB
Electric locomotives P < 4 500 kW at the rail wheel	82
Electric locomotives P >/= 4 500 kW at the rail wheel and OTMs with electric traction	85
Diesel locomotives P < 2 000 kW at the engine output shaft	86
Diesel locomotives P >/= 2 000 kW at the engine output shaft and OTMs with diesel traction	89
EMUs	82
DMUs P < 500 kW/engine	83
DMUs P >/= 500 kW/engine	85

Table 5: Limiting values LpAeq,Tp for the pass-by noise of electric and diesel locomotives, OTMs, EMUs, DMUs and coaches

Vehicle	LpAeq, Tp in dB
Electric locomotives and OTMs with electric traction	85
Diesel locomotives and OTMs with diesel traction	85
EMUs	81
DMUs	82
Coaches	80

ANNEX III: COMPARISON OF COVERAGE OF BOGIES FROM DIFFERENT MODERN ROLLING STOCK EQUIPMENT

Well covered bogies by engine body of Swiss Engine type RE 460 (Lok 2000)

Open bogie of modern Bombardier Engine Traxx (example German type 186)

Well covered bogies of Swiss passenger wagon IC2000

Open bogie of modern German double deck wagons

ANNEX IV: IMPORTANT AND ANALYSED REGULATIONS

EU Political Papers and Directives	Relevant Contents with Respect to Railway Regulation and Railway Noise
Political Papers	
White Paper 2001	EU transport policy for 2010. Shifting the balance between the modes of transport. Revitalising the railways. Towards multi-modal corridors giving priority to freight.
White Paper 2011	A true internal market for railway services. Standards for controlling noise pollution. Among the ten goals for achieving a competitive and sustainable transport system: Shift 30 (50)% of road freight over 300 km to rail and IWW by 2030 (2050).
Directives	
Directives 1991/440	Framework and legal requirements for a competitive railway system. Commercial organization of companies. Separation of infrastructure management and service undertakings. Open access to the railway network. Liberalized cross-border transport.
Directives 2001/12-14	Comprehensive railway regulation framework, e.g.: Clear separation of public and commercial issues. Freeing companies from old debt. Separate bookkeeping and balance sheets for infrastructure management and service provision. Capacity provision and pricing for infrastructure provision.
Railway Packages 2001, 2002, 2004	Specification of open access, essential facilities. Specification of regulatory requirements. Establishment of national and EU regulatory bodies (European Railway Agency). Rail track charging principles (marginal cost plus mark-ups). Market opening for freight (2007) and passenger long-distance (2010) transport. Regulation of passenger rights and freight transport quality. EU train driver license.
Recast of the First Railway Package 2010 Status: Under discussion.	Comprehensive specifications for establishing a single European railway area. General objectives: Establish an internal railway market with high degree of competitiveness and harmonious, balanced and sustainable development of economic activities. Revitalization of railways, modal shift. Horizontal objectives: Legal simplification, clarification and modernization to facilitate implementation. Specific objectives: Ensuring sustainable funding of the infrastructure. Avoiding distortions of competition. Providing effective and independent regulation. Applied principles of rail track charging under consideration of external effects (e.g. noise). 12 appendices with detailed specifications for application

Related COM Decision	
COM 2006/66 (TSI Noise)	Technical Specifications for Interoperability related to the subsystem 'rolling stock-noise'. Functional and technical specification of the sub-system. Limits for pass-by and stationary noise. Limits for locomotives, multiple units and coaches. Measurement, assessment, application to new and existing rolling stock.
Related Directives	
Directive 2002/49	Assessment and management of environmental noise. Noise indicators, noise measurement and assessment. Obligation to publish noise maps. Obligation to develop noise action plans. Obligation for reviews and regular reporting. 6 Annexes with detailed specifications.
Report from the Commission to the EU Parliament and to the Council on the Implementation of Directive 2002/49	First implementation report based on the implementation deadlines 2005 – 2012. Noise indicators and limit values widely transposed. Significant achievements with harmonized measurement and statistical reporting/noise mapping. Difficulties still existing with health-based noise assessment and heterogeneous situation with country-based action plans.
Directive 2006/38 revised	Charging heavy goods vehicles on motor- and freeways for infrastructure use. Basis: Allocated infrastructure costs plus mark-ups for noise and air pollution. This was the pre-condition set in Dir. 2001/14 for including noise costs in the rail track charging scheme.

EUROPEAN PARLIAMENT

BA-32-12-105-EN-C

DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT B
STRUCTURAL AND COHESION POLICIES

Role

The Policy Departments are research units that provide specialised advice to committees, inter-parliamentary delegations and other parliamentary bodies.

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- Agriculture and Rural Development
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Publications Office

Council, City

From: Svetlana Yepanechnikova <svetlana.yepanechnikova@gmail.com>
Sent: Monday, October 15, 2018 10:55 AM
To: Council, City
Subject: Trench/Tunnel Option

October 15, 2018

To: Rail Committee

RE: Tunnel/Trench vs. Hybrid and Viaduct

Dear City Council and City Staff,

As a longtime resident of Palo Alto and the property owner on Park Boulevard, I would like to state that **you have my full support on Tunnel/Trench option**. As young mother with two kids I do care for safety and decreased/eliminated noise level this option provides.

I would like to ask City Council and City Staff to get Caltrain to approve 2% grade. Please publish those efforts as a standing agenda for the CAP and for all the committee/council meetings. As I see it, this is the one most critical factor that will reduce the cost irrespective of the option chosen.

Additionally, I would like to ask to get Caltrain to approve 18.5ft top of rail to bridge clearance instead of 24.5ft". Please publish those efforts as a standing agenda for the CAP and for all the committee/council meetings.

An update on the Trench/Tunnel Option would be greatly appreciated. AECOM / Rail Committee cannot make unilateral decision to suddenly stop or merge this option with Shallow Trench. These are two different options. The Tunnel for Charleston/Meadow should be analyzed with Caltrain electric for tunnel and freight single rail at grade. CAP/Residents should be provided with detailed analysis on the Trench/Tunnel option. While the Shallow Trench should continue to be explored assuming 2% grade is approved by Caltrain. Since underground is a preferred choice, all options from this category should have detailed analysis.

Furthermore, I would like to ask for Raised rail options to be merged to one - Hybrid and Viaduct option.

In conclusion, I would like to restate that Tunnel/Trench is my preferred choice and our petition for the LOWERED RAIL has 555 signatures as of today.

Respectfully,

Svetlana Yepanechnikova

Council, City

From: Yuriy <yuriy.yepanechnikov@gmail.com>
Sent: Monday, October 15, 2018 12:07 PM
To: Council, City
Subject: Tunnel/Trench vs. Hybrid and Viaduct

Dear City Council and City Staff,

As a longtime resident of Palo Alto and the property owner on Park Boulevard, I would like to state that **you have my full support on Tunnel/Trench option**. As young father with two kids I do care for safety and decreased/eliminated noise level this option provides.

I would like to ask City Council and City Staff to get Caltrain to approve 2% grade. Please publish those efforts as a standing agenda for the CAP and for all the committee/council meetings. As I see it, this is the one most critical factor that will reduce the cost irrespective of the option chosen.

Additionally, I would like to ask to get Caltrain to approve 18.5ft top of rail to bridge clearance instead of 24.5ft". Please publish those efforts as a standing agenda for the CAP and for all the committee/council meetings.

An update on the Trench/Tunnel Option would be greatly appreciated. AECOM / Rail Committee cannot make unilateral decision to suddenly stop or merge this option with Shallow Trench. These are two different options. The Tunnel for Charleston/Meadow should be analyzed with Caltrain electric for tunnel and freight single rail at grade. CAP/Residents should be provided with detailed analysis on the Trench/Tunnel option. While the Shallow Trench should continue to be explored assuming 2% grade is approved by Caltrain. Since underground is a preferred choice, all options from this category should have detailed analysis.

Furthermore, I would like to ask for Raised rail options to be merged to one - Hybrid and Viaduct option.

In conclusion, I would like to restate that Tunnel/Trench is my preferred choice and our petition for the LOWERED RAIL has 555 signatures as of today.

Respectfully,

Yuriy Yepanechnikov

Council, City

From: Amie Neff <amie.neff@gmail.com>
Sent: Tuesday, October 16, 2018 9:14 AM
To: Council, City; Keene, James; Shikada, Ed; De Geus, Robert
Cc: Mandar Borkar
Subject: Public Comment , Wednesday October 17th. Caltrain Grade Separation

Good Morning Council and Rail Committee Members,

I'd like to address the committee and and our city transportation specialists about a few clarifications and requests I believe are crucial before moving forward with the very costly and important decision about how to address Caltrain's pending electrification and increased ridership goals.

