inter.noise
21-24 AUGUST
SCOTTISH EVENT CAMPUS
GLASGOW 2022

Why noise control must be considered in the context of sustainable development

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ABSTRACT

The United Nations 2030 Agenda for sustainable development comprises 17 Sustainable Development Goals (SDGs) of interlinked social, environmental and economic dimensions. Since noise and noise control are not directly apparent in any of the goals, Dr. Eoin King from the NUI Galway, presented an article at the Internoise 2021 conference with the objective of sparking "a debate about how noise might be further considered in the context of sustainable development". Inspired by Dr. King´s article, this paper presents examples from the planning of two new railroad lines in Sweden, where the Swedish Transport Administration has based the goals of the projects on the 2030 Agenda. Different SDGs have been applicable for different aspects of the projects. For traffic noise the SDG nr 3 - Good Health and Well-being, and nr 11 - Sustainable Cities and Communities, are considered the most relevant. The reasoning and the method to integrate the SDGs in the railroad projects are described and discussed in this paper. The author also emphasizes the importance of including noise in the SDGs for infrastructure projects, by expressing why noise control must be considered in the context of sustainable development, especially from the viewpoint of the 10th SDG – Reduced Inequality.

1. INTRODUCTION

The United Nations 2030 Agenda for sustainable development comprises 17 Sustainable Development Goals (SDGs) and 169 targets of interlinked social, environmental and economic dimensions [1]. The Agenda 2030 was signed by all 193 United Nations member countries in September 2015, it´s declaration is solemnly and beautifully phrased, and perhaps this sentence says it all: "We are determined to end poverty and hunger, in all their forms and dimensions, and to ensure that all human beings can fulfil their potential in dignity and equality and in a healthy environment".

Stop poverty, let all people live healthily in peace without harming the conditions for life on Earth (water, air, nature) – what´s noise got to do with that? A lot - in fact, noise and noise control cannot be ignored in the context of sustainable development – which Dr Eoin King from the NUI Galway presented at the INTER-NOISE 2021 conference [2]. Dr. King´s study showed that noise, although not clearly expressed in any of the Agenda 2030 goals, " is an issue cross-cutting through almost all

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of the SDGs. Excessive noise has very well-established links to adverse economic, environmental and social impacts".

All parts of society have to contribute to a sustainable development, within their sector and area of responsibility. This paper presents an example from Sweden where the national Transport Administration has based the goals of the New Railway line projects on the Agenda 2030, and where the Sustainability Assessment is one fundamental base for the decision about the location of the new stations and railway lines in the Southwestern part of Sweden. Noise is one key factor, and the traffic noise from both the new planned railways as well as the present national rails and roads are taken into account, motivated by targets within the SDG nr 3 - Good Health and Well-being, nr 11 - Sustainable Cities and Communities and nr 15 – Life On Land. These could be complemented with the 10th SDG, Reduced Inequality, as will be discussed in this paper.

2. WHY IS NOISE CONTROL NECESSARY FOR SUSTAINABLE DEVELOPMENT?

Traffic noise is the second largest environmental cause of health problems in Europe, after the impact of air pollution [3]. **At least 20%** of the EU population, more than 100 million people, lives in areas that are exposed to traffic noise levels that are harmful to health. Since traffic noise is a particular public health problem in many urban areas, the problem is expected to grow with the continuing urbanisation, which is a general trend across the World. Thus, it may not be a too wild estimation that nearly one billion people are exposed to harmful traffic noise levels worldwide (based on world population of nearly 8 billion in March 2022, of which more than 55 % live in urban areas [4]).

Chronic exposure to environmental noise has significant impacts on physical and mental health and well-being. It is well established that traffic noise causes stress, and negatively affects concentration, communication, learning and productivity. Noise causes sleep disturbance, fatigue, high blood pressure, increased risk of cardiovascular disease and early deaths [5,6].

As a further matter, there are studies reporting inequalities in exposure to environmental noise, showing that socio-economically disadvantaged groups may be both exposed to higher levels of noise and also be more vulnerable to noise, due to poorer housing, pre-existing health conditions or fewer opportunities for coping with noise (for instance, have less access to quiet areas) [3,7]. New facts are regularly presented, like in February 2021, when the Public Health Agency in Sweden published a report on how the health of children is affected by the environment [8]. Depressingly, but not surprisingly, it reports a relationship between the grade of environmental noise disturbance of children and the socio-economic status of their guardians.

