Design Activism

The Intersection of Design, Technology and Social Change in Zero Energy Communities

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The Intersection of Sustainable Theory and Practice

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Part 1:

Approaches to Sustainability and the Beliefs Underlying Them

Defining Sustainability

There is increasing consensus on the need to lesson the environmental impacts of human activity. There are many approaches and each reflects radically different views on the relationship between human society and the environment. In order to act effectively, solutions need to be found which can encompass many viewpoints and attain widespread support and applicability.

Although it is increasingly clear that our current state of human activity cannot be sustained, there are radically different views on what it means to be "sustainable". This term can be simply defined as that which is "capable of being sustained" but underlying this simple definition is a tremendous diversity of opinion on what can or should be sustained. Even more fundamentally, there are many different views what it means to "sustain".

Haughton (1999) did an analysis of the various approaches to sustainability and there implications for both the environment and social justice. One extreme is the use of technology to lessen or alleviate environmental impacts with little change in social behavior or lifestyle. The other is a complete re-visioning of society to attain greater social justice and environmental harmony.

In considering these two approaches, what is critical is whether an implicit or explicit definition of sustainability is used. In the explicit definition, sustainability is something which can be quantified and measured and the degree of success readily determined. This approach was described by Haughton (1999) as the:

"neoclassical view that environmental problems can be addressed effectively by improving the workings of the free market to […] generate problem-solving technologies with the implicit assumption of considerable substitutability between human and natural capital stocks" (238).

The basis of the explicit approach is using technology and market forces to address environmental problems with only minor modifications in social, political and economic systems.

In contrast to the explicit approach, the implicit definition of sustainability is more holistic. This definition sees sustainability as a fundamentally different approach to living on the earth from the way we are living currently. The implicit definition can best be summed up in William Mcdonough's definition of sustainability: "loving the children of all species for all time". In this view, sustainability is seen as a way of thinking that leads to actions mutually beneficial to human society, the earth and all species.

Practical Consequences of the Definitions

These definitions of sustainability have a profound effect on the strategies used to address environmental problems. Global warming is widely regarded as the most serious environmental threat that we are currently facing. It would seem that this issue would be ideally suited to the explicit approach to sustainability. The main contributing factor to global warming, atmospheric carbon dioxide, can be easily measured and the many technologies exist to reduce CO_2 emissions.

The possible technological solutions to global warming range from large-scale generation to small-scale conservation. Faced with the tremendous diversity of solutions, the technologies which are used are largely determined by political, social and economic factors. A report by the American Physical Society found that small scale energy saving technologies over their lifetime save money and reduce carbon emissions while large scale generation technologies cost money to save carbon. For example, improving the efficiency of residential and commercial electronics, has a net *savings* of $90 dollars per ton of CO_2 saved, while generating technologies such as onshore wind farms or distributed PV *cost* between $0 and $30 per ton of CO_2 saved.

From an economic perspective, the most cost-effective technological solutions to global warming are small-scale efficiency improvements. Confronted with this clear economic reality, why are large-scale generating technologies still often favored over small-scale energy saving technology? Although the answer to this question is complex, it certainly has much to with the fact that small-scale technologies require significant changes in individual and societal behavior while large-scale changes largely do not. Thus explicit approach to sustainability often favors large-scale technology changes which can be implemented quickly and be largely transparent to the end user. However, given the high *cost* per unit of carbon saved, the use of large-scale technologies is questionable when small-scale improvements in energy efficiency *save* money per unit of carbon saved.

The explicit approach to sustainability does seek to change individual and social behavior through market forces. However, there are serious questions about the costs and effectiveness of these market-based approaches. For instance, small-scale energy savings measures often do not have the profit motivations that large scale projects possess and thus by relying on market forces alone these more humble solutions are often overlooked. Although some would argue that this is due to imperfections in the markets, the problem is more fundamental. Capitalism as it is currently practiced is based on increasing individual consumption not reducing it. Although there is strong profit motivation to increasing the efficiency of commercial and industrial processes, profit motivation will never seek to convince *consumers* to use less.

