White Paper

Building 4 People: People-Centric Buildings for European Citizens

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www.buildings2030.com

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Foreword

We'd like to thank all the contributors, from both public and private sectors, who volunteered their time to participate in two workshops, review and offer their comments. This white paper offers a state-of-the-art on the issue of people's health, well-being and productivity in buildings.

Today, almost all presentations, studies or reports on energy efficiency in buildings mention multiple benefits of renovation, including improvement of people's health, comfort and wellbeing. There is a good reason for it – these benefits make it possible to place people at the heart of a building's renovation.

Focusing on people's health, wellbeing and productivity makes it possible to respond to real concerns, such as fuel poverty, asthma and allergies, the ability to concentrate, and sleep well.

The built environment sector has technologies, expertise and the means to mitigate climate change and improve people's daily lives while making an impact on their long-term health and wellbeing. In fact, the 2017 Lancet Countdown report has compiled a body of evidence demonstrating that climate change directly affects people's health.

Unfortunately, there is a lack of clear definition of multiple benefits of energy efficiency. These benefits have been called "green", social, non-energy or co-benefits. Moreover, health, wellbeing and productivity benefits are rarely quantified and properly accounted for during a building renovation. There is a need for an industry-wide consensus and a reliable financial modeling to strengthen the economic model of energy efficiency.

There is movement in the right direction. We welcome the new phase of the COGfx study led by Harvard T.H. Chan School of Public Health that aims to examine how the indoor environments of 100 office buildings around the world impact employee productivity and health.

This paper brings together perspectives from NGOs, industry associations, companies and think tanks working to better understand the impact of buildings on people's health, well-being and productivity. We believe that a strong focus on people will contribute to increasing the rate of renovation in Europe and bring concrete benefits to all Europeans.

As a next step, we are encouraging you to join Buildings 2030 efforts to design a voluntary commitment scheme from the private sector. Together we can build a movement promoting sustainable and healthy buildings so that the energy transition brings full benefits to all Europeans. It is time to put people at the center, we call this approach Building4People.

Rodolphe Nicolle,

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Buildings we live and work in are affecting our environment, our physical & mental health, our wellbeing and even our productivity. People spend on average 90% of time indoors and one in six Europeans live in unhealthy buildings. Plus, studies show that in more than 40% of enclosed spaces, people suffer health and comfort complaints.[1] Buildings also have a key role to play in combatting the impacts of climate change. In Europe, buildings are responsible for 40% of energy consumption and nearly 36% of CO2 emissions. In order to meet the COP21 Paris Agreement goals and European Union's 2030 climate and energy targets, it is essential to focus on existing buildings, the vast majority of which are inefficient and will require renovation between now and 2050.

People spend on average 90% of their time indoors

The broad alignment of environmental and health agendas presents an opportunity to not only invest in better performing buildings, but also to improve the quality of life for people using these buildings. Enhancing the health and comfort of people in buildings has a huge potential for economic and societal benefits such as better health, increased productivity, reduced sick leave and a decrease in associated medical costs.[2] We call this approach "Building 4 People."

There is a wealth of evidence demonstrating the links between healthy indoor environment and productivity. Digitalization and automation is making building performance data (e.g. air quality, temperature, noise, energy consumption) more available; in parallel, consumer awareness and expectations for comfortable and healthy places are growing.

1 Philomena Bluyssen. 2009. The Indoor Environment Handbook: How to Make Buildings Healthy and Comfortable.

2 The Healthy Indoor Environment: How to Assess occupants' wellbeing in buildings. Philomena Bluyssen. Routledge: London 2014.

This paper describes a "state of the art" for the debate about healthy, comfortable and productive buildings by looking at both policy and market dimensions The European Union has demonstrated leadership in fighting climate change, promoting the energy transition and creating new opportunities for European citizens through the circular economy. However, health, wellbeing and productivity of building users remain subsidiary topics in the EU policy discourse, and there is no clear champion within the Commission where these issues are prioritized.

On the market side, real estate owners, managers, and investors are reporting an increasing demand for healthy, comfortable and productive spaces. Employers are looking closely at real estate through a lens of employee productivity. At the same time, the energy efficiency community is recognizing that the transition to high performing buildings will not be driven by energy savings alone; instead it must be approached through a people-centric perspective. Increasingly, companies are making commitments to promoting healthy, comfortable buildings that improve people's wellbeing and productivity.

Having surveyed the existing efforts, out of many building attributes affecting people's health and wellbeing, we are focusing on four parameters:

Temperature
reflecting the basic human need for protection from extremes of temperature

Light
pointing to the need for adequate workspace lighting and the effect of light on wellbeing

Air
demonstrating the needs for clean, healthy air, free from harmful pollutants – many of which cannot be directly sensed, but can nevertheless cause serious health effects

Noise
showing that noise can be extremely disruptive, damage our hearing or cause distress, anxiety, hindered communication and reduced concentration

Executive Summary

Buildings are highly fragmented by type, ownership and use; this paper will focus on non-residential buildings.

In order to stay at the forefront of the transition to people-centric buildings, companies should:

- **Invest in and promote people-centric and healthy buildings**
- **Publicly commit to lead the industry**
- **Establish a voluntary commitment framework**
- **Calculate the financial impact of healthier, happier and more productive people**
- **Invest and support people-centric building professionals.**

To foster broad adoption of human-centric high performing buildings, policy makers need to:

- **Increase support for research and innovation on how buildings impact human health and wellbeing**
- **Improve national renovation strategies to include considerations for health**
- **Provide guidance for optimization and building automation.**
- **Ensure optimization of the energy use of technical building systems and building automation**
- **Reform the cost-optimal methodology**
- **Incorporate financial considerations for healthy buildings in policy documents**
- **Provide guidance for people-centric public procurement.**

Buildings 2030, in collaboration with strategic partners, is promoting Building 4 People approach to accelerate the transition to people-centric buildings.

Focus on Buildings

As 70% of the world's population will live in cities by 2030, urban resilience is quickly moving to the forefront of the local, state and global public and private agendas. IClimate change impacts communities worldwide; cities are especially vulnerable to its effects - increased temperatures, higher frequency and intensity of extreme weather events due to high concentrations of people and assets. For cities, climate change translates into increased costs for public safety, transportation, infrastructure and public health.

In Europe, buildings use 40% of energy and produce nearly 36% of CO2 emissions.[1] Buildings represent a significant CO2 mitigation opportunity, thus improving existing buildings and building new sustainable assets is key in creating resilient communities and fighting climate change. Also, a focus on buildings is essential in meeting the Sustainable Development Goal 11 which focuses on making cities and human settlements inclusive, safe, resilient and sustainable.

Approximately 35% of the EU's buildings are older than

1 European Commission. Energy Efficiency. 2017. https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings

NON-RESIDENTIAL BUILDINGS IN EUROPE, BY FLOOR SPACE

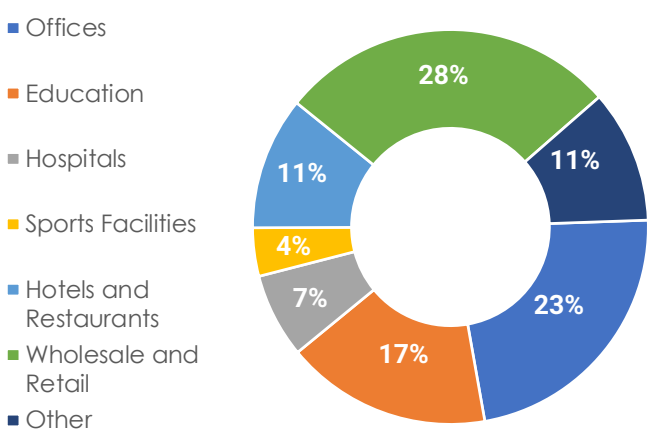


Figure 1

Source: BPIE. 2015. "Europe's Buildings Under the Microscope." http://bpie.eu/wp-content/uploads/2015/10/HR_EU_B_under_microscope_study.pdf

50 years[2] and it is estimated that over 70% of the existing buildings will still be in use by 2050[3], which means that focusing on highly efficient new construction alone will not suffice in order to reach the 2030 goals and 2050 ambitions set by the EU. Plus, some Member States have internal energy performance targets for new and existing buidings . For instance, the UK intends to mandate all buildings to have an energy rating of E or better, starting April, 2018[4] and the Netherlands will ensure that social housing has a B-rating on average[5]. It is imperative to focus on the existing buildings, the vast majority of which are inefficient. [6]

In Europe, people spend on average 90% of time indoors.[7] This includes both the time spent at work and at home.

To zoom in further, European buildings could be segmented into two broad categories; the non-residential sector represents nearly 25% of the building stock, while the majority (~75%) of buildings are single and multi-family homes.[8] The sector is responsible for a large part of total energy consumption, while electricity consumption in particular has increased significantly over the past 20 years (mostly due to air conditioning systems penetration and IT equipment).[9]

Non-residential buildings comprise between 10 – 20% of final energy consumption[10], depending on the country. The sector is fragmented both in terms of building type (see Figure 1), ownership (private vs public) and use structure (tenant, owner-use). Therefore, the non-residential sector is challenging to address through policy alone.[11] The non-residential sector offers faster decision-making due to a smaller number of owners to square meter of floor space ratio and a higher investment capacity, compared to the residential sector. Additionally, private sector competition often drives higher and quicker uptake in the market. Corporate users tend to see offering green and people-centric buildings as a competitive advantage. Whilst all non-residential building types need to be tackled, corporate leadership in building design and management is currently most visible in offices.

A market-based bottom-up approach is needed to maximize the demand for people-centric, high-performing buildings. Therefore, Buildings 2030's initial focus is on applying strategies that improve health, wellbeing and productivity of people in non-residential buildings. We recognize that is equally important to focus on health and wellbeing of people in homes and many findings of the underlying research can apply for residential buildings.

Studies show that poor quality of indoor environment is associated with adverse mental health effects, cardiovascular diseases, lung cancer, asthma-related health issues, obesity and productivity loss.[12] According to the recent Healthy Homes Barometer, in Europe, one in six Europeans lives in unhealthy homes. Such buildings are defined as having "leaking roof or damp floor, walls or foundation, a lack of daylight, inadequate heating during the winter or overheating problems."[13]

Buildings designed and operated with people in mind can result in increased connectivity, safety, and improved standards of living. An ecosystem of building owners, investors, insurers and managers can all benefit from improved buildings designed and optimized for people. Buildings 2030 recognizes this opportunity to promote sustainable and healthy and to broaden the dialogue beyond the built sector.

