



Sustainability Indicators

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ENVIRONMENTAL PERFORMANCE ASSESSMENT

Indoor Environment

- Presence of individual toxic chemicals (bldg. materials, cleaning and maintenance materials:
Are they present? Are they toxic in this form?)
- Levels of a criteria pollutants as an indicator or surrogate for a subset class of human health threats (e.g. as defined by EPA for CO, NO_x, O₃ and P.M.)
- Presence of specific organisms or their indicators, or presence of growth conditions (e.g., %RH, carbon source, etc.)
- Levels of certain VOC's as indicators, but need to know species, since the effects of each VOC on human health differ
- Worker absenteeism; Lost hours or \$ / person * yr (for building or group of buildings)
- Worker productivity
- Number of operable windows, size of workspace, accessibility, amount and kind of amenities as well as lighting, noise, temperature and noise
- Exposure to electromagnetic fields
- Daylight access, outside view

Resource Consumption

- Energy; Energy use / sq ft * degree day * hour occupied
- Raw materials; Waste disposed ([tons or cost of disposal] / capita * yr)
- Land consumption of building per person
- Downstream environmental impacts per unit (sqft or person) (reusability, dismantleability, recycleability, biodegradability, solid waste, air/water emissions)

Global/Regional Ecosystem Impacts

- Water consumption
 - Gallons / capita or s.f.
 - Gallons used (total) / gallons used (sustainable)
 - Gallons waste water / capita
- Annual air emissions per unit (sqft or person), categorized by HVAC, lighting, motors, plug loads
- Reclaimed land vs. newly developed land ratio
- Ozone depletion
- Eutrophication
- Nitrification
- Acidification



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- Air pollutants
 - Tons of CO₂, NO_X, SO₂, ... / capita * yr
 - Ton-miles of building materials used
- Water pollutants



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ECONOMICS

Federal level

- Existence and level of federal/state subsidies for environmentally damaging industries
- Value of tax deductions allowed for “green” building measures
- \$ value of investments in “green” technology R&D
- Inclusion of external social/environmental costs of energy, pollution, materials and land consumption in energy/water prices (e.g., level of energy or emissions tax)?

State level

- Existence and level of federal/state subsidies for environmentally damaging industries
- Value of tax deductions allowed for “green” building measures
- Procurement incentives for use of “green” materials
- \$ value of investments in “green” technology R&D
- Demand-Side-Management investment tax brakes

Regional/City level

- % materials (measured in \$ value) that support local economy
- # of commercial loans for “green” building projects
- Insurance discounts for “green” buildings
- Procurement incentives for use of “green” materials
- Availability of insurance/warranties for new approaches/technologies/materials
- Availability of net-metering for independent, renewable resources (or level of reimbursement if utilities purchase power)
- Demand-Side-Management investment tax brakes
- Price structure for energy consumers (power, NG, oil); progressive vs. regressive

Building owner level

- Profit per sqft (“green”) / profit per sqft (conventional)
- Public relations benefits of being green
- \$ per sq ft at time of building sale (green) / \$ per sq ft (conventional)
- Average life of “green” building
- Average age of building stock
- Ton-miles of building materials used
- Average cost or length (miles) of commute
- On a renovation/construction project: are hidden benefits incorporated into project budget, is full cost accounting being practiced (e.g., energy and water savings, productivity gains, reduced absenteeism, reduced costs for landfilling and handling/transportation/storage of regulated materials)?
- Possibility of recouping the higher initial investments costs from bldg. occupants
- Is energy modeling an integral part of a building project budget?



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Lending Institutions

- Payback-time guidelines (i.e., time horizon, importance as decision-making tool)
- Variations in interest rates and down-payments of "green" vs. conventional projects
- Availability of grants
- Availability of insurance/warranties for new approaches/technologies/materials
- Skills and facts available to translate all "green building" benefits into Dollar values?



