

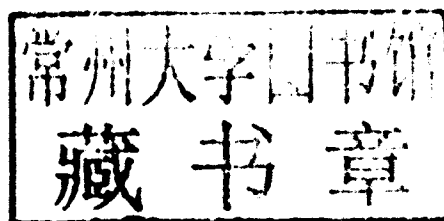


Sustainable Design and Construction Practice Guide

- The must-have reference on sustainable design and construction documentation
- Provides best practices for project delivery methods as related to sustainable design
- Bonus content available on a password-protected website



The CSI Sustainable Design and Construction Practice Guide



WILEY

Cover Photographs: (from left to right) © iStockphoto.com/Andrew Manley, © iStockphoto.com/Alex Nikada, © iStockphoto.com/Pawel Gaul, © iStockphoto.com/Fotografia Inc., and © iStockphoto.com/Nikada
Cover Design: Wiley

This book is printed on acid-free paper.

Copyright © 2013 by John Wiley & Sons, Inc. All rights reserved

Published by John Wiley & Sons, Inc., Hoboken, New Jersey
Published simultaneously in Canada

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 646-8600, or on the web at www.copyright.com. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at www.wiley.com/go/permissions.

Limit of Liability/Disclaimer of Warranty: While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with the respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your situation. You should consult with a professional where appropriate. Neither the publisher nor the author shall be liable for damages arising herefrom.

For general information about our other products and services, please contact our Customer Care Department within the United States at (800) 762-2974, outside the United States at (317) 572-3993 or fax (317) 572-4002.

Wiley publishes in a variety of print and electronic formats and by print-on-demand. Some material included with standard print versions of this book may not be included in e-books or in print-on-demand. If this book refers to media such as a CD or DVD that is not included in the version you purchased, you may download this material at <http://booksupport.wiley.com>. For more information about Wiley products, visit www.wiley.com.

Library of Congress Cataloging-in-Publication Data:

The CSI sustainable design and construction practice guide / the Construction Specifications Institute.
pages cm

Includes bibliographical references and index.

ISBN 978-1-118-07855-6 (acid-free paper); 978-1-118-41605-1 (ebk); 978-1-118-41852-9 (ebk)

1. Sustainable buildings—Design and construction—Handbooks, manuals, etc. 2. Sustainable architecture—Handbooks, manuals, etc. I. Construction Specifications Institute. II. Title: Sustainable design and construction practice guide. III. Title: C.S.I. sustainable design and construction practice guide.

TH880.C69 2013

720'.47—dc23

2013013981

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1



The CSI Sustainable Design and Construction Practice Guide

Preface

Introduction to the Practice Guide Series

Beginning with the publication of the first *Manual of Practice* (MOP) in 1967 continuing through the publication of its successor document, the *Project Resource Manual* (PRM), it has been the intent of CSI that these publications embody accepted standards for the preparation of construction specifications and project manuals, and a detailed source of information on quality documentation for the life cycle of a facility.

Through these publications, CSI has sought to aid owners, designers, specifiers, contract administrators, contractors, construction product representatives, and facility managers in the performance of their jobs.

In 2008, CSI began an effort to update the knowledge formerly contained in the MOP and PRM to present it anew and ensure its continued relevance. As with the earlier collections of this knowledge, the intent is to provide an authoritative resource on the organization, preparation, use, and interpretation of construction documents, encompassing the entire life cycle of a facility from conception through facility management.

To accomplish this update CSI established the Practice Guides Task Team. One of the task team charges was to organize the presentation of this information into modules to support areas of practice where CSI currently offers certificates and certifications, such as Project Delivery addressed by the Construction Documents Technology (CDT) certificate; Specifications, addressed by the Certified Construction Specifier (CCS) certification; Contract Administration, addressed by the Certified Construction Contract Administrator (CCCA) certification; and Product Representation, addressed by the Certified Construction Product Representative (CCPR) certification, as well as other areas of practice for which education and certification may be developed.

To keep current with changes in the industry, the task team also reviewed other CSI documents and standards, and updated references to them that appear in the *Practice Guides*. A similar effort was made to incorporate changes in contract documents produced by The American Institute of Architects (AIA) and the Engineers Joint Construction Documents Committee (EJCDC), and to introduce the new standard contract documents developed by the ConsensusDOCS Coalition.