2 European Commission. https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings

3 Energy Efficiency Financial Institution Group (EEFIG). 2015. "Energy Efficiency – the first fuel for the EU Economy How to drive new finance for energy efficiency investments."

4 Residential Landlords Association. 2017. https://www.rla.org.uk/landlord/guides/minimum-energy-efficiency-standards.shtml

5 Netherlands Enterprise Agency. 2015. http://www.epbd-ca.eu/outcomes/2011-2015/CA3-2016-National-NETHERLANDS-web.pdf

6 European Commission. 2016. "Accelerating clean energy in buildings" https://ec.europa.eu/energy/sites/ener/files/documents/1_en_act_part1_v6_0.pdf

7 https://www.buildinggreen.com/blog/we-spend-90-our-time-indoors-says-who

8 BPIE. 2015. "Europe's Buildings Under the Microscope." http://bpie.eu/wp-content/uploads/2015/10/HR_EU_B_under_microscope_study.pdf

9 Ibid.

10 Energy, Transport and Climate Institute, Joint Research Centre. Towards Nearly Zero Energy Buildings in Europe: A Focus on Retrofit in Non-Residential Buildings" https://ec.europa.eu/jrc/en/publication/towards-nearly-zero-energy-buildings-europe-focus-retrofit-non-residential-buildings

11 Ibid.

12 The Healthy Indoor Environment: How to Assess occupants' well-being in buildings. Philomena Bluyssen. Routledge: London 2014.

13 EcoFys, Fraunhofer, Copenhagen Economics. 2017. Healthy Homes Barometer 2017. http://velcdn.azureedge.net/~/media/com/health/healthy-home-barometer/507505-01%20barometer_2017.pdf

Buildings and People in European Policy

The European Union has demonstrated leadership in fighting climate change, promoting the energy transition and creating new opportunities for European citizens through the circular economy. The EU played a key role in developing and achieving the Paris Climate Agreement in 2015, and each Member State has individually signed or ratified the accord.

EU's 2030 climate and energy goals (currently under discussion) encompass a commitment to a 40% greenhouse gas reduction, 27% improvement in energy efficiency and attainment of a 27% share in renewable energy. The energy efficiency commitment is expected to be strengthened further, in accordance with the proposed "Clean Energy for All Europeans" package, published in 2016.

An increase from 27% to 30% in the energy efficiency target was proposed for 2030, while some are advocating a 40% target.[1] In addition, the European Union has established a 2050 ambition for a reduction of greenhouse gas emissions by 80-95%, compared to 1990 levels[2].

1 Putting energy efficiency first: consuming better, getting cleaner, European Commission (2016)

2 European Commission website: 2050 Climate strategy - https://ec.europa.eu/clima/policies/strategies/2050_en

One policy area that is dedicated to people occupying the buildings is a small but still growing body of policy measures focused on fuel and energy poverty (currently roughly 11% of European citizens live in some form of fuel poverty[3]).

To address the issue of fuel poverty, the European Commission established several initiatives:

01 The Citizen's Energy Forum[4] to foster energy-efficient and fair markets for consumers,

02 The Vulnerable Consumer Working Group[5] chaired by DG Energy and DG Health and Food Safety, which convenes representatives from non-profit, regulators and public and private sectors,

03 European Energy Poverty Observatory[6] was funded by the European Commission to improve transparency of the issue, and

04 Many funding instruments have a specific focus on energy poverty. More recently, as part of the Summer Energy Package, the Commission made a clear emphasis on energy poverty in "Delivering a New Deal to Energy Consumers" communication[7].

3 Insight_E. 2015. Energy poverty and vulnerable consumers in the energy sector across the EU: analysis of policies and measures. https://ec.europa.eu/energy/sites/ener/files/documents/INSIGHT_E_Energy%20Poverty%20-%20Main%20Report_FINAL.pdf

4 Build Up. http://www.buildup.eu/en/events/citizens-energy-forum

5 Vulnerable Consumer Working Group Guidance Document on Vulnerable Consumers, November 2013. http://ec.europa.eu/energy/sites/ener/files/documents/20140106_vulnerable_consumer_report_0.pdf

6 European Energy Poverty Observatory. 2016. http://www.mui.manchester.ac.uk/cure/research/projects/euro-energy-poverty-observatory/

7 European Commission. Deliveriing a New Deal to Energy Consumers. 2015. https://ec.europa.eu/energy/sites/ener/files/documents/1_EN_ACT_part1_v8.pdf

Furthermore, the European Commission's Joint Research Centre brought together the health and built environment communities in a paper "Promoting healthy and energy efficient buildings in the European Union" published in 2016[8]. One of the conclusions of the paper was:

> *"There is a need to investigate further and produce more data to fully understand the implications of highly energy-efficient buildings on the relationships between energy-efficiency measures, IEQ[9] and comfort conditions, ventilation and health in Europe."*

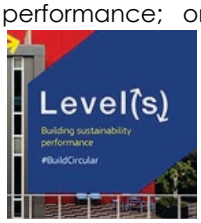
It goes further to conclude that "in order to guarantee that highly energy efficient buildings in the EU will also be healthy for their occupants, a number of Indoor Environmental Quality" issues should be considered as part of the Energy Performance Buildings Directive (EPBD). In fact, there are only scarce references to health and comfort in the "Clean Energy for All Europeans" package. Some of the MEPs from various parties proposed an amendment to the EPBD, currently being debated by the European institutions, that address the importance of health and wellbeing for building users.

Furthermore, the following statement from the EU Commission's impact assessment of the EPBD notes the current shortcomings in national policy addressing healthy buildings[10]:

> *"When not covered by other pieces of EU legislation, Member States keep the responsibility to ensure that the implementation of the EPBD improves and is coherent. Gaps in the national regulatory framework were observed regarding the indoor environment quality [IEQ] (i.e. indoor air quality, thermal comfort, noise and lighting) and ventilation requirements, in particular for existing buildings where health-based mandatory minimum IEQ requirements can hardly be found in several national/regional building codes."*

This statement underscores the need for European legislation to not only protect people from unhealthy buildings, but to promote people's health and wellbeing.

DG Environment released an open source assessment framework for sustainable buildings called Level(s)[11]. The framework focuses on various aspects of a building's performance; one set of indicators is dedicated to "healthy and comfortable spaces."[12] Level(s) is focused on mainstreaming a framework of core performance indicators. Based on the conversations Buildings 2030 has had with DG Environment, there is an effort underway to conduct a market test of the proposed framework. The Level(s) framework has started an important multi-stakeholder process, which resulted in an early industry consensus focused on a building's performance.



Health, wellbeing and productivity remain subsidiary topics in the EU policy discourse. The reason is that building occupants' health, wellbeing and productivity doesn't fit into the core priority of DG Energy, DG Environment, DG Climate Action, DG Health and Food Safety or other European Commission bodies. **Consequently, there is no clear champion within the Commission and the issues are not well-addressed and resourced.**

From an advocacy perspective, the ultimate goal for Buildings 2030 is to facilitate the European Commission to make a commitment to a people-centric built environment and thus embrace health, wellbeing and productivity in buildings. At the same time, a question arises whether it should be a European prerogative and whether it is the right place for the Commission to ask the Member States to elaborate and set their own objectives.

8 Joint Research Centre. Promoting healthy and energy efficient buildings in the European Union: National implementation of related requirements of the Energy Performance Buildings Directive (2010/31/EU). http://www.buildup.eu/en/practices/publications/promoting-healthy-and-energy-efficient-buildings-european-union-jrc-science

9 IEQ – Indoor Environmental Quality

10 European Commission. IMPACT ASSESSMENT Accompanying the document Proposal for a Directive of the European Parliament and of the Council amending Directive 2010/31/EU on the energy performance of buildings. 2016. http://ec.europa.eu/energy/sites/ener/files/documents/1_en_impact_assessment_part1_v3.pdf

11 European Commission. 2017. Level(s). http://ec.europa.eu/environment/eussd/pdf/factsheet_DEF.pdf

12 Ibid.

Thinking Beyond Energy Savings

Historically, the business case for energy efficiency has been supported by energy savings.[1] The most cited "indirect benefits" of energy efficiency typically tend to focus on economic development and job creation in the local communities as a result of building renovations projects. Some studies and reports show that energy efficiency investment in buildings results in decreased air pollution and broad health benefits for the society.[2] Nevertheless, the so-called "multiple benefits" of energy efficiency have not been a part of the mainstream conversation until recently.

The energy efficiency community is recognizing that the transition to high performing buildings[3] will not be driven by energy savings alone; instead it must be approached through a people-centric perspective.

1 Alliance to Save Energy. 2013. History of Energy Efficiency. http://www.ase.org/sites/ase.org/files/resources/Media%20browser/ee_commission_history_report_2-1-13.pdf

2 Copenhagen Economics. 2012. Multiple benefits of investing in energy efficient renovation of buildings. https://www.copenhageneconomics.com/dyn/resources/Publication/publicationPDF/8/198/0/Multiple%20benefits%20of%20EE%20renovations%20in%20buildings%20-%20Full%20report%20and%20appendix.pdf

3 In our view, a high performing building is one that minimizes environmental footprint and contributes to health, wellbeing and productivity of people living and working inside. Nowadays, people expect dynamic buildings that offer flexibility for both work and leisure.

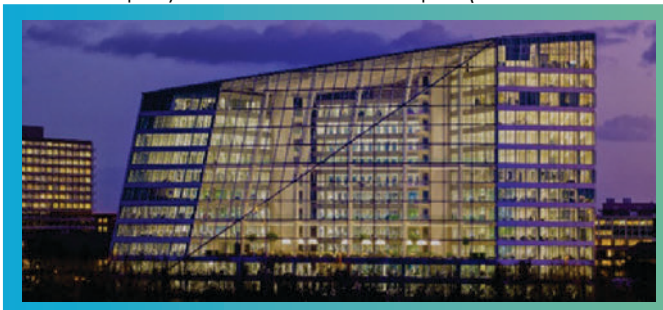
People do not usually 'buy' energy efficiency; instead they mostly tend to solve a problem or seek an emotionally-charged benefit, e.g. comfort, safety, pleasure, privacy, etc.[4] Thus, the multiple benefits of a good energy strategy (impacting comfort, health, productivity, etc.) are key in increasing demand for energy efficiency in buildings.

