



by JCDecaux



REMINDER OF THE CONTEXT

There are many sources of noise in our daily lives: at work, on public transportation, in public places, at home, on the street. Noise is everywhere, all the time, making its management particularly challenging.

This note focuses primarily on perceptible noise disturbances in public spaces.

ш

PUBLIC HEALTH ISSU

Key figures about noise pollution in the world

2 billion people worldwide will experience varying degrees of hearing impairment by 2050 Source – OMS, 2021

18 million inhabitants of the EU

suffer from high chronic annoyance due to noise

Source – European Environment Agency Report, 2021

12,000

premature deaths per year in Europe are attributed to noise Source – Press Release form the European Commission, 2020

57% of French people now consider themselves more sensitive to the quality of the sound environment than before Source - CidB, 2020

740 million adults worldwide suffer from tinnitus Source – JAMA Neurology study, 2022

JCDecaux

NOISE POLLUTION

Monitoring of water and air pollution has long been at the forefront of concerns, at the expense of noise pollution, which has recently come under increasing attention.

There is an increasing amount of research demonstrating the health and environmental impacts of prolonged noise exposure.

Noise has been identified by the World Health Organization (WHO) as the second leading cause of morbidity in Europe, behind air pollution.

Noise disturbances are now recognized as a significant public health issue. The latest surveys conducted in France indicate that 65% of the French population personally declare being bothered by noise and sound disturbances (French Institute for public opinion survey, 2022).

Due to its invisible and omnipresent nature, noise is challenging to identify. The lockdowns implemented worldwide during the health crisis and the associated decrease in sound volume served as a unique example of an experiment with a quieter city.

This experience has raised awareness of the impact of such disturbances on the quality of life for everyone.

Noise has been identified by the World Health Organization as the second leading cause of morbidity in Europe, behind air pollution.

Source - World Health Organization (WHO)



NOISE POLLUTION: WHAT DOES IT MEAN?

NOISE IN PUBLIC SPACES: DEFINITIONS AND IDENTIFIED CAUSES

"Noise" can be associated with a variety of definitions and interpretations. Noise pollution is identified here in the sense of a multitude of noises, from different and cumulative sources. This note will therefore focus mainly on the **different sources of noise** with which users of public spaces are confronted, and more specifically what is referred to as "environmental noise".

The World Health Organisation (WHO) defines *environmental noise* as "*noise emitted by all sources, except those in the workplace*".

The main sources of exposure to environmental noise include transportation (road, rail and air traffic), as well as construction sites, nuisances produced by industries, businesses, leisure activities and those arising from the neighbourhood.

The World Health Organization (WHO) defines noise above 65 decibels (dB) as noise pollution, and it becomes harmful when it exceeds 75 dB. Source – WHO

When noise exceeds 120 dB, it becomes "painful for the ear". Across the European Union, at least 20% of citizens are currently exposed to noise levels primarily associated with road traffic and considered harmful to health (WHO). The adverse effects related to noise are manifold on public health and pose a growing concern for cities worldwide.

WHAT REGULATORY MEASURES ARE IMPLEMENTED IN CITIES AROUND THE WORLD TODAY? (1/2)

All cities in Europe and even worldwide are currently facing issues related to noise pollution. The European Union has adopted regulations regarding ambient noise in the environment, transposed into the national legislations of member states. Among these directives to combat noise pollution are requirements for member states to monitor the assessment and management of noise, mapping noise exposure in urban areas and developing an action plan to reduce noise in these zones.

In May 2021, the European Union also adopted the plan **"Towards Zero Pollution for Air, Water, and Soil".** This zero-pollution ambition for 2050 is a cross-cutting goal contributing to the United Nations' 2030 Sustainable Development agenda. The objective of this action plan is to promote the integration of pollution prevention into all EU policies. Within this action plan, several measures address the management of noise disturbances, including a 30% reduction in the proportion of individuals chronically affected by transport noise.

In **Europe**, some countries like **Germany** and **Italy** have decided to limit the speed of motorized vehicles, especially motorcycles, to reduce noise pollution. In the Dolomites, for instance, the Italian government has implemented Low Emission Zones (LEZ) and quotas to restrict the number of vehicles allowed to circulate daily, in anticipation of the 2026 Winter Olympic Games.

By introducing toll systems for access to certain areas, the goal is to promote quieter vehicles and limit traffic in that zone.