Many studies have concluded that children are especially vulnerable to noise. A noisy environment can affect their cognitive development negatively and cause learning impairment. Children also have less control over their situation than adults and less means to handle noise exposure [7]. This was confirmed by the Stockholm Region Environmental Health report in December 2021 [9], a study which is done every third year, where every other study focus on the environmental health for children. The 2021 child focused study showed that the number of children having problems with concentration and sleep disturbance (difficulties to fall asleep and awakening) due to traffic noise has increased in the Stockholm region. The percentage of twelve-year-old children that are annoyed by traffic noise, above all noise from road traffic, have doubled between 2011 and 2019, from 4,3% to 8,9%, which in real numbers are even more since the number of inhabitants have increased by 14 %

during that period. Further, 25 % of all children who live in apartment buildings in the Stockholm region have at least one window in the apartment which is oriented towards a noisy side of the building. Noticeable is that the percentage is higher in newer apartment houses (since 2004), nearly 30%, which can be explained by creative applications of noise limits, as well actual raised noise limits for new dwellings in Sweden [10,11]. The outdoor noise limits were raised in two steps, 2015 and 2017, generally by 5 dBA, but for small apartments (<35 sqm) by 10 dBA, which means that double as loud traffic noise can be allowed outside small apartments compared with earlier noise limits (LAeq,24 h < 55 dB). prior to the year 2015 i.e., The reason for this was said to decrease the lack of housing in the bigger cities, and that the noise limits indoors still would be possible to meet with good sound insulation. However, the new regulations were spiced with a restriction for new house plans, so that a local community could not demand "excessively" high sound insulation for new buildings in noisy areas! The new noise limits were accepted by the Swedish parliament in spite of all presented facts about the negative effects of noise.

Health and equality are above all considered in the social sustainability goals, SDG number 3 and 10, but there is also a strong connection with economic sustainability. In the EU region only, the cost of annoyance, sleep disturbance, ischemic heart disease and cognitive impairment in children is estimated to 86 billion EUR every year. [3]. Except for the burden on health care and social systems, noise exposure also leads to a loss of productivity of workers whose health and well-being are affected by noise and cause a substantial depreciation of real-estate value according to the European Commission [12].

Furthermore, traffic noise disturbs nature and wildlife, resulting in emigration, increased mortality, lower reproduction and reduced populations of species [3, 13]. Noise mitigation measures can contribute to improved biodiversity and environmental/ecological sustainability.

3. THE SDGS AS BASES FOR INFRASTRUCTURE PLANNING

3.1 The Swedish transport administration Target 2030

An accessible, safe, functional and sustainable transport system is crucial for a sustainable society, it has the potential to affect all three dimensions of sustainability and the means to create human well-being and happiness, which is an end goal for sustainable development. The Swedish Transport Administration – Trafikverket – is the national authority that plans, builds and maintains the main roads and rail lines in Sweden. Trafikverket is one key actor that can make a difference, and it has been decided upon an overall frame for the tasks of the organisation as declared in the report "Accessibility in a sustainable society – Target 2030" where Trafikverket states that the transport system can contribute to 12 of the SDGs [14]. Based on these twelve, ten aspects of the transport system have been prioritized and targeted with 14 goals for 2030, concerning for instance Accessibility for All, Safety, Climate, Biodiversity, Air pollution and Traffic Noise**.** One of the conclusions about the long-term objectives and strategy towards 2050 is: No one is killed or seriously harmed in/of the transport system, neither in accidents nor by air pollution or noise.

3.2 Application of SDGs for planning of new infrastructure

However, for the application in planning, building and maintaining of the national infrastructure , the political and overall sustainability phrases have to be transformed into more concrete goals, relevant for the specific project or work at hand. One method for doing this is the SDG Compass, which is described as "*a guide with five steps for companies to maximize their contribution to the SDGs* [15].

The first two steps of the Compass were performed by the Trafikverket New Railway (NR) project organisation at the start of the planning of two new railroad lines in the Southwestern part of Sweden: Hässleholm-Lund (70 km) and Göteborg – Borås (60 km), both links in a new high speed railway network between Stockholm and Göteborg/Malmö.

The present planning stage for the Hässleholm – Lund project is concerning the location of the railway line, which means that several corridors are surveyed in an 80 km long and 30 km wide area with respect to the criteria of the project. The start of construction is planned for 2027-2029 [16]. In the Göteborg-Borås project, the location analysis is finished and one of the corridors has been chosen for further planning in order to find the optimal line for the new railway. This phase will end with a Rail Plan, after which it is possible to start the detailed design and construction process. Start of construction is planned for 2025-2027 [17].

