Sustainability Development and Capital Investments: Exploring Planning in Public Housing and Higher Education Building Construction

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ABSTRACT

As public agencies consider costs, management, and environmental impact in developing goods and services with high capital investment in a world of increasingly limited resources, inclusion of sustainability goals becomes increasingly important (Leuenberger 2006 a and 2006b). Focus on sustainable development and financial planning for public services with high long-term capital investment costs is necessary and can have huge long-run impacts. Public housing and higher-education construction projects, which require high investment in capital through building and land costs, also require long-run planning, resource management, and environmental impact assessment. This paper offers examples of sustainable building planning decision making tools and related financial measurement techniques. It investigates the financial impact of initially investing in sustainable properties, the costs of maintenance, projections for resource, and cost savings into the future. This paper discusses economic planning in sustainability management outcomes by looking at system impacts of government decision making. It offers measurement tools for use in planning for existing and new developments (Leuenberger 2006c). Finally, it provides examples of sustainable development outcomes for public housing and higher education building construction projects and explores mechanisms by which costs for capital investments can be managed for maximum short-run efficiency as well as long-run sustainability.

Key Words: Public Agency Planning, Construction, Capital Investment, Public Housing, Higher Education

INTRODUCTION

Sustainability focuses on preserving natural capital or natural resources for future generations. Human welfare is balanced with the well-being of the environment through preservation and renewal (Bartle and Leuenberger, 2006; Pearce, Markandya, and Barbier, 1989; and Hempel, 1992). Sustainability is a philosophy, wherein long-run management of resources is considered in decision making. Sustainable development is the action driven by a plan to maintain resource integrity and human well-being over the long-run as well as the short-run. Resources are maintained at the current levels or better and the impact of overlapping systems are considered in planning. Sustainable development requires the management of resources in a manner that preserves the welfare of humans and of the environment, with emphasis on multi-generational effects.

With a growing demand for environmental sustainability, sustainable construction of public buildings is receiving increased attention in a world with quickly diminishing resources (Cohen, 2006). Public agencies, through mandates led by political leaders and through agency-inspired initiatives, are including sustainability as a part of their planning and decision making. In the United States, seventeen states (34%) required or promoted green building practices in public construction in 2006 (Massachusetts Sustainable Design Roundtable, 2006). Under programs such as the *Leadership in Energy and Environmental Design (LEED) Green Building Rating System* developed by the United States Green Building Council (USGBC), nationally agreed upon guidelines for construction, maintenance, and design of buildings are being established in the United States. The increased use of these programs may be a sign that sustainable design and green building are becoming mainstream (Gordon, 2005). This work discusses the relevance of sustainable development planning for capital development in public housing and in higher education construction projects. It also discusses how goal setting, outcomes measurement, and planning can fully integrate sustainable development and sustainability into agencies' planning and actions. It investigates the financial impact of initially investing in sustainable properties, the costs of maintenance, and projections for resource and cost savings into the future.

Effective inclusion of sustainable development into agency planning requires complete integration of sustainability into the goals, resource allocations, and outcomes of organizational plans. It also requires consideration of the overlapping system interests and opportunities for intra- and inter-agency collaboration in practice. According to LEED certification guidelines, public construction standards should be established for the following categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design process. (Kats and Capital E, 2003). Designs should include a "deep understanding of natural systems", of natural assets and opportunities, of the consequences of future action, and of human-centered values (Childs and Croxton, 2005). Public housing and higher education can improve long-run sustainability in terms of the services they are providing and in relation to the management of resources they

use to support the agency infrastructure. A number of examples of sustainability improvements in higher education and public housing construction emerge when overlapping systems and associated services are included in planning (Figure 1). For purposes of comparison, buildings are divided into two categories based on use: residential use construction and administrative/educational use construction.

For low-income families, green building techniques can reduce utility bills alone by 35% (Noonan and Vogel, 2005). The impact on citizens, economically and in welfare gains can be tremendous. The support, in the United States, of government programs is an indicator of the potential of green design for improved citizen well-being. Programs such as the U.S. Department of Housing and Urban Development (HUD), the Environmental Protection Agency (EPA), and the Department of Energy (DOE) provide financial incentives and educational support for such developments (Noonan and Vogel, 2005). These agencies require construction practices that include recycling of materials on the job site, the use of energy efficient appliances, the use of energy efficient light fixtures, proximity to public transportation, the installation of high quality plumbing fixtures, the provision of training sessions for residents and maintenance staff, the use of health conscious, durable interior materials, and prohibition on the use of vinyl siding (Hutchet, 2005). In order to effectively accomplish the type of sustainability improvements discussed above, it is important to understand the value of information, stakeholder participation, and education in the decision making process. The following section outlines the role of government in coordinating information and knowledge for sustainable development initiatives.

