MSc Program Environmental Technology & International Affairs

Application of LEED to Austrian Buildings: a Case-Study

A Master's Thesis submitted for the degree of
"Master of Science"

supervised by
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Vienna, 17/06/2009

Affidavit

I, **KLAUS KOGLER**, hereby declare

1. that I am the sole author of the present Master's Thesis, "APPLICATION OF LEED TO AUSTRIAN BUILDINGS: A CASE-STUDY", 118 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 17.06.2009

Signature

Abstract

Sustainability rating tools for buildings have been spreading increasingly wide over the globe, but they have hardly found any recognition throughout continental Europe so far. According to Cheriyan (2008), European countries, including Austria, are succeeding with energy efficient building constructions, but common established criteria for an ecological and comprehensive building evaluation are not available.

In order to analyse the potential of a Leadership in Energy and Environmental Design (LEED) certification on a building construction in Austria, as an example of a country usually not following US design standards, firstly the most significant implications on the project scheduling are identified; and secondly contractual implications are discussed. Subsequently an office building in Vienna is taken into consideration. After a short presentation of the LEED certification, the criteria of LEED for New Construction are examined in regard of their applicability to the case study building. This analysis aims at identifying the impacts LEED would have had, if it had been considered right from the project beginning.

It is found that the case study building has performance in the relevant categories as follows: weak performance in Water Efficiency, Materials & Resources; average performance in: Sustainable Sites; and exceptionally good performance in: Energy & Atmosphere, Indoor Environmental Quality, and Innovation & Design Process. In total, up to 48 points are identified as being attainable for the case study building, reaching LEED gold certification level according to LEED for New Construction, Version 2.2.

In regard of the documentation effort, the introduced analysis is limited to the additional costs – the so called soft costs – of obtaining a “green” building certificate. In the case study additional costs like fees for registration, certification and additional man-power are estimated, as required to perform the LEED certification successfully. In total, an additional budget requirement of approx. $ 143,600 (€ 103,000) was identified for the 71,000 sq.ft. (6,500 m²) net floor area case study.

Acknowledgements

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1. Introduction

1.1 Background on Building Certification and Introduction to LEED

Green buildings have less negative impact on the environment and increase the well being of its occupants. Renewable materials are used for construction, the building is well connected to the public transport infrastructure, and the operation costs are lower than for comparable standard buildings. Overall, it is proven that well designed and constructed buildings, which also are considering environmental aspects, reduce overhead costs, increase employee productivity and reduces absenteeism. According to Lockwood in the *Harvard Business Review* of June 2006:

> *"Companies as diverse as Bank of America, Genzyme, IBM, and Toyota are constructing or have already moved into green buildings. Green is not simply getting more respect; it is rapidly becoming a necessity as corporations – as well as home builders, retailers, health care institutions, governments, and others – push green buildings fully into mainstream over the next five to ten years."*

First in the UK and then in the US comprehensive building rating tools have been developed, to have a check on new and existing infrastructure projects. Those tools find increasingly spread in accordance with the above statement from Lockwood, 2009, but still have not spread to continental Europe yet. According to Cheriyan (2008), European countries, including Austria, are succeeding with energy efficient building constructions, but common established criteria for an ecological and comprehensive building evaluation are not available.

Sustainability building rating systems are a demand side approach to "green" the building sector. Rather than imposing regulations, rating guidelines offer a reference system one can comply voluntarily with. Besides this, most rating tools have at its core an inventory analysis, but may largely vary in their range of application; from very specific to a single product, to very wide covering a whole building incl. infrastructure utilities and local transport.

The first and most widespread building assessment is the Building Research Establishment Environmental Assessment Method (BREEAM), which was launched in the UK in 1990. Many other tools have been developed since then, like the Total

Quality (TQ) Standard in Austria, the Green Building Standard launched by the European Commission, the Leadership in Energy and Environmental Design (LEED) in the United States, or the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) which is mainly applied at buildings in Japan. According to a report by the Pacific Northwestern National Laboratory (PNNL, 2006) more than 50 tools have been developed to support, carry out Life Cycle Assessment or perform related analysis

The Leadership in Energy and Environmental Design (LEED) belongs to the most comprehensive tools available globally. Originally designed to transform the United States building sector, via a bottom up approach and impact on the respective industries, it has meanwhile developed to a building rating tool with comparable recognition to BREEAM. Both rating standards have a similar scope of application, not only including office buildings, but also such for retail and non commercial use, as well as for already existing objects. Both require and facilitate an integrated design process, and take into consideration not only the building as a whole, incl. finishes and interfaces related to the surrounding infrastructure and environment.

Since the economic downturn in 2008, the business with internationally acknowledge rating systems has been increasing significantly. Investors and owners have become more focused on “sustainable investments” and an increasing demand has been recognised by the civil engineering branch and international consultancy firms. This new trend is the main reason for choosing that topic for my master thesis, as well as its relevance to my current job, as a project manager at iC consulenten (http://www.ic-group.org), which received a LEED Platinum related design order last year.

This master thesis aims at providing a first insight into the Leadership in Energy & Environnmental Design (LEED) building rating system for stakeholders in Austria, or in a wider picture, to other countries usually not following US design standards as well. The objective is also to provide guidance for the first step decision making, through identifying key characteristics and loopholes and possible challenges, which an investor, owner, the design team or other stakeholders may face especially with the first projects.

1.1.1 LEED in its Broader Sense

The methodological approach of building rating system is not comparable to a Life Cycle Assessment according to ISO 14040. LEED, like most other comprehensive

tools was developed by a non-profit organisation – The U.S. Green Building Council USGBC) in order to "green" the building sector. The council was formed in 1993 by stakeholder including architects, building product manufacturers, owners, contractors and environmental groups strongly interested in promoting green buildings in the U.S. The USGBC is a committee-based, voluntary, nongovernmental organisation.

Launched for the first time in 1998, the LEED pilot programme reflected much more the stakeholder's positions, than a system based on a conceptual scientific methodology. (Scheuer and Keoleian, 2002); but from the beginning it carried the vision, and served as a marketing tool for green building. Meanwhile several revisions have been introduced. The latest revision was published in May 2009, which for the first time has reflected the LCA related impact criteria in a quantitative way. In brief, the latest revision is promoted the following (USGBC, 2008):

> *The LEED 2009 weighting system represents an incremental attempt to integrate the existing structure of LEED with an analytical assessment of building impacts. The system represents a series of compromises to accommodate goals for market transportation, consideration for building impacts, operational constraints, and system design requirements. Consequently, it represents a complex mixture of quantitative analysis, rules, policies, and values. Fortunately, this process can be described in details and is ultimately transparent with regard to its assumptions and outcomes. The LEED 2009 system provides a first step toward a dynamic, content-depended weighting system.*

LEED has also become more specialised offering at present distinctive rating procedures as follows: LEED for New Constructions, LEED for Existing Buildings, LEED Commercial Interiors, LEED Core and Shell, as well as LEED for Homes and LEED Neighbourhood developments. For each of these specialised procedures, degrees from LEED "certified" to LEED "platinum" can be awarded by the USGBC, upon review, and approval of the respective documentation. Taking into consideration the fact, that LEED is in most cases associated with new developments, or major renovation projects, this master thesis focuses in its advancement solely on LEED for New Construction (NC, 2006).

1.1.2 Award of the Certificate

LEED for New Construction is characterised by 6 sustainability categories. Each category is further defined by Credits[1], which are in turn weighted by points.

Category	Credits	Points
Sustainable Sites	8	14
Water Efficiency	3	5
Energy & Atmosphere	6	17
Materials & Resources	7	13
Indoor Environmental Quality	8	15
Innovation in Design	2	5

Depending on the total points achieved from all the sustainability categories the building is awarded according to the following scale:

Certified	26 – 32 points
Silver	33 – 38 points
Gold	39 – 51 points
Platinum	52 – 69 points

Certification is done by the USGBC, acting as a third party certification office. Independent of the sustainability category the points are added up and certification is awarded accordingly. Thus, LEED for New Construction provides certain flexibility in where to achieve points, and how many. Investors and owners are generally interested in "Which is the sustainability category, where most points could be achieved at the lowest marginal capital costs?" Accordingly to the significant impact of the targeted certification level, it is vital to define the targeted certification level at an early stage in the project, to keep additional costs at a minimum. See also sections 3.2 to 3.4 of this master thesis.

1.2 Objective and Research Questions

This master thesis aims at providing a first insight into the Leadership in Energy & Environmental Design (LEED) building rating system for stakeholders in Austria, or in a wider picture, to other countries usually not following US design standards as well. The objective is also to provide guidance for the first step decision making,

[1] A single credit may also be split into sub-credits for documentation purposes.

through identifying key characteristics and loopholes and possible challenges, which an investor, owner, the design team or other stakeholders may face especially with the first projects. In emphasising this, the following key questions are addressed:

- Which procedural steps have to be followed for a successful certification and how does the certification impact on the overall project scheduling and contract requirements?
- What are the limits of LEED when being applied on a building in Austria?
- How much additional effort does an LEED building certification require?
- Could LEED help defining more clearly design targets in regard to energy efficiency measures and the application of renewable energies?
- At which project stage should an owner/investor decide to go for LEED certification at best?

1.3 Demarcations and Study Approach

The findings presented in this master thesis are results of the reference guide investigation for New Construction. Limits are set to the scientific methods in the depth of this analysis considering the given timeframe of approx. 2 months.

For LEED specific issues, the LEED reference guide for New Construction, Version 2.2, Second Edition September 2006, and related documents, was used. Accordingly the scope of this master thesis is limited by the scope of the reference guide, namely devoted to new constructions. Major renovations were not taken into consideration, although most of the findings below may easily be transferred to those as well. Besides the reference guide, other primary, but mainly secondary literature was used to substantiate this work. The respective literature is listed in chapter 5. For linking the overall findings of the reference guide analysis with its potential application on a building in Austria, a case study building analysis was performed. Based on the design drawings and a personal interview with the resident engineer, the suitability of LEED credits on a building in Austria was discussed. By discussing the documentation requirement for two credits in more detail, potential caveats of documentation, its effort and challenges on the way to LEED certification are exemplified.

1.4 Master Thesis Organisation

Chapter 1 provides a brief outline on the present situation of the green building rating schemes, and distinguishes rating systems to the well promoted term life cycle assessment. Furthermore it provides an introduction to the US Leadership in Energy and Environmental Design.

Chapter 2 describes with the procedural steps required when going for LEED, discusses possible implication on the overall project scheduling and also identifies some possible major contractual implications.

Chapter 3 summarises the credit requirements and links these with the case study building in Vienna. By means of discussing the documentation requirement for two credits in more detail, potential caveats of documentation, its effort and challenges on the way to LEED certification are exemplified.

Chapter 4 concludes.

Chapter 5 contains the bibliography, list of tables, list of figures.

Chapter 6 lists the appendices.

2. Procedural Steps till Certification and Possible Implications on the Project Scheduling

This chapter summarises the most significant steps till certification, especially focusing on those which are considered having an impact on the overall project scheduling, and/or are contractually significant for the owner.

2.1 Procedural Steps till Certification

LEED for New Construction is characterised by a two-phase application, namely the phase till design related documentation submission, and the phase till submission of the construction related documentation. The design submittal at the USGBC is merely for checking the likelihood of credits achieved by the design.[2] Certification is not obtained hereafter, nor will any credits be awarded. The construction phase review on the other hand is the final evaluation step by the USGBC. In case of any changes during the construction phase, related to a design submission documentation made for the design review, this part of the project related design submission documentation has to resubmitted. The construction phase review requires the whole documentation and can be finished approx. 10 months after substantial completion at earliest, if post occupancy credits are applied.

Following the reference guide, the most significant steps are firstly to do the online-registration at the USGBC webpage, and next to prepare the respective documentation for the design submittal. But in fact, implementing a LEED strategy is rather a process, than a follow up step by step procedure till certification. LEED distinguishes for some credits between buildings below a gross floor area of 50,000 sq.ft.. (4,500 m^2), and above. For the larger ones the salient steps till LEED certification can be summarised as follows:

a. USGBC web-based registration. Once registered, a project is officially recognised as applying for LEED. The communication with the USGBC is web-based (www.usgbc.org), including documentation submittals, appeals,

[2] It has to be noted, that not all credits are eligible for a design phase review, but only those which are covered by the design. Thus e.g. a credit related to Indoor Chemical & Pollutant Source Control (EQc5) can not be assessed at the design phase review, as by its nature it is part of the post-construction phase.

clarification requests, and the certification. Although there is no reference to a deadline for registration, it is highly recommended to register at the USGBC once the decision is made to apply LEED on a project. Furthermore it is recommended to involve an experienced LEED professional, or LEED AP[3], in order to coordinate the whole process, as well as to to provide guidance throughout.

b. Design considerations. In parallel to the registration, or slightly later, the LEED certification level has to be clearly communicated to the design-team, and the other parties concerned. In case of LEED gold and LEED platinum building certification additional design considerations are required, that could be either directly included into the initial design contract, or if decided later, into an additional contract.

c. Commissioning. Independent of the targeted LEED certification level, a commissioning review is required by a third party professional, or for projects below 50,000 sq.ft. (4,500 m²) a senior engineer of the design team can take the role of the commissioning authority. The commissioning authority provides a review of the detailed design and all construction documents (quality assurance), but according to the LEED reference guide has no executive power over the design team; except otherwise contractually specified. The commission-ability review continues during the construction phase, however expands in man-power.

d. Documentation. Hardly depended on the size of the project, the documentation effort for design and construction phase submittal documentation is significant.

Summarising the process steps till the LEED certification, it has to be also noted, that each of those steps is clearly defined in the reference guide, or a referenced standard. An LEED experienced party should be taken on board at the very beginning of the project in order to coordinate all those steps and to keep all the responsibilities within the project clearly assigned to the project members.

[3] LEED Accredited Professional

2.2 Implications on the Project Scheduling

Regardless of the contractual dimension, in general, building construction projects can be divided into the following project phases: Phase 1: Project definition; Phase 2: Design; Phase 3: Construction; Phase 4: Post-Construction.

Figure 1: Project Phases

For the purpose of this study possible overlaps of the four phases and the respective sub-phases are not considered. The four project phases characteristically comprise of the following sub-phases:

Project definition (Baretta, 2009):

- *Discovery: the identification and analysis of project requirements and constraints*
- *Integration: the description of the project and the plan (including an estimate of cost and time for delivering it)*

Design (Baretta, 2009):

- *Schematic design: the basic appearance and plan*
- *Design development: an evolution of design that defines the functional and aesthetic aspects of the project and the building systems that satisfy them*
- *Construction drawings and specifications: the details of assembly and construction technology*

Construction (Baretta, 2009):

- *Procurement: the purchasing, negotiation or bid and award of contracts to construct the project*
- *Shop drawings: the final fabrication drawings for building systems*
- *Fabrication, delivery and assembly: the manufacture and installation of the building components*
- *Site construction: the labour-intensive field construction and the installation of systems and equipment*

Post-Construction (Michigan University, 2009)

- Operations review: monitoring and verification of the building operations from substantial completion till closure of a project
- Post-occupancy review: post occupancy interviews, or questionnaire, based on experience and satisfaction made

Figure 2 visualises the phasing incl. sub-phasing as described above and also includes the most significant process steps for achieving LEED certification.

During the design phase the commissioning authority plays a vital role by reviewing drawings and preparing relevant documents. In larger projects this service can be made equal to a design review, conventionally performed by a client's representative engineering or consultancy firm, and thus no significant additional budget would be required. In parallel, or even slightly earlier, a design documentation process has to be started, by preparing the LEED respective documents for the online submission at the USGBC webpage.

During the construction phase, either the commissioning authority from the design phase can further be in charge of the ongoing construction review; in case of a larger project it is recommended to extend this position to a team involving an expert of each discipline involved in the construction. The construction phase documentation has to be reported from the first works on site, that can be a demolition (recycling of material), site clearance from trees, or excavation. Both, the commissioning team review and the construction documentation continue after substantial completion. Furthermore it is shown, that LEED covers the post-construction phase also quite well by operations review and post-occupancy reviews, till closure of a project.

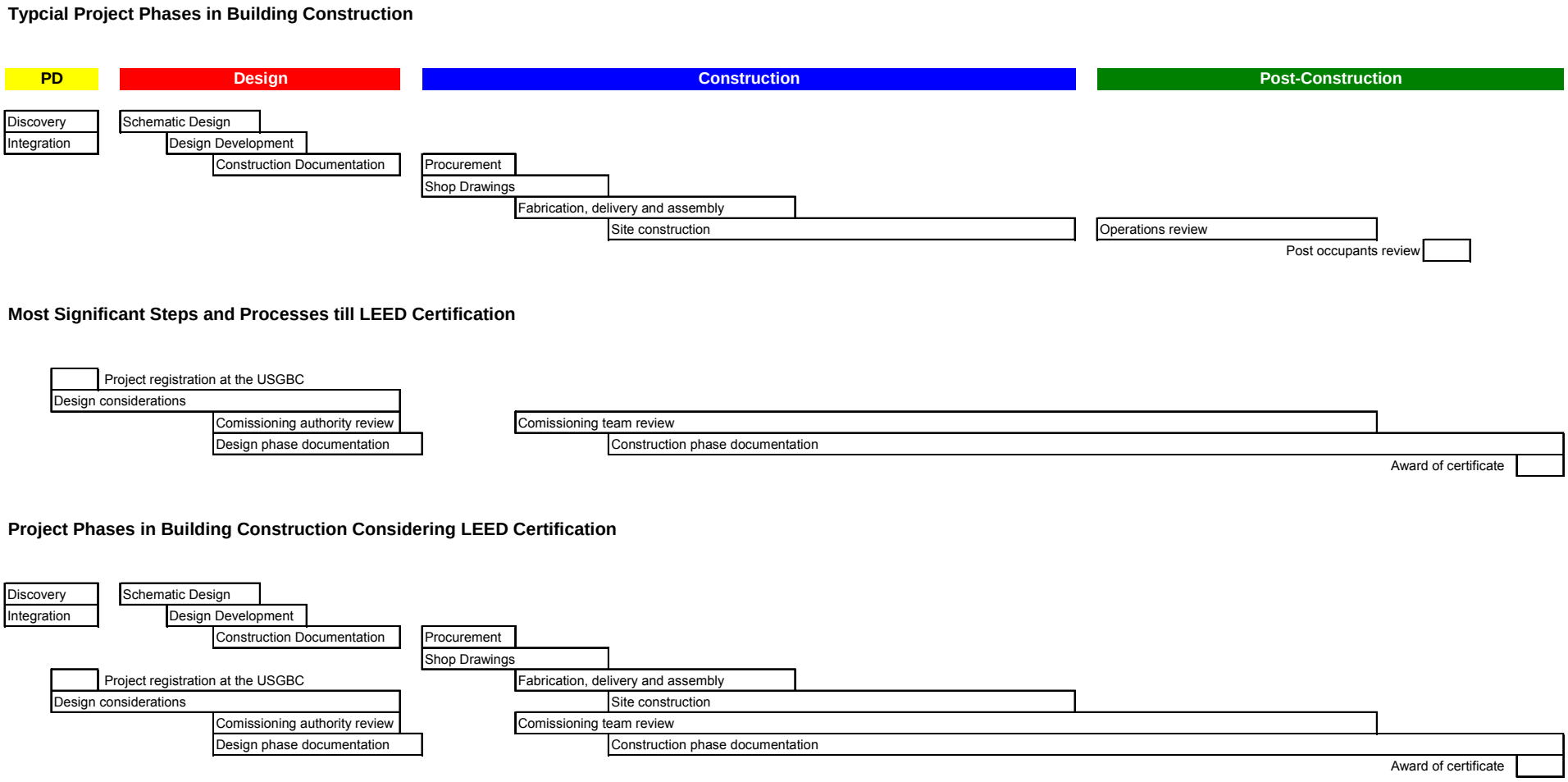

Figure 2: Project Phasing and Implications of LEED

2.3 Contractual Implications

The above outlined implication on the project scheduling can also be linked to a budgetary requirement. Accordingly, this section aims at the introduction of the major contractual implications when applying LEED on a building construction project. As a reference, a typical two-contract design-bid-build project strategy has been chosen. Firstly, figure 3 briefly outlines the two major contracts required for project delivery. Secondly, it shows the minimum of the contract requirements when considering LEED for a building project.

The four lines under the LEED minimum contractual requirements represent the LEED most significant project steps as identified in section 2.2 of this master thesis. Right from the beginning, a LEED experienced professional, or LEED AP should be contracted to coordinate the project throughout all its steps till the certification, and also to be personally in charge of being interface between the USGBC. but furthermore to consult the design team and others parties involved in all questions regarding LEED. This position could be taken either by a single person, by a team or a company

Following the LEED for New Construction, the building design is considered as an inevitable prerequisite for successful LEED certification award, and thus a certain budget for the design team has to be provided, which should be planned in collaboration with the LEED project administrator, the design team, and in accordance with the clients´ (Owner, Investor) expectations. This will not require an additional contract, but consideration as an additional cost item in the design team contract

The commissioning authority has to be a third party engineer, who has commissioning experience in not less than two similar projects. For small projects this position may be taken by one senior member of the design team. However, in case of a project larger than a gross floor area of 50,000 sq.ft.. (4,500 m²) a third party engineer or company is required for this task. Depending on the size and complexity of a project, a single person can be contracted for the design phase review, although it is more likely that two or three experts from different disciplines are required to perform a sound review. In contrast to the design phase, for the constructional and operational reviews (construction and post-construction phase) a whole commissioning team is needed, which in the majority of cases involves a

single representative of each discipline involved in the construction, and the commissioning authority as the commissioning team coordinator.

The LEED documentation is represented in the fourth bar, and does not have to be underestimated in regard of its effort. In general it is a task of the design team to perform a detailed LEED documentation, being allowed by a separate cost item. However, for very complex, and/or large projects this task may be shared with the LEED experienced party, or a company. The construction phase documentation can be done by the design team, or issued to the contractor.

Figure 4 combines the LEED respective considerations in project scheduling, and the contractual implications as discussed above. Furthermore, additional illustrated cycles have been added, representing control loops and feedback reviews, which have to be interdisciplinary. Moreover, and as well as a hint, the best appropriate time for the decision on whether to go for LEED, or not, was marked.

For earning LEED at the lowest capital costs it is recommended to set a clear environmental target and an adequate budget right at the beginning of a project. Moreover, it is being recommended to make sure the overall team is focused on the LEED goal, and rather perform engineering for Life Cycle Values, than focusing o the initial investment costs (BRGOV, 2007). See also appendix 6.4: *The Economic Case of High Performance Buildings* (Johnson, 2000).