Sustainability Indicators

CODE ISSUES

- Do codes include in their definition of welfare issues such as local or global ecosystem issues? (e.g., maximum levels of annual air emissions (by HVAC, lighting, plug loads etc.), water emissions, land consumption)
- Are codes helping to increase community involvement/awareness? Do they consider regional planning issues (e.g., provisions for re-development of lots and buildings, provision of parking vs. public transportation access/bike racks)
- Do codes require life-cycle assessments and life-cycle costing?
- Are codes sufficiently region- or climate-specific?
- Do building permits include environmental performance requirements?
- Prescriptive vs. performance codes
- Are codes easy to understand and follow?
- Do codes establish a process of total resource accounting?
- Do codes address the following areas:
 - Efficiency
 - Renewability of resources
 - Ability to recycle/reuse
 - Human well-being?
- Efficiency
 - Energy efficiency (i.e., energy use of the building + embodied energy)
 - Resource efficiency (i.e., materials consumption)
 - Human efficiency (i.e., reduce the need to commute + performance codes promoting creative solutions)
- Renewability of resources
 - *(acknowledgment of the difficulty to approach this issue through codes, discussion was tabled)*
- Ability to recycle/reuse
 - Long term use of the building material
 - Requirement of a certain amount recycled material
 - Requirement of assessment of re-use of materials before a building can be torn down
- Human well-being
 - Indoor Air Quality
 - Noise
 - Daylight



Sustainability Indicators

ORGANIZATIONAL CONDITIONS

Phase-overarching issues

- Are there research programs in place for a) renewable energies, b) “green” technologies, and c) design tools?
- Is there a sufficient number of award programs like Energy Star available?

Conceptual phase

- Have the following questions been evaluated/answered: Actual need of project? What problem does it solve? Are there alternatives to this project? What other uses can these buildings can be used for if reason for bldg changes?
- Has a team membership chart been developed for each project stage in order to have enough people involved at the right mix at each stage?
- Has the planning and construction timeline been adopted to the increased requirements, specially in first-time projects?
- Has the team established the time frame for project, as opposed to the “higher-ups”?

Programming/pre-design phase

- Space allocation -- usable square footage versus gross square footage?
- What are the qualitative and quantitative Sustainability goals?
- Are all your players at the table: users, designers, O&M, owner, contractors?
- Is there budget money to evaluate the design by interested parties and/or peer reviewer?
- Are there any cost guidelines to help in choosing materials during design phase (e.g., willingness to spend 20% over traditional material costs)
- Are timeline issues addressed up front?
- Are externalities being internalized? (e.g., portion of budget that goes toward mitigation of long-term life cycle impacts)
- Sufficient focus on design aspects that relate to future alternative uses of building?

Schematic design phase

- Is design proposal evaluated against criteria -- involving all key stakeholders?
- Is design reviewed by all interested parties?
- Are sustainable building systems being defined?
- Are decision makers educated and informed?
- Value engineering with emphasis on value?
- Is a process facilitator designated?



Sustainability Indicators

Design development phase

- Are total building systems and their performance being optimized (e.g., reduced dependence on HVAC, daylighting etc.)?
- Is effective metering integrated into the design (environmental conditions of bldg) to inform and educate the decision makers?
- Is Operation & Maintenance personnel represented in planning and design process?
- Is flexibility for alternative future changes and/ or uses part of the design?
- Are decommissioning/ deconstruction plan/ salvage plans being developed?
- Is the use of salvaged materials being planned?
- Is integrated sustainable site design/ landscaping happening?
- Is Life cycle cost and payback time being determined?
- Are materials assessed and evaluated in terms of environmental impacts?
- Peer review process?

Construction documents phase

- “Green” specifications for all aspects of construction being developed?
- Are “green” specs in the RFP process?
- Have construction procedures to minimize environmental impacts been established (incl. recycling goals; sustainable construction and demolition methods, health impacts)?
- Is adequate time for review and research set aside?
- Quality control mechanisms in place (materials, methods; including indoor air quality)?
- Stakeholder review and comment as part of process?
- Is there an educational process of contractors, subcontractors, suppliers, design and construction inspection team members, owner in place?

Construction phase

- Quality control established?
- Regular site visits by entire design team?
- Does the entire design team review submittal and change orders to assure compliance with project goals?
- Is value engineering with emphasis on value happening?
- Is there a feedback loop established from construction crews to designers? (e.g., site lunch)
- Are materials reused and recycled? Are records maintained?
- Are lessons learned captured in a document?

Commissioning phase

- Is O&M staff trained?
- Is building checked by the full design team to assure it is operating as planned?
- Are lessons learned captured in a document?
- Has occupant feedback solicited?
- Will there be a performance evaluation?

