



Healthy Homes Barometer 2019

Growing up in (un)healthy buildings



Morten Helveg Petersen
Vice-Chair of the European Parliament's ITRE Committee

Making buildings better and healthier for our children's sake

We live in an era where it has become impossible to ignore the environmental impact that we have on our planet. And if the 2019 European Parliament elections have taught us one thing, it is that Europeans want changes for a more sustainable future.

It is the ambition of a vast majority of the Parliament, as well as the Commission, that Europe becomes the first climate-neutral continent in the world by 2050. To reach this goal and the targets laid out in the Paris Agreement, it is essential that we deliver a green transformation to all parts of society.

A key area for change is Europe's old building stock. Today, three quarters of Europe's buildings are energy inefficient. These buildings alone are responsible for 40 percent of Europe's energy consumption and over a third of its CO₂ emissions. Improving the state of European buildings is essential to achieving our ambition within the next three decades.

When optimising the energy performance of our buildings, we should also use this opportunity to improve the immediate impact that buildings have on their residents' health and quality of life. Decisions about how to improve buildings must automatically involve considerations about their most vulnerable residents – our children.

The Healthy Homes Barometer 2019 reminds us that buildings are intended to be safe and healthy places for our children to grow up in. Therefore, it is alarming to read that 1 out of 3 European children live in unhealthy homes. Moreover, this year's barometer also shows us that modernising our buildings does not only result in economic gains from reduced energy bills. There is, in fact, also potential for a substantial boost to the European economy by solving the building deficiencies that harm our children's health.

In order for Europe to achieve its climate and sustainability goals, while at the same time making sure that

the health of our children and future generations is not side-lined, a long-term national renovation strategy must be pursued. The newly revised Energy Performance of Buildings Directive (EPBD) tasks Member States with establishing such a strategy to support renovation of their building stocks with targets and recommendations on energy efficiency as well as indoor air quality, comfort and health.

Europe is struggling with an aging housing stock with severe consequences for the health of our youngest generations, but the EPBD – if properly implemented – offers a great, cost-efficient opportunity to achieve major improvements in health, comfort and efficiency.



David Briggs
CEO of The VELUX Group

Safeguarding the future of the youngest generation

Welcome to the Healthy Homes Barometer 2019. Since our first Barometer in 2015, our ambition has been to work with accredited research partners to examine how the European building stock can be improved to the benefit of people, society and the planet. This fifth edition of the Barometer takes these findings a step further and turns its attention to some of the most vulnerable members of our society – our children. It is high time that we assess the situation for children living in Europe and the impact that our buildings have on them.

I believe children have the right to grow up in an environment that is good for their health and well-being. To safeguard this right, it is our responsibility to ensure that the homes they grow up in and the schools they learn in do not cause them harm or impede their ability to thrive. So, a sustainable future for our children also means combining healthy and comfortable buildings with care for our children and the environment.

Today, as many as 1 out of 3 European children live in homes with deficiencies that could negatively impact their health. This Barometer not only examines the effects that unhealthy buildings can have on children's health and learning. It also explores the great potential benefits that improved indoor conditions in homes across Europe could have on health, learning, productivity, and even the economy.

Continuing the trend from last year, the Healthy Homes Barometer 2019 looks beyond the four walls of the home and examines the places where our children spend a huge amount of their time – schools. The study shows how important improved indoor climates in classrooms are to ensure that children get the most out of their education.

UN Sustainable Development Goal (SDG) 3 underlines the importance of ensuring good health and well-being. Taking the health risks of unhealthy homes and schools seriously, by assessing the need for improvements

to buildings across Europe, is essential to achieving this goal. To face this challenge and ensure the best possible future for our children, collective action or partnerships, as outlined in SDG 17, are needed. Because only by working together across industries, the public and private sectors, educational institutions, NGOs and national boundaries can we create a more sustainable future. With the Barometer, we wish to reach out to all partners who are interested in sustainable buildings.

We thank our research partner RAND Europe for collaborating with us on this year's barometer to shed light on the state of our buildings and their effect on children. We look forward to continuing a much-needed dialogue with stakeholders at all levels on how to improve our buildings so that we can safeguard the future of our younger generations.



Are our homes making our children sick?

Today, more than 26 million European children are living in unhealthy homes putting them at higher risk of experiencing health problems. How do we address the challenges facing The Indoor Generation?

It is no secret that a healthy home and a healthy childhood go hand-in-hand. Good air quality, sufficient access to daylight and adequate ventilation are important for creating a healthy indoor