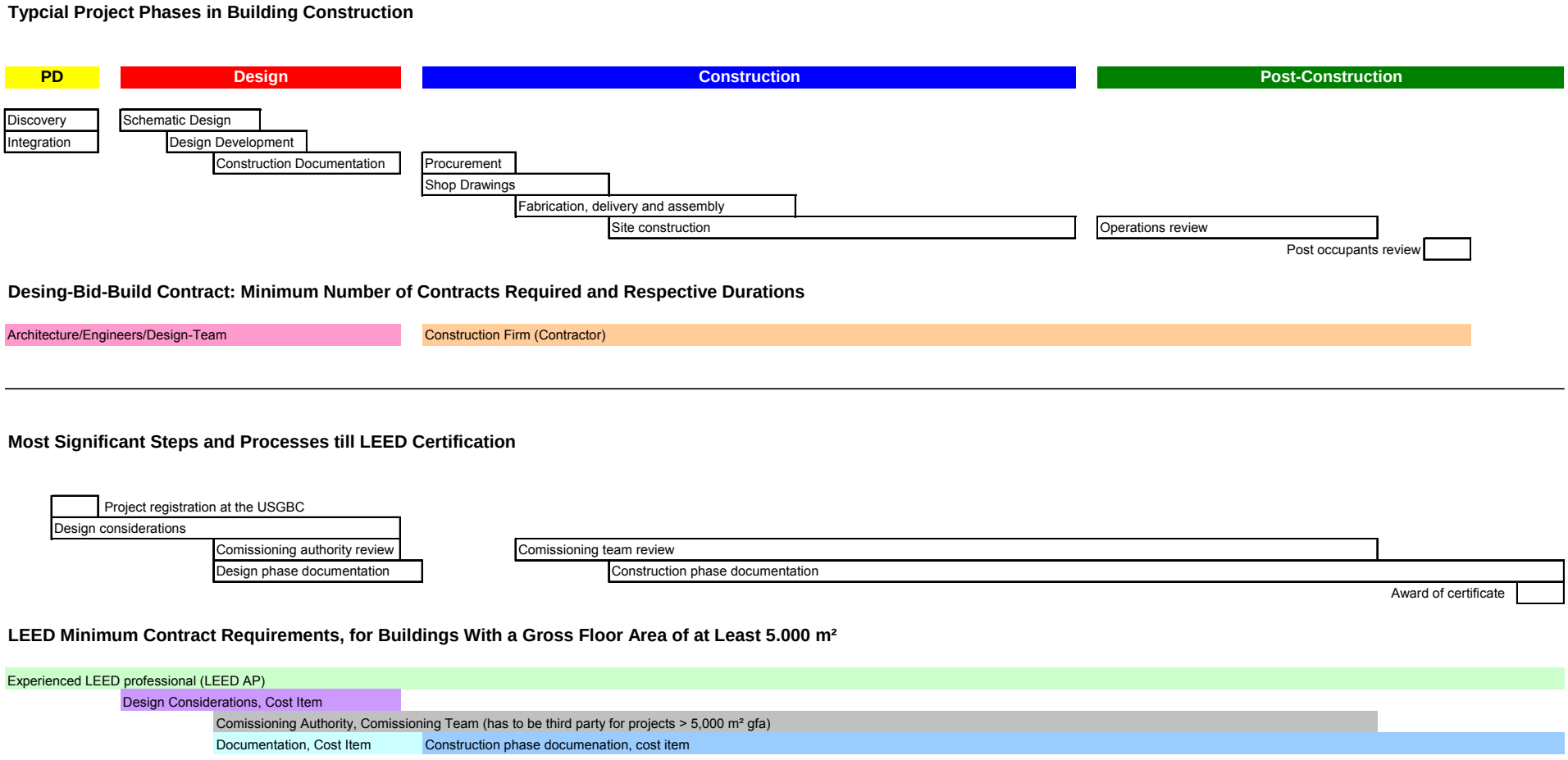

Figure 3: Minimum Number of Contracts required for a Typical Design-Bid-Build Project and major Contract Requirements for LEED

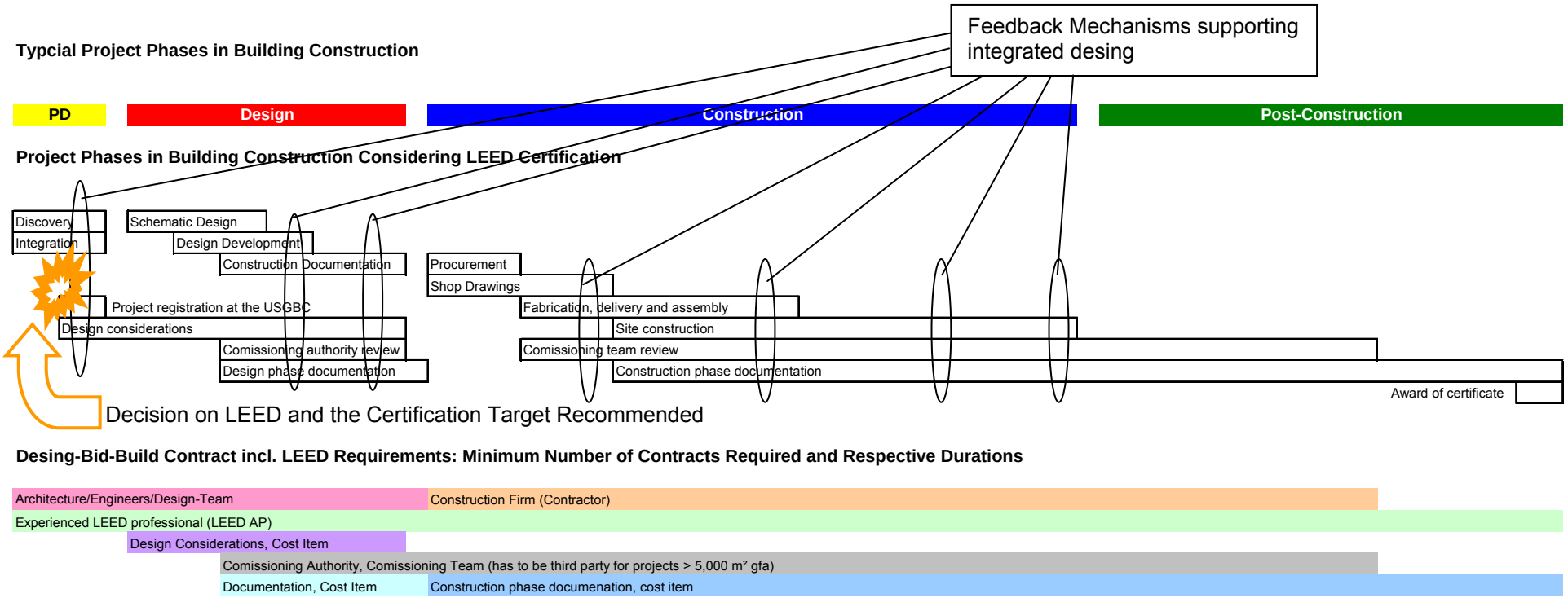

Figure 4: LEED: Implications on the overall Project Scheduling, Contractual Implications, Decision for LEED and Interactions

3. Case Study in Austria and Effort of Certification

The following chapter provides an detailed introduction of the credit requirements for a LEED certification. In section 3.2, an office building of the business park EURO PLAZA in Vienna is introduced as a case study, including the limitations/restriction of applying for LEED in a country like Austria, where the design codes and standards are usually different from these in the US.
Under 3.3, two credits are further discussed in detail, showing what documentation is required by the USGBC web-based credits submission. Furthermore, the documentation efforts required for achieving all the eligible credits in the case of the case study are estimated in two groups as follows:

- Group A: The effort of documentation is assumed to be less than 1 man-day, and no additional design/modelling/reports has/have to be prepared for documentation reasons only.
- Group B: The effort of documentation is assumed to be more than 1 man-day, and some additional design/modelling/reports is/are required.

Section 3.4 includes the findings of this chapter, extended by additional literature and a breakdown of the major cost items.

3.1 Categories and Credit Requirements

As introduced in section 1.1.2 of this master thesis, LEED for New Construction addresses 6 major categories. Each of them is equivalent to certain credits, which in turn are weighted in points, as follows:

Category	Credits	Points
Sustainable Sites	8	14
Water Efficiency	3	5
Energy & Atmosphere	6	17
Materials & Resources	7	13
Indoor Environmental Quality	8	15
Innovation in Design	2	5

Furthermore some categories have specified several mandatory prerequisite criteria, which have to be met in any case, otherwise the LEED certification won't be granted. This section provides a closer look at each of the credits and prerequisites. The summaries added below, present a short resume of the credit summaries, placed in the reference guide for LEED New Construction, Version 2.2, but revised in order to achieve a better understanding when interpreting them.

At this point, it is important to point out once again, that LEED for New Construction does not give any defaults, in exactly which categories points are to be earned. Once the decision about the LEED certification level is taken, it is up to the project parties discretion (owner, investor and design team), to agree on where to collect a sufficiently high number of points to achieve the targeted level.

Category: Sustainable Sites (SS)

SS Prerequisite 1: Construction Activity Pollution Prevention

Aim: Prevent loss of soil during construction by storm water runoff and/or erosion including protection topsoil by stockpiling for reuse. Prevent sedimentation of storm sewer or receiving streams. Prevent polluting the air with dust and particulate matter.

Strategy: Create an Erosion and Sedimentation Control Plan during the design phase of the project. Consider employing strategies such as temporary and permanent seeding, mulching, earth dikes, silt fencing, sediment traps and sediment basins.

SS Credit 1: Site Selection

Aim: Avoid development of inappropriate sites and reduce the environmental impact from the location of a building on a site.

Strategy: Give preference to those sites that do not include sensitie site elements and restrictive land types. Select a suitable building location and design the building with the minimal footprint to minimize site disruption of those environmentally sensitive areas. See LEED reference guide for the definition of sensitive areas.

SS Credit 2: Development Density & Community Connectivity

Aim: To channel development to urban areas with existing infrastructure, protect Greenfield and preserve natural habitat and natural resources.

Strategy: Give preference to urban sites with pedestrian access to a variety of services like: Bank, Place of Worship, Convenience Grocery etc.

SS Credit 3: Brownfield Redevelopment

Aim: Rehabilitate damaged sites where development is complicated by environmental contamination.

Strategy: Identify tax incentives and property cost savings. Coordinate site development plan with remediation activity, as appropriate.

SS Credit 4.1: Alternative Transportation – Public Transportation Access

Aim: Reduce pollution and land development impacts from automobile use.

Strategy: Perform a transportations survey of future building occupants to identify transportation needs. Site the building near mass transit.

SS Credit 4.2: Alternative Transportation – Bicycle Storage & Changing Rooms

Aim: Provide secure bicycle racks at the building and showers, to reduce pollution and land development impact from automobile use.

Strategy: Design the building with transportation amenities such as bicycle racks and showering/changing facilities.

SS Credit 4.3: Alternative Transportation – Low-Emitting & Fuel-Efficient Vehicles

Aim: Reduce pollution and land development impacts from automobile use.

Strategy: Provide low-emitting, fuel efficient vehicles, or preferred parking area for low-emitting, fuel efficient vehicles, or provide refuelling stations

SS Credit 4.4: Alternative Transportation – Parking Capacity

Aim: Reduce pollution and land development impacts from single occupancy vehicle use.

Strategy: Minimise the parking lot/garage size. Consider Sharing parking facilities with adjacent building. Consider alternatives that will limit the use of single occupancy vehicles.

SS Credit 5.1: Site Development – Protect or Restore Habitat

Aim: Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

Strategy: On Greenfield sites, perform a situ survey to identify site elements and adopt a master plan for development of the project site. Minimise the building footprint, and establish clearly marked construction boundaries. Use native, or adapted plants, instead of invasive once.

SS Credit 5.2: Site Development – Maximize Open Space

Aim: Provide a high ratio of open space to development footprint to promote biodiversity.

Strategy: Perform a site survey to identify site elements and adopt a master plan for development of the project site. Select a suitable building location and design the building with a minimal footprint to minimize site disruption. Provide tuck –under parking and sharing facilities with neighbours to maximize open space on the site.

SS Credit 6.1: Stormwater Management – Quantity Control

Aim: Limit disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, and managing storm water runoff.

Strategy: Design the project site to maintain natural storm water flows by promoting infiltration. Specify vegetated roofs, pervious paving, and other measures to minimize impervious surfaces. Reuse storm water volumes generated for non-potable uses such as landscape irrigation, toilet and urinal flushing and custodial uses.

SS Credit 6.2: Stormwater Management – Quality Control

Aim: Reduce or eliminate water pollution by reducing impervious cover, increasing onsite infiltration, eliminating sources of contaminants, and removing pollutants from storm water runoff.

Strategy: Use vegetated roofs, pervious pavement, rain gardens and other alternatives to promote infiltration. Design natural and mechanical treatment systems to treat storm water runoff.

SS Credit 7.1: Heat Island Effect – Non-Roof

Aim: Reduce heat island (thermal gradient differences between developed and undeveloped areas) to minimize impact on microclimate and human and wildlife areas.

Strategy: Shade construction surfaces on the site with landscape features and utilize high –reflectance materials for hardscape.

SS Credit 7.2: Heat Island Effect – Roof

Aim: Reduce heat island to minimize impact on microclimate and human and wildlife areas.

Strategy: Consider installing high-albedo and vegetated roofs to reduce heat absorption. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C

SS Credit 8: Light Pollution Reduction

Aim: Minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve night-time visibility through glare reduction and reduce development impact on nocturnal environments.

Strategy: Adopt site lighting criteria to maintain safe light levels while avoiding off-site lighting and night sky pollution. Minimize site lighting where possible and model the site lighting using a computer model. Technologies to reduce light pollution include full cut-off luminaries, low-reflectance surfaces and low-angel spotlights.

Category: Water Efficiency (WE)

WE Credit 1.1: Water Efficient Landscaping – Reduction by 50 %

Aim: Limit or eliminate the use of potable water, or other natural surface or subsurface wate resources available on, or near the project site, for landscape irrigation.

Strategy: Perform a soil/climate analysis to determine appropriate plant material and design the landscape with native or adapted plants to reduce or eliminate irrigation requirements. Utilize rainwater, recycled grey water, or water treated and conveyed by a public agency specifically for non-potable uses.

WE Credit 1.2: Water Efficient Landscaping – No Potable Water use or No Irrigation

Aim: Eliminate the use of potable water, or other natural surface or subsurface water resources available on or near the project site, for landscape irrigation.

Strategy: Either install landscape that does not require irrigation, or use secondary source non-potable water, like storm water, grey water, and/or condensate water or irrigation.

WE Credit 2: Innovative Wastewater Technologies

Aim: Reduce generation of wastewater and potable water demand, while increasing the local aquifer recharge.

Strategy: Specify high-efficiency fixtures and dry fixtures such as composting toilet systems and non-water using urinals to reuse wastewater volumes. Consider reusing storm water or gray water for sewage conveyance or non-site wastewater treatment systems.

WE Credit 3.1: Water Use Reduction -20 %

Aim: Maximise water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Strategy: use high-efficient fixtures, dry fixtures such as composting toilet systems and non-water using urinals, and occupant sensors to reduce the potable water demand. Consider reuse of storm water and grey water for non-potable applications such as toilet and urinal flushing and custodial uses.

WE Credit 3.2: Water Use Reduction -30 %

Same like 3.1, but with -30 % target.

Energy & Atmosphere (EA)

EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems

Aim: Verify that the building energy related systems are installed, calibrated and perform according to the owner's project requirements, basis of design and construction documents. Commissioning review is one of major distinct processes, as identified under section 2.1 of this master thesis. Benefits of commissioning include reduced energy use, lower operating costs, reduced contractor call-backs, better building documentation, improved occupant productivity, and verification that the systems perform in accordance with the owner's project requirements.

Strategy: In order to meet this prerequisite, owners are required to use qualified individuals to lead the commissioning process. Furthermore owners are encourages to consider including water-using systems, building envelope systems, and other systems in the scope of the commissioning plan as appropriate. The building envelope is an important component of a facility which impacts energy consumption, occupant comfort and indoor air quality. While it is not required to be commissioned by LEED, an owner can receive significant financial savings and reduced risk of poor indoor air quality by including building envelope commissioning.

The Reference Guide for New Construction, Version 2.2 provides guidance on the rigor expected for this prerequisite for the following: a.) Owners Project Requirements; b.) Basis of Design; c.)Commissioning Plan; d.) Commissioning Specification, e.) Performance Verification Documentation; f.) Commissioning Report

EA Prerequisite 2: Minimum Energy Performance

Aim: Establish the minimum level of energy efficiency for the proposed building and systems.

Strategy: Design the building envelope, HVAC, lighting and other systems to maximize energy performance. The ASHRAE 90.1-2004 Users Manual contains worksheets that can be used to document compliance with this prerequisite.

EA Prerequisite 3: Fundamental Refrigerant Management

Aim: Reduce ozone depletion.

Strategy: Specify equipment that uses no CFC refrigerants.

EA Credit 1: Optimise Energy Performance

Aim: Achieve increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

Strategy: Design the building envelope and systems to maximize energy performance. Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures. Quantify energy performance as compared to a baseline building according to ASHRAE 90.1-2004.

EA Credit 2: On-Site Renewable Energy

Aim: Encourage and recognise increasing levels of on-site renewable energy self-supply in order to reduce environmental and economic impacts associated with fossil fuel energy use.

Strategy: Assess the project for non-polluting and renewable energy potential including solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies. Achieve at least 2.5 % of the overall energy required, in terms of local energy costs, on site.

EA Credit 3: Enhanced Commissioning

Aim: Begin the commissioning process early during the design process and execute additional activities after systems performance verification is completed. Higher quality assurance than achieved by EA prerequisite 1: Fundamental Commissioning.

Strategy: Prior to the start of the construction documents phase, designate an independent Commissioning Authority (CxA) to lead, review, and oversee the completion of all commission process activities. Although it is preferable that the Commissioning Authority (CxA) be contracted by the Owner, for the enhanced commissioning credit, the CxA may also be contracted through the design firms or construction management firms not holding construction contracts. The reference guide for New Construction, Version 2.2, provides detailed guidance on the rigor expected for following process activities: a.) Commissioning design review; b.) Commission submittal review; c.) System manual. . Commissioning review is one of major distinct processes, as identified under section 2.1 of this master thesis.

EA Credit 4: Enhanced Refrigerant Management

Aim: Reduce ozone depletion and support early compliance with the Montreal Protocol, while minimising direct contributions to global warming.

Strategy: Design and operate the facility without mechanical cooling and refrigeration equipment. Where mechanical cooling is used, utilize base building HVAC and refrigeration system for the refrigeration cycle that minimize direct impact on ozone depletion and global warming. Utilize fire suppression systems that do not contain HCFCs or Halons.

EA Credit 5: Measurement & Verification

Aim: Provide for the ongoing accountability of building energy consumption over time.

Strategy: Develop and implement a Measurement & Verification (M&V) Plan as specified in the International Performance Measurement & Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003. The M&V period shall cover a period of no less than one year of post-construction.

EA Credit 6: Green Power

Aim: Encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis.

Strategy: Provide at least 35 % of the buildings electricity from renewable sources by engaging in at least a two-year renewable energy contract.

Materials & Resources (MR)

MR Prerequisite 1: Storage & Collection of Recyclables

Aim: Facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills.

Strategy: Provide an easily accessible area that serves the entire building and is dedicated to the collection and storage of non-hazardous materials for recyclnig, including (at a minimum) paper, corrugated cardboard, glass, plastics and metals.

MR Credit 1.1: Building Reuse: Maintain 75 % of Existing Walls, Floors & Roof

Aim: Extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as the relate to materials manufacturing and transport.

Strategy: Maintain at least 75 % (based on surface area) of existing building structure and envelope. Consider reuse of existing, previously occupied buildings. Remove elements that pose contamination risk to building occupants and upgrade components that would improve energy and water efficiency such as windows, mechanical systems and plumbing fixtures.

MR Credit 1.2: Building Reuse: Maintain 95 % of Existing Walls, Floors & Roof

Same like MRc1.2, but with -95 % target.

MR Credit 1.3: Building Reuse: Maintain 50 % of Interior Non-Structural Elements

Aim: Extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impact of new buildings as the relate to material manufacturing and transport.

Strategy: Reuse existing interior non-structural elements in at least 50 % of the completed building.

MR Credit 2.1: Construction Waste Management: Divert 50 % From Disposal

Aim: Divert construction and demolition debris from disposal in landfills and incinerators. Redirect recyclable recovered resources back to the manufacturing process. Redirect reusable materials to appropriate sites.

Strategy: Recycle and/or salvage at least 50 % of the non-hazardous construction and demolition.

MR Credit 2.2: Construction Waste Management: Divert 75 % From Disposal

Same like MRc2.1, but with 75 % target.

MR Credit 3.1: Material Reuse: 5 %

Aim: Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extrication and processing of virgin resources.

Strategy: Use salvaged, refurbished or reused materials such that the sum of these materials constitutes at least 5 %, based on cost, of the total value of materials on the project.

MR Credit 3.2: Material Reuse: 10 %

Same like MRc3.1, but with 10 % target.

MR Credit 4.1: Recycled Content: 10 % (post-consumer + ½ pre-consumer)

Aim: Increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials.

Strategy: Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10 % (based on cost) of the total value of the materials in the project.

MR Credit 4.2: Recycled Content: 20 % (post-consumer + ½ pre-consumer)

Same like MRc4.1, but with 20 % target.

MR Credit 5.1: Regional Material: 10 % Extracted, Processed & Manufactured Regionally

Aim: Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation.

Strategy: Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles (310,7 km) of the project site for a minimum of 10 % (based on cost) of the total materials value.

MR Credit 5.2: Regional Material: 20 % Extracted, Processed & Manufactured Regionally

Same like MRc5.1, but with 20 % target.

MR Credit 6: Rapidly Renewable Materials, Specify 2.5 %

Aim: Reduce the use and depletion of finite raw material and long-cycle renewable materials by replacing them with rapidly renewable materials.

Strategy: Establish a project goal for rapidly renewable materials and identify products and suppliers that can support achievement of this goal. Consider materials such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheat board, strawboard and cork.

MR Credit 7: Certified Wood

Aim: Encourage environmentally responsible forest management.

Strategy: Use a minimum of 50 % of wood-based materials and products, which are certified in accordance with the Forest Stewardship Councils (FSC) Principles and Criteria, for wood building components.

Indoor Environmental Quality (EQ)

EQ Prerequisite 1: Minimum IAQ Performance

Aim: Establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants.

Strategy: Design ventilation systems to meet or exceed the minimum outdoor air ventilation rates as described in ASHRAE standard.

EQ Prerequisite 2: Environmental Tobacco Smoke (ETS) Control

Aim: Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to Environmental Tobacco Smoke (ETS).

Strategy: Prohibit smoking in commercial buildings or effectively control the ventilation air in smoking rooms. Fro residential buildings, prohibit smoking in common areas, design building envelope and system to minimise ETS transfer among dwelling units.

EQ Credit 1: Outdoor Air Delivery Monitoring

Aim: Provide capacity for ventilation system monitoring to help sustain occupant comfort and well-being.

Strategy: Install carbon dioxide and airflow measurement equipment and feed the information to the HVAC system and/or Building Automation System (BAS) to trigger corrective action, if applicable.

EQ Credit 2: Increased Ventilation

Aim: Provide additional outdoor air ventilation to improve indoor air quality for improved occupant comfort, well-being and productivity.

Strategy: Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30 % above the minimum rates required by ASHRAE Standard 62.1-2004 as determined by EQp1.

EQ Credit 3.1: Construction IAQ Management Plan: During Construction

Aim: Reduce indoor air quality problems resulting from the construction/renovation process in order to help sustain the comfort and well being of construction workers and buildings occupants.

Strategy: Develop an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building as follows. a.) During construction meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 1995, Chapter 3. b.) Protect stored on-site or installed absorptive materials from moisture damage. C.) If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 shall be used at each return air grill, as determined by ASHRAE 52.2-1999.

EQ Credit 3.2: Construction IAQ Management Plan: Before Occupancy

Aim: Reduce indoor air quality problems resulting from the construction process in order to help sustain the comfort and well-being of construction workers and building occupants.

Strategy: After construction ends, prior to occupancy and with all interior finished installed, perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area (4,260 m^3/m^2) while maintaining an internal temperature of at least 60 °F and relative humidity not higher than 60 %. Or perform an IAQ testing according to the reference guide for New Construction, Version 2.2.

EQ Credit 4.1: Low-Emitting Materials: Adhesives & Sealants

Aim: Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-begin of installers and occupants.

Strategy: Specify low-VOC materials in construction documents. Ensure that VOC limits are clearly stated in each section of the specifications where adhesives and sealants are addressed.