In **Africa**, noise pollution remains a relatively overlooked issue today. Several countries have taken measures regarding noise disturbances, but there are no tools to measure their implementation and validate their impact. In Nigeria, for example, noise pollution is deemed "illegal", but the law is rarely enforced because residents do not report these disturbances. In these African countries, the situation is becoming increasingly concerning due to various factors indicating that noise pollution will rise: rapid population growth and urban expansion, linked to economic growth.



Score*	City
1,82	Guangzhou
1,72	Delhi
1,7	Cairo
1,67	Mumbai
1,57	lstanbul
1,41	Beijing
1,36	Barcelona
1,32	Mexico
1,31	Paris
1,3	Buenos Aires
1,27	Moscow
1,22	Shanghai
1,2	Saint Petersburg
1,19	Taipei
1,19	Rome
1,17	Madrid
1,15	Hong Kong
1,12	Los Angeles
1,12	Seongnam
1.09	O :
1,00	Singapore
1,08	Singapore Manchester
1,08 1,05 0,97	Manchester Dubaï
1,08 1,05 0,97 0,97	Manchester Dubaï Johannesburg
1,08 1,05 0,97 0,97 0,95	Singapore Manchester Dubaï Johannesburg London

© World Economic Forum

*Based on the results of a study conducted with over 200,000 participants during their hearing test, World Health Organization statistics, and the report from the Foundation for Scientific and Industrial Research (SINTEF, an independent Norwegian scientific organization) on noise pollution.

WHAT REGULATORY MEASURES ARE IMPLEMENTED IN CITIES AROUND THE WORLD TODAY? (2/2)

In **the United States**, the primary federal law for controlling noise pollution is the Noise Control Act, enacted in 1972. This law regulates various 'major' noise sources, including construction equipment, electric and electronic transportation, and railway carriers, at different thresholds.

In 2023, **New York City** passed a law aimed at combating excessive noise by installing "anti-noise cameras", to measure the sound footprint. This measure specifically targets motorists and, more broadly, all users of public space who exceed a certain decibel threshold, subjecting them to fines.

Meanwhile, **China** adopted a law on the prevention and control of noise pollution on December 24, 2021. This law, effective from June 5, 2022, aims to regulate noise disturbances related to industry, construction, transportation, and leisure activities by defining permissible maximum levels.

In **France**, several local authorities have implemented metropolitan strategies dedicated to noise pollution management. French metropolitan areas address the issue in line with regulatory obligations. Rennes Métropole, through its 2022-2028 plan, aims to implement several measures aligned with the following guiding principles: "Prevent, Reduce, Protect, Understand, Share, Evaluate." Among the various actions planned across the territory are: introducing new traffic models, accelerating the acoustic insulation of housing, renewing road surfaces, strengthening and updating acoustic measurement tools, and more.



Noise map of the U.S

WHAT IS THE FRENCH NATIONAL NOISE COUNCIL?

Established in 1982 in France, the National Noise Council (CNB) was the first advisory body placed under the Ministry of Ecological Transition. It is composed of representatives from the government, local authorities, experts, and associations. The CNB is mandatorily consulted in the examination of environmental and sustainable development policies and can also provide opinions on any matters related to combating noise nuisances and improving the quality of the acoustic environment.

The CNB is the initiator of the "Golden Decibels", a competition that highlights and rewards the most innovative initiatives in the fight against noise. Candidates can compete in five different categories, including "Cities and Territories", specifically addressing the actions of local authorities.

Among the winning projects in recent years is the public development company "Territoires Publics" for its "Habited Wall", an acoustic screen and creative space for artists, built in Rennes as part of the redevelopment of an old industrial site. Another winner is "Recticel Insulation" for its "Silentwall", an acoustic insulation panel made from recycled polyurethane foam combined with a plasterboard (estimated acoustic reduction between 9 and 12dB).

NOISE POLLUTION: SERIOUS IMPACTS ON URBAN RESIDENTS' HEALTH AND BIODIVERSITY

NOISE POLLUTION AND HEALTH ISSUES

Noise has many effects on health. Until a few years ago, noise was merely identified as a nuisance affecting quality of life. However, today, noise is recognized as having a **significant impact on individuals' health**. Noise disturbances are indeed identified by many experts as a real threat.

The World Health Organization (WHO) has determined various types of health impacts associated with prolonged exposure to noise: **auditory effects**, primarily related to hearing disorders (hearing loss, even deafness), and **objective extra-auditory effects** that involve sleep disturbance, cardiovascular system disruption, and psychosocial effects related to mental health.