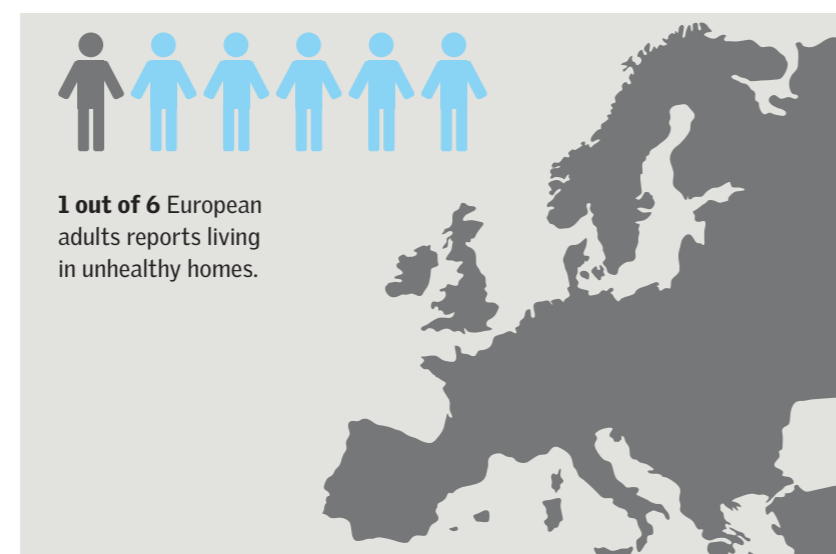
environment in any home, with the effects reaching far beyond childhood.

In previous Healthy Homes Barometers, we learned that 1 out of 6, or around 80 million, European adults live in unhealthy homes, which is in itself a surprisingly high number. This year's barometer finds that the situation for the youngest members of society is even more severe. Today, 1 out of 3 European children – equal to over

26 million or more than the entire population of Scandinavia – live in unhealthy homes.

Furthermore, our results show that mould and dampness, as well as poor ventilation, can take a child from good health to poor health with links to higher levels of asthma, allergies, eczema, and lower and upper respiratory conditions. A growing number of children are burdened with ailments that challenge

” Our results show that 1 out of 3 European children, equal to over 26 million – or more than the entire population of Scandinavia, live in unhealthy homes



their ability to be present and fully engaged at school. Across Europe, the prevalence of children affected by asthma has become an increasing problem in the last few decades. Even though the frequency varies across the continent, in some countries more than 20 percent of children suffer from the illness¹.

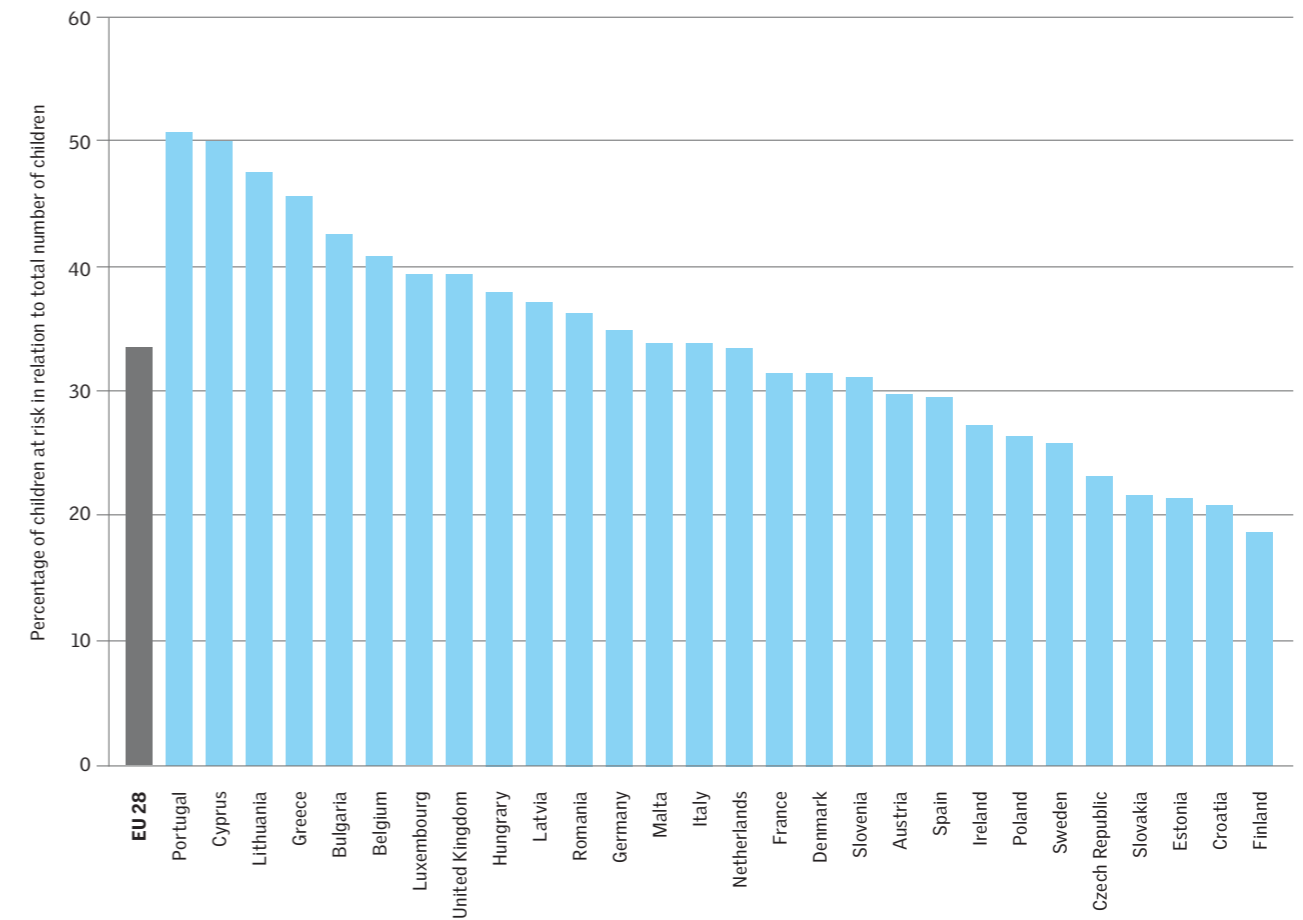
It is not just childhood health that is affected by poor indoor climate. As you will see in the following pages, we found that unhealthy home environments can result in higher absence from school and work, putting a greater strain on both children, parents and the economy.