The Friday workshop session ended before the following phases could be addressed:

Occupancy

Post occupancy



Sustainability Indicators

Indicators at the owner's level

- Is there an open planning and design process?
- Level of feedback from affected communities?
- CEO commitment to green design?
- High level Green Building champion appointed?
- Are environmental externalities and hidden costs known by the decision makers?
- Are environmental externalities internalized (e.g., Btu or emissions tax)?
- Has the project been signed up for a rating system or an Energy Star-like system?
- Is there a willingness to take risks (new products/technologies) and invest in green technologies?
- Has the planning and construction timeline been adopted to the increased requirements, specially in first-time projects?
- Are Sustainability benchmarks being tracked, measured, reported throughout the process as a continuous evaluation?
- Is life cycle costing part of the decision making process, and is decision maker in it for the long haul?
- Green consultant hired?
- What percentage of effort is put into innovation as compared to previous buildings?
- Education of bldg. users about the bldg. use and green features?
- Adequate inspection and quality control in place?
- Is the partnership agreements between owner, architect and engineers and contractors fostered and encouraged?

Indicators at the architects' level

- Performance-based contracts in place?
- Is sustainable design embedded in performance standards at all levels of design and construction (architects, suppliers, contractors/ subcontractors)?
- Level of investments in staff development re green design education?
- Is the budget process and allocation determined by the initial team to optimize environmental performance within total budget?
- Is the partnering of owner/architect/contractor being advocated?
- Is there an increased adoption and refinement of green specs happening? (e.g., time for research, budget for library resources)?
- What is the level of investment in green design tools i.e. software?
- Availability of user-friendly, integrated software that merges the steps: architectural design, quantity take-off, environmental life-cycle inventory, use-phase energy calculation, and cost estimate?
- Is a whole-systems design approach used (e.g., design charrettes with building owner and users, architects, engineers, contractors, maintenance folks)?
- How well are communications between architects and the engineers who will operate facility?
- Is there a protocol in place to evaluate at each stage of any new building project its environmental impacts, needs assessment and optimization of sustainability?
- Is the environmental impact presented with the conceptual design?
- Is there a commitment to public/community education?
- Does an in-house "green" review exist?
- Is there a project mentor (as opposed to partner)?



Sustainability Indicators

- Level of continuity of staff (team architects and engineers together) in order to retain “green” institutional memory?
- Peer review process in place?
- Have “green” standards and ratings been adopted?
- Does commissioning and post occupancy monitoring include designers?

Indicators at the trade organizations’ level

- Level of research in green construction and materials?
- Is cooperation across trades being promoted?
- Training for green practices provided?
- Have trade-specific green goals been established for the product development?
- Do testing institutions/programs on new green materials/products/technologies exist?
- Is user friendly software for green design evaluation being developed?
- Level of marketing and promotion of green materials?
- Are there licensing and certification programs of green products in place?
- Are environmental aspects included in AIA and NCARB certification guidelines?

Indicators at the Non-governmental agencies’ level

- Are incentives provided for green design?
- Is public awareness promoted (e.g., through pilot programs and projects)? Are “sustainable” building benefits publicized through the media?
- Are there international partnerships among NGO and among them and research institutions?
- Is there a sufficient number of NGOs that function as “green” clearing houses?

Indicators at the governmental level

- What regulatory requirements exist to build "green" (e.g., ordinances re environmental performance of buildings, emissions trading)?
- Are there regulatory requirements and/or economic incentives to expand re-manufacturing and recycling industry?
- Does the public sector provide a good forum for demonstrating “green” building techniques? Is the government leading through an increased level of sustainable design of its buildings?
- Is there "adequate" protection of workers throughout entire chain of product life (raw material extraction, processing, building construction, maintenance, deconstruction, transportation, recycling)?

Indicators at the utility companies’ level

- Are independent, decentralized power producers allowed /encouraged, especially renewable energies?
- Are green example in their own facilities set?
- Is research into energy conservation and renewable energy applications being sponsored?
- Pollution taxes of Btu taxes being paid?
- What is the level of renewable energy investment?
- Is there a consumer option to buy renewable energy?