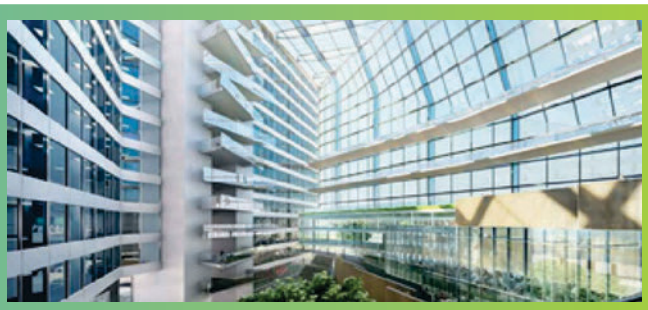
The trend towards a more people-centric building design, focused on walkable, human-scaled communities and building automation, is resulting in increased interaction between buildings and people. Technology helps drive this change and offers tools to facilitate more efficient

4 European Environment Agency. 2013. "Achieving energy efficiency through behaviour change: what does it take?" https://www.eea.europa.eu/publications/achieving-energy-efficiency-through-behaviour

"Savings should be the secondary message, the justifier of the expense. But the reason to be energy efficient should be about satisfying a greater need, a deeper driver. Once we get that messaging right, we'll start to get some real traction in the energy efficiency market." **Susan Shelton, President and CEO of Shelton Group**

use of space and energy in buildings. One of the prime examples of technology-driven environment is Deloitte Headquarters in Amsterdam Zuid – **the Edge**. The building is fully automated and allows its users a degree of control over space selection, lighting, workplace flexibility, and temperature. The project exemplifies leadership by a real estate developer (OVG Real Estate), an MEP & Sustainable engineering firm (Deerns) and tenants (Deloitte and AKD).





The Edge, Amsterdam

Buildings are starting to be seen by owners and investors as a service rather than as a financial asset[5]. In fact, Global Real Estate Sustainability Benchmark (GRESB) noted that health and wellbeing is quickly becoming an important issue for the global real estate industry. GRESB's Health and Wellbeing Module [6]showed that companies are more likely to apply health and wellbeing strategies internally and to focus more closely on their own employees, as opposed to tenants or the community in general. [7]

An overwhelming 84% of real estate professionals interviewed by the Urban Land Institute reported the impact of 'health and wellbeing demand of occupiers/ policy makers on the built environment' will be from moderate to significant in the next 3-5 years.[8] Moreover, one of the respondents added: "Sustainability has always seemed like quite a remote concept, but our health is personal and immediate, it affects you, me and our families right now."[9] Investors and real estate managers are responding to this trend. In fact, British Land, the UK's largest Real Estate Investment Trust, has added a wellbeing expert to its staff.

5 Urban Land Institute. 2016. Emerging Trends in Real Estate. https://europe.uli.org/research/emergingtrends/

6 GRESB. 2017. Health and Wellbeing Module. https://gresb.com/health-well-being-module/

7 GRESB. 2016. Health and Wellbeing Snapshot. https://gresb-public.s3.amazonaws.com/2016/content/2016_Health-and-Well-being_Snapshot.pdf

8 Urban Land Institute. 2016. Emerging Trends in Real Estate. http://europe.uli.org/wp-content/uploads/sites/127/ULI-Documents/2016_etre_report_final_web.pdf

9 Ibid.

Increasingly, people prefer flexible workplaces and a growing share of the EU population works part-time or from home from time to time (e.g. in the Netherlands up to 47% work part-time and more than 4 million Britons work from home). Urban Land Institute affirms that in Europe, people will spend less time in the office and the focus on wellbeing and digital connectivity is becoming more prevalent among real estate companies. [10] In fact, the 2017 Emerging Trends in Real Estate report notes, "the quality of the workplace and how it aligns with all the other places we spend our increasingly integrated lifestyles will become a key tool in the war for talent." Forbes magazine puts teleworking and flexibility and total well-being at the top of its 2017 corporate trends to watch.[11]

Overall, the way we work is changing, which puts pressure on employers to adapt to the needs of their employees by embracing a people-centric approach to buildings.

> "We know that 72% of companies are looking to real estate to deliver improved workplace productivity, with 61% and 57% expecting real estate to deliver enhanced people and business productivity outcomes" **Global Corporate Real Estate Trends, Jones Lang LaSalle, Corporate Research, 2014.**

10 Urban Land Institute. 2017. Emerging Trends iin Real Estate. New Market Realities. http://europe.uli.org/wp-content/uploads/sites/127/ULI-Documents/ETRE-2017-Europe.pdf

11 Forbes. Alan Kohll. 2017 "The Top Corporate Wellness Trends To Watch For In 2017" https://www.forbes.com/sites/alan-kohll/2017/01/18/the-top-corporate-wellness-trends-to-watch-for-in-2017/#71fdb5ba7b28

The link between health, wellbeing and productivity

A growing body of evidence indicates a link between productivity and the wellbeing of employees.[1] An examination of the health and productivity programmes of over 350 companies with more than 1,000 employees shows that companies which incorporate health, wellbeing and productivity in their business strategies achieve remarkably better financial outcomes. Organisations that put into action effective programmes on health and productivity achieved returns to shareholders within five years of over 14.8%, while for companies without effective programmes returns declined by 10.1%. Plus, companies with effective health and productivity programmes had a 15% turnover rate, while those without had a higher rate of 21%.[2]

Work performance is closely linked to employee wellbeing[3]; poor wellbeing substantially increases the probability of negative business outcomes, which can be witnessed in the form of direct health-related costs, as well as deteriorating business performance. Indicatively, employees with poor well-being are:

- **2** times as likely to have high healthcare claims cost
- **4 times** more likely to have emergency room visits and short-term disability days
- **7 times** more likely to have low job performance
- **2 times** more likely to be absent, and
- **2 times** as likely to have low intention to stay with the same employer.

There is a statistically significant relationship between successful health and productivity programmes championed by Human Resources and business profitability - improved business outcomes; lower medical expenses; better task effectiveness; and reductions of wasted time - all of which lead to higher return on sales.[4]

While there is a relationship between indoor stressors and the comfort, health and productivity of those using the buildings, ways to measure this are neither definitive nor fully established. It is a developing field of study and Bluyssen states that an increased focus must be "on users instead of single components and in which the goal is to improve quality of life as opposed to preventing people from getting ill or feeling bad"[5]. Bluyssen also notes that whereas actions from a wide range of sectors are necessary to provide healthy and comfortable buildings, this also results in a great potential to increase the quality of life of citizens.[6]

There is a need for more research, industry case studies and communication efforts to elevate the relationship between people and buildings.
Overall, there is evidence that healthy and happy people are more productive and that buildings affect our mental and physical health. Clearly though, the quality of the building is not the only factor that impact people's health and wellbeing. Corporate

1 Linking Workforce Health To Business Performance Metrics. s.l. : Integrated Benefits Institute, Gifford, Brian. 2015

2 The Health and Productivity Advantage. Towers Watson.2010

3 Classification of Individual Well-Being Scores for the Determination of Adverse Health and Productivity Outcomes in Employee Populations. Healthways. 2013, POPULATION HEALTH MANAGEMENT

4 Linking Workforce Health To Business Performance Metrics. s.l. : Integrated Benefits Institute, Gifford, Brian. 2015

5 The Healthy Indoor Environment: How to Assess occupants' wellbeing in buildings. Philomena Bluyssen. Routledge: London 2014.

6 The Healthy Indoor Environment: How to Assess occupants' wellbeing in buildings. Philomena Bluyssen. Routledge: London 2014.

workplace policies play a significant role. Therefore, there needs to be a more coordinated action among facility managers, human resources, corporate social responsibility and sustainability departments.

The health community is looking at the built environment through a lens of air quality, noise, temperature, and lighting. For instance, the European Federation for Allergies and Airway Diseases Patients Association is seeking an indoor air quality performance certificate.[7]

The built sector must adapt to the changing needs, desires and drivers of the building users. This is an opportunity to not only boost the investments in better performing buildings, but to improve the quality of life for people using these buildings.

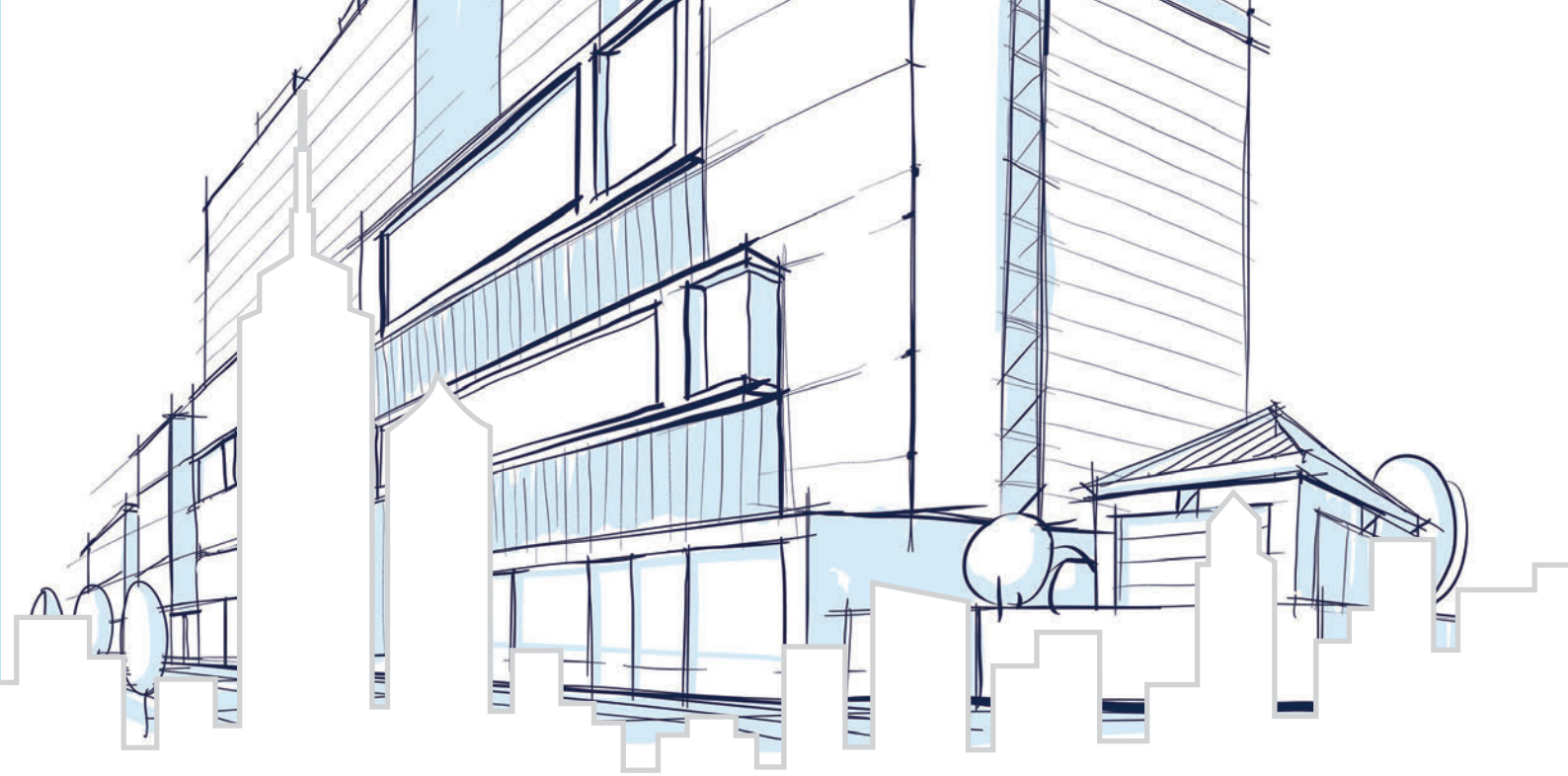
In recent years, BIM (Building Information Modeling) has become an increasingly important tool to assist building professionals in the planning, design, construction, renovation and management of both new and existing buildings. It is a strategic enabler for improving decision making across the whole lifecycle of a building. By virtue of its ability to model different possible solutions, BIM also has a role to play in facilitating the interoperability of different functional requirements affecting both the energy performance and the quality of the internal environment.

