# POLITECNICO DI TORINO

Master in Building engineering

Master thesis in

## Green building certification systems: European Commission Level(s) and the WELL Building Standard (v1 e v2)

A critical comparison between a voluntary framework and a commercial program.


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# ABSTRACT

Green building certification systems are nowadays driving the sustainability agenda in the construction industry at a global level. However, regardless of their wide pervasiveness, it is challenging to clearly characterise the different priorities behind various schemes and how they have evolved since their inception. In this context, this dissertation aims to illustrate the peculiarities and differences among selected rating systems, critically discussing how they are structured and how they have developed over recent years. More specifically, this research describes and compares a European self-reporting program, Level(s), and a commercial certification system originated in the US, the WELL building standard. The first is a non-commercial framework that aims to sensitize all European countries towards sustainability and the concept of "Life Cycle Assessment". The second belongs to a new generation of certification programs that stress the importance of occupant health and well-being, while maintaining a high standard in sustainable design, construction and operation processes. This analysis aims to explain why they were created, when they were firstly released, and the impact they have on the market. The main scope is to highlight the steps that have brought these certification programs to their current structure and discuss whether they have become more useful, important, user-friendly and clear to apply. Starting from a comprehensive review of the literature, including scientific papers, websites and report from conferences, this research provides an overview of the history and evolution of each system, exploring whether all the changes made have enhanced comprehension and applicability of these programs. Ultimately, this work wishes to uncover the challenges and the opportunities that are presented to project teams and building professionals, together with building owners, in the application of green rating systems, towards the creation of more comfortable, higher performing and healthier green-rated buildings.



Keywords: Level(s), Life cycle Assessment, WELL, Wellness, Well-being, sustainability, green building certification systems, occupants satisfaction.

# CHAPTER 1

# 1 Introduction

## 1.1 Green Building Certification Systems

Green building certification systems are nowadays driving the sustainability agenda in the construction industry at a global level. It has now been established with sustained certitude that human activities of the last two centuries have negatively affected the terrestrial system, possibly in a non-reversible way (Altomonte, 2008). Since the Industrial Revolution, combustion of fossil fuels and emissions of harmful substances have speeded up the change of chemistry in the atmosphere around the globe, among several other effects, driving a change in global climate patterns. Considering that buildings have been ascertained to cause nearly half of energy consumptions and greenhouse gas emissions all over the world (IPCC, 2007a), it is mandatory that a new approach to building construction and operation can bring together the concepts of integrated design with sustainable methods of producing and using energy (Altomonte, 2008).

Buildings can play a primary role in mitigating the impacts of human activities on climate change. They represent the place in which people spend more than the 90% of their everyday life (Steemers, 2003). Yet, between 1970 and 1990 their direct greenhouse gases emissions have increased by 26% and the indirect ones by much more than 75% (IPCC, 2007b). The need for design, management and renovation strategies, for new and existing buildings, that – in a responsible and responsive way – can reduce energy demands, harmful emissions and wastes is clear. In response, over the last couple of decades, actors of the building industry have started to engage with theoretical design "frameworks" based on criteria and principles, featured within an integrated design strategy, aiming to reduce the impacts of buildings to the environment. Some of these interconnected concepts include the following (Altomonte, S., Luther, M.B., 2006):

- Site & Climate Analysis;
- Flexible & Adaptive Structural System;
- Renewable & Environmental Buildings Materials;
- Modular Building System;
- Building Envelope System;
- Renewable & Non-commercial Energy System;
- Innovative Ventilation & Air conditioning System;

- Water Collection & Storage System;

Obviously, this "sustainable framework" should not be seen like a recipe, rather it is extremely important to understand that all principles and categories have to be considered within a holistic and iterative methodology that brings together social, economic and cultural factors, and measures them against impending climate challenges.

Awareness of the challenges of sustainability, and recent advances in knowledge and technology, have helped the development of green building rating systems, which are now spreading all over the world (Altomonte, 2008). The most widely known are BREEAM (originated in the UK) and LEED (first introduced in the USA). BREEAM is considered as the first green building program, launched in 1990 by BRE (Building Research Establishment), a company with more than one-hundred years of experience in the field of built environment and its connection with human beings and nature. BREEAM's distinction is specifically linked to its flexibility of application. Also, it was the first framework that introduced the evaluation of buildings' lifecycle in design, operation and renovation. LEED (Leadership in Energy and Environmental Design) was published by USBGC (US Green Building Council) in 1998. Despite having released after BREEAM, following its lines, LEED is currently the most widely used rating system in the wold with projects in more than 160 countries. Similar to BREEAM, LEED is built around the evaluation of several environmental factors, including sustainable sites, water efficiency, energy and atmosphere, material and resources, and indoor environmental quality (Dat Tien Doan, 2017). Another more recent green building system that is worth mentioning is Green Mark. This evaluation scheme was officially launched in 2009 in Singapore by a collaboration between the SGBC (Singapore Green Building Council) and the BCA (Building and Construction Authority). In its latest 2015 version, Green Mark is built around five main sections: Climatic Responsive Design; Building Energy Performance; Resource Stewardship; Smart and Healthy Building; and, Advanced Green Building Effort. Even though it is a relatively new framework, it has the same aim of the older building systems, that is to contribute to an environmentally-sustainable and high-quality built environment (BCA, 2015).

Nowadays, green buildings certification systems have become part of a more comprehensive approach that pushes the building industry towards the achievement of "circularity". At the very base, there is the idea of "Circular Economy" (CE). This term was firstly introduced in 1989 by UK's environmental economists David W. Pearce and R. Kerry Turner. Only during the 90's, however, with the work of a British ecological economist, Tim Jackson, this idea was systematised within a theoretical basis trying to sensitize industrial

production processes. In this direction, the linear idea of "taking, making, disposing" in industrial processes was replaced by a more comprehensive model that more suitably embodies CE: "cradle to cradle" (William McDonough, 2002). The idea is to create a loop with lower resource inputs and depletions, wastes, emissions, and environmental pollution due to the recycling processes that are triggered. In essence, a circular approach means considering our environmental system as a living organism, an imitation of nature, which creates things that later can be put again in the "circle" as an infinite loop of making producing, using, recycling and reusing.

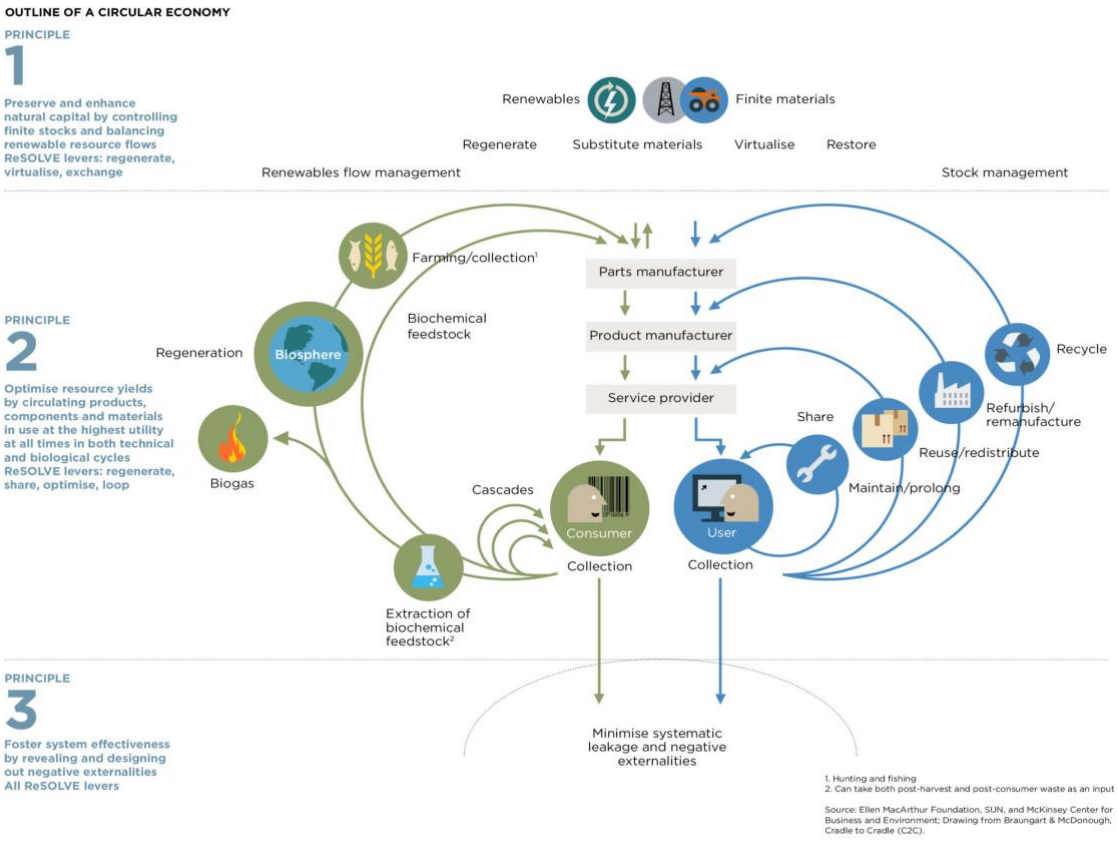


*Figure 1.1Outline of Circular Economy (www.ellenmacarthurfoundation.org)*

An example of this new approach within the construction industry is represented by the European Level(s) system. This building evaluation scheme consists of a voluntary framework measuring sustainable performance based on the "Life Cycle Assessment" of buildings, a methodology of analysis founded on the "cradle to cradle" concept. However, if the idea of circularity is becoming central to the development of many certification systems, another important focus that has driven the advance of rating tools in recent years has also been represented by an increased attention towards the comfort, health and well-being of occupants. In this context, WELL, the new 'frontier' of green building certification systems, is based on

the convergence of new scientific discoveries in both medicine and environmental research towards the realisation of a holistic and comprehensive program specifically aimed at sustained user satisfaction and health in high-performance buildings. It is towards these new drivers of the building market that this research aims to point its attention.

## 1.2 Research Questions, Aims and Methodology

Since their inception, green building certification systems have intended to increase the awareness of sustainability in the building industry, trying to stimulate a "sustainable behaviour" that could reduce impacts on the environment. Although it is clear that existing schemes are bringing substantial improvements both to the economic and social environment and, more importantly, to the quality of design and construction processes, this research aims to investigate how existing schemes are evolving in response to:

- current shifts in the framework of sustainability;
- new models of regenerative and circular economy;
- stronger attention to the comfort, health and well-being of buildings occupants.

A green certification system allows experts to compare buildings' performance and quality by evaluating a certain number of criteria. Nowadays, rating programs are divided in three main groups: 1) single attribute product certification; 2) multiple attributes product certification; and, 3) multiple attribute building certification (Birgisdottir, 2018). The first group focuses on a single aspect of the sustainability agenda such as, for example, energy efficiency or reducing water usage. The second type of systems addresses standards for a "cluster" of sustainable concepts that can range from energy efficiency to life cycle of products involved in construction processes. The last one, the more complex, considers the building as a "whole system" that involves surroundings, wastes, emissions, performances, energy use, lights, and well-being of occupants, hence approaching buildings from a holistic point of view (Birgisdottir, 2018).

This dissertation focuses on one rating system that belongs to the second group - Level(s) - and one of the third type - WELL (in its versions 1 & 2). The main objective of this research is to understand how these frameworks have been originally structured and how they are evolving, exploring their peculiarities, and studying the development and differences between successive releases of the same program. In essence, based on a documentation work founded on a critical review of the available literature, this research explores the implementation in voluntary building standards of design, operation and renovation criteria

responding to the recent shift of attention towards circular economy and occupant wellbeing, critically enquiring the drivers and priorities behind their current and future developments.

## 1.3 Structure of the Dissertation

After a brief introduction on climate change and which are the most famous Green rating systems, the first chapter explain which are ideas behind Level(s) and WELL: respectively “Circular economy” and “shift of attention from building toward occupant”.

Then, in the second chapter, the focus is on Level(s) framework. This section talks about what Level(s) is, why it is based on the concept of circular economy and what is the Life Cycle Assessment (LCA). After that it is introduced Level(s) pilot program, starting from its structure, then describing how it is divided in 6 Macro-objectives and in the end giving precise information about steps and documentation required for the assessment.

In chapter number three the attention shifts on the WELL Building Standard. It starts from the beginning talking about Delos, why and with they created this program, later it is introduced the WELL Building Standard with specification on: certification steps, levels of certification, WELL core concepts, WELL project types, the scoring system and fees. The last part in this chapter defines WELL’s crosswalks with others certification programs.

The chapter number 4 is substantially centred on WELL v2 pilot program, the latest release of the rating system. It starts with explanation about the new principles then describes all the changes made: one program for all project types, from 7 to 10 concepts, the new scoring system and new price system.

Chapter number 5 is focused on Light concept. There is a comparison between Light concept in v1 and Light in v2. At first there the analysis stresses which preconditions become optimization and then which feature part moved inside the concept from a feature to another

The sixth provides the discussion and then the seventh chapter provides the conclusions to this dissertation, emphasising the limitations of this research and opening up new avenues for further research.

# CHAPTER 2

## 2 Level(s)

### 2.1 What is Level(s)?

In September 2017, the European Commission unveiled the pilot phase of Level(s), the world first framework and reporting tool focusing on the sustainability performance of buildings from a perspective of a circular management of resources (DG environment, 2018).

Level(s) is a voluntary framework, an open source reporting and assessment tool in the sector of sustainable construction, which can be used to measure, report upon and share information on the environmental performance of buildings. It is a pan-European, region-wide, reporting tool, this demonstrating its ambition to find a common language for sustainability across all European countries. Level(s) aims to be the European Commission's answer to the lack of standardization in global standards of sustainability. The construction industry is considered a key sector for shaping a better sustainable future for people and, with Level(s), the European Community is trying to make people aware of how important it is.

The most significant difference between Level(s) and other green building certification systems such as BREEAM or LEED is that it is a non-commercial yardstick to measure building environmental impacts. Currently under its pilot program, this initial phase will last until 2019 and it is structured around the following performance indicators:

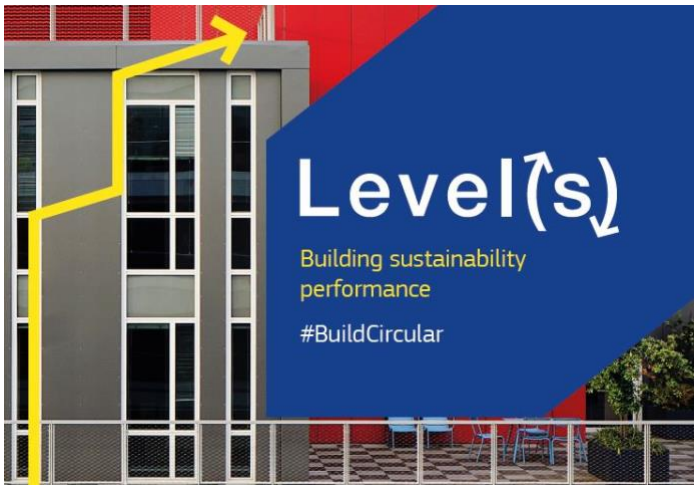

*Figure 1.1 Level(s) logo (ec.europa.eu)*

- greenhouse gases emissions;
- resources efficiency;
- water efficiency;
- health;
- comfort.