In order to solve this problem, economists have sought to create markets which somewhat paradoxically place value on using less. In his provocative book, Cool It economist Bjorn Lomborn questions the wisdom of current market based attempts to control carbon. For instance, the carbon markets created to realize the goals of the Kyoto Protocols have cost $23 per ton of carbon saved. Confronted with the cost of over $5 trillion (Lomborn, 130) to reduce the future global temperature rise by 0.3 ^{o}F over the next century, Lomborn questions whether this money could be best spent elsewhere i.e. dramatically reducing poverty, disease and environmental destruction in the third world where billions currently live in poverty, millions die of curable diseases and majority of the impacts of global warming are likely going to be felt (Lomborn, 1).

There are real questions about the cost of seeking to use large-scale technology and market forces to solve environmental problems. This issue calls into question the viability of using the explicit approach to attain long term sustainability. In contrast, the implicit approach to sustainability seeks a fundamental change in individual and collective behavior and the thinking which underlies this behavior. Although this level of change is much more difficult to implement than technological and market fixes, it also has the potential to be more lasting, less costly and more stable in the long term.

In comparing the explicit and implicit approaches to sustainability, the fundamental questions remain the same. The issue of sustainability cannot be boiled down to a simple equation or solution, for it is precisely that over simplification of the issue which has gotten us into this problem in the first place. Thus regardless of one's view on sustainability these are some fundamental questions:

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1) Appropriate scale: What are the appropriate scales to advocate for and implement changes in order to have maximum lasting effects and expediency?

2) Use of technology vs changing behavior: When is the use of expensive, high technology justified vs. less expensive, low technology coupled with social and behavior changes?

3) The use of market forces vs. community and social structures: To what extent is it necessary to use markets and economic strategies to bring about social change vs. using community, government and social structures?

4) Social Justice: Who are we making these changes for and is the investment we are making helping this group of people most?

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Part 2:

Rating Systems: What Exactly are We Trying to Accomplish?

The questions outlined above are fundamentally concerned with the approach to sustainability. The deeper question is what precisely are we trying to accomplish. There are many ratings systems which have been developed to answer this question. Some of these rating systems primarily focus on reducing energy use and emissions. The Net Zero and Passivehaus systems fall into this category. Other rating systems, like LEED, Living Building, 2030, etc. take a more holistic approach. Of these, the UK based Bioregional One Planet Program is perhaps one of the most visionary and comprehensive.

Net Zero

The Net Zero Energy/Carbon concept is increasingly popular because it represents an elegantly simple goal that is a significant accomplishment to achieve with our current technology. However, as the following discussion will illustrate, this concept is not nearly as simple as it appears.

The Meaning of Zero

There are four widely accepted definitions of a net-zero building (ZEB):

- Net-Zero Site Energy: " A site ZEB produces at least as much energy as it uses in a year, when accounted for at the site" (Carlisle, 2009). This is the common definition of a Net Zero Emissions Building (ZEB) in the US. The building produces as much energy through renewable sources as it uses on an annual bases. At different times during the year it may import or export energy from the grid.

- Net-Zero Source Energy: “A source ZEB produces at least as much energy as it uses in a year when accounted for at the source” (Carlistle, 2009) This is a much more rigorous definition of Net Zero which requires that the source to site transmission losses be taken into account.
- Net-Zero Energy Costs: “In a cost ZEB, the amount of money the utility pays the building owner for energy exported to the grid is at least equal to the amount the owner pays the utility for the energy services and energy used over the year. ” (Carlistle, 2009). In this definition cost is used as the arbitrator of zero.
- Net-Zero energy Emissions: “ A net-zero emissions building produces at least as much emissions-free renewable energy as it uses from emissions-producing energy source.” (Carlistle, 2009) This is the most common definition outside of the US and Canada where ZEB are often refereed to as zero carbon buildings.

Although the net-zero concept appears simple, in reality it is arbitrary were the building ends and other systems begin. Thus as long as a building is connected to larger energy systems there will necessarily be complexities in calculating net-zero. This difficulty perhaps illustrates the futility of an individual building ever being said to be sustainable in the context of a society which is so very unsustainable.

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Application of Net Zero at the Community Scale

The application of the net-zero concept to the community scale offers a hope of it becoming more meaningful. In the extension of this concept, local infrastructure and transportation energy can be included into the equation, which can better account for tradeoffs such as land cost/distance from city center etc. The use of net-zero at the community scale also bring up some questions about the concept. At the individual building scale (as seen in many high profile projects) it is possible to attain net zero in many cases through a large investment in expensive technologies such as PV. At the community scale, the expense of this approach is much greater and there is usually not the lavish funding that high profile projects enjoy. This issue also points out a weakness in the net zero concept: by considering only one factor (energy use) in isolation, an extraordinary amount of investment is often put into expensive generation technologies such as PV. It is likely in most cases this money could be used much more effectively to reduce energy through conservation on multiple projects or to fund community scale renewable generation projects.

