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Sustainable Housing

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How may the living conditions of the bottom third of the world's population be improved?

Over 2 billion people, one third of the world's population, are in need of appropriate shelter, according to the United Nations (http://www.grisb.org). For many, life in today's world is not sustainable, and what is more, "humanity's demand on the planet's resources, its Ecological Footprint, now exceeds the planet's regenerative capacity by about 30 per cent and growing (http://www.gsa.gov). Sustainable housing may be a significant part of the solution to both of these problems. This paper will focus on the need for low cost housing at the base of the economic pyramid, but those impacted by disasters such as hurricanes, earthquakes, tsunamis, and certain military applications could also benefit by the availability of inexpensive and sustainable housing.

Our world is considered by most to be a closed ecological system. There is a finite amount of energy and matter on the Earth, supplemented by comparatively diminutive external energy and matter, primarily sunlight and meteorites respectively. According to Wikipedia "Sustainability economics involves ecological economics where social, cultural, health-related and monetary/financial aspects are integrated." So to solve our problem, we must work within the framework of our ecological system, while satisfying social and financial needs. David A. Smith, the founder of the Affordable Housing Institute (AHI) tells us that "markets alone will never satisfactorily house a nation's poorest citizens...housing is typically affordable to only half of the population." (http://www.300house.com). Surely there is a way to close that gap.

In 1987 the United Nations World Commission on Environment and Development (WCED) published the Brundtland Report called Our Common Future. The report deals with the change of politics needed for sustainable development. According to the report: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The two key concepts demonstrated in the report are: 1) "the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given;" and 2) "the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs." (http://en.wikipedia.org/wiki/Brundtland_Commission) While upon cursory inspection, these keys run contradictory to capitalism, clever organizations will find attractive opportunities in their exploitation, as will be shown in the subsequent paragraphs.

Incidentally, the report also goes on to say "Sustainable global development requires that those who are more affluent adopt lifestyles within the planet's ecological means" and "Sustainable development can only be pursued if population size and growth are in harmony with the changing productive potential of the ecosystem." The omission of these statements, your author believes, would have resulted in more accurate and better received message. Lifestyles and population rates need not be affected if the proper technologies are utilized (e.g. what if foot traffic on sidewalks and floors were used to generate power for local use? What possible purpose did it serve to alienate the very people who were best able to affect change?).

According to the World Business Council for Sustainable Development (WBCSD) on Energy Efficiency in Buildings (http://www.wbcsd.org), buildings are one of the largest end users of energy, accounting for 25-40% of a country's energy demand. As a result of this finding, the WBCSD created the "Urban Infrastructure Initiative with the vision to create a world where

cities provide a sustainable environment to live, work, and play." This implies that buildings, and therefore sustainable housing, plays a vital role in a sustainable environment. Poorly constructed houses contribute to the spread of disease (because they have no proper sanitation or ventilation), the perpetuation of poverty (because children have inadequate light to study by) and the general sense of insecurity (because they are prone to collapsing or catching fire). (Economist, 2011).

While the name 'sustainable housing' and its extended application to the underprivileged is new, the concept itself is not. Company towns have been a part of American existence since the settlers at Jamestown learned about their new environment the hard way, and in a more onerous counter example, mining concerns invented the company store, but more recent and salient examples include Andrew Jackson Downing's rural cottages, the cluster-dwellings applied by the Tennessee Valley Authority during the Depression, and more famously, Levittown.

As soldiers returned home from World War II, housing became a problem. They had jobs, GI loans in hand, babies on the way, and a pioneering spirit, but apartments were scarce, and houses, when they could be found, were too expensive for young veterans (http://www.levittowners.com). Enter former Navy Seabee William Levitt, who provided a new concept in development as a solution . A $100 down payment, $10 deposit, and $90 at settlement would yield a new 800-square-foot house. Assuming 1950 dollars, and doubling 6 times to 2010, that would be the equivalent in today's dollars of $12,800, a real deal at $16/sqft. (http://tigger.uic.edu/~pbhales/Levittown/building.html)