EQ Credit 4.2: Low-Emitting Materials: Paints & Coatings

Aim: Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-begin of installers and occupants.

Strategy: Specify low-VOC paints and coatings in construction documents.

EQ Credit 4.3: Low-Emitting Materials: Carpet Systems

Aim: Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-begin of installers and occupants.

Strategy: All carpet installed in the building interior shall meet the testing and product requirements of the Carpet and Rug Institutes' Green Label Plus program.

EQ Credit 4.4: Low-Emitting Materials: Composite Wood & Agrifiber Products

Aim: Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-begin of installers and occupants.

Strategy: Specify wood and agrifiber products that contain no added urea-formaldehyde resins.

EQ Credit 5: Indoor Chemical & Pollutant Source Control

Aim: Minimize exposure of building occupants to potentially hazardous particulates and chemical pollutants.

Strategy: Design facility cleaning and maintenance areas with isolated exhaust systems for contaminants.

EQ Credit 6.1: Controllability of Systems: Lighting

Aim: Provide a high level of lighting system control by individual occupants or by specific groups in multi-occupant spaces, to promote the productivity, comfort and well-being of building occupants.

Strategy: Provide individual lighting controls for 90 % (minimum) of the building occupants, or lighting system controllability for all shard multi-occupant spaces.

EQ Credit 6.2: Controllability of Systems: Thermal Comfort

Provide a high level of thermal comfort system control by individual occupants or by specific groups in multi occupant spaces to promote the productivity, comfort and well-being of building occupants.

Strategy: ASHRAE Standard 55-2004 identifies the factors of thermal comfort and a process for developing comfort criteria for building spaces that suit the needs of the occupants involved in their daily activities. Control strategies can be developed to expand on the comfort criteria to allow adjustments to suit individual needs and preferences.

EQ Credit 7.1: Thermal Comfort: Design

Aim: Provide a comfortable thermal environment that supports the productivity and wellbeing of building occupants.

Strategy: Establish comfort criteria per ASHRAE Standard 55-2004 that support the desired quality and occupant satisfaction with building performance.

EQ Credit 7.2: Thermal Comfort: Verification

Aim: Provide for the assessment of building thermal comfort over time.

Strategy: Agree to implement a thermal comfort survey of building occupants within a period of six to 18 months after occupancy.

EQ Credit 8.1: Daylight & Views: Daylight for 75 % of Space

Aim: Provide for the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

Strategy: Achieve a minimum glazing factor of 2 % in a minium of 75 % of all regularly occupied areas. The glazing factor can be calculated as specified in the reference guide, or a strategy can be chosen, of modelling daylight illumination level throughout the regular occupied spaces.

EQ Credit 8.2: Daylight & Views: Daylight for 90 % of Space

Aim: Provide for the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and vies into the regularly occupied areas of the building.

Strategy: Achieve direct line of sight to the outdoor environment via vision glazing for 90 % of all regularly occupied areas.

Innovation in Design (ID)

ID Credit 1-1.4: Innovation in Design

Aim: To provide design teams and projects the opportunity to be awarded points for exceptional performance.

Strategy: Substantially exceed a LEED for New Construction performance credit such as energy performance of water efficiency. Apply strategies or measures that demonstrate a comprehensive approach and quantifiable environmental and/or health benefit.

ID Credit 2: LEED Accredited Professional

Aim: To support and encourage the design integration required by a LEED for New Construction green building project and to streamline the application and certification process.

Strategy: At least one principal participant of the project team shall be a LEED Accredited Professional (LEED AP)

3.2 Case Study and LEED Compliance Analysis

For exemplifying the LEED certification requirements an office building in Vienna (Wagenseilgasse 14 / Lehrbachgasse 6, 1120 Vienna) has been taken into consideration as a case study. The above mentioned office building is a part of the business park EURO PLAZA, a building complex expanded on approx. 212.000m² net floor area in 10 office buildings. The office building used for this case study, owned by Kapsch Immobilien GmbH , has 6 floors above ground and 2 floors below, with a total net floor area of approx. 71,000 sq.ft. (6,500 m²).

- The aim of this section is not to deliver a detailed LEED compliance analysis, but rather to identify whether LEED credits are in general applicable on constructions in Austria.

- An identification of which impact an LEED application may have when it would have been considered right from the design beginning, is made bellow.
- Furthermore, the additional documentation effort is estimated in man-days.

Keeping an eye on these three points, an excel spreadsheet is developed in order to compare the LEED requirements with the building specification of the office building, mentioned above. The compliance check is done with the strong support of the resident engineer Mr. Christoph Trenner, who accompanied the construction as clients representative construction project manager[4]. By reading the summaries as specified in the excel sheet, the following questions were answered:

a) Is the respective prerequisite/credit applicable? This question aims at answering, whether the project in general would allow for attaining this credit, or not. Considering e.g. SSc3, Brownfield Redevelopment, in case that site would not be identified as a Brownfield, according to the reference guide there is no chance to attain this credit, as it is simply no applicable.

b) In case a prerequisite/credit is identified being applicable, then it is asked, if certain design considerations were taken in this regard. In case of e.g. EQc6.1 Controllability of Systems, Lighting: Has a system been installed that satisfies LEED requirements? The design considerations are briefly summarised in the column “design considerations”.

c) As stated above, points were either allocated directly (in case LEED respective requirements are achieved), or if applicable, and possibly attained, points were assigned to the category “?”. When a credit is achievable, but not achieved, a point is given in the column “NO”. In case that a point is identified as not being applicable (NA), also if hypothetically considered right from the beginning (see also paragraph a. above), then NA is noted in the “NO” column.

(For further details on the analysis, please see the attached excel spreadsheet: *Case Study Analysis, LEED for New Construction Project Checklist)*

A summary of the final results is presented in figure 5 (see below), which shows 15 points that are considered of being very likely gained, if LEED was considered right

[4] For project delivery, a design-bid-build contract procedure was followed, however, this was not taken into consideration in the case study analysis

Yes	?	No				
5	5	4	**Sustainable Sites**		**14** Points	**Effort**
Y			Prereq 1	**Construction Activity Pollution Prevention**	Required	B
1			Credit 1	**Site Selection**	1	A
1			Credit 2	**Development Density & Community Connectivity**	1	A
1			Credit 3	**Brownfield Redevelopment**	1	A
1			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1	A
		1	Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1	A
	1		Credit 4.3	**Alternative Transportation**, Low-Emitting and Fuel-Efficient Vehicles	1	A
	1		Credit 4.4	**Alternative Transportation**, Parking Capacity	1	A
		1	Credit 5.1	**Site Development,** Protect of Restore Habitat	1	A
		1	Credit 5.2	**Site Development,** Maximize Open Space	1	A
	1		Credit 6.1	**Stormwater Design,** Quantity Control	1	A
		1	Credit 6.2	**Stormwater Design,** Quality Control	1	A
	1		Credit 7.1	**Heat Island Effect,** Non-Roof	1	A
	1		Credit 7.2	**Heat Island Effect,** Roof	1	A
1			Credit 8	**Light Pollution Reduction**	1	B

Yes	?	No				
	1	2	**Water Efficiency**		**5** Points	**Effort**
		NA	Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1	A
		NA	Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1	A
		1	Credit 2	**Innovative Wastewater Technologies**	1	A
	1		Credit 3.1	**Water Use Reduction**, 20% Reduction	1	A
		1	Credit 3.2	**Water Use Reduction**, 30% Reduction	1	A

Yes	?	No				
1	13	1	**Energy & Atmosphere**		**17** Points	**Effort**
Y			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required	B
Y			Prereq 2	**Minimum Energy Performance**	Required	B
Y			Prereq 3	**Fundamental Refrigerant Management**	Required	A
1	9		Credit 1	**Optimize Energy Performance**	1 to 10	B
		1	Credit 2	**On-Site Renewable Energy**	1 to 3	A
	1		Credit 3	**Enhanced Commissioning**	1	B
	1		Credit 4	**Enhanced Refrigerant Management**	1	A
	1		Credit 5	**Measurement & Verification**	1	B
	1		Credit 6	**Green Power**	1	A

Yes	?	No				
1	6	6	**Materials & Resources**		**13** Points	**Effort**
Y			Prereq 1	**Storage & Collection of Recyclables**	Required	A
		1	Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1	B
		1	Credit 1.2	**Building Reuse**, Maintain 100% of Existing Walls, Floors & Roof	1	B
		1	Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1	B
	1		Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1	B
	1		Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1	B
		1	Credit 3.1	**Materials Reuse**, 5%	1	B
		1	Credit 3.2	**Materials Reuse**,10%	1	B
	1		Credit 4.1	**Recycled Content**, 10% (post-consumer + ½ pre-consumer)	1	B
		1	Credit 4.2	**Recycled Content**, 20% (post-consumer + ½ pre-consumer)	1	B
1			Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured Regior	1	B
	1		Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured Regior	1	B
	1		Credit 6	**Rapidly Renewable Materials**	1	A
	1		Credit 7	**Certified Wood**	1	A

Yes	?	No				
8	6	**1**	**Indoor Environmental Quality**		**15** Points	**Effort**
Y			Prereq 1	**Minimum IAQ Performance**	Required	A
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required	A
1			Credit 1	**Outdoor Air Delivery Monitoring**	1	A
1			Credit 2	**Increased Ventilation**	1	A
		1	Credit 3.1	**Construction IAQ Management Plan**, During Construction	1	B
	1		Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1	B
	1		Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1	B
	1		Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1	B
	1		Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1	B
	1		Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1	B
	1		Credit 5	**Indoor Chemical & Pollutant Source Control**	1	A
1			Credit 6.1	**Controllability of Systems**, Lighting	1	A
1			Credit 6.2	**Controllability of Systems**, Thermal Comfort	1	A
1			Credit 7.1	**Thermal Comfort**, Design	1	A
1			Credit 7.2	**Thermal Comfort**, Verification	1	B
1			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1	B
1			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1	B
Yes	?	No				
	2		**Innovation & Design Process**		**5** Points	**Effort**
	1		Credit 1.1	**Innovation in Design**: Provide Specific Title	1	A
			Credit 1.2	**Innovation in Design**: Provide Specific Title	1	A
			Credit 1.3	**Innovation in Design**: Provide Specific Title	1	A
			Credit 1.4	**Innovation in Design**: Provide Specific Title	1	A
	1		Credit 2	**LEED® Accredited Professional**	1	A
Yes	?	No				
15	33		**Project Totals** (pre-certification estimates)		**69** Points	

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52-69 points

Figure 5: Case Study Analysis, Project Checklist Summary

from the project beginning (project definition phase). Another 33 points were identified being possibly within reach, and were assigned to the category “?”. All in all up to 48 points have been identified being reasonably attainable, after careful consideration for the case study building in the Wagendseilgasse 14. The remaining 21 points have been identified as hardly being achievable considering due to the current design concept. 2 out of those 21 points are identified as inapplicable. In regard to the latter, it has to be stressed, that those are generally being considered attainable as well, but not under the existing design concept. Taking all these findings into account, an LEED gold certification is likely to be achievable for an office building design in Austria.

For the analysis of the possible additional effort of LEED certification of the case study, only the additional effort was considered. Accordingly the additional investments, or design effort to save more water were not taken into consideration, as those are considered being an inherent part, and directly linked to the measure itself. However, if e.g. a light simulation is carried out in order to proof credit compliance with SSc8, Light Pollution Reduction, then this improvement is considered as an additional effort for documentation purposes. In case that all credits are applicable on a building, up to 38 credits (incl. prerequisites and ID) are identified as having a documentation requirement of up to 1 man-day, and the rest 27 - more than this. Within the case study used in this master thesis 26 credits were identified with an effort belonging to group A, and the rest 20 with an effort belonging to B (See also the definitions of group A and group B at the beginning of chapter 3). In other words it means that he required additional effort for achieving LEED for a building comparable to this from the case study, is more than 46 man-days. The expected documentation effort is depicted in the column “Effort” of figure 5 above.

3.3 Exemplified Documentation and Documentation Requirements

This section presents the effort, caused by the documentation requirements when going for LEED, by choosing 2 credits related to the case study and then discussing the credit compliance in the sections 3.3.1 and 3.3.2, respectively. The first documentation requirement considered in detail concerns the Sustainable Site Credit 4.1: Alternative Transport, Public Transportation Access. It is one of least time consuming requirements with an effort of well below one man-day. The second one is related to the Energy and Atmosphere Credit 1: Optimised Energy Performance, it is one of the most cost-consuming credits and requires a lot of work additional to the original design.

3.3.1 Documentation Requirement for the SSc4.1 – Alternative Transportation, Public Transport Access

The reference guide for New Construction, Version 2.2 requires either a project location with ½ mile (804.5 m) distance from existing – or planned and funded – commuter rail, lightrail or subway station, or one with ¼ mile (402.25 m) distance from a public (or campus) bus station

As figure 6 shows bellow, in the case study (Wagenseilgasse 14.) more than the required connections are available – one sub-way station and two fast train stations (for urban and suburban connection) only about ½ mile away from the building. As a reference, the credit compliance submittal template has been completed, and attached to this master-thesis (see section 6.3).

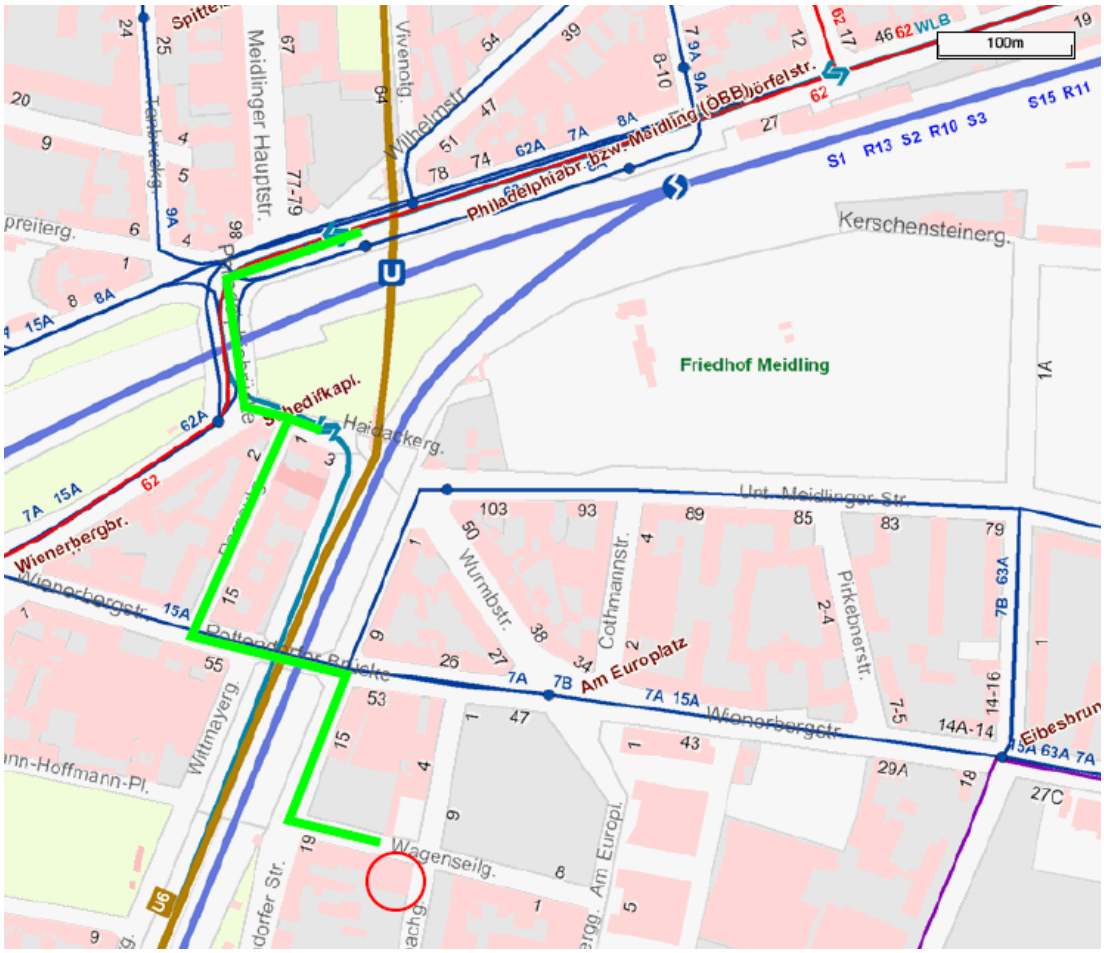

Figure 6: Site plan, Wagenseilgasse 14, compliance path option 1

3.3.2 Documentation Requirement for the EAc1 – Optimize Energy Performance

In contrast to the credit compliance documentation of SSc4.1, that of the Energy and Atmosphere Credit 1 is distinguished by much more comprehension. In total up to 10 points can be earned in respect of the percentage improvement of the building energy performance. The actual performance of the case study building has to be compared to a building designed according to The ASHRAE/IESNA Standard 90.1-2004 and the evidence of the improvement has to be provided by a whole building

project simulation. The minimum energy cost[5] saving percentage for each point threshold is as follows (Table 1):

Table 1: Energy Cost Savings and Points

Energy Cost Saving	Points
10.5 %	1
14 %	2
17.5 %	3
21 %	4
24.5 %	5
28 %	6
31.5 %	7
35 %	8
38.5 %	9
42 %	10

The overall analysis has to be dynamic, following appendix G of the ASHREA 90.1-2004 Standard, and has to include all the energy costs caused by the building project. For the purpose of this energy analysis, all of the following energy consumers have to be taken into consideration: the office and general miscellaneous equipment, incl. computers, elevators and escalators, kitchens equipment and refrigeration, as well as the laundry washing and drying. For the complete list, please see the reference guide for New Construction, Version 2.2., 2006, or the summary of EAc1 provided in Annex 6.2 of this master thesis.

Besides the comprehensive compliance path described above, other two compliance paths are available as well. The second one is applicable to office buildings with a max. floor area of 20,000 sq.ft. (1,800 m²), and could yield 4 points. The third compliance paths could get a single point, when the building complies with the Basic Criteria and Prescriptive Measures of the Advanced Buildings Benchmar™ Version 1.1. Option two and three are both prescriptive methods, which do not require a dynamic simulation for the compliance documentation. Nevertheless, a profound knowledge of the ASHRAE Advanced Energy Design Guide for Small

[5] Energy Costs: All energy required by the building is multiplied by the local tariffs of the respective sources. Thus the energy required per year is calculated under consideration of the regional tariffs. Energy savings have to be related to the respective energy source, arriving at the percentage cost savings.

Office Buildings 2004 is required for compliance path 2 and the design for compliance path 3 has to meet the Basic Criteria and Prescriptive Measures of the Advanced Buildings Benchmar™ Version 1.1. However, in case that a dynamic analysis of a building is required by the design team, it is recommended to take mutual advantage of this, and perform credit compliance documentation according to option one.

Although an energy performance certificate for the office building in the Wagenseilgasse 14 was feasible, the compliance documentation was not possible to be considered within the given scope of this master-thesis, due to the complexity and time requirement for this. For information purposes the required sample templates for EAc1 compliance are attached to this master-thesis (see appendix 6.3). For either compliance path one to three, the estimated effort for modelling the building, compliance check, and documentation is between 10 and 60 man-days.

3.4 Cost of Obtaining LEED Certification

This aim of this master thesis was not to assess any effects of applying LEED, nor to judge its approach, but rather to provide a comprehensive statement of the different dimensions of the LEED in order to support all project parties concerned when applying for LEED the first time. Due to its importance, this master thesis is also focused on the cost issues, however, for the purpose of this master thesis only the soft costs are considered, as being relevant for a discussion. According to the USGBC (2009) and NEMC (2003) those may include:

Registration Fees at USGBC

- $ 450 for members
- $ 600 for non-members

Certification Fees for LEED-NC

- $ 1,750 to $ 17,500 for members (depending on project size)
- $ 2,250 to $ 22,500 for non-members (depending on project size)

Design Costs

- 0.4 % to 0.6 % of construction costs[6]

Commissioning

- 0.5 % to 1.5 % of construction costs

[6] Construction costs incl. costs for interior and the project site

Documentation & Fees incl. Whole Building Simulation

- 0.6 % to 1 % of construction costs

However, since once going for a building construction with above average quality it will naturally demand some more design works, thus increasing effort as outlined in chapter 2. In larger projects commissioning can provide an equal service to the conventionally performed design review, and thus would in most cases no require an additional budget.

Accordingly, it is recommended to limit the additional costs of obtaining a "green" building certificate – the so called "soft costs" – to the original professional consultancy costs like these for the LEED experienced professional, or LEED AP, the registration and certification fees and the documentation fees only. For the case study building those are as follows[7]:

- 600 $ for registration fees
- 2,880 $ for certification fees
- Approx. $ 72,600 consultancy fees for the LEED professional involved in the project, based on the assumption of 3 months full time engagement
- Approx. $ 71,000 for preparing the LEED respective energy modelling and documentation, considering the results made in section 3.2, as well as the requirements of above 46 man-days for documentation purposes
- Approx. $ 143,600 (€ 103,679) in total of all soft costs for a project of comparable size and complexity to the case study building.

However, all the above calculated LEED certification costs should also be considered from a critical point of few, due to the fact that the these may not only depend on the definition and limits of the respective cost-category, but may also referred to as a long term investment. Some authors are even of the opinion that rather high performance buildings, than sustainable buildings are from importance; as the additional costs occurred by "sustainable buildings" may be miss-interpreted in some regards. Most property rating tools e.g. takes ecological sustainability into

[7] A detailed budget breakdown is not given, as consultancy fees may very greatly according to the consultants' experience. For the cost estimates an average daily fee of USD 1,100 was assumed. Exchange rate USD 1 is equal to EUR 0.722, as per 15th June 2009: Source: http://finance.yahoo.com/currency-converter?u#from=USD;to=EUR;amt=1

consideration, but not weighting it hither than 2 % of the overall criteria. LEED, like most other comprehensive building rating systems, takes into consideration many more fields than the ecological perspective, and in case this is considered it impacts also on conventional property rating tools greatly (Lechner, 2007).

According to Johnson (2000), a building owner spends nine times more time to build a facility than to design it, and thirty times more time for operation and maintenance than for its design. Overall the owner even pays in general about 460 times more to the people who will work later in the facility (over its useful life) than it was spent on the design.

Johnson furthermore outlines in his paper on *The Economic Case for High Performance Buildings*, also the different perspective of cost considerations possible. Some slides of the presentation are attached to the master thesis (see Annex 6.4).

4. Conclusion

The US based Leadership in Energy and Environmental Design rating system for New Construction evaluates sustainable design through six sustainability categories: “Sustainable Sites”, “Water Efficiency”, “Energy & Atmosphere”, “Materials & Resources”, “Indoor Environmental Quality” and “Innovation in Design”. Within each sustainability category, points can be collected. Where to gain points is up to the owner, the investor/s and the design team. According to the total points achieved from all categories, the building is awarded either LEED “certified”, LEED “silver”, LEED “gold”, or LEED “platinum”.

To verify what an LEED application could mean to stakeholders in Austria, firstly the most significant implications on the project scheduling are identified, and secondly, contractual implications are discussed. Consequently, an office building was chosen as a case study. The office building used for this case study, has 6 floors above ground and 2 floors below, with a total net floor area of approx. 71,000 sq.ft. (6,500 m²). Based on the as built status an analysis the projects compliance with LEED criterions was made. In regard of the additional effort, the analysis was limited to the additional costs – the so called soft costs – of obtaining a “green” building certificate.

In conclusion, LEED has been identified to impact a project not through single step by step inputs, but rather through permanently applying project control loops. The LEED for New Construction provides an open scoring system, and does not specify the categories “where to gain most points” in, but much more allows the setting project specific targets by the project team.