It is not just an urban problem either. Children who live in suburban single-family homes were found to be especially at risk of living with leaky roofs, mould, and inadequate temperature.

The Healthy Homes Barometer 2018 puts focus on the fact that Europeans spend about 90 percent of their time indoors². The growing number of people spending the majority of their time indoors is sometimes referred to as "The Indoor Generation"³. Read on to see how a healthy indoor climate can help our children by giving them the best starting point to live long and healthy lives in our increasingly indoor world.



Living in unhealthy homes puts children at high risk of experiencing unwanted health issues



1. WHO, 2007 "Prevalence of asthma and allergies in children"

2. European Commission, 2003 "Indoor air pollution: new EU research reveals higher risks than previously thought"

3. <https://www.velux.com/indoorgeneration>



Victims of unhealthy homes

Housing deficiencies like dampness, mould, darkness and excess noise can contribute negatively to our children's health, regardless of where they live and their social background. However, some are more at risk than others.

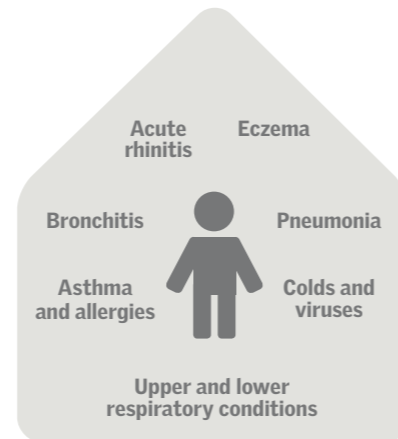
Our analysis defines unhealthy homes as buildings with structural or environmental issues that affect their indoor climate. An alarming 26 million out of the 79 million European children under the age of 15 live in unhealthy homes. Our research shows that several of these risk factors are linked.

This means that 26 million children live with at least one of the deficiencies and many of them live in homes with two or more.

In fact, children living in homes with one of the four risk factors are 1.7 times more likely to report poor health. Whereas children being exposed to all four factors are strikingly 4.2 times more likely to report poor health.

Childhood health issues related to poor indoor climate
Common household issues like dampness, mould, and poor insulation have been linked to several serious childhood health issues.

Secondary effects of these conditions also include higher school absence rates, loss of work for adults and loss of healthy life years.



Dampness:
11.5 million children report living with leaky roofs, damp walls or rot/mould in window frames or floors.

Darkness:
Around 4.2 million report living in houses without enough daylight.

Cold temperatures:
Almost 6 million report living in homes that cannot stay adequately warm.

Excess noise:
Over 13 million report excessive noise pollution from neighbours or traffic.

Note that these building deficiencies are not mutually exclusive. Dwellings with several deficiencies are therefore counted more than once.

How do unhealthy homes make for unhealthy children?

When our bodies are exposed to building deficiencies that create poor indoor climate, we become vulnerable to a variety of illnesses⁴.