The task team also recognized the growing impact of “green” or sustainable practices on the subject matter contained in the *Practice Guides*. Each *Practice Guide* now addresses the topic of sustainable practice to some degree and a more detailed examination of the topic is contained in this *Practice Guide*.

Two other topics that have had an impact on the *Practice Guides* are: Building Information Modeling (BIM) and Integrated Project Delivery (IPD). The growing impact of BIM on the practice of specification writing and its potential impact on quality documentation made a discussion of this topic imperative. Likewise, IPD has grown in importance over the past several years and has had an impact on the way practitioners relate to the process of creating and interpreting construction documents.

The *Practice Guide Series* is not intended to be composed of static documents but to be a living set of guides with the capacity to change and be updated as the construction industry changes around them. The input of users of this Series will be critical to the future updating of the Series and the authors and reviewers welcome feedback from users.

Description of *The CSI Sustainable Design and Construction Practice Guide*

The CSI Sustainable Design and Construction Practice Guide is a compilation of information and recommended practices for those who participate in some way in the design and construction of sustainable facilities. As one volume in the series of *Practice Guides* published for the CSI, this *Practice Guide* presents a comprehensive body of knowledge regarding sustainable design principles, and contains important and useful information on how to apply sustainable practices for the design and construction of facilities. This *Practice Guide* does not endorse any specific existing sustainable design rating system or program, and does not attempt to establish or defend any scientific or philosophical arguments that have created a market for sustainable design. This *Practice Guide* offers guidelines and standards on how to apply sustainable design and construction principles in practical terms. Whether new to the practice of sustainable design and construction or familiar with the practice, this *Guide* provides the reader with tools to do their job smarter and better.

Additional CSI publications that complement the *Practice Guides* are available for download to purchasers of the *Practice Guides*. These documents can be obtained at www.wiley.com/go/csipracticeguides:

- MasterFormat® numbers and titles
- UniFormat™
- SectionFormat™/PageFormat™
- Sample CSI Forms
- GreenFormat™ questionnaire
- Practice Guide Glossary

To access the content on this site, you will need the unique Access Code printed on the card included with this book. If you have purchased an ebook version of this title, please contact Customer Care at 877-762-2974 or at <http://support.wiley.com> for a unique Access Code in order to take advantage of this website.

Acknowledgments

No project of this magnitude can be accomplished single-handedly. In the best CSI tradition, many people volunteered to write, review, and contribute to the production of the *CSI Practice Guides*. CSI wishes to recognize the following people who contributed in many ways to this project. If we have omitted anyone's name, it was inadvertent, not intentional.

Ross G. Spiegel, FCSI, CCS, CCCA, FAIA, LEED AP BD+C
Chairman, Practice Guides Task Team

The CSI Sustainable Design and Construction Practice Guide authors

Greg Markling, FCSI, CCS, CCCA, SCIP, NCARB, LEED AP BD+C, Lead Author
Paul Bertram, FCSI, CDT, LEED AP BD+C
Bob Burns, AIA, LEED AP BD+C
Ellen Crews, FCSI, CCS, CCCA, FMP
Courtney France, LEED AP BD+C
Tom Hickey, PE, LEED AP
Bernadette Kelly, RA, LEED AP BD+C, CDT
Jonathan Miller, FCSI, CCS, CCCA, AIA, SCIP, NCARB
Drew Russ, PE, LEED AP
Jeff Sawarynski, PE, LEED AP
Ross G. Spiegel, FCSI, CCS, CCCA, FAIA, LEED AP BD+C

Practice Guide Task Team Members

George Wade Bevier, FCSI, CCS, SCIP, LEED AP
Ellen Kay Crews, FCSI, CCS, CCCA, FMP
Dennis J. Hall, FCSI, CCS, CCCA, FAIA, SCIP
Gregory J. Marking, FCSI, CCS, CCCA, AIA, SCIP, NCARB, LEED AP
Chris Pechacek, CSI, LEED AP
Jim Rains, CSI, FAIA
Robert Saumur, FCSI, CCPR
Walter R. Scarborough, CSI, CCS, CCCA, AIA, SCIP
Paul W. Simonsen, RA, FCSI, CCS, CCCA, LEED AP, NCARB, SCIP
Paul M. Sternberg, CSI, CCS, CCCA, AIA, NCARB, LEED AP