I would like to thank the committee for their time, and the city for providing access to the big Design Boards that were presented at the August 23rd meeting. I was not able to attend that meeting and am glad to be able to see what is being discussed with more time and attention. You provided enough information that I see where each option begins and ends, the depth or height of the tracks, and the slope profile.

There are notable omissions on the "Typical Section" images which makes it difficult to understand how each alternative might look.
PLEASE SEE:
https://pagradesep.com/wp-content/uploads/2018/08/Meadow-Dr-Charleston-Rd-Viaduct-Full-Trench-MCV-MCT.pdf

The 100' graphical scale in the right hand bottom corner is only applicable to the already graphed section and mapped segment. That scale doesn't apply to the "Typical Sections" of the train in the trench, or elevated options on either board.

In fact, the Typical Sections, (images which are most relatable to us,) have no scale, no context and no dimensions. Other than information about track height or depth, I have no way of understanding, if I live along Park, how close that wall or viaduct will to be to my back deck or roofline or how high it is in relation to my house. I know the average home heights along the track are 12'-0", if the tracks might be 3'-0 or even 8'-0" above the top of my house, how high will the train be? How tall is a train?

I hope that we can ask the team who put together these boards to go a small step further in giving us a sense of the proposals that corresponds to our understanding of the real world. It doesn't take much to draw in a tree, a house, a car, or a person for context, but it informs our understanding enormously.

More importantly, I want to make it clear that without an approval from CalTrain that we can design with a 2% grade, the option to trench in South Palo Alto is not on the table. Why continue to entertain a trenching option without that approval? I would ask that the City Council do their due diligence. Request the following design assurances and clarifications from Caltrain:
1) Grant us permission to design for 2% grade due to the streams we are working around.
2) Elsewhere clearance height for trains is 18-1/2', why are we being held to different design standard of 24-1/2'? Can we shoot for the lower clearance?
3) We would like clarification about what options we have to reclaim the space returned to us in the right of way now occupied by the rails should we chose to construct a tunnel or a viaduct. Will that space be available to Palo Alto's community?

Finally, I would like the committee to leave among our options the construction of a short, shallow tunnel between San Antonio and Cal Ave stations that allowed the freight to remain in place above and CalTrain to go in a tunnel below. It can be lumped into the city wide tunnel option.

Many Regards,
--
Amie Neff
M.Arch, LEED® AP

Council, City

From: Florence LaRiviere <florence@refuge.org>
Sent: Tuesday, October 16, 2018 9:23 PM
To: Council, City
Subject: Rail Separation

Dear Council members,

We live in South Palo Alto a block from the train. We have lived here since 1950. We favor the trench/tunnel option for Meadow and Charleston railroad crossings. By the way, what is the status of the partial tunnel with single rail at grade for freight?

Apparently a crucial step that needs to take place is to get Caltrain to approve the 2% grade (the consultants did their plans based on the 2% grade). We respectfully ask that you and city staff let us know progress on this issue. Also, please work with Caltrain to lower the top of the rail to bridge from 24.5 feet to 18.5 feet and keep us informed about those efforts.

Thank you so much for the time and effort already put into this project. Again, our preference is trench/tunnel. The idea of the train on a wall/viaduct is out of the question and would badly degrade the surrounding neighborhoods. Please listen to those most affected by the Caltrain electrification. Let's put equal energy and consideration for the south part of Palo Alto. If all parties are truly heard and valued, we can come up with the least intrusive option that is also the least divisive politically and physically to our city.

Respectfully yours,
Florence LaRiviere
Virginia LaRiviere

453 Tennessee Lane
Palo Alto, Ca 94306

Council, City

From: Jagdish Pamnani <jpamnani@gmail.com>
Sent: Tuesday, October 16, 2018 8:33 PM
To: Council, City
Subject: Grade separation at Meadow and Charleston rail crossings

Dear City Council Rail Committee,

I live a few blocks from the Meadow rail crossing. My **strongly preferred choice** for both the Meadow and Charleston crossing is the shallow trench option as it significantly reduces the noise of passing trains, hides the train below grade level and allows a slightly elevated road over rail. However, to make this choice as cost-effective as possible, we need to do the following:

1. Get Caltrain to approve a 2% grade, publish the progress of this issue as a standing agenda item for the CAP and city council meetings.

2. Get Caltrain to approve 18.5ft top of rail to bridge clearance instead of 24.5ft, publish the progress of this issue as a standing agenda item for the CAP and city council meetings.

The residents (550 of them who signed the petition) also need an update on the "Tunnel Option". AECOM / Rail Committee cannot make the unilateral decision to suddenly stop the tunnel option and merge this option with the Shallow Trench.
There are two distinct options: Shallow trench and the Tunnel for Charleston/Meadow should be analyzed with **Caltrain electric for tunnel and freight single rail at grade**. The CAP/Residents need to be provided with detailed analysis on both these options.

Also to keep the options to three, merge the least popular options of raised rail (Hybrid and Viaduct) into one.

Items 1, 2 will significantly reduce costs of whatever final option is chosen so it is extremely important for the council to get answers to these questions before making any final decision.

Regards, Jagdish

Council, City

From: Ken Joye <kmjoye@gmail.com>
Sent: Tuesday, October 16, 2018 4:36 PM
To: Council, City
Subject: study session on traffic 22 October

I will not be able to attend the study session on traffic scheduled for 22 October 2018, so write you here instead.

I wish to propose that you and staff ***consider prioritizing cross-rail traffic*** at the Charleston and Meadow crossings. I believe that this can be done by re-programming the traffic light signals at those two intersections. I concede that I am not a traffic engineer and so my naive idea may have fatal flaws. Nonetheless, I believe it worthy of your consideration.

Currently, when a train approaches those intersections, the crossing arms come down and these things happen: all directions are shown a red light except for traffic headed toward Middlefield Rd, following which traffic on Alma is given a green light (first "southbound, then "northbound" after southbound left-turning). From that, the normal cycle ensues.

I propose a fundamental change: when the crossing arms descend, give a red light to all directions except for traffic headed toward Middlefield Rd, ***followed by a red light in all directions until the rail tracks are clear*** and the crossing arms are lifted. At that point, begin the normal cycle with "westbound" traffic toward El Camino Real, followed by "eastbound" traffic toward Middlefield Rd, then Alma "southbound" and "northbound". That is, don't have every crossing arm trigger a north/south flow on Alma St.

The effect of this will be to reduce wait time for Palo Alto residents attempting to cross the rail tracks, favoring that movement over the out-of-town traffic between Mountain View and Palo Alto.

Obviously this would be a considerable change and would need to be validated by a proper traffic study. I believe that the time currently between the green light to southbound and the lifting of the crossing arms is approximately 20 seconds. This would not be an overly long time to delay traffic movement and would considerably improve cross rail travel.

thank you for your consideration,
Ken Joye
Ventura neighborhood

Carnahan, David

From: Siddarth Sharma <ssharm47@ucsc.edu>
Sent: Thursday, October 11, 2018 10:39 AM
To: Council, City
Subject: Approve 429 University Ave

Dear Palo Alto City Council,

As a resident of Palo Alto, I would urge you to approve the development (429 University) near downtown as is and improve the development environment in Palo Alto.

Best,
Siddarth Sharma

Council, City

From: cassandra_moore6@aol.com
Sent: Monday, October 15, 2018 12:47 PM
To: Council, City
Cc: cassandra_moore6@aol.com
Subject: Bol Park

First we waved the trailer park, then we saved Maybell, now we have to save Bol Park.

The city council seems to have ignored the importance of Bol Park for the entire neighborhood.
It is a treasure used by children, hikers, bicyclists, and those who would simply like to sit and contemplate the seasons.

It should never be a toxic treatment site: I am anxious to ensure that staff and Council are aware that they may not negatively impact our neighborhood.

Cassandra Moore
Resident in Basson Park since 1974 a jogger,hiker, and walker. Leave it be!!

cassandra_moore6@aol.com
Phone: 650-493-7358

Carnahan, David

From: Kerry Yarkin <kyarkin895@gmail.com>
Sent: Friday, October 12, 2018 10:20 AM
To: Council, City
Subject: Churchill accident last week

Carnahan, David

From: Kerry Yarkin <kyarkin895@gmail.com>
Sent: Friday, October 12, 2018 10:06 AM
To: Council, City
Subject: Churchill between Alma/Emerson

Dear CouncilMembers:
I am sending you a short video I witnessed last week on Churchill Ave, middle of block between Alma and Emerson. A van was backing out of his driveway and he didn't see a car from Castilleja driving West on Churchill. The Paly school day had ended. Bicyclists are riding East on Churchill, having just crossed the railroad tracks.I hope you close this RRCrossing at Churchill and make safety your number one priority!
Respectfully,
KerryYarkin
I'll be sending video in another e-mail.