Finally, **subjective extra-auditory effects**, stemming from individual perception, include effects on attitudes and social behavior (especially isolation). Noise is also recognized as a factor in environmental stress, associated with the degradation of well-being.

THE "SOCIAL COST" OF NOISE POLLUTION: THE FRENCH USE CASE

The "social cost" of an impact or nuisance is defined by the French Agency for Ecological Transition (ADEME) as "the sum of internal and external costs to the activity borne by society, i.e., the costs incurred by economic agents to ensure and enable the activity, as well as the externalities generated by the activity and suffered by society."

The "social cost" of noise is thus defined by the monetary value associated with the impact of noise nuisances.

In France, according to a report by the National Council of Noise and ADEME, the social cost of noise would amount to a total of 147.1 billion euros per year, with nearly 66% attributed to transport noise, almost 18% to neighborhood noise, and 14% to workplace nuisances. In comparison, the social cost of air pollution was estimated at over 100 billion euros in 2015, and the social cost of tobacco at 120 billion euros per year.



The costs of noise-related effects



Source – The French Agency for Ecological Transition (ADEME) – 2021

NOISE POLLUTION AND BIODIVERSITY

The noise-related nuisances in public spaces also affect **biodiversity**. Noise pollution has **negative consequences on animal species**, altering their behaviors, and noisy environments can become a source of stress. The primary disturbances **involve communication challenges among species** that use acoustic signals to communicate, **changes in their feeding behavior**, and **disruptions to their reproductive cycles**. Birds, insects, and mammals present in urban environments are particularly vulnerable to noise from traffic and human activities.

The consequences on bird behavior are also significant. For instance, some birds migrate to quieter areas or sing louder and earlier to avoid interference with urban noises.

Noise pollution generated in cities can have a long-term, significant impact on the animal population, affecting species diversity and even survival.

THE NEED TO PAY SPECIAL ATTENTION TO VULNERABLE POPULATIONS

The exposure to ambient noise does not affect all individuals in the same way: **inequalities in exposure to ambient noise persist**. Even though there is a difference in perception related to tolerance for noise, certain populations are considered **more vulnerable and sensitive** to disturbances.

Among the identified vulnerable populations: **pregnant women, young children**, who may experience developmental or cognitive disorders, concentration issues, or increased stress; **the elderly**, whose sleep patterns can be disrupted by noise, and who have a higher risk of cardiovascular diseases; and **people with disabilities**, especially those with mental or cognitive impairments, for whom noise can become a new source of stress. **Homeless people** can also experience pronounced effects of noise, as they have little to no access to quiet areas. Their prolonged exposure to noise in urban areas makes them inherently vulnerable.

Finally, socially disadvantaged groups may also be more exposed to noise.

The World Health Organization acknowledged in its 2018 report that there is still insufficient research today pointing to the adverse effects of noise on vulnerable populations. Currently, most measures aimed at limiting and controlling noise for these populations predominantly focus on children.

"NOISE MANAGEMENT": ACTIONS IMPLEMENTED BY CITIES WORLDWILDE

There are several types of responses to address noise pollution in urban environments: actions taken upstream, such as the control and prevention of noise pollution, as well as actions aimed at mitigating ambient noise.

PREVENTION AND CONTROL OF NOISE POLLUTION (1/2)

As mentioned in the European directive previously mentioned, which mandates the assessment and management of environmental noise exposure, member states must provide the public with strategic noise maps (SNMs) in municipalities with over 100,000 inhabitants. Mapping the spatial distribution of noise in an urban environment allows each stakeholder to monitor and prevent it. This provides common data and indicators to identify the noisiest areas and support decision-making in implementing actions on the territory. Therefore, several countries make these maps available based on the collection of noise measurement data.

Implementation of a noise monitoring network in Dublin (Ireland)

The Dublin City Council ambient air quality and noise pollution has established several **noise monitoring stations** at approximately 14 locations across the city.

The objective of this monitoring network is to provide real-time access to information on sound levels to which people are exposed near the monitoring sites.





Measuring noise pollution yourself in Barcelona (Spain)

.....

Another pilot initiative initiated in **Spain** allowed residents to **monitor and measure noise disturbances** in Plaza Del Sol (Barcelona) **themselves**.

Spanish researchers have developed a digital platform capable of collecting and analyzing complaints made by residents on social networks using machine learning and transmitting all this information to the authorities.