The key feature of Level(s) is that its assessment framework is based on a life-cycle approach that wants to considers the performance of buildings throughout their entire

lifetime. In so doing, Level(s) goes beyond the sole idea of better energy performance, promoting the principles of circular economy (Nicholas Dodd, 2017).

As an EU framework, Level(s) wants to be easily accessible for its users, hence addressing some of the current issues with the dissemination of standards for sustainable building, such as the European norm "CEN/TC 350 – Sustainability of Construction Works" (CEN , 2018). This norm regulates the development of standardized methods for the assessment of sustainability in buildings and for product declaration of construction products. This standard is applicable horizontally across different construction types in order to assess the integrated performance of buildings over their life cycle. This norm also features a methodology for evaluation of environmental performance of buildings, life cycle cost performance of buildings, and several measurable performance aspects of health and comfort (CEN, 2018). On the basis of the CEN/TC 350 standard, and with the aim of facilitating and increasing access to its methods of analysis and tools, the EU Commission developed the Level(s) framework to:

- provide an easy starting point for sustainability and life-cycle thinking;
- optimize building design;
- minimize the gaps between design and actual performance;
- support the tracking of performance from design stage to operation and occupation;
- allow users to choose between three levels of performance evaluation.

### 2.1.1 Life Cycle Assessment (LCA): Cradle to Cradle

Level(s) promotes a method of performance assessment based on the life cycle of buildings and each part of the framework contributes to this overall life cycle approach. The framework supports awareness of life cycle principles and how performance can be assessed.

The Life Cycle Assessment (LCA) is a methodology that considers the most significant environmental impacts of a building, evaluating when and where selected environmental impacts may occur during the different stages of the life cycle of a building. Employing an LCA approach requires a lot of expertise, also with the support of specific software tools.

In the context of LCA, a "cradle to cradle" approach to the design of products and systems is based on the premise that industry must protect and enrich ecosystems and nature's biological metabolism in the context of a production cycle based on high-quality use of organic and technical nutrients (William McDonough, 2002). This is a holistic economic, industrial and social framework that seeks to crate systems that are efficient and waste-free.

In Level(s), the LCA framework based on a cradle to cradle approach is strictly connected to the reduction of the environmental impacts due to the use of materials and products. The process of LCA might be streamlined on the basis of the calculation method embedded in the reference norm EN 15978 (British Standard Istitution , 2018) or with specific on-line software such as Oneclick LCA. This is an automated LCA process tool that works with existing data and, on the basis of a standardised protocol, helps also tracking future operation performance of buildings. Oneclick LCA is fully compliant with Level(s) since, as illustrated in Table 1.1, there is a specific correspondence between the three levels of Level(s) performance assessment (for their detailed description see the following paragraphs) and Oneclick's indicators (LCA, 2018).

*Table 1.2.1 Correspondence between Level(s) and automate One Click LCA software.*

| **Goal of the study** | **Testing/learning** | **Benchmarking** | **Life cycle optimization** |
|---|---|---|---|
| Recommended level of assessment | Level 1 | Level 2 | Level 3 |
| Matching tier in One Click LCA | Starter | Business | Enterprise |

## 2.2 Level(s) Pilot

The Level(s) Pilot program will be available and usable until the 30$^{th}$ of June 2019. Level(s) can be used by architects, investors, designers, engineers and construction companies and it is structured on a flexible framework based on three different levels of performance assessment, as detailed below:

*Level 1) The common performance assessment*

The common performance assessment provides the simplest and most accessible type of use, common units of measurements, and basic reference calculation methodologies.

*Level 2) The comparative performance assessment*

The comparative performance assessment allows a comparison between buildings that are functionally equivalent. The results gained are comparable at national level.

*Level 3) The optimized performance assessment*

The optimized performance assessment is the most advanced type of use. It provides guidance to professionals that want to test the Level(s)' framework in a more detailed way. It gives suggestion for making more accurate calculations, optimize design and building

performance and anticipating future cost and risks throughout the whole life-cycle of buildings (Nicholas Dodd, 2017).

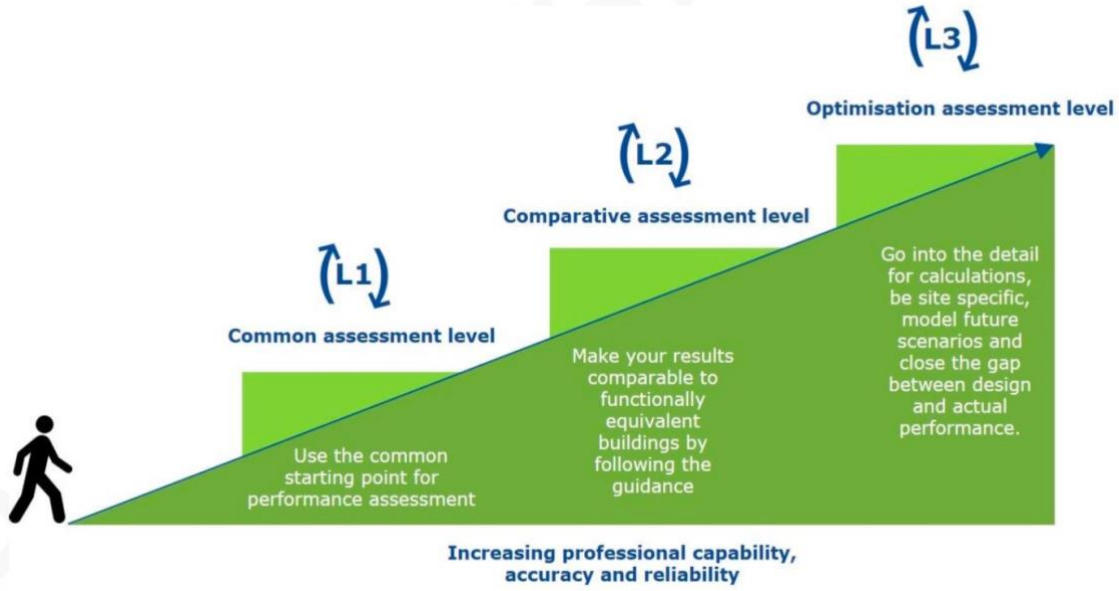


*Figure 1.4 The three levels of Level(s) performance assessment (Nicholas Dodd, 2017).*

*Figure 2.5 IWBI logo (Source: wellcertified.com).Figure 1.6 The three levels of Level(s) performance assessment (Nicholas Dodd, 2017).*

### 2.2.1 Structure of the Level(s) Framework

The framework of Level(s), as provided in the technical documentation produced by the European Commission, is structured in three parts (DG environment, 2018). After a general introduction about Level(s) and how it is built (part 1), an explanation is given about the macro-objectives that the program is made of, their performance indicators and a description of the three different levels of accuracy on which the program is based. The final technical document (part 3) offers support to complete and report the results of the performance assessment.

### 2.2.2 Level(s) Macro-Objective and Associated Indicators

#### 2.2.2.1 Macro-Objective 1: Greenhouse Gas Emission Along a Building Life Cycle ‘

Definition

- Minimize emission during buildings' life cycle. It is important to consider emissions during the operation of a building but also those that are embodied in buildings materials and in their associated production process.

Intended scope and focus

- Energy performance during the operation of the building, considering the contribution of cost effective and low/zero emissions energy technologies;
- Reduction of gas emissions along the building life cycle (including those associated with the manufacturing of construction materials).

*Table 1.2.2 Indicators of Macro-Objective 1*

| Indicator | Performance metric |
|---|---|
| 1.1 Operation performance<br>1.1.1 Primary energy performance<br>1.1.2 Delivered energy demand | Kilowatt hours per square meter per year $\left({}^{kWh}/_{m^2}/_{yr}\right)$ |
| 1.2 Life cycle Global Warming potential | kg $CO_2$ equivalent per square meter per year $\left({}^{kg\ CO_2\ eq.}/_{m^2}/_{yr}\right)$ |

### 2.2.2.2 Macro-Objective 2: Resource efficient and circular material life cycle

Definition:

- Optimization of building design, energy and form in order to support lean and circular flows, extend long-term material utility, and reduce significant environmental impacts.

Intended scope and focus:

- This Macro-objective includes every aspect and action focused on materials' efficiency and circular utility. It concerns the life cycle of all steps from construction and product manufacturing, passing through design and engineering matters, to deconstruction and replacements cycles. To sum up, the main objective is to reduce waste, optimize

material use and reduce the life cycle environmental impacts of design and materials choices.

*Table 1.3 Life cycle tools of Macro-Objective 2*

| Life cycle tool | Performance metric or reporting form |
|---|---|
| 2.1 Life cycle tools: Building bills of materials | Reporting on the Bills of Materials for the building, as well as for the four main types of materials used. |
| 2.2 Life cycle tools: scenarios for buildings lifespan, adaptability and deconstruction | According to the performance assessment level:<br>- Design aspects that are proposed/have been implemented (common performance assessment)<br>- Semi-qualitative assessment giving a score (comparative performance assessment)<br>- LCA-based assessment of scenario performance (design optimisation) |

*Table 1.2.3 Indicators of Macro-Objective 2*

| Indicator | Performance metric |
|---|---|
| 2.3 Construction and demolition waste | Kg waste and materials per $m^2$ of total useful floor area (per life cycle and project stage reported on) |
| 2.4 Cradle to grave Life Cycle Assessment | Seven environmental impact category indicators (detailed guidance is provided under 4.4 Overarching assessment tool) |

#### 2.2.2.3 Macro-Objective 3: Efficient use of water resources

Definition

- Make efficient use of water resources, especially in those areas where during certain period of the years there are seasonal water stress.

Intended scope and focus

- This Macro-Objective aims to minimize the use of water within the built environment. The attention is particularly focused to areas that suffer from continuous water stress. This could lead to efficiency measures, as well as help the reuse of grey water and rainwater harvesting.

*Table 1.2.4 Indicator of Macro-Objective 3*

| Indicator | Performance metric |
|---|---|
| 3.1 Total water consumption | $m^2$ of water per occupant per year |

#### 2.2.2.4 Macro-Objective 4: Healthy and comfortable spaces

Definition:

- The Design of building has to be comfortable, attractive, productive and also has to protect human health

Intended scope and focus:

- The starting point for Macro-Objective 4 is concerned with indoor air quality and thermal comfort, in particular:
  - indoor air quality in two composite indicators;
  - range of thermal comfort during an average year.
- Macro-Objective 4 also gives suggestion for further aspects that may be developed:
  - lighting and visual comfort;
  - acoustic performance of the building fabric.

*Table 2.5 Indicators of Macro-Objective 4*

| Indicator | Performance metric |
|---|---|
| 4.1 Indoor air quality | 4.1.1 Good indoor air quality: parameters for ventilation, $CO_2$ and humidity. |
| 4.2 Time outside the thermal comfort range | % of the time out of a defined range of minimum and maximum temperatures during heating and cooling seasons. |

### 2.2.2.5 Macro-Objective 5: Adapting and resilience to climate change

Definition

- The future proofing of building performance against projected climate changes, in order to protect the health and comfort of building occupants and to sustain and minimize risks to property values.

Intended scope and focus

- The main aim of Macro-Objective 5 is explaining how to improve building health and comfort considering projected future climate conditions. It also recognizes some future potential scenarios about:
  - increased risk of extreme weather events;
  - increased risk of flooding.

*Table 2.6 Indicators of Macro-Objective 5*

| Indicator | Performance metric |
|---|---|
| 5.1 Life cycle scenario: scenarios for projected future climate conditions | Scenario1) protection of occupants' health and thermal comfort<br>Simulation of the building's projected time out of thermal comfort range between 2030 and 2050. |

### 2.2.2.6 Macro-Objective 6: Optimized life cycle cost and value

Definition

- Optimization of the life cycle cost and value of buildings. It indicates the potential for long term performance, from acquisition to the end of the building's life.

Intended scope and focus

- Life Cycle Costing (LCC) is fundamental for achieving a better level of environmental performance and also represent a good way for making effective long-term decision about buildings life. LCC, in addition, is used to select and evaluate the design that will provide the lowest overall cost and risks of investments. EU standard on LCC also address the

concept of property value and, together with the building environmental performance, estimate how they effects positively value, lettings and stability of built-out in the property market.

*Table 2.7 Indicators of Macro-Objective 6 indicators.*

| Indicator | Performance metric |
|---|---|
| 6.1 Life cycle cost | Euros per square meter of usable floor area per year $\left({}^{Euro}/_{m^2}/_{yr}\right)$ |
| 6.2 Value creation and risk factor | Reliability ratings of the data and calculation methods for the reported performance of each indicator and life cycle scenario tool. |

### 2.2.3 Level(s) Steps and Documentation Required

#### 2.2.3.1 Detailed Testing Protocol

Part 3 of the Level(s) framework is structured as an interconnected document for it to be used in the easiest possible way. Every indicator is provided with an interactive link that brings to the precise part of the framework in which a full explanation of its use is given, so as to facilitate the assessments and eventually the calculation of the parameters. The level 1 of the performance assessment should be evaluated before passing to the levels 2 and 3.

The testing protocol is made up of 5 steps:

*Step 1) Describe the building to be reported on*

- Part 3 provides detailed information on the aspects of the building that have to be given, together with the associated goal and scope of the performance assessment (A reporting format is supplied in Part 3).

*Step 2) Chase the level of performance assessment sought*

- The appropriate assessment level sought needs to be selected from the three available;
- The indicators and life cycle tools intended to be satisfied have to be indicated.

*Step 3) Follow the guidance and rules on how to carry out an assessment*

- Part 2 has to be checked to obtain a general introduction for each indicator;
- Part 3 has to be checked for guidance on how to carry out the performance assessment.

*Step 4) Complete the reporting format*

- For each indicator and tool, Part 3 provides a specific reporting format.