Figure 1: Examples of Sustainability Improvements in Public Housing and Higher Education

Type of Service Use	Resource Category	Examples of Planning Applications to Improve Sustainability
Public Housing and Higher Education Residential Construction	Construction, Energy, and Land Management	• Sustainable construction with use of renewable, readily available materials (such as concrete, recycled materials, straw build, mud build) • Use of materials indigenous/local to the community • Remodeling to improve energy efficiency and improved fit with new technologies • Repair and reconstruction of failing infrastructural components (such as leaking underground water or steam pipes or single-walled fuel storage units) • Building with materials with low environmental impact if buildings' materials become waste when building is destroyed or reconstructed • Use of high efficiency insulations with low environmental impact • Creation of energy efficient envelopes for heat management may include passive solar energy use) • Use of renewable energy systems with low environmental impact (such solar and turbine/wind energy) • Shared common spaces to reduce amount of land required and recreational space
	Water	• Grey water use • Sustainable appliances (air conditioning, dishwashers, washers and dryers) • Reduced waste water use (especially toilets) • Drinking water management
	Waste	• Biohazard waste management • Waste removal systems with low environmental impact • Recycling of plastics, paper, glass with individual user incentives and collection areas • Biodegradable cleaning materials use
	Food	• Food and nutritional management • Food related packaging (including pre-cycling and recycling) • Community gardening and strategic landscaping
	Transportation	• Creation of bike and walking paths to encourage movement away from fossil fuel dependent transportation • Availability of mass transit systems as an alternative to automobile travel • Minimization of impact from parking space
	Other	• Air quality management • Creation and preservation of outdoor habitat for native wildlife species

Administrative and Educational Building Construction	Construction , Energy, and Land Management	• Sustainable construction with use of renewable, readily available materials (such as concrete, recycled materials, straw build, mud build) • Use of materials indigenous/local to the community • Remodeling to improve energy efficiency and improved fit with new technologies • Repair and reconstruction of failing infrastructural components (such as leaking underground water or steam pipes or single-walled fuel storage units) • Building with materials with low environmental impact if buildings' materials become waste when building is destroyed or reconstructed • Use of high efficiency insulations with low environmental impact • Creation of energy efficient envelopes for heat management may include passive solar energy use) • Use of renewable energy systems with low environmental impact (such solar and turbine/wind energy) • Natural lighting incorporation • Recreational outdoor space
	Water	• Grey water use • Reduced waste water use (especially toilets) • Drinking water management
	Waste	• Biohazard waste management • Waste removal systems with low environmental impact • Recycling of plastics, paper, glass with individual user incentives and collection areas • Recycling and management of technological related waste (such as cell phones, computers, automobile oil and fluids) • Biodegradable cleaning materials use • Special attention byproducts of research (such as from chemistry and biology labs)
	Transportation	• Availability of mass transit systems as an alternative to automobile travel • Minimization of impact from parking space • Creation of bike and walking paths to encourage movement away from fossil fuel dependent transportation
	Other	• Air quality management (such as filtering and reduced carbon dioxide emissions) • Energy efficient air heating, cooling, and distribution • Creation and preservation of outdoor habitat for native wildlife species

INFORMATION ASYMMETRY, TIME-AND-PLACE KNOWLEDGE, CITIZEN PARTICIPATION, AND STAKEHOLDER EDUCATION

One of the key roles of public agencies is to reduce risk (Giddens, 2003). The depletion of natural resources used to support economic well-being is one of the most significant risks humans face today. Sustainable development in public and non-profit agencies resolves some of this risk by addressing gaps created by market failure. By redistributing resources and by providing educational and preventative mechanisms to improve social welfare, public agencies insure a higher standard of living for citizens and stakeholders than can private markets alone. Governments and non-profit organizations serve as a balancing force for stakeholders to obtain costly, but necessary information for decision making and for managing voice, efficiency, equity, and inclusion. Governments also mediate resources and information in an effort to maximize human welfare, both for the citizens as a whole and for citizens with higher demonstrated need or limited access to resources. Institutions of higher learning and public housing programs are in a position to demonstrate sustainable practices in day to day provision of services as well as offering educational support to increase sustainable practices of users.