The citizen platform "Noise data in Plaça del Sol", launched by a group of tech activists, proposes a new way of approaching noise through collaborative mapping.

As part of the "Making Sense" project, residents were indeed invited to monitor the disturbances on the square by placing noise sensors on their balconies.



Development of a digital twin in Singapore

There are also other solutions based on the use of a **digital twin**.

Making Sense

For instance, the city of **Singapore** has developed **Virtual Singapore**, a digital twin used to monitor various indicators, such as air pollution, sustainable urban planning, and noise pollution. This tool, developed by Dassault Systems, allows for example running simulations through a 3D digital replica of Singapore.

The use of a digital twin in managing issues related to noise pollution enables both real-time monitoring of disturbances to quickly implement measures, modeling and testing noise reduction solutions, such as sound barriers, and evaluating the implemented solutions and their impact over time.

PREVENTION AND CONTROL OF NOISE POLLUTION (2/2)

.....

Knowing the level of ambient noise is possible in Berlin (Germany)

Finally, other measures can be implemented to **communicate noise levels in public spaces**, aiming to prevent users from excessive noise exposure.

For example, in **Berlin**, Germany, the municipal authorities have set up a "**City Tree**" in a noisy and lively neighborhood.

This wooden tower is equipped with sensors, displaying real-time ambient noise levels. Beyond a certain threshold (55dB), the tower flashes to encourage users to reduce the sound level in public spaces.

This device also filters the ambient air through foam panels that absorb fine particles.





;

In **Mumbai (India)**, 70% of the city's noise pollution is due to the excessive honking of cars.

As a result, local authorities have decided to take drastic measures to limit this traffic-related noise pollution, affecting nearly 20 million residents.

"The punishing signal" penalizes motorists when honking crossed 85dB, by resetting the traffic signal countdown and making them wait longer.

© FCB Interface

REDUCING NOISE AT THE SOURCE

Noise pollution is a global issue that affects millions of inhabitants every day. However, there are several solutions available today to mitigate city noises. Policies for the prevention and action against noise disturbances should be conceived as a set of interconnected solutions, addressing the challenges faced by cities worldwide, such as climate change, the preservation of residents' health, and air quality, among others.

Some solutions ultimately remain closely tied to lifestyle and transportation habits:

- reduction of road traffic,
- speed reduction,
- promotion of electric vehicles,
- the development of bike lanes to encourage new modes of mobility.

Pavement Parking Parking Parking



© Senate Department of Berlin/LK Argus GmbH.

For example, in **Berlin**, road traffic is the leading cause of noise pollution. To address this issue, the city has launched several pilot projects to **redesign certain noisy thoroughfares** by reducing space allocated to cars to a single lane, creating bike lanes, and pedestrian areas. According to the evaluation by the European Environment Agency, the number of people exposed to high nighttime noise levels has been reduced by more than 50,000. Several other countries have adopted these measures to reduce disturbances, improve air quality, and promote more sustainable mobility.

In addition to their ability to improve air quality, contribute to reducing the urban heat island effect through shading, and provide a more pleasant living environment for all users, trees can also serve as effective sound barriers: certain species can reduce sound by intercepting and modifying sound waves. **Tree planting, the creation of vegetated barriers, and more broadly, green spaces** can act as an 'acoustic buffer' against noise disturbances. In **Singapore**, for example, the architecture of the 'Garden by the Bay' park has created an urban oasis in the heart of the city. The design of water features and vast green spaces act as natural sound absorbers, significantly reducing environmental noise.

FOCUS ON SOME EXPERIMENTS AND INNOVATIVE SOLUTIONS (1/2)

Here is an overview of some initiatives and innovative solutions devised to measure, control, cancel or replace noise nuisance.

Glass as an acoustic barrier

DeNoize is a Franco-Dutch startup founded in 2019 that offers technology capable of turning any glass surface into an acoustic barrier. Their "smart window" operates as glass counter-vibration, using sensors integrated into the window frame that generate opposing sound to cancel out unwanted external sounds. This solution is primarily intended for individuals, but could easily be envisioned in public spaces, such as public transportation, for example.

.....





© Denoize

Directing sound towards the user

.....

The French startup **Akoustic Arts** also offers a personalized listening experience. It uses directional sound technology, projecting sound in a straight line to specifically target individuals within its trajectory, and it prevents the spread of ambient noise and helps maintain a quiet environment for all users.