*Step 5) Determine the valuation influence and reliability of the assessment*

- This is an optional step for each indicator (this is described in Table iii, Part 3, Level(s) Framework).
- Part 3 gives a rating methodology for each indicator focusing on property evaluation and reliability of the data and calculation method (Nicholas Dodd, 2017).

#### 2.2.3.2 Documentation Required

The European Commission has recently launched an on-line procedure to collect information about the testing of Level(s). To participate to the testing, a *Registration Form* and a *Commitment* have first of all to be submitted on-line for these to be sent to the EU. The *Commitment* has to be sent to the DG Environment and the DG Joint Research Center (JRC) in order to share results and knowledge about the testing of Level(s).

The DG Environment is the Environment Directorate-General of the European Commission and was set up in 1973. It proposes policies to protect natural habits, limit the waste of clean water and defend clean air, ensure proper waste disposal, bring knowledge about the toxicity of chemical substances and help the spread of a sustainable economy. The DG JRC is the European Commission's science and knowledge service. JRC scientists carry out research to provide independent scientific advice to support EU policies. The JRC also offers a dedicated helpdesk to assist with information about the testing phase of Level(s).

Once the performance test is completed a *Common Reporting Format*, an excel file provided by Level(s), is ready to be sent to the EU Commission. This document certifies the conclusion of the Level(s) assessment process. The EU Commission evaluates the results and offers feedback with the help of the JRC. This document has to be submitted at the latest

by the 30th June 2019, when the pilot programme of Level(s) will terminate. The last procedure to fulfil is the online Level(s) Survey. This document is available from June 2018 and the deadline for submitting it is the 30th September 2019 at the latest (Nicholas Dodd, 2017).

# CHAPTER 3

# 3 The WELL Building Standard Version 1

## 3.1 Delos and the International WELL Building Institute (IWBI)

Delos is a company known as the pioneer of "Wellness Real Estate". Wellness Solution Consulting, Residential and Hospitality Wellness Programming, and Integrated Wellness Design are the main services offered by Delos who, with these green programs, is trying to transform the built environment by putting health and wellness at the center of design and construction decisions. With these initiatives, Delos aims to reshape the estate market services by focusing on the importance of human health and wellbeing (Delos.com, 2018).

Delos invested years of research studying how environmental factors can have an impact on people's lives and health[1]. Many important research centers such as the Cleveland Clinic, the Mayo Clinic and a board of experts from Columbia University, contributed to this research work. Among the research centres engaged by Delos, Mayo Clinic is a non-profit organization committed to clinical practice, education and research, providing expert, whole-person care towards healing. They contribute to health and wellbeing by providing care through integrated clinical practice, education and research (mayoclinic.org, 2017). A collaboration between Delos and the Mayo Clinic brought to the first human-centred research facility, the Well Living Lab. The Well living lab was launched in September 2015 at Mayo Clinic's Transform 2015 conference. It is located in Rochester, Minnesota and it was purposely built to identify how buildings impact human health and wellbeing (Delos.com, 2017) and define the best conditions for wellness under all aspects of building occupancy. To have a more comprehensive understanding of how to preserve people's wellbeing, professionals from different backgrounds were involved in the study, from physicians to scientists. Applying the best innovation in technology, health, science, design, and enterprise helped Delos to establish clear benchmarks in the green building industry. In so doing, Delos has gone beyond the scope of environmental sustainability, discovering that "human sustainability" is a much more important aspect. Based on this idea Delos wants to create healthier spaces with a scientific based approach. (Delos.com, 2018)

[1] Health is defined as: "a state of complete physical, mental and social well - being and not merely the absence of disease of infirmity. (Preamble to the Constitution of WHO as adopted by the International Health Conference, 1946). Conversely, wellbeing and wellness have the following definitions: Wellness: Noun, [mass noun], "the state of being in good health, especially as an actively pursued goal" (Oxford, 2018); Wellbeing: Noun, [mass noun], "the state of being comfortable, healthy or happy" (Oxford, 2018)

The International WELL Building Institute (IWBI) was created by Delos in 2013, as a public benefit corporation whose stated mission is to improve human health and well - being in buildings and indoor environment. The IWBI has as its mission to find good and innovative ways to help people thrive and make buildings and communities more liveable and workable places. The result of this process and ambitions is the WELL Building Standard (WELL), that the IWBI administers globally.

*Figure 3.1 IWBI logo (Source: wellcertified.com).*

The WELL building standard is a certification method applicable to most building types. During the last four years, IWBI has strengthened WELL's strategy, developing the requirements for certification under several points of view such as for example the features, scoreboards structures, and the project types that can seek certification under WELL. (wellcertified.com, 2017).

## 3.2 The WELL Building Standard Version 1

The first version (v1) of the WELL building standard was officially launched in 2014. WELL provides guidelines and design criteria for buildings, interior spaces, and communities so as to implement, validate and measure features that support and advance human health and wellbeing. It is the first standard focusing exclusively on the health and wellness of the people that live or work in the buildings being certified. It is a performance-based system that measures and certifies the features of the built environment that are most impacting on human life. In addition, WELL aims to combine best practice in design and construction with evidence-based medical and scientific research. Its main objective is to create spaces that improve the health and performance of its occupants from various perspectives, also including aspects such nutrition, fitness, mood, sleep patterns, etc., other than the "conventional" environmental factors of light, sound, air quality and thermal comfort (wellcertified.com, 2017).

The WELL building standard wants to be a benchmark for innovation in the sustainable building construction field. In fact, WELL it is defined by IWBI with these three words: *Comprehensive*; *Third Party Verified*; and, *Reviewed by experts* (Institute, 2017). It is *Comprehensive* because it integrates scientific and medical research, literature on

environmental health, behavioural factors, and many other aspects that are connected with people's life. It is *Third - Party Verified* in that the certification process is partly administrated through IWBI's collaboration with Green Business Certification Inc. (GBCI), which is a body that also offers LEED (Leadership in Energy and Environmental Design) certification (USGBC, 2018). GBCI is an independent organization that provides green building certification through a scientific process made by an unbiased third party (GBCI, 2018). The scope of the process is to verify that a set of features, credits, or criteria are effectively being met. Finally, WELL is *Reviewed by the experts*, which means that it undergoes a "peer review process" that thoroughly analyses all aspects of a project registered for certification. The reviewing process includes scientific, medical and practice-oriented criteria.

The WELL building standard v1 features requirements in 7 core concepts, each one trying to address issues that impact the health, comfort or the knowledge of occupants through design, operations and behaviour. These 7 categories are: air; water; nourishment; light; fitness; comfort; mind. Each concept is structured in several credits, or features, some of which are necessary to be fulfilled to obtain certification, the "Preconditions", while others can be optionally pursued, the "Optimizations", although they might be required the highest levels of WELL rating. The WELL standard can be applied to different categories of constructions: New and existing buildings; New and existing interiors; and, Core and Shell. The newest addenda to the WELL v1 program (Q1 2018 Addenda), published in February 2018, also further expanded the specification of the typologies of buildings that are directly addressed by the standard, including retail, multifamily residential, education, restaurant and kitchen projects.

### 3.2.1 Certification steps

In order to attain certification under WELL, at first a project has to be registered through the WELL Online service. Upon registration, a well coaching contact is assigned from the IWBI. This person has the role of helping the project administrator to use the WELL certification in the simpler way possible. In this instance, a WELL AP (Accredit Professional) can also be involved. WELL AP is a qualification that is awarded after an examination test that certifies knowledge of the standard and its relationship to human health and wellness in the built environment. After the registration process, the full documentation has to be submitted. At this point, a WELL assessor can check compliance with the standard's requirements. The WELL Assessor is also responsible for the following steps of the process, consisting in the: 1) Documentation Review; and, 2) Performance Verification.

Under the Documentation Review, all the documents for each WELL feature that want to be pursued have to be submitted to GBCI. The WELL assessor completes two technical reviews (preliminary and final) after which, if the result is positive, the project moves to Performance Verification, which is a post occupancy confirmation of performance. Once that these two steps have been completed, and all the applicable features have been verified, the project can achieve WELL Certification.

WELL certification is valid for three years. After this period, it is possible to pursue a Recertification if the project has maintained the same high level of performance. In this case, and before the end of the three years, the project has to undergo another Performance Verification and has to apply for recertification. The first review by the WELL assessor follows immediately the submission of all documents (within 20-25 business days). Within this period, the preliminary evaluation is completed, and in case of compliance, the project team can move to the next step. If something is not correct, the project team will have another chance to send correct and satisfactory documents and the WELL Assessor will have another 20-25 business day for reviewing them. If more than two rounds of reviewing are needed, WELL may apply additional fees ((IWBI), 2017).

### 3.2.2 Levels of WELL certification

Once all procedures have been completed, WELL certification can be achieved under three different levels: Silver, Gold and Platinum. Silver certification is guaranteed by satisfying all Preconditions applicable for the project type chosen. Gold certification is achieved by fulfilling all Preconditions and at least 40% of available Optimizations. Finally, a Platinum rating can be achieved by meeting all Preconditions and 80% or more of Optimizations.

| STANDARD VERSION | LEVEL OF ACHIEVEMENT | PRECONDITIONS THAT MUST BE ACHIEVED | OPTIMIZATIONS THAT MUST BE ACHIEVED |
|---|---|---|---|
| WELL Building Standard® | Silver Certification | All applicable | None |
| | Gold Certification | All applicable | 40% of applicable |
| | Platinum Certification | All applicable | 80% of applicable |

*Figure 3.2 Well Building Standard levels of certification (Source: wellcertified.com).*

Since the inception of the programme in 2014, more than 800 projects have registered, and then admitted for pre-certification and certification under WELL in over 30

countries around the world, corresponding to about 150 million square feet of building surface. These are described in detail in the IWBI project directory, downloadable from their web site (Institute, 2018). 98 of these buildings have been certified to date, while 85 are "precertified" and 648 are registered. The number of buildings having registered for certification is significantly higher than those having completed all procedures for certification since, upon the registration, every project has a specific timeframe (5 years) by which the submission of documents and the verification of performance need to take place.

### 3.2.3 Core Concepts

The Well Building Standard explores how design, operations and behaviours within the place where we live, work and share time with people can be certified to advance human health and well - being (Institute, 2017). It is built around seven core concepts, plus an additional concept dedicated to innovation. These are: 1) Air; 2) Water; 3) Nourishment; 4) Light; 5) Fitness; 6) Comfort; 7) Mind. The final core concept is dedicated to Innovation.

#### 3.2.3.1 Air

*Figure 3.3 Air concept logo (wellcertified.com).*

WELL features requirements centred around how to reduce or minimize air pollution and the concentration of contaminants in indoor environment. The standard tries to combine best practice from industrial organizations whose guidelines are recommended by professionals to improve the quality of the air. In particular, the attention is focused on air filtration systems and building materials

#### 3.2.3.2 Water

*Figure 3.4 Water concept logo (wellcertified.com).*

WELL promotes high quality standards across all uses of potable water. It seeks simultaneously to preserve the waste of this very important resource while enhancing the quality of it for every use needed. Certification requires an initial assessment of the building's water source and promotes the installation of suitable filtration systems and periodic tests to reach the standard levels required.

### 3.2.3.3 Nourishment

WELL encourages a better food culture. Among other requirements, the standard limits the use of unhealthy food, and promotes a policy of "less distance" between workplace and grocery stores where fresh vegetables and fruits are sold.

*Figure 3.5 Nourishment concept logo (wellcertified.com).*

### 3.2.3.4 Light

WELL encourages the use of lighting systems designed to enhance visual experience, increase alertness, preserve metabolic functions, promote sleep quality, etc. It is among the first standards to include a requirement on circadian lighting, hence acknowledging that the human state of mind and body is affected by light and by regular periods of exposure to brightness and darkness.

*Figure 3.6 Light concept logo (wellcertified.com).*

### 3.2.3.5 Fitness

WELL encourages fitness in everyday life. Since the built environment is a key point to fulfil the requirements of this concept, WELL promotes policies and strategies to improve physical activity within and around buildings.

*Figure 3.7 Fitness concept logo (wellcertified.com).*

### 3.2.3.6 Comfort

WELL has the aim of creating comfortable and productive indoor environments. The standard focuses on reducing significantly those factors that can cause disruption, distraction, or irritation particularly on the workplace, while preserving ergonomic, acoustic and thermal comfort.

*Figure 3.8 Comfort concept logo (wellcertified.com).*

#### 3.2.3.7 Mind

*Figure 3.9 Mind concept logo (wellcertified.com).*

WELL pays attention to the optimisation of cognitive and emotional health through design, technology and treatment strategies. The standard identifies the features that the built environments needs to include and supports the implementation of workplace policies that can promote occupant health and wellbeing.

#### 3.2.3.8 Innovation

*Figure 3.10 Innovation concept logo (wellcertified.com).*

As a scientific way of understanding health, WELL always keeps evolving. Therefore, it embraces new creative thinking to improve its understanding of the various and complex design and operation strategies by which built spaces can contribute to human health and wellbeing.

### 3.2.4 Project types

The first version of the Well Building Standard (WELL v1) has been designed to be applicable specifically to commercial and institutional buildings. In particular it specifies three different "project types": 1) New and Existing Buildings; 2) Core and Shell; and, 3) Interior.

#### 3.2.4.1 New and Existing Buildings

This project type, applicable to both new and existing buildings, addresses the entirety of project design and construction processes. For office buildings, a minimum of 90% of the building's total floor area is required to be occupied by the building owner and operated by the same management.

*Table 3.1 N&E Buildings scoreboard.*

| PROJECT TYPE | PRECONDITIONS | OPTIMIZATIONS | TOTAL SCORE |
|---|---|---|---|
| New and existing buildings | 41 | 59 | 100 |

#### 3.2.4.2 Core and Shell

This project type is specifically referred to the building structure, window location and glazing, building proportions, heating, cooling and ventilation systems and water quality. It encourages consideration of amenities and opportunities for wellness, trying to implement fundamental features in support of comfort within the building. For this project type to be applicable, the following conditions need to be fulfilled:

- minimum 25% of the area has to belong to the owner;
- 75% of the area could be occupied by one or more tenants.

Regardless of the portion of building occupied by the owner, the entirety of the project scope has to be included in the process of certification.

*Table 3.2 C&S Scoreboard.*

| PROJECT TYPE | PRECONDITIONS | OPTIMIZATIONS | TOTAL SCORE |
|---|---|---|---|
| Core and shell | 26 | 28 | 54 |

#### 3.2.4.3 Interior

This project type applies only to spaces occupying a portion of a building, particularly to those that cannot be certified under the Core and Shell category. At the time of registration, the spatial borders of the project have to be clearly defined, making sure that all building characteristics are precisely described in the documentation. The exclusion of parts uniquely to comply with some credit requirements is not allowed.