According to the LEED requirements, the case study building performs in the relevant sustainability categories as follows: weak performance in Water Efficiency, Materials & Resources; average performance in: Sustainable Sites; and exceptionally good performance in: Energy & Atmosphere, Indoor Environmental Quality, and Innovation & Design Process. In total, up to 48 points are identified as being attainable for the case study building, reaching LEED gold certification level according to LEED for New Construction, Version 2.2.

Concerning the effort needed, the additional budget identified for the case study building amounts to approx. $ 143,600 (€ 103,000).

5. Bibliography, List of Tables, List of Figures

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6. Appendix

6.1 Case-Study Building

02.05.2007 V|SUAL|S|ERUNG WAGENSE|LGASSE / LEHRBACHGASSE

ATELIER HAYDE ARCHITEKTEN
ZIVILTECHNIKER - GES.M.B.H.
A 1150 WIEN STORCHENGASSE 1 TEL. 0043 1 892 77 FAX DW 17

02.05.2007 V|SUAL|S|ERUNG LEHRBACHGASSE / WAGENSE|LGASSE ATELIER HAYDE ARCHITEKTEN ZIVILTECHNIKER - GES.M.B.H. A 1150 WIEN STORCHENGASSE 1 TEL. 0043 1 892 77 FAX DW 17

6.2 Case-Study Analysis, LEED for New Construction Project Checklist

LEED-NC Project Checklist

Case Study: Wagenseilgasse 14

2009-06-02

Yes	?	No	Sustainable Sites	14 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
			Prereq 1 **Construction Activity Pollution Prevention**	Required	**Intent** Reduce pollution from construction activities by controlling soil erosion, waterway sedimentation and airborne dust generation. **Requirements** Create and implement an Erosion and Sedimentation Control (ESC) Plan for all construction activities associated with the project. The ESC Plan shall conform to the erosion and sedimentation requirements of the 2003 EPA Construction General Permit OR local erosion and sedimentation control standards and codes, whichever is more stringent. The Plan shall describe the measures implemented to accomplish the following objectives: a.) Prevent loss of soil during construction by stormwater runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse. b.) Prevent sedimentation of storm sewer or receiving streams. c.) Prevent polluting the air with dust and particulate matter. The Construction General Permit (CGP) outlines the provisions necessary to comply with Phase I and Phase II of the National Pollutant Discharge Elimination System (NPDES) program. While the CGP only applies to construction sites greater than 1 acre, the requirements are applied to all projects for the purposes of this prerequisite. Information on the EPA CGP is available at: http://cfpub.epa.gov/npdes/stormwater/cgp.cfm. **Potential Technologies & Strategies** Create an Erosion and Sedimentation Control Plan during the design phase of the project. Consider employing strategies such as temporary and permanent seeding, mulching, earth dikes, silt fencing, sediment traps and sediment basins.	X		No specific measures of e.g. development of a erosion and sedimentation control plan were taken, however, via ground structure interaction methods the building pit was protected.	B
1			Credit 1 **Site Selection**, Avoid Development of Inappropriate Sites	1	**Intent** Avoid development of inappropriate sites and reduce the environmental impact from the location of a building on a site. **Requirements** Do not develop buildings, hardscape, roads or parking areas on portions of sites that meet any one of the following criteria: a.) Prime farmland as defined by the United States Department of Agriculture in the United States Code of Federal Regulations, Title 7, Volume 6, Parts 400 to 699, Section 657.5 (citation 7CFR657.5) b.) Previously undeveloped land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by FEMA (Federal Emergency Management Agency) c.) Land that is specifically identified as habitat for any species on Federal or State threatened or endangered lists d.) Within 100 feet of any wetlands as defined by United States Code of Federal Regulations 40 CFR, Parts 230-233 and Part 22, and isolated wetlands or areas of special concern identified by state or local rule, OR within setback distances from wetlands prescribed in state or local regulations, as defined by local or state rule or law, whichever is more stringent e.) Previously undeveloped land that is within 50 feet of a water body, defined as seas, lakes, rivers, streams and tributaries which support or could support fish, recreation or industrial use, consistent with the terminology of the Clean Water Act f.) Land which prior to acquisition for the project was public parkland, unless land of equal or greater value as parkland is accepted in trade by the public landowner (Park Authority projects are exempt) **Potential Technologies & Strategies** During the site selection process, give preference to those sites that do not include sensitive site elements and restrictive land types. Select a suitable building location and design the building with the minimal footprint to minimize site disruption of those environmentally sensitive areas identified above.	X		The site was previousely developed, and fully paved	A

LEED-NC Project Checklist

Case Study: Wagenseilgasse 14

2009-06-02

Yes	?	No	Sustainable Sites	14 Points		Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
1			Credit 2	**Development Density and Community Connectivity**	1	**Intent** Channel development to urban areas with existing infrastructure, protect greenfields and preserve habitat and natural resources. Requirements OPTION 1 — DEVELOPMENT DENSITY Construct or renovate building on a previously developed site AND in a community with a minimum density of 60,000 sq.ft. per acre net. (Note: density calculation must include the area of the project being built and is based on a typical two-story downtown development.) OR OPTION 2 — COMMUNITY CONNECTIVITY Construct or renovate building on a previously developed site AND within 1/2 mile of a residential zone or neighborhood with an average density of 10 units per acre net AND within 1/2 mile of at least 10 Basic Services AND with pedestrian access between the building and the services. Basic Services include, but are not limited to: 1) Bank; 2) Place of Worship; 3) Convenience Grocery; 4) Day Care; 5) Cleaners; 6) Fire Station; 7) Beauty; 8) Hardware; 9) Laundry; 10) Library; 11) Medical/Dental; 12) Senior Care Facility; 13) Park; 14) Pharmacy; 15) Post Office; 16) Restaurant; 17) School; 18) Supermarket; 19) Theater; 20) Community Center; 21) Fitness Center; 22) Museum. Proximity is determined by drawing a 1/2 mile radius around the main building entrance on a site map and counting the services within that radius. **Potential Technologies & Strategies** During the site selection process, give preference to urban sites with pedestrian access to a variety of services.	X		The site was previousely developed, and fully paved	A
1			Credit 3	**Brownfield Redevelopment**	1	**Intent** Rehabilitate damaged sites where development is complicated by environmental contamination, reducing pressure on undeveloped land. **Requirements** Develop on a site documented as contaminated (by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local Voluntary Cleanup Program) OR on a site defined as a brownfield by a local, state or federal government agency. **Potential Technologies & Strategies** During the site selection process, give preference to brownfield sites. Identify tax incentives and property cost savings. Coordinate site development plans with remediation activity, as appropriate.	X		Some contaminated material was found after demolition of the existing infrastructure; material was disposed according to Austrian regulations	A
1			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1	**Intent** Reduce pollution and land development impacts from automobile use. **Requirements** Locate project within 1/2 mile of an existing—or planned and funded—commuter rail, light rail or subway station. OR Locate project within 1/4 mile of one or more stops for two or more public or campus bus lines usable by building occupants. **Potential Technologies & Strategies** Perform a transportation survey of future building occupants to identify transportation needs. Site the building near mass transit.	X		Several stops are within 1/2 mile of the buidling	A

LEED-NC Project Checklist

Case Study: Wagenseilgasse 14

2009-06-02

Yes	?	No	Sustainable Sites	14 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
		1	Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms 1	**Intent** Reduce pollution and land development impacts from automobile use. **Requirements** For commercial or institutional buildings, provide secure bicycle racks and/or storage (within 200 yards of a building entrance) for 5% or more of all building users (measured at peak periods), AND, provide shower and changing facilities in the building, or within 200 yards of a building entrance, for 0.5% of Full-Time Equivalent (FTE) occupants. OR For residential buildings, provide covered storage facilities for securing bicycles for 15% or more of building occupants in lieu of changing/shower facilities. **Potential Technologies & Strategies** Design the building with transportation amenities such as bicycle racks and showering/ changing facilities.	X		It is up to the individual parties renting the building, every party has some storage room in the basement and could use this for bicyle storage, however, no permanent bicylce storage and changing rooms are available	A
	1		Credit 4.3	**Alternative Transportation**, Hybrid and Alternative Fuel Vehicles 1	**Intent** Reduce pollution and land development impacts from automobile use. Requirements OPTION 1 Provide low-emitting and fuel-efficient vehicles for 3% of Full-Time Equivalent (FTE) occupants AND provide preferred parking for these vehicles. OR OPTION 2 Provide preferred parking for low-emitting and fuel-efficient vehicles for 5% of the total vehicle parking capacity of the site. OR OPTION 3 Install alternative-fuel refueling stations for 3% of the total vehicle parking capacity of the site (liquid or gaseous fueling facilities must be separately ventilated or located outdoors). *For the purposes of this credit, low-emitting and fuel-efficient vehicles are defined as vehicles that are either classified as Zero Emission Vehicles (ZEV) by the California Air Resources Board or have achieved a minimum green score of 40 on the American Council for an Energy Efficient Economy (ACEEE) annual vehicle rating guide.* *"Preferred parking" refers to the parking spots that are closest to the main entrance of the project (exclusive of spaces designated for handicapped) or parking passes provided at a discounted price.* **Potential Technologies & Strategies** Provide transportation amenities such as alternative fuel refueling stations. Consider sharing the costs and benefits of refueling stations with neighbors.	X		Some separate parking lots are available for the overall office park, but not for the office building in the Wagenseilgasse 14, as considered for the case study; thus this point can not be considered under the reference Guide for New Construction, Version 2.2, 2006, but might find consideration in the Community Connectivity Guide	A

LEED-NC Project Checklist

Case Study: Wagenseilgasse 14
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Yes	?	No	Sustainable Sites	14 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
	1		Credit 4.4 **Alternative Transportation**, Parking Capacity	1	**Intent** Reduce pollution and land development impacts from single occupancy vehicle use. **Requirements** OPTION 1 — NON-RESIDENTIAL # Size parking capacity to not exceed minimum local zoning requirements, AND, provide preferred parking for carpools or vanpools for 5% of the total provided parking spaces. OR OPTION 2 — NON-RESIDENTIAL For projects that provide parking for less than 5% of FTE building occupants: # Provide preferred parking for carpools or vanpools, marked as such, for 5% of total provided parking spaces. OR OPTION 3 — RESIDENTIAL # Size parking capacity to not exceed minimum local zoning requirements, AND, provide infrastructure and support programs to facilitate shared vehicle usage such as carpool drop-off areas, designated parking for vanpools, or car-share services, ride boards, and shuttle services to mass transit. OR OPTION 4 — ALL Provide no new parking. *"Preferred parking" refers to the parking spots that are closest to the main entrance of the project (exclusive of spaces designated for handicapped) or parking passes provided at a discounted price.* **Potential Technologies & Strategies** Minimize parking lot/garage size. Consider sharing parking facilities with adjacent buildings. Consider alternatives that will limit the use of single occupancy vehicles.	X		Local parking lots available, are far below of potential numbers of occupancy	A
		1	Credit 5.1 **Site Development**, Protect or Restore Habitat	1	**Intent** Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity. **Requirements** On greenfield sites, limit all site disturbance to 40 feet beyond the building perimeter; 10 feet beyond surface walkways, patios, surface parking and utilities less than 12 inches in diameter; 15 feet beyond primary roadway curbs and main utility branch trenches; and 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities and playing fields) that require additional staging areas in order to limit compaction in the constructed area. Greenfield sites are those that are not previously developed or graded and remain in a natural state. Previously developed sites are those that previously contained buildings, roadways, parking lots, or were graded or altered by direct human activities. OR On previously developed or graded sites, restore or protect a minimum of 50% of the site area (excluding the building footprint) with native or adapted vegetation. Native/adapted plants are plants indigenous to a locality or cultivars of native plants that are adapted to the local climate and are not considered invasive species or noxious weeds. Projects earning SS Credit 2 and using vegetated roof surfaces may apply the vegetated roof surface to this calculation (if the plants meet the definition of native/adapted), in which case the requirement is 20% of the total site area (including building footprint). This option is intended for urban sites with little or no building setback (i.e. zero-lot-line). **Potential Technologies & Strategies** On greenfield sites, perform a site survey to identify site elements and adopt a master plan for development of the project site. Carefully site the building to minimize disruption to existing ecosystems and design the building to minimize its footprint. Strategies include stacking the building program, tuck-under parking and sharing facilities with neighbors. Establish clearly marked construction boundaries to minimize disturbance of the existing site and restore previously degraded areas to their natural state. For previously developed sites, utilize local and regional governmental agencies, consultants, educational facilities, and native plant societies as resources for the selection of appropriate native or adapted plant materials. Prohibit plant materials listed as invasive or noxious weed species. Native/adapted plants require minimal or no irrigation following establishment, do not require active maintenance such as mowing or chemical inputs such as fertilizers, pesticides or herbicides, and provide habitat value and promote biodiversity through avoidance of monoculture plantings.	X		Fully graded site, no vegedate roof	A

LEED-NC Project Checklist

Case Study: Wagenseilgasse 14

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Yes	?	No	Sustainable Sites	14 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
		1	Credit 5.2	**Site Development**, Maximize Open Space 1	**Intent** Provide a high ratio of open space to development footprint to promote biodiversity. **Requirements** OPTION 1 Reduce the development footprint (defined as the total area of the building footprint, hardscape, access roads and parking) and/or provide vegetated open space within the project boundary to exceed the local zoning's open space requirement for the site by 25%. OR OPTION 2 For areas with no local zoning requirements (e.g., some university campuses, military bases), provide vegetated open space area adjacent to the building that is equal to the building footprint. OR OPTION 3 Where a zoning ordinance exists, but there is no requirement for open space (zero), provide vegetated open space equal to 20% of the project's site area. ALL OPTIONS: a.) For projects located in urban areas that earn SS Credit 2, vegetated roof areas can contribute to credit compliance. b.) For projects located in urban areas that earn SS Credit 2, pedestrian oriented hardscape areas can contribute to credit compliance. For such projects, a minimum of 25% of the open space counted must be vegetated. c.) Wetlands or naturally designed ponds may count as open space if the side slope gradients average 1:4 (vertical:horizontal) or less and are vegetated. **Potential Technologies & Strategies** Perform a site survey to identify site elements and adopt a master plan for development of the project site. Select a suitable building location and design the building with a minimal footprint to minimize site disruption. Strategies include stacking the building program, tuck-under parking and sharing facilities with neighbors to maximize open space on the site.	X		Fully graded site, no vegedate roof	A
	1		Credit 6.1	**Stormwater Design**, Quantity Control 1	**Intent** Limit disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, and managing stormwater runoff. Requirements OPTION 1 — EXISTING IMPERVIOUSNESS IS LESS THAN OR EQUAL TO 50% Implement a stormwater management plan that prevents the post-development peak discharge rate and quantity from exceeding the pre-development peak discharge rate and quantity for the one- and two-year, 24-hour design storms. OR Implement a stormwater management plan that protects receiving stream channels from excessive erosion by implementing a stream channel protection strategy and quantity control strategies. OR OPTION 2 — EXISTING IMPERVIOUSNESS IS GREATER THAN 50% Implement a stormwater management plan that results in a 25% decrease in the volume of stormwater runoff from the two-year, 24-hour design storm. **Potential Technologies & Strategies** Design the project site to maintain natural stormwater flows by promoting infiltration. Specify vegetated roofs, pervious paving, and other measures to minimize impervious surfaces. Reuse stormwater volumes generated for non-potable uses such as landscape irrigation, toilet and urinal flushing and custodial uses.	X		The site was 100 % developed and paved before, and is 100 % graded now, thus there can not be any difference in the storm water quantity be assumed. The storm is discharged into a storm water sewer.	A

LEED-NC Project Checklist

Case Study: Wagenseilgasse 14
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Yes	?	No	Sustainable Sites	14 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
			Credit 6.2 **Stormwater Design**, Quality Control	1	**Intent** Reduce or eliminate water pollution by reducing impervious cover, increasing onsite infiltration, eliminating sources of contaminants, and removing pollutants from stormwater runoff. **Requirements** Implement a stormwater management plan that reduces impervious cover, promotes infiltration, and captures and treats the stormwater runoff from 90% of the average annual rainfall1 using acceptable best management practices (BMPs). BMPs used to treat runoff must be capable of removing 80% of the average annual post development total suspended solids (TSS) load based on existing monitoring reports. BMPs are considered to meet these criteria if (1) they are designed in accordance with standards and specifications from a state or local program that has adopted these performance standards, or (2) there exists in-field performance monitoring data demonstrating compliance with the criteria. Data must conform to accepted protocol (e.g., Technology Acceptance Reciprocity Partnership [TARP], Washington State Department of Ecology) for BMP monitoring. **Potential Technologies & Strategies** Use alternative surfaces (e.g., vegetated roofs, pervious pavement or grid pavers) and nonstructural techniques (e.g., rain gardens, vegetated swales, disconnection of imperviousness, rainwater recycling) to reduce imperviousness and promote infiltration, thereby reducing pollutant loadings. Use sustainable design strategies (e.g., Low Impact Development, Environmentally Sensitive Design) to design integrated natural and mechanical treatment systems such as constructed wetlands, vegetated filters, and open channels to treat stormwater runoff.	X		No measures are set in this regard, as storm water is discharged into a storm water sewer	A
	1		Credit 7.1 **Heat Island Effect**, Non-Roof	1	**Intent** Reduce heat islands (thermal gradient differences between developed and undeveloped areas) to minimize impact on microclimate and human and wildlife habitat. Requirements OPTION 1 Provide any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots): a.) Shade (within 5 years of occupancy) b.) Paving materials with a Solar Reflectance Index (SRI)2 of at least 29 c.) Open grid pavement system OR OPTION 2 Place a minimum of 50% of parking spaces under cover (defined as underground, under deck, under roof, or under a building). Any roof used to shade or cover parking must have an SRI of at least 29. **Potential Technologies & Strategies** Shade constructed surfaces on the site with landscape features and utilize high-reflectance materials for hardscape. Consider replacing constructed surfaces (i.e., roof, roads, sidewalks, etc.) with vegetated surfaces such as vegetated roofs and open grid paving or specify high-albedo materials to reduce the heat absorption.	X		Site fully covered with buidling, however, parking is placed under the building	A
	1		Credit 7.2 **Heat Island Effect**, Roof	1	**Intent** Reduce heat islands (thermal gradient differences between developed and undeveloped areas) to minimize impact on microclimate and human and wildlife habitat. **Requirements** OPTION 1 Use roofing materials having a Solar Reflectance Index (SRI)3 equal to or greater than the values in the table below for a minimum of 75% of the roof surface. OR OPTION 2 Install a vegetated roof for at least 50% of the roof area. OR OPTION 3 Install high albedo and vegetated roof surfaces that, in combination, meet the following criteria: (Area of SRI Roof / 0.75) + (Area of Vegetated Roof / 0.5) >= Total Roof Area **Potential Technologies & Strategies** Consider installing high-albedo and vegetated roofs to reduce heat absorption. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C	X		White/grey gravel is used for the roof surface	A

LEED-NC Project Checklist

Case Study: Wagenseilgasse 14

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Yes	?	No	Sustainable Sites	14 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
1			Credit 8 **Light Pollution Reduction**	1	**Intent** Minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce development impact on nocturnal environments. **Requirements** FOR INTERIOR LIGHTING The angle of maximum candela from each interior luminaire as located in the building shall intersect opaque building interior surfaces and not exit out through the windows. OR All non-emergency interior lighting shall be automatically controlled to turn off during non-business hours. Provide manual override capability for after hours use. AND FOR EXTERIOR LIGHTING Only light areas as required for safety and comfort. Do not exceed 80% of the lighting power densities for exterior areas and 50% for building facades and landscape features as defined in ASHRAE/IESNA Standard 90.1-2004, Exterior Lighting Section, without amendments. All projects shall be classified under one of the following zones, as defined in IESNA RP-33, and shall follow all of the requirements for that specific zone: LZ1 — Dark (Park and Rural Settings) Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.01 horizontal and vertical footcandles at the site boundary and beyond. Document that 0% of the total initial designed fixture lumens are emitted at an angle of 90 degrees or higher from nadir (straight down). LZ2 — Low (Residential Areas) Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.10 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 10 feet beyond the site boundary. Document that no more than 2% of the total initial designed fixture lumens are emitted at an angle of 90 degrees or higher from nadir (straight down). For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary. LZ3 — Medium (Commercial/Industrial, High-Density Residential) Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.20 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 5% of the total initial designed fixture lumens are er site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary. LZ4 — High (Major City Centers, Entertainment Districts) Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.60 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 10% of the total initial designed site lumens are emitted at an angle of 90 degrees or higher from nadir (straight down). For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary. **Potential Technologies & Strategies** Adopt site lighting criteria to maintain safe light levels while avoiding off-site lighting and night sky pollution. Minimize site lighting where possible and model the site lighting using a computer model. Technologies to reduce light pollution include full cutoff luminaires, low-reflectance surfaces and low-angle spotlights.	X		Interiro lighting is sensor controlled, and shuts off during non-business hours, for all exterior lighting fixtures, down-lights are installed in niches of the buidling, except 2 spots for marketing purposes	B

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Yes	?	No	Water Efficiency	5 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
		NA	Credit 1.1	**Water Efficient Landscaping**, Reduce by 50% 1	**Intent** Limit or eliminate the use of potable water, or other natural surface or subsurface water resources available on or near the project site, for landscape irrigation. **Requirements** Reduce potable water consumption for irrigation by 50% from a calculated mid-summer baseline case. Reductions shall be attributed to any combination of the following items: a.) Plant species factor b.) Irrigation efficiency c.) Use of captured rainwater d.) Use of recycled wastewater e.) Use of water treated and conveyed by a public agency specifically for non-potable uses **Potential Technologies & Strategies** Perform a soil/climate analysis to determine appropriate plant material and design the landscape with native or adapted plants to reduce or eliminate irrigation requirements. Where irrigation is required, use high-efficiency equipment and/or climate-based controllers.		X	Fully graded site, no vegedate roof	A
		NA	Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation 1	Intent Eliminate the use of potable water, or other natural surface or subsurface water resources available on or near the project site, for landscape irrigation. **Requirements** Achieve WE Credit 1.1 and: Use only captured rainwater, recycled wastewater, recycled graywater, or water treated and conveyed by a public agency specifically for non-potable uses for irrigation. OR Install landscaping that does not require permanent irrigation systems. Temporary irrigation systems used for plant establishment are allowed only if removed within one year of installation. **Potential Technologies & Strategies** Perform a soil/climate analysis to determine appropriate landscape types and design the landscape with indigenous plants to reduce or eliminate irrigation requirements. Consider using stormwater, graywater, and/or condensate water for irrigation.		X	Fully graded site, no vegedate roof	A
		1	Credit 2	**Innovative Wastewater Technologies** 1	**Intent** Reduce generation of wastewater and potable water demand, while increasing the local aquifer recharge. **Requirements** OPTION 1 Reduce potable water use for building sewage conveyance by 50% through the use of water-conserving fixtures (water closets, urinals) or non-potable water (captured rainwater, recycled graywater, and on-site or municipally treated wastewater). OR OPTION 2 Treat 50% of wastewater on-site to tertiary standards. Treated water must be infiltrated or used on-site. **Potential Technologies & Strategies** Specify high-efficiency fixtures and dry fixtures such as composting toilet systems and non-water using urinals to reduce wastewater volumes. Consider reusing stormwater or graywater for sewage conveyance or on-site wastewater treatment systems (mechanical and/or natural). Options for on-site wastewater treatment include packaged biological nutrient removal systems, constructed wetlands, and high-efficiency filtration systems.	X		Manual standard faucets are used, Toiltets have a low and high volume flush, urinals have a temperature sensor for precise flushes; grey water is not used throughout the building	A