Several use cases have been identified in different sectors (retail, transportation). In 2021, Akoustic Arts installed several directional speakers in the City of Architecture and Heritage in Paris, positioned above artworks for targeted diffusion to visitors.

.....

© Akoustic Arts

Personalized audio content for everyone

Odiho is a French startup founded in 2017, offering a solution that enhances the content offered by screens by providing users with access to the audio through an application and their personal headphones.

This noise-free solution for the external environment provides users with a personalized experience through adjustable settings.

Various use cases have been implemented using silent screens, especially in museums, transportation, large events, and public spaces.



.....

© Odiho



© Les Jardins de Babylone

ICDecaux

Being in your own bubble

Other initiatives implemented by cities encourage users to "take a break" by having a nature-based approach.

For instance, the City of Paris experimented the project "**My Bubble, My Plant, and Me**". Imaginate by Les Jardins de Babylone and floral designer Amaury Gallon, four plant-filled bubbles of 60m3 were installed in four different locations in the capital, offering users 15 minutes of silence and relaxation amid greenery. This type of setup helps reduce the harmful effects of urban noise pollution and contributes to the overall ambiance of the city.

.....

FOCUS ON SOME EXPERIMENTS AND INNOVATIVE SOLUTIONS (2/2)

A noise-absorbing material

.....

Vibiscus is a French startup specializing in intelligent noise control and reduction. In contrast to other noise management solutions that cancel out noise, this solution can absorb it, both in open and closed environments.

The startup has developed a programmable material that absorbs noise locally by modifying acoustic impedance (the relationship between air pressure and its velocity). Recent tests conducted by the startup show a noise reduction of up to 40dB.

Vibiscus was recently selected to join the 2023 cohort of the RATP Group startup accelerator.

.....





Batirama

Mapping noise levels

Finally, **Meersens** is a French startup that uses environmental data to facilitate decision-making and contribute to the health and well-being of residents and users.

Among the various indicators available on their platform are air quality, meteorological data (temperatures, humidity), pollen levels, water quality (bacteria, radioactivity), and noise pollution through the modeling of sound levels.

Through its application, Meersens informs users about average noise levels, geolocates areas with high noise pollution, shares risk indices related to exposure based on the user's health profile and provides personalized advice and recommendations.

Reduce noise levels on construction sites

A completely different solution, more geared towards public works operators, has been devised by the French startup **Acousteam**.

.....

This startup offers acoustic protections (panels, tarps, and tents) to be directly placed on construction sites.

When design captures sound

The French startup **Metabsorber** offers a solution for controlling acoustic waves and reducing noise through design.

Indeed, the startup has developed a material capable of transforming any type of material into an acoustic insulator (glass, plastic, wood, metal). The innovation relies on an acoustic metamaterial allowing the reflection or absorption of acoustic waves, thus transforming surfaces into effective sound traps.

Several experiments have been conducted, particularly in the building sector (offices, open spaces), transportation, industry (noisy machinery), and on furniture (chairs, tables). In 2021, the startup deployed its technology for the first time in a school in Besançon, creating a wooden isolating partition to shield students from the noise generated by the tram construction site.

The Irish startup **Lios** has also developed **SoundBounce**, an acoustic metamaterial to dampen noise and vibrations.

The startup addresses noise pollution comprehensively and has developed the **SoundRelief** application, offering at-home therapy for people suffering from tinnitus.

.....





© Meersens

KEY TAKEAWAYS

Noise pollution is a global concern that affects all cities and urban areas.

Several sources contribute to noise nuisances in public spaces, but **road traffic is currently the primary source** of pollution in Europe, followed by trains, airplanes, and industry.

In recent years, this issue has sparked increased interest among researchers, public authorities, and citizens, especially since the **link between ambient noise** and its **consequences on human and animal health** has been demonstrated.

Many cities around the world attribute increasing value to noise pollution management, and several **innovative solutions** and initiatives have been conceived to **improve the quality of the sound environment in their territory** (mapping, monitoring of measurement indicators, green initiatives, specific materials).

Recognized as a **major public health issu**e, noise pollution is expected to **continue to expand in our cities** due to demographic and economic growth and climate change. Today, the research field remains **wide open** to **make progress** on this topic.

The concept of "silence", now considered a luxury, raises the question of "silence by design": why not seek to avoid generating noise in the first place?