CSI Certification Committee Members 2010–2013

Ann G. Baker, RA, CSI, CCS, CCCA, LEED AP, SCIP
Peter A. Baker, CSI, CCS, CCCA, AIA, LEED AP
David G. Dixon, CSI, CCCA, CCPR, RRC, RRO
George A. Everding, CSI, CCS, CCCA, AIA, LEED AP
Raymond E. Gaines, FCSI, CCS, AIA
Alan M. Horne, CSI, CCS, CCCA, AIA, LEED AP

Richard G. Howard, CSI, CCS, AIA, NCARB, SCIP
Kent R. Kile, CSI, CCPR
Sandy McLelland, CSI, CCS, CCCA, LEED AP, SCIP
Jonathan M. Miller, FCSI, CCS, CCCA, AIA, SCIP
Stephen E. Nash, FCSI, CCS, CCCA, AIA, SCIP
Marilyn G. Smith, FCSI, CCS, SCIP, AIA
Geoffrey Stoner, CSI, CCCA, LEED AP
David Robert Trudell, CSI, CCS, CCCA, AIA, LEED AP, SCIP
Sandra M. Velleca, FCSI, CCS, CCCA
M. Keith West, CSI, CCPR
Laurence E. Wightman III, CSI, CCPR, AHC

CSI Education Committee Members 2010–2013

Loren R. Berry, FCSI, CDT, AIA, NCARB
Marc C. Chavez, CSI, CCS, CCCA, AIA, SCIP
Cornelius H. Davison, FCSI, CCS, CCCA, AIA
Laura Jean I. Frye, CSI, CCS, AHC
Patricia S. Gallup, RA, CSI, CCS
Mitch Lawrence, CSI, CCS, CCCA, AIA
Gregory J. Markling, SCIP, FCSI, CCS, CCCA, LEED AP, NCARB
Robert T. Matschulat, CSI, CCS, AIA
Jack Phillip Morgan, RA, CSI, CCS, CCCA, AIA, NCARB, SCIP
Walter R. Scarborough, CSI, CCS, CCCA, AIA, SCIP
Cherise S. Schacter, CSI, CDT
Robert W. Simmons, FCSI, CCPR, CEO, BS
Sandra M. Velleca, FCSI, CCS, CCCA
James F. Whitfield II, FCSI, CCPR, CTC, LEED AP

CSI Technical Committee Members 2010–2013

Gary L. Beimers, FCSI, CDT, CSC, SCIP
Lane J. Beougher, FCSI, CCS, CCCA, AIA, LEED AP
Randall A. Chapple, CSI, CCS, AIA, SE
Mark J. Kalin, FCSI, CCS, FAIA
Deborah L. MacPherson, CSI, CCS
Michael MacVittie, CSI, AIA
Richard C. Master, CSI, AIA
Larry Nordin, CSI, CCS, AIA, LEED AP
Chris Pechacek, CSI, LEED AP
Louise M. Schlatter, RA, CSI, CCS, LEED AP, EIT, AIA
David A. Stutzman, CSI, CCS, AIA, SCIP
Robert S. Weygant, CSI, CCS, AIA, SCIP

CSI Staff

Greg Ceton, CSI, CDT, Director of Technical Services

Contents

Preface ix

Acknowledgments xi

Chapter 1 Sustainable Design and Construction 1

1.1 Definitions 3

- 1.1.1 Building Energy Conservation 3
- 1.1.2 Building Energy Efficiency 3
- 1.1.3 Embodied Energy 3
- 1.1.4 Environmental Product Declaration 4
- 1.1.5 Green Building 4
- 1.1.6 Greenwashing 4
- 1.1.7 Heat Island Effect 4
- 1.1.8 High-Performance Building 4
- 1.1.9 Historic Investment Tax Credit 4
- 1.1.10 Life Cycle Assessment 5
- 1.1.11 Net Zero or Zero Energy Building 5
- 1.1.12 Product Category Rule 5
- 1.1.13 Recycling 5
- 1.1.14 Renewable Resources 5
- 1.1.15 Renewable Energy 6
- 1.1.16 Reuse 6
- 1.1.17 Sustainability 6
- 1.1.18 Sustainable Design 6
- 1.1.19 Sustainable Construction 6
- 1.1.20 Sustainable Management 6

1.2 Building Codes 7

- 1.2.1 International Codes and the International Code Council 7
- 1.2.2 Emerging Trends in Building Codes 9