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Yes	?	No	Water Efficiency	5 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
	1		Credit 3.1 **Water Use Reduction**, 20% Reduction	1	Intent Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems. **Requirements** Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. Calculations are based on estimated occupant usage and shall include only the following fixtures (as applicable to the building): water closets, urinals, lavatory faucets, showers and kitchen sinks. **Potential Technologies & Strategies** Use high-efficiency fixtures, dry fixtures such as composting toilet systems and nonwater using urinals, and occupant sensors to reduce the potable water demand. Consider reuse of stormwater and graywater for non-potable applications such as toilet and urinal flushing and custodial uses.	X		Manual standard faucets are used, Toiltets have a low and high volume flush, urinals have a temperature sensor for precise flushes; grey water is not used throughout the building	A
		1	Credit 3.2 **Water Use Reduction**, 30% Reduction	1	**Intent** Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems. **Requirements** Employ strategies that in aggregate use 30% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. Calculations are based on estimated occupant usage and shall include only the following fixtures (as applicable to the building): water closets, urinals, lavatory faucets, showers and kitchen sinks. **Potential Technologies & Strategies** Use high-efficiency fixtures, dry fixtures such as composting toilets and waterless urinals, and occupant sensors to reduce the potable water demand. Consider reuse of stormwater and graywater for non-potable applications such as toilet and urinal flushing, mechanical systems and custodial uses.	X		Manual standard faucets are used, Toiltets have a low and high volume flush, urinals have a temperature sensor for precise flushes; grey water is not used throughout the building	A

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Yes ? No

Yes	?	No	Energy & Atmosphere	17 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
			Prereq 1 **Fundamental Commissioning**	Required	**Intent** Verify that the building's energy related systems are installed, calibrated and perform according to the owner's project requirements, basis of design, and construction documents. Benefits of Commissioning Benefits of commissioning include reduced energy use, lower operating costs, reduced contractor callbacks, better building documentation, improved occupant productivity, and verification that the systems perform in accordance with the owner's project requirements. **Requirements** The following commissioning process activities shall be completed by the commissioning team, in accordance with this Reference Guide. 1) Designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities. a) The CxA shall have documented commissioning authority experience in at least two building projects. b) The individual serving as the CxA shall be independent of the project's design and construction management, though they may be employees of the firms providing those services. The CxA may be a qualified employee or consultant of the Owner. c) The CxA shall report results, findings and recommendations directly to the Owner. d) For projects smaller than 50,000 square feet, the CxA may include qualified persons on the design or construction teams who have the required experience. 2) The Owner shall document the Owner's Project Requirements (OPR). The design team shall develop the Basis of Design (BOD). The CxA shall review these documents for clarity and completeness. The Owner and design team shall be responsible for updates to their respective documents. 3) Develop and incorporate commissioning requirements into the construction documents. 4) Develop and implement a commissioning plan. 5) Verify the installation and performance of the systems to be commissioned. 6) Complete a summary commissioning report. Commissioned Systems Commissioning process activities shall be completed for the following energy-related systems, at a minimum: # Heating, ventilating, air conditioning, and refrigeration (HVAC&R) systems (mechanical and passive) and associated controlsq Lighting and daylighting controls # Domestic hot water systems # Renewable energy systems (wind, solar, etc.) **Potential Technologies & Strategies** In order to meet this prerequisite, owners are required to use qualified individuals to lead the commissioning process. Qualified individuals are identified as those who possess # high level of experience in the following areas: # Energy systems design, installation and operation # Commissioning planning and process management # Hands-on field experience with energy systems performance, interaction, start-up, balancing, testing, troubleshooting, operation, and maintenance procedures # Energy systems automation control knowledge Owners are encouraged to consider including water-using systems, building envelope systems, and other systems in the scope of the commissioning plan as appropriate. The building envelope is an important component of a facility which impacts energy consumption, occupant comfort and indoor air quality. While it is not required to be commissioned by LEED, an owner can receive significant financial savings and reduced risk of poor indoor air quality by including building envelope commissioning. This Reference Guide provides guidance on the rigor expected for this prerequisite for the following: a.) Owner's Project Requirements b.) Basis of Design c.) Commissioning Plan d.) Commissioning Specification e.) Performance Verification Documentation f.) Commissioning Report	X		The project was accompanied by three companies, one for civil engineering, one for electrical engineering, and one for HVAC related questions, ensuring high quality commissioning	B

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Yes	?	No	Energy & Atmosphere	17 Points		Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
			Prereq 2	**Minimum Energy Performance**	Required	**Intent** Establish the minimum level of energy efficiency for the proposed building and systems. **Requirements** Design the building project to comply with both— # the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) of ASHRAE/IESNA Standard 90.1-2004 (without amendments); and # the prescriptive requirements (Sections 5.5, 6.5, 7.5 and 9.5) or performance requirements (Section 11) of ASHRAE/IESNA Standard 90.1-2004 (without amendments). **Potential Technologies & Strategies** Design the building envelope, HVAC, lighting, and other systems to maximize energy performance. The ASHRAE 90.1-2004 User's Manual contains worksheets that can be used to document compliance with this prerequisite. For projects pursuing points under EA Credit 1, the computer simulation model may be used to confirm satisfaction of this prerequisite. If a local code has demonstrated quantitative and textual equivalence following, at a minimum, the U.S. Department of Energy standard process for commercial energy code determination, then it may be used to satisfy this prerequisite in lieu of ASHRAE 90.1-2004. Details on the DOE process for commercial energy code determination can be found at www.energycodes.gov/implement/determinations_com.stm.	X		Considering Austrian Standards (Transposed EC Law), it can be assumed that this EAp2 is fulfilled	B
			Prereq 3	**Fundamental Refrigerant Manageme**	Required	**Intent** Reduce ozone depletion. **Requirements** Zero use of CFC-based refrigerants in new base building HVAC&R systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phase-out conversion prior to project completion. Phase-out plans extending beyond the project completion date will be considered on their merits. **Potential Technologies & Strategies** When reusing existing HVAC systems, conduct an inventory to identify equipment that uses CFC refrigerants and provide a replacement schedule for these refrigerants. For new buildings, specify new HVAC equipment in the base building that uses no CFC refrigerants.	X		CFC free refrigerant is being used	A

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Yes	?	No	Energy & Atmosphere	17 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
10			Credit 1 **Optimize Energy Performance**	1 to 10	**Intent** Achieve increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use. **Requirements** Select one of the three compliance path options described below. Project teams documenting achievement using any of the three options are assumed to be in compliance with EA Prerequisite 2. OPTION 1 — WHOLE BUILDING ENERGY SIMULATION (1–10 Points) Demonstrate a percentage improvement in the proposed building performance rating compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2004 (without amendments) by a whole building project simulation using the Building Performance Rating Method in Appendix G of the Standard. The minimum energy cost savings percentage for each point threshold is as follows: Appendix G of Standard 90.1-2004 requires that the energy analysis done for the Building Performance Rating Method include ALL of the energy costs within and associated with the building project. To achieve points using this credit, the proposed design— a.) must comply with the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) in Standard 90.1-2004 (without amendments); b.) must include all the energy costs within and associated with the building project; and c.) must be compared against a baseline building that complies with Appendix G to Standard 90.1-2004 (without amendments). The default process energy cost is 25% of the total energy cost for the baseline building. For buildings where the process energy cost is less than 25% of the baseline building energy cost, the LEED submittal must include supporting documentation substantiating that process energy inputs are appropriate. For the purpose of this analysis, process energy is considered to include, but is not limited to, office and general miscellaneous equipment, computers, elevators and escalators, kitchen cooking and refrigeration, laundry washing and drying, lighting exempt from the lighting po (e.g., waterfall pumps). Regulated (non-process) energy includes lighting (such as for the interior, parking garage, surface parking, façade, or building grounds, except as noted above), HVAC (such as for space heating, space cooling, fans, pumps, toilet exhaust, parking garage ventilation, kitchen hood exhaust, etc.), and service water heating for domestic or space heating purposes. For EA Credit 1, process loads shall be identical for both the baseline building performance rating and for the proposed building performance rating. However, project teams may follow the Exceptional Calculation Method (ASHRAE 90.1-2004 G2.5) to document measures that reduce process loads. Documentation of process load energy savings shall include a list of the assumptions made for both the base and proposed design, and theoretical or empirical information supporting these assumptions. OR OPTION 2 — PRESCRIPTIVE COMPLIANCE PATH (4 Points) Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004. The following restrictions apply: # Buildings must be under 20,000 square feet # Buildings must be office occupancy # Project teams must fully comply with all applicable criteria as established in the Advanced Energy Design Guide for the climate zone in which the building is located OR OPTION 3 — PRESCRIPTIVE COMPLIANCE PATH (1 Point) Comply with the Basic Criteria and Prescriptive Measures of the Advanced Buildings Benchmark™ Version 1.1 with the exception of the following sections: 1.7 Monitoring and Trend-logging, 1.11 Indoor Air Quality, and 1.14 Networked Computer Monitor Control. The following restrictions apply: # Project teams must fully comply with all applicable criteria as established in Advanced Buildings Benchmark for the climate zone in which the building is located. **Potential Technologies & Strategies** Design the building envelope and systems to maximize energy performance. Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures. Quantify energy performance as compared to a baseline building. If a local code has demonstrated quantitative and textual equivalence following, at a minimum, the U.S. Department of Energy standard process for commercial energy code determination, then the results of that analysis may be used to correlate local code performance with ASHRAE 90.1-2004. Details on the DOE process for commercial energy code determination can be found at www.energycodes.gov/implement/determinations_com.stm.	X		Energy Certificate is established and shows a result of 44 kWh/m²a, which is a very good rating for an office building in Austria. However, considering the reference guide requirements only 1 point may be gained, if no further proof is provided, in case case Energy Performance is calculated according to OPTION 1 up to the max. points, or even an additional ID point can be expected to be gained. Overall System description: Central air distribution system, with chilled rips at the outlets (air passes by and thus the room is cooled) humidification and dehumidifcation facilities, automatic blinds outside the windows, closing automatically according to position of the sun; presents switch in each room, if switched "out of room" temperature increases by 2 °C in case of general cooling requirements, or decreses by 2 °C in case of general heating requirements	B

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Yes	?	No	Energy & Atmosphere	17 Points		Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
		1	Credit 2.1	**On-Site Renewable Energy**, 2.5%	1	**Intent** Encourage and recognize increasing levels of on-site renewable energy self-supply in order to reduce environmental and economic impacts associated with fossil fuel energy use. **Requirements** Use on-site renewable energy systems to offset building energy cost. Calculate project performance by expressing the energy produced by the renewable systems as a percentage of the building annual energy cost and using the table below to determine the number of points achieved. Use the building annual energy cost calculated in EA Credit 1 or use the Department of Energy (DOE) Commercial Buildings Energy Consumption Survey (CBECS) database to determine the estimated electricity use. (Table of use for different building types is provided in this Reference Guide.) **Potential Technologies & Strategies** Assess the project for non-polluting and renewable energy potential including solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies. When applying these strategies, take advantage of net metering with the local utility.	X			A
		1	Credit 2.2	**On-Site Renewable Energy**, 7.5%	1		X			
		1	Credit 2.3	**On-Site Renewable Energy**, 12.5%	1		X			
	1		Credit 3	**Enhanced Commissioning**	1	**Intent** Begin the commissioning process early during the design process and execute additional activities after systems performance verification is completed. **Requirements** Implement, or have a contract in place to implement the following additional commissioning process activities in addition to the requirements of EA Prerequisite 1 and in accordance with this Reference Guide: 1. Prior to the start of the construction documents phase, designate an independent Commissioning Authority (CxA) to lead, review, and oversee the completion of all commissioning process activities. The CxA shall, at a minimum, perform Tasks 2, 3 and 6. Other team members may perform Tasks 4 and 5. a. The CxA shall have documented commissioning authority experience in at least two building projects. b. The individual serving as the CxA shall be— i. independent of the work of design and construction; ii. not an employee of the design firm, though they may be contracted through them; iii. not an employee of, or contracted through, a contractor or construction manager holding construction contracts; and iv. (can be) a qualified employee or consultant of the Owner. c. The CxA shall report results, findings and recommendations directly to the Owner. d. This requirement has no deviation for project size. 2. The CxA shall conduct, at a minimum, one commissioning design review of the Owner's Project Requirements (OPR), Basis of Design (BOD), and design documents prior to mid-construction documents phase and back-check the review comments in the subsequent design submission. 3. The CxA shall review contractor submittals applicable to systems being commissioned for compliance with the OPR and BOD. This review shall be concurrent with A/E reviews and submitted to the design team and the Owner. 4. Develop a systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems. 5. Verify that the requirements for training operating personnel and building occupants are completed. 6. Assure the involvement by the CxA in reviewing building operation within 10 months after substantial completion with O&M staff and occupants. Include a plan for resolution of outstanding commissioning-related issues. **Potential Technologies & Strategies** Although it is preferable that the CxA be contracted by the Owner, for the enhanced commissioning credit, the CxA may also be contracted through the design firms or construction management firms not holding construction contracts. This Reference Guide provides detailed guidance on the rigor expected for following process activities: a.) Commissioning design review b.) Commissioning submittal review c.) Systems manual	X		The project was accompanied by three companies, one for civil engineering, one for electrical engineering, and one for HVAC related questions, ensuring high quality commissioning	B

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Yes	?	No	Energy & Atmosphere	17 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
	1		Credit 4 **Enhanced Refrigerant Management**	1	**Intent** Reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to global warming. **Requirements** OPTION 1 Do not use refrigerants. OR OPTION 2 Select refrigerants and HVAC&R that minimize or eliminate the emission of compounds that contribute to ozone depletion and global warming. The base building HVAC&R equipment shall comply with the following formula, which sets a maximum threshold for the combined contributions to ozone depletion and global warming potential: LCGWP + LCODP x 105 ≤ 100 Where: LCODP = [ODPr x (Lr x Life +Mr) x Rc]/Life LCGWP = [GWPr x (Lr x Life +Mr) x Rc]/Life LCODP: Lifecycle Ozone Depletion Potential (lbCFC11/Ton-Year) LCGWP: Lifecycle Direct Global Warming Potential (lbCO2/Ton-Year) GWPr: Global Warming Potential of Refrigerant (0 to 12,000 lbCO2/lbr) ODPr: Ozone Depletion Potential of Refrigerant (0 to 0.2 lbCFC11/lbr) Lr: Refrigerant Leakage Rate (0.5% to 2.0%; default of 2% unless otherwise demonstrated) Mr: End-of-life Refrigerant Loss (2% to 10%; default of 10% unless otherwise demonstrated) Rc: Refrigerant Charge (0.5 to 5.0 lbs of refrigerant per ton of cooling capacity) Life: Equipment Life (10 years; default based on equipment type, unless otherwise demonstrated) For multiple types of equipment, a weighted average of all base building level HVAC&R equipment shall be applied using the following formula: [Σ (LCGWP + LCODP x 105) x Qunit] / Qtotal ≤ 100 Where: Qunit = Cooling capacity of an individual HVAC or refrigeration unit (Tons) Qtotal = Total cooling capacity of all HVAC or refrigeration Small HVAC units (defined as containing less than 0.5 lbs of refrigerant), and other equipment such as standard refrigerators, small water coolers, and any other cooling equipment that contains less than 0.5 lbs of refrigerant, are not considered part of the "base building" system and are not subject to the requirements of this credit. AND Do not install fire suppression systems that contain ozone-depleting substances (CFCs, HCFCs or Halons). **Potential Technologies & Strategies** Design and operate the facility without mechanical cooling and refrigeration equipment. Where mechanical cooling is used, utilize base building HVAC and refrigeration systems for the refrigeration cycle that minimize direct impact on ozone depletion and global warming. Select HVAC&R equipment with reduced refrigerant charge and increased equipment life. Maintain equipment to prevent leakage of refrigerant to the atmosphere. Utilize fire suppression systems that do not contain HCFCs or Halons.	X			A

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Yes	?	No	Energy & Atmosphere	17 Points		Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
	1		Credit 5	**Measurement & Verification**	1	**Intent** Provide for the ongoing accountability of building energy consumption over time. **Requirements** a.) Develop and implement a Measurement & Verification (M&V) Plan consistent with Option D: Calibrated Simulation (Savings Estimation Method 2), or Option B: Energy Conservation Measure Isolation, as specified in the International Performance Measurement & Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003. b.) The M&V period shall cover a period of no less than one year of post-construction occupancy. **Potential Technologies & Strategies** Develop a M&V Plan to evaluate building and/or energy system performance. Characterize the building and/or energy systems through energy simulation or engineering analysis. Install the necessary metering equipment to measure energy use. Track performance by comparing predicted performance to actual performance, broken down by component or system as appropriate. Evaluate energy efficiency by comparing actual performance to baseline performance. While the IPMVP describes specific actions for verifying savings associated with energy conservation measures (ECMs) and strategies, this LEED credit expands upon typical IPMVP M&V objectives. M&V activities should not necessarily be confined to energy systems where ECMs or energy conservation strategies have been implemented. The IPMVP provides guidance on M&V strategies and their appropriate applications for various situations. These strategies should be used in conjunction with monitoring and trend logging of significant energy systems to provide for the ongoing accountability of building energy performance.	X		Measurement and Verification plan is in place, evaluating the buiding in regard of its desing; with the key aim to keep operation costs at a miniumum and increase occupancy satisfaction	B
	1		Credit 6	**Green Power**, 35% of electricity from renewables (2 year contract)	1	**Intent** Encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis. **Requirements** Provide at least 35% of the building's electricity from renewable sources by engaging in at least a two-year renewable energy contract. Renewable sources are as defined by the Center for Resource Solutions (CRS) Green-e products certification requirements. DETERMINE THE BASELINE ELECTRICITY USE Use the annual electricity consumption from the results of EA Credit 1. OR Use the Department of Energy (DOE) Commercial Buildings Energy Consumption Survey (CBECS) database to determine the estimated electricity use. **Potential Technologies & Strategies** Determine the energy needs of the building and investigate opportunities to engage in a green power contract. Green power is derived from solar, wind, geothermal, biomass or low-impact hydro sources. Visit www.green-e.org for details about the Green-e program. The power product purchased to comply with credit requirements need not be Green-e certified. Other sources of green power are eligible if they satisfy the Green-e program's technical requirements. Renewable energy certificates (RECs), tradable renewable certificates (TRCs), green tags and other forms of green power that comply with Green-e's technical requirements can be used to document compliance with EA Credit 6 requirements.	X		Not considered	A

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Yes	?	No	Materials & Resources	14 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
			Prereq 1 **Storage & Collection of Recyclables** Required		**Intent** Facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills. **Requirements** Provide an easily accessible area that serves the entire building and is dedicated to the collection and storage of non-hazardous materials for recycling, including (at a minimum) paper, corrugated cardboard, glass, plastics and metals. **Potential Technologies & Strategies** Coordinate the size and functionality of the recycling areas with the anticipated collection services for glass, plastic, office paper, newspaper, cardboard and organic wastes to maximize the effectiveness of the dedicated areas. Consider employing cardboard balers, aluminum can crushers, recycling chutes and collection bins at individual workstations to further enhance the recycling program.	X		Waste management concept, incl. areas for recyclables are available	A
		1	Credit 1.1 **Building Reuse**, Maintain 75% of Exiting Walls, Floor & Roof	1	**Intent** Extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport. **Requirements** Maintain at least 75% (based on surface area) of existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and non-structural roofing material). Hazardous materials that are remediated as a part of the project scope shall be excluded from the calculation of the percentage maintained. If the project includes an addition to an existing building, this credit is not applicable if the square footage of the addition is more than 2 times the square footage of the existing building. **Potential Technologies & Strategies** Consider reuse of existing, previously occupied buildings, including structure, envelope and elements. Remove elements that pose contamination risk to building occupants and upgrade components that would improve energy and water efficiency such as windows, mechanical systems and plumbing fixtures. Quantify the extent of building reuse.	X		Not maintained	B
		1	Credit 1.2 **Building Reuse**, Maintain 95% of Exiting Walls, Floor & Roof	1	**Intent** Extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport. **Requirements** Maintain an additional 20% (95% total, based on surface area) of existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and non-structural roofing material). Hazardous materials that are re-mediated as a part of the project scope shall be excluded from the calculation of the percentage maintained. If the project includes an addition to an existing building, this credit is not applicable if the square footage of the addition is more than 2 times the square footage of the existing building. **Potential Technologies & Strategies** Consider reuse of existing, previously occupied buildings, including structure, envelope and elements. Remove elements that pose contamination risk to building occupants and upgrade components that would improve energy and water efficiency such as windows, mechanical systems and plumbing fixtures. Quantify the extent of building reuse.	X		Not maintained	B

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Yes	?	No	Materials & Resources	14 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
		1	Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements 1	**Intent** Extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport. **Requirements** Use existing interior non-structural elements (interior walls, doors, floor coverings and ceiling systems) in at least 50% (by area) of the completed building (including additions). If the project includes an addition to an existing building, this credit is not applicable if the square footage of the addition is more than 2 times the square footage of the existing building. **Potential Technologies & Strategies** Consider reuse of existing, previously occupied buildings, including structure, envelope and interior non-structural elements. Remove elements that pose contamination risk to building occupants and upgrade components that would improve energy and water efficiency, such as mechanical systems and plumbing fixtures. Quantify the extent of building reuse.	X		No reuse	B
	1		Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	**Intent** Divert construction and demolition debris from disposal in landfills and incinerators. Redirect recyclable recovered resources back to the manufacturing process. Redirect reusable materials to appropriate sites. **Requirements** Recycle and/or salvage at least 50% of non-hazardous construction and demolition. Develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or comingled. Excavated soil and land-clearing debris does not contribute to this credit. Calculations can be done by weight or volume, but must be consistent throughout. **Potential Technologies & Strategies** Establish goals for diversion from disposal in landfills and incinerators and adopt a construction waste management plan to achieve these goals. Consider recycling cardboard, metal, brick, acoustical tile, concrete, plastic, clean wood, glass, gypsum wallboard, carpet and insulation. Designate a specific area(s) on the construction site for segregated or comingled collection of recyclable materials, and track recycling efforts throughout the construction process. Identify construction haulers and recyclers to handle the designated materials. Note that diversion may include donation of materials to charitable organizations and salvage of materials on-site.	X		Contractor was issued with disposal accordingly, however, the rate of waste diversion can not be identified; some of the bricks were grounded by to contractor and taken for refilling	B
	1		Credit 2.2	**Construction Waste Management**, Divert 75% from Landfill 1	**Intent** Divert construction and demolition debris from disposal in landfills and incinerators. Redirect recyclable recovered resources back to the manufacturing process. Redirect reusable materials to appropriate sites. **Requirements** Recycle and/or salvage an additional 25% beyond MR Credit 2.1 (75% total) of nonhazardous construction and demolition debris. Excavated soil and land-clearing debris does not contribute to this credit. Calculations can be done by weight or volume, but must be consistent throughout. **Potential Technologies & Strategies** Establish goals for diversion from disposal in landfills and incinerators and adopt a construction waste management plan to achieve these goals. Consider recycling cardboard, metal, brick, acoustical tile, concrete, plastic, clean wood, glass, gypsum wallboard, carpet and insulation. Designate a specific area(s) on the construction site for segregated or comingled collection of recyclable materials, and track recycling efforts throughout the construction process. Identify construction haulers and recyclers to handle the designated materials. Note that diversion may include donation of materials to charitable organizations and salvage of materials on-site (see page 251).	X		Contractor was issued with disposal accordingly, however, the rate of waste diversion can not be identified; some of the bricks were grounded by to contractor and taken for refilling	B