Council, City

From: Amie Neff <amie.neff@gmail.com>
Sent: Wednesday, October 17, 2018 10:49 AM
To: Council, City
Subject: Elimination of the viaduct

I vehemently oppose elimination of the viadct option without also eliminating the hybrid option.

Between the two above ground options I feel the viaduct offers a much better option for the community for the following reasons:

It opens up space below the raised rail for landscaping, possible bike or walking lanes, and should train ever become obsolete, offers the community a walking path option to reclaim.

The hybrid will visually divide our city, it will severely degrade housing values, block light in people's yards, and be a general eyesore.

If you plan on keeping any elevated options on the table at all, which I believe is a different question entirely, do not eliminate the viaduct.

Thank you
Amie Neff

Carnahan, David

From: Arlene Goetze <photowrite67@yahoo.com>
Sent: Wednesday, October 10, 2018 1:45 PM
To: Sara Cody; Joe Simitian
Subject: Fluoride & ADHD; CDC no proof Flu deaths

Forwarded by Arlene Goetze, No Toxins for Children, photowrite67@yahoo.com

I . From Fluoridealert.org <info@fluoridealert.org> . Oct 10 at 11:16 AM

3 Studies link Fluoride to ADHD and thyroid

Stuart Cooper, Campaign Director, Fluoride Action Network
Read article below #2.

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2. Autism Action Network <jgilmore@autismactionnetwork.org> Oct 10 at 6:06 AM

CDC claims 80,000 flu deaths, NCHS says 2,000

*** Where's the data? 71 shots prevent 1 case of flu**
*** Flu shot associated with autism**

In a recent interview with the Associated Press Centers for Disease Control and Prevention (CDC) Director Robert Redfield predictably said, "I'd like to see more people vaccinated," but added that in last year's season, "We lost 80,000 people to the flu." But there is **utterly no data or evidence** to back up Redfield's claim of that extraordinarily high number of deaths from flu. We would like to ask Dr. Redfield to please share the data that supports his claim.

According to the National Center for Health Statistics there is usually somewhere between 1,000 to 2,000 deaths from lab-verified flu annually in the US. Even though the number of flu shots given in the US increased 800% since the 1980s the number of verified deaths never seems to budge.

The flu shot is notoriously ineffective, according to an meta-analysis by the Cochrane Collaboration typically 71 flu shots need to be administered to prevent one case of the flu.

There are significant associations between flu shots and autism.

A recent study showed flu shots given to pregnant women in the first trimester of pregnancy are associated with a significant increase in autism in the child, but obstetricians still give flu shots to pregnant women in the first trimester.

About 20% of flu shots in the US still contain thimerosal, a mercury-based preservative. Internal CDC studies performed by Thomas Verstraeten in the late 90s showed 700% more autism in children given thimerosal-containing vaccines in infancy (google Simpsonwood), but pediatricians still give thimerosal-containing flu shots to infants. Thimerosal is banned in most of the developed democracies but not here. Any flu shot taken from a multi-dose vial, rather than a pre-filled syringe, contains thimerosal.

Please share this message with friends and family, and social networks.
jgilmore@autismactionnetwork.org>

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1. Fluoridealert.org <info@fluoridealert.org>
Oct 10 at 11:16 AM

3 Studies link Fluoride to ADHD and thyroid

Stuart Cooper, Campaign Director, Fluoride Action Network

Three significant studies—two of which were U.S. government funded (NIH)--have been published today linking fluoride exposure to ADHD, thyroid problems, and showing that pregnant women in "optimally" fluoridated Canada have significantly higher levels of fluoride in their urine than women in non-fluoridated communities.

This third study also showed that pregnant Canadians had fluoride urinary levels similar to those that reduced IQ in offspring from last year's Bashash et al, 2017 NIH-funded study. These findings suggest that the Bashash results from Mexico City may be applied to Canada, and probably the United States, namely that pre-natal exposure to fluoride has the potential to lower IQ in children. In other words, the claim by the ADA that the 2017 Bashash study was not relevant to the U.S. is more about propaganda than serious scientific analysis.

Here are the three new studies:

--Prenatal fluoride exposure and attention deficit hyperactivity disorder (ADHD) symptoms in children at 6–12 years of age in Mexico City.

--Fluoride exposure and thyroid function among adults living in Canada: Effect modification by iodine status.

--Community Water Fluoridation and Urinary Fluoride Concentrations in a National Sample of Pregnant Women in Canada.

Below is an article that appeared this morning in **Environmental Health News.**

We add it to tap water for teeth, but is fluoride hurting us?

By Brian Bienkowski, Environmental Health News, Oct. 10, 2018

Two studies — one from Canada and one Mexico — released today point to potential health problems from fluoride, which, in a majority of U.S. communities, is purposefully added to drinking water to protect people's teeth.

The Canada study found that adults who are iodine deficient and have higher levels of fluoride in their system have a greater risk of an underactive thyroid. The Mexico study found mothers with higher fluoride exposure during pregnancy were more likely to have children with symptoms of ADHD. Both studies were published in the journal *Environmental International.*

A third study, published in *Environmental Health Perspectives*, found that among 1,566 pregnant women in Canada, fluoride levels in urine were almost two times higher for women who lived in regions where the element was added to their drinking water compared to pregnant women in regions with non-fluoridated water.

The studies call into question the practice of purposely adding fluoride to water or salt, which is done to prevent cavities and, to a lesser extent, osteoporosis. Many cities in the U.S. and Canada add fluoride to public drinking water and in Mexico it's added to some salt.

Approximately 66 percent of people in the U.S. receive drinking water with added fluoride, according to the Centers for Disease Control and Prevention (CDC).

About 80 percent of fluoride exposure comes from water and beverages such as tea, which can leach fluoride from soil. Other sources include grapes and shellfish. . . . .

....this article is very lengthy. It explores iodine deficiency and thyroid problems.

One Conclusion: "The problem is that it's an uncontrolled dose – everyone is exposed to different levels. It may be prudent for pregnant women to reduce ingesting fluoride during pregnancy."

Read complete article info@fluoridealert.org OR

https://www.ehn.org/we-add-it-to-drinking-water-for-our-teeth-but-is-fluoride-hurting-us-2611193177.html

Carnahan, David

From: Linda M. Saunders <linda.saunders@stanford.edu>
Sent: Thursday, October 11, 2018 10:13 AM
To: editor@paweekly.com; news@padailypost.com; editor@almanacnews.com; news@stanforddaily.com; doc_coordinators@lists.stanford.edu; Eileen O'Rourke; stanfordstaffers@lists.stanford.edu; Jo-Ann Cuevas; cardinalatwork; hrcommunications@stanford.edu; OConnell, M; Police; Clerk, City; City Mgr; Council, City; Dueker, Kenneth; Perron, Zachary; Williams, Simon; policechief@menlopark.org; police@losaltosca.gov; board@ctra.org; stanfordwestapartments@stanford.edu; lucy.wicks@stanford.edu; Russell Furr; Robert L. Carpenter; Cynthea A. Kingsley; Norman W Robinson; bbond@stanfordhealthcare.org; lharwood@stanfordhealthcare.org; kaharris@stanfordhealthcare.org; Rami Abdelhadi; jennifer@icrichild.org; debbie@icrichild.org; allison@icrichild.org; christine@icrichild.org; Bonan@kc-education.com; esun@kc-education.com; susan@ccscparentcoop.org; hope@ccscparentcoop.org; sally@icrichild.org; christine@icrichild.org; elham@icrichild.org; bingschool
Subject: FW: Annual AlertSU Test Notification

Please read message below and share with your community.

Thank you
Stanford Department of Public Safety

-----Original Message-----
From: Stanford Department of Public Safety [mailto:alertsudps@lists.stanford.edu]
Sent: Thursday, October 11, 2018 9:46 AM
To: alertsudps@lists.stanford.edu
Subject: Annual AlertSU Test Notification

Dear Stanford Faculty & Staff,

On Thursday, October 18th, between noon-12:30 pm, Stanford University will conduct its annual test of the campus AlertSU system. Alert messages will be sent via text message and email to the Stanford community.

The test will also include activation of the outdoor warning system, which will sound an audible tone for approximately 30 seconds followed by a verbal message from each of the 7 sirens at various campus locations. The sirens will be audible throughout the campus and may also be heard in parts of the surrounding communities including Palo Alto, Menlo Park and Los Altos.

Also being tested is Cisco VoIP speaker phones. VoIP speaker phones are found in many of the academic and office buildings throughout campus. If you have a Cisco phone in your area, the alertsu message will broadcast from the speaker phone and a banner message will appear in the display.

In the test message, you will be asked to click a link to acknowledge or confirm that you have received the message. This is an important step which will help us monitor the success of this test. If you receive both a text and email, you only need to acknowledge one of the messages you receive.