Stakeholders in higher education and public housing programs may be valuable partners in decisions to improve environmental sustainability. Sustainable development encourages stakeholder participation and incorporation of time-and-place knowledge. As organizations such as USGBC reduce information asymmetry by providing training, guidelines, and educators, stakeholders with varying levels of expertise can be included in planning. Critical market failures are addressed when information provided by community members and by professionals is used to make organizational decisions through informal and formal participation opportunities (Leuenberger, 2006; Ostrom et al, 1993; von Hayek ,1945). For instance, users of services may be best equipped to judge whether specific approaches to sustainability are practical and meaningful on a day-to-day basis. Will decisions lead to practical, useful, and effective project designs? Those who hold time-and-place knowledge about community needs and assets, provide another balancing force in the decision making process about the goods and services they receive and use. Because stakeholders are likely to better understand local application of solutions and resources in the resolution of their own needs, efficiency and effectiveness are improved and risk is reduced. Waste is reduced when services and incentives match needs, wants, and human behaviors more closely. When service users are directly involved in creating their own plans, they may be more invested in and carry more responsibilities than those who have a plan imposed upon them.

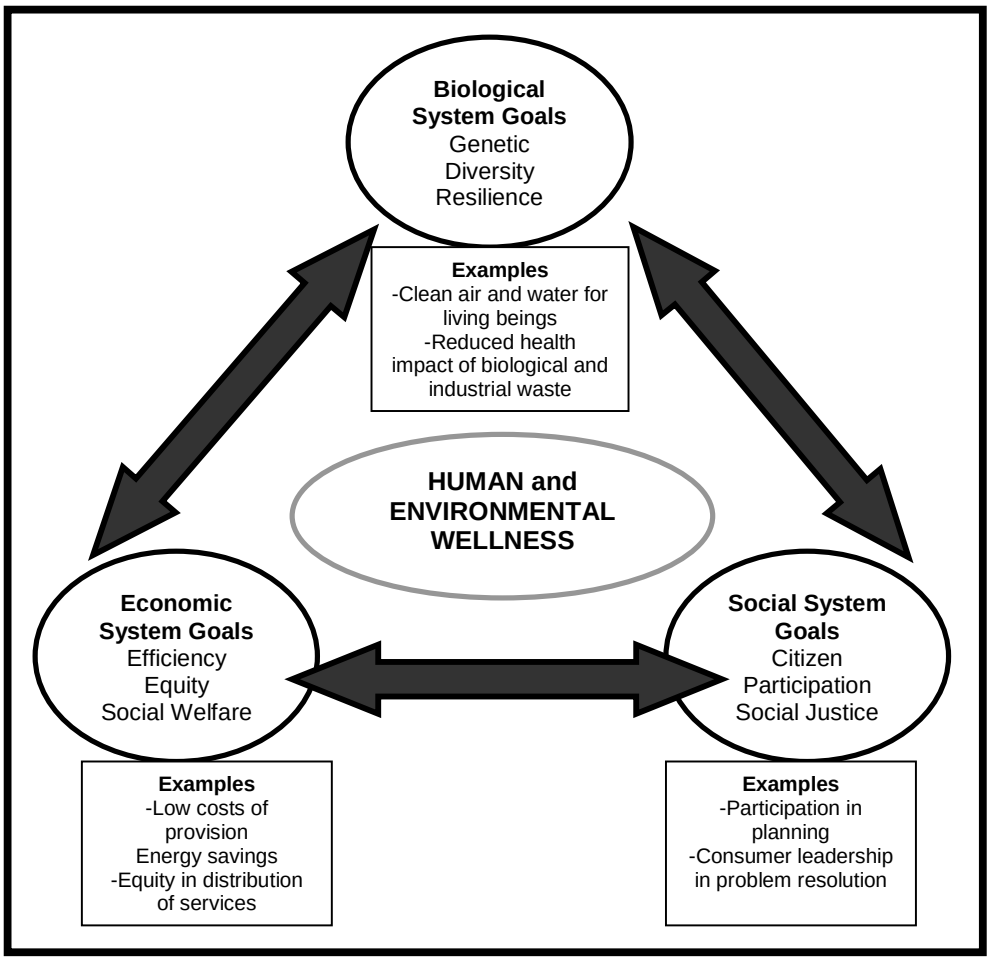
One of the key roles of governments and non-profit organizations, therefore, is to provide education to assist stakeholders in developing sustainability plans. They may include technical information as well as philosophical background for green construction projects and for related service systems. Also, the provision of this type of training and information gathering may facilitate green building by covering the very expensive costs of necessary

educational infrastructures. For instance, the costs of green analysis, design, and certification for K-12 education buildings totaled between $75,000 and $300,000 (HMFH Architects Inc. and Vermont Energy Investment Corp., 2005). Because there is a lack of “accurate financial and economic information” for green building, public and non-profit agencies can serve as a clearing house for knowledge (Kats and Capital E, 2003). Manuals for construction, management, lessons-learned, and operations of sustainable buildings are examples of information that can be shared with a number of agencies undertaking sustainable construction. Essentially the transaction costs of green construction can be significantly reduced for individual builders when information and education is coordinated through public agencies.