7 Euractiv. 2017. Health activists join EU building renovation crusade https://www.euractiv.com/section/energy/news/health-activists-join-eu-building-renovation-crusade/

"At IWBI we believe sustainability and health are synonymous. That is why we're collaborating with environmental sustainability leaders in Europe and beyond – to accelerate not only market transformation, but human transformation as well. Only together will we be able to ride this second wave of sustainability to a brighter, healthier future." **Rick Fedrizzi, Chairman and CEO International WELL Building Institute**

"The clear challenge to the industry is to be less about bricks and mortar and more about service. As one interviewee concludes: 'Twenty years ago we had tenants, now we have customers. In 20 years' time, we'll have guests.'" **Urban Land Institute, Emerging Trends in Real Estate Europe 2016.**

"A sustainable building must be an energy-efficient one, however, a productivity-enhancing building offers much greater savings. Therefore, integrating both features will boost both GHG emission reduction and economic lifecycle benefits, to their mutual advantage both.'" **Jan Karel Mak, CEO of Deerns**



Key Influencers

It has been shown that companies spend the most on staff costs, which account for about 90% of business operating costs.[1] Jones Lang LaSalle (JLL) explored the relationship between "green" workspace and employee productivity and coined "a 3-30-300" rule of thumb" which demonstrates the relationship between company spending on utilities, rent and payroll[2].

JLL showed that a company typically spends $3 on utilities, $30 on rent and $300 on payroll by square foot of real estate. Thus, office space selection can be approached from an employee productivity standpoint.

There are a number of companies investing, developing, managing and equipping comfortable, healthy and sustainable spaces for people. Some have been more active in the European market than others. There are numerous non-profits, public initiatives, SMEs and other stakeholders who work to further peoples' health wellbeing and productivity in homes, offices, schools, hospitals, etc. Some initiatives make a clear link between energy efficiency and building energy performance. Many approach the issue as a campaign and seek members/signatories to commit to a certain goal.

Over the course of 2016 and 2017, Buildings 2030 engaged with major initiatives, organizations and think tanks

- World Green Buildings Council's Better Places for People Initiative
- UK's Better Buildings Partnership
- Urban Land Institute's Greenprint platform
- Global Real Estate Sustainability Benchmark
- Lighting Europe
- Joint Research Centre's Level(s) framework
- International WELL Building Institute
- Building Research Establishment Group
- Technical University Delft's Architecture and the built environment department
- Harvard's T.H. Chan School of Public Health
- The Lancet Countdown
- Health and Environment Alliance
- European Federation of Allergies and Airways Disease Patients Association
- Comfortmeter, and
- Reset Standard

Please see Annex B: Key Influencers for more details on the aforementioned initiatives.

These groups and market leaders mentioned above produced several case studies that point to measurable improvements in people's health, wellbeing and productivity as a result of a better indoor environment.

While the healthy buildings movement is young and growing, several organizations collaborate with their peers. For instance, there are ongoing collaborations with IWBI, BRE, RESET, and WorldGBC. There is a need for more coordination and Buildings 2030 functions as an umbrella organization bridging stakeholders from the built environment sector with those from the health sector.

1 WorldGBC. 2017. http://www.worldgbc.org/files/6114/1152/1351/WorldGBC_-_Health_Wellbeing__Productivity_Exec_Summary.pdf

2 JLL. Green+Productive Workspace. http://www.us.jll.com/united-states/en-us/Documents/green%20productive%20workplace%20overview_JLL_april2014.pdf

Challenges and Opportunities

As noted in the foreword, we have the knowledge, evidence and technology and it is now time to move to the implementation phase by incorporating health, wellbeing and productivity considerations in building design and operation. As an industry, we need to embrace the fact that meeting 2030 climate goals and making buildings more energy efficient is not enough. There must be a strong focus on people living and working in these buildings. The challenges ahead can be grouped in the following four categories:

01 **Lack of political and market awareness.** There is a need for a comprehensive library of evidence and case studies to create a public debate and to motivate academia and the private sector to invest in more knowledge generation and market testing.

02 **Lack of a clear definition and commonly accepted metrics of health, wellbeing and productivity considerations.** Benefits of building renovations that go beyond pure energy savings have been given many names: co-benefits, indirect benefits, non-energy benefits, health and wellness, health and well-being benefits, to name a few. The industry needs a clear shorthand for a standard set of benefits related to health, wellbeing, and productivity improvement on an individual and societal levels. Additionally, the connections between health, wellbeing, productivity, and energy efficiency need to be studied more. An energy efficient building does not always provide a healthy and productive environment for people and vice versa.

03 **The need to bring together architects, engineers, developers, building owners, health advocates and investors to affect a meaningful change.** The issues of health, wellbeing and productivity are interdisciplinary and require a multi-stakeholder approach. While each sector is approaching these issues through its own lens, findings need to be shared and elevated. For instance, a recent report produced by GRESB regarding their members' reporting on Health & Wellbeing showed that over 700 real estate companies are informed, continuously evaluate and take action to increase their employee's health and wellbeing[1]. The report encouraged the health community to work with the real estate community to "inform the way that real estate companies pursue public health promotion".

04 **Increasing consumer expectations and sub-adequate consumer engagement strategies.** Today, people tend to take a more active role in designing and managing their spaces. Consumer electronic devices facilitate easy access to building-related data and pollution information. Thus, there is an opportunity for building owners and employers to embrace the recent active design and Internet of Things (IoT) trends.

Buildings 2030 intends to respond to these challenges by acting as an umbrella initiative bringing various stakeholders to the table to raise political and market awareness of health, wellbeing and productivity in buildings. We intend to provide broad categories of easily measurable building parameters (temperature, light, air and noise) impacting people's health, wellbeing and productivity.

Buildings 2030 focuses on the use phase of a building. Given the long life of most buildings, the use phase is normally associated with the largest carbon footprint, so efforts to reduce greenhouse gas emissions at all stages of its usage are crucial. A change of use or ownership, upgrade to the building services, pursuit of building certification, or deferred maintenance concerns are trigger points for buildings improvement. Buildings 2030 is essentially making a case for another trigger for a building's upgrade – building users' commitment to improving health, wellbeing, and productivity of people using the building.

Ultimately, our vision is for all buildings in Europe to provide people with comfortable, healthy and productive spaces, while minimizing their carbon footprint. Our initial focus on corporate leaders and the public sector is intended to trickle down through all non-residential buildings and ultimately to encompass residential buildings as well – particularly multi-family buildings.

1 USGBC. 2016. http://www.usgbc.org/sites/default/files/2016-1222-State-of-Health-in-CRE.pdf

Foundations for health, wellbeing and productivity

The health, wellbeing and productivity of building occupants depend on environmental and building factors that the scientific literature has explored to a significant extent (see illustrative examples in Table 1).

It has been shown that exposure to improved lighting, temperature and air quality conditions positively affects cognitive functioning and the performance of tasks. Additionally, the productivity of employees in the commercial building sector is dependent on multiple variables, including interpersonal relations at work, corporate workplace policies, work team dynamics and in personal life, which cannot be influenced by the choice of building elements and technical systems.

Table 1: impact of building related elements on productivity.

Element	Impact on Productivity	Context
Ventilation	Up to ~2% increase in office employee productivity from two-fold increase in ventilation rate	Offices
Air Quality	6%–9% decreased productivity in poor indoor air quality environments	Offices
Lighting	Learning progress showed 7% to 26% improvement in highly daylight rooms compared with low levels of daylight	Schools
Lighting	Learning progress showed ~20% improvement when skylight provided additional access to daylight compared with non-daylight rooms	Schools
Lighting	Average length of stay (hospitalization) decreased between 16% and 41% in highly daylight rooms	Hospitals
Lighting	30 % increased reading speed with cold white activating light	Schools
Lighting	30% increased concentration performance with biologically optimized light	Schools
Views	Learning progress showed 15% to 23% improvement in classrooms with largest windows	Schools
User Control	7% to 8% improvement in classrooms with operable vs. not operable windows	Schools
User Control	4.5% increase in productivity at workstations with lighting control	Manufacturing
Air Quality and Lighting	Significant improvements in cognitive functioning with improved air quality and lighting conditions	Offices
Temperature	When temperature is >25°C, each additional degree increase leads to up to 2% decrease in productivity	Offices
Biophilia	The presence of nature in indoor or exterior spaces can lead to 6% to 12% productivity increase	Offices

Sources: Wargocki P, 2000, Wyon, 2004, Heschong, 1999, Juslén, Wouters, & Tenner, 2007, Allen, 2016, Barkman 2012), (Keis 2014)

Key parameters that impact health,wellbeing and productivity

To better understand a building's impact on health, wellbeing and productivity, four sets of easily measurable building parameters were developed. Selection of these key parameters allows for a further exploration with experts, leading to a monitoring framework that can be implemented in real situations.

