SHH!

WE'RE MAKING FAR TOO MUCH NOISE...

It's not widely realised that noise is one of the world's major health challenges. It makes millions seriously ill, and kills thousands every year. But help is on the way. Engineers are developing everything from sound-deadening roads to noise-cancelling plasma that can silence the incessant noise.

By **Mikkel Meister**

Noise from transport, industry and construction bothers millions of people every day.

SHUTTERSTOCK

Car tyres on roads, the roar of aeroplane engines, the evening sirens of police cars, and the constant clatter of machinery on construction sites – millions of people around the world get out of bed every day and go to work or school with the annoying, invisible companion of noise.

Many of us have become used to a noisy environment, and we may rarely notice it consciously. But it nevertheless affects our bodies and minds, and every year noise pollution takes a toll. According to the World Health Organisation, noise is the world's second biggest environmental cause of ill health, second only to air pollution.

There are often noise controls in the workplace, although a 2019 Curtin University study found that almost one in five Australian working men experienced noise above recommended limits on their most recent working day. But environmental noise on the commute, in social venues, and particularly when it affect the home environment: it can have dramatic effects. One EU study estimates that 22 million people in Europe live with chronic noise-induced stress, and that constant noise causes 12,000 premature deaths in Europe annually.

The good news is that scientists and engineers are starting to focus on technological solutions that could dampen the noise from our loudest transportation, and might even enable the walls of our homes to neutralise noise.

Unwanted sound

Noise is defined as unwanted sound. The definition is imprecise, given that what is unwanted varies from person to person and may depend on both the physical environment and a person's mental state. If our mood is bright, we are better at coping with the noise around us. When we are tired or sad or hungover, even low noise levels can be annoying.

Despite the imprecise definition, there is general agreement on what is harmful. The WHO recommends a noise limit of 55 decibels (dB) – roughly equivalent to a washing machine. Safe Work Australia suggests 50dB for work involving concentration or lots of conversation, and 70dB for faster-paced occupations, with a limit of 85dB as an average over eight hours. Noise above that level is considered harmful to health over time, and even momentary noise levels above 140dB – the level of sledgehammering or gun shots – can cause instant hearing damage.

24%

of people aged 20-69 who report having excellent hearing actually have measurable damage.

US CENTERS FOR DISEASE CONTROL AND PREVENTION

The unit of sound is the decibel: tenths of the fundamental 'bel' named in honor of Alexander Graham Bell. (The decibel has proven more practical for everyday use.) Its scale is logarithmic, so that an increase in just 3dB indicates a doubling of noise

EU gets serious on sound

With 12,000 deaths attributed to noise annually in the EU, noise is considered an environmental health problem second only to particle pollution. And it is likely to get worse in the future.

Washing machine is about the limit

1 Sound is measured in decibels (dB). A whisper is around 30dB, while a siren is around 120dB. Safe Work Australia recommends noise limits of 50dB or 70dB depending on work type; 50dB is around the level of a washing machine.

intensity. So if you turn on two machines that each make 80dB of noise, the noise is now twice as loud, but it is 83dB, not 160dB.

There are also different types of noise, using different decibel ratings, so that dB(A) is used for steady noise over a period of time, such as traffic noise or background music throughout the day, while dB(C) is used for impulse noise, such as an explosion. But in fact while short-term noise can cause permanent hearing damage, it is the constant noise of everyday life that really takes its toll. Harvard University researchers scanned the bodies of 500 people and found that the risk of severe heart conditions such as heart attack and stroke increases by 34% for every 5dB increase in noise levels over a 24-hour period.

Noise has also been linked to several types of cancer, diabetes, obesity, and high blood pressure. Traffic is the biggest source of noise, and traffic noise is a growing problem in cities around the world, as more people live more densely than ever, with more cars on the roads. An estimated 254 billion vehicle kilometres were travelled on Australia's roads in ▶

Noise pollution is measured using a decibel meter like this one, which here indicates 53.7dBA, just above the recommendations of Safe Work Australia for a work environment requiring concentration.