SYSTEMS THEORIES

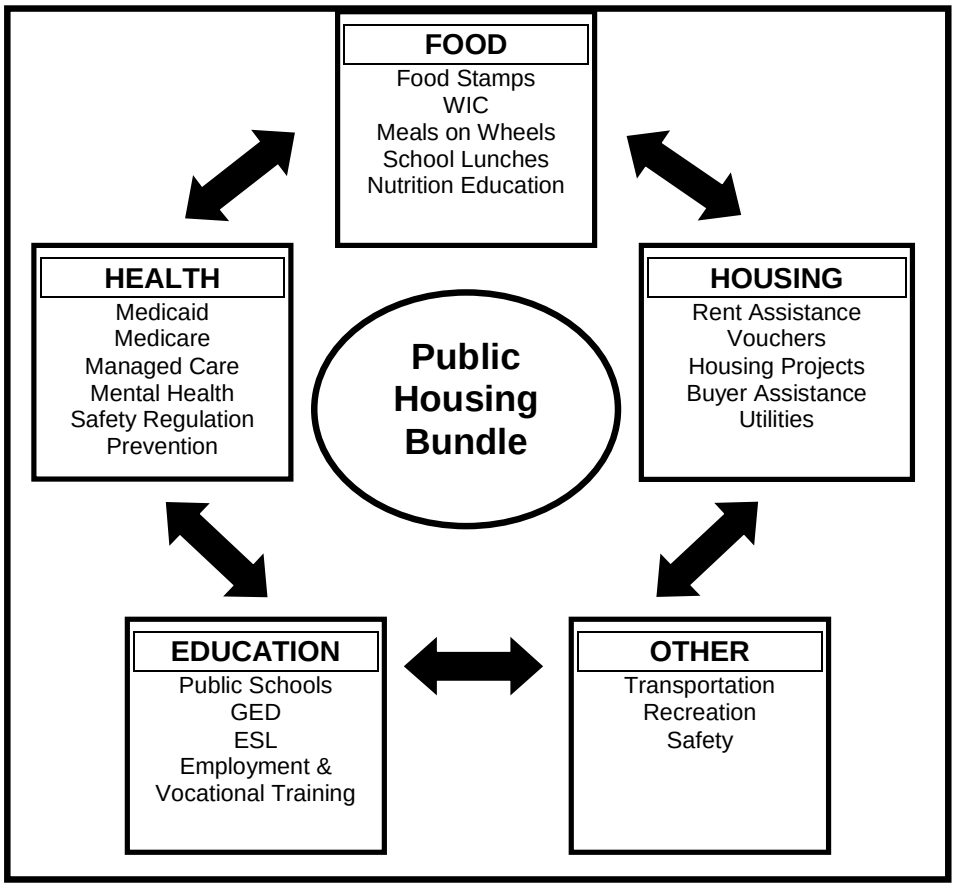
Another important concept to consider in sustainable planning and measurement is the relationship between systems of stakeholders, services, and goods. One of the reasons that sustainable development is able to make important contributions in public building construction is because of its link to systems theories. Today’s building designers must “work within systems” and “design new ways of living and working” (Hawken, 2005). Because investments of capital into higher education construction and public housing are tied to social as well as economic outcomes, considering multiple systems in interaction is critical. Sustainable development considers biological, economic, and social system goals (Barbier,1987, cited in Rao, 2000). Genetic diversity, resilience, biological productivity, efficiency, equity, social welfare, citizen participation, and social justice are components of these systems and of sustainability. These goals have parallels in public housing and higher education construction (Figures 2). Sustainable development planning requires consideration of multiple systems in order to assure balance and to reduce ambiguous effects from overlapping goals and actions emerging from multiple agencies or actors.

Figure 2: Goals of Sustainable Development and Examples of Related Activities in Public Housing and Higher Education Construction



Systems approaches can be used to address a diverse set of problems such as “air and water pollution, traffic congestion, urban blight, juvenile delinquency and organized crime” (Bertalanffy, 1968). In the management of human welfare, it is clear that many problems overlap into the domain of multiple agencies and systems. Human and environmental welfare depends on the management of several critical resource systems for long-run well being. Figure 3 demonstrates the relationship between multiple resources such as food, health care, education, and housing in the management of the public housing bundle. Often these resources or services are managed through a number of public and non-profit organizations, which must coordinate their efforts to maximize the benefit of individual citizens. When services are coordinated, then efficiency and effectiveness are improved, but the failure of any of the contributing systems may result in critical disadvantages for these individuals.