1.3 Reference Standards 11

- 1.3.1 ASHRAE Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size 11
- 1.3.2 ASHRAE Standard 55, Thermal Environmental Conditions for Human Occupancy 11
- 1.3.3 ASHRAE Standard 62.1, Ventilation for Acceptable Indoor Air Quality 12

- 1.3.4 ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings 12
- 1.3.5 ASTM E60 Committee on Sustainability 14

1.4 Green Building Rating Systems 15

- 1.4.1 Domestic (USA and Canada) Systems 16
- 1.4.2 International Systems 25

Chapter 2 Roles and Expectations of the Design and Construction Team 47

2.1 Owner Team 47

- 2.1.1 Roles and Responsibilities 47
- 2.1.2 Owner's Expectations 48

2.2 Design Team 49

- 2.2.1 Roles and Responsibilities 49
- 2.2.2 Design Team Expectations 50

2.3 Product Manufacturers and Representatives 51

- 2.3.1 Role and Responsibilities 51
- 2.3.2 GreenFormat™ 53
- 2.3.3 GreenSpec® 55
- 2.3.4 Environmental and Sustainability Product Information 55
- 2.3.5 Corporate Sustainability Reporting 55

2.4 Contractor Team 56

- 2.4.1 Roles and Responsibilities 56
- 2.4.2 Contractor's Expectations 58

2.5 Commissioning Authority/Agent 59

- 2.5.1 Roles and Responsibilities 59
- 2.5.2 Systems Subject to Commissioning 62

2.6 Facility Manager 63

- 2.6.1 Roles and Responsibilities 63
- 2.6.2 Facility Manager's Expectations 64

Chapter 3

Sustainable Design and Construction Best Practices 67

- 3.1 **Site Optimization 67**
 - 3.1.1 Site Selection Best Practices 68
 - 3.1.2 Site Design Best Practices 72
 - 3.1.3 Site Construction Best Practices 74
- 3.2 **Energy Performance and Conservation 76**
 - 3.2.1 Energy Demand 76
 - 3.2.2 Renewable Energy Supply 78
 - 3.2.3 Performance Maintenance and Improvement 79
- 3.3 **Water Use and Conservation 80**
 - 3.3.1 Outdoor Water Use Reduction 80
 - 3.3.2 Indoor Potable Water Use Reduction 80
 - 3.3.3 Process Water Use Reduction 81
 - 3.3.4 Reused, Recycled, and Reclaimed Water Use 82
- 3.4 **Materials and Resources 82**
 - 3.4.1 Material Design 82
 - 3.4.2 Material and Resource Construction 86
- 3.5 **Environmental Quality 87**
 - 3.5.1 Indoor Environment 88
 - 3.5.2 Outdoor Environment 89
 - 3.5.3 Construction Indoor Air Quality 90
- 3.6 **Historic Preservation and Rehabilitation 92**
 - 3.6.1 Historic Rehabilitation Opportunities 93
 - 3.6.2 Financial Opportunities 95

Chapter 4

Green Product and System Evaluation 97

- 4.1 **Identify Project Criteria 97**
 - 4.1.1 Owner's Project Requirements 97
 - 4.1.2 Basis of Design 98
 - 4.1.3 Project Budget and Schedule 99
 - 4.1.4 Federal Mandates 99
 - 4.1.5 Funding Opportunities 102

- 4.1.6 Applicable Codes and Regulations 103
- 4.1.7 Sustainability and Historic Preservation 105
- 4.1.8 Green Building Rating Systems 108

4.2 Preferred Material and Product Attributes 109

- 4.2.1 Introduction 109
- 4.2.2 Life Cycle Analysis 110
- 4.2.3 Raw Material Attributes 110
- 4.2.4 Material and Energy Efficiency 111
- 4.2.5 Efficient Use of Water 116
- 4.2.6 Waste Reduction or Elimination 116
- 4.2.7 Local/Regional Materials and Manufacturing 119
- 4.2.8 Recycled Content and Recyclability 119
- 4.2.9 Materials Reuse 120
- 4.2.10 Low-Emitting Materials 120
- 4.2.11 Bio-Based Materials 122
- 4.2.12 Certified Wood 123
- 4.2.13 Sustainable Use of Site Timber 124

4.3 Evaluating Sustainability Options 124

- 4.3.1 Product Certifications 125
- 4.3.2 Labeling 129
- 4.3.3 Materials Evaluation Guidelines and Resources 131