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Yes	?	No	Materials & Resources	14 Points		Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
		1	Credit 3.1	**Materials Reuse**, Specify 5%	1	**Intent** Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extraction and processing of virgin resources. **Requirements** Use salvaged, refurbished or reused materials such that the sum of these materials constitutes at least 5%, based on cost, of the total value of materials on the project. Mechanical, electrical and plumbing components and specialty items such as elevators and equipment shall not be included in this calculation. Only include materials permanently installed in the project. Furniture may be included, providing it is included consistently in MR Credits 3–7. **Potential Technologies & Strategies** Identify opportunities to incorporate salvaged materials into building design and research potential material suppliers. Consider salvaged materials such as beams and posts, flooring, paneling, doors and frames, cabinetry and furniture, brick and decorative items.	X		Materials were not reused directly	B
		1	Credit 3.2	**Materials Reuse**, Specify 10%	1	**Intent** Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extraction and processing of virgin resources. **Requirements** Use salvaged, refurbished or reused materials for an additional 5% beyond MR Credit 3.1 (10% total, based on cost). Mechanical, electrical and plumbing components and specialty items such as elevators and equipment shall not be included in this calculation. Only include materials permanently installed in the project. Furniture may be included, providing it is included consistently in MR Credits 3–7. **Potential Technologies & Strategies** Identify opportunities to incorporate salvaged materials into building design and research potential material suppliers. Consider salvaged materials such as beams and posts, flooring, paneling, doors and frames, cabinetry and furniture, brick and decorative items.	X		Materials were not reused directly	B
	1		Credit 4.1	**Recycled Content**, Specify 10% (post-consumer + ½ pre-consumer)	1	**Intent** Increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials. **Requirements** Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the materials in the project. The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value. Mechanical, electrical and plumbing components and specialty items such as elevators shall not be included in this calculation. Only include materials permanently installed in the project. Furniture may be included, providing it is included consistently in MR Credits 3–7. Recycled content shall be defined in accordance with the International Organization for Standardization document, ISO 14021—Environmental labels and declarations—Selfdeclared environmental claims (Type II environmental labeling). Post-consumer material is defined as waste material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose. Pre-consumer material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it. **Potential Technologies & Strategies** Establish a project goal for recycled content materials and identify material suppliers that can achieve this goal. During construction, ensure that the specified recycled content materials are installed. Consider a range of environmental, economic and performance attributes when selecting products and materials.	X		Some parts of the floor construction and other contain e.g. significant amounts of saw mill dust, but can not be quantified	B

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Yes	?	No	Materials & Resources	14 Points		Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
		1	Credit 4.2	**Recycled Content**, Specify 20% (post-consumer + ½ pre-consumer)	1	**Intent** Increase demand for building products that incorporate recycled content materials, thereby reducing the impacts resulting from extraction and processing of virgin materials. **Requirements** Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes an additional 10% beyond MR Credit 4.1 (total of 20%, based on cost) of the total value of the materials in the project. The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value. Mechanical, electrical and plumbing components and specialty items such as elevators shall not be included in this calculation. Only include materials permanently installed in the project. Furniture may be included, providing it is included consistently in MR Credits 3–7. Recycled content shall be defined in accordance with the International Organization for Standardization document, ISO 14021—Environmental labels and declarations—Selfdeclared environmental claims (Type II environmental labeling). Post-consumer material is defined as waste material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose. Pre-consumer material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it. **Potential Technologies & Strategies** Establish a project goal for recycled content materials and identify material suppliers that can achieve this goal. During construction, ensure that the specified recycled content materials are installed. Consider a range of environmental, economic and performance attributes when selecting products and materials.	X		Some parts of the floor construction and other contain e.g. significant amounts of saw mill dust, but can not be quantified => is is unlikely that it makes up for 20 % based on costs	B
1			Credit 5.1	**Local/Regional Materials**, 10 % Extracted, Processed & Manufactured Regionally	1	**Intent** Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation. **Requirements** Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% (based on cost) of the total materials value. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value. Mechanical, electrical and plumbing components and specialty items such as elevators and equipment shall not be included in this calculation. Only include materials permanently installed in the project. Furniture may be included, providing it is included consistently in MR Credits 3–7. **Potential Technologies & Strategies** Establish a project goal for locally sourced materials, and identify materials and material suppliers that can achieve this goal. During construction, ensure that the specified local materials are installed and quantify the total percentage of local materials installed. Consider a range of environmental, economic and performance attributes when selecting products and materials.	X		Most of the construction material is extracted, processed, manufactured regionally	B

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Yes	?	No	Materials & Resources	14 Points		Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
	1		Credit 5.2	**Local/Regional Materials**, 20 % Extracted, Processed & Manufactured Regionally	1	**Intent** Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation. **Requirements** Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for an additional 10% beyond MR Credit 5.1 (total of 20%, based on cost) of the total materials value. If only a fraction of the material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value. **Potential Technologies & Strategies** Establish a project goal for locally sourced materials and identify materials and material suppliers that can achieve this goal. During construction, ensure that the specified local materials are installed. Consider a range of environmental, economic and performance attributes when selecting products and materials.	X		Most of the construction material is extracted, processed, manufactured regionally	B
	1		Credit 6	**Rapidly Renewable Materials**, Specify 2.5%	1	**Intent** Reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials. **Requirements** Use rapidly renewable building materials and products (made from plants that are typically harvested within a ten-year cycle or shorter) for 2.5% of the total value of all building materials and products used in the project, based on cost. **Potential Technologies & Strategies** Establish a project goal for rapidly renewable materials and identify products and suppliers that can support achievement of this goal. Consider materials such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheatboard, strawboard and cork. During construction, ensure that the specified renewable materials are installed.	X		In some parts of the buidilng bamboo floor and plankings are installed	A
	1		Credit 7	**Certified Wood**, 50% of wood-based materials	1	**Intent** Encourage environmentally responsible forest management. **Requirements** Use a minimum of 50% of wood-based materials and products, which are certified in accordance with the Forest Stewardship Council's (FSC) Principles and Criteria, for wood building components. These components include, but are not limited to, structural framing and general dimensional framing, flooring, sub-flooring, wood doors and finishes. Include materials permanently installed in the project. Wood products purchased for temporary use on the project (e.g., formwork, bracing, scaffolding, sidewalk protection, and guard rails) may be included in the calculation at the project team's discretion. If any such materials are included, all such materials must be included in the calculation. If such materials are purchased for use on multiple projects, the applicant may include these materials for only one project, at its discretion. Furniture may be included, providing it is included consistently in MR Credits 3–7. **Potential Technologies & Strategies** Establish a project goal for FSC-certified wood products and identify suppliers that can achieve this goal. During construction, ensure that the FSC-certified wood products are installed and quantify the total percentage of FSC-certified wood products installed.	X		Wood is only used for one construction "bridge" element in the buildilng in significatn amounts, however, FSC certification may be assumed	A

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Yes	?	No	Indoor Environmental Quality	15 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
			Prereq 1 **Minimum IAQ Performance**	Required	**Intent** Establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants. **Requirements** Meet the minimum requirements of Sections 4 through 7 of ASHRAE 62.1-2004, Ventilation for Acceptable Indoor Air Quality. Mechanical ventilation systems shall be designed using the Ventilation Rate Procedure or the applicable local code, whichever is more stringent. Naturally ventilated buildings shall comply with ASHRAE 62.1-2004, paragraph 5.1. **Potential Technologies & Strategies** Design ventilation systems to meet or exceed the minimum outdoor air ventilation rates as described in the ASHRAE standard. Balance the impacts of ventilation rates on energy use and indoor air quality to optimize for energy efficiency and occupant health. Use the ASHRAE 62 Users Manual for detailed guidance on meeting the referenced requirements.	X		Designed according to Austrian Standards (or EN), in general compliance with ASHRAE can be assumed	A

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Yes	?	No	Indoor Environmental Quality	15 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
			Prereq 2 **Environmental Tobacco Smoke** (ETS) **Control**	Required	**Intent** Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to Environmental Tobacco Smoke (ETS). **Requirements** OPTION 1 a.) Prohibit smoking in the building. b.) Locate any exterior designated smoking areas at least 25 feet away from entries, outdoor air intakes and operable windows. OR OPTION 2 a.) Prohibit smoking in the building except in designated smoking areas. b.) Locate any exterior designated smoking areas at least 25 feet away from entries, outdoor air intakes and operable windows. c.) Locate designated smoking rooms to effectively contain, capture and remove ETS from the building. At a minimum, the smoking room must be directly exhausted to the outdoors with no re-circulation of ETS-containing air to the non-smoking area of the building, and enclosed with impermeable deck-to-deck partitions. With the doors to the smoking room closed, operate exhaust sufficient to create a negative pressure with respect to the adjacent spaces of at least an average of 5 Pa (0.02 inches of water gauge) and with a minimum of 1 Pa (0.004 inches of water gauge). d.) Performance of the smoking room differential air pressures shall be verified by conducting 15 minutes of measurement, with a minimum of one measurement every 10 seconds, of the differential pressure in the smoking room with respect to each adjacent area and in each adjacent vertical chase with the doors to the smoking room closed. The testing will be conducted with each space configured for worst case conditions of transport of air from the smoking rooms to adjacent spaces with the smoking rooms' doors closed to the adjacent spaces. OR OPTION 3 (For residential buildings only) a.) Prohibit smoking in all common areas of the building. b.) Locate any exterior designated smoking areas at least 25 feet away from entries, outdoor air intakes and operable windows opening to common areas. c.) Minimize uncontrolled pathways for ETS transfer between individual residential units by sealing penetrations in walls, ceilings and floors in the residential units, and by sealing vertical chases adjacent to the units. d.) All doors in the residential units leading to common hallways shall be weatherstripped stripped to minimize air leakage into the hallway. e.) If the common hallways are pressurized with respect to the residential units then doors in the residential units leading to the common hallways need not be weatherstripped provided that the positive differential pressure is demonstrated as in Option 2 above, considering the residential unit as the smoking room. Acceptable sealing of residential units shall be demonstrated by a blower door test conducted in accordance with ANSI/ASTM-E779-03, Standard Test Method for Determining Air Leakage Rate By Fan Pressurization, AND use the progressive sampling methodology defined in Chapter 4 (Compliance Through Quality Construction) of the Residential Manual for Compliance with California's 2001 Energy Efficiency Standards (www.energy.ca.gov/title24/residential_manual). Residential units must demonstrate less than 1.25 square inches leakage area per 100 square feet of enclosure area (i.e., sum of all wall, ceiling and floor areas). **Potential Technologies & Strategies** Prohibit smoking in commercial buildings or effectively control the ventilation air in smoking rooms. For residential buildings, prohibit smoking in common areas, design building envelope and systems to minimize ETS transfer among dwelling units.	X		On request of the individual renting parties, the air conditioning system was either desigend for smoking, or non-smoking (distinction in ductwork is being made, and different air handling units + additioanl air volumes)	A

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Yes	?	No	Indoor Environmental Quality	15 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
1			Credit 1 **Outdoor Air Delivery Monitoring**	1	**Intent** Provide capacity for ventilation system monitoring to help sustain occupant comfort and well-being. **Requirements** Install permanent monitoring systems that provide feedback on ventilation system performance to ensure that ventilation systems maintain design minimum ventilation requirements. Configure all monitoring equipment to generate an alarm when the conditions vary by 10% or more from setpoint, via either a building automation system alarm to the building operator or via a visual or audible alert to the building occupants. FOR MECHANICALLY VENTILATED SPACES a.) Monitor carbon dioxide concentrations within all densely occupied spaces (those with a design occupant density greater than or equal to 25 people per 1000 sq.ft.). CO2 monitoring locations shall be between 3 feet and 6 feet above the floor. b.) For each mechanical ventilation system serving non-densely occupied spaces, provide a direct outdoor airflow measurement device capable of measuring the minimum outdoor airflow rate with an accuracy of plus or minus 15% of the design minimum outdoor air rate, as defined by ASHRAE 62.1-2004. FOR NATURALLY VENTILATED SPACES Monitor CO2 concentrations within all naturally ventilated spaces. CO2 monitoring shall be located within the room between 3 feet and 6 feet above the floor. One CO2 sensor may be used to represent multiple spaces if the natural ventilation design uses passive stack(s) or other means to induce airflow through those spaces equally and simultaneously without intervention by building occupants. **Potential Technologies & Strategies** Install carbon dioxide and airflow measurement equipment and feed the information to the HVAC system and/or Building Automation System (BAS) to trigger corrective action, if applicable. If such automatic controls are not feasible with the building systems, use the measurement equipment to trigger alarms that inform building operators or occupants of a possible deficiency in outdoor air delivery.	X		CO2, humidity, temperature and air volume are measured and controlled individually in all meeting or public rooms, in the offices Austrian standard demands 30 m³/h of air exchange per person, and thus is far above ASHRAE requirements, and CO2 control becomes nonessential	A
1			Credit 2 **Increased Ventilation**	1	**Intent** Provide additional outdoor air ventilation to improve indoor air quality for improved occupant comfort, well-being and productivity. **Requirements** FOR MECHANICALLY VENTILATED SPACES a.) Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates required by ASHRAE Standard 62.1-2004 as determined by EQ Prerequisite 1. FOR NATURALLY VENTILATED SPACES b.) Design natural ventilation systems for occupied spaces to meet the recommendations set forth in the Carbon Trust Good Practice Guide 237 [1998]. Determine that natural ventilation is an effective strategy for the project by following the flow diagram process shown in Figure 1.18 of the Chartered Institution of Building Services Engineers (CIBSE) Applications Manual 10: 2005, Natural ventilation in non-domestic buildings. AND c.) Use diagrams and calculations to show that the design of the natural ventilation systems meets the recommendations set forth in the CIBSE Applications Manual 10: 2005, Natural ventilation in non-domestic buildings. OR d.) Use a macroscopic, multi-zone, analytic model to predict that room-by-room airflows will effectively naturally ventilate, defined as providing the minimum ventilation rates required by ASHRAE 62.1-2004 Chapter 6, for at least 90% of occupied spaces. **Potential Technologies & Strategies** For mechanically ventilated spaces: use heat recovery, where appropriate, to minimize the additional energy consumption associated with higher ventilation rates. For naturally ventilated spaces: follow the eight design steps described in the Carbon Trust Good Practice Guide 237: 1) Develop design requirements, 2) Plan airflow paths, 3) Identify building uses and features that might require special attention, 4) Determine ventilation requirements, 5) Estimate external driving pressures, 6) Select types of ventilation devices, 7) Size ventilation devices, 8) Analyze the design. Use public domain software such as NIST's CONTAM, Multizone Modeling Software, along with LoopDA, Natural Ventilation Sizing Tool, to analytically predict room-byroom airflows.			CO2, humidity, temperature and air volume are measured and controlled individually in all meeting or public rooms, in the offices Austrian standard demands 30 m³/h of air exchange per person, and thus is far above ASHRAE requirements, and CO2 control becomes nonessential	A

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Yes	?	No	Indoor Environmental Quality	15 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
		1	Credit 3.1	**Construction IAQ Management Plan**, During Construction 1	**Intent** Reduce indoor air quality problems resulting from the construction/renovation process in order to help sustain the comfort and well-being of construction workers and building occupants. **Requirements** Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building as follows: a.) During construction meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 1995, Chapter 3. b.) Protect stored on-site or installed absorptive materials from moisture damage. c.) If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 shall be used at each return air grille, as determined by ASHRAE 52.2-1999. Replace all filtration media immediately prior to occupancy. **Potential Technologies & Strategies** Adopt an IAQ management plan to protect the HVAC system during construction, control pollutant sources and interrupt contamination pathways. Sequence the installation of materials to avoid contamination of absorptive materials such as insulation, carpeting, ceiling tile and gypsum wallboard. Coordinate with EQ Credits 3.2 and 5 to determine the appropriate specifications and schedules for filtration media. If possible, avoid using permanently installed air handlers for temporary heating/cooling during construction. Consult this LEED for New Construction v2.2 Reference Guide for more detailed information on how to ensure the well-being of construction workers and building occupants if permanently installed air handlers must be used during construction.	X		Substantial Completion was reached within 1 year from construction start, no indoor air quality measures were taken in compliance with the requirement according to LEED	B

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Yes	?	No	Indoor Environmental Quality	15 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
1			Credit 3.2	**Construction IAQ Management Plan**, Testing Before Occupancy 1	**Intent** Reduce indoor air quality problems resulting from the construction/renovation process in order to help sustain the comfort and well-being of construction workers and building occupants. **Requirements** Develop and implement an Indoor Air Quality (IAQ) Management Plan for the preoccupancy phase as follows: OPTION 1 — FLUSH-OUT a.) After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while maintaining an internal temperature of at least 60ºF and relative humidity no higher than 60%. OR b.) If occupancy is desired prior to completion of the flush-out, the space may be occupied following delivery of a minimum of 3,500 cu.ft. of outdoor air per sq.ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm/sq.ft. of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu.ft./sq.ft. of outside air has been delivered to the space. OR OPTION 2 — AIR QUALITY TESTING a.) Conduct baseline IAQ testing, after construction ends and prior to occupancy, using testing protocols consistent with the United States Environmental Protection Agency Compendium of Methods for the Determination of Air Pollutants in Indoor Air and as additionally detailed in this Reference Guide. b.) Demonstrate that the contaminant maximum concentrations listed below are not exceeded. c.) For each sampling point where the maximum concentration limits are exceeded conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, take samples from the same locations as in the first test. d.) The air sample testing shall be conducted as follows: 1) All measurements shall be conducted prior to occupancy, but during normal occupied hours, and with the building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing. 2) The building shall have all interior finishes installed, including but not limited to millwork, doors, paint, carpet and acoustic tiles. Non-fixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing. 3) The number of sampling locations will vary depending upon the size of the building and number of ventilation systems. For each portion of the building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq.ft., or for each contiguous floor area, whichever is larger, and include areas with the least ventilation and greatest presumed source strength. 4) Air samples shall be collected between 3 feet and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum 4-hour period. **Potential Technologies & Strategies** Prior to occupancy, perform a building flush-out or test the air contaminant levels in the building. The flush-out is often used where occupancy is not required immediately upon substantial completion of construction. IAQ testing can minimize schedule impacts but may be more costly. Coordinate with EQ Credits 3.1 and 5 to determine the appropriate specifications and schedules for filtration media.	X		During the commissioning phase, before occupancy a building flush out with an air volume of well above 5,000 m³/m² was performed, and thus most likely would comply with this credit	B

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Yes	?	No	Indoor Environmental Quality	15 Points		Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
1			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1	**Intent** Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants. **Requirements** All adhesives and sealants used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with the requirements of the following reference standards: ==> Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management District (SCAQMD) Rule #1168. VOC limits are listed in the table below and correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005. ==> Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000. **Potential Technologies & Strategies** Specify low-VOC materials in construction documents. Ensure that VOC limits are clearly stated in each section of the specifications where adhesives and sealants are addressed. Common products to evaluate include general construction adhesives, flooring adhesives, fire-stopping sealants, caulking, duct sealants, plumbing adhesives, and cove base adhesives.	X		Contractor was issued to consider health related substances, and consider mitigation of those	B
1			Credit 4.2	**Low-Emitting Materials**, Paints and Coatings	1	**Intent** Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants. **Requirements** Paints and coatings used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with the following criteria: # Architectural paints, coatings and primers applied to interior walls and ceilings: Do not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993. # Flats: 50 g/L # Non-Flats: 150 g/L # Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: Do not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997. # Clear wood finishes, floor coatings, stains, sealers, and shellacs applied to interior elements: Do not exceed the VOC content limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004. # Clear wood finishes: varnish 350 g/L; lacquer 550 g/L # Floor coatings: 100 g/L # Sealers: waterproofing sealers 250 g/L; sanding sealers 275 g/L; all other sealers 200 g/L # Shellac: clear 730 g/L; pigmented 550 g/L # Stains: 250 g/L **Potential Technologies & Strategies** Specify low-VOC paints and coatings in construction documents. Ensure that VOC limits are clearly stated in each section of the specifications where paints and coatings are addressed.	X		Contractor was issued to consider health related substances, and consider mitigation of those	B

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Yes	?	No	Indoor Environmental Quality	15 Points		Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
1			Credit 4.3	**Low-Emitting Materials**, Carpets	1	**Intent** Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants. **Requirements** All carpet installed in the building interior shall meet the testing and product requirements of the Carpet and Rug Institute's Green Label Plus program. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute Green Label program. All carpet adhesive shall meet the requirements of EQ Credit 4.1: VOC limit of 50 g/L. **Potential Technologies & Strategies** Clearly specify requirements for product testing and/or certification in the construction documents. Select products that are either certified under the Green Label Plus program or for which testing has been done by qualified independent laboratories in accordance with the appropriate requirements. The Green Label Plus program for carpets and its associated VOC emission criteria in micrograms per square meter per hour, along with information on testing method and sample collection developed by the Carpet & Rug Institute (CRI) in coordination with California's Sustainable Building Task Force and the California Department of Health Services (DHS), are described in Section 9, Acceptable Emissions Testing for Carpet, DHS Standard Practice CA/DHS/EHLB/R-174, dated 07/15/04. This document is available at: www.dhs.ca.gov/ps/deodc/ehlb/iaq/VOCS/Section01350_7_15_2004_FINAL_PLUS_ADDENDUM-2004-01.pdf (also published as Section 01350 Section 9 [dated 2004] by the Collaborative for High Performance Schools [www.chps.net]).	X		Contractor was issued to consider health related substances, and consider mitigation of those	B
1			Credit 4.4	**Low-Emitting Materials**, Composite Wood and Agrifiber	1	**Intent** Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants. **Requirements** Composite wood and agrifiber products used on the interior of the building (defined as inside of the weatherproofing system) shall contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins. Composite wood and agrifiber products are defined as: particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates and door cores. Furniture and equipment are not considered base building elements and are not included. **Potential Technologies & Strategies** Specify wood and agrifiber products that contain no added urea-formaldehyde resins. Specify laminating adhesives for field and shop applied assemblies that contain no added urea-formaldehyde resins.	X		Contractor was issued to consider health related substances, and consider mitigation of those	B

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Yes	?	No	Indoor Environmental Quality	15 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
	1		Credit 5 **Indoor Chemical & Pollutant Source Control**	1	**Intent** Minimize exposure of building occupants to potentially hazardous particulates and chemical pollutants. **Requirements** Design to minimize and control pollutant entry into buildings and later cross-contamination of regularly occupied areas: a.) Employ permanent entryway systems at least six feet long in the primary direction of travel to capture dirt and particulates from entering the building at all entryways that are directly connected to the outdoors. Acceptable entryway systems include permanently installed grates, grilles, or slotted systems that allow for cleaning underneath. Roll-out mats are only acceptable when maintained on a weekly basis by a contracted service organization. Qualifying entryways are those that serve as regular entry points for building users. b.) Where hazardous gases or chemicals may be present or used (including garages, housekeeping/laundry areas and copying/printing rooms), exhaust each space sufficiently to create negative pressure with respect to adjacent spaces with the doors to the room closed. For each of these spaces, provide self-closing doors and deck to deck partitions or a hard lid ceiling. The exhaust rate shall be at least 0.50 cfm/sq.ft., with no air re-circulation. The pressure differential with the surrounding spaces shall be at least 5 Pa (0.02 inches of water gauge) on average and 1 Pa (0.004 inches of water) at a minimum when the doors to the rooms are closed. c.) In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media prior to occupancy that provides a Minimum Efficiency Reporting Value (MERV) of 13 or better. Filtration should be applied to process both return and outside air that is to be delivered as supply air. **Potential Technologies & Strategies** Design facility cleaning and maintenance areas with isolated exhaust systems for contaminants. Maintain physical isolation from the rest of the regularly occupied areas of the building. Install permanent architectural entryway systems such as grilles or grates to prevent occupant-borne contaminants from entering the building. Install high-level filtration systems in air handling units processing both return air and outside supply air. Ensure that air handling units can accommodate required filter sizes and pressure drops.	X		Increased ventilation rates for the garage space, but no other ares that may contain other hazardous gases or chemicals. A permanent entry-way system is not being in place	A
1			Credit 6.1 **Controllability of Systems**, Lighting	1	**Intent** Provide a high level of lighting system control by individual occupants or by specific groups in multi-occupant spaces (i.e., classrooms or conference areas) to promote the productivity, comfort and well-being of building occupants. **Requirements** Provide individual lighting controls for 90% (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences. AND Provide lighting system controllability for all shared multi-occupant spaces to enable lighting adjustment that meets group needs and preferences. **Potential Technologies & Strategies** Design the building with occupant controls for lighting. Strategies to consider include lighting controls and task lighting. Integrate lighting systems controllability into the overall lighting design, providing ambient and task lighting while managing the overall energy use of the building.	X		All public places are sensor controlled (daylight and occupany), other places incl. office space allow for individual control	A