Figure 3: Resources and Systems in the Public Housing Bundle



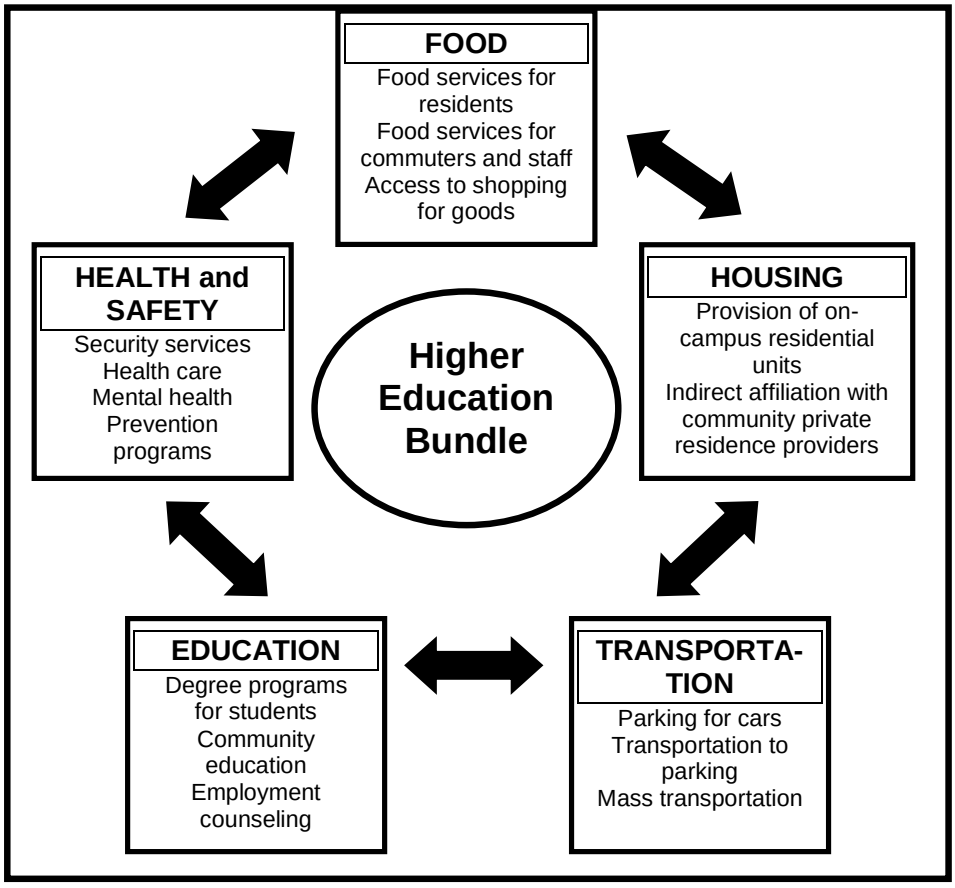
Sustainable development seeks to manage scarce resources in a manner that improves communication and coordination between systems of public agencies. In the planning for sustainable public housing communities, for instance, it is important to include agencies providing health care, education, and food. While attention to the use of energy efficient construction and appliances and renewable resources for heating, cooling, and lighting may be used in the public housing community development, consideration of other systems is important. Without access to sustainable transportation to health care, school, or work, the impact of the agencies sustainability plan may be diminished. For good air quality, proper waste management and recycling, and access to clean water the public housing system must also rely on other agencies. Sustainable development requires collaboration not only because of increased efficiency due to reduced overhead or transaction costs, but because failing to do so may actually eliminate the net environmental gains of careful, devoted, but uncoordinated agency sustainability planning.

In the case of higher education, a similar set of services are provided to consumers. These services, however, tend to be more centrally controlled and the university or college may have direct control over the provision of a number of services in the higher education bundle. Figure 4 demonstrates the

relationship of systems in the higher education services bundle. Because of the centralized nature of decision making, institution-wide planning programs may be especially effective.

For both public housing and higher education, capital investment in construction must carefully consider the systems linked to primary service provision goals. Because the planning of buildings and physical infrastructures could significantly impact the environmental sustainability of other services, construction decisions must use a holistic approach. In essence, public housing and higher education institutions create communities. Their design is a project in community planning, as well as architecture.