4.4 Impact of Choice 133

- 4.4.1 Life Cycle Analysis 133
- 4.4.2 Evidence-Based Design 134
- 4.4.3 Sustainable Return on Investment 135
- 4.4.4 Operations and Maintenance 136
- 4.4.5 Indoor Environmental Quality and Occupant Health 137
- 4.4.6 Impact of Choice 138

Chapter 5

Sustainable Design and Project Delivery 139

5.1 Project Delivery 140

- 5.1.1 Design-Bid-Build 141
- 5.1.2 Design-Negotiate-Build 142
- 5.1.3 Design-Build 144
- 5.1.4 Construction Management 146
- 5.1.5 Owner-Build 148
- 5.1.6 Integrated Project Delivery 149

Chapter 6

Construction Documentation Practices 153

6.1 Contract Issues 153

- 6.1.1 Owner-Design Professional Agreements 153
- 6.1.2 Owner-Contractor and Integrated Project Delivery Agreements 157
- 6.1.3 Contractual Responsibilities 160

6.2 Integration of Sustainable Design Requirements 161

- 6.2.1 Sustainable Design Rating System Influences 161
- 6.2.2 Division 01 Concept 162

6.3 Construction Specifications 163

- 6.3.1 Role of Specifications 163
- 6.3.2 Procurement and Contracting Requirements Group 164
- 6.3.3 Division 01—General Requirements Subgroup 166
- 6.3.4 Work Results Specifications Sections 177

6.4 Construction Drawings 191

- 6.4.1 Role of Drawings 191
- 6.4.2 Alternates 192
- 6.4.3 Temporary Facilities 193
- 6.4.4 Facility Construction 195
- 6.4.5 Facility Services 196
- 6.4.6 Site and Infrastructure 196

INDEX 199



Chapter 1

Sustainable Design and Construction

Sustainable design and construction is not merely an emerging trend in the construction industry, it is now a standard of professional practice. Sustainable design and construction practices have been in use in Europe and other parts of the world for many decades. Such practices have also been in use in the United States of America for many years.

The American Institute of Architects (AIA) Energy Committee was founded in 1973 by a group of architects known for their work in energy, architecture, and research. The Committee collaborated with the government and with many other interested organizations for more than a decade, during which time the Carter Administration founded what became the US Department of Energy, which funded building research focused on energy. Out of this early focus on energy-related issues, the AIA formed the Committee on the Environment (COTE) in 1990. The AIA/COTE was responsible for the development of a number of foundational documents which address what is now known as sustainable design, including the Environmental Resource Guide (AIA Press, 1992), the Design Charrette Workbook (AIA Press, 1996), and the Top Ten Green Projects program introduced on Earth Day in 1997. The Top Ten Green Projects program first introduced a blend of qualitative and quantitative assessment metrics, with an online submission process. Many COTE chairpersons went on to serve as board members of the United States Green Building Council (USGBC), and many others were instrumental in the development of the Leadership in Energy and Environmental Design (LEED®) Program.

With the formation of the USGBC in 1994, the implementation of a defined and measurable standard for sustainable design in the United States was formally introduced to the design and construction industry. The USGBC introduced its first LEED® Pilot Project Program, also referred to as LEED Version 1.0, in August of 1998. This program has undergone extensive development since that time, progressed through a number of versions, and has been expanded to include a series of different rating systems that address a wide variety of building types. The LEED Reference Guide for Green Building Design and Construction is the most current document in use in the United States of America as of the publication of this Practice Guide.

According to the USGBC, buildings have the following calculated impacts on the environment (*USGBC, Reference Guide for Green Building Design and Construction, 2009 edition: page xi*):

- Buildings consume more than 30 percent of the total energy used in the United States.

- Buildings consume more than 60 percent of the total electricity used in the United States.
- In 2006, the commercial building sector produced more than 1 billion metric tons of carbon dioxide; an increase of more than 30 percent over 1990 levels.
- Toilet flushing alone uses more than 5 billion gallons of potable water each day.
- A typical North American commercial building generates about 1.6 pounds of solid waste per employee each working day; that amounts to approximately 300 tons of waste each year in a building housing 1,500 employees.