ANNEXE

Bibliography

- United Nations Environment Program, "Frontiers 2022: Noise, Blazes and Mismatches – Emerging Issues of Environmental Concern", 2022
- Ifop, "Le comportement et les attentes des Français face aux nuisances sonores" 2022
- Rennes Métropole, Plan de prévention du bruit dans
 l'environnement Rennes Métropole (2022-2026), 2022
- U.Chatterjee, A. Biswas, J.Mukherjee, S. Majumdar, Advances in urbanism, smart cities, and sustainability, (Chapter 11 : Urban Soundscape and Noise Pollution), 2022
- European Environment Agency, "Environmental Noise in Europe 2020", 2019
- World Health Organization, Environmental noise guidelines for the European Region, 2018
- European Environment Agency "Redesign of roadways to reduce traffic noise in Berlin, Germany", 2022
- Evrard, Anne-Sophie, et al. "Chapitre 28. Bruit", Isabelle Goupil-Sormany éd., Environnement et santé publique. Fondements et pratiques. Presses de l'EHESP, 2023, pp. 737-768.

Webography

- Directive 2002/49/CE du Parlement européen et du Conseil du 25 juin 2022 relative à l'évaluation et à la gestion du bruit dans l'environnement, available at : <u>https://eur-lex.europa.eu/legal-</u> <u>content/FR/TXT/HTML/?uri=CELEX%3A52004DC0060</u>
- Commission Européenne, Zero Pollution action plan, available at : <u>https://ec.europa.eu/environment/strategy/zero-pollution-action-plan_en</u>
- United States Environmental Protection Agency, EPA History : Noise
 and the Noise Control Act, available at :
- https://www.epa.gov/history/epa-history-noise-and-noise-control-act
 Géo.fr. 2023. New York : les caméras anti-bruit sont-elles la solution au
- Geo.n, 2023, New York : les cameras anti-bruit sont-elles la solution au vacarme ?, available at : <u>https://www.geo.fr/environnement/new-york-les-cameras-anti-bruit-sont-elles-la-solution-au-vacarme-2023-205548</u>
- Bruit.fr, 2023, Lutte contre le bruit à travers le monde : la loi chinoise de 2021, available at : <u>https://www.bruit.fr/actualites/lutte-contre-le-bruit-a-travers-le-monde-la-loi-chinoise-de-2021</u>
- Aix-Marseille-Provence La Métropole, Environnement sonore et lutte contre le bruit – observer et améliorer la gestion de notre environnement sonore, available at : <u>https://www.ampmetropole.fr/environnement-sonore-et-lutte-contre-le-</u> bruit
- Dublin City Council, Near Real-time Noise Monitoring in Dublin City, available at : <u>https://www.dublincity.ie/residential/environment/noise-</u> control/near-real-time-noise-monitoring-dublin-city
- The Guardian, 2018, Smart cities need thick data, not big data, available at : <u>https://www.theguardian.com/cities/2018/jan/29/smartcities-thick-data-not-big-data</u>
- Van der Berk Nurseries, 2023, How trees reduce noise pollution in urban areas, available at : <u>https://www.vdberk.com/articles/how-trees-</u> reduce-noise-pollution-in-urban-areas/
- Léonard, 2019, Des bruits dans la ville : acoustique et 'ville intelligente', available at : <u>https://www.leonard.vinci.com/des-bruits-dans-la-villeacoustique-et-ville-intelligente/</u>

Webography

- Demain la ville, 2022, Penser en animal pour aménager la ville, available at : <u>https://www.demainlaville.com/penser-en-animal-pour-amenager-laville/</u>
- Usbek & Rica, 2023, Le bruit est-il le fléau de la modernité ?, available at
 : <u>https://usbeketrica.com/article/le-bruit-est-il-le-fleau-de-la-modernite</u>
- Ademe, Site web, available at : <u>https://www.ademe.fr/</u>
- Ministère de la Transition écologique et de la Cohésion des territoires, Conseil national du bruit, 2023, available at : https://www.ecologie.gouv.fr/conseil-national-du-bruit
- Adaptaville, Des solutions pour s'adapter au changement climatique, available at : <u>https://www.adaptaville.fr/</u>
- European Environment Agency, Site web, available at :
 <u>https://www.eea.europa.eu/en</u>
- Cerema, Climat et territoires de demain, available at :
 <u>https://www.cerema.fr/fr</u>

<u>urbanistik</u>

by JCDecaux



Want to know more? We are at your disposal!

Contact us at urbanistik@jcdecaux.com