Figure 4: Resources and Systems in the Higher Education Bundle

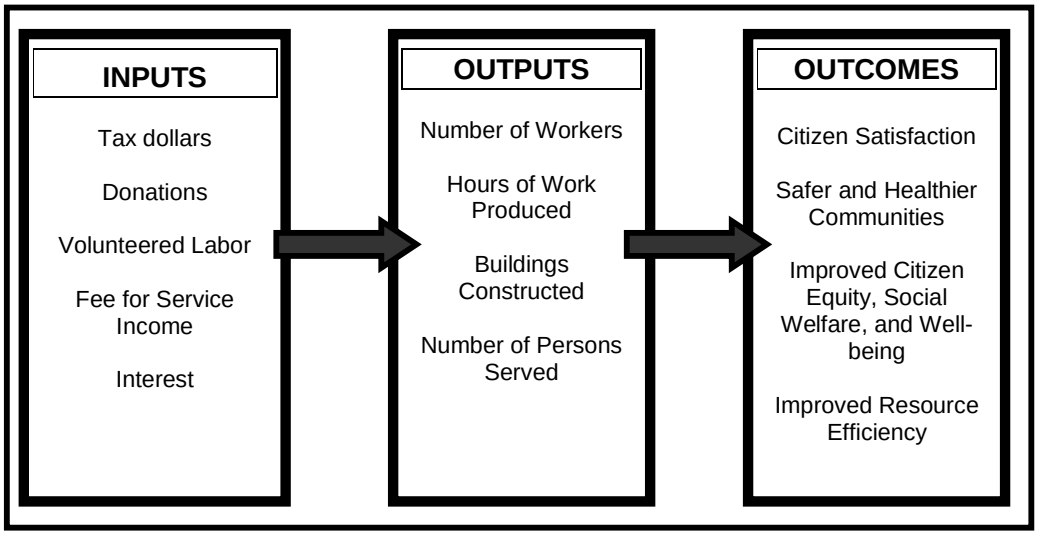


MEASURING AND PLANNING FOR OUTPUTS AND OUTCOMES

If sustainable planning of capital projects is to be comprehensive, inputs, outputs, and outcomes must be defined. Inputs are investments into the resolution of identified problems (Figure 5). Outputs are the products created through that investment, for instance buildings and supporting facilities. Outcomes are the results of the action the agency has taken to resolve problems of its choice. Outcomes for public housing may be improved community safety or

long-run increases in user independence. For higher education, the outcomes include education of users, increased civic responsibility of users, and increased earning power for graduates. The outcomes, because they hard to measure, are often stated in terms of outputs. The number of citizens moving from public housing to independent living arrangements or the number of graduates might be counted instead of outcomes. Using outcome measurements often requires more sophisticated planning and data collection and may depend, again, on considering multiple system goals concurrently.

Figure 5: Inputs, Outputs, and Outcomes



The measurement of outcome goals is especially important in a world of resource competition and diminishing abundance of natural capital. As government institutions are continuously invested in securing funding and resources to provide serves at their current levels. By demonstrating resource efficiency, organizations increase their competitive advantage for securing resources as well as maximizing the resources available to themselves and others. Sustainable development can be applied at the input and output stages of service delivery to increase outcomes or efficiency.

Defining outcomes clearly and goal setting requires several planning components, all of which improve measurement. During the implementation of these components, sustainable development can be integrated to facilitate resource efficiency. These components are: 1. Choosing a Plan Type, 2. Viewing Problems through a Systems Approach, 3. Research and Information Gathering, 4. Collaborating with Partners in Neighboring Systems, 5. Including Stakeholders 6.Clarifying the Short-Run and Long-Run Periods, and 7. Reviewing Outcomes and Adjusting to Changing Information (Leuenberger, 2006 a; 2006 b).. Each of these is discussed in detail below.

1. Choosing a Plan Type: Prior to implementing viable outcome and sustainability goals, it is important to have a plan of action. A service agency must not only have a plan of action, but must have a plan of action that is a living

document. This means that it is used by all employees of the agency and that it allows flexibility for changing environments. Most agencies use a version of strategic planning, which is intended to manage two to three year time lines. Other plans, such as a master plan, may also be used. The benefit of using a strategic plan is that it incorporates many of the components listed below to some degree such as research and information gathering, inclusion of citizens, using a systems approach, and review of outcomes.

When implementing a new plan, or revising one already in use, there are two important issues to consider. First, in order to be viable, sustainability issues should be addressed at all levels of the plan. This means that resources, assignment of tasks, research, goal setting, timelines, and outcomes must be rethought through the lens of sustainability. Creating a separate goal within the plan that addresses sustainability or a plan completely separate from the primary plan will result in conflicts between outcome-based actions and sustainability-based action. Second, all outcomes for problem resolution must be stated in measurable terms. This suggests that when outcomes cannot be measured directly, that proxy measures will be defined and used for data collection. For instance the satisfaction of customers can be measured in terms of a percentage change in customer reported satisfaction on a written survey. For especially difficult to measure outcomes, it might be important to consider two or more approximations of the outcome for measurement. When sustainability issues are considered at each level and outcomes are measured, agencies are essentially determining the primary target outcome first and then imposing resource efficiency on that outcome.