Many other statistical accounts can be cited, but it is clear that the design and construction industries produce major impacts on the environment (though these are not the only industries producing such impacts). To be fair, those impacts are both positive and negative. On the positive side, buildings create exciting and useful indoor environments that allow us to live better and more productive lives in a host of ways. On the negative side, our need for buildings requires consumption of nonrenewable resources and produces waste that is not entirely recyclable or reusable, and the ongoing operation and maintenance of buildings can produce pollutants and other byproducts that can harm the environment and building occupants.

As building owners, design professionals, product manufacturers, suppliers, and contractors in the design and construction industry (among many other participants too numerous to name), we have a collective responsibility to be aware of the impacts that our industry has on the environment, and to do what we can to maximize the positive benefits of our activities while minimizing or eliminating resulting negative impacts.

This *Sustainable Design and Construction Practice Guide* will provide a compilation of information and recommended practices for those who participate in some way in the design and construction of sustainable buildings and facilities, regardless of location worldwide. As one volume in a series of Practice Guides published by the Construction Specifications Institute (CSI), this Practice Guide will establish a comprehensive body of knowledge regarding sustainable design and construction principles, and will contain important and useful information on how to apply sustainable practices to the design and construction of buildings and facilities.

This Practice Guide does not endorse any specific existing sustainable design or green building rating system or program. This Practice Guide generally addresses nonresidential construction, though larger-scale multiunit residential facilities and similar project types are certainly addressed in the same context as nonresidential facilities.

This Practice Guide does not attempt to establish or defend scientific or philosophical arguments that have created a market for sustainable design. This Practice Guide addresses the issues of sustainable design and construction presuming the need for these practices as a professional standard. This Practice Guide offers guidelines and standards on how to apply sustainable design and construction principles in practical terms, and contains the following:

- Key definitions that are in common use in the sustainable design and construction industry.
- Building Codes, Reference Standards, and other regulatory issues related to the practice of sustainable design and construction.
- Basic information on existing sustainable design standards and rating systems, and a discussion of their applicability to sustainable design and construction practices.

- Description of the roles and responsibilities of each of the common participants in the design and construction process regarding sustainable design and construction.
- A compendium of suggested “best practices” that are not specifically related to a particular green building program or rating system.
- A brief guide to green building material product selection to provide a basic understanding of this process as a basis for the practical application of sustainable product selections.
- Discussion of sustainable design and construction practices in the context of each of the project delivery methods identified in the Project Delivery Practice Guide (Wiley & Sons, 2010).
- Practice standards for design professionals and product representatives regarding the proper documentation of sustainable design and construction information. These practice standards also extend to the end user of sustainable design and construction information, including the contractor, the owner, and the facility manager.

1.1 Definitions

The following terms are commonly used in discussions of sustainable design and construction. For the purposes of this Practice Guide, the following definitions are established:

1.1.1 Building Energy Conservation

Minimizing thermal energy transfer through the building envelope.

(Sources: www.c2es.org/technology/factsheet/BuildingEnvelope and www.energyland.emsd.gov.hk/en/building/energy_use/envelope.html—definition is a compilation made from both references)

1.1.2 Building Energy Efficiency

Reducing electrical power, gas, and other fossil fuel usage through high-performance equipment, appliances, and products, and by implementing design strategies to reduce and control electrical use.

(Author’s definition)

1.1.3 Embodied Energy

1. Defined by the AIA as “a measure of the total energy consumed by a product during its life or complete life cycle. It includes all the energy used during mining or milling the raw materials, manufacturing the raw materials into a product, transporting the product, and installing the product, as well as finally removing or recycling the product.”

(Source: wiki.aia.org/Wiki%20Pages/Embodied%20Energy.aspx)

2. Energy used directly and indirectly in raw material acquisition, production of materials, and the assemblage of those materials into a building.

(Source: Jean Carroon, *Sustainable Preservation: Greening Existing Buildings*. Hoboken, NJ: John Wiley & Sons, 2010)

1.1.4 Environmental Product Declaration

According to ISO 14025 Environmental Product Declaration (EPD) is quantified environmental data for a product with pre-set categories of parameters based on the ISO 14040 series of standards, but not excluding additional environmental information.

1.1.5 Green Building

Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life cycle from siting to design, construction, operation, maintenance, renovation, and deconstruction.