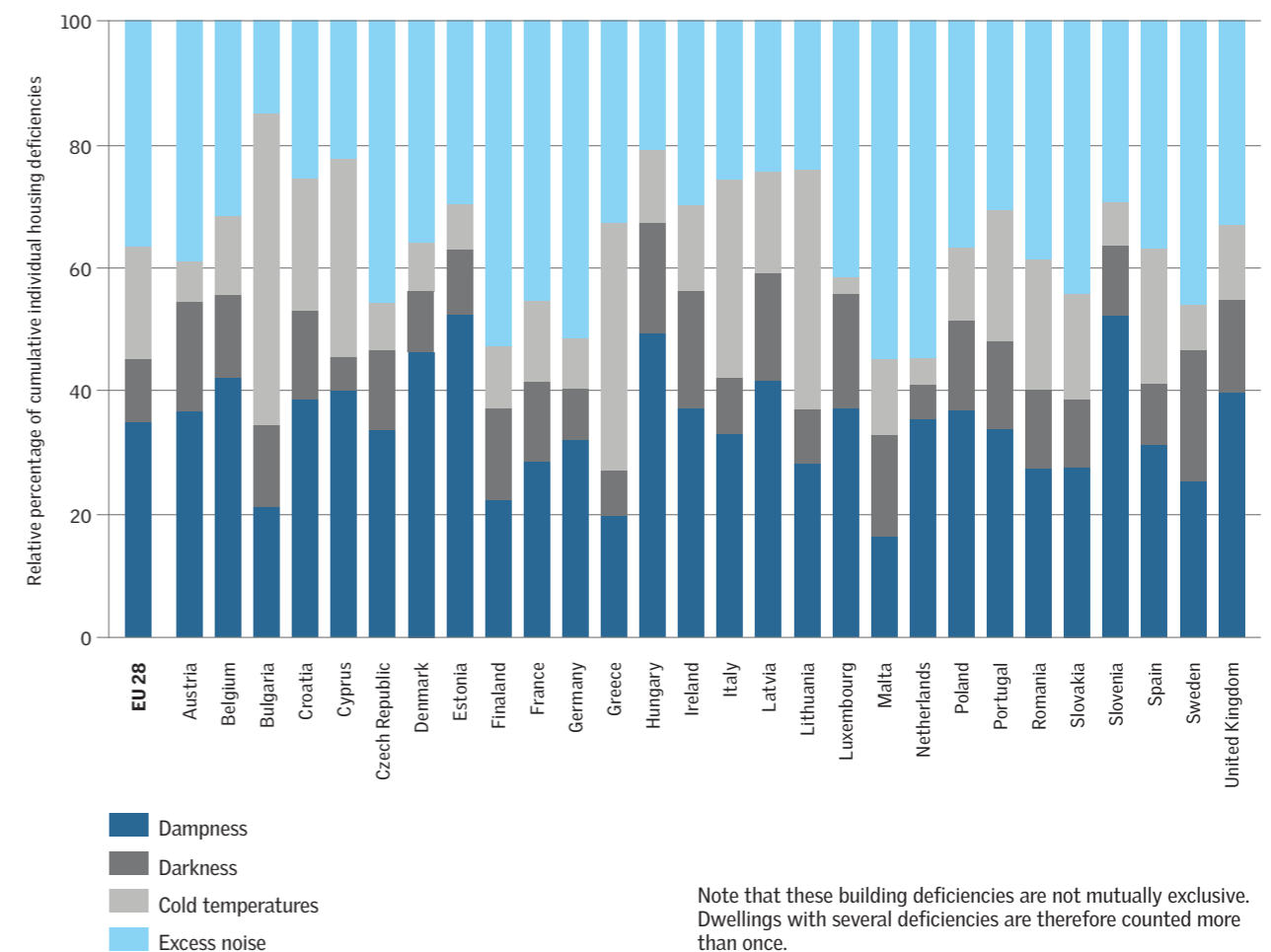
Previous research shows that people are 40 percent more likely to have asthma when living in a damp or mouldy home⁵. Today, 2.2 million Europeans have asthma, which can often be linked to their living conditions⁵. Analyses done in previous Healthy Homes Barometers showed that Europeans who live in unhealthy homes are significantly more likely to report health issues like this⁶.

This year's analysis focuses on children – and the results are not positive. We see a clear link between poor indoor climate and poor childhood health,

especially in children who are at a higher risk of developing respiratory conditions in the first place. Children living with unhealthy indoor climates were significantly more likely to report eczema, coughing, wheezing, asthma, allergy and poor respiratory health. These are health issues that often follow children into adulthood. So, your childhood home could determine your adult health.

Children living in homes with one of the four risk factors of buildings deficiencies are 1.7 times more likely to report poor health

Building deficiencies and the distribution of dampness, darkness, cold temperatures and excess noise



Note that these building deficiencies are not mutually exclusive. Dwellings with several deficiencies are therefore counted more than once.

4. WHO, 2009. "WHO guidelines for indoor air quality. Dampness and mould"
5. Fraunhofer, 2016. "Mould and dampness in European homes and their impact on health"
6. Healthy Homes Barometer 2017



The suburban disadvantage

Urban and suburban populations are growing across Europe. While cities are attractive, principally for their economic activity, people generally move to the suburbs to be close to work opportunities and cultural activities, while seeking a better quality of life in terms of housing cost, pollution, noise and more space⁷.

However, the type of home – single-family home or multi-family home – and its location in an urban, suburban or rural area, will influence how severe the problems with housing deficiencies and their impact on childhood health can be. Therefore, we need to look at where the issues occur to get a full overview of the problem.

The Healthy Homes Barometer 2018 showed that suburban areas have roughly twice as many single-family homes as urban areas, and this could prove to be an increasing challenge. In this barometer, we find that children in single-family homes which are typical of suburbs, are more likely to experience fair to bad health when their homes

are too dark or too cold compared to children in multi-family homes.

Damp, dark and cold single-family homes

Bigger homes do not always equal better ones. Single-family homes, which are typical of suburbs, are more likely to have several exposed exterior elements per dwelling, which is where deficiencies like dampness and cold indoor climates most often occur⁷.

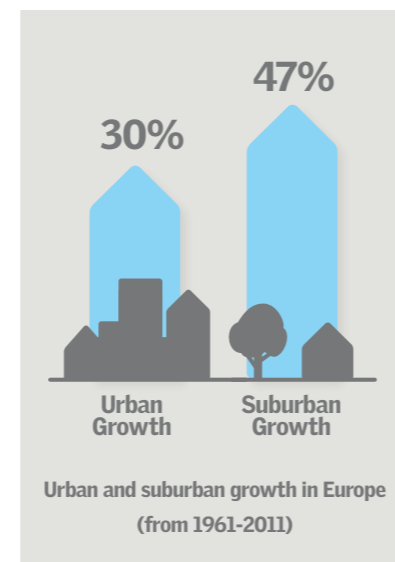
In turn, children living in single-family suburban homes are especially vulnerable to the health effects associated with having a poor indoor climate.