Drawing on existing research, industry efforts, and indicators used by leading initiatives, the following four key parameters covering TEMPERATURE, LIGHT, AIR and NOISE are proposed as means to assess healthy buildings.

These categories were developed during two workshops convened by Buildings 2030 in 2017. The selection of these four key parameters was confirmed by experts from the built environment, public health, energy efficiency solution providers, engineers and architect communities.

Temperature
reflecting the basic human need for protection from extremes of temperature

Light
pointing to the need for adequate workspace lighting and the effect of light on wellbeing

Air
demonstrating the needs for clean, healthy air, free from harmful pollutants – many of which cannot be directly sensed, but can nevertheless cause serious health effects

Noise
showing that noise can be extremely disruptive, damage our hearing or cause distress, anxiety, hindered communication and reduced concentration

These four foundations impact the overarching outcome goal of:
Health, Wellbeing and Productivity

There are several approaches to monitor, evaluate and measure health, wellbeing and productivity in buildings. This paper offers quantitative, qualitative or standards-based approaches, including in combination with each other, reflecting the organisation's particular circumstances.

Quantitative methods:

Quantitative methods rely primarily on measurable values such as temperature (°C) or number of decibels (dB). With the current technologies (sensors, building automation, Internet of Things, online connected database, etc.), this approach is relative easy to implement[1] for commercial buildings. However, a simple one-dimensional monitoring approach might not capture the complexity of a real work environment.

Qualitative methods:

Qualitative methods focus on surveys, feedback and self-reporting from building users and occupants. This approach is often perceived as subjective, but it is crucial to monitor the building performance in respect to the most important criterion of success, namely through the eyes of the daily user.[2] This is a good tool to measure the individual preferences for temperature, light, etc. which vary from person to person. Methods like surveys must be developed with care to minimise burden on the respondent and take into account issues such as privacy concerns (e.g. asking people about their mental state might cause suspicion), duration and frequency. However, it should be recognised that qualitative approaches, without the backing of quantitative metrics based on actual measurement, are unlikely to give a full picture of the state of a particular building parameter.

1 In some sectors the trend is noticed that building occupants bring their own sensors and monitoring systems to self-assess the quality and comfort of the environment they work in.

2 The Comfortmeter (http://comfortmeter.eu) measures the performance of office buildings by applying an online questionnaire to document the actual comfort level based on user satisfaction.

Standards-based approaches:

Standards-based approaches rely on meeting national or international standards. They are mostly a result of long-term and continuous improvement undertaken by experts, and are therefore the most comprehensive of the three monitoring approaches (e.g. certain standards even take into account the dress code of the company to provide optimal comfort temperatures). The complexity (and sometimes cost) and 'all-inclusivity' of standards may make them less accessible to implement for some organisations than the other approaches.

The fast evolution of technology influences not only the way buildings are occupied but also monitored: this allows not only to improve user's experience, but also to better register and analyse occupation parameters (related to health & wellbeing) and to better manage buildings and their resources consumption. Therefore, it is essential to consider the potential and impact of the Internet of Things (IoT) on the performance and monitoring of buildings but also on the services provided to users, enabling the optimization of the different indicators related to health, wellbeing, productivity.

Increasingly dynamic and self-learning building control and automation systems can improve occupants' health and comfort. Sensors offer real-time monitoring of large number of parameters that determine the environmental conditions created by the building's technical systems (HVAC, lighting, building envelop, etc). Sensors can raise an alarm when a certain parameter is out of the 'healthy' range for building occupants (e.g. humidity or CO2 levels). Plus, ongoing occupant feedback/complaints which can assist in refining set points in response to particular weather conditions.

Buildings should react and adjust to the occupants' needs and preferences, and the energy use of the building should be continuously optimized, by ensuring

that energy is used only when and where necessary and that all technical building systems are properly integrated. The performance of a building and its technical systems should be controlled and monitored by correlating physical measures and real occupancy in a use-friendly way to building occupants to make necessary changes. This means that informed decisions on the operation and performance of the building can be taken based on real data. It also opens the possibility for consumption patterns to be collected and used for the management of the building and for informing future maintenance and renovation strategies at building level.

Monitors can establish occupancy levels throughout the working day/week and help inform building managers on the efficiency of space utilisation, which in turn can be used for optimisation purposes in redesign of the existing space, or design of new premises on a lower physical footprint. For example, it may result in reducing the overall building area per occupant and therefore optimize the m² use. Building Information Modelling (BIM) can be an important tool not only at the design stage, but also throughout the operational life of a building.

Whilst noting that digitalisation is playing an increasingly important role, the most important sensors are the building occupants themselves. If the environmental conditions in a building are not right, people will be distracted from their tasks and not perform at peak productivity. Having effective means to gather and respond to comments from occupants about the indoor environment must be a vital component of an organisation's health and wellbeing programme and can often be carried out digitally through apps, which increases a building's adaptability to subjective perceptions of comfort by different users.

Temperature

Appropriate thermal conditions are vital to occupants of non-residential buildings who spend long periods of time indoors. One of the main complaints of employees is the thermal comfort of the workspace. Even when quantitative monitoring (e.g. through sensors) suggest that a building is within a thermal comfort zone, individuals may feel uncomfortable due to the location of air vents, internal air velocity, localized over/underheating, or frustration over the inability to control their local environment. Taking all these factors into consideration, it is clear that the "effective" temperature is key to occupants, more so than that measured by thermometers.[1]

Beyond space temperature, the dress code of a firm can also significantly impact the thermal comfort of its staff, leading to different perceptions of comfort for the same temperature level.

How does temperature link to energy efficiency?

Around two thirds of the energy consumption in non-residential buildings is used for space heating or cooling, leading as well to the highest energy saving potential linked to the thermal comfort indicator. Maintaining the desired temperature is highly dependent on the insulation of the building's envelope, appropriate sizing and dimensioning of the heat generator and optimized controls of the energy flows. Dynamic and self-learning control systems combined with sensor technology can further increase the efficient regulation of temperature, humidity and moisture levels.

Additionally, the connection between IoT and sensors can enable the tracking of real time occupancy and temperature, making it possible to adapt systems functioning to the actual use of the buildings, for example, to vary the internal temperature depending on the actual occupancy of spaces and number of users, consequently avoiding or reducing energy consumption during periods of low or no occupancy.

Relevant Metrics

Quantitative:

Indoor air temperature thermal comfort range

Qualitative:

User satisfaction

Standards:

Compliance with ISO 7730:2005, EN 15251, draft EN 16798, WELL Features 72-83.

1 Self-Reported Health and Comfort in 'modern' Office Buildings: First Results from the European OFFICAIR Study. Bluyssen, P. M., C. Roda, C. Mandin, S. Fossati, P. Carrer, Y. de Kluizenaar, V. G. Mihucz, E. de Oliveira Fernandes, and J. Bartzis. 2015.
Effects of Thermal Discomfort in an Office on Perceived Air Quality, SBS Symptoms, Physiological Responses, and Human Performance. Lan, L., P. Wargocki, D. P. Wyon, and Z. Lian. 2011.

Light

Daylighting and artificial lighting must be taken into account to assess appropriate lighting in non-residential buildings. People using buildings need light to see and perform their tasks. These visual requirements are well known and measured in minimum luminance and illumination levels as described in European Standards (EN)[1]. Direct sunlight is the most frequent source of discomfort glare, so appropriate shading technologies must be part of the total lighting design of the building[2].

People also need light to support their biological and emotional needs. Light is the most important influence to support our biological clock or circadian rhythm[3]. Our body does not differentiate whether this light comes from the sun or from artificial lighting. The right light at the right time at the right place improves our mood, has the power to energize, to relax, to increase alertness, to improve cognitive performance, and to improve the sleep-wake cycle of people[4]. And last but not least, lighting needs to respect emotions of humans related to light as otherwise feelings of discomfort or reduced well being can be the consequence. The so-called "Human Centric Lighting" supports health, well-being and performance of humans by combining visual, biological and emotional benefits of light.

Most traditional light sources cannot provide the dynamics and the spectral qualities that we need at the different times of the day. Conversely, the lack of natural light or its equivalent using electric light, is connected to potential detrimental effects like circadian disruptions leading to lack of sleep, or depressive symptoms, as well as to reduced activity, alertness and cognitive performance. An ideal solution is where light sources change the colour temperature and iluminations of the light during the day mimicking the sun, avoid glare and provide true colour rendering of objects within the building.

Office workers exposed to ample daylight provision or higher intensity electric light with more short-wavelength (blue) content report enhanced alertness, concentration and mood compared to when working in standard office lighting. They also report better sleep quality during the night.[5]

How does light link to energy efficiency?

Systems that allow the right amount of natural lighting, such as bigger windows or solar shading, can decrease energy consumption while improving productivity. Conversely, large glazed areas without adequate shading could lead to overheating, while the heat loss through transparent surfaces such as windows

1 European Standards (ENs) are documents that have been ratified by one of the three European Standardization Organizations (ESOs), CEN, CENELEC or ETSI; recognized as competent in the area of voluntary technical standardization as for the EU Regulation 1025/2012.

2 Daylighting in Schools: An Investigation into the Relationship between Daylighting and Human Performance. Heschong, L. 1999.
Impacts of indoor daylight environments on patient average length of stay (ALOS) in a healthcare facility. Choi, J.H., Beltran, L.O. and Kim, H.S. 2012.
Lighting level and productivity: A field study in the electronics industry. Juslén, H.T., Wouters, M.C.H.M. and Tenner, A.D. 2007.

3 For a further description of circadian houses, please see: http://thedaylightsite.oxmond.com/wp-content/uploads/papers/Circadian%20House%20-%20Principles%20and%20guidelines%20for%20healthy%20homes.pdf

4 Sleep and Wakefulness Out of Phase with Internal Biological Time Impairs Learning in Humans. Wright Jr, K. P., Hull, J. T., Hughes, R. J., Ronda, J. M., & Czeisler, C. A. 2006.

5 Impact of Windows and Daylight Exposure on Overall Health and Sleep Quality of Office Workers - A Case-Control Pilot Study - http://www.aasmnet.org/jcsm/acceptedpapers/jc-274-13.pdf

Light

is greater than through opaque and well insulated building elements such as walls and roofs.

The choice of electric lighting favours innovation in LED lighting, as they are more efficient than conventional lighting, can be more easily dimmed, positioned and tuned to support specific needs and to be human centric lighting.