The rancher he called the "Levittowner" included features such as radiant heating, roofed carport, a Bendix washer, a General Electric stove, and even a built-in TV. A detached, single-family house with a lawn, there was no basement or second story. Levitt set up a highly efficient mass-production assembly line for rapid construction using standardized parts. The houses were pre-kitted and assembled in batches. A truck would pull up to a lot and pour the concrete for a house foundation. Then it would move on to the next lot, and the next, and the next. Less than a week later, a construction team would assemble the wood frames. Levittown houses could be built at the rate of more than 30 per day (http://www.capitalcentury.com/1951.html). Rooted in historical precedent and social engineering, the clever and pragmatic design allowed for a moderately priced but highly useful house. Levitt tightly controlled the suppliers of goods and services, from lumberyards to appliance wholesalers, and a workforce with highly specialized skills. Eventually, tweaks owing to interchangeable parts allowed for some customization. William's brother, Alfred, was the architect. Alfred had been an apprentice under Frank Lloyd Wright, and Wright actually borrowed some of Levitt's ideas for his Usonian houses. Levittown houses could be expanded to keep up with owner needs. (http://tigger.uic.edu/~pbhales/Levittown/building.html)

The location of the housing development was also an important feature, and marked the birth of modern suburbia, not adjacent to any particular company, but near enough to urban centers and their jobs. (http://www.capitalcentury.com/1951.html) Despite the focus on single units, Levittowns were actually planned at the community level as organic clusters with swimming pools, parks or larger open areas, and schools at their center, rather than rigid grid planed subdivisions. This new kind of community promoted the child-centric and optimistic values of this generation. (http://tigger.uic.edu/~pbhales/Levittown/building.html)

The price stated above is very close to the price that is thought to be viable for sustainable housing in economically stressed environments, that being $10,000. A general rule of thumb states that an average family can afford to devote about 36% of their net income for house rental or purchase, so a $10,000 house would be affordable well into the income range of poverty. But the concept of sustainable housing goes further, and does not require very much in the way of input for successful service. However, the environments that could benefit most by sustainable housing, generally speaking, poor countries, have neither the income nor the infrastructure to support such growth, and the governments may need to bear the entire expense in some cases.

There are other challenges to consider as well. According to a report by Nessa Winston, in the journal Sustainable Development, the barriers to achieving sustainable housing include the lack of a shared vision of sustainable housing, inadequate building regulations, noncompliance with existing regulations, limited knowledge and expertise in green building methods, negative perceptions of higher density housing, poor quality designs, negative attitudes to social mix, an emphasis on demolition, a failure to recognize the need for social regeneration and limited resources, the lack of social infrastructure required for sustainable communities, and the lack of adequate management and maintenance of new and existing sustainable housing. Quite a list.

Additionally, sustainable housing projects need to be exempted from stamp duties, government fees, and expenses including taxes due to their financially sparse nature. In order to attract the best providers, there must be some margin for profit in the cost, and the cost also needs to allow for land/title survey, land registration, mortgage arrangement, and their related fees, duties or taxes, because freehold land for the house is most important for stability and therefore success of the project. Some governments may be disagreeable to these considerations. (Winston, 2010).

And in order to be beneficial to the local economy, growth pertaining to infrastructure such as roads, potable water, waste water, power, and public amenities must be planned as sustainable housing is only viable at scale. The use of local materials and labor should be given preference. Again, location is also important. Planned communities of sustainable housing should be safe, close to areas of employment or other sustenance, medical facilities, common areas, and schools. But location, labor, and materials may be government controlled, and again, some governments may be disagreeable to these considerations. (Winston, 2010). It is important to note that the intrusion of local corrupt practices has probably been the single most significant problem faced by most low-cost and sustainable housing projects around the world. (http://web.worldbank.org/)

To be successful, sustainable housing designs must take the environment into consideration. Environmental studies including culture, use, and political climate must be performed before the successful product can be designed. If the correct and complete data is not determined and used properly, failure will most likely result. Social phenomena need to be included in the design process. For example, in some environments, a ‘rebound effect’ may occur where, existing resources may be used without regard for efficiency due to its availability. Therefore, another challenge is to partner with the residents, including the identification of roles and responsibilities for use, maintenance, and repair. Partnering and open communications with all stakeholders including the developers, suppliers, and government bodies is also critical. Established processes must be followed and enforced. And finally, the ability to exchange or expand property, to allow for economic and family flexibility, must be established. (Winston, 2010).