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Yes	?	No	Indoor Environmental Quality	15 Points		Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
1			Credit 6.2	**Controllability of Systems**, Thermal Comfort	1	Intent Provide a high level of thermal comfort system control by individual occupants or by specific groups in multi-occupant spaces (i.e., classrooms or conference areas) to promote the productivity, comfort and well-being of building occupants. **Requirements** Provide individual comfort controls for 50% (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences. Operable windows can be used in lieu of comfort controls for occupants of areas that are 20 feet inside of and 10 feet to either side of the operable part of the window. The areas of operable window must meet the requirements of ASHRAE 62.1-2004, paragraph 5.1, Natural Ventilation. AND Provide comfort system controls for all shared multi-occupant spaces to enable adjustments to suit group needs and preferences. Conditions for thermal comfort are described in ASHRAE Standard 55-2004 to include the primary factors of air temperature, radiant temperature, air speed and humidity. Comfort system control, for the purposes of this credit, is defined as the provision of control over at least one of these primary factors in the occupant's local environment. **Potential Technologies & Strategies** Design the building and systems with comfort controls to allow adjustments to suit individual needs or those of groups in shared spaces. ASHRAE Standard 55-2004 identifies the factors of thermal comfort and a process for developing comfort criteria for building spaces that suit the needs of the occupants involved in their daily activities. Control strategies can be developed to expand on the comfort criteria to allow adjustments to suit individual needs and preferences. These may involve system designs incorporating operable windows, hybrid systems integrating operable windows and mechanical systems, or mechanical systems alone. Individual adjustments may involve individual thermostat controls, local diffusers at floor, desk or overhead levels, or control of individual radiant panels, or other means integrated into the overall building, thermal comfort systems, and energy systems design. In addition, designers should evaluate the closely tied interactions between thermal comfort (as required by ASHRAE Standard 55-2004) and acceptable indoor air quality (as required by ASHRAE Standard 62.1-2004, whether natural or mechanical ventilation).	X		High level of controlability is given to all individual areas, other spaces incl. individual offices. Furthermore operable windows are available for all offices.	A
1			Credit 7.1	**Thermal Comfort**, Design	1	**Intent** Provide a comfortable thermal environment that supports the productivity and wellbeing of building occupants. **Requirements** Design HVAC systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy. Demonstrate design compliance in accordance with the Section 6.1.1 Documentation. **Potential Technologies & Strategies** Establish comfort criteria per ASHRAE Standard 55-2004 that support the desired quality and occupant satisfaction with building performance. Design building envelope and systems with the capability to deliver performance to the comfort criteria under expected environmental and use conditions. Evaluate air temperature, radiant temperature, air speed, and relative humidity in an integrated fashion and coordinate these criteria with EQ Prerequisite 1, EQ Credit 1 and EQ Credit 2.	X		HVAC design is based on the experience of the owner, and optimised to minimise occupancy complaints. Thus e.g. air is humidified during the summer, when the cooling rips are switched on. Considering this optimisation steps it can be considered to comply with LEED.	A

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Yes	?	No	Indoor Environmental Quality	15 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
1			Credit 7.2 **Thermal Comfort**, Verification	1	**Intent** Provide for the assessment of building thermal comfort over time. **Requirements** Agree to implement a thermal comfort survey of building occupants within a period of six to 18 months after occupancy. This survey should collect anonymous responses about thermal comfort in the building including an assessment of overall satisfaction with thermal performance and identification of thermal comfort-related problems. Agree to develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied with thermal comfort in the building. This plan should include measurement of relevant environmental variables in problem areas in accordance with ASHRAE Standard 55-2004. **Potential Technologies & Strategies** ASHRAE Standard 55-2004 provides guidance for establishing thermal comfort criteria and the documentation and validation of building performance to the criteria. While the standard is not intended for purposes of continuous monitoring and maintenance of the thermal environment, the principles expressed in the standard provide a basis for design of monitoring and corrective action systems.	X		The office building has only taken up operation recently, and thus a survey has not been perfomred yet. However, renters satisfaction is usually a high aim and thus verified.	B
1			Credit 8.1 **Daylight & Views**, Daylight 75% of Spaces	1	**Intent** Provide for the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building. **Requirements** OPTION 1 — GLAZING FACTOR CALCULATION Achieve a minimum glazing factor of 2% in a minimum of 75% of all regularly occupied areas. The glazing factor is calculated as follows: OR OPTION 2 — DAYLIGHT SIMULATION MODEL Demonstrate, through computer simulation, that a minimum daylight illumination level of 25 footcandles has been achieved in a minimum of 75% of all regularly occupied areas. Modeling must demonstrate 25 horizontal footcandles under clear sky conditions, at noon, on the equinox, at 30" above the floor. OR OPTION 3 — DAYLIGHT MEASUREMENT Demonstrate, through records of indoor light measurements, that a minimum daylight illumination level of 25 footcandles has been achieved in at least 75% of all regularly occupied areas. Measurements must be taken on a 10-foot grid for all occupied spaces and must be recorded on building floor plans. In all cases, only the square footage associated with the portions of rooms or spaces meeting the minimum illumination requirements can be applied towards the 75% of total area calculation required to qualify for this credit. In all cases, provide daylight redirection and/or glare control devices to avoid high-contrast situations that could impede visual tasks. Exceptions for areas where tasks would be hindered by the use of daylight will be considered on their merits. **Potential Technologies & Strategies** Design the building to maximize interior daylighting. Strategies to consider include building orientation, shallow floor plates, increased building perimeter, exterior and interior permanent shading devices, high performance glazing and automatic photocellbased controls. Predict daylight factors via manual calculations or model daylighting strategies with a physical or computer model to assess footcandle levels and daylight factors achieved.	X		Daylight view and light is obviousely optimised, and from nearly each point in the officese daylight & views can be experienced.	B

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Yes	?	No	Indoor Environmental Quality	15 Points		Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
1			Credit 8.2	**Daylight & Views**, Views for 90% of Space	1	**Intent** Provide for the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building. **Requirements** Achieve direct line of sight to the outdoor environment via vision glazing between 2'6" and 7'6" above finish floor for building occupants in 90% of all regularly occupied areas. Determine the area with direct line of sight by totaling the regularly occupied square footage that meets the following criteria: a.) In plan view, the area is within sight lines drawn from perimeter vision glazing. b.) In section view, a direct sight line can be drawn from the area to perimeter vision glazing. Line of sight may be drawn through interior glazing. For private offices, the entire square footage of the office can be counted if 75% or more of the area has direct line of sight to perimeter vision glazing. For multi-occupant spaces, the actual square footage with direct line of sight to perimeter vision glazing is counted. **Potential Technologies & Strategies** Design the space to maximize daylighting and view opportunities. Strategies to consider include lower partition heights, interior shading devices, interior glazing, and automatic photocell-based controls.	X		Daylight view and light is obviously optimised, and from nearly each point in the officese daylight & views can be experienced.	B

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Yes	?	No	Innovation & Design Process	5 Points	Description of the Requirement	Applicable	Not Applicable	Design Considerations	Effort
	1		Credit 1.1 **Innovation in Design**	1	**Intent** To provide design teams and projects the opportunity to be awarded points for exceptional performance above the requirements set by the LEED for New Construction Green Building Rating System and/or innovative performance in Green Building categories not specifically addressed by this Rating System. Requirements Credit 1.1 (1 point) In writing, identify the intent of the proposed innovation credit, the proposed requirement for compliance, the proposed submittals to demonstrate compliance, and the design approach (strategies) that might be used to meet the requirements. Credit 1.2 (1 point) Same as Credit 1.1 Credit 1.3 (1 point) Same as Credit 1.1 Credit 1.4 (1 point) Same as Credit 1.1 **Potential Technologies & Strategies** Substantially exceed a LEED for New Construction performance credit such as energy performance or water efficiency. Apply strategies or measures that demonstrate a comprehensive approach and quantifiable environment and/or health benefits.	X		An innovative design point can be assumed for the high energy efficiency reached, and especially due to the advanced BMS system, also considering the position of the sun and respective control of the outside blinds	A
			Credit 1.2 **Innovation in Design**	1					A
			Credit 1.3 **Innovation in Design**	1					A
			Credit 1.4 **Innovation in Design**	1					A
	x		Credit 2 **LEED® Accredited Professional**	1	**Intent** To support and encourage the design integration required by a LEED for New Construction green building project and to streamline the application and certification process. **Requirements** At least one principal participant of the project team shall be a LEED Accredited Professional (AP). **Potential Technologies & Strategies** Educate the project team members about green building design and construction and application of the LEED Rating System early in the life of the project. Consider assigning the LEED AP as a facilitator of an integrated design & construction process.	x		Can be assumed being applicable, when LEED was considered from the beginning	A

6.3 Case-Study Analysis, LEED Sample Submittal Templates

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SS Credit 4.1: Public Transportation Access

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(Responsible Individual) (Company Name)

I, Klaus Kogler, from iC consulenten ZT GmbH

verify that the information provided below is accurate, to the best of my knowledge.

CREDIT COMPLIANCE

Please select the appropriate compliance path option:

- (•) **Option 1:** Commuter Rail Service
- ( ) **Option 2:** Bus Service

OPTION 1: COMMUTER RAIL SERVICE

SUPPORTING DOCUMENTATION

The site vicinity plan has been uploaded. The drawing shows the commuter rail stop locations and identification.

Sheet Description Log

Please include sheet name, sheet number and file name for each uploaded, referenced drawing (e.g. A-101, Site Plan, siteplan.pdf)

Figure 5: Site plan, Wagenseilgasse 14, compliance path option 1

☒ I have provided the appropriate supporting documentation in the document upload section of LEED Online. Please refer to the above sheets.

Rail Statiion Description Table

Distance to Station / Stop (miles)	Line Designation / Description of Service
.25	Station: Schedifkaplatz; Service: Urban, suburban, regional train (Badnerbahn)
.4	Station: Philadelphisbrücke; Service: Large train-station, hosting mor than 5 urban, sub-urban fast trains, and an underground line

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OPTION 2: BUS SERVICE

SUPPORTING DOCUMENTATION

TThe site vicinity plan has been uploaded. The drawing shows the bus stop locations and identification.

Sheet Description Log
Please include sheet name, sheet number and file name for each uploaded, referenced drawing (e.g. A-101, Site Plan, siteplan.pdf)

☐ I have provided the appropriate supporting documentation in the document upload section of LEED Online. Please refer to the above sheets.

Bus Statiion Description Table

Distance to Station / Stop (miles)	Line Designation / Description of Service

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NARRATIVE (Optional)

Please provide any additional comments or notes regarding special circumstances or considerations regarding the project's credit approach.

☐ The project is seeking point(s) for this credit using an alternate compliance approach. The compliance approach, including references to any applicable Credit Interpretation Rulings is fully documented in the narrative above. *(Indicate the number of points documented in the field below).*

Alternative Compliance Points Documented

Project Name:

Credit: SS Credit 4.1: Public Transportation Access Points Documented: 1

READY TO SAVE THIS TEMPLATE TO LEED-ONLINE? Please enter your first name, last name and today's date below, followed by your LEED-Online Username and Password associated with the Project listed above to confirm submission of this template.

Klaus	Kogler	2009-05-31	Test	*******
First Name	Last Name	Date	Username (Email Address)	Password

Letter Template Version A1

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(Responsible Individual) (Company Name)

I, _____, from _____

verify that the information provided below is accurate, to the best of my knowledge.

CREDIT COMPLIANCE

(Please complete the color coded criteria(s) based on the option path selected)

Please select the appropriate compliance path option

- ○ Option 1 (Pg 2): Performance Rating Method, ASHRAE 90.1-2004 Appendix G or equivalent (up to 10 points possible)
- ○ Option 2 (Pg 14): ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004 (4 points)
- ○ Option 3 (Pg 14): Advanced Buildings Benchmark™ Version 1.1, Basic Criteria & Prescriptive Measures (1 point)

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OPTION 1: PERFORMANCE RATING METHOD

☐ I confirm that the energy simulation software used for this project has all capabilities described in EITHER section `G2 Simulation General Requirements' in Appendix G of ASHRAE 90.1-2004 OR the analogous section of the alternative qualifying energy code used.

☐ I confirm that the baseline building and proposed building in this project's energy simulation runs use the assumptions and modeling methodology described in EITHER Appendix G of ASHRAE 90.1-2004 OR the analogous section of the alternative qualifying energy code used.

Complete the following sections to document compliance using Option 1:

Section 1.1 - General Information
Section 1.2 - Space Summary
Section 1.3 - Advisory Messages
Section 1.4 - Comparison of Proposed Design Versus Baseline Design Energy Model Inputs
Section 1.5 - Energy Type Summary
Section 1.6 - On-Site Renewable Energy *(if applicable)*
Section 1.7 - Exceptional Calculation Measure Summary *(if applicable)*
Section 1.8 - Performance Rating Method Compliance Report

Section 1.1 - General Information

Provide the following data for your project

Simulation Program:		Quantity of Stories:	
Principal Heating Source:		Weather File:	
Energy Code Used:	ASHRAE 90.1-2004 Appendix G	Climate Zone:	
New Construction Percent:	100 %	Existing Renovation Percent:	0 %

Enter the Target Finder score for your building from the Energy Star website (http://www.energystar.gov/index.cfm?fuseaction=target_finder.&CFID=154897). The score has no bearing on the number of EAc1 points earned. Use the following process to evaluate the Target Finder score:

1. Enter the facility information
2. Enter the facility characteristics. Select each primary and secondary space type that applies to the project. Then complete the required information for each space type.
4. Enter the total energy use per energy source for your project based on the totals reflected in the Proposed Design energy simulation output report.

Target Finder Score:

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Section 1.2 - Space Summary

Provide the space summary for your project
(click "CLEAR" to clear the contents of any row All numeric entries must be entered as whole numbers without commas):

Table 1.2 - Space Summary

Building Use (Occupancy Type)	Conditioned Area (sf)	Unconditioned Area (sf)	Total Area (sf)	
				CLEAR
				CLEAR
				CLEAR
				CLEAR
				CLEAR
				CLEAR
				CLEAR
				CLEAR
				CLEAR
				CLEAR
				CLEAR
Total:				

Section 1.3 - Advisory Messages

Complete the following information from the simulation output files (all entries should be entered as whole numbers, without commas)

TABLE 1.3 - Advisory Messages	Proposed Building	Baseline Building (0 deg. rotation)	Difference
Number of hours heating loads not met:			
Number of hours cooling loads not met:			
Number of warning messages:			
Number of error messages:			
Number of defaults overridden:			

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Section 1.4 - Comparison of Proposed Design Versus Baseline Design Energy Model Inputs

Use **Table 1.4** to document the Baseline and Proposed design energy model inputs for your project. Include descriptions for:

1. Exterior wall, underground wall, roof, floor, and slab assemblies including framing type, assembly R-values, assembly U-factors, and roof reflectivity when modeling cool roofs. (Refer to ASHRAE 90.1 Appendix A)
2. Fenestration types, assembly U-factors (including the impact of the frame on the assembly), SHGCs, and visual light transmittances, overall window-to-gross wall ratio, fixed shading devices, and automated movable shading devices.
3. Interior lighting power densities, exterior lighting power, process lighting power, and lighting controls modeled for credit.
4. Receptacle equipment, elevators or escalators, refrigeration equipment, and other process loads.
5. HVAC system information including types and efficiencies, fan control, fan supply air volume, fan power, economizer control, demand control ventilation, exhaust heat recovery, pump power and controls, and any other pertinent system information. (Include the ASHRAE 90.1-2004 Table G.3.1.1B Baseline System Number).
6. Domestic hot water system type, efficiency and storage tank volume.
7. General schedule information

Documentation should be sufficient to justify the energy and cost savings numbers reported in the Performance Rating Table.

(Click "CLEAR" to clear the contents of any row.)

TABLE 1.4 - Comparison of Proposed Design Versus Baseline Design

Model Input Parameter	Proposed Design Input	Baseline Design Input	
Exterior Wall Construction			CLEAR
Roof Construction			CLEAR
Floor/Slab Construction			CLEAR
Window-to-gross wall ratio			CLEAR
Fenestration type			CLEAR
Fenestration U-factor			CLEAR
Fenestration SHGC - North			CLEAR
Fenestration SHGC - Non-North			CLEAR
Fenestration Visual Light Transmittance			CLEAR
Shading Devices			CLEAR
			CLEAR
Interior Lighting Power Density (W/sf)			CLEAR

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TABLE 1.4 - Comparison of Proposed Design Versus Baseline Design

Model Input Parameter	Proposed Design Input	Baseline Design Input	
Daylighting Controls			CLEAR
Other Lighting Control Credits			CLEAR
Exterior Lighting Power (kW)			CLEAR
Process Lighting (kW)			CLEAR
Receptacle Equipment Power Density (W/sf)			CLEAR
			CLEAR
Primary HVAC System Type		Table G3.1.1B System # X - LIST DESCRIPTION	CLEAR
Other HVAC System Type			CLEAR
Fan Supply Volume			CLEAR
Fan Power			CLEAR
Economizer Control			CLEAR
Demand Control Ventilation			CLEAR
Unitary Equipment Cooling Efficiency			CLEAR
Unitary Equipment Heating Efficiency			CLEAR
Chiller parameters			CLEAR
Chilled water loop & pump parameters			CLEAR
Boiler parameters			CLEAR
Hot water loop & pump parameters			CLEAR
Cooling tower parameters			CLEAR
Condenser water loop & pump parameters			CLEAR
			CLEAR

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Section 1.5 - Energy Type Summary

List the energy types used by your project (i.e. electricity, natural gas, purchased chilled water or steam, etc.) for either the Baseline or Proposed design. Also describe the utility rate used for each energy type (i.e. Feswick County Electric LG-S), as well as the units of energy used, and the units of demand used. (Click "CLEAR" to clear the contents of any row):

TABLE 1.5 - Energy Type Summary

Energy Type	Utility Rate Description	Units of Energy	Units of demand	
Electricity		kWh	kW	CLEAR
Natural Gas		therms	MBH	CLEAR
				CLEAR
				CLEAR

Energy Units:
1 kBtu = 1,000 Btu
1 kWh = 3.412 kBtu
1 therm = 100 kBtu
1 MBtu = 1,000 kBtu
1 MWh = 3,412 kBtu
1 ton hr = 12 kBtu

Demand Units
1 MBH = 1,000 Btu/h
1 kW = 3.412 MBH
1 MMBtuh = 1,000 MBH
1 ton = 12 MBH

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Section 1.6 - On-Site Renewable Energy
If the project does not include on-site renewable energy, skip to Section 1.7

☐ The project includes On-Site Renewable Energy

How is the on-site renewable energy cost calculated?

(•) This form will automatically calculate the *Renewable Energy Cost* based on the "virtual" energy rate from the proposed design energy model results. This form will subtract the *Renewable Energy Cost* from the proposed design energy model results to calculate the *Proposed Building Performance Rating*. (You do NOT need to fill out the "Renewable Energy Cost" field in Table 1.6 below)

( ) *Renewable Energy Cost* for each on-site renewable source is analyzed separately from the energy model based on local utility rate structures. The *Renewable Energy Cost* for each renewable source is reported in Table 1.6 below, This form will subtract the reported *Renewable Energy Cost* from the proposed design energy model results to calculate the *Proposed Building Performance Rating*.

( ) On-site renewable energy is modeled directly in the energy model. *Renewable Energy Cost* is already credited in the proposed design energy model results (i.e. the energy model already reflects zero cost for on-site renewable energy, and this form will NOT subtract the *Renewable Energy Cost* a second time).

Indicate the on-site renewable energy source(s) used, the backup energy type for each source (i.e. the fuel that is used when the renewable energy source is unavailable - ASHRAE 90.1-2004, Section G2.4), the rated capacity for the source, and the annual energy generated from each source.

TABLE 1.6 - Renewable Energy Source Summary

Renewable Source	Backup Energy Type	Annual Energy Generated	Rated Capacity	Renewable Energy Cost	
					CLEAR
					CLEAR

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Section 1.7 - Exceptional Calculation Measure Summary

(If the energy analysis does not include exceptional calculation methods, skip to Section 1.8)

☐ The energy analysis includes exceptional calculation method(s) (ASHRAE 90.1-2004, G2.5)

How is the exceptional calculation measure cost savings determined?

◉ This form will automatically calculate the exceptional calculation measure cost savings based on the "virtual" energy rate from the proposed design energy model results. This form will subtract this cost savings from the proposed design energy model results to calculate the *Proposed Building Performance Rating*.

○ Exceptional calculation measure cost for each exceptional calculation measure is analyzed based on local utility rate structures. The *cost savings* for each exceptional calculation is reported below, This form will subtract the reported exceptional calculation cost savings from the proposed design energy model results to calculate the *Proposed Building Performance Rating*.

For each exceptional calculation method employed, document the predicted energy savings by energy type , the energy cost savings (if option 2 above is selected), and a narrative explaining the exceptional calculation method performed, and theoretical or empirical information supporting the accuracy of the method. Reference any applicable Credit Interpretation Rulings. [Note: if an end-use has an energy loss rather than an energy savings, enter it as a negative number]

Exceptional Calculation Measure Short Description: CLEAR

Energy Type(s)	Annual Energy Savings by Energy Type	Annual Cost Savings	Exceptional Calculation Measure Narrative:

Exceptional Calculation Measure Short Description: CLEAR

Energy Type(s)	Annual Energy Savings by Energy Type	Annual Cost Savings	Exceptional Calculation Measure Narrative:

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Section 1.8 - Performance Rating Method Compliance Report *(Option 1 Compliance Only)*

In **Table 1.8.1**, list each energy end use for your project (including all end uses reflected in the baseline and proposed designs). Then check whether the end-use is a process load, select the energy type, and list the energy consumption and peak demand for each end-use for all four Baseline Design orientations. In **Table 1.8.1(b)** indicate the total baseline energy cost for each energy type for all four Baseline Design orientations. If either the baseline or proposed design uses more than one energy type for a single end use (i.e. electric resistance reheat, and central natural gas heating), enter each energy type as a separate end use (i.e. *Heating - Electric*, and *Heating, NG*).

Fill out the Proposed Design energy consumption and peak demand for each end use in **Table 1.8.2.** In **Table 1.8.2 (b)** indicate the total proposed energy cost for each energy type. [Note: Process loads for the proposed design must equal those listed in the Baseline design. Any process load energy savings for the project must be reported in Section 1.7.]