*Table 3.3 N&E Interiors*

| PROJECT TYPE | PRECONDITIONS | OPTIMIZATIONS | TOTAL SCORE |
|---|---|---|---|
| New and existing Interiors | 36 | 62 | 98 |

### 3.2.5 Scoring

Each of the previous project type has its own checklist with a specific score as detailed in the previous paragraph. The final score includes both the preconditions and the optimizations achieved. Every project that fails to achieve any precondition in one of the concepts of course will not be allow to pursue certification. The wellness scoring (WS) system necessary to attain WELL certification depends on the total and achieved preconditions (TP and PA) and optimizations (TO and OA). The calculation method is described below.

TP = total preconditions
PA = preconditions achieved
TO = total optimization
OA = optimization achieved
WS = wellness score

PASS)

$$if\ \left(\frac{PA}{TP}\right) = 1\ \ then\ \ WS = 5 + \left(\frac{OA}{TO}\right) \cdot 5$$

FAIL)

$$if\ \left(\frac{PA}{TP}\right) < 1\ \ then\ \ WS = \left(\frac{OA}{TO}\right) \cdot 5$$

Every result is rounded down to the nearest whole number (Institute, 2017).

### 3.2.6 Fees for WELL certification

The fees for WELL certification depend on the size and type of the project as described below:

- Registration: when project is registered, the fees range between 1500 USD and 10000 USD.
- Certification: certification fees start from 4000 USD, with a cost per unit of surface ranging from 0,08 USD to 0,23 USD per square foot.
- Performance Verification: the baseline fee is 9000 USD and ranges from 0,15 USD to 0,35 USD per square foot.

If a project exceeds ten million square feet, a volume pricing can be required.

## 3.3 IWBI's Crosswalks

The WELL building standard has been designed to work alongside other certifications programs such as BREEAM (Building Research Establishment Environmental Assessment Method), LEED (Leadership in Energy and Environmental Design), the Living Building Challenge (LBC) and Green Star.

BRE (Building Research Establishment, UK) and IWBI are working together to promote health and wellbeing in the design, construction and operation of buildings and fitouts. Their collaboration started in November 2016. Both recognize the importance of health and wellbeing in buildings, also promoting a holistic assessment of social impacts within the built environment. In addition, they operate to sensitise people towards a new way of thinking about communities, everyday life, physical and mental health, wellness and wellbeing (Chris Ward & Alan Yates - BRE Jaclyn Whitaker, 2017).

Another important collaboration of the IWBI is with LEED, a globally renowned US-based green building rating system. LEED and WELL have supported each other in the growing of their certification programs. At first, the attention was especially focused on energy saving measures, but common work has then addressed best practice in design and construction to exploit evidence-based medical and scientific research to support human health and life in general (Scialla, 2016), (Heider, 2017).

IWBI joined forces also with the Living Building Challenge. LBC is a rating system administered by the International Living Future Institute, a non-profit organization that works to promote an ecologically-minded world for people, trying to develop net-zero or net-positive energy buildings (ILFI, 2018).

Last but not the least, IWBI announced partnership in 2016 with the Green Building Council of Australia who administers Green Star certification. Green Star is an internationally-recognized sustainability rating system program launched in 2003.

IWBI promotes a collaboration with projects that are pursuing all the previous green certifications. There are several credits and features inside these programs that are substantially similar to WELL and are described in the "Crosswalks" of the WELL Building Standard (Institute, 2017). IWBI provides documents that describe in detail how many features are in common between the programs, so that it is possible to pursue one assessment and, at the end, decide to follow also another one. For example, if you have a building WELL certified you can decide to also assess it with BREEAM, and vice versa. The online documentation helps to streamline this process. For this, it is necessary to provide:

- a proof that a level of certification has already been achieved;

- a short report which identifies credits that are being used to claim the feature of the other assessment;
- evidence that supports that a feature or credit has been satisfied.

Every certification method has its own crosswalk documentation and its own way of describing connections between features/credits. For example:

- WELL/LEED features may be: (Jaclyn Whitaker, 2017)

  - *equivalent*= it indicates that a feature or credit has been evaluated and deemed satisfactory to achieve the complete WELL feature or LEED credit indicated; the feature or credit awarded can be used as a verification to take the equivalent feature or credit;

  - *partial*= it indicates the credit or feature is partly met or may contribute toward the achievement of the associated feature or credit;

  - *aligned*= it indicates that the feature or credit is aligned, but the requirement does not fully overlap.

- WELL/LBC features may be: (Jaclyn Whitaker, 2017)

  - *complete*= it means that the entire feature or imperative has been evaluated and deemed satisfactory to achieve the intent of the WELL feature or LBC imperative, the feature awarded can be used as a verification to take the same feature or imperative;

  - *partial*= the imperative share similar outcomes but the requirements of one are not precisely the same in the other;

  - *non equivalent*= the imperative or feature is currently not addressed in one the program.

- WELL/BREEAM features may be: (Chris Ward & Alan Yates - BRE Shalini Ramesh, 2018)

  - *equivalent*= formal certification under one standard can be used as evidence of full compliance with the other, the feature or credit awarded can be used as a verification that the requirement has been satisfied;

  - *aligned*= the outcomes and/or methodologies are aligned but there are material differences between the requirements of the standards;

  - *not applicable*= the requirements are not covered by BREEAM and so will require full assessment under WELL;

  - *UK/EU regulation*= UK or EU regulation is aligned with the WELL feature. The project will still need to comply with the verification method in WELL;

- *BREEAM compliant WELL evidence*= WELL evidence may be used to demonstrate full or partial compliance with the BREEAM requirements but formal review will be needed by the BREEAM Assessor.

- WELL/Green Star features may be: (Jorge Chapa, 2017)

  - *equivalent*= it indicates that a feature or credit has been evaluated and deemed satisfactory to achieve the intent of the WELL feature or Green Star credit indicated, the awarded feature or credit can be used as verification that the issue has been satisfied;

  - *partial*= it indicates that the credit or feature is partly met;

  - *aligned*= it indicates that the credit or feature is aligned, but the issue is not addressed fully;

  - *not addressed*= this means that the outcome in either credit is not addressed as part of either rating tool, though they may be recognized through either Green Star or WELL's innovation systems.

At the end, it can be said that the main purpose of these Crosswalks between systems is to try to move the attention from "buildings" towards the "occupants" or however to take these two ways of thinking at the same level of importance during building construction and operation.

| | LEED v4 LEED Pilot | Well v1 | LBC 3.1 |
|---|---|---|---|
| Third Party Certified **36** | Yes | Yes | Yes |
| Certification Costs | Medium | High | Medium |
| Recertification | None* | Every 2 Years | None |
| Number of Health-Related Prerequisites | 2 | 37 **39** | All |
| Market Maturity | High | Medium | Medium |
| General Environmental Benefit **41** | Comprehensive ◆ | | Comprehensive ◆ ✓ |

*Figure 3.11 General comparison between different certification programs. (Radoff, 2017)*

# CHAPTER 4

# 4 The WELL Building Standard Version 2

## 4.1 WELL v2 Pilot

A completely new version of the WELL building standard, the WELL v2 pilot, was launched by IWBI on the 31st of May, 2018. The new pilot program aims to offer a step forward from the previous WELL v1 under several points of view.

First of all, the set of features has been changed and, as a result, the number of preconditions has been decreased, while optimizations have been weighted in order to make the process of certification easier and fairer to complete. Another important innovation is that all the previous iterations and pilots now belong to same program, *one WELL*, which now applies to all project types. WELL v2 is structured upon a dynamic scorecard. Its online support system is a digital platform that aids project teams for developing their unique scorecard, and recommending a selection of features based on building characteristics. The features chosen can however be refined during the certification process. In addition, new pathways have been introduced with a special focus on feasibility for existing buildings and commercial interiors. An optional early phase has also been introduced to confirm the progress made in seeking WELL certification: the WELL Design & Operations (WELL D&O) (IWBI, 2018a). WELL D&O is managed by GBCI and it certifies that a project has a temporary good evaluation before the actual attainment of WELL certification (IWBI, 2018b). A further novelty consists in the possibility offered to project teams that want to undergo performance verification to decide to contact local providers. Previously, the WELL Assessor was the only professional who could perform all the onsite tests (International WELL Building Institute, PBC, 2017). Finally, adjustments have been introduced to the pricing structure and a new subscription option has been added (IWBI, 2018a).

### 4.1.1 WELL v2 Pilot New Principles

The WELL v2 pilot is built around the following principles:

- *Equitable*: it tries to benefit the greatest number of people;
- *Global:* applications of new features are relevant throughout the world;
- *Evidence-based*: it is validated by scientific experiments and research;
- *Technically robust:* it draws upon best practice and proven strategies;
- *Customer-focused*: defines program requirements with a dynamic process;
- *Resilient:* responds to advances in scientific knowledge and technology, continuing the integration of new findings (IWBI, 2018d).

## 4.2 The New Architecture of the Standard

### 4.2.1 One WELL for all Project Types

WELL v2 takes all iterations and pilots into one single programme that is applicable to all project types. The several pilot programs on which WELL v1 was structured, in fact, e.g. multifamily residential, commercial kitchen, retail, education facilities, restaurants, etc. have now combined in the WELL v2 pilot. As a direct consequence of this strategy, the new scoreboard is extremely flexible in order to accommodate several project types.

The project types that want to pursue WELL v2 certification have now to respond to a renewed set of unified preconditions and multiple optimizations that can be applied to all buildings, hence bringing together previous WELL v1 pathways and thresholds. The new set of features have been designed with a focus on feasibility for existing buildings and commercial interiors, building maintenance, operations and organizational policies.

Preconditions have become *universal*, which means that they are applicable to all projects. The whole set of universal preconditions is mandatory for certification and every part of each precondition is required. To make the process more adaptable to the specific requirements of different project types, however, in WELL v2 pilot, the number of preconditions has been reduced by half while more freedom has been given in the choice of optimizations (IWBI, 2018b). Optimizations have in fact become *flexible*. Project teams can choose which optimization they want to pursue at the very beginning of the certification process. Yet, within all the optimizations, it is mandatory to decide which part is intended to be followed in order to achieve a final certification score (IWBI, 2018d).

Another important innovation brought to the new pilot is a maximum score that can be achieved through optimizations. This means that each feature has a point-value and each

optimization has a maximum point-value that can be attained with all, or only some, of its features. Any score obtained over the maximum point-value is not counted towards the certification final score. The maximum point-value for every optimization is determined on the basis of its potential impact (IWBI, 2018d).

#### 4.2.1.1 WELL Core

The only project type that is not featured under the *one WELL* programme is WELL Core, which is the equivalent of the previous Core and Shell. This alternative pathway is applicable when fundamental changes are made to the base building to make tenants have a healthier place and occupancy. To pursue this pathway, the owner needs to occupy 25% or less of the gross floor area of the entire project. In addition, WELL Core requires that at least 2.5% of the total floor area be ready for performance testing, and that features about common areas and spaces are achieved (IWBI, 2018d).

### 4.2.2 From 7 to 10 core concepts

The structure of the WELL v2 pilot programme changed significantly in comparison to WELL v1. The most relevant change is related to the number of core concepts that increased from 7 to 10. The ten core concepts featured in WELL v2 are: 1) Air; 2)Water; 3) Nourishment; 4) Light; 5) Movement; 6) Thermal Comfort; 7) Sound; 8) Materials; 9) Mind; and, 10) Community. WELL v2 has now a total of 112 features (IWBI, 2018b).

#### 4.2.2.1 Differences and Comparison between Concepts

*AIR*: The features of Air were 29 in v1, and now they have become 14. Some of the previous Air features moved to two completely new concepts, Thermal Comfort and Materials. This has helped to focus Air on holistic clean air design strategies that reduce human exposure to contaminants (IWBI, 2018c).

*Table 4.1 Changes of Air features between v1 and v2*

| AIR | v1 | v2 |
|---|---|---|
| Preconditions | 12 | 4 |
| Optimizations | 17 | 10 |

- Air Quality Requirements (A01), Smoke Free Environment (A02), Ventilation Effectiveness (A03), and Construction Pollution Management(A04) are now Preconditions in v2;
- Fundamental Air Quality (A01) is a new precondition in v2;
- Features 04, 09, 10, 11, 25 and 26 (note that the numbering preceded by the word Feature refers to v1), previously connected to materials, have now been moved to the Materials core concept;
- Some parts of Feature 16 - Humidity Control have been moved from Air to Thermal Comfort
- Some parts of Feature 12 - Moisture Management have now been moved to the Water core concept.

*WATER*: This is one of the concepts that saw the fewest changes (IWBI, 2018c).

*Table 4.2 Changes of Water features between v1 and v2*

| WATER | v1 | v2 |
|---|---|---|
| Preconditions | 5 | 3 |
| Optimizations | 3 | 5 |

- The Preconditions have remained essentially the same but Fundamental Water Quality (W01) and Water Contaminants (W02) have become two separate features;
- W01 is a new Precondition in v2;
- W02 has new thresholds for Cadmium and Chromium;
- Feature 36, Legionella Control has become a Precondition in v2 (W03);
- V2 changed the thresholds also for the following substances: Styrene, Benzene, Toluene, Atrazine and Chlorine.

*NOURISHMENT*: Nourishment had a reduction in Preconditions (IWBI, 2018c).

*Table 4.3 Changes of Nourishment features between v1 and v2*

| NOURISHMENT | v1 | v2 |
|---|---|---|
| Preconditions | 7 | 2 |
| Optimizations | 7 | 11 |

- Parts of Features 38, 40 and 44 have been retained in Fruits and Vegetables (N01) and Nutritional Transparency (N02);
- The Precondition Features 39 - Processed Food, 43 - Artificial Ingredients and 45 - Food Advertising have become Optimizations in v2
- Precondition 42 - Hand Washing has been moved to the Water concept as an Optimization;
- Features 42, 46, 50 have been eliminated;

*LIGHT*: Light in v2 has had significant changes between v1 and v2, with important consequences in terms of the design of the luminous environment. For this reason, a specific section of this dissertation has been dedicated to the changes in this core concept. Among the most relevant, the Circadian Lighting Feature is no longer a Precondition, although its requirements have been further specified and linked to other lighting criteria (IWBI, 2018c).

*Table 4.4 Changes of Light features between v1 and v2*

| **LIGHT** | **v1** | **v2** |
|---|---|---|
| Preconditions | 4 | 2 |
| Optimizations | 7 | 6 |

- Feature 54 - Circadian Lighting Design has become an Optimization in v2;
- A new feature on Light Exposure and Education has been included as a Precondition (L01);
- New Optimizations have been created: Electric Light Quality (L07) and Occupant Control of Lightning Environment (L08);
- Feature 57 - Low-Glare Workstation Design, Feature 59 - Surface Design, Feature 63 - Daylight Fenestration have been removed.