The advancements of LED-efficiency have already led to significant energy reductions in buildings. The costs for utilities (including energy) at a typical workplace is meanwhile below 1% of the total costs for labour and space. This is limiting the potential for future cost savings when solely looking at energy efficiency.[6] Only a focus on the 90% factor which is related to humans may enhance the benefit/cost ratio.

Relevant Metrics

Quantitative:

Visual needs, Illuminance level in the working plane Lx, glare control UGR, colour quality CRI, colour temperature K, Daylight Autonomy (DLA), Daylight Factor, UDI (Useful Daylight Index), Window to Wall ratio transmittance .
Non-visual needs (see footnote)[7]

6 http://www.us.jll.com/united-states/en-us/Documents/Workplace/green-productive-workplace-perspective.pdf
7 In a forthcoming publication - CIE JTC9 "Quantifying ocular radiation input for non-visual photoreceptor stimulation" the metric they propose is the "Melanopic Daylight Equivalent Illuminance" with a target value arriving vertically in to the eye of Emel,D65 > 240 lx having the D65 illuminant as the reference.

Qualitative:

User satisfaction and comfort with the use of general lighting, length of unobstructed views.

Standards:

EN 12464-1 (Light and Lighting for indoor workplaces), EN15193-1: LENI (Lighting Energy Numeric Indicator), EN 17037 Daylight in Buildings, WELL Features 53-63, CEN/TR 16791:2017 Quantifying irradiance for eye-mediated non-image-forming effects of light in humans,

The amount of light of any other light source must be calculated with its "Melanopic and photonic weighted spectral power distribution ", in comparison with incandescent lamps we need 500lx to achieve the same melanopic weighted illuminance as 240 lx of daylight.

We must also take in account the age of the subject with a correction factor: a person of 75 years of age will need 443 lux compared with the 240lx of the reference.

We need 240 lux or more to activate us during the day, reduce progressively at sunset and no light to sleep.

Lastly, timing and duration of lighting must also be considered.

Air

Poor air circulation in buildings is bad for occupants and may result in a range of symptoms such as sneezing and coughing, sinus congestion, fatigue, headache, nausea, dizziness and irritation of the throat, eyes, nose and skin. Exposure to indoor air pollutants such as Volatile Organic Compounds (VOCs) is associated with allergies, asthma and bronchitis, and even certain types of cancer, both to sensitive and non-sensitive groups. Dust is a highly influencing factor of occupant health because it contains large concentrations of unsafe agents such as fabric fibres, allergens (spores, mould, mites, pollen, pets), viruses, chemicals, bacteria, and building materials[1].

Ventilation is essential to bring fresh air inside the building, filter it, and remove pollutants that are either generated by occupants (e.g., CO2) or by products (e.g. volatile organic compounds - VOCs). Polluted external air can also enter the building when doors and windows are opened. It is clear that adequate filtration and other means of preventing polluted air ingress, or otherwise efficiently removing harmful substances, is an important component of a healthy indoor climate.

VOCs are perhaps the most important group of chemicals that impact indoor air quality from internal sources (external sources include particulates, nitrous oxides and other airborne pollutants). They originate from a vast array of consumer products, personal care products, building materials, furniture, paints, and more. Studies[2] in office employee populations have proven the connection between lower ventilation rates and sick leave, respiratory infections and asthma. Poor ventilation is also linked with higher operational costs and lower productivity as it impacts cognitive functioning. Conversely, highly ventilated classrooms (with appropriate filtration of pollutants) offer longer attention spans and calm students.

The combination of temperature, humidity and moisture can be a sensitive balance, since dry but cold air favours the spread of the influenza virus, while humid and warm surroundings favour mould and fungal growth. Moisture impacts the health of infants, children and the elderly disproportionately, and the most prevalent condition is mould-related asthma. Mould can also trigger a number of allergies, leading to sneezing, runny nose, eye irritation, coughing, congestion, and skin rash, while it has been associated with potentially fatal conditions. People living in damp or wet buildings are 40% more likely to have asthma and other diseases.[3]

Indoor moisture can impact productivity, especially in communal areas of office buildings where occupants are exposed to building-related illnesses cause by water damage and the presence of mould. The symptoms caused by employee exposure to mould create an unpleasant work environment and negatively impact productivity[4].

1 Hazard Assessment of Chemical Air Contaminants Measured in Residences. Logue, J. M., T. E. McKone, M. H. Sherman, and B. C. Singer. 2011.
Short-Term Exposure to Air Pollution and Cardiac Arrhythmia: A Meta-Analysis and Systematic Review. Song, Xuping, Yu Liu, Yuling Hu, Xiaoyan Zhao, Jinhui Tian, Guowu Ding, and Shigong Wang. 2016.

2 Economic, Environmental and Health Implications of Enhanced Ventilation in Office Buildings. . MacNaughton, P., Pegues, J., Satish, U., Santanam, S., Spengler, J. D., & Allen, J. 2015, International Journal of Environmental Research and Public Health.

3 http://nuovolaw.co.uk/millions-at-risk/

4 Indoor Environmental Quality: Dampness and Mould in Buildings.

Air

Relevant Metrics

Quantitative:

Rate of fresh air ventilation. Measure the concentrations of: Particulate Matter, presence of VOCs, tobacco smoke, CO, CO2 SO2, NOx, Radon, Ammonia, Formaldehyde, Asbestos, dust/fibres, Benzene, Phthalates, Ash, Microbes, O3, PFCs, Mould, Lead, Mercury. Compare these to the World Health Organisation guidelines on Indoor Air Quality[5].

Qualitative:

User satisfaction

Standards:

Material and product standards. Ventilation requirements according to standards (i.e. ISO 16814:2008 or EN 13779, EN 14134, EN 15242 and EN 15251:2007, or CEN TR 1752 1998), WELL Features 1-29.

CDC. 2013.

5 Germany and France have guideline values for list of pollutants they measure

How does indoor air quality link to energy efficiency?

Appropriate ventilation is key to achieving good indoor air quality. Energy efficient ventilation systems are responsive to the needs of occupants and adjust according to levels of occupancy, measured using CO2 sensors, while also capturing the heating or cooling energy in extracted air through heat recovery systems.

Opening windows or running ventilation systems at night when the air is cooler lowers internal temperatures and reduces the daytime cooling load. Thus, adaptive ventilation systems can impact thermal comfort as well. With the support of IoT and/or sensors, variable ventilation depending on occupancy levels results in reduced energy consumption. Effective operational management and maintenance such as commissioning, regular inspections and cleaning/ changing filters are essential to achieve both energy efficient ventilation and good indoor air quality.

Noise

The annoyance from noise is a form of psychological stress that causes discomfort, frustration, distress and irritation. Noise from inside and outside the building can impact building users. Road traffic, aircraft, trains and construction sites can generate unhealthy levels of noise. The building's mechanical systems, such as HVAC, or the presence of repetitive sounds from office equipment, or even group conversations amongst occupants, can also cause discomforting levels of noise. Background noise can be unsettling and increase accidents, or impede employee abilities in simple tasks, e.g. in recognising speech, but especially in more difficult and complex tasks.

Office employees in particular report that ambient noise reduces their work performance and contentment. Exposure to noise raises a range of non-auditory concerns, as it affects the functioning of many human organs and systems, causing higher blood pressure, heart rate anomalies, and hypertension[1]. Plus, noise can result in productivity loss of 8%, according to the Smart Building Alliance[2].

In some buildings already in operation, IoT connected to sensors and user applications ("apps") already allow users to adapt their working space depending on the sound level which they can select (based on their work concentration needs, or background noise preferences). This can allow for acoustic adaptability of spaces regarding the noise tolerance or expectation of each user.

How does noise & acoustics link to energy efficiency?

Sound insulation can complement thermal insulation and vice versa. The effective overlap of thermal and sound insulation reduces refurbishment costs and can lead to considerable energy cost savings. This synergy is dependent on the choice of materials, the quality of refurbishment, the method of assembling elements and the occupational use of the building. Properly designed HVAC systems can ensure that occupants do not need to open windows for ventilation purposes, thereby minimising extraneous noise. Dynamic hydronic balancing of water-based heating systems can diminish (rushing) noises in pipes.

Relevant Metrics

Quantitative:

Noise rating of different sound frequencies, Vibration,, Reverberation time (Tr), Speech transmission index (STI), Distance Distraction, Spatial decay (D2, S)

Qualitative:

User satisfaction; design of internal space – access to breakout areas and quiet spaces

Standards:

ISO 10137:2007, BS 6472-1:2008, EN ISO 3382-3, Part 3, WELL Features 72-83

1 Environmental Noise Pollution in the United States: Developing an Effective Public Health Response. Environmental Health Perspectives. Hammer, M. S., Swinburn, T. K., & Neitzel, R. L. 2014.
Cardiovascular effects of environmental noise exposure. Münzel, T., Gori, T., Babisch, W., & Basner, M. 2014.
Auditory and Non-Auditory Effects of Noise on Health. Basner, M., Babisch, W., Davis, A., Brink, M., Clark, C., Janssen, S., & Stansfeld, S. 2014.
The Quantitative Relationship Between Road Traffic Noise and Hypertension: A Meta-Analysis. Van Kempen, E., & Babisch, W. 2012.
Linking Noise And Vibration To Sick Building Syndrome In Office Buildings. Schwartz, Sandi. 2008.

2 Smart Building Alliance. http://www.smartbuildingsalliance.org/

Health, Wellbeing and Productivity

Workplace performance is linked to the good physical and psychological health of employees. Successful initiatives for health, wellbeing and productivity such as "Better Places for People" and certification systems such as the "WELL Building Standard" aim to minimise environmental, physical health and psychological stressors, while also promoting conditions that support employee productivity. The physical health of employees has a significant bearing on the productivity of a company, and as such the effectiveness of successful health and productivity programmes can be observed in the financial returns of an organisation.

Physical health has been studied extensively and can be diagnosed with self-reporting or medical examinations, and linked to conditions in a building, such as the presence of allergens, or other parameters explored under the four foundation indicators described above. Psychological health is also extremely important, especially in the service economy as it impacts cognitive functioning. Chronically elevated stress-induced hormones, like adrenaline and cortisol, suppress the immune systems, thus exacerbating autoimmune diseases and other inflammatory conditions. Elevated blood pressure is also a symptom of stress and leads to cardiovascular diseases[1].