If your department would like to participate in an evacuation drill to your emergency assembly point (EAP) during this scheduled test, please contact AlertSU at alertsudps@stanford.edu.

Prior to the test, it is important you verify that your contact information is correct in StanfordYou. Make sure there is an entry in the mobile phone field as this is the most rapid and direct way of communication with you during an emergency.

Additionally, in order to know you are receiving an official AlertSU message, please program the following information into your mobile phone contacts.

- Email Address: alertsudps@lists.stanford.edu
- Phone Number: 650-725-5555
- Text Message phone number: 89361

If there were a real emergency, you would be asked to follow the specific instructions in the alert message. Other avenues, which might be used to inform the community about critical incidents, include:

- Stanford's emergency website: http://emergency.stanford.edu
- Department of Public Safety website: https://police.stanford.edu
- KZSU 90.1 FM
- University emergency information hotlines: 650-725-5555 and 844-253-7878 (844-AlertSU)

Upon receipt of an AlertSU message, notify others in your immediate vicinity to ensure they are also aware of the situation and the recommended safety precautions.

For more information about the AlertSU system, please visit the AlertSU FAQ page at: https://police.stanford.edu/alertsu-faq.html.

Evacuation procedures and how to respond to other emergencies can be found on the following resource pages.

- Evacuation Procedure: https://ehs.stanford.edu/manual/emergency-response-guidelines/evacuation-procedure
- Fire: https://ehs.stanford.edu/manual/emergency-response-guidelines/fire
- Earthquake: https://ehs.stanford.edu/manual/emergency-response-guidelines/earthquake
- Stanford University Emergency Response Guidelines: https://ehs.stanford.edu/manual/emergency-response-guidelines
- Safety, Security, and Fire Report 2018: https://police.stanford.edu/security-report.html

Thank you for your cooperation.

Stanford Department of Public Safety

Council, City

From: Kate Crane <katecrane@gmail.com>
Sent: Monday, October 15, 2018 12:42 PM
To: Council, City
Subject: Fwd: Another two trucks, 20 minutes later

Dear City Council,

I'm wondering what is being done to fix the problem I alerted you to three weeks ago. There is a full-time truck loading dock in Palo Alto city no parking zone. I live next-door to it in prime downtown Palo Alto real estate, with prime downtown Palo Alto rent, and I cannot be home during the day anymore because of the constant beeping sound. I did hear from a lieutenant who said he was going to inquire about turning it into a no loading zone, but it already is! There are no parking signs everywhere. Also said he would work on police enforcement to improve the problem.

Nothing has changed. If I wanted to live next to a loading dock, I would not pay Palo Alto rent.

It is a flagrant misuse of city property and a menace to residents like me. Attached, right now.

Best,
Kate

---------- Forwarded message ---------
From: Maloney, Con <Con.Maloney@cityofpaloalto.org>
Date: Fri, Sep 28, 2018 at 11:48 AM
Subject: RE: Another two trucks, 20 minutes later
To: Kate Crane <katecrane@gmail.com>

Hi Kate. That's plenty of information. I've been by the alley several times myself yesterday and today. I think I have a pretty good idea of how this alley is being used. Essentially the "No Parking" alley has become a defacto loading zone. A huge part of the issue is the large trucks can't drive through the alley because of the garage, so they are compelled to back in all the time. It looks like even the normal sized vans choose to back in. I see why this is so annoying.

I called our transportation engineer yesterday, but they were busy. They are out of the office today. I need to have them look at the alley to evaluate the expected use and the current use. They are the entity that regulates roadway use and signage and I find it preferable to start with them. I'll ask if they can make loading and unloading prohibited in the alley. I honestly don't know if they would consider that.

Are you in contact with any of your neighbors? Are there more people that have expressed their displeasure with the noise from the alley? It's fine to stand alone, but more voices can help.

Con

From: Kate Crane [mailto:katecrane@gmail.com]
Sent: Friday, September 28, 2018 11:26 AM
To: Maloney, Con
Subject: Another two trucks, 20 minutes later

This is fairly representative of what a typical morning here is like. The day I wrote the letter to the city Council, it was double this level of truck activity.

Best,

Kate

Council, City

From: Maryjane Marcus <maryjane.marcus@gmail.com>
Sent: Monday, October 15, 2018 11:08 PM
To: boardoperations@cob.sccgov.org
Cc: Council, City
Subject: GUP Stanford comment - request voluntary commitment from Stanford

Dear Board of Supervisors,

First, please hold off on moving forward without an EIR.

Second, as someone who lives in College Terrace adjacent to Stanford University, I urge Stanford to voluntarily limit their purchasing & tear down/reno of homes here as part of the GUP.

REQUEST:
I request that Stanford agree voluntarily....

1. To limit how many 'lots' they will purchase in a particular neighborhood to not more than 10% of the lots in a particular neighborhood (or a % less to be negotiated), and not more than 15% on any one street;
2. Commit to renovating 50% of the homes rather than tearing what seems to be 80-90% of them down.
3. Commit to not buy any of the small groups of cottages in College Terrace for the purposes of tearing them down and building one large home.

Background: Because of the housing shortages they face, Stanford has greatly accelerated their purchases of property in College Terrace so much so that it is almost impossible for anyone else to buy a home here in the past year, far accelerating what they started maybe 5 years ago.

My street alone (Cornell Street) - Stanford owns 5 homes, or 25% of the homes on our street, and I am personally faced with a tear down of 2 1 story homes that will now be 2 story homes and will take the next 1.5-2 years to build on either side of our house. By opting for what seems to be a few standard designs with minor customizations, Stanford is changing College Terrace house by house into something that WILL like a Stanford development. (Most homes are being built now so you do not see the effect yet.) The very cute Craftsman home next door to me (2080 Cornell) had a huge amount of interest and yet Stanford bought it on Friday (5 months ago) before it was even fully open. I learned today they will tear it down. They seem to be greatly accelerating their purchases over time because their economics are very different than any other buyer, and once Stanford buys the home it is permanently off the market.

Please review any GUP with consideration for how Stanford's efforts to increase their housing stock are affecting the neighboring communities and ask Stanford to make voluntary commitments to reduce how many homes they purchase in neighboring communities.

I am happy for Stanford to build lots and lots of housing -- just keep it on Stanford campus and of course pay their fair share for amenities incuding schooling. I want everyone to have affordable housing too.

I have to be at work at 10 am tomorrow or I would join you. Feel free to call.

Warmly,
Mary Jane Marcus
2090 Cornell St Palo Alto, CA
4152699079

Carnahan, David

From: Lawrence Frank <lhfrank99@gmail.com>
Sent: Friday, October 12, 2018 11:48 AM
To: Council, City
Subject: leaf blower ban

To whom it may concern:
I understand that your municipality has banned the use of leaf blowers (https://hdsupplysolutions.com/shop/static--leaf_blower_noise_regulation). I am interested in getting my town, Winchester, MA, to also ban leaf blowers. I mainly object to the air pollution they generate and its health consequences, though I also resent the noise and recognize they present other harms. I am writing to request any information you can provide regarding your experience in enacting the ban, including the actual legislation text, citizens' response to the ban, the basis for your ban, and the response of landscaping companies and other users to the ban, both before and after the ban was enacted.
Legislation that I envision includes a combination of a phase-out period during which licenses must be purchased, eventually culminating in a complete ban, penalties violating the rules, citizen documentation/reporting/enforcement, and possibly a buy-back program for individual users as an incentive to stop use very soon. I am curious whether you have found that rakes suffice as a substitute. I greatly appreciate any help you can provide. Thank you for considering my request.
(I recommend banning vehicle curbside engine idling, as well, if you have not looked into that. Some states/localities have rules but these are rarely if ever enforced, to everyone's detriment.)
Sincerely,
Lawrence Frank
Winchester, MA

cell phone (917) 882-3553

Council, City

From: Svitlana Koliadenko <svitlana@levettproperties.com>
Sent: Tuesday, October 16, 2018 10:47 AM
To: Council, City; Maloney, Con
Cc: galina@levettproperties.com; 'Kate Crane'
Subject: LeVett Properties Management: Complains about Webster&Cowper parking garage

Dear City Council and Lieutenant Maloney,

We have been hearing from our tenants that the city property leading to the Webster Cowper parking garage has become a loading dock for private trucks. The noise is a terrible nuisance for our tenants at 530 Webster. This area is signed as no parking.

Could you please stop this misuse of city property?

Thank you

Kind Regards,

Svitlana Koliadenko, LeVett Property Management
http://www.levettproperties.com
Office: (650)321-0440
Fax: (650)328-4859
502 Waverley St, Suite 304
Palo Alto, CA 94301

Council, City

From: Eva Wallack <ewallack@stanford.edu>
Sent: Tuesday, October 16, 2018 4:19 PM
To: Council, City
Subject: Misuse of City Property/ Noise hazard

Dear City Council,

I hope this finds you well. I would like to both inform you of and ask you for help with a problem facing the residents of 530 Webster street apartments.