*MOVEMENT*: Movement replaces the core concept Fitness that was present in v1. It has been built on the previous features to whom ergonomic requirements from the core concept Comfort of v1 have been added (IWBI, 2018c).

*Table 4.5 Changes of Movement features between v1 and v2*

| MOVEMENT | v1 | v2 |
|---|---|---|
| Preconditions | 2 | 2 |
| Optimizations | 6 | 10 |

- The new Precondition Active Building Community (V01) has the peculiarity to be fulfilled achieving points also from features V03, V04, V05, V07, V09;
- Feature 73 - Ergonomics: Visual and Physical was in Comfort in v1, but has now been moved to Movement (V02);
- Site Planning and Selection (V05) and Enhanced Ergonomics (V10) are new features of v2.

*THERMAL COMFORT*: Thermal comfort is a new core concept mostly derived from the previous Comfort (IWBI, 2018c).

*Table 4.6 The Thermal Comfort core concept of v2.*

| THERMAL COMFORT | v1 | v2 |
|---|---|---|
| Preconditions | n/a | 1 |
| Optimizations | n/a | 6 |

- The Precondition Thermal Comfort (T01) is similar to v1's Feature 76 - Thermal Comfort. T01 but new requirements have been added concerning ongoing monitoring of dry-bulb temperature, relative humidity, air speed and mean radiant temperature;
- Parts of Feature 16 - Humidity Control and Feature 20 - Outdoor Air System have been moved to Thermal Comfort from the Air core concept of v1;
- Enhanced Thermal Performance (T02) is a new Optimization in v2.

*SOUND*: This is also a new core concept derived, with some adjustment, from Comfort of v1 (IWBI, 2018c).

*Table 4.7 The Sound core concept*

| SOUND | v1 | v2 |
|---|---|---|
| Preconditions | n/a | 1 |
| Optimizations | n/a | 4 |

- The Preconditions Features 74 and 75 - Maximum Noise Level have been changed to an Optimization in v2 (S02).

*MATERIALS*: Materials is a separate core concept in v2, while in v1 its Features were present in Air and in Mind (IWBI, 2018c).

*Table 4.8 The Materials core concept*

| MATERIALS | v1 | v2 |
|---|---|---|
| Preconditions | n/a | 3 |
| Optimizations | n/a | 11 |

- The Preconditions are now Fundamental Material Precaution (X01), Hazardous Materials Precautions (X02) and Outdoor structures (X03)
- Feature 04 - VOC Reduction, which was a Precondition in v1, has now become an Optimization divided in the Features Long-Term Emission Control (X11) and Short-Term Emission Control (X12);
- New Optimizations Features in v2 are Waste Management (X04), In-place Management (X05) and Site Remediation (X06).

*MIND*: The Mind core concept in v2 has been focused on design, policies and programmatic strategies to support emotional health. In v1, this concept was mostly focused on social well-being, which is now comprised within the Community concept (IWBI, 2018c).

*Table 4.9 Changes of Mind features between v1 and v2*

| MIND | v1 | v2 |
|---|---|---|
| Preconditions | 5 | 2 |
| Optimizations | 12 | 13 |

- New Optimizations Features in v2 are Mental Health Support and Education (M03, M04), Restorative Spaces, Support and Programs

(M06, M07, M08), Tobacco Prevention and Cessation (M13), Substance Use Education and Opioid Emergency Response Plan (M14, M15).

*COMMUNITY*: Community is a completely new core concept in v2. Some of Community's features are pulled from v1's Mind concept. The majority of Community features are new and it is the concept that has the most number of feature in v2 (IWBI, 2018c).

*Table 4.10 The Community core concept*

| COMMUNITY | v1 | v2 |
|---|---|---|
| Preconditions | n/a | 3 |
| Optimizations | n/a | 13 |

- The Features 84, 85 and 86 that belonged to the Mind concept have now become Preconditions in Community.
- New Optimizations Features in v2 are Enhanced Occupant Survey (C04), New Mother Support (C09), Bathroom Accommodations (C14), Emergency Preparedness (C15), and Community Access and Engagement (C16).

The tables featured in the following pages synthetize how Preconditions. Optimizations and Features have been changed from version 1 to version 2 of the WELL building standard. All data are taken from the excel file provided by wellcertified.com, they have been only reorganized in order to explain better what are the changes. (environment, 2018).

*Table 4.11 Synthesis of changes from v1 to v2: Preconditions to Optimizations. Made*

| PRECONDITIONS to OPTIMIZATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **WELL v1** | | | | **WELL v2** | | | |
| **P/O** | **Feature number** | **Feature name** | **Part number** | **P/O** | **Feature number** | **Feature name** | **Part number** |
| P | Feature 03 | Ventilation Effectiveness | Part 2. Demand Controlled Ventilation | O | A06 | Enhanced Ventilation | Part 2. Implement Demand-Controlled Ventilation |
| P | Feature 04 | VOC Reduction | Part 1. Interior Paints and Coatings | O | X12 | Short-term Emission Control | Part 1. Manage Material Emission OR Part 2. Manage Material Content |
| P | Feature 04 | VOC Reduction | Part 2. Interior Adhesives and Sealants | O | X12 | Short-term Emission Control | Part 1. Manage Material Emission OR Part 2. Manage Material Content |
| P | Feature 04 | VOC Reduction | Part 3. Flooring | O | X11 | Long-term Emission Control | Part 2. Manage flooring and insulation emissions |
| P | Feature 04 | VOC Reduction | Part 4. Insulation | O | X11 | Long-term Emission Control | Part 2. Manage flooring and insulation emissions |
| P | Feature 04 | VOC Reduction | Part 5. Furniture and Furnishings | O | X11 | Long-term Emission Control | Part 1. Manage Furniture and Furnishings Emissions |
| P | Feature 05 | Air Filtration | Part 2. Particle Filtration | O | A12 | Air Filtration | Part 1. Implement Particle Filtration |
| P | Feature 05 | Air Filtration | Part 3. Air Filtration Maintenance | O | A12 | Air Filtration | Part 1. Implement Particle Filtration |
| P | Feature 06 | Microbe and Mold Control | Part 1. Cooling Coil Mold Reduction | O | A14 | Microbe and Mold Control | Part 1. Implement Ultraviolet Air Treatment |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| P | Feature 06 | Microbe and Mold Control | Part 2. Mold Inspections | O | A14 | Microbe and Mold Control | Part 2. Manage Condensation and Mold |
| P | Feature 08 | Healthy Entrance | Part 1. Entryway Walk-Off Systems | O | A09 | Pollution Infiltration Management | Part 1. Design Healthy Envelope and Entryways |
| P | Feature 08 | Healthy Entrance | Part 2. Entryway Air Seal | O | A09 | Pollution Infiltration Management | Part 1. Design Healthy Envelope and Entryways |
| P | Feature 08 | Healthy Entrance | Part 3. Playing Field Staging Area | O | A09 | Pollution Infiltration Management | Part 1. Design Healthy Envelope and Entryways |
| P | Feature 09 | Cleaning Protocol | Part 1. Cleaning Plan For Occupied Spaces | O | X09 | Cleaning Products and Protocol | Part 1. Ensure Acceptable Cleaning Ingredients Part 2. Implement Acceptable Cleaning Practices |
| P | Feature 10 | Pesticide Management | Part 1. Pesticide use | O | X07 | Pesticide Use | Part 1. Manage Pesticides |
| P | Feature 11 | Fundamental Material Safety | Part 1c. Asbestos and Lead Restriction | O | X08 | Hazardous Material Reduction | Part 1. Limit Hazardous Materials |
| P | Feature 12 | Moisture Management | Part 1. Exterior Liquid Water Management | O | W07 | Moisture Management | Part 1. Manage Exterior Liquid Water |
| P | Feature 12 | Moisture Management | Part 2. Interior Liquid Water Management | O | W07 | Moisture Management | Part 3. Manage Interior Liquid Water |
| P | Feature 12 | Moisture Management | Part 3. Condensation Management | O | A14 | Microbe and Mould Control | Part 2. Manage Condensation and Mould |
| P | Feature 12 | Moisture Management | Part 4. Material Selection and Protection | O | W07 | Moisture Management | Part 2. Isolate Moisture-sensitive Materials |
| P | Feature 39 | Processed Foods | Part 1. Refined Ingredient Restrictions | O | N03 | Refined Ingredients | Part 1. Limit Total Sugars Part 2. Promote Whole Grains |
| P | Feature 39 | Processed Foods | Part 2. Trans Fat Ban | O | N03 | Refined Ingredients | Part 3a. Manage Oils |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| P | Feature 39 | Processed Foods | Part 3. Fryer Oil | O | N03 | Refined Ingredients | Part 3b. Manage Oils |
| P | Feature 39 (Education) | Processed Foods | Part 4. Beverages for Early Education and Primary School | O | N03 | Refined Ingredients | Part 1. Limit Total Sugars |
| P | Feature 39 (Education) | Processed Foods | Part 5. Beverages for Secondary School and Adult Education | O | N03 | Refined Ingredients | Part 1. Limit Total Sugars |
| P | Feature 39 (Education) | Processed Foods | Part 6. Ingredients Restrictions for Schools | O | N03 | Refined Ingredients | Part 1. Limit Total Sugars<br>Part 2. Promote Whole Grains |
| P | Feature 41 | Hand Washing | Part 1. Hand Washing Supplies | O | W08 | Hand Washing | Part 2. Provide Handwashing Support |
| P | Feature 41 | Hand Washing | Part 2. Contamination Reduction | O | W08 | Hand Washing | Part 2. Provide Handwashing Support |
| P | Feature 41 | Hand Washing | Part 3. Sink Dimensions | O | W08 | Hand Washing | Part 1. Provide Adequate Sink |
| P | Feature 41 | Hand Washing | Part 4. Hand Washing Station Location | O | W08 | Hand Washing | Part 2. Provide Handwashing Support |
| P | Feature 43 | Artificial Ingredients | Part 1. Artificial Substance Labeling | O | N05 | Artificial Ingredients | Part 1. Restrict Artificial Ingredients |
| P | Feature 44 | Nutritional Information | Part 2. Healthy Cooking Guidelines | O | N07 | Nutrition Education | Part 1. Provide Nutrition Education |
| P | Feature 45 | Food Advertising | Part 4. Healthy Menu Design | O | N04 | Food Advertising | Part 2. Implement Healthy Menu Design |
| P | Feature 53 | Visual Lighting Design | Part 2. Brightness Management Strategies | O | L06 | Visual Balance | Part 1. Manage Brightness |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| P | Feature 54 | Circadian Lighting Design | Part 1. Melanopic Light Intensity For Work Areas | O | L03 | Circadian Lighting Design | Part 1. Lighting for the Circadian System |
| P | Feature 55 | Electric Light Glare Control | Part 1. Luminaire Shielding | O | L04 | Glare Control | Part 2. Manage Glare from Electric Lighting |
| P | Feature 55 | Electric Light Glare Control | Part 2. Glare Minimization | O | L04 | Glare Control | Part 2. Manage Glare from Electric Lighting |
| P | Feature 56 | Solar Glare Control | Part 1. View Window Shading | O | L04 | Glare Control | Part 1. Control Solar Glare |
| P | Feature 64 | Interior Fitness Circulation | Part 1. Stair Accessibility and Promotion | O | V03 | Movement Network and Circulation | Part 2. Integrate Point-of-Decision Signage |
| P | Feature 64 | Interior Fitness Circulation | Part 2. Staircase Design | O | V03 | Movement Network and Circulation | Part 3. Promote Visible Stairs |
| P | Feature 64 | Interior Fitness Circulation | Part 3. Facilitative Aesthetics | O | V03 | Movement Network and Circulation | Part 1. Design Aesthetic Circulation Networks |
| P | Feature 65 | Activity Incentives Programs | Part 1. Activity Incentive Programs | O | V11 | Physical Activity Promotion | Part 1. Promote Physical Activity |
| P | Feature 65 | Activity Incentives Programs | Part 2. Sedentary Behavior Reduction | O | V11 | Physical Activity Promotion | Part 1. Promote Physical Activity |
| P | Feature 66 (Education) | Structured Fitness Opportunities | Part 3. Physical Activity Breaks | O | V06 | Physical Activity Opportunities | Part 2. Implement Activity Programs for Students |
| P | Feature 72 | Accessible Design | Part 1. Accessibility and Usability | O | C13 | Accessibility and Universal Design | Part 1. Ensure Essential Accessibility |
| P | Feature 74 | Exterior Noise Intrusion | Part 1. Sound Pressure Level | O | S02 | Maximum Noise Levels | Part 1. Limit Background Noise Levels |
| P | Feature 74 | Exterior Noise Intrusion | Part 2. Sound Pressure Level in Residences | O | S02 | Maximum Noise Levels | Part 1. Limit Background Noise Levels |
| P | Feature 74 | Exterior Noise Intrusion | Part 4. Sound Pressure Level in Schools | O | S02 | Maximum Noise Levels | Part 1. Limit Background Noise Levels |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| P | Feature 74 | Internally Generated Noise | Part 2. Mechanical Equipment Sound Levels | O | S02 | Maximum Noise Levels | Part 1. Limit Background Noise Levels |
| P | Feature 74 | Internally Generated Noise | Part 6. Noise Criteria in Schools | O | S02 | Maximum Noise Levels | Part 1. Limit Background Noise Levels |
| P | Feature 74 | Internally Generated Noise | Part 7. Disruptive Music Limitation | O | S02 | Maximum Noise Levels | Part 1. Limit Background Noise Levels |
| P | Feature 76 | Thermal Comfort | Part 1. Ventilated Thermal Environment | O | T02 | Enhanced Thermal Performance | Part 1. Enhance Thermal Environment |
| P | Feature 82 | Individual Thermal Control | Part 1. Free Address | O | T03 | Thermal zoning | Part 2. Promote free adress |
| P | Feature 84 | Health and Wellness Awareness | Part 3. Health and Wellness Narrative | O | C06 | Health Promotion | Part 1. Promote Culture of Health |