A home is the largest investment that most families ever make, therefore it needs to be a structure that will last for many generations without major expense. The construction materials are a good place to start. Some experts suggest using locally available components such as straw-bale, straw-clay and bamboo (http://www.grisb.org). Most experts seem to prefer modular, prefabricated, interlocking, high strength concrete based elements that can easily be put in place by local unskilled labor, without the need for heavy equipment or machinery. These low-cost construction elements may be produced on site, using as much of the locally available material as possible. Such projects have been built in the Asia-Pacific, Africa, Latin America and the Middle East. (http://www.habitech-international.com). One new technology includes plastic concrete formwork systems, which are light weight, strong, and long lasting. (http://moladi.com). Another interlocking clay brick system uses an ionic clay stabilizer formula, which improves compaction, density, bearing strength, and fire-safety while maintaining a low cost and durability (http://www.locosthousing.com). Some companies use polystyrene insulation and recycled concrete for their antibacterial building product, and even provide financing for the end user. (http://www.cemex.com/SustainableDevelopment/Framework.aspx).

But the design must also incorporate other appropriate technologies to achieve the sustainable housing goal, the development of which is continuous, both in business and academic sectors. The U.S. Department of Energy Solar Decathlon challenges 20 university teams to design, build, and operate solar-powered houses that are affordable, energy-efficient, and attractive. The winning team produces a house that is affordable, attractive, and easy to live in, maintains comfortable and healthy indoor environmental conditions, supplies energy to household appliances for cooking, cleaning, and entertainment, provides adequate hot water, and produces as much or more energy than it consumes. But even with energy efficiency as a the goal, health and safety are priority considerations such as plumbing, ventilation, electrical, fire suppression, the ability to withstand weather, and egress concerns, make each contest entry a likely product. (DOE 2011). Another effort, the $300 House, was first described in a *Harvard Business Review* blog post by Vijay Govindarajan and Christian Sarkar. The $300 House goal is to bring together people, institutions, and businesses in a "creation space" to turn the idea of very low cost sustainable housing into a reality, and then test it in the field. (http://www.300house.com). Mr Govindarajan admits that the $300 figure was partly an attention-grabbing device, but states that Tata Motors would have found it more difficult to produce the Tata Nano if it had simply been trying to produce a “cheap” car rather than a “one lakh” car (about $2,200). Idealab, a consultancy, is on the verge of unveiling a $2,500 house that will be mass-produced in factories, sold in kits, and feature breakthroughs in ventilation, lighting and sanitation. (Economist, 2011).

Other design considerations might call for a single room structure with drop-down partitions for privacy. Furniture, such as sleeping hammocks and fold -down chairs, could be built in. The roof should support an inexpensive solar panel and energy storage to light the house, and charge a mobile phone and tablet computer. An inexpensive water filter and insect screens should be built in as well. In effect, the house is one room, designed around the family ecosystem. (http://blogs.hbr.org/govindarajan/2010/08/the-300-house-a-hands-on-lab-f.html). New innovations in solar technology are improving efficiency while driving down price. Energy storage is another challenge to tackle, and fuel cell technology will eventually replace common dry and wet batteries. FogQuest, a Canadian charity, has been installing devices using a plastic mesh to catch water droplets, fog harvesting, in developing countries for more than a decade.

Additionally, Ground Fault Interrupter (GFI) receptacles, smoke alarms, and a fire extinguisher should be installed. Hot water and heat could be provided by a solar hot water heater, and natural cooling could be performed by ventilation and, if water is readily available, evaporative cooling built into the walls. LED lighting should be used to conserve power. Consideration should be given to food storage and preparation; Philips has produced a cheap cooking stove, the Chulha, that cuts out the soot that kills 1.6 million people a year worldwide. (Economist, 2011).

Sustainable housing projects face a daunting task, and so they must be planned and performed perfectly in order to be successful. We have addressed the functional, environmental, social, and accordingly the economic aspects of such projects, but we must now address the business perspective. In order to participate in a sustainable housing project in any capacity, a business has the fiduciary responsibility to its owners to generate a profit. Although research has shown that pursuing sustainability can promote greater long-term profitability, this connection is not always obvious (HRH 2006). Accounting is concerned with the discovery and communication of knowledge. Adapting or extending conventional accounting techniques may help management address the challenges and opportunities pertaining to sustainable housing by providing the tools necessary for risk assessment and decision making, particularly by addressing the attributes of performance and value. These tools and techniques also need to accurately identify and measure the investments and costs, and the efficiency improvement (hopefully) resulting from the related activities and decisions. While none of this is new, the focus on the future, rather than primarily an examination of the past, is. And there is a need to look at all resource flows, not only the cash flows, but those of social and environmental concern. Economics attempts to measure human and social welfare in monetary terms, and economic theory assumes that a constantly growing economy is desirable, therefore anything seen as stifling economic growth is undesirable, and any activity that supports growth is desirable. (HRH 2006). Business, and therefore accounting, should embrace sustainability.