(Source: www.epa.gov/greenbuilding/pubs/about.htm; definition by the US Environmental Protection Agency [EPA])

1.1.6 Greenwashing

The act of misleading consumers regarding the environmental practices of a company; or the environmental benefits of a product or service, or any form of marketing or public relations that links a corporate, political, religious, or nonprofit organization to a positive association with environmental issues for an unsustainable product, service, or practice.

(Sources: <http://sinsofgreenwashing.org/findings/faqs/> and www.sustainabilitydictionary.com/greenwashing/—definition is a compilation made from both references)

1.1.7 Heat Island Effect

Occurs when hardscapes, such as dark, nonreflective pavement and buildings, absorb heat, and radiate it to surrounding areas.

(Source: LEED for New Construction 2009 Reference Guide Glossary)

1.1.8 High-Performance Building

High-performance buildings maximize operational energy savings; improve comfort, health, and safety of occupants and visitors; and limit detrimental effects on the environment.

(Source: www.nyc.gov/html/ddc/downloads/pdf/guidelines.pdf; definition from New York City Guidelines)

1.1.9 Historic Investment Tax Credit

The Historic Investment Tax Credit (HITC) is a program run on the federal and state levels to provide tax credits to building owners, homeowners, and developers as a financial

incentive to rehabilitate historic buildings and stimulate private investment. Credits received may be used to offset income tax liability or as equity in the rehabilitation project by investors. The federal program is administered by the National Park Service on behalf of the Secretary of the Interior and the Internal Revenue Service on behalf of the Secretary of the Treasury in partnership with state historic preservation offices.

(Source: Commonwealth Architects)

1.1.10 Life Cycle Assessment

Life Cycle Assessment (LCA) is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service by:

- Compiling an inventory of relevant energy and material inputs and environmental releases;
- Evaluating the potential environmental impacts associated with identified inputs and releases;
- Interpreting the results to help make a more informed decision.

(Source: www.epa.gov/nrmrl/lcaccres)

1.1.11 Net Zero or Zero Energy Building

Net Zero or Zero Energy Building (ZEB) is a residential or commercial building with greatly reduced energy needs through efficiency gains such that the balance of energy needs can be supplied with renewable technologies.

(Source: www.nrel.gov/sustainable_nrel/pdfs/39833.pdf)

1.1.12 Product Category Rule

Product Category Rules (PCRs) define the criteria for identification of a specific product category and establish the parameters for preparing an Environmental Product Declaration (EPD) compliant with ISO-14025.

1.1.13 Recycling

Collecting recyclable materials that would otherwise be considered waste; sorting and processing recyclables into raw materials such as fibers, manufacturing raw materials into new products, and purchasing recycled products.

(Source: www.epa.gov/osw/conserve/rrr/recycle.htm)

1.1.14 Renewable Resources

A resource that can be used continuously without being completely depleted (because it regenerates itself within a useful amount of time).

(Source: www.geysers.com/glossary.htm)

1.1.15 Renewable Energy

An energy source replenished by natural processes at a rate comparable or faster than its rate of consumption. Examples include solar radiation, tides, winds, and hydroelectricity.

(Source: <http://agsci.oregonstate.edu/orb/biotechnology-terms>)

1.1.16 Reuse

The recovery of materials and products for the same or a similar end use.

(Source: www.consumersunion.org/other/zero-waste/reuse.html)

1.1.17 Sustainability

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

(Source: www.un-documents.net/ocf-02.htm; definition created in 1987 at the World Commission on Environment and Development [the Brundtland Commission])

1.1.18 Sustainable Design

1. The careful meshing of human purposes with the larger patterns and flow of the natural world.

(Source: www.aia.org/practicing/groups/kc; paraphrase of educator and author David Orr)

2. A process that supports and improves the health of the systems that sustain life.

(Source: www.aia.org/practicing/groups/kc; paraphrase of architect Bill Reed)

1.1.19 Sustainable Construction

Sustainable construction aims at reducing the environmental impact of a building over its entire lifetime, while optimizing its economic viability and the comfort and safety of its occupants.

(Source: www.isover.com/Our-commitment-to-sustainability/Toward-sustainable-buildings/What-is-sustainable-construction)

1.1.20 Sustainable Management

The ability to direct the course of a company, community, organization, or country in ways that restore and enhance all forms of capital (human, natural, manufactured, and financial) to generate stakeholder value and contribute to the well-being of current and future generations.

(Source: www.sustainabilitydictionary.com)