There is a significant misuse of property next to my residence in 530 Webster street apartments. Commercial trucks use the no parking zone entering the parking lot next to my residence consistently 8 hours a day as a loading zone. The trucks back into the space and cause extremely loud beeping on end.

It has become practically unlivable. The beeping of the trucks is extremely disruptive not only during the day, but in the morning when they start around 7AM. I believe you have been in touch with my neighbor Kate Crane about the issue and I would like to let you know that all of us at 530 Webster street apartments support these concerns and are looking for answers. She and I both live in the apartments that face the area, and so are particularly afflicted by this.

As a student at Stanford, I am incredibly busy with work and am routinely woken up by the noise of these trucks as I am up working late. I cannot stay at my residence during the day to do work due to these disturbances.

This is not simply a noise complaint, this is a misuse of city property that does not comply with city parking law and regulation and affects quality of life of residents on Webster street.

Please let me know what can be done to address this matter,

All the Best,
Eva Wallack

Council, City

From: Art Liberman <art_liberman@yahoo.com>
Sent: Saturday, October 13, 2018 9:23 PM
To: Council, City
Cc: Jon Affeld
Subject: Not in Bol Park

Council -

This is a note about the proposed storm water diversion project, reported on just a few days ago by the Weekly. The project would divert storm water run-off from the Stanford Research Park and capture it in a new underground structure in Bol Park. **This is an ill conceived project.** It could be another case where Barron Park would suffer the consequences of being downstream of the Research Park. Several decades ago the groundwater in our neighborhood was contaminated with volatile organic compounds, such as trichloroethene and perchoroethylene, which were carried downstream in Matadero Creek. This was caused by the sloppy and careless practices of eight or nine companies in the Research Park, who for a long time kept leaking tanks and sumps full of these solvents on their sites, whose contents entered the subsurface groundwater and made their way into Matadero Creek and then into Barron Park.

Those were the practices that created the Hillview-Porter superfund site in the Research Park. The California Department of Toxics Substances Control (DTSC) mandated an extensive remediation effort, a process that is still ongoing in number of significantly contaminated sites in the Research Park ...and which very well may continue for decades.

Those practices created a wide swath of contamination, a plume, in the ground waters in Barron Park. The evidence was obvious in measurements in test wells all over our neighborhood, some in Bol Park alongside the Bol Park Path and others next to the bridge over Matadero Creek (next to the donkey pasture). The level of contamination, measured and analyzed and reported regularly to the DTSC and recorded on the Envirostor database, has decreased over the past decades, but the level of TCE remains above cleanup goals in several areas in Barron Park - one place in particular is in Bol Park, right where Public Works proposes to put a linear filtration chamber/cistern for this storm water storage project!. Digging up the soil in the park, which would happen if this new project were to proceed, could very well bring remaining VOC's and their degradation products (dichoroethene [DCE], vinyl chloride[VC], etc - both cancer causing agents along with TCE itself) to the surface.

In summary, adding insult to injury, we have just learned that the City proposes that Barron Park once again be the recipient of the detrius and the toxic compounds from the Research Park, this time in the storm water runoff. What hubris! I say: "Stanford Research Park: Heal Thyself!”

Arthur Liberman
751 Chimalus Drive

Council, City

From: Adequacy Assurance <adequacyassurance@yahoo.com>
Sent: Saturday, October 13, 2018 3:58 PM
To: adequacyassurance@gmail.com
Subject: "PEOPLE FOR CASH" EXJUDGE RUNNING FOR CALIF. ATTORNEY GENERAL? What?

DISGRACED "PEOPLE FOR CASH" EXJUDGE STEVE BAILEY, RUNNING FOR CALIF. ATTORNEY GENERAL? What?

"Ole Juryless, Constitution Out The Window Bailey"--, CHARGED WITH OBSTRUCTION OF JUSTICE FROM THE "PROBATE BENCH"

THIS "STINKS"----DESPITE BEING CHARGED WITH RIGGING CASES AS PROBATE JUDGE. "PEOPLE FOR CASH" TYPE CHARGES, EX PROBATE JUDGE STEVE BAILEY while facing a CA ethics committee during the current election season, is the GOP nominee for California attorney general. Former probate judge Steven Bailey has been accused and evidence presented of his using his judgeship for election purposes, illegally receiving gifts, and rigging cases to direct business and funds to a firms where his son and nephew worked and benefited from.....ALL IN VIOLATION OF LAW. Bailey served as an El Dorado County judge from 2009 through the end 2017.

LINK TO CHARGING DOCUMENTS-https://cjp.ca.gov/wp-content/uploads/sites/40/2018/05/Bailey_Amended_NFP_05-07-18.pdf

Steven Bailey, GOP nominee for California attorney general, faces ethics panel

Steven Bailey, GOP nominee for California attorney general, faces ethics panel

Former judge Steven Bailey is accused of using his office to further his statewide campaign, improperly acceptin...

Carnahan, David

From: Naomi Moresi <naomi.moresi@gmail.com>
Sent: Friday, October 12, 2018 9:17 AM
To: Council, City
Subject: Potential "Before I Die Wall"
Attachments: Before I Die Resources.zip

Dear Palo Alto City Council,

I just graduated from Palo Alto High School and I am currently a freshman at the University of Washington in Seattle. I am emailing about potentially installing a "Before I Die Wall" in the summer 2019 in Palo Alto. I believe this type of project would be great for the community as it allows people to reflect and creates perspective.
In relation to the benefits it has on the community this project is extremely cheap (around $200). I am willing to fundraise this money by myself but I would extremely appreciative of your support. I am hoping you will be on board with this project and allow Palo Alto citizens to have a creative and influential outlet to allows them to reflect on their lives.
I have many idea of where this wall could be constructed but I am hoping you would be able to help in this aspect.

Below is the link to the "Before I Die Project" and the PFD of resources needed:
https://beforeidieproject.com/

Thank you!
Naomi Moresi

Carnahan, David

From: Elizabeth Wong <elizabethwong2009@gmail.com>
Sent: Friday, October 12, 2018 10:51 AM
To: Stump, Molly
Cc: Shikada, Ed; De Geus, Robert; Lait, Jonathan; Council, City; Morse, Rosemary; Hoyt, George; Eggleston, Brad; Peter Ko; Laura Roberts
Attachments: harbouroff.pdf; permitstatus0001.pdf

Dear Ms. Stump,

Attached is a letter by Mr. Michael Harbour published subsequent to the ARB Minor Level Hearing on 429 University Ave. on October 4, 2018. The purpose of the hearings was to review three items: (a) materials board, (b) landscape and (c) design of the upper portion of the west wall; the review was required in the Approval No 2017-2, Record of the Council of the City of Palo Alto Land Use Action for 425 and 419 University Avenue. The October 4, 2018, hearing was the third of such ARB Minor Level review on the subject matters.

At all three ARB Minor Level hearings, Mr. Harbour brought up all the issues that he used for the last 6 years in opposing this council-approved project and did not address any of the issues above which were the subject of the ARB Minor Level review. His letter attached is representative of his presentation at all three ARB Minor Level hearings.

Neither Ms. Jodie Gerhardt, who represented Planning at the ARB, nor Alexander Lew, chairman of the ARB, was able to stop the irrelevant criticism of the project by Mr. Harbour which was subsequently internalized and echoed by the new member of the ARB, Osma Thompson. Mr. Robert Gooyer was the third and only other member of the ARB and he has opposed this project from its start in 2013. Mr. Harbour was again successful at tainting the ARB and, also, the Planning staff. Out of the three ARB members, Chair Lew voted to approve the project while Ms. Thompson and Mr. Gooyer opposed it.

As one person told me yesterday, who "calls Mr. Harbour my friend", for Mr. Harbour's opposition to the project has become "personal".

It is time for the City to stand firm against Mr. Harbour. This project was approved and what remains is determination of materials, landscape and small portion of the western wall, all of which (1) were revised per Planning and ARB comments, (2) were reviewed by Planning prior to each ARB and (3) were recommended by Planning in all three Planning Staff Report to the ARB.

After working diligently on construction requirements and documents for most of the last two years, this project is in the last stages of the Building Permit process. All departments have approved the project except for Planning due to the three items under consideration and for Public Works with whom we are finalizing the Logistics of the project. Please see Building Permit approval list attached.

The severe delay in the issuing of the Building Permit has caused enormous and unfair run up in costs. The review of the three Minor Level ARB alone has cost over $50,000.

Please set up a meeting for me with you to discuss.

Thank you.