*Table 4.12 Synthesis of changes from v1 to v2: Optimizations to Preconditions*

| **OPTIMIZATIONS to PRECONDITIONS** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **WELL v1** | | | | **WELL v2** | | | |
| **P/O** | **Feature number** | **Feature name** | **Part number** | **P/O** | **Feature number** | **Feature name** | **Part number** |
| O | Feature 13 | Air Flush | Part 1. Air Flush | P | A04 | Construction Pollution Management | Part 1. Mitigate Construction Pollution |
| O | Feature 24 | Combustion Minimization | Part 4. Construction Equipment | P | A04 | Construction Pollution Management | Part 1. Construction Pollution |
| O | Feature 36 | Water Treatment | Part 5. Legionella Control | P | W03 | Legionella Control | Part 1. Implement Legionella Management Plan |
| O | Feature 53 | Visual Lighting Design | Part 4. Visual Acuity in Living Environments | P | L02 | Visual Lighting Design | Part 1. Light level for Visual Acuity |

*Table 4.13 New Preconditions in v2*

| NEW PRECONDITIONS | | | |
|---|---|---|---|
| **WELL v1/WELL v2** | | | |
| **P** | **Feature number** | **Feature name** | **Part number** |
| P | A01 | Fundamental Air Quality | Part 5. Monitor Fundamental Air Parameters |
| P | W01 | Fundamental Water Quality | Part 3. Monitor Fundamental Water Properties |
| P | N02 | Nutritional Transparency | Part 3. Implement Refined Ingredient Labeling |
| P | L01 | Light Exposure and Education | Part 2. Promote Lighting Education |
| P | V01 | Active Buildings and Communities | Part 1. Design Active Buildings and Communities |
| P | V02 | Visual and Physical Ergonomics | Part 5. Provide Ergonomics Education |
| P | T01 | Thermal Performance | Part 2. Monitor Thermal Parameters |
| P | S01 | Sound Mapping | Part 2. Manage Acoustical Privacy |
| P | X03 | Outdoor Spaces | Part 1. Ensure Acceptable Structures |
| P | X03 | Outdoor Spaces | Part 2. Manage Exterior Paint and Soil |
| P | M01 | Mental Health Promotion | Part 1. Commit to Mental Health Promotion |
| P | M01 | Mental Health Promotion | Part 2. Promote Mental Health Literacy |

*Table 4.14 New Optimizations in v2*

| NEW OPTIMIZATIONS | | | |
|---|---|---|---|
| **WELL v1/WELL v2** | | | |
| **O** | **Feature number** | **Feature name** | **Part number** |
| O | A07 | Operable Windows | Part 3. Apply Universal Design to Windows |
| O | A06 | Enhanced Ventilation | Part 4. Implement Advanced Air Distribution |
| O | A05 | Enhanced Air Quality Standards | Part 1. Meet Enhanced Standards for Particulate Matter |
| O | A05 | Enhanced Air Quality Standards | Part 2. Meet Enhanced Standards for Organic Gases |

| | | | |
|---|---|---|---|
| O | A05 | Enhanced Air Quality Standards | Part 3. Meet Enhanced Standards for Inorganic Gases |
| O | N09 | Special Diets | Part 2. Implement Enhanced Ingredient Labeling |
| O | L07 | Electric Light Quality | Part 2. Manage Flicker |
| O | L08 | Occupant Control of Lighting Environments | Part 2. Provide Supplemental Lighting |
| O | L05 | Enhanced Daylight Access | Part 3. Ensure Views |
| O | V11 | Physical Activity Promotion | Part 2. Promote Participation Awareness |
| O | V09 | Exterior Active Design | Part 1. Integrate Active Facades |
| O | V05 | Site Planning and Selection | Part 2. Select Sites with Access to Mass Transit |
| O | V05 | Site Planning and Selection | Part 4. Select Sites with Bike Friendly Streets |
| O | V10 | Enhanced Ergonomics | Part 1. Utilize Ergonomic Consultation |
| O | T02 | Enhanced Thermal Performance | Part 2 Achieve Thermal Comfort |
| O | T03 | Thermal Zoning | Part 1. Ensure Thermostat Control |
| O | T04 | Individual Thermal Comfort | Part 2. Facilitate Individual Thermal Comfort Preferences |
| O | T06 | Thermal Comfort Monitoring | Part 1. Monitor Thermal Environment |
| O | X10 | Volatile Compound Reduction | Part 3. Purchase Compliant Products |
| O | X14 | Material Transparency | Part 1. Promote Ingredient Disclosure |
| O | X04 | Waste Management | Part 1. Manage Hazardous Waste |
| O | X05 | In-Place Management | Part 1. Manage Hazardous Materials |
| O | X06 | Site Remediation | Part 1. Implement Site Assessment and Cleanup |
| O | M03 | Mental Health Support | Part 1. Provide Mental Health Screening |
| O | M03 | Mental Health Support | Part 3. Provide Workplace Support |
| O | M04 | Mental Health Education | Part 1. Offer Mental Health Education |
| O | M04 | Mental Health Education | Part 2. Offer Mental Health Education for Managers |
| O | M05 | Stress Support | Part 1. Develop Stress Management Plan |
| O | M06 | Restorative Opportunities | Part 1. Provide Micro- and Macro-Breaks |

| | | | |
|---|---|---|---|
| O | M07 | Restorative Spaces | Part 2. Provide Restorative Outdoor Spaces |
| O | M08 | Restorative Programming | Part 1. Provide Restorative Programming |
| O | M13 | Tobacco Prevention and Cessation | Part 1. Promote Tobacco Prevention |
| O | M13 | Tobacco Prevention and Cessation | Part 2. Support Tobacco Cessation |
| O | M14 | Substance Use Education and Services | Part 1. Promote Substance Abuse Prevention and Education |
| O | M14 | Substance Use Education and Services | Part 2. Provide Access to Substance Use Services |
| O | M15 | Opioid Emergency Response Plan | Part 1. Provide Opioid Emergency Response Kits and Training |
| O | C06 | Health Promotion | Part 2. Offer Health Risk Assessments |
| O | C04 | Enhanced Occupant Survey | Part 1. Select Enhanced Survey |
| O | C04 | Enhanced Occupant Survey | Part 2. Administer Pre-Occupancy Survey and Report Results |
| O | C04 | Enhanced Occupant Survey | Part 3. Monitor Survey Responses |
| O | C04 | Enhanced Occupant Survey | Part 4. Facilitate Interviews and Focus Groups |
| O | C13 | Accessibility and Universal Design | Part 2. Integrate Universal Design |
| O | C14 | Bathroom Accommodations | Part 1. Provide Essential Accommodations |
| O | C14 | Bathroom Accommodations | Part 2. Provide Single-User Bathrooms |
| O | C14 | Bathroom Accommodations | Part 3. Provide Family Bathrooms |
| O | C15 | Emergency Preparedness | Part 1. Develop Emergency Preparedness Plan |
| O | C15 | Emergency Preparedness | Part 2. Promote Emergency Resources |
| O | C16 | Community Access and Engagement | Part 1. Provide Community Space |

### 4.2.3 The New Scoring System

A new scoring system has been introduced within the WELL v2 pilot programme, based on a 100-point scale with mandatory Preconditions and weighted Optimizations. Every Optimization has a precise value depending upon its impact on health. In v2, it is possible to pursue different parts within an Optimization in order to achieve the

maximum score of that Feature. IWBI also assigned a maximum points value for each core concept in order to make the program more balanced (IWBI, 2018b).

To achieve a concept, at least 2 points from its features must be gained (this minimum threshold is reduced to 1 point for WELL Core projects), with a maximum of 12 points for each concept. This is an important innovation considering that, since some of v2's concepts have more than 20 points achievable, over-scoring 12 would not be counted towards the final certification score. In addition, the scoring system has been made more flexible, since it gives the possibility to choose which feature inside each concept are pursued (IWBI, 2018c).

In essence, projects that want to be certified by WELL v2 pilot must fulfil all the Preconditions and a certain number of points with Optimizations. The sum of all points gained will give the certification level., as follows:

For "All project types":

- WELL Silver Certification: 50 points.
- WELL Gold Certification: 60 points.
- WELL Platinum Certification: 80 points.

For "WELL Core" projects:

- WELL Core Certification: 40 points.
- WELL Core Silver Certification: 50 points.
- WELL Core Gold Certification: 60 Points.
- WELL Core Platinum Certification: 80 points (IWBI, 2018d).

### 4.2.4 Pricing

The WELL v2 pilot introduced a new way of pricing that embraces the renovation of the standard. The main difference with v1's is that, instead of adjusting the price by building type, costs are now calculated at a nominal flat rate per square foot. WELL v2 pilot has different options for payment, i.e. the "Single Cycle", which is very similar to the WELL v1 pricing, and the 3 or 5 years subscriptions. An option has been introduced to select the on-site performance testing agent, hence practically separating on-site performance testing fees from certification ones (IWBI, 2018d). Subscriptions can be prepaid or paid on an annual basis giving the opportunity to be integrated into the annual budget of a costumer. Subscribers have a number of advantages, such as, for example: no deadline for documents submission; 10 more AAPs(Alternative Adherence Paths); 35% of discount for WELL AP registration for at least 10 people of the team; recertification is included in the fees; and, project teams that aim a better score can re-submit for extra points within a period of 12 months before recertification without

any additional costs (IWBI, 2018c). The table below shows what is included in the certification fees for the Single-Cycle and the Subscription option:

*Table 4.15 Fees throughout the certification process (IWBI, 2018d).*

| CERTIFICATION MILESTONES | ACTIVE SUBSCRIBERS | SINGLE-CYCLE PROJECTS |
|---|---|---|
| Registration | One-time fee | One-time fee |
| Documentation review by WELL Reviewer | Included | Included |
| WELL D&O | Additional fees apply | Additional fees apply |
| WELL Performance Verification: on-site performance testing | Not included | Not included |
| WELL Performance Verification: Performance Review | Included | Included |
| Certification | Included | Included |
| **CERTIFICATION SUPPORT** | **ACTIVE SUBSCRIBERS** | **SINGLE-CYCLE PROJECTS** |
| Ongoing support from WELL coaching contact prior to certification | Included | Included |
| Complimentary AAPs | 10 | 10 |
| Access to monthly webcasts that are otherwise exclusively available to WELL APs | Included | Included |
| WELL AP discounts (35% off list price for up to 10 project team members | Included | Not included |
| **RECERTIFICATION MILESTONES** | **ACTIVE SUBSCRIBERS** | **SINGLE-CYCLE PROJECTS** |
| Ongoing support from WELL coaching contact following certification | Included | Not available |
| Optional annual mid-cycle review to increase your score or certification level | Included | Additional fees apply |
| Recertification (every three years) | Included | Additional fees apply |
| Ability to transfer a subscription to a new space or building, post-certification (terms and conditions apply) | Included | Not available |
| **MANAGING TIMELINE** | **ACTIVE SUBSCRIBERS** | **SINGLE-CYCLE PROJECTS** |
| Fee guarantee | For the length of your subscription contract | Subject to annual pricing increases if documentation is not submitted within two years of registering. |
| Registration expiration | No expiration | Registration will expire if the project does not undergo WELL Performance |

| | | |
|---|---|---|
| | | Verification within five years of registering. |
| Deadlines for documentation submission | No deadlines | Subject to annual pricing increases if documentation is not submitted within two years of registering. |

The pricing labels divided by “sq ft” are checkable onto the web site (https://v2.wellcertified.com/pricing).

# CHAPTER 5

## 5 Light Concept

### 5.1 The Light concept in versions 1 and 2 of the WELL Building Standard

As described in the previous chapter (par. 4.2.2.1), the Light concept was subject to substantial changes between the versions v1 and v2 of the WELL certification program. In fact, under v1, there were 4 preconditions and 7 optimizations; in v2, preconditions have become 2 and optimizations 6. Features 57, 59 and 63 have been removed. The table below shows the differences between the Light concept in v1 (left column) and v2 (right column).

*Table 5.1 The Light concept in the two versions of WELL.*

| LIGHT | | | | | |
|---|---|---|---|---|---|
| **WELL v1** | | | **WELL v2** | | |
| **P/O** | **Feature number** | **Feature name** | **P/O** | **Feature number** | **Feature name** |
| P | F53 | Light Exposure and Education | P | L01 | Light Exposure and Education |
| P | F54 | Circadian Lighting Design | P | L02 | Visual Lighting Design |
| P | F55 | Electric Light Glare Control | O | L03 | Circadian Lighting Design |
| P | F56 | Solar Glare Control | O | L04 | Glare Control |
| O | F57 | Low-Glare Workstation Design | O | L05 | Enhanced Daylight Access |
| O | F58 | Color Quality | O | L06 | Visual Balance |
| O | F59 | Surface Design | O | L07 | Electric Light Quality |
| O | F60 | Automoted Shading and Dimming Controls | O | L08 | Occupant Control of lighting Environment |
| O | F61 | Right to Light | | | |
| O | F62 | Daylight Modelling | | | |

| | | |
|---|---|---|
| O | F63 | Daylight Fenestration |

Table 5.2 provides a critical overview of the contents of each feature, showing how different parts, criteria and requirements have been moved/changed/removed within the new layout of the v2 WELL standard.

*Table 5.2 Differences and equivalences between v1 and v2 Light concept.*

| **LIGHT** | | | |
|---|---|---|---|
| **WELL v1** | | **WELL v2** | |
| **Feature name** | **Feature parts** | **Feature name** | **Feature parts** |
| F53 Visual Lighting Design | Part. 1) Visual acuity for focus | L02 Visul Lighting Design | Part. 1) Light level for visual Acuity |
| | Part. 2) Brightness management strategies | L06 Visual Balance | Part. 1) manage brightness |
| | Part. 3) Commercial kitchen lighting | L02 Visul Lighting Design | Part. 1) Light level for visual Acuity |
| | Part. 4) Visual acuity in living environment | | |
| | Part. 5) Visual acuity for learning | | |
| | Part. 6) Visual acuity for dining | | |
| F54 Circadian Lighting Design | Part. 1) Melanopic light intensity for work areas | L03 Circadian lighting Design | Part. 1) Lighting for the Circadian System |
| | Part. 2) Melanopic light intensity in living environment | | |
| | Part. 3) Melanopic light intensity in breakrooms | | |
| | Part. 4) Melanopic light intensity in learning areas | | |

| | | | |
|---|---|---|---|
| F55 Electric Light Glare Control | Part. 1) Luminaire shielding | L04 Glare Control | Part. 2) Manage glare from electric lighting |
| | Part. 2) Glare minimization | | |
| F56 Solar Glare Control | Part. 1) View Window Shading | L04 Glare Control | Part. 1) Control solar glare |
| F58 Color Quality | Part. 1) Color rendering index | L07 Electric Light Quality | Part. 1) Ensure color rendering quality |
| F60 Automoted Shading and Dimming Controls | Part. 2) Responsive light control | L08 Occupant Control of Lighiting Design | Part. 1) Enehance occupant controllability |
| F61 Right to Light | Part. 2) Window Access | L05 Enhanced Daylight Access | Part. 1) Implement enhanced daylight plan |
| F62 Daylight Modelling | Part. 1a) Healthy sunlight exposure | L05 Enhanced Daylight Access | Part. 2) Implement enhanched daylight simulation |
| | Part. 1b) Healthy sunlight exposure | L04 Glare Control | Part. 1) Control solar glare |

## 5.2 Features comparison

After having provided a general overview of the differences in structure between the Light concept in v1 and v2, some more detailed explanations are given below about the changes made inside each feature, how some parts have been moved from one to another, those that have been unchanged and those that have been entirely removed.