Relevant Metrics

Quantitative:

Measured stress levels (i.e. salivary cortisol), mental health assessments, cognitive functioning tests, absenteeism

Qualitative:

Staff self-reporting of fatigue, headaches, asthma, allergies and other related symptoms

Standards:

Occupational Health and Safety standards like WELL Building Standard, RESET Standard, BREEAM, and others.[1]

1 Stress and Health: Psychological, Behavioral, and Biological Determinants. Schneiderman, N., Ironson, G. & Siegel, S. 2005.
45. Linking Workforce Health to Business Performance Metrics. Integrated Benefits Institute. 2015.
46. Improving Occupant Wellness in Commercial Office Buildings through Energy Conservation Retrofits. McArthur J., Chris Jofeh and Ann-Marie Aguilar. 2015.

1 Buildings 2030 remains standard agnostic. As an impartial non-profit advocate for healthy and productive buildings we do not favor any particular building standard.

Buildings for People: Recommendations

Based on the "state of the art" of market leaders highlighted in this paper, Buildings 2030 presents the following recommendations for market leaders and policy-makers.

Recommendations for the market:

- ***Invest in and promote people-centric and healthy buildings:*** Over the past 20 years, the concept of sustainability has transitioned from being a "buzz word" to common practice, well-entrenched in national and international law. The emphasis on people is well entrenched in sustainability (people, planet, profit rationale). Collectively, we must ensure that all sustainable building improvements go hand in hand with maximizing occupants' health, wellbeing and productivity. Companies spend most on the people they employ, therefore improvements in indoor environment and adoption of workplace strategies to maximize health, wellbeing and productivity of their employees produce a higher return.

- ***Publicly commit to lead the industry:*** In order to transition to healthy buildings that are comfortable and productive for people, industry leaders should publicly commit to providing healthy buildings for their staff. The early movers in the market will lead the industry to a healthy building transition and reap the benefits of being early adopters.

- ***Establish a voluntary commitment framework:*** Beyond individual company commitments, there is a need for a wider private sector commitment platform accommodating a broad range of companies from various sectors committed to minimizing their buildings' carbon footprint and maximizing their employee's health, wellbeing and productivity. Buildings 2030 intends to provide such commitment platform as a vehicle for leadership, knowledge and peer-to-peer experience sharing among members.

- ***Calculate the financial impact of healthier, happier and more productive people:*** There is growing evidence, highlighted in this report, that people are more productive in healthy buildings. Calculating the productivity benefits and the synergies between space design, building maintenance & operation and human resources costs in a company will help executives understand the financial importance and management implications. A full economic appraisal should encompass the productivity, staff turnover and absenteeism dimensions as well as the energy saving opportunities of building renovation.

- ***Invest in and support people-centric building professionals:*** There is a need for highly trained building professionals (property developers, architects, contractors, installers, energy

services companies and appraisers) able to apply innovative building solutions to result in healthy people-centric buildings. Ultimately, property managers and owners should be able to rely on the skills of building professionals and be confident that they will get a return on their investments. Indeed, building practice should evolve into a performance-oriented approach allowing for an integrated design where sustainability parameters can be optimized simultaneously with benefits for users in terms of health, comfort and wellbeing. BIM has a role to play here in facilitating the interoperability of different functional requirements.

Recommendations for policymakers:

- ***Increase support for research and innovation on how buildings impact human health and wellbeing:*** More research is needed to identify the connections between health, wellbeing and productivity and the energy efficiency of a building. European funding, for example, Horizon 2020, should include a dedicated track focusing on health, wellbeing and productivity in buildings[1]. DG Energy, DG Environment, DG Climate Action, DG Health and Food Safety could offer targeted funding for projects falling directly in their purview. Furthermore, Structural and Cohesion funds can encourage their beneficiaries to consider benefits of energy efficiency outside of pure energy savings.

- **Improve national renovation strategies to include considerations for health:** All Member States are now required to develop long term national building renovation strategies under Art. 4 of the EU Energy Efficiency Directive (EED)[2]. However, a large number of Member States are not in compliance with the minimum EU requirements for renovation, and the Directive has not, to date, resulted in large scale building upgrades. These strategies should highlight and quantify the potential health and wellbeing benefits to living and working environments in order to boost the demand for healthy buildings. Renovation requirements, targets, public investments and financing schemes should take into account improved health wellbeing and productivity.
- ***Ensure optimization of the energy use of technical building systems and building automation:*** The EPBD obliges Member States to set minimum requirements for building optimisation, but implementation has been slow. Minimum performance requirements for technical building systems should be more explicit and linked to functionalities such as impact on health, wellbeing and productivity. Larger commercial and residential buildings should be equipped to continuously monitor, control and adapt energy use in order to optimise their indoor air quality, thermal comfort and energy use and consumption. Guidance for member states on implementation of the EPBD, supported by best practice examples for different building types could additionally support implementation of the minimum requirements.

- ***Reform the cost-optimal methodology:*** The introduction of the cost-optimal calculation methodology to define energy performance levels for buildings was a major innovation in the 2010 EPBD recast. It introduced the prerequisite to consider the global lifetime costs of buildings to shape their future energy performance requirements. Cost-optimal performance targets must pave the way for a well performing building stock in the coming years. This can be achieved through the consideration of additional benefits, not only energy cost savings - health, wellbeing and productivity, for example, via a lower discount rate in the macroeconomic perspective.

- ***Incorporate financial considerations for healthy buildings in policy documents:*** Health, wellbeing and productivity benefits of high performing buildings need to be better captured, measured and tracked by financing entities. Financial organizations, committees, and groups with market influence, e.g. G20, EEFIG, DEEP, already recognize the multiple benefits of energy efficiency, can go further and recommend prioritizing the impacts of buildings on people.

- ***Provide guidance for people-centric public procurement:*** An emphasis must be put on healthy and comfortable building in Public Procurement Guidance. Building parameters such as lighting, air quality, acoustics, and thermal comfort should be evaluated from a people-centric standpoint. This is an opportunity to build better buildings for people, improve existing buildings for people and to collect and track health and productivity improvements.

1 One example of a European Commission-funded project focused on the topic is - COMBI project focused on identifying the multiple benefits of energy efficiency. The project provided useful societal benefits and metrics but stopped short of offering tool for building owners and users to implement health, wellbeing and productivity practices.

2 In the proposal of the Clean Energy for All policy package, this article is moved towards Article 2a under the Energy Performance of Buildings Directive.

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The white paper offers a perspective of Buildings 2030 and does not represent the official position of the companies and organizations represented by the contributors.

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Annex A: Market Leaders

CBRE has been leading the debate on healthy offices and most recently it released "Healthy Offices: The snowball effect of Healthy Offices" report that shows the impact of healthy buildings on CBRE's employees.
CBRE is one of the first companies to achieve WELL Certification and accredited many of its employees through WELL standard. The company partnered with Delos and Mayo Clinic to establish the Well Living Lab™, world's first human-cantered research lab designed to study the interaction between human health and well-being and buildings.
CBRE launched "Workplace 360", an initiative focused on wellness and employee productivity improvement. The initiative engaged with 100 Fortune 500 clients and explore issues related how Millennials live and work, wellness in a workplace and others.
"More and more occupiers are recognizing the role the physical and environmental characteristics of their offices can play on the recruitment, retention, health, and even performance of their employees. Space matters." said Dave Pogue, Global Director of Corporate Responsibility for CBRE.

Deerns is an international Consulting Engineering firm, specialized in MEP Design (Mechanical, Electrical and Plumbing), Sustainability and Smart Building Consultancy. Experienced in different market segments (Real Estate, Airports, Data-Centres, Clean Technology and Healthcare), Deerns multi-expertise allows it to push building design to new levels of performance, in terms of resources consumption or user's experience. Deerns innovative engineering contributed to bring new concepts to life on the field of Productivity, Health and Wellbeing for occupiers, of Zero Energy buildings, or Biodiversity integration in Buildings, all these through

a performance-oriented, collaborative-design approach that shows that cooperation between Engineers, Architects and FM in early design stages, do allow to influence significantly how a building performs and its impact on users. Amongst Deerns engineering and sustainability design we find:

- The Edge (Deloitte HQ in Amsterdam), a BREEAM outstanding building mentioned as the most sustainable worldwide, where Deerns was able to combine Building Systems knowledge and IoT smart technologies (namely bGrid for OVG) in order to design for energy-efficient, flexible and productive workplaces, allowing for new levels of interaction between a building and its users.
- Bosco Verticale (Residential Tower in Milan), also called "Vertical Forest": elected best Tall Building 2015, the building includes a façade composed of trees and was designed for high levels of comfort and well-being, through interaction with nature.
- LVM Münster (Office Tower in Munich) and Maison Île de France (Students' resident in Paris), both net-zero energy buildings, showing that it is possible to building today highly efficient building that are also pleasant and healthy for its users.

JLL is part of the World Green Building Council's Corporate Advisory Board. The company is involved in the Better Places for people campaign and played a role in developing Health, Wellbeing & Productivity in Offices report. JLL intends to be the most sustainable real estate services and investment management firm . The company produces report on health wellbeing and productivity and often host webinars on the issue through its engagement service – CorAdvisors.

"The business case for healthy buildings is being proven. All over the world, companies, both large and small, are redesigning their offices, changing working practices and trialing new technologies, to improve the wellbeing of their staff, tenants and customers, " noted Beth Ambrose, Director within the Upstream Sustainability Services team at JLL.

OVG Real Estate, one of the largest Netherlands-based real estate technology companies, put the traditional real estate business model on its head by declaring that the "core purpose is to create healthier working, living and learning environments by using smart technology."

The company promotes a healthy living and working balance and believes that "air quality, temperature

and light are the main factors that influence the wellbeing of the users of a building."

OVG is the company behind the most sustainable building in the world - the Edge in Amsterdam. The Edge is not just sustainable, it is a building that is prioritizes the users experience and health. For instance, the new app developed by OVG allows the Edge occupants to order healthy groceries and plan their meals.

In a TED talk, Coen van Oostrom notes the "the new technology and big data possibility allow us to change existing buildings into smart buildings…technology is not the problem, what we need is a climate deal".

Saint-Gobain is a worldwide sponsor of campaigns disseminating the evidence of the strong link between better buildings and increased wellbeing among occupants. In particular, it is an early sponsor of the Better Places for People campaign and one of the strongest partners of the World GBC, actively engaged locally in close to 40 national GBC and globally as member of the Corporate Advisory Board.