According to the Brundtland commission, "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Prognostication aside, as of 2006, more than half of the Global Fortune 250 produce environmental or sustainability reports. The Global Reporting Initiative (GRI) provides best-practice guidelines for sustainability reporting, but many organizations produce reports based on their own unique frameworks, which makes comparison very difficult. But some concepts have become universal, especially those which are adaptations of well known tools, techniques, and indicators. (HRH 2006). One possible indicator would be to establish a benchmark, and a goal, and then measure the progress toward that goal. Other Indicators are as follows: The Ecological Footprint helps to conceptualize sustainability, and provide a useful starting point (benchmark) to address environmental impacts. The Triple Bottom Line combines economic, environmental and social considerations to promote eco-efficiency, fair trade and environmental justice. The Balanced Scorecard, and accordingly, the Sustainability Balanced Scorecard use strategy maps to integrate sustainability into the decision-making process. The Sustainability Assessment Model uses the concept of full-cost accounting, i.e. translating all internal and external costs into financial values, just as cost based accounting does for factories, to measure the sustainability of a project. The Triple Top Line promotes using the waste from one process to advantage in another process. The Critical Natural Capital attempts to provide a way of describing essential

stocks or flows that cannot be substituted by either man-made or natural goods, for example the accounting of energy. (HRH 2006). We will now describe these indicators with a bit more detail.

The Ecological Footprint (EF) is a method for calculating the area that a population's resource consumption would occupy, as "the total area of productive land and water ecosystems required to produce the resources that the population requires" and it indicates biophysical limits to development and sustainability, especially if the calculated EF is larger than the land area occupied by the population in question. EF has also been used as an aggregate indicator of resource usage patterns, distilling this complex data down to a single number useful for evaluating resource usage relative to, for example, the geographic reach or number of customers. (HRH 2006).

The Triple Bottom Line (TBL) was designed to create greater environmental and social awareness in consideration of markets, values, access to information, life cycle technology, partnerships, time scale of decisions, and corporate governance. TBL indicators are approximations of sustainability principles, but should not be mistaken as having achieved sustainability merely by their presence. In 2006, TBL was modified to include indicators on economic sustainability, environment, human rights, labor, product responsibility and society. (HRH 2006).

The Balanced Scorecard (BSC) was introduced as the outcome of a reaction against the strict reliance on financial data for measuring success. An adaptation called the Sustainability Balanced Scorecard (SBSC) is a framework for improved environmental reporting, developed by Moller and Schaltegger, that ties together sustainability accounting, reporting, and eco-efficiency analysis. It calls for the standardization of accounting and performance measurement based on sector-specific sustainability indicators. (HRH 2006).

The Sustainability Assessment Model (SAM) is also a top-down approach that uses the concept of full-cost accounting (FCA). FCA is a method of identifying all internal and external costs of a project and translating them into monetary values. SAM is a means of measuring the sustainability impacts over a project's full life cycle, from resource extraction, through the production process, to final consumption. It is a means for generating a corporation's unique sustainability "signature," which includes a measurement of costs and benefits for social, environmental, economic and resource effects. This signature can be further distilled to produce a percent distance from sustainability, termed an index of sustainability. (HRH 2006).

The Triple Top Line, proposed by McDonough and Braungart , is a tool for refocusing "product development from a process aimed at limiting end of pipe liabilities." Like an ecosystem, industrial production could be coordinated so that the waste from one process could be an input for complementary processes. This is sometime called industrial symbiosis. (HRH 2006).

Back to the bottom line, the market for cheap houses could be "worth at least $424 billion, but is worth far more than that, by preventing the Earth from becoming a planet of slums" (Economist, 2011). Hopefully, the drive for profits can be put to further good use in moving our economy and world-wide standard of living forward.

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