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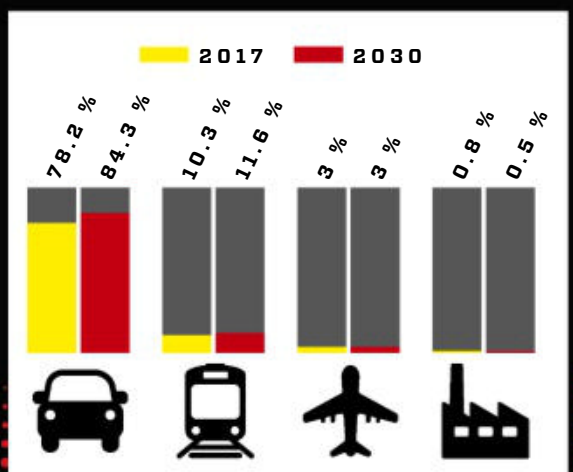
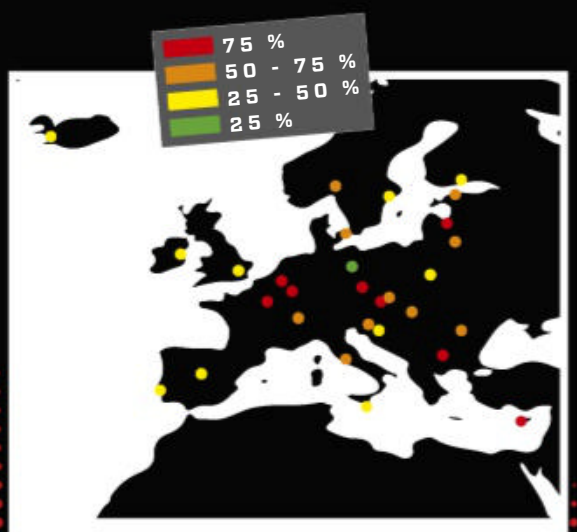


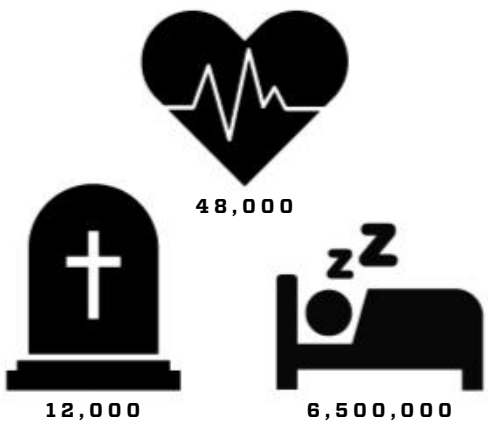
Cars cause more noise

2 Europe knows its noise problem is increasing. By 2030, 84 million Europeans are expected to live with constant noise above 55dB from cars – up from 78 million in 2017. Noise from trains will also increase, while planes and industry are expected to stay level.



Vienna holds the noise record for big cities

3 Austria's capital has the highest proportion of residents living with noise above 55dB. Brussels is almost as noisy, while Copenhagen is slightly quieter, Stockholm even quieter, and Berlin the quietest.



Noise kills

4 According to EU data, noise is a contributing factor in 48,000 people developing cardiovascular disease annually, while causing noise-related sleep problems for 6.5 million people. Some 12,000 die prematurely every year due to noise pollution in the EU.

SHUTTERSTOCK

4SILENCE

Passive walls have long been used to absord sound from roads and railways. These new metal grids from 4Silence in the Netherlands use diffraction to direct the noise away from nearby buildings.

2022-23, a rise of 5.8% on the year before, and up more than 20% on 20 years before.

Countries with a rapid take-up of electric vehicles may benefit slightly from their quieter operation, but noise from tyres on the roads and wind buffeting is worse than engine noise, and in many nations there are calls or initiatives to reduce traffic and environmental noise.

Rubber to muffle car noise

Noise-reduction technology comes in two variants: passive and active. Passive methods do not need to be activated or otherwise switched on, but reduce noise continuously by virtue of the materials they are built from, or their design. Active methods perform more mechanical or electronic work in response to noise.

The most common passive silencer is an ordinary wall. It absorbs a significant portion of the sound that hits it, while some of the noise is reflected back into the street or back into the indoor room. Noise barriers around highways use this simple, passive mechanism.

A variation on the passive wall uses new diffraction technology developed by 4Silence in the Netherlands under an EU-funded 'Whissper' project. Special noise-barrier fences use curved metal grids that direct the noise upwards and away from the surroundings, instead of just blocking it. Such a grid just one metre in height can remove noise as efficiently as a 3-metre concrete wall.

There are also opportunities to reduce noise under car tyres. In the EU engineers are to test asphalt with rubber powder added from end-of-life car tyres, making the asphalt less stiff and thus reducing vibrations in car tyres, lowering noise levels by 4-5dB. In Australia, Boral is partnering with southern Sydney councils on a similar but recycling-led initiative titled 'Reusing Rubber: Recycling Tyres for Roads', applying research that suggests that adding crumbed rubber to asphalt can double the life of a road.

Pushing silence with plasma

Other researchers are working on reducing indoor noise. In a lab at the EPFL technical university in Switzerland, researcher Stanislav Sergeev and his colleagues have developed a new type of noise reduction technology based on plasma.