Through its Multi Comfort concept, Saint-Gobain aims to deliver its brand promise "create great living place and improve daily life" at building level. With already 29 reference projects covering many segments (residential, offices, schools, etc.) and a research force of over 50 people working daily on the different aspects of comfort (acoustic, thermal, visual comforts, IAQ, etc.), Saint-Gobain aims to contribute with its expertise to the understanding of the benefits of improved comfort, health and wellbeing in buildings that take care of their environment, through all possible ways.

Skanska partnered with the World Green Building Council's Better Places for people campaign to undertake research into health, wellbeing and productivity in buildings. The company also sponsored the initiatives itself. Skanska's offices in Northern England (rated as BREEAM Outstanding) demonstrated 3.5 times fewer building -related sick days and staff satisfaction went up from 58% to 78%. The case study was featured in WGBC's "Health and Wellbeing: Offices" part of Better Places for People initiative.

The company leadership has repeatedly spoken out about comfortable and healthy buildings. Chris Pottage, a Skanska Sustainable and Healthy Buildings

Officer, noted: "A healthy building is an experience." Staffan Haglind, Skanska AB's green business officer stated: "I'm totally convinced that optimizing premises from a human perspective will help people as well as organizations to thrive and outperform. To support the development of the tools and metrics needed to make this happen is perfectly aligned with Skanska's company values."

For more than 75 years, the Velux Group has been promoting energy efficiency hand in hand with people's comfort, health and wellbeing, ensuring access to daylight and to a good indoor climate.

VELUX specialists and researchers have contributed to this White Paper through active participation in Buildings 2030 expert roundtable, held in Brussels in May 2017, sharing latest research findings, best-practices from their demonstration buildings program and ways to achieve more people-centric buildings. Their approaches have fueled this White Paper thanks to a solid foundation of best-practices, based on their long-term research and demo buildings, including 26 cases in 11 different countries and demonstrating that healthy and people-centric buildings can be built using today's technology[1].

The company hosted multiple events on the topic, authored papers and industry publications. The Velux Group has a 35-page dedicated to all resources about health and productivity of people working in buildings. Another initiative by the VELUX Group, is the Healthy buildings Day, hosted for three years in a row, bringing together advocates, corporate actors and the policy experts to shed more light on the issues of health, wellbeing and productivity. It was held for the third consecutive year in May, where the Healthy Homes Barometer 2017 was launched, unveiling that one in six Europeans lives in an "unhealthy" building, increasing the chance of illness by 66%.[2]

1 http://www.velux.com/innovation/demo-buildings
2 http://www.velux.com/health/healthy-homes- barometer-2017

Annex B: Key Influencers

Better Places for People Campaign, set up by the World Green Building Council (Buildings 2030 Strategic partner). Better Places for People aims to accelerate the demand and the supply of buildings that support people in living healthier, happier lives by raising awareness of how buildings impact people, and by presenting the business case for action. Campaign sponsors are: Lendlease, Delos, Skanska, Saint-Gobain, B+H, Arup, Mark and Spenser, Uponor and LandSecurities.

BETTER PLACES FOR PEOPLE | PUT WELLBEING AT THE HEART OF YOUR BUILDING

BBP | BETTER BUILDINGS PARTNERSHIP

Better Buildings Partnership, set up by commercial property owners in London, UK. The BBP is a collaboration of the UK's leading commercial property owners who are working together to improve the sustainability of existing commercial building stock. The organization often highlights its members activities in the health, wellbeing and productivity arena.

Greenprint platform, an initiative of the Urban Land Institute in the US. Greenrprint is a New York-based non-profit that focuses on reducing the carbon footprint of existing buildings—which currently represent one-third of global carbon emissions—and works to achieve its carbon-reduction goals through education and action.

ULI

GRESB®

GRESB is an investor-driven organization committed to assessing the ESG performance of real assets with more than 250 members, of which more than 60 are pension funds and their fiduciaries. GRESB has launched an optional reporting module that evaluates and benchmarks actions by property companies and funds to promote the health and well-being of employees and their strategy to create value through products and services that promote health and well-being for their tenants and customers.

The International WELL Building Institute (Buildings2030 Strategic Partner) is a public benefit corporation that is leading the movement to promote health and wellness in buildings and communities everywhere. IWBI delivers the cutting-edge WELL Building Standard™ and the WELL Community Standard™, performance-based systems for measuring, certifying and monitoring features of buildings and communities that impact the health and wellness of the people who live, work and learn in them.

BRE (Building Research Establishment Group) – A multidisciplinary group of researchers, scientists, engineers and technicians who share a common goal – to make the built environment better for all. BRE is the organization behind the BREEAM certification standard.

IWBI and BRE have joined forces to promote health and sustainability in the design, construction and operation of buildings, and to streamline the process to pursue both WELL and BREEAM certifications

TU Delft: The University recently opened the SenseLab, which is built around four indoor environmental quality factors (air, thermal, light and acoustic quality) in order to deepen the understanding of the indoor environment interaction with people.

Harvard's T. H. Chan School of Public Health: University' launched ForHealth.org with support from United Technologies. The research showed that an interdisciplinary approach is not just valuable - it is required to understand how built environment affects people.

Health and Environment Alliance (Buildings 2030 Strategic partner) is working to promote healthy indoor and outdoor environment and to reduce the exposures to harmful chemicals to decrease the harm to human health and the environment.

A web based tool to monitor indoor comfort satisfaction in buildings, based on a survey of the building users. The Comfortmeter report identifies and prioritizes measures that increase the health, wellbeing and productivity of the building users. The tool has been developed in the frame of R&D-projects supported by the European Commission and is the result of scientific research by 6 European Universities and the company Factor4.

The UK Indoor Environments Group (UKIEG) is an independent and impartial multidisciplinary network of professionals working in the field of health, wellbeing and indoor environments, committed to improving health and wellbeing.

Wellbeing experts, Robertson Cooper are passionate about creating Good Days at Work. Founded by Professors Ivan Robertson and Sir Cary Cooper, they have been working with clients and partners to deliver strategic and integrated wellbeing solutions for almost 20 years. Pioneers of workplace wellbeing, they continue to lead the way in the sector via research, thought leadership and landmark events

The Lancet Countdown is an international research collaboration, dedicated to tracking the world's response to climate change, and the health benefits that emerge from this transition. The Lancet Countdown was established by the Lancet Journals and the Wellcome foundation. The initiative intends to develop indicators and track progress across the following domains: the health impacts of climate change; health resilience and adaptation; health co-benefits of mitigation; finance and economics associated with health and climate change; and political and broader engagement.

LIGHTINGEUROPE
THE VOICE OF THE LIGHTING INDUSTRY

RESET is a technology driven building standard and certification program focused on real-time data for human health and wellbeing. RESET encompasses standards for IEQ sensor performance, calibration, installation and data reporting RESET's assessment infrastructure and metrics are used to track and communicate the health performance of buildings.

This is not an exhaustive list of actors in the field, but a group of stakeholders with which Buildings 2030 has been engaged in conversations since 2016.

These organizations produced a number of case studies to support the claim that buildings designed with people in mind improve health, wellbeing and productivity.

- After British Land's office renovation, out of 190 respondents to a survey, 88% feel it enables them to work productively, up from 67% and 88% say it supports their wellbeing, up from 56%.1
- After Skanska's office renovation, staff satisfaction rose from 58% to 78%, £28,000 was saved in staff

1 http://www.betterbuildingspartnership.co.uk/wellbeing-and-productivity-british-land%E2%80%99s-head-office

LANCET COUNTDOWN: TRACKING PROGRESS ON HEALTH AND CLIMATE CHANGE

LightingEurope is an industry association of 34 European lighting manufacturers, national associations, and companies producing materials. LightingEurope members represent over 1,000 European companies, a majority of which are SMEs; a total workforce of over 100,000 people in Europe; and an annual turnover estimated to exceed 20 billion Euros. LightingEurope is dedicated to promoting efficient lighting practices for the benefit of the global environment, human comfort, and the health and safety of consumers.

HEALTHY BUILDINGS
RESET
STANDARD

costs and 3.5 times fewer building-related sick days.2

- Occupants of high-performing buildings, exhibit 26% higher cognitive function, sleep better and show fewer health symptoms. 3
- Googlers surveyed about nature-driven design elements, reported 11% higher satisfaction with their workplace.4
- Offices with better daylight and views took 6.5% fewer sick days as evidenced by a study involving Northwest University in Washington state.5
-

2 http://www.worldgbc.org/sites/default/files/WGBC_BtBC_Dec2016_Digital_Low-MAY24_0.pdf
3 Ibid.
4 Ibid.
5 http://www.usgbc.org/sites/default/files/OR10_Daylighting%20Bias%20and%20Biophilia.pdf

As mentioned earlier in the paper, the following organizations and initiatives play a key role in elevating health, wellbeing and productivity of building users and linking it to building performance. The table below summarises and compares the main indicators tracked by each initiative.

	HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH	BETTER PLACES FOR PEOPLE	Level(s)	INTERNATIONAL WELL BUILDING INSTITUTE
Organization	Harvard Chan School of Public Health	Better Places for People Campaign by the World GBC	Level(s) Framework developed by the European Commission	International WELL Building Institute (WELL)
Temperature	Thermal Health; Moisture	Thermal Comfort	Time out of thermal comfort range	Thermal Comfort
Lighting	Lighting & Views	Daylighting & Lighting	Lighting/visual comfort (Under discussion)	Minimise disruption to circadian system, and provide appropriate visual acuity
Air	Air Quality; Ventilation	Indoor Air Quality & Ventilation	Indoor air class (ventilation, CO2 and relative humidity)	Promote clean air and reduce /minimise sources of indoor air pollution
Sound	Noise	Noise & Acoustics	Acoustics (Under discussion)	Internal noise & External noise intrusion
Safety	Safety & Security	Interior Layout & Active Design		
Water	Water Quality			Safe and clean water
Setting		Location & Access To Amenities		
Food				Availability of fresh, wholesome foods
Fitness				Integration of physical activity into everyday life
Pollutants	Dust & Pests		Target pollutants	
Engagement		Employee Engagement		
Ambience		Look & Feel; Biophilia & Views		Biophilia

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About Us

MISSION

We aim to mainstream the demand for high performing buildings in Europe by seeking public and private sector commitments to invest in better indoor environments by 2030. People's health, wellbeing and productivity must be a core priority within building performance.

VISION

Our vision is for all buildings in Europe to provide people with comfortable, healthy and productive spaces, while minimizing their carbon footprint. The health and built environment sectors work together towards this common ambition.

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BUILDINGS 2030

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