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Indicators at the construction and building products industry's level

- Are there partnership in green issues?
- Level of training in green issues?
- Does the procurement of labor and material consider the following: "green" issues, transportation, regional ecology?
- Is post-occupancy evaluation common practice?
- Are de-construction skills being developed?
- Does supply side bear responsibility within traditional product specifications or through performance specification or through value added service?

Indicators at the lenders and insurance industry's level

- Do lower rates incentives exist?



Sustainability Indicators

STAKEHOLDER AND PUBLIC EDUCATION

Green products

- Third-party review/certification of “green” product information in place?
- Are laws in place to regulate the development process so that no unsustainable products are created (e.g., take-back regulations)?
- Collaborative efforts - do grassroots and corporations work together?

Stakeholders

K-12

- Quality of curriculum materials in:
 - raising environmental awareness
 - providing opportunities for outdoor education (ecosystem-human interaction)
 - integrating sustainability issues into all curriculum rather than a stand alone curriculum
- Congruity of buildings facilities - is bldg. green?
 - transparency of organization
 - transparency/visioning of bldg./org performance
 - building performance - daylighting, toxics in building/landscaping/cleaning, energy use
 - energy conservation program
 - recycling/impacts integrated
- Commitment to being an integral part of community (e.g., facility available for community use)?
- Students as stakeholders in facilities processes?
- Inclusive education (diversity)?
- Service learning opportunities?

Architects/Designers/Planners

- Are registration exams expanded to include information on sustainable building issues?
- Do continuing education opportunities include “sustainable building” agenda, e.g.:
 - building-related environmental impacts
 - new "greener" technologies/approaches/materials and code requirements
 - IAQ, electromagnetic fields, and other well-being issues
 - integrated design software
 - commissioning and monitoring?
- Is there a certification e.g., in green building, in place?
- Level of attendance at conferences/workshops/symposia.
- Level of access/use of tools re sustainability/green building
- “Track record” of implementation of “green building” projects
- Is there public appreciation of designer's "greening" efforts (e.g., Green Project of the Year, Contractor of the Year, Subcontractor, Manufacturer, Supplier, Permit Granting Agency, "Trash Hauler", Owner of the year)?



Sustainability Indicators

Building Owners and Facilities Staff

- Are there rewards/recognition for owners of “green” buildings?.
- Do architects use sophisticated economic analysis/analytic tools for first cost/payback time calculations?
- Are there broader standards in RFP and programs to include sustainability issues?
- Existence of educational programs re
 - intersection of lower impacts/lower operating costs
 - entrainment of land development & financial & speculative & commercial behavior
 - toxics use, in building materials and what’s used in cleaning/maintaining?
- Education of facilities and maintenance staff on the environmental impact of their work and systems?
- Availability of continuing education programs re new technologies
- Awareness of, and ability to quantify hidden benefits of "greener" project budgets (e.g., energy and water savings, productivity gains, reduced absenteeism, reduced costs for landfilling and handling/transportation/storage of regulated materials, longer product life)

Public Institutions

- Are practices being monitored?
- Dedication of resources to address sustainability issues (e.g., office of sustainability)?
- Outreach/educational efforts to constituents in place?
- Good practices “on the ground”/walking the walk?
- Is there a transparency of practices - free with information about practices?
- Level of stakeholder participation/engagement?

Trades (construction, demolition)

- Are there workshop/educational opportunities on practices & benefits of sustainable approaches/technologies (including indigenous technologies/materials)?
- Do certification/licensing programs lead to better qualifications re sustainability issues?
- Are there performance-based contracts available, rewards for the team rather than individual?
- Are trade associations/unions committed to sustainability?
- Is deconstruction recognized as a trade?

Colleges

- Presence of environmental sustainability issues in curriculums (architecture, business, engineering, policy, economy, urban planning)?
- Transparency of environmental performance of campus facilities, and explicit use for educational purposes?

General Public/Building users

- Existence of informational programs (e.g., public service announcements) to inform the public about Sustainability/built-environment issues
- Instruction "intensity" about environmental impacts of building systems
- Level of knowledge about equipment operation

Additional constituents the group identified as important are listed below. Time constraints led the group to not being able to address the sustainability indicators for any of them:

-Media -Commissioning -Non-profit organizations