That is particularly concerning, because suburban growth in Europe has significantly outpaced urban growth. From 1961-2011, urbanisation has gone up 30 percent and suburbanisation a striking 47 percent⁷.

We know that residents of single-family homes are more likely to be owners than those living in multi-family homes. This influences decision-making when it comes to renovations, as

private homeowners tend to be less informed about when renovation is needed and the potential health and economic benefits of renovation⁸.

Furthermore, our research shows that when it comes to deficient housing, it is the home itself that plays a role in the likelihood of contracting illness. In other words, housing deficiencies are likely to have a negative impact on residents' health, regardless of available income⁸.



Low-income families are more vulnerable

Although poor indoor climates are found to have the same effect on rich and poor, The Healthy Homes Barometer 2019 shows that children from low-income families are more likely to live in homes with structural deficiencies.

Those in the lower 20 percent on the household income scale are nearly 25 percent more likely to live in homes with deficiencies like a leaky roof or inadequate heating.

Children from low-income households were also more likely to report lack of daylight in their homes. This is a consistent trend across almost all countries included in the study. Moreover, children from low-income households, who are at a higher risk of experiencing poor health in general, are at an even higher risk of health issues related to poor indoor climate.

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7. Healthy Homes Barometer 2018
8. Healthy Homes Barometer 2017

Loss of "healthy life years"

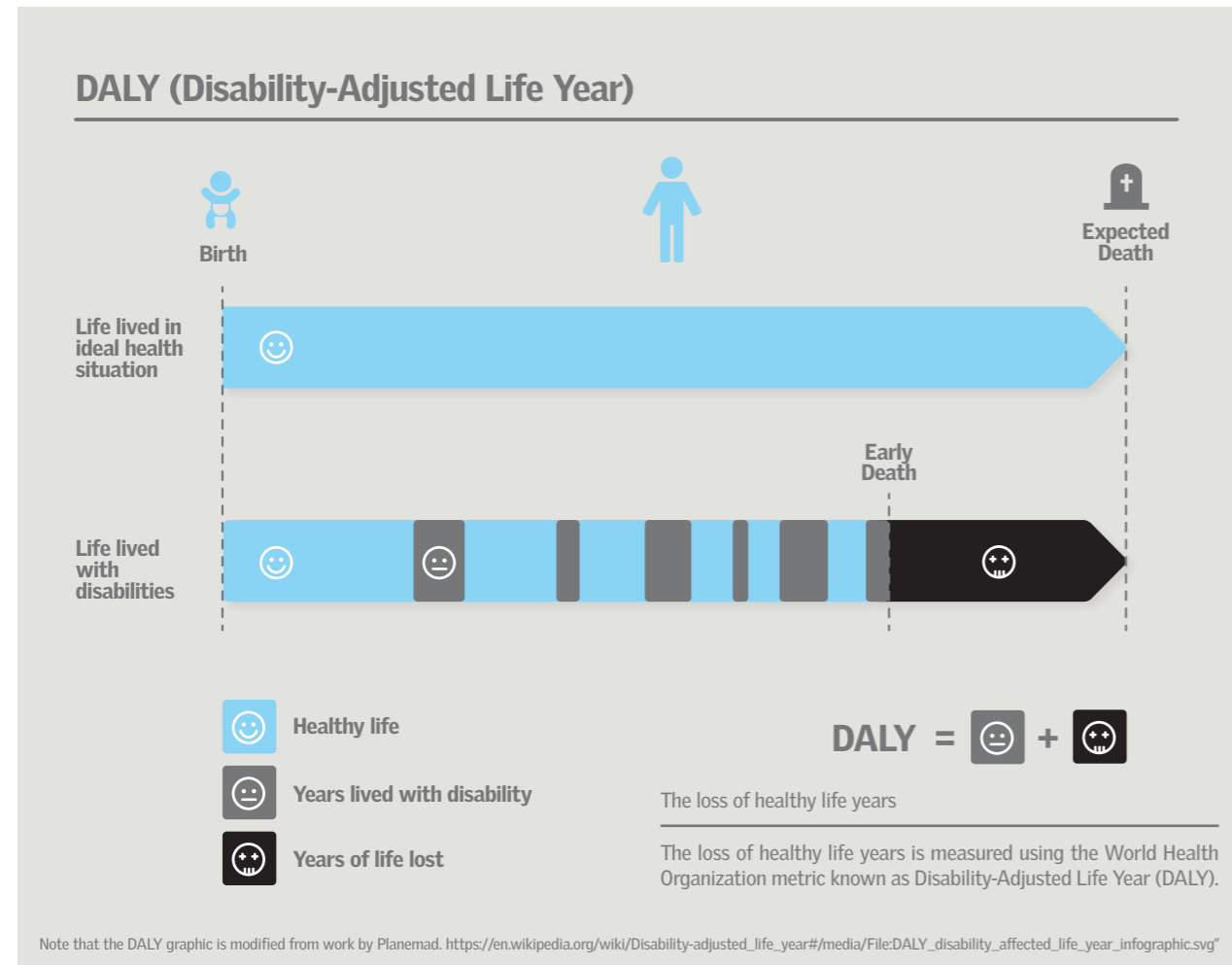
Living with housing deficiencies is putting our children at risk. More than 37,000 years of disease-free life are lost because of diseases linked to unhealthy homes.