2. Viewing Problems through a Systems Approach: Another component of measurable outcomes that integrate sustainability is the use of a systems approach to decision making. Systems approaches reduce waste because the costs of infrastructure support or transaction costs are not duplicated.

3. Research and Information Gathering: Good decision making and goal setting requires research. As in strategic planning processes, this may include SWOT and/or PEST analyses, wherein the environmental and internal strengths and weakness are considered. This also means that data collection of base lines prior to initiation of plans and periodically follow actions must be recorded and examined. Information gathering of citizen and stakeholder desires is also critical. Efficiency maybe further increased if the organization is clear about what it wants to measure and assures that data collection systems and methodology match these measurements.

Research as to specific actions to be undertaken by the agency to address sustainability is also important. Alternatives to current actions and discussion of costs and benefits of all actions will improve conservation of resources. The cost/benefit analysis should be based on a systematic energy-use assessment (Creighton, 1998). This research will need to be updated regularly to accommodate new information and technological advances. Universities may access grants to support research.

4. Collaborating with Partners in Neighboring Systems: Following improved understanding of the environment and systems through initial research,

it may be beneficial to collaborate with other stakeholders with overlapping services to reduce resource use in output production. In fact, research following the preliminary stages of research may include sharing the costs of in depth research. Partnerships may also include managing spaces and staff together to maximize sustainability goals. This includes assuring that decisions and outcomes of one organization do not conflict with the decisions of others, perhaps eliminating resource and quality gains or even causing harm.

5. Including Stakeholders: It is important to insure that stakeholders are active participants in planning. Because they carry information that is at the micro-level, the agency must be careful in aggregating results for macro-level decisions without eliminating the impact of individual cases and stories. A combined qualitative and quantitative approach to gathering information may be informative. Because stakeholders have differing types and levels of expertise, it is also critical to create an opportunity for stakeholder education on sustainable development. This type of education may be completed in collaboration with agencies with experience in green building design, and planning. By using government funding and resources to provide this information to those planning sustainability projects, the transaction costs of developing educational tools can be significantly reduced.

6. Clarifying the Short-Run and Long-Run Periods: Another component is the need to clarify both the short-run and the long-run periods for planning. As time horizons are arbitrary unless they are set by the organization based on some key events holding meaning for the agency, it is important to state the length of a plan for the immediate future. This should be followed by consideration of a long-run time horizon that considers resources and outcomes balanced under sustainable practices. For instance, for a non-renewable resource, it would be important to set a long-run goal of 0% use prior to anticipated depletion with a short-run goal that addresses incremental movement in that direction. The short- run goal might read “the agency will reduce consumption of ___ by _____ percent annually”. For renewable resources the goal would provide the resource adequate regeneration periods through reduced consumptions. By aligning the two time periods, the agency meets current outcome goals with existing resources while setting a long-run plan that reduces or stabilizes resource use across generations. The problem of identifying the time periods for renewal and depletion are difficult to determine and require additional research and consultation with appropriate specialist. As time goes on, the lack of information may be remedied due to substantial global interest in answering such questions. The key is that efforts made today by organizations, regardless of how small, are not wasted, but extend the long-run horizon for resources and provide additional opportunities for technological and knowledge-based innovations.

7. Reviewing Outcomes and Adjusting to Changing Information: Finally, it is important to review outcomes and make changes based on new and better information. This information may come in the form of updated knowledge reflecting change or may come from technological improvements. Technologies improving sustainability of products used by service providers and tools for

improved decision making will allow the agency to meet their sustainability goals if they are implemented carefully into the existing plan. Construction should allow flexibility for changes in technologies of the future if possible.

MEASURING THE FINANCIAL COSTS OF SUSTAINABLE CONSTRUCTION

Before engaging in sustainable building planning, it is important to determine financial benefits and costs. The measurement of the benefits and costs of sustainable construction is made very difficult by issues such as insufficient information about technologies and their development, lack of resources to determine life cycle costs, and incomplete integration between and within systems or projects (Kats and Capital E, 2003). On average, the costs for green building add about 2% to the cost of construction (Kats and Capital E, 2005). But how do and can decision makers measure the financial benefits of investing in sustainable construction? What parameters and assumptions must be made in order to produce accurate projections on the outcomes of this investment? This section provides information on what documents, tools, and data need to be included in making cost/benefit projections and provides examples from measurement techniques used by decision makers in the field.