3.3 Relevance and Feasibility Analysis of Agenda 2030

The first two steps of the SDG Compass are to identify and prioritize the relevant SDGs/targets for the project. The New Railway project organisation conducted a relevance and feasibility analysis of Agenda 2030 in the form of workshops with participants from the project management and several specialists of different subject areas at Trafikverket, including sustainability specialists [18]. The first step, the relevance study, was to identify the SDGs that the New Railway projects would or should affect, thus the workshop groups studied all the 169 targets of the 17 SDGs to see which goals were directly or indirectly affected by the two rail projects. In the second step, the feasibility analysis, all the relevant targets were sorted under three different target classes, depending on the role or possibility the NR project had (has) for realizing the target, see Table 1 below. The Central and Important targets were then more thoroughly described, both with respect to why they were chosen and how they would be integrated in the project goals.

Table 1: The priority classes of relevant SDG targets.

Priority class	Target type	Description
1	Central	Target that the project is specifically responsible for, part of the project´s mission or core business/activity
2	Important	Target which the project has strong possibility or high risk to affect, though not being a core activity
3	General	Target already handled in the project due to existing laws or regulations, or target that another part of the organisation is responsible for
4	Not relevant	Target sorted out during the relevance analysis

3.3 Noise in the SDG targets and basis for the project goals

The relevance and feasibility study resulted in 44 identified central or important targets. Central targets were found in six of the SDGs and important targets in twelve of the SDGs. Even though noise

is not directly mentioned in any of the 169 targets, the New Railway organisation included it in the interpretation and motivation for target 3.4, 11.7, and 15.1, as defined by UN [1]:

Goal 3. Ensure healthy lives and promote well-being for all at all ages.
Target 3.4. By 2030, reduce by one third premature mortality from non-communicable diseases through prevent and treatment and promote mental health and well-being.
NR Motivation: A target that NR can affect, positively or negatively. By increasing public transport by train the noise and air pollution from road traffic may decrease in general, which can improve well-being and mental health. However, it is important to create safe and attractive areas around the train stations as well as minimize the risk of disturbance in the surroundings from the new railway infrastructure. To reach the objective, high sensitivity is needed and a public consultation process which invites all stakeholders, both weaker and stronger, from different levels of the society.

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable
Target 11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.
NR motivation: Important to pay attention to the risk of barrier effects of the railway, since it can decrease the accessibility to green areas/recreation areas and public spaces, and also acknowledge if the railway is affecting the quality of those areas, due to **noise**, fragmentation etc. This is above all critical for groups with lower degree of mobility, i.e., children, elderly people or persons with disabilities, who are more dependent on accessible local green recreation areas and public spaces

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Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
Target 15.1. By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.
NR Motivation: New infrastructure needs new space, and there is a risk that this will negatively affect target 15.1 not only by land footprint but also by noise disturbance and barrier effects for wildlife.

NR also prioritized target 10.2 but traffic noise exposure was not mentioned in the motivation, even though it could have been included, as will be discussed later:

Goal 10. Reduce inequality within and among countries
Target 10.2. By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status
NR Motivation: This target is highly relevant for the planning and construction of the new railroad. First, we (Trafikverket) have to consider the the demands of all sectors in the society, planning for an including and user-friendly infrastructure for all groups. Second, we must adopt an intergenerational perspective since the majority of the future users belong to coming generations. Furthermore, an equal planning process is essential for an equal society. There are examples of earlier infrastructure projects where tunnels have been built for new roads and railroads under certain areas while they emerge to ground level in socioeconomically weaker areas, were the political and public influence is lower.

3.4. Location study and the Sustainability Assessment

The following text is mainly based on the process of the Göteborg – Borås project, since the location study is finished and the reports are published [19].

After the relevance and feasibility analysis, the resulting SDGs/targets were integrated in the project goals, which were processed with the regional and local authorities. The following phase was the Location study, in which several alternatives for the locations of the new stations and the railway corridors in between were investigated. Within the location study a **Sustainability Assessment,** SA, was performed to rate the different alternatives from social, ecological and economic sustainability points of view. The SA was one of six essential bases for decisions that were taken into account concerning the location of the new railway. The others were Environmental assessment, Investment costs and benefits, Acceptance for the alternative and Fulfilment of main project goals (e.g., maximum travel lengths etc).