There is good and bad news in the Healthy Homes Barometer 2019. The good news is that the vast majority of European children are reported as being in "good" or "very good" health. The bad news is that the research also showed that their health could be in jeopardy due to issues like leaky roofs, dampness, rot in windows and lack of access to daylight at home.

Our analysis predicts that decreasing dampness and noise and increasing daylight access, could improve the health status of about 1.2 million children under the age of 15 in the European Union, who today report living with poor health.

The loss of healthy life years is measured using the World Health Organization metric known as Disability-Adjusted Life Year (DALY). This metric, DALY, expresses the number of years lost to ill-health, disability or early death by looking at the gap between the ideal health

” Health status of about 1.2 million European children under the age of 15 can be improved



Total Disability-Adjusted Life Years (DALY)

Burden of disease from indoor mould and dampness, children age 0-15

Country	DALY
Austria	414
Belgium	1,093
Bulgaria	621
Croatia	113
Cyprus	125
Czech Republic	310
Denmark	548
Estonia	82
Finland	134
France	4,576
Germany	3,982
Greece	507
Hungary	975
Ireland	427
Italy	3,059
Latvia	182
Lithuania	214
Luxembourg	59
Malta	13
Netherlands	1,231
Poland	1,756
Portugal	1,128
Romania	3,568
Slovakia	225
Slovenia	100
Spain	1,976
Sweden	508
United Kingdom	9,649
EU 28	37,577

situation – where everyone lives in perfect health to standard life expectancy – and the current health status of a population.

Years of disease-free life lost

DALYs combine the health burden associated with; a) mortality, the lifetime years lost because of premature death due to disease; and b) morbidity, the lifetime years living with serious illness that could have been spent living a healthy life.

Today, about 10-15 percent of new cases of childhood asthma in Europe

can be attributed to indoor exposure to dampness and mould⁹. This exposure can be linked to more than 37,000 years of healthy life lost for European children.

To put this into perspective, WHO points at second-hand smoke as one of the most harmful exposure risks in the indoor environment. In terms of loss of 'healthy' life years, exposure to dampness and mould is about a third of the impact of harmful second-hand smoke.

9. WHO Europe 2011 "Environmental burden of disease associated with inadequate housing"



Before



After

Nearly two million empty desks

Children are not only losing years of healthy living. They are also losing out on their education. Each year, diseases related to unhealthy buildings are responsible for European children missing 1.7 million school days.

Asthma, eczema and respiratory conditions are more than just uncomfortable – they can also be debilitating. So, it is no surprise that the conditions that are associated with unhealthy homes are also associated with higher school absence rates.

Children are missing school days European children under the age of 15 will miss over 250,000 days in school due to respiratory conditions, about 365,000 days due to asthma, and almost 1,100,000 days because of issues related to eczema.

Together, the conditions that are often linked to living in unhealthy homes are

responsible for about 1.7 million missed school days. On average, this means about 2.5 missed school days per sick child per year because of illnesses that frequently correlate with an unhealthy indoor climate alone. In comparison, adults in Europe average a little fewer than 12 sick days per year¹⁰.

Missed work, missed opportunities When a child is sick, it affects the entire family. Parents must stay home to care for their children, which means less productivity at work.

To illustrate this, one study showed that more than 40 percent of parents of children suffering from eczema reported missing work to care for their children, losing on average about three days a month¹¹. For the children themselves, conditions like eczema and asthma are likely to last into adulthood, which could affect productivity in their own careers.

” Living in unhealthy homes can result in nearly 2 million missed school days

Better indoor air quality will:

-  Increase performance
-  Increase speed in solving tasks
-  Improve attention and concentration
-  Reduce absenteeism

Unhealthy schools

In Europe, more than 65 million students and almost 4.5 million teachers spend between 170 and 190 days annually at school, and up to 70 percent of that time is spent inside the classroom¹². Ensuring a

good indoor climate in schools is key to protecting children's learning and well-being.

Just like at home, poor indoor climate in schools and day-care centres is

linked to serious health conditions. Schools and day-care centres are also sources of mould, poor lighting, noise and ventilation issues. And in fact, there is much evidence regarding the potential detrimental effect on health

of a variety of indoor pollutants that can be found in school environments, either originating from the ambient air or produced indoors from building materials, products or activities¹³.

Air quality is key here. But, regrettably, ventilation rates in classrooms across Europe often fall below national and European recommended guidelines – and that is harming our children.

On the flip side, good air quality is linked to better performance. A review of multiple studies found that improved air quality could boost student performance by up to 15 percent, with a positive effect on working speed, attention level, and concentration¹⁴.