Because a true assessment of project outcomes is unique to each construction project, decision makers must consider a number of documents and the results of analytic tools in order to improve measurement. Some of the review documents critical to measurement include project manuals, architectural design documents, energy modeling reports, green feasibility studies, cost estimates for construction, and project budgets are critical (HMFH Architects Inc. and Vermont Energy Investment Corp., 2005). In addition to these documents, reports of agency wide mission and strategic planning as well as considerations of other construction, renovation, operation, and maintenance projects need to be considered. These documents allow an assessment of the internal benefits and costs of the project itself, while considering the impact of the project on other projects and the impact from adjacent systems. As the collection and evaluation of these documents is, itself, time consuming, costly, and requires technical knowledge, government funding or support may be used to offset this burden. The financial impact of these relationships also needs to be included in the evaluation process.

In addition to a review of these documents, specific attention to areas where investments are expected to be made must be considered individually and compared in the long-run and the short-run. Investments may be categorized into the costs of materials, of energy, and of water, for instance (Figure 6). Drawing on the documents above, assessment is made as to the long-run costs if no investment is made at this time toward sustainability gains. This is then compared with expected costs and savings if sustainability investments are made immediately. Often, the savings from introduction of sustainability investments outweigh the costs of the initial investment in the long-run. For instance, an article by Greg Kats states that the benefits of “greening” K-12 schools brought returns averaging $74 per square foot in the long-run with an investment of about

$3 per square foot, resulting in a gain of $71 per square foot (Kats and Capital E, 2006). Establishing the lifecycle costs of investing or not investing is critical to understanding the true results of specific planning decisions. A cost/benefit analysis would be most effective if it compares the costs and benefits of not investing in any green construction updates, to the benefits and costs of investing in green building design. The projection of benefits and costs from investment in green building may also be best understood in considering it in a couple of long-run time horizons, for instance five years and twenty-five years after construction. This suggests that three cost/benefit analyses should be compared: 1. outcomes of doing nothing, 2. outcomes of investment in the short-run, and 3. investment of outcomes is the long-run.

Figure 6: Sample Aggregation Chart for Cost/ Benefit Analysis
(Modified from Kats and Capital E, 2006)

SAMPLE COST/ BENEFIT AGGREGATION CHART (in thousands of dollars)							
Categories of Investment	Construction Materials	Electricity	Land	Maintenance	Water	Appliances	Other
Benefits							
Costs							
Net Gain or Loss Per Category							
TOTAL NET GAIN OR LOSS:							

In order to project the impact of investments into the long-run, the term of measurement and discount rates are examples of factors to be included. First, the duration of time representing the “long-run” must be established. This is the “term”. A twenty-year term for new construction and a fifteen year term for remodeling to increase energy efficiency, for instance, may be an appropriate term of measurement (Greening America’s Schools). After the term has been defined, it is important to assure that comparisons of benefits and costs into the long-run are adjusted for inflation and that the net present value of investments are evaluated against each other. Not considering these factors could lead to serious misinterpretations of the cost and benefit data.

Also, the impact of systems upon one another may create problems for measurement of costs and benefits. In complex project design, it may make sense to consider systems separately and in collaboration. For instance, there may be a relationship between lighting costs and heating costs as measured through the electricity use. It may be helpful to consider the benefits of green

design on lighting and heating separately to measure the potential gains and costs to each system. The impact on electricity use, an area of overlap between the two systems, may also need to be explored.

Finally, it is important to recognize that not all of the costs and benefits of sustainable capital investments are easily translated to financial data. It is important to review the financial information in conjunction with other types of data in decision making. For instance, increased satisfaction of service users and some improvements productivity may be difficult to define in monetary terms. The financial measurement of costs and benefits is one decision making dimension in choices of whether to invest or not to invest in green building design. The voice of citizens and stakeholders should also play a role in the decision making process.

CONCLUSION

Measuring the true outcomes of capital investments into sustainable design and related costs is difficult and expensive. Overlaps with other systems of services, difficulties in projecting future costs and benefits accurately, uncertainty of the value of newly developing technologies and the individual differences between construction projects make measurement of the financial gains and losses complex. The success of such planning and measurement must include holistic, systems-wide planning, a strategic plan with measurable goals, linking of inputs, outputs, and outcomes, careful application of cost/benefit analysis into the short- run and the long-run, inclusion of expert and citizen knowledge, and comprehensive education of stakeholders and decision-makers. The role of service users, especially in higher education and public housing construction projects, may be to provide critical information that improves the match between technical knowledge and human behaviors. By creating inclusive, comprehensive, multi-systemic data collection and decision making processes, the overall efficiency and effectiveness of projects should be improved.

As sustainable development and green design become mainstream concepts in public and private construction, the transaction costs of gathering and analyzing decision making information should be significantly reduced. Governments can support the increased use of sustainable design by providing infrastructural tools, expert knowledge, and education. Communities and agencies engaged in green building can contribute to reduction in transaction costs by maintaining good records, by creating case studies of their projects, by collaborating on appropriate development projects, and by providing public access to their lessons learned.

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