### 5.2.1 L01, Light Exposure and Education

This feature wants to enhance the access to daylight for people inside the built environment. It is proven that light can affect positively mood, work and health. Daylight is also fundamental for men's circadian rhythms because it helps with the alignment with day-night cycle. Projects has to provide proper light exposure for indoor spaces with design and education of users.

*Table 5.3 Light Exposure and Education in V2.*

| LIGHT EXPOSURE AND EDUCATION | | | |
|---|---|---|---|
| **WELL v2** | | | |
| **L01** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurance** | **Annotated documents** | **On-site assessment** |
| **1a) Ensure Indoor Light Exposure**<br>For all spaces except dwelling units<br>One of the following has to be met: | | | |
| **1a.1) Daylight in regularly occupied spaces**<br>At least one of the requirements that can be found here have to be met.<br>. | | 1) Architectural drawing<br>2) Modeling report | |
| **1a.2) Daylight in common spaces**<br>For all common spaces inside project boundary at least one of the following requirements that can be found here have to be met. | | | |
| **1a.3) Electric light in regularly occupied spaces**<br>The requirement that can be found here has to be followed. | | | |
| **2) Promote lighting education**<br>At least two of the requirements that can be found here has to be followed in order to give occupants awareness about the importance of light for health. | | Educational materials | |

As reported in table 5.2, L01 is not included in the first version of the WELL certification program, instead it is a new feature of the latest version. The implementation of the concept that light is very important for the mental and physical well-being of a person, represents a big step forward in the development of the program. Including this concept as precondition becomes crucial if WELL goal is to improve health and productivity of the people working in a certified environment. However, if all the prescriptions required to obtain such certification are only taken into account during the design phase, the effort will be useless. It is important to sensitize and make the individuals who will be using the certified space, conscious of, for example, why their desk is located at that specific distance from a window. Therefore, the central innovation is the intent to educate the occupants of a specific certified space,

explaining why certain features can preserve and improve their health. Finally, this new feature can also be assigned by fulfilling at least one of the requirements of L3.

To summarize, the addition of the light exposure and education feature significantly improves the certification and its execution.

### 5.2.2 Feature 53/L02, Visual Lighting Design and L06 Visual Balance

Brightness and an adequate level of light is fundamental to accomplish everyday visual tasks. Light, throughout this feature, is measured in "lux" or "foot candles" (the latter relates to the imperial system, still in use in the USA). These units of measurement refer to the photopic response provided by the cone photoreceptors in the eye. For most internal spaces, it has been proven that 300 lux provides suitable luminous conditions for workspaces, allowing people to stay focused. The WELL v2 L02 feature also gives suggestions about how to achieve the minimum targeted level of illuminance and defines the impact of fulfilling this threshold from the point of view of visual acuity (IWBI, 2017a) (IWBI, 2018(1)).

*Table 5.4 Visual Lighting Design in v1*

| **VISUAL LIGHTING DESIGN** | | | |
|---|---|---|---|
| **WELL v1** | | | |
| **Feature 53** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurance** | **Annotated documents** | **On-site assessment** |
| **1) Visual Acuity for focus** This requirement has to be met at work station. Requirements can be found here. | Architect | Policy Documents | Spot measurement |
| **2) Brightness Management Strategies** It is needed to provide a narrative that describes the strategies for maintaining luminance balance in spaces, which consider two of the following requirements that can be found here. | | Professional narrative | |

| | | | |
|---|---|---|---|
| **3) Commercial Kitchen Lighting**<br>The following light levels, that can be found here, have to be achieved. | Architect | | Spot measurement |
| **4) Visual Acuity in Living Environment**<br>One or more light sources have to provide the following amount of lux, check here. | Architect | | Spot measurement |
| **5) Visual Acuity for Learning**<br>The lighting system in classroom, at desk, has to meet requirements that can be found here. | Architect | | Spot measurement |
| **6) Visual Acuity for Dining**<br>The lighting system at dining surfaces has to meet requirements that can be found here. | Architect | | Spot measurement |

*Table 5.5 Visual Lighting Design in v2*

| **VISUAL LIGHTING DESIGN** | | | |
|---|---|---|---|
| **WELL v2** | | | |
| **L02** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurance** | **Annotated documents** | **On-site assessment** |
| **1) Light levels for Visual Acuity**<br>For all spaces, requirements that can be found here, have to be meet. | | Design specifications | Performance test |

*Table 5.6 Visual Balance in v2*

| VISUAL BALANCE | | | |
|---|---|---|---|
| **WELL v2** | | | |
| **L06** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurance** | **Annotated documents** | **On-site assessment** |
| **1) Manage Brightness**<br>For all spaces, at least two of the requirements that can be found here, have to be meet in regularly occupied spaces. | Architect | | |

Feature 53, Visual Lighting Design has been included in L02 and L06 in WELL v2 as shown in the above tables. ,

This feature was for the most part left as precondition also in Vol2 with the exception of part n2 “Brightness Management Strategies”. This highlights its importance in the Light concept. The more substantial change was made to the included parts: from six it is now down to just one as shown in table 5.2. Although L02 appears to only have one part, it is subdivided in two specific and different requirements. Overall, the requests have been simplified and clarifed and the design teams will be able to more easily satisfy the requests. For example, in v2, different building types do not have specific programs. In comparison, 4 out of 6 parts of feature 53 in version 1 were specifications only to be applied to certain building projects.

Furthermore, part 2 of feature 53 has been moved and has now become an optimization. It is not yet clear whether this move was the right choice. In fact, on one hand it highlights the importance of following certain criteria related to the lighting of a specific environment but, on the other hand it is now an optimization and as such the client can decide to not follow this suggestion. It is possible that such change had to be done in order to make the certification program easier to pursue. Despite what is discussed above, when reading the modified part in Vol2, one can immediately notice that it is now more complicated to satisfy such optimization. In fact, it is required that 4 out of 6 of the criteria have to be met, while in the previous version only 2 out of 4 were.

In summary, feature 53 remains a precondition but, it is an improvement compared to version 1 as it is simpler and more accesible which is a clear advantage for the clients.

### 5.2.3 Feature 54/L03, Circadian Lighting Design

Light is one of the most effective stimuli to entrain the human circadian system via its effect on the *intrinsically photosensitive retinal ganglion cells* (ipRGCs) that are located in the human retina. Throughout the ipGRCs, exposure to light of the right intensity, duration, and spectral composition several metabolic responses are regulated, including alertness, body temperature, the sleep/wake cycle, etc. This is why preserving a proper entraining of the circadian rhythm is very important for people's health and productivity.

The *Equivalent Melanopic Lux* (EML) is the unit of measurement that describes lights effects on humans' circadian system. In the WELL standard, the EML is measured on the vertical plane at the eye level of the occupant (IWBI, 2017b) (IWBI, 2018(2)).

*Table 5.7 Circadian Lighting Design in v1*

| CIRCADIAN LIGHTING DESIGN | | | |
|---|---|---|---|
| **WELL v1** | | | |
| **Feature 54** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurance** | **Annotated documents** | **On-site assessment** |
| **1) Melanopic Light Intensity for Work Areas**<br>With the help of light calculations and light models it has been demonstrated that at least one of the requirements that can be found here have to be meet. | Architect | | Spot measurement |
| **2) Melanopic Light Intensity in Living Environment**<br>One or more of the following fixtures have to be provided in all bedrooms, bathrooms and any kind of room that has a window, check here. | Architect | | Spot measurement |

| | | | |
|---|---|---|---|
| **3) Melanopic Light Intensity in Breakrooms**<br>Workplace that have employees that spend most of their time in spaces with limited light levels have to have breakrooms with the following requirement, check here. | Architect | | Spot check |
| **4) Melanopic Light Intensity in Learning Areas**<br>At least one of the following requirements has to be met, check here. | Architect | | Spot check |

*Table 5.8 Circadian Lighiting Design in v2*

| **CIRCADIAN LIGHTING DESIGN** | | | |
|---|---|---|---|
| **WELL v2** | | | |
| **L03** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assuranace** | **Annotated documents** | **On-site assessment** |
| **1) Lighting for The Circadian system**<br>Electric lighting is used to achieve light levels showed in the table (check here). It is always measured on the vertical plane at eye level. Those light levels have to be achieved at least between 9 a.m. to 1 p.m. and maybe lowered after 8 p.m. | | | Perfomance test |

Feature 54 on Circadian Lighting Design in the latest version is now an optimization and has been shrunk from 4 to just one part. The change to optimization is most likely due to the commercial nature of the program. In fact, making it accessible to more clients remains one of the most important goals of the program developers, second in importance only to the health of the individuals. The program has evolved during the years and the release of an improved version 2 was possible only because suggestions from users were carefully evaluated and implemented.

As with feature 53, feature 54 (now L03) includes a reduced number of parts because a single standard for all environments has been established. (L03 is also characterized by new content compared to feature 54). Changing from precondition to optimization leads to a more difficult process in order to meet the criteria. In fact, the minimum levels of EML have been significantly raised and the application of these levels has been extended to 100%. In

version 1 meeting 75% of the levels was sufficient. Despite the demotion to optimization, L03 remains among the most important categories regarding the health and well-being of individuals. This is denoted by the fact that by fulfilling only one category it is also possible to obtain precondition L01.

In conclusion, feaure 54/L03 has been downgraded to optimization but it is now more complete, efficient and strict.

### 5.2.4 Feature 55 Electric Light Glare Control/L04 Glare Control

Discomfort glare is defined in WELL as due to "*excessive brightness of the light-source, excessive brightness-contrasts and excessive quantity of light*"; this phenomenon can be linked to uneven levels of brightness within the field of view of an observer. The luminance of electric light sources is measured in cd/m$^2$ and the potentially resulting glare effects can be calculated with lighting specification sheets or can be measured directly on site with appropriate tools (IWBI, 2017c) (IWBI, 2018(3)) .

*Table 5.9Electric Light Glare Control (v1)*

| **ELECTRIC LIGHT GLARE CONTROL** | | | |
|---|---|---|---|
| **WELL v1** | | | |
| **Feature 55** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurance** | **Annotated documents** | **On-site assessment** |
| **1) Luminaire Shielding**<br>Shielding for lamps in regularly occupied spaces must observe the shielding angles that can be found here. | Architect | | |
| **2) Glare Minimization**<br>One of the following requirements have to be met (check here). | Architect | | |

*Table 5.10 Glare Control (v2)*

<table>
<tr><th colspan="4">GLARE CONTROL</th></tr>
<tr><th colspan="4">WELL v2</th></tr>
<tr><th colspan="4">L04</th></tr>
<tr><th colspan="2" rowspan="2">Part requirement</th><th colspan="2">Verification</th></tr>
<tr><th>Letter of assurance</th><th>Annotated documents</th><th>On-site assessment</th></tr>
<tr><td colspan="2">1) Control Solar Control<br>For all spaces</td><td rowspan="2"></td><td rowspan="2">1) Policy document<br>2) Modeling report</td><td rowspan="2"></td></tr>
<tr><td>1.1) Window shading<br>All the requirements that can be found here have to be met.</td><td>1.2) Glare calculation<br>The requirement that can be found here has to be followed.</td></tr>
<tr><td colspan="2" rowspan="2">2) Manage Glare from Electric Lighting<br>For all spaces, each luminaire have to meet one of the requirements that can be found here.</td><td colspan="3">Photographic Verification</td></tr>
<tr><td>Architect</td><td></td><td></td></tr>
<tr><td colspan="2"></td><td colspan="3">Photographic Verification</td></tr>
</table>

Feature 55 concerning the Electric Light Glare Control is part 2 of L04 Glare Control in the newest version. Even this feature has been changed from precondition to optimization.

Only part 2 of L04 reflects feature 55 of version 1, specifically the one regarding “Manage Glare from Electric Lighting”. It is evident that the ways of meeting the requirements have increased despite the fact that from 2 parts it is now only 1. In this specific case, it seems that the change from precondition to optimization made it easier to achieve the standard. In fact only one of the offered alternatives has to be satisfied to obtain the highest score. Finally, regarding the documentation required to prove the fulfillment of the prescriptions, a copy of a document signed by the designing architect during the confirmation of the project is all that is needed. It is very easy to obtain such document as it is readily available on line under section L04 in Light WELL v2. Another important innovation is to attach pictures as proof.

The maximum score obtainable for L04 is 3 but, if you fulfill both parts the maximum score is 4. From the analysis it is not clear what happens if you obtain a score of 4.

To summarize, the criteria to be met in the Glare control section of version 2 has become less strict but more severe in terms of the documentation to be presented.

### 5.2.5 Feature 56 Solar Glare Control/ L04 Glare Control

Other than contributing to the entrainment of the circadian system, bright natural light exposure during the day can improve mood and mental health. However, uneven and/or excessive levels of brightness can cause discomfort and visual fatigue. Usually, in the built environment, the problem of solar glare control is connected to unproperly protected sunlight directly hitting the eye of an observer or reflecting on internal or external surfaces (IWBI, 2017d), (IWBI, 2018(4)).

*Table 5.11 Solar Glare Control (v1)*

| SOLAR GLARE CONTROL | | | |
|---|---|---|---|
| **WELL v1** | | | |
| **Feature 56** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurance** | **Annotated documents** | **On-site assessment** |
| **1) View Window Shading**<br>At least one of the following is present for all glazing less than 2.1m above the floor regularly occupied spaces (check here). | Architect | | Spot check |
| **2) Daylight Management**<br>At least one of the following is required for all glazing greater than 2.1 m above the floor (check here). | Architect | | Spot check |

*Table 5.12 Glare Control (v2)*

| GLARE CONTROL | | | |
|---|---|---|---|
| **WELL v2** | | | |
| **L04** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurnace** | **Annotated documents** | **On-site assessment** |
| **1) Control Solar Control**<br>For all spaces | | 1) Policy document | |

| | | | | |
|---|---|---|---|---|
| **1.1) Window shading**<br>All the requirements that can be found here, have to be met. | **1.2) Glare calculation**<br>The requirement that can be found here, has to be followed. | | 2) Modeling report | |
| | | Photographic Verification | | |
| **2) Manage Glare From Electric Lighting**<br>For all spaces, each luminaire have to meet one of the following requirements (check here). | | Architect | | |
| | | Photographic Verification | | |

Feature 56 Solar Glare Control is now L04 Glare Control in WELL v2. They tried to merge F55 and F56 in a single feature in fact they are both included in L04. Even F56 is now an optimization and it has been simplified to meet the required standards (only one part needs to be satisfied compared to two in version 1). It is however more strict in terms of the type of documentations requested that certifies what has been decided during the project planning. In addition to the above mentioned phographic portfolio a modeling report and a policy document are also required.