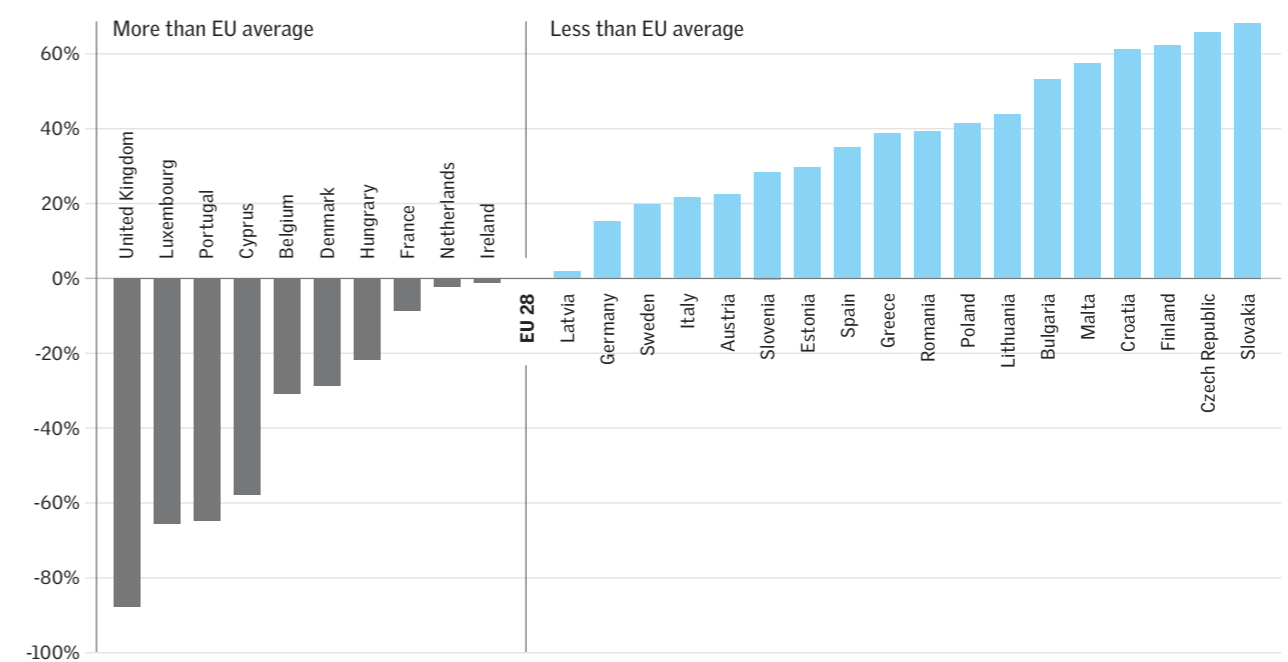
In addition to impacting the performance of students, studies found statistically significant improvements in at least some health symptoms or signs of health with increased ventilation rates, for example better respiratory health. There is also evidence that increased ventilation rates can lead to reduced student absence¹⁵.

Burden of disease from indoor mould and dampness, children age 5-15

Country	Total missed school days	Total number of children in school*	Number of school-day per year ^{12*}
Austria	20,639	1,014,350	180
Belgium	54,058	1,588,806	180
Bulgaria	10,371	832,145	183
Croatia	5,207	519,924	178
Cyprus	6,410	162,366	173
Czech Republic	12,793	1,328,072	193
Denmark	29,393	793,118	200
Estonia	3,156	175,628	175
Finland	7,665	743,760	188
France	246,095	9,745,312	162
Germany	200,924	8,872,741	185
Greece	20,785	1,350,676	175
Hungary	37,296	1,169,536	181
Ireland	22,647	845,617	183
Italy	153,538	6,761,074	200
Latvia	6,078	249,575	171
Lithuania	5,010	354,235	174
Luxembourg	3,231	76,832	176
Malta	540	51,021	171
Netherlands	65,587	2,349,288	189
Poland	74,857	4,714,332	187
Portugal	52,115	1,213,978	180
Romania	37,384	2,536,504	168
Slovakia	5,982	688,130	188
Slovenia	4,925	252,629	188
Spain	93,828	5,725,513	175
Sweden	28,686	1,397,916	178
United Kingdom	490,379	9,519,061	190
EU 28	1,699,580	65,032,137	181

*(ISCED 1/2)

Missed school days, of total school days, due to dampness in EU housing stock – percentage difference from EU average



10. WHO, 2015 "Absenteeism from work due to illness, days per employee per year"

11. Filanovsky et al., 2016 "The Financial and Emotional Impact of Atopic Dermatitis on Children and Their Families."

12. European Commission, 2018. "The Organisation of School Time in Europe. Primary and General Secondary Education – 2018/19"

13. European Commission, 2014. "Schools Indoor Pollution & Health Observatory Network in Europe. Executive Summary of the Final Report"

14. Fraunhofer-Institut für Bauphysik IBP, 2015, "Impact of the indoor environment on learning in schools in Europe"

15. Fisk et al., 2015. "Parent-reported outcomes of a shared decision-making portal in asthma: a practice-based RCT"

Healthier homes and schools for healthier economies

Improving the indoor climate of the places where our children spend most of their time will not only be beneficial to their health, it could also boost the European economy by more than €300 billion.




This barometer finds that enhanced ventilation in European schools could lead to substantial economic benefits. Even a small improvement in ventilation rates in schools is associated with a high cumulative increase in GDP in Europe.

The economic effects would increase over time as the number of children benefiting from better air quality would continuously increase and, in time, enter the labour market.

Improving ventilation in European schools could lead to an increase of European GDP of more than €250 billion in the next 40 years. That equals approximately half of the overall yearly government expenditure across EU Member States in 2017 on education¹⁶.