Passivehaus

The Passivehaus standard defines highly ambitious targets for heating and cooling energy as well as air leakage. Specifically, the standard requires an annual space heating limit of 15kWh/m^2/year and an airtightness limit of 0.6 air changes per hour (ACH) (Holladay, 2010). These requirements represent very ambitious targets in most climates. The advantage of this standard is costly on-site generating technologies can be avoided in preference for off-site generation or until these technologies are sufficiently economical to be justified. However, as Holladay (2010) has pointed out, the tremendous amount of insulation required to achieve the Passivehaus requirement in cold climates can actually be less cost-effective than PV. The Passivehause standard justifies this level of insulation by arguing that insulating to this level will be sufficient to allow heating to be provided by means of the ventilation system; thus eliminating the expense of a separate heating system.

The fundamental criterion for evaluating the effectiveness of a standard is whether the provisions and requirements of the standard brings about the changes which were intended. The limitation of both Net Zero and Passivehaus standards is that they only address energy and thus money can be over-allocated to this single resource. In order to better evaluate the most effective use of resources, more far reaching certification programs seek to account for all impacts generated by the occupants of a project.

BioRegional One Planet Community Certification

UK based BioRegional's One Planet program is remarkable in that it seeks to account for all environmental impacts of the residents of a community. The basis for this program is to calculate the amount of land required to support each resident of a community (for food production, water, carbon offset, raw materials and waste) and then to calculate how many planets would be required if every person in the world lived in the same way. What is fundamental to this program is a focus on social justice: the idea that every individual only has a right to their share of the earth's resources regardless of economic and political disparities.

In order to be certified as a One Planet Community, every aspect of residents' life, including housing, transportation, food, material use, waste and community services, must be able to be sustained on 1.2 hectares (3 acres); an individual's fair share of earth's productive land. This is a very ambitious goal as the average UK resident uses three times this amount of land. Although to date no community has attained One Planet Certification, the One Planet approach in approach to taking into account all of the impacts of a community resident. Using this system of holistic accounting, the significance of savings in individual areas are more properly put into the context of an individual's overall impact.

Part 3:

Small Scale Community Case Studies

Mindful of these four issues of sustainability as well as the goals of these three certification programs, let us look at the potential for small scale communities to address these issues and goals through the lens of two case studies.

- The first case study is BedZED or Beddington Zero Energy Development, a pioneering community net zero project designed by architect Bill Dunster and BioRegional for Peabody Trust housing association. It is one of the first and most radical attempts to creating a prototype for zero energy worker housing following the comprehensive One Planet Community guidelines. The project consists of 100 homes with sizes ranging from studio to 4 bedrooms.
- The second, Lopez Island Common Ground, is a more recent development of 11 affordable homes and 2 rental units along with an office/resource center. Designed by the Minthun Architects and finished in 2009. the project was part of the work of the Lopez Island Community Land Trust which created an innovative 110 page manual to accompany the project.

BEDZED

What were they Trying to Accomplish?

BedZED is perhaps best known for its goal of being a net-zero carbon community development. Beyond this, it was also a prototype for the much more ambitious and comprehensive BioRegional One Planet program. Specifically the goals for BedZED were to:

- Reduce water consumption compared to the UK average by 33%.
- Reduce electricity consumption compared to the UK average by 33%.
- Reduce space heating needs compared to UK average by 90%.
- Reduce private fossil fuel car mileage to 50% of the UK average.
- Eliminate carbon emissions due to energy consumption.

As part of the testing and evaluation for BioRegional One Planet program, extensive data collection and surveys were conducted to evaluate the impact of every aspect of the residents' lives at BedZED. The results of this data collection effort as well as the design team's approach will be presented in regard to the four fundamental issues of sustainability outlined previously.

Appropriate Technology vs. Changing Behavior

As a demonstration community housing project, BedZED is exceptional in the effective use of technology to achieve maximum impact on a modest budget. This project was a result of a long-standing collaboration between architect Bill Dunster and the engineering firm, Arup, and formed a proof of concept for the ideas which they jointly developed. Peabody Trust, one of the largest providers of social housing in London, was very concerned with the project's economic viability and thus controlling cost was essential for the design team.