Elizabeth Wong

Michael Harbour, Downtown North

429 University Ave Proposal is Rejected Again by Palo Alto ARB

https://www.paloaltoonline.com/news/2018/10/11/divisive-downtown-project-suffers-setback

The proposed building at the corner of University Avenue and Kipling Street is inappropriate in size, mass, scale and design. Kipling St is a charming street lined by Victorian homes. The solid cement square structure shares no design linkages with any of its surroundings. The proposed building violates the Palo Alto Municipal Code, the Palo Alto Comprehensive Plan,and Downtown Development Guidelines. This building has been rejected by the Palo Alto Architectural Review Board (ARB) numerous times. It was also unanimously rejected by the Historical Review Board (HRB) as being too large and incompatible with neighboring architectural design. Multiple Birge Clark buildings will be demolished and replaced with a design that the ARB says does not benefit the city. The City Council gave the developer a gracious opportunity to get the design right, but the developer has failed to do that and now is the time for the this building design to be permanently denied.

If it were approved, the developer would nearly triple the existing cubic square footage due to a series of giveaways and incentives from the city including Transfer Development Rights (TDRs). This has allowed the building to go from an existing one story structure to a massive four story complex. It is not pedestrian friendly as it lacks overhangs, alcoves and warmth. It will cast a tall shadow over neighboring buildings. It is located on the most narrow street in downtown Palo Alto where parking is already very difficult and cars sideswipe one another when passing. It is under parked by dozens of parking spaces and will further worsen the downtown parking problem and traffic congestion.

The developer has refused to work with the neighbors and citizen groups to offer any concessions. Unfortunately the goal of maximizing square footage for profit has torpedoed the age-old adage of being a good neighbor. This building represents everything that is wrong with the current state of Palo Alto development including profits over people and community. Now is the time for this building to be permanently denied by the Palo Alto Planning Department and City Council. The citizenry deserves a better designed project that will benefit all.

10/9/18

Task	Status	Status Date	Action By
Application Submittal	Submitted - PC Required	03/02/2018	HENRY RAF...
Building Review	Approved	10/05/2018	DAVID CHU...
Elect Utilities Review	Approved With Conditions	04/05/2018	DANIEL ER...
Fire Review	Approved Inspection Re...	06/29/2018	HENRY RAF...
Planning Review	Not Approved	09/17/2018	ADAM PETE...
Public Works Eng. Review	Not Approved	09/26/2018	PAIGE SAF...
Water Quality Review	Approved Inspection Re...	03/16/2018	BRIAN JON...
WGW Utilities Review	Approved With Conditions	08/03/2018	JOHN NGUY...
Landscape Review	Not Required	06/07/2018	KELSEY AN...
Urban Forestry Review	Approved	06/25/2018	WALTER PA...
Ready To Issue			
Permit Issuance			
Structural	Approved	08/02/2018	MEDHAT HE...
Structural	Approved	07/13/2018	MEDHAT HE...
Architectural	Approved	08/02/2018	DAVID CHU...
Mechanical/Plumbing	Approved	08/02/2018	DAVID CHU...
Electrical	Approved	08/02/2018	DAVID CHU...
Structural	Approved	08/01/2018	DAVID CHU...
Architectural	Approved	08/01/2018	DAVID CHU...
Mechanical/Plumbing	Approved	08/01/2018	DAVID CHU...
Electrical	Approved	08/01/2018	DAVID CHU...

18000-00536 - KIPLING POST LP

Task	Status	Status Date	Action By
Application Submittal	Submitted - PC Required	05/31/2018	HENRY RAF...
Building Review			
Elect Utilities Review	Approved	08/06/2018	GOPAL JAG...
Fire Review			
Planning Review	Not Approved	09/17/2018	ADAM PETE...
Public Works Eng. Review	Not Approved	09/11/2018	PAIGE SAF...
Water Quality Review			
WGW Utilities Review	Approved	08/17/2018	JOHN NGUY...
Landscape Review			
Urban Forestry Review	Approved	07/25/2018	WALTER PA...
Ready To Issue			
Permit Issuance			

18000-00537 - KIPLING POST LP

Council, City

From: Mike Alexander <malemike@earthlink.net>
Sent: Monday, October 15, 2018 8:09 PM
To: Council, City
Subject: Proposed Bol Park storm water processing plant

To: Palo Alto City Council

To: Palo Alto Storm Water Management Oversight Committee

Re: Proposal for Bol Park processing plant

The purpose of this project (Bol Park processing plant) is laudable -- to improve habitat in the San Francisco Bay estuary through reducing PCB's and mercury that flow to the Bay. Due to unconcerned industrial and domestic use before 1980, both are found everywhere and are washed to the sea by rainfall. There they disrupt the well-being of all species, people included. Both are now used much less often, but will be present in elevated levers in the environment for many generations.

Projects like this are helpful, and are mandated by the EPA and the State of California. Santa Clara County is required to achieve collective storm water clean-up goals during each of the next four decades, and this project is part of that effort. And it's suitable, due to the harsh uses historically present at both of the uphill sites (VA and Stanford Industrial Park).

That said, contaminants in Matadero Creek can be removed anywhere along its run to the Bay. Bol Park is an attractive site because it is owned the City; there are no buildings on it; and the creek runs through it. But from my point of view, Bol Park is an unsuitable site because it is dedicated parkland owned by the people of Palo Alto; because it a pristine natural retreat in a quiet residential neighborhood; and because the creek runs throught it.

The site at CPI, identified by Doug Moran in the October 12 PA Weekly article, has most of the same attractive qualities for the project: it is right by the creek and has no buildings on it. Plus ... it will capture even more inducstrial drainage than Bol Park would. And... it is already an industrial site -- the motors trucks, gates, pipes, etc., needed to operate the plant will fit right in. And, finally, the parking lot can be restored to all its prior glory once the plant is built. All told, it seems a much better site tha Bol Park.

The City and County make deals with Stanford all the time, and this is another one that I'm sure can be made. But if you take Bol Park for this, even if temporarily and in a seemingly small way, there's nothing you can give the people in return.

Please reconsider this horrible idea.

Sincerely,

Mike Alexander

Council, City

From: Winter Dellenbach <winterdell@earthlink.net>
Sent: Monday, October 15, 2018 11:15 AM
To: cassandra_moore6@aol.com
Cc: Council, City
Subject: Re: Bol Park

Writing an email to members the City Council:
City Council <city.council@cityofpaloalto.org> Do it right now - meeting is tonight.

For now, simply say that "Bol Park is completely inappropriate for a Regional Project that will be processing PCB's and Mercury when doing so will entail digging up Bol Park soil that is already contaminated with VOC's from groundwater contamination. Soil that should never be disturbed. "

Put you name on the email and say you live in Barron Park.

This is all you have to say for now, Cassandra. I don't have time to say more. What I just stated is true. There will be a neighborhood meeting on Nov. 11 at the elementary school that city staff will give us more info and will answer questions.

Winter

On Oct 13, 2018, at 7:30 PM, cassandra_moore6@aol.com wrote:

>
> Winter:
>
> First we saved the trailer park, then we nixed building on Maybell, now we hbe to contend with the cit’s idiotic and dangerous proposal to undermine the playground, the bike lanes, the walking paths, that is, the sanctity of Barron Park.
:
>
> The Palo Alto weekly noted your e-mail written in opposition. Whom should I contact besides Sue Dremann and what are the best arguments.
>
> Cassandra

Council, City

From: m m <mmPaLoAlTo@hotmail.com>
Sent: Sunday, October 14, 2018 8:03 AM
To: Raj Shetty; Council, City
Subject: Re: RVs in Palo Alto

All, I am shocked to see that nothing has been done to remove the RV's parking along El Camino.

I saw this on the news: https://sanfrancisco.cbslocal.com/2018/10/09/rv-landlords-homeless-low-income-silicon-valley/
That's right people are buying RV's parking them on El Camino and renting them.

WHY has nothing been done with regards to this overnight camping in vehicles that are too big for El Camino blocking part of the lane that a passing bus needs. Many of them have expired tags and some of the are running gas generators that are sitting on the road/sidewalk. They are parked ON THE SIDEWALK, trash under and around them, and yes needles too.

PLEASE do something to get these off our streets, this is getting out of hand. Soon Palo Alto will resemble San Francisco, you all should be ashamed of yourselves for allowing this to happen.

mm
#voteforchange

RV 'Landlords' Renting To Homeless, Low-Income Workers In Silicon Valley

sanfrancisco.cbslocal.com

A new kind of landlord has popped up the Bay Area, where affordable housing can be notoriously out of reach. These landlords' rentals come with four wheels.