A sound economic argument for improving our homes






Our analysis shows that eradicating mould and dampness in all European homes could lead to an economic gain of €55 billion for the European economy by 2060. This is driven by improvements in children's health leading to fewer missed school and work days and increased productivity for children and their parents, respectively. Altogether, improving ventilation in schools and reducing dampness and mould in homes across Europe, could increase the European GDP by over €300 billion by 2060.

Economic benefits by 2060 – EU	
 Increasing ventilation in schools	€ 252,8 Billion
 Reducing exposure to mould and damp in homes	€ 55,7 Billion
 Total economic benefit of improving indoor environments in schools and homes	€308,5 Billion

On top of that, there are additional economic advantages to reducing noise exposure, increasing daylight access and improving indoor temperature. If we include these, the economic incentives for improving the conditions on all housing deficiencies leading to a poor indoor climate would be even greater.

Ensuring a safe learning environment

To guarantee that children – and teachers – can thrive in the classroom, it is crucial to create a healthy indoor climate that has:

-  Adequate daylight
-  Comfortable indoor temperature and humidity levels
-  Artificial lighting
-  Proper ventilation
-  Good acoustics

Quick return on investment

Each year, inadequate housing costs EU economies nearly €194 billion a year in direct and indirect costs from health-care, social services, loss of productivity and reduced opportunities¹⁷.

Studies have estimated that if all improvements needed in order to bring housing standards across Europe up to acceptable levels were made at the same time, the cost would be repaid within 18 months. Lower costs of healthcare, social services and increased productivity and opportunities would mean that within one year of improving the European housing stock, €2 out of every €3 spent would be repaid¹⁷.

Note that these numbers do not take into account the likely economic benefits that renovation brings in terms of added value to homes and energy savings. So, by facing these challenges, we could also improve the inefficiency of the existing building stock, which is responsible for 40 percent of Europe's energy consumption, and for over a third of its CO₂ emissions¹⁸.

Conclusion

Mould, dampness, leaky roofs and window rot may seem like nuisances, but for many European children, these household issues can create lasting health effects. It is crucial to ensure safe and healthy futures for our children. That means creating home and school environments where all children can thrive.

Whether it is apartments or houses, cities or suburbs, schools or day-care centres, we must upgrade our standards when it comes to creating healthy

indoor climates. As this barometer shows, doing so can lead to health and economic advantages across Europe.

We have seen the vast potential of improving indoor climate, which not only reduces health risks but also benefits children's abilities to learn and thrive. Renovating homes, schools and childcare places to create sustainable buildings with adequate daylighting, comfortable temperatures, proper ventilation and good acoustics is the logical first step.

Tackling the unhealthy homes in which a third of European children live and the many unhealthy schools and day-care centres they attend, is an opportunity to improve the health and quality of life of the most vulnerable Europeans. Furthermore, it is also an opportunity to improve societies, deliver on our energy and climate commitments and address inequalities, while saving money and valuable resources at the same time.

About the Healthy Homes Barometer 2019

The Healthy Homes Barometer is a series of pan-European surveys designed to investigate the link between homes and health. The first edition of the Healthy Homes Barometer was published in 2015. This is the fifth edition published by the VELUX Group.

This year's barometer was compiled using a new analysis of the material in the EU SILC and EUROSTAT databases, which was carried out by the research institute RAND Europe, a not-for-profit policy research organisation.

RAND Europe's research is based on analysis of the Eurostat microdata from the EU-wide survey "Income and Living Conditions in Europe" (EU-SILC). The EU-SILC survey assesses the status and development of income and living conditions in Europe and covers the domains income, poverty, social exclusion, housing, education, labour and health.

The research presented here is based on anonymised self-reported observations. The data in EU-SILC are collected either on household or individual level.

In order to address the research objectives, RAND Europe incorporated three methodological strands in the study; a rapid evidence assessment (REA), statistical analysis and economic modelling. Within the REA, RAND completed a systematic literature review based on a set of pre-defined criteria. While it does (purposefully) not achieve full coverage, a REA constitutes a robust, systematic and replicable method providing a reliable indication of the evidence available in a particular domain.

Furthermore, RAND Europe analysed secondary databases with information on the following two issues; 1) the prevalence of factors related to poor indoor climate across Europe and the number of households

and children affected; and 2) the health status of children in different European countries. Additionally, a regression analysis was carried out in order to identify possible correlations between suboptimal indoor climate and sickness rates of children.

Finally, a bespoke macro-economic model was developed to assess the economic effects associated with improving ventilation rates in European primary and secondary schools. Results and numbers in this Healthy Homes Barometer are based on the analyses conducted by RAND Europe, unless otherwise stated.

Download the full report at www.rand.org/t/RR3256



16. Eurostat, 2019. "Government expenditure on education"
 17. Eurofund, 2016. "Inadequate housing is costing Europe €194 billion per year"
 18. Healthy Homes Barometer 2018

” Today, as many as 1 out of 3 European children live in homes with deficiencies that could negatively impact their health. This Barometer not only examines the effects that unhealthy buildings can have on children’s health and learning. It also explores the great potential benefits that improved indoor conditions in homes across Europe could have on health, learning, productivity, and even the economy.

David Briggs
CEO of the VELUX Group