First, a clarification might be useful since Sustainability assessment (SA) often can be confused with Environmental impact assessment (EIA). There are some common aspects but there is one fundamental difference: In the EIA the consequences of an infrastructure project are assessed **in relation to the present situation** or a so called zero alternative, present situation at the year of the prognosis for the infrastructure project, while the Sustainability is assessed by degree of SDG fulfilment **in relation to the wanted future situation.** It may not be clear to the project management or the authorities what future they want, but the Agenda 2030 Sustainable Development Goals are already defined, well-founded and phrased, signed by nearly all the countries in the World. Then it is up to us to perform our tasks or projects to contribute to the fulfilment of the SDGs – or at least minimize the effects of a negative development.

To perform the Sustainability Assessment, the three sustainability dimensions (social, ecological and economic) were defined by five relevant parameters/descriptors each. Then the project goals were sorted under the three sustainability dimensions, depending on which parameter each goal would/could have the biggest influence.Traffic noise was sorted under Social sustainability and the parameter Health and Safety Only the project goals that separates one alternative from another/others were considered in the SA, i.e., the ones that were meaningful for the selection process.

The noise targets of the overall NR project goals led to prerequisites for the Sustainability assessment of the different railway alternatives:
1. The more tranquil the area, the more noise restrictions, down to “Not accepted to introduce or increase traffic noise in quiet areas where LAeq, 24h < 40 dB”.
2. Location of the new railway is preferred in already noise exposed areas, under condition that the traffic noise from all national infrastructure (rails and roads) in the area is reduced to below the Trafikverket noise limits [20], for dwellings, housing areas, schools as well as parks and recreation areas.
3. The NR projects should contribute to an improved environment to live in and enable development of (urban) areas.

The Göteborg – Borås project is now preparing for the detailed rail planning phase, within the chosen rail corridor. The project goals based on the relevant SDGs/targets and the Sustainability Assessment will continue to be a part of the planning and designing process as well as the future construction phase.

4. CONCLUSION

Noise and noise control is highly prioritized in Trafikverket (the Swedish Transport Administration), both generally on the national transport system level, and specifically in infrastructure projects. This paper presents an example from the planning of two new railroad lines in Sweden, where the New Railway (NR) project organisation has based the goals of the projects on the 2030 Agenda [1]. Following the method of the SDG Compass [15] and integrating the relevant SDGs and targets of Agenda 2030 in the project goals, has resulted in a clearer overall picture and a more pronounced direction of all the measures that have been, and will be, taken to reduce the negative impacts of the new infrastructure. But not only that, the NR organisation have taken the initiative to actually try to contribute to a social, economic and ecological sustainable *development* - to improve the present situation and the forecast for the future, the true meaning of the Agenda 2030.

We have to keep in mind though, that it is not possible to achieve a sustainable transport system standing alone, you have to consider the transport system as a *part* of an environmental, social and economical sustainable society.

Since decades it has been well known that environmental noise has a severe impact on both humans and nature. Noise management is essential for health, well-being, equality, biodiversity – all foundations for a sustainable society. But noise is often the forgotten or even ignored pollutant**,** as Dr Eoin King expressed at INTER-NOISE 2021 [1]. In Sweden, there are other stakeholders and decision-makers than Trafikverket that have a strong impact on the noise situation of the population. In 2015, the same year as the Agenda 2030 was signed by the Swedish government, it passed new noise regulations that allowed *higher* traffic noise levels outside new dwellings than before, to enable more residential/housing developments in the bigger cities. This was accepted in spite of all presented facts about noise and health impact. And, as mentioned earlier in this paper, there are already reports about the increased number of children being disturbed by traffic noise, many of them living in newer houses in the Stockholm Region were the “New Noise Regulations” have been widely used.

Traffic noise is usually connected to the SDG nr 3 - Good Health and Well-being - and sometimes to SDG nr 15 - Life on Land /Biodiversity. But they are not very tangible aspects, considering the long-term consequences of noise on both health and biodiversity –and thus not very suitable for short-term politicians. I believe, that by connecting noise to the 10th SDG - Reduced Inequality, and by this acknowledging the vulnerable groups of people that often are the most negatively affected by traffic noise, it could make a stronger case. This could also support the intentions of Trafikverket to reduce the number of people who are exposed to harmful traffic noise levels by 50 % by the year of 2030, and the long-term objective of 2050 that:”No one is killed or seriously harmed in/of the transport system, neither in accidents nor by air pollution or noise”.

5. ACKNOWLEDGEMENTS

I would like to thank Mia Becker, Maria Luisa Botella, Elin Bylund and Jeanette Svensson at Trafikverket, The Swedish Transport Administration, for kindly sharing information from the ongoing New Railway projects. If this text contains any faults in the description of the NR projects, they are definitely mine.

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