From: m m
Sent: Saturday, September 22, 2018 1:57:30 PM
To: Raj Shetty; city.council@cityofpaloalto.org
Subject: Re: RVs in Palo Alto

All, so now there are even MORE RV's, more dirt and more RV's parked on the sidewalk on El Camino. Now they are showing up at our parks, example Peers Park On Park Boulevard, see attached photo. Why is it impossible for me to get a clear answer to as why these RV's are allowed to park on El Camino camping overnight, not moving their vehicles, dumping trash outside, occasional needles laying around, gas generators running etc What has happened here? Why is this allowed? Please do something to make this illegal which it should have been all along.

mm
I vote and this matters

From: m m
Sent: Friday, July 20, 2018 6:50:24 PM
To: Raj Shetty
Subject: Re: RVs in Palo Alto

Hi Raj, thank you for your response.

I refuse to use use google docs as I have found it very insecure. I have had documents made available for me to view which were confidential and belonged to companies of which I have no connection. With that said I guess councilman Tanaka does not want to include the public. I would like to know what is being done by the city of Palo Alto to have these RV's removed from our City Streets?

mm

From: Raj Shetty <raj.shetty@gregtanaka.org>
Sent: Monday, July 16, 2018 4:49:33 PM
To: Raj Shetty
Subject: RVs in Palo Alto

Hello,

My name is Raj and I am a legislative aide for Councilmember Tanaka. I am writing to you on his behalf.

You are receiving this email because you wrote to the Palo Alto City Council expressing concerns regarding RVs in Palo Alto. Councilman Tanaka wishes to connect those with similar interests together.

If you wish to be included in this discussion, please respond to me within a week stating your intention to do so. After a week, I will send out a Google Group invite to all those that are interested. From there, those in the group will be able to discuss opinions on RVs.

Have a great week.

Regards,
Raj

Raj Shetty | Legislative Aide
Palo Alto City Council Member Tanaka's Office
W: www.GregTanaka.org | D: 650.503.4329 | E: raj.shetty@gregtanaka.org

Council, City

From: Gillian Rose Brassil <gbrassil@stanford.edu>
Sent: Wednesday, October 17, 2018 11:56 AM
To: Council, City
Subject: request for comment: Peninsula Press

Hi City Council members,

My name is Gillian, I'm a reporter for the Peninsula Press.

I'm working on a story about Measure F and I am looking for comment from the City Council members about their stance on the Measure. I read in the Palo Alto Weekly that the Council was unanimously opposed to the issue and was hoping to receive some follow-up comment on the issue.

I have a deadline of Friday, Oct. 19, and would appreciate any insights members had on Measure F before then. Would someone from the Council be willing to speak with me briefly in-person or over the phone in the next few days?

Best,

Gillian
--
Stanford University | Class of 2019
M.A. Candidate | Journalism
B.A. Candidate | Communication

Council, City

From: laure laprais <llaprais@yahoo.com>
Sent: Saturday, October 13, 2018 8:11 PM
To: Council, City
Subject: Ross bike corridor

Dear Palo Alto city council,

I am writing to express my gratitude for the Ross Road bike corridor. Ever since I found out about it, I celebrate the improvements. I commute 6 miles from Menlo Park to Greendell school at Cubberley around 7:30AM and again around 3PM most days (I drive 101 otherwise from and to the University exit). The Bike improvements on Ross have transformed my commute. It is much easier, safer and faster now for me to bike to work. I live East of Middlefield, and until now, my only option was to bike 10 blocks down to Bryant and another 4+ back to Middlefield, which added a significant detour to my already 30 minutes route. I see many other bicycles, especially children and teens on Ross. There is an obvious need for such safe corridors, thank you for making it happen. Negotiating the roundabouts and intersections with cars, the wait time at the lights at Oregon and Embarcadero is far from being ideal but giving bikes the priority definitely improves my comfort zone as a biker.
I also want to celebrate the beautiful crosswalks on Louis.
Thank you for leading the way by making Palo Alto bike friendly.

Laure Laprais
154 Oak Court
Menlo Park

Sent from my iPhone

Council, City

From: Elizabeth Wong <elizabethwong2009@gmail.com>
Sent: Tuesday, October 16, 2018 11:28 AM
To: Shikada, Ed
Cc: Lait, Jonathan; Timothy Kassouni; Andrew Wong; Jaime Wong; Stump, Molly; Council, City
Subject: 429 University Approval

Dear Mr. Shikada,

Please see my comments below:

1. City code does not require Planning to have ARB's recommendation to approve the project specially when ARB relied on an inexperienced and new member of the ARB. In fact, the Director of Planning can issue his decision after only the first meeting of an ARB Minor Level Review by code which approval applies to this project.

2. At the ARB, Osma Thompson brought up issues that were heard multitude of times in Major ARB reviews, notably compatibility with neighboring buildings and the look and feel of the building, all of which were rejected by the ARB and subsequently presented to and approved by Council, . Council approved a modern concrete building and it is wrong to backtrack this approval. In fact, the Council approved drawings incorporate the look and feel of the building including description of its concrete, notably on page A3.7 of the packet submitted to the Council as Option 1.

3. Mr. Lait approved and recommended for approval all 3 submissions to the Minor Level ARB in each of his 3 staff reports to the ARB. Mr. Lait was instrumental in reviewing Applicant's packet prior to submission to the ARB and he did not record verbally nor in writing any objections to the submitted plans. It is wrong for Mr. Lait to make a 180 degree turn and to disapprove this project after review from a partial and limited Minor Level ARB, as explained below.

The ARB was limited to 3 members. Two ARB members were recused (Baltay was my previous tenant and Furth was severely opposed to my project before she became a member of the ARB).
Of the 3 remaining members Chairman Lew voted to approve and member Robert Gooyer has never supported the project since it was appealed in 2014 and he just threw his hands up in the air and said "it will go to Council, let them decide". The make up of the ARB created a situation where Ms. Thompson received enormous leverage on the decision. She liked the project but not for downtown Palo Alto, a modern concrete building whose look and compatibility was already settled and approved by Council. She then worked her objections to the building into her objection for its materials and colors.

There has been unwarranted delay in this project at the approval level and, after Council approval, at the Minor Level ARB review level. (I had emailed planning to request for an Minor Level ARB hearing in January of 2018 but it was not granted until August 2018.) Are there statutes that will permit me to collect compensation from the City for all my extreme costs caused by the City's unwarranted delays?

I evicted all tenants at the site, disconnected and yanked off all utilities, clear the property of all hazardous materials, uprooted 4 city trees, contracted sub contractors , paid hundreds of thousands of dollars to the City for building permit and other permits, etc etc All this at enormous costs to me.

Presently I have approvals from most departments in the City, including Building Department, for my Building Permit. Planning Department has approved and such status is recorded in the city files with notation of the unapproved Minor Level ARB issues of landscape, western wall, and materials board.

Very importantly also is the issue of Planning's undue deference to Michael Harbour who has been continuously calling the City, Council, HRB, ARB, other committee members and also my previous architects (many have told me of the constant calls). Harbour has been eloquently opposed my project to all, specially the Planning Department, accusing the project of false violations of the terms in the Land Use Approval Letter. This is totally untrue given the immense level of scrutiny by Planning and the multiple changes made by Ko Architects in compliance with Planning's reviews.

———

Lastly, please be informed that I personally in conjunction with Mr. Kassouni will be legally representing the Applicant. Please have City staff reply to my communications.

In case you may not remember, Argentinian Spanish is my native language. Sorry about my mistakes in the English language in this letter and in future communications as I know I make.

Thank you very much.

Elizabeth

POLITICS

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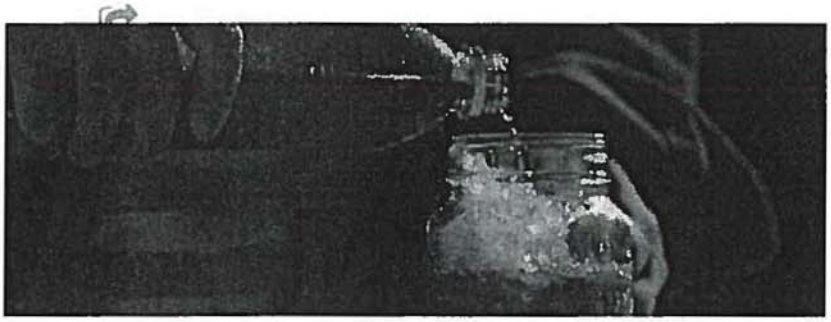
California prepares for a new war over soda taxes – and it could spill over into the 2020 election

- A proposed ballot measure backed by California doctors to tax sugary drinks was given the nod by the state to start collecting signatures to qualify for the 2020 ballot.
- The measure seeks to use state taxes on the sugary beverages to fight childhood obesity and dental disease.
- But tl asure also seeks to change the state constitution and could upend a compr...se reached in June between California lawmakers and the beverage indus ...t banned new local taxes on soda until 2031.