Plasma is an ionised gas, where positively-charged ions and negatively-charged electrons from the molecules of the gas have been torn apart and are drifting freely. Because of its properties, plasma can be controlled to push air and thereby produce sound, in the same way a loudspeaker moves the air with its cone.

Sergeev and his colleagues have used a series of Ni-chrome wires, passing electricity through the wires to generate heat, ionising the air around them and causing the ions to travel in waves from one pole of the circuit (the wires) towards the other pole – a metal grid facing the room.

So when a sound wave travels towards the wall, it is neutralised by an opposing wave, the sound absorbed and disappearing instead of being reflected back into the room and continuing to reverberate. The method is somewhat similar to noise-cancelling headphones, where a microphone records the incoming sound signal, after which a circuit calculates an anti-noise signal to be emitted in opposition via a speaker membrane, cancelling the noise.

The advantage of plasma is that it can move air much faster and more precisely than a physical membrane. The method is also more efficient: researchers have calculated that a standard noise-reducing wall would have to be four metres thick to achieve the same reduction as the plasma unit can achieve.

So with plasma technology, we might have homes which actively reduce noise from outside, and even noise between rooms, all without having to make the walls any higher or thicker.

It's a start, at least, to address a problem which doesn't get enough attention – the insidious and dangerous growth of noise pollution in our modern world. SI

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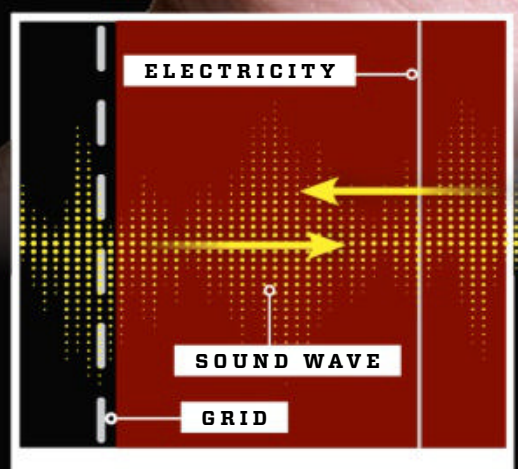
dB is the loudest sound ever recorded.

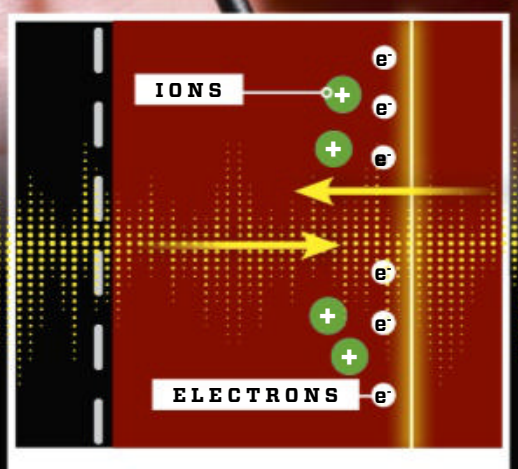
Plasma waves reduce noise

Electrically-charged particles in the air can be controlled to make – or eliminate – sound. The method makes it possible to produce thin lightweight panels that could be installed in walls to reduce noise.



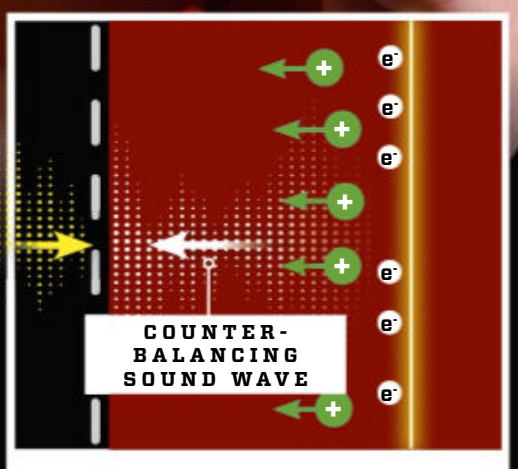
Steel grid and wires form a circuit

1 A steel grid in the outer wall (1) and Ni-chrome wires (2) 6mm further in act as the minus and plus of a circuit. Without power, sound waves from the outside (3) can pass through unobstructed and/or reflect back into the room.



Voltage generates electric charges

2 When power is applied to the circuit, the electric field in the wires is strong enough to ionise the air: the molecules in the air are split into positively-charged ions (4) and negatively-charged electrons (5), producing plasma.



Ions produce a wave

3 The positively-charged ions travel towards the negative side of the circuit, i.e. the grid. En route they push the air, which starts to move in a wave (6) that counter-balances a sound wave from the outside. The result is silence.

KEN IKEDA MADSEN, ?????