(Click "CLEAR" to clear the contents of any end use)

Table 1.8.1 - Baseline Performance - Performance Rating Method Compliance

End Use	Process?	Baseline Design Energy Type	Units of Annual Energy & Peak Demand	Baseline (0° rotation)	Baseline (90° rotation)	Baseline (180° rotation)	Baseline (270° rotation)	Baseline Design	
Interior Lighting	☐	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
Exterior Lighting	☐	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
Space Heating	☐		Energy Use						CLEAR
			Demand						
Space Cooling	☐	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
Pumps	☐	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
Heat Rejection	☐	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
Fans - Interior	☐	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
Fans - Parking Garage	☐	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
Service Water Heating	☐	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
Receptacle Equipment	☒	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						

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Table 1.8.1 - Baseline Performance - Performance Rating Method Compliance

End Use	Process?	Baseline Design Energy Type	Units of Annual Energy & Peak Demand	Baseline (0° rotation)	Baseline (90° rotation)	Baseline (180° rotation)	Baseline (270° rotation)	Baseline Design	
Interior Lighting (Process)	☒	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
Refrigeration	☒	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
Data Center Equipment	☒	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
Cooking	☒		Energy Use						CLEAR
			Demand						
Elevators & Escalators	☒	Electricity	Energy Use (kWh)						CLEAR
			Demand (kW)						
	☐		Energy Use						CLEAR
			Demand						
Baseline Energy Totals:		Total Annual Energy Use (kBtu/year)		0	0	0	0	0	
		Annual Process Energy (kBtu/year)						0	

Note: Process Cost accounts for 0% of Baseline Performance. Process cost must equal at least 25% of Baseline Performance, or the narrative at the end of this form must document why this building's process costs are less than 25%

Table 1.8.1(b) - Baseline Energy Costs

Energy Type	Baseline Cost (0° rotation)	Baseline Cost (90° rotation)	Baseline Cost (180° rotation)	Baseline Cost (270° rotation)	Baseline Building Performance
Electricity					
Natural Gas					
Total Baseline Costs:					

Table 1.8.2 - Performance Rating Table - Performance Rating Method Compliance

End Use	Process?	Proposed Design Energy Type	Proposed Design Units	Proposed Building Results	Baseline Building Units	Baseline Building Results	Percent Savings
Interior Lighting		Electricity	Energy Use (kWh)		Energy Use (kWh)		0 %
			Demand (kW)		Demand (kW)		0 %

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Exterior Lighting		Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
Space Heating			Energy Use			Energy Use		0	%
			Demand			Demand		0	%
Space Cooling		Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
Pumps		Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
Heat Rejection		Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
Fans - Interior		Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
Fans - Parking Garage		Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
Service Water Heating		Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
Receptacle Equipment	X	Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
Interior Lighting (Process)	X	Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
Refrigeration	X	Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
Data Center Equipment	X	Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
Cooking	X		Energy Use			Energy Use		0	%
			Demand			Demand		0	%
Elevators & Escalators	X	Electricity	Energy Use (kWh)			Energy Use (kWh)		0	%
			Demand (kW)			Demand (kW)		0	%
			Energy Use			Energy Use		0	%
			Demand			Demand		0	%
Energy Totals:		Total Annual Energy Use (kBtu/year)		0			0	0	%
		Annual Process Energy (kBtu/year)		0			0	0	%

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Table 1.8.2(b) - Energy Cost and Consumption by Energy Type - Performance Rating Method Compliance

	Proposed Design			Baseline Design			Percent Savings	
Energy Type	Energy Use		Cost	Energy Use		Cost	Energy Use	Cost
Electricity	0	kWh		0	kWh		0 %	0 %
Natural Gas	0	therms		0	therms		0 %	0 %
	0			0			0 %	0 %
	0			0			0 %	0 %
Subtotal (Model Outputs):	0	(kBtu/year)		0	(kBtu/year)		0 %	0 %

On-Site Renewable Energy	Energy Generated	Renewable Energy Cost

Exceptional Calculations	Energy Savings	Cost Savings

	Proposed Design			Baseline Design			Percent Savings	
	Energy Use		Cost	Energy Use		Cost	Energy	Cost
Total:	0	(kBtu/year)	0	0	(kBtu/year)		0 %	0 %

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DOCUMENTATION DESCRIPTION LOG

Please upload the compliance summaries for ASHRAE 90.1-2004 (or qualifying local energy code) and/or LEED if available from the energy simulation software used. Please also upload the energy rate tariff from the project's energy providers if the project is not using the default rates in the LEED-NC v2.2 Reference Guide.

If the software is incapable of producing the energy code or LEED compliance summaries please provide output summaries and example input summaries for both the baseline and proposed buildings that support the data entered in the template tables above.

* Output summaries must include simulated energy consumption by end use as well as total building energy consumption and cost by energy type used in the building.
* Example input summaries must be a sampling of model input assumptions, focusing on the most common systems present in the building. The example input summaries should be taken from the simulation software's standard input reports if available; if the software will not produce input summary reports then screen captures of representative inputs are acceptable. The example input summaries must include samples of the following input information:

1. Occupancy and usage patterns
2. Assumed envelope component sizes and traits (area, R-value, U-value, etc.)
3. Assumed mechanical equipment types and traits (capacity, efficiency, etc.)

Please note that uploaded documents should be SUMMARIES, and not large quantities of detailed data

Documentation Description Log

In the text box below, please reference the file name of each uploaded file (e.g. simulationsummary.pdf)

☐ I have provided the appropriate supporting documentation in the document upload section of LEED Online. Please refer to the above sheets.

OPTION 2: ASHRAE ADVANCED ENERGY DESIGN GUIDE FOR SMALL OFFICE BUILDINGS, 2004

The building complies with all the prescriptive measures of the ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004. The following restrictions are applicable:

☐ The project is less than 20,000 square feet.

☐ The project is office occupancy.

☐ The project has fully complied with all applicable criteria as established in the Advanced Energy Design Guide for the climate zone in which the building is located

_____ Climate zone

OPTION 3: ADVANCED BUILDINGS BENCHMARK ™ VERSION 1.1

☐ The project fully complies with the Basic Criteria and Prescriptive Measures of the Advanced Buildings Benchmark™ Version 1.1 with the exception of the following sections: 1.7 Monitoring and Trend-logging, 1.11 Indoor Air Quality, and 1.14 Networked Computer Monitor Control.

_____ Climate zone

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NARRATIVE (Optional)

Please provide any additional comments or notes regarding special circumstances or considerations regarding the project's credit approach.

☐ The project is seeking point(s) for this credit using an alternate compliance approach. The compliance approach, including references to any applicable Credit Interpretation Rulings is fully documented in the narrative above. *(Indicate the number of points documented in the "Alternative Compliance Points Documented" field below).*

Alternative Compliance Points Documented

Project Name:

Credit: EA Credit 1: Optimize Energy Performance

Points Documented: 0

READY TO SAVE THIS TEMPLATE TO LEED-ONLINE? Please enter your first name, last name and today's date below, followed by your LEED-Online Username and Password associated with the Project listed above to confirm submission of this template.

First Name	Last Name	Date	Username (Email Address)	Password

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6.4 Presentation: The Economic Case of High Performance Buildings

The Economic Case for High Performance Buildings

Scott D. Johnson, Ph.D.
Vice President
CH2M HILL, Inc

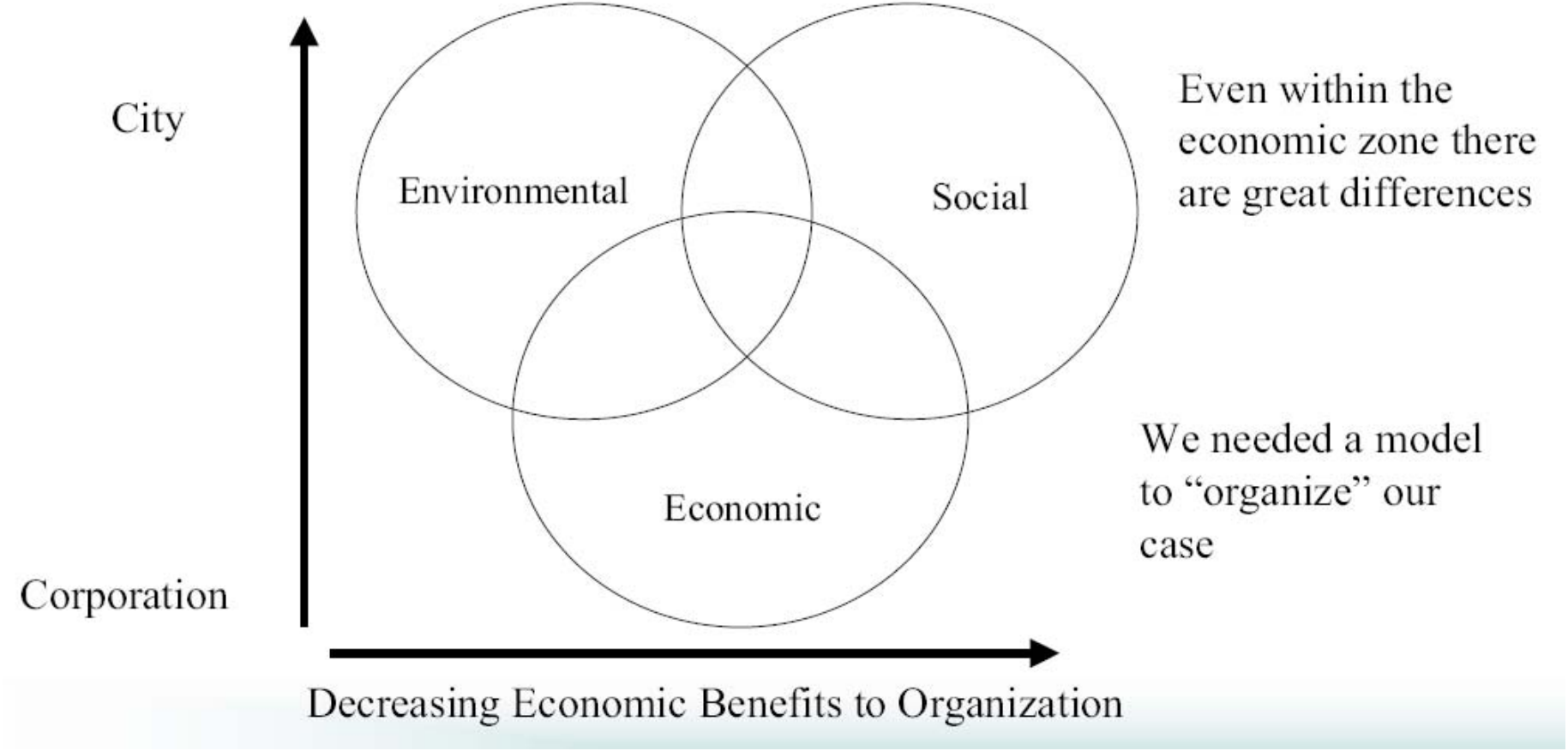
Documented in the paper: Johnson, Scott, "The Economic Case for High Performance Buildings," Corporate Environmental Strategy, Vol. 7, No. 4, 2000, pp. 350-361

~~Green Buildings~~ High Performance Buildings often provide us with the potential to have it both ways

Green Ecologically
and
Green Economically

But it doesn't <u>necessarily</u> just happen...

All Sustainability Benefits are not Created Equal Economically



In Order to Make the Economic Case, we Must:

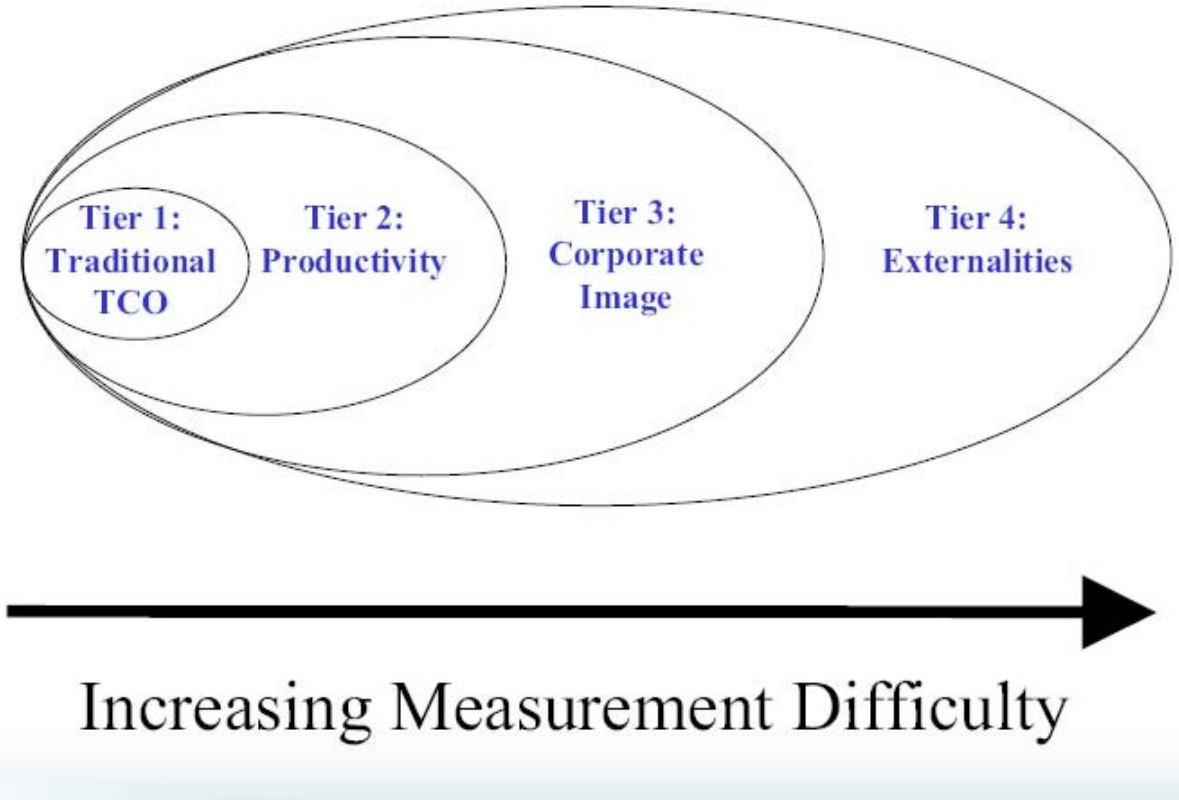
1. Understand the unique sustainability costs and benefits of our project,
2. Understand the perspective of our target audience, and...
3. Understand the different "categories" or "tiers" of costs and benefits

- use only those necessary to make the business case and which are salient to our target audience

Tiers of Economic Costs and Benefits

- Tier 1 (Traditional view of Total Cost of Ownership)
  - 2 Parts
    - – First Costs (design & construction)
    - – Life-cycle Facility Costs
- Tier 2 Productivity
- Tier 3 Corporate Image/Public Relations
- Tier 4 External Benefits (Externalities)

Potential Economic Costs and Benefits of Green Buildings can be divided into 4 Tiers



Tier One

Potential Costs and Benefits

- First Costs

Examples:
  - Utilize a Brownfield site (costing less)
  - Reuse materials from onsite
  - Minimize need for mechanical systems (systems and space for systems)
  - Utilize recycled materials
  - Demo and site clearing costs

- Life Cycle Costs

Examples:
  - Energy use
  - Water use
  - Wastewater generation
  - Insurance/Liability

Tier Two

Potential Costs and Benefits

Examples

- Productivity (estimates of 6 - 16% improvement)
  - US Post Office
  - West Bend Insurance
- Absenteeism (estimates of 15 - 45% improvement)
  - Lockheed Building 157
  - Veriforce
  - ING Bank
- Reliability (estimates not available yet)

Tier Three & Tier Four
Benefits

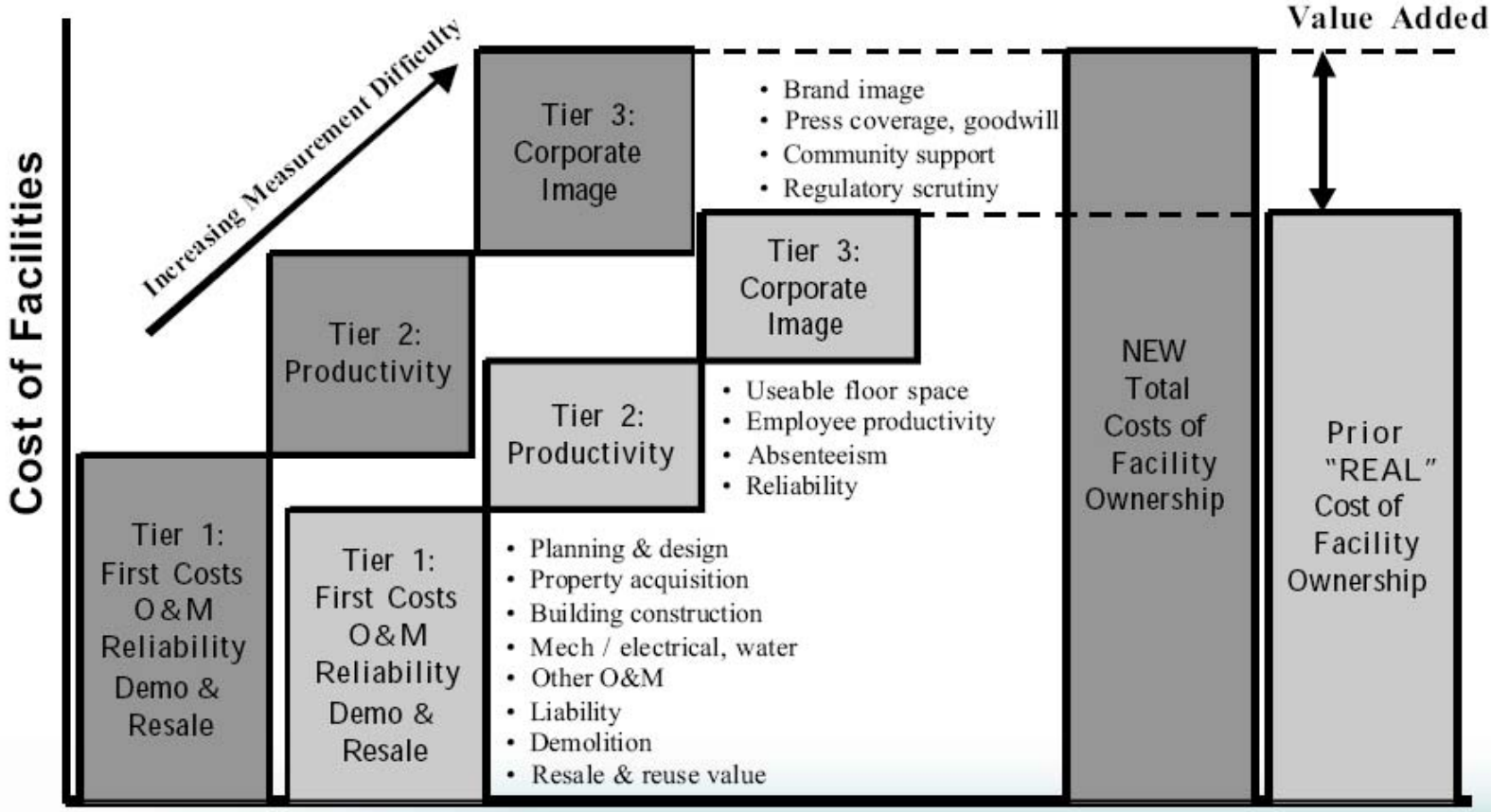
- Tier Three

Examples
- Image and Reputation
- Community and Regulatory Goodwill
- Brand Image
- Press Coverage

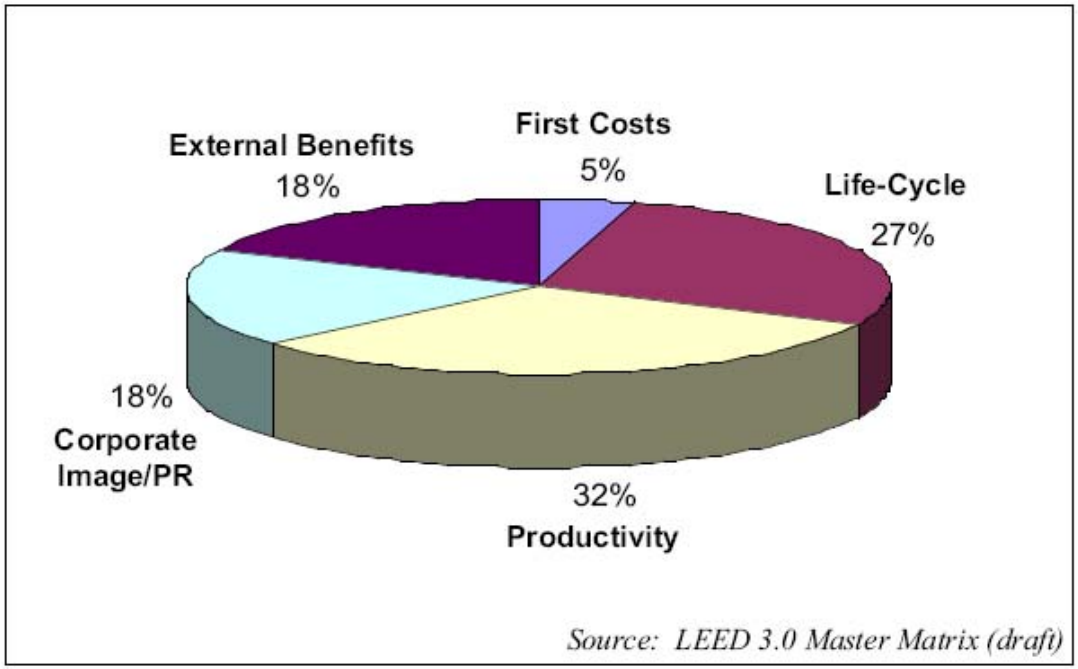
- Tier Four

Examples
- Heat Island Effect
- Light Pollution
- Ozone Depletion
- Certified Wood Use
- Green Power Use
- Urban Density

Potential to Add "Bottom-line" Value Through High Performance Buildings



Consideration -
LEED Criteria vs. Tiers of Costs/Benefits



Source: LEED 3.0 Master Matrix (draft)

Tier 1 - First Costs	3	0
Tier 1 - Life Cycle	1	5
Tier 2 - Productivity	1	3
Tier 3 - Corporate Image/PR	0	1
Tier 4 - External Benefits	4	0
NA	0	1
TOTAL	**9**	**12**

Note: Innovation in Design (8 pts.) can apply to any tier, Professional Accreditation (5 pts.) applies to none.

Challenges

1. Current mindsets and incentives often cause "scrimping"on the design phase-- discouraging a "whole systems approach"
   - compensation based as % on first costs
   - no sharing of life cycle cost savings
2. Challenge of the difficulty of quantifying Tier 1 (life-cycle), Tier 2, Tier 3 (and perhaps 4) benefits

Challenge #1

The Design Phase is where all the opportunity is--this is NOT the place to scrimp!

A building owner generally spends nine times more to build a facility than to design it, and thirty times more for O & M than for design, and 460 times more to pay the people that will work in the facility (over its useful life) than was spent on the design.

We must look to change the remuneration structure

Challenge #2

The potential savings of Tier 2 (and perhaps 3) are so great that the lack of certainty about estimates may not be an insurmountable issue.

Analyzing One Percent Productivity Improvement

A) Average Campus Building Construction Cost	$80-150/SF
B) Average Campus Building Size	100,000 SF
C) Number of Employees per Average Building	500
D) Average Fully-burdened Salary per Employee	$100,000
E) Useful Life of Building	30+ years
F) Labor Costs per SF Over Useful Live (C*D*E/B)	$15,000/SF
Labor Cost per SF vs. Construction Cost per SF (F/A)	**100 to 1**
1% Productivity Improvement over 30 years (1%*C*D*E)	**$15 million**

Conclusions

- A compelling economic case for green buildings can usually be made (to some degree), regardless of the audience.
- Understanding the tiers that are relevant to your target audience can help you make your case.
- Use only the tiers you need to make your case.
- Designer's compensation system must avoid disincentives to take a whole-systems approach.
- Benefits are potentially so great that all facility owners should consider High Performance Buildings whether they are "Green" or not.