Jeff Dani ...@jeffdanielsca
Published ... ET Fri, 7 Sept 2018 | Updated 4:47 PM ET Fri, 7 Sept 2018



California prepares for a new war over soda taxes
5:04 PM ET Fri, 7 Sept 2018 | 00:53

There's a new effort to bring a statewide sugar-sweetened drink tax to California.

The measure is meant to fight childhood obesity and dental disease. But it could upend a compromise reached with the beverage industry in June that banned new local taxes on soda until 2031.

Initiative 18-004

18-0004

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† Also admitted to practice in New York and Massachusetts

July 2, 2018

RECEIVED
JUL 02 2018
INITIATIVE COORDINATOR
ATTORNEY GENERAL'S OFFICE

VIA MESSENGER

Ashley Johansson, Initiative Coordinator
Office of the Attorney General
1300 I Street, 17th Floor
Sacramento, California 95814

Re: Request for Preparation of Title and Summary
The California Sugar-Sweetened Beverages Tax Act of 2020

Dear Ms. Johansson:

This firm is counsel for the proponents of the proposed statewide initiative, "The California Sugar-Sweetened Beverages Tax Act of 2020." The proponents of the proposed initiative are Dustin Corcoran and Carrie Gordon. On their behalf, I am enclosing the following documents:

- The text of "The California Sugar-Sweetened Beverages Tax Act of 2020"
- Signed authorizations from each of the proponents requesting that the Attorney General's Office prepare a circulating title and summary
- The certifications and statements required by Elections Code § 9001, subdivision (b) and Elections Code § 9608

Please direct all inquiries and correspondence regarding this proposed initiative to the address listed below:

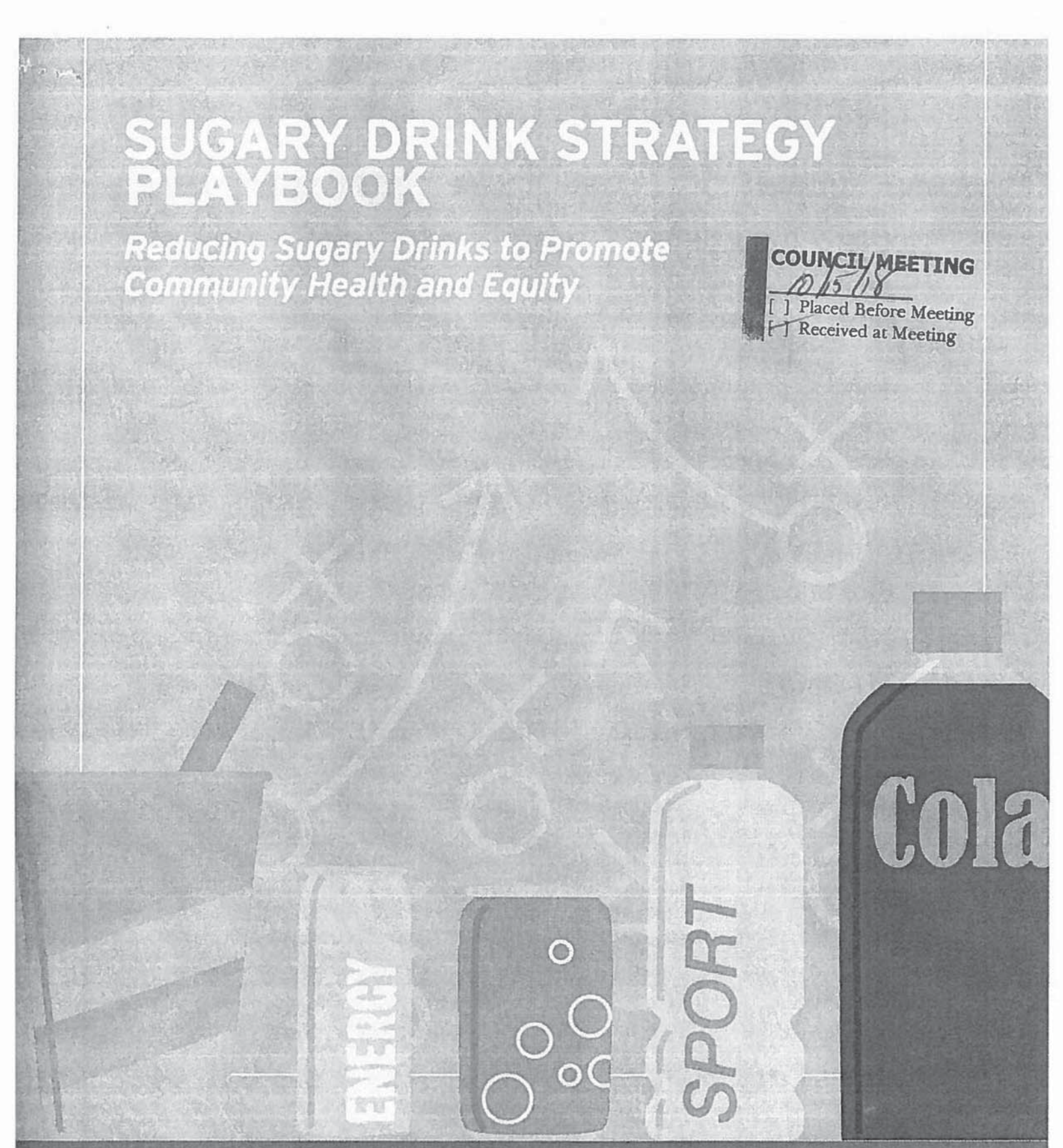
Michael J. Strumwasser, Esq.
Beverly Grossman Palmer, Esq.
Strumwasser & Woocher LLP
10940 Wilshire Boulevard, Suite 2000
Los Angeles, CA 90024
mstrumwasser@strumwooch.com
bpalmer@strumwooch.com

Very truly yours,

Beverly Grossman Palmer

SUGARY DRINK STRATEGY PLAYBOOK

Reducing Sugary Drinks to Promote Community Health and Equity



ChangeLab Solutions
Law & policy innovation for the common good

10 WAYS TO LIMIT SUGARY DRINKS IN YOUR COMMUNITY

1 Launch a Public Awareness Campaign (page 16)

2 Start a Healthy Retail Store Program (page 20)

3 Establish Healthy Checkout Areas (page 24)

4 Build on Federal Standards to Expand Sugary Drink Restrictions in Youth-Oriented Settings (page 28)

5 Restrict Marketing of Sugary Drinks in Schools (page 36)

6

Eliminate Sugary Drinks from Kids Meals

(page 40)

7

Limit Sugary Drinks Through Government and Private Sector Procurement Policies

(page 44)

8

Reduce Sugary Drinks at Anchor Institutions

(page 48)

9

Tax Sugary Drinks

(page 52)

10

Adopt Cutting-Edge Sugary Drink Reduction Strategies

(page 58)

WHAT ARE SUGARY DRINKS?

Sugary drinks (also called sugar-sweetened beverages or SSBs) are any non-alcoholic beverages that contain added caloric sweeteners. Examples of these beverages include non-diet soda, fruit ades, sports drinks, energy drinks, sweetened waters, and sweetened coffee and tea beverages.

Acknowledgments

The 2018 edition of this playbook was written by Aysha Pamukcu, senior staff attorney, and Melissa Peters, policy analyst. The original playbook was written by Christine Fry and Ian McLaughlin. All are affiliated with ChangeLab Solutions.

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Design and illustration by Karen Parry/Black Graphics

RETURN ADDRESS:

R Ms. Asma Rabbani
420 Hale St.
Palo Alto, CA 94301-2207

SAN FRANCISCO CA 941
PM
9 OCT
2013

I support Castilleja's proposal to increase enrollment and modernize its campus because...

The proposed underground parking structure will reduce traffic and parking on neighborhood streets. Pls allow the school to go ahead with their plans.

CITY OF PALO ALTO, CA
CITY CLERK'S OFFICE
18 OCT 12 AM 9:49

Office of the Clerk
Please distribute to a
250 Hamilton Avenue, 7th Floor
Palo Alto, CA, 94301

RETURN ADDRESS:

USMAN RABBANI
420 HALE STREET
PALO ALTO CA 94301

SAN FRANCISCO CA 941
PM
9 OCT
2013

I support Castilleja's proposal to increase enrollment and modernize its campus because... women's education is extremely important. Right now it is almost impossible to get into Castilleja due to the small number of students they accept. The school needs to expand & increase enrollment so more students have access to the amazing education Castilleja has to offer.

CITY OF PALO ALTO, CA
CITY CLERK'S OFFICE
18 OCT 12 AM 9:49

Office of the Clerk
Please distribute to all City Council Members
250 Hamilton Avenue, 7th Floor
Palo Alto, CA, 94301