Briefly, the developers tried on one hand to simplify and on the other to make the required documentation more precise and complete.

### 5.2.6 Feature 58 Color Quality/L07 Electric Light Quality

Color quality is connected to the spectral power distribution (SPD) of a light source, to the absorbance/reflectance of an object and, also, to the specific sensitivity of the eye's photoreceptors. The common unit of measurement for color quality is the Color rendering index (CRI), capturing all the colors from R1 to R9 (usually, R9 is not reported, and it explains how it is perceived the saturation of warmer hues) (IWBI, 2017e), (IWBI, 2018(5)).

*Table 5.13 Color Quality (v1)*

| **COLOR QUALITY** | | | |
|---|---|---|---|
| **WELL v1** | | | |
| **Feature 58** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurnace** | **Annotated documents** | **On-site assessment** |

| | | | |
|---|---|---|---|
| **1) Color Rendering Index**<br>To enhance occupant comfort all the electric lights have to meet the following requirement, (check here). | Architect | | |

*Table 5.14 Electric Light Quality (v2)*

| **ELECTRIC LIGHT QUALITY** | | | | |
|---|---|---|---|---|
| **WELL v2** | | | | |
| **L07** | | | | |
| **Part requirement** | | **Verification** | | |
| | | **Letter of assurnace** | **Annotated documents** | **On-site assessment** |
| **1) Ensure Color Renering Quality** | | Architect | | |
| **1.1) For all spaces except circulation areas**<br>At least one of the following color rendering requirements have to be met (check here). | **1.2) For circulation areas**<br>At least one of the following color rendering requirements have to be met, (check here). | | | |
| **2) Manage Fliker**<br>For all spaces, all electric lights used in regularly-occupied spaces, have to meet at least one of the following requirements, (check here) | | Architect | | |

Feature 58 Color Quality became part 1 of L07 Electric Light Quality. It remains an optimization but it is now more strict. In fact, the predetermined levels of color rendering obtained through electric lighting are no longer applicable to all the environments but, there is now a distinction between all spaces and circulation areas. The documentation required remains the same (a letter of assurance = LoA written by the signing architect).

To sum up, improvements are included in different aspects of the feature but are mostly reflected by the new schematic order and a more accurate explanation of the requirements.

### 5.2.7 Feature 60 Automated Shading and Dimming Control/L08 Occupant Control of Lighting Environment

Automated control over window shades and lights (e.g., with dimmers) can be conducive to the avoidance of glare and to foster energy savings. A customizable lighting

environment can also help to improve productivity, mood and well-being, meeting occupants' preferences and requirements for visual comfort (IWBI, 2017f), (IWBI, 2018(6)).

*Table 5.15 Automated Shading and Dimming Control (v1)*

| AUTOMATED SHADING AND DIMMING CONTROL | | | |
|---|---|---|---|
| **WELL v1** | | | |
| **Feature 60** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurnace** | **Annotated documents** | **On-site assessment** |
| **1) Automated Sunlight Control** All windows that measure 0,55 m2 have to meet the following requirement, (check here). | MEP | | |
| **2) Responsive Light Control** In all major workareas the following requirement have to be met, (check here). | MEP | | |

*Table 5.16 Occupant Control of Lighting Environment (v2)*

| OCCUPANT CONTROL OF LIGHTING ENVIRONMENT | | | |
|---|---|---|---|
| **WELL v2** | | | |
| **L08** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurnace** | **Annotated documents** | **On-site assessment** |
| **1) Enhance Occupant Controllability** Ambient Lighting system have to meet the following requirements in all regularly occupied spaces, (check here). | | Professional narrative | |
| | Photographic Verification | | |
| **2) Provide Supplement Lighting** The following requirements have to be met, (check here). | | Policy document | |
| | Photographic Verification | | |

Feature 60 Automated Shading and Dimming Control is now L08 Occupant Control of Lighting environment, more specifically part 2 of F60 is now part 1 of L08 (see table 5.15 and 5.16).

The criteria is the same and it is mandatory for all environments while the LoA MEP (Mechanical Electrical and Plumbing) has been replaced by a letter from experts.

There are major differences between version 1 and 2 regarding this matter in fact L08 is mostly new to version 2. It is therefore hard to compare the two.

### 5.2.8 Feature 61 Right to Light/L05 Enhanced Daylight Access

Being exposed to a good amount of daylight is very important for health and well-being. The scientific evidence is supported by subjective occupant reports. It is therefore fundamental to provide daylight access for the majority of internal spaces, considering daylight from the early design stages of the lighting environment. Daylight is also an integral requirement for alignment of the circadian rhythm (IWBI, 2017g), (IWBI, 2018(7)).

*Table 5.17 Right to Light (v1)*

| RIGHT TO LIGHT | | | |
|---|---|---|---|
| **WELL v1** | | | |
| **Feature 61** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurnace** | **Annotated documents** | **On-site assessment** |
| **1) Lease Depth**<br>The following requirement has to be met, (check here). | | Architectural drawing | Spot check |
| **2) Window Access**<br>The following conditions have to be met, (check here). | | Architectural drawing | Spot check |

*Table 5.18 Enhanced Daylight Access (v2)*

| DAYLIGHT ENHANCED ACCESS | | | |
|---|---|---|---|
| **WELL v2** | | | |
| **L05** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurnace** | **Annotated documents** | **On-site assessment** |
| **1) Implement Enhanced daylight Plan** | | Architectural drawing | |

| | | | | |
|---|---|---|---|---|
| **1.1) For all spaces except Dwelling units**<br>At least one of the following requirements have to be met in each floor, (check here). | **1.2) For dwelling units**<br>The following requirement has to be met in each dwellin unit, (check here). | | | |
| **2) Implement Enhanced Daylight Simulation** | | | | |
| **2.1) For all spaces except Dwelling units**<br>The following requirement has to be met, (check here). | **2.2) For dwelling units**<br>The following requirement has to be met in each dwelling unit, (check here). | | Modeling report | |
| **3) Ensure Views**<br>Views have to meet two of the following requirements, (check here). | | | Architectural drawing | |

Feature 61 Right to Light has been replaced by L05 L05 Daylight Enhanced access. Three new parts are now included in this feature.

First, minimal percentages of lighting transparency (?) have been added and make the fulfilment of this part more difficult. In addition, minimal parameters for working environments and apartments have been described. In terms of documentation, it is now only necessary to show the architectural designs and to report models to justify the choices made and obtain a maximum score. A formal inspection was previously required. Lastly, as for L04, the new program establishes that the maximum score obtainable is 3 while the sum of the points from all parts is 4. Differently from L04, there are three parts with respectively 1- 2- 1 maximum obtainable points. This way the design team has more room to choose the parts that would fit better with their project.

This new feature has been extensively changed and it is now more complete and detailed than version 1. It is harder to meet the requirements but it is an optimization and as such is at the discrection of the project team to pursue it or not.

### 5.2.9 Feature 62 Daylight Modelling/L05 Daylight Enhanced Access/L04 Glare Control

As said before, it is important to consider the effects of daylight along a day as well as along an entire year in order to make occupants comfortable during all the seasons. For this, there is a need is to find the right balance between the Spatial Daylight Autonomy (sDA) and Annual Sun exposure (ASE). (IWBI, 2017h), (IWBI, 2018(7)), (IWBI, 2018(4)).

*Table 5.19 Daylight Modeling (v1)*

| DAYLIGHT MODELING | | | |
|---|---|---|---|
| **WELL v1** | | | |
| **Feature 62** | | | |
| **Part requirement** | **Verification** | | |
| | **Letter of assurnace** | **Annotated documents** | **On-site assessment** |
| **1) Healthy Sunlight Exposure** Throughout lighting simulations it has be demonstrated that at least one of the following requirements have met, (check here). | | Modeling report | |

(L05 Daylight Enhanced Access check subchapter 5.2.7)

(L04 Glare Control check subchapter 5.2.4)

Feature 62 Daylight Modeling has been replaced by part 2 of L05 e in part by L04 and the new version is completely different from the previous one and it makes the comparison very difficult.

# CHAPTER 6

## 6 Discussion

Although this reseach has brought some important insights in the structure and development of two certification systems, Level(s) and WELL, before generalizing its conclusions, and transferring its findings to other rating schemes, some limitations should be acknowledged.

First of all, the methodology chosen for this research has been based on the consultation of online documentation supported by the promoters and developers of the rating schemes. This was indeed a reasoned choice in the attempt to replicate the process that a designer would undertake in applying such systems to the design (or renovation) of a building. However, if a methodological bias might be hypothesized due to the use of material that was directly published by the organisms responsible for the systems analyzed, this limitation has been substantially mitigated by complementing the review of the criteria embedded in each system with a vast body of references from the scientific literature.

The following section aims at explaining more clearly what was learned from this analysis regarding building certification systems. The analysis resulted in a non consistent result but at the same time it can provide a careful comparison between the different certification programs, the non-commercial ones, Level(s), and the commercial ones, WELL v1 and v2

The majority of the green building certification systems tried for a long time to satisfy the designer needs only in terms of building performance. Unfortunately, this lead to neglecting the happiness of the users of these buildings (Sergio Altomonte, 2017). The newer generation of the green building certification programs like WELL are trying to implement the certifications with increased attention to the well-being of the individuals occupying the buildings.

Every new program is trying to overcome this limitationand at the same time attempting to keep up with the progress of science in terms of sustainability and human health. However, it is often hard to reach a great building performance and at the same time meeting all the minimal requirements to obtain a green building certification. Some studies regarding the satisfaction of the occupants (IEQ, Indoor Environmental Quality) in LEED (2.0, 2.1,2.2) certified buildings showed that a direct correlation between high scores in the above certification and the user satisfaction was not always present (Sergio Altomonte, 2017). There are several factors that could have played a role in in the results of the studies but it is clear that improvements in the certification plans are making the direct correlation more likely.

Additionally, it is important to mention that the systems are regulating various aspects of the project, from the initial design to the final evaluation after occupation. This is likely the reason for various shortcomings in the final outcome but, a careful evaluation and a constant update of the standards will most likely solve the issue (Sergio Altomonte, 2017).

## 6.1 Understandings about Level(s) framework.

Through the analysis of the framework Level(s), it became clear what were the strenghts and what the weaknesses of this EU program. The analysis went from the basic principles on which the program was founded on, the nature of the plan, the structure of the program and the procedure needed to carry it out.

What is described in chapter 2 regarding Level(s) allows to understand the differences between the different kind of programs. Level(s) is a non commercial plan and it is completely free. It aims at bringing awareness to the entire construction field. The idea of "circular economy" is the focal point of this program. "Circular economy" is the evaluation of a building during its entire life time, "Life Cycle Assessment, LCA", from the origin of the used materials to their disposal (Nicholas Dodd, 2017). More specifically, the "Cradle to cradle" approach aims at diminishing the ever-increasing amount of waste and wants to promote a manufacturing sector that protects nature and its organisms (William McDonough, 2002). Moreover, Level(s) is a self-evaluating tool and not a certification program which makes its application different and more open. The project manager has the freedom to decide which level to follow and the EU commission provides the tools and the framework.

It is important to mention that Level(s) is a pilot program and the trial period will end in 2019 (exact date not specified).

## 6.2 WELL v1 and WELL v2

WELL v1 and v2 are the perfect example of a program that tries to satisfy a great energetic performance and a careful design to improve the mental and physical health of the occupants. Clearly, pushing the boundaries of the design requirements that are necessary to support human health and well-being needs also to consider some of the recurrent issues that often severely impact the translation of design principles into actual building strategies (e.g., the availability of specialized competence, budgets, etc.). As a matter of fact, a building standard that is too restrictive for building designers and operators to achieve might actually deter from the implementation of strategies conducive to health and quality of life for all. It is therefore in this context of accessibility that the translation of many preconditions into

optimizations, from version 1 to version 2 of WELL, needs to be contextualized, even if putting in place stricter requirements clearly goes into the direction of improved performance for the benefits of buildings and their users.

The detailed analysis of the Light criteria is a clear example. It is in fact, more accesible than the previous one, it provides more clear requests and rules. However, after meeting the requirements for the precondition, the criteria for the optimization have become more strict and harder to fulfill.

In conclusion, even if the green building certification system is complicated, convoluted and has to meet many different criteria at the same time, it keeps up with the medical and scientific progress and, it represents a way to increase the awareness about the importance of the mental and physical well being of the individuals inside the buildings.

# CHAPTER 7

## 7 Conclusions

This master thesis has been developed in the department of "Architecture et Climat" in Louvain la Neuve, Belgium, and describes two completely different way of talking about "Green Building Certification systems": Level(s) and WELL. More precisely this dissertation reports history, structure and methodology to pursue this building assessments.

Based on literature, papers and website this thesis states that:

- Level(s) is a good try for EU commission to try to sensitize European country towards sustainability matters and circular economy thinking
- WELL is a performance-based system that wants to combine best practice in design and construction with evidence-based medical and scientific research.
- WELL focuses not only on energy performance but also on health, wellness and well-being of occupants

Also, the conclusions driven in terms of the development of the rating schemes - for example the comparison of the evolution between the version 1 and 2 of the WELL standard - have been uniquely based on a critical reflection on the requirements necessary for the fulfilling of each feature. Clearly, a direct verification of the outcomes in terms of building performance and impacts on health and well-being of users would be required to objectively measure and quantify the effectiveness of all the criteria described. This paves the way for further research, based on the collection of field study data from monitored buildings, that is necessary to support the further development of rating schemes that can effectively facilitate the inclusion of principles of circular economy and occupants' health and well-being among their drivers and priorities.

This research provides a solid starting point for professionals to carry out the important practical test. The follow up of this work will lean on the practical concretization of the certification program, or one of its features. This will effectively demonstrate whether the newer version is indeed improved and whether the willingness at making it more accessible is actually pursued. This could be accomplished by engineers, architects or professionals invested in this specific topic.

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