Energy Grading

In order to maximize cost effectiveness, Arup developed a concept of energy grading which linked the most appropriate renewable energy source for each end-use need. Electricity, a high-grade energy source, was used only for high-grade uses such as powering lights and appliances. Heating loads were greatly reduced through a combination of insulation, high thermal mass and winter solar gain. Work spaces with higher occupant and equipment loads were placed on the north side of the project; away from unwanted solar gain. Using these measures, the heating loads were reduced to the extent that boilers were unnecessary and a central community scale Combined Heat and Power (CHP) plant could supply all the heating needs for the community.

After optimizing heating, the design team extended the concept of energy grading to ventilation. Typically, high-grade electricity is used to accomplish the low-grade functions of ventilation and heat recovery. To replace this active system, Arup developed an innovative passive wind cowl ventilation system. The result of 10 years of research at Arup on using low velocity wind for ventilation, this system demonstrates the potential of research and design to arrive at solutions which dramatically reduce energy use and cost.

Thermal Energy Use

BedZED is remarkable in the care taken to match the climate and available sources of renewable energy to occupant needs. Sometimes this specificity had unintended consequences. The work spaces on the north side of the project were used less than expected and many were converted to residences. When used as residences, these spaces no longer had high occupant and equipment loads and the energy required to heat these spaces was up to 22.2 kWh per day, four times the BedZED average of 5.2 kWh/person/day. Even with these unintended use patterns, BedZED residences used 77% less heating energy than the Sutton average. Although short of the goal of a 90% reduction, this saving still represents a significant accomplishment.   Each of the units had a hot water meter which allowed the residents to track their usage of thermal energy. These meters promoted awareness of usage and in changing behavior they were one of the most important technologies for saving energy.

Electricity Use

The electricity and water use at BeZED followed a very similar pattern to thermal energy usage with large overall reductions and large variations between individual occupant usage. The average electricity energy usage was 3.4 kWh/per person/day, a 38% reduction from the Sutton average usage of 5.5 kWh/per person/day. The range of electricity use varied from 1.1 kWh/person/day to 10.9 kWh/person/day.

BeZED was originally planned to be net zero carbon with the CHP plant meeting the project's energy needs.   However, the plant never attained a maximum energy output above 90 KW; 30% less than the design output of 120 KW. Constant staffing and maintenance issues eventually caused the plants manufacturer, EXUS Energy to stop supporting the plant and it was decommissioned. To date, BeZED has not attained net zero carbon although replacement renewable sources of energy are planned which would allow this benchmark to be attained.

Water Use

The BedZED average water use was 72 litres/person per day. This represented a 50% reduction from the Sutton average of 143 litres/person per day. Some of the water saving features in the project were dual flush toilets, low flow taps and showers. A green water treatment plant was used to treat waste-water to be reused for flushing toilets and irrigating gardens. This waste-water recycling system reduced waste-water by 15 litres/person per day. Of these technologies, what was perhaps the most effective in reducing water were water use meters which made water consumption easily visible.

Technology vs Behavior

In each of these categories: electricity, thermal energy, and water use, a combination of technology the behavior changes were responsible for the savings achieved. In terms of technology, BedZED represented a unique pragmatism- a combination of tremendous design and engineering expertise with a constant dedication to using low cost, economically viable technologies. But the commitment to monitoring and changing individual use habits at BedZED has been equally impressive. With much of the building technology now fixed, this has become the main focus for the future.

The use of Market Forces vs. Community and Social Structures:

What is commendable about the Biogional's One Planet program is that it seeks to measure the total environmental impact of each community resident. Using this approach, the relative impact of various technological and lifestyle choices can be seen in proportion to the total impact. This holistic accounting creates a reliable bases for making smart decisions. As part of the One Planet monitoring at BeZED, residents were surveyed on their transportation, consumable items consumption, waste and diet. This data, along with energy use, was used to calculate the total carbon footprint of the average BeZED resident. The carbon footprint was then converted into the number of earths required if every person on earth lived in a similar manner.

The carbon footprint for the average BedZED resident was 9.9 tons per year, a 11% reduction from the Sutton average of 11.2 tons. The number of planets equivalents was reduced by 10% from 2.9 to 2.6 planets. These results are sobering from a project with the ambition of BedZED and this information underscores that building efficiency improvements, although important, have a relatively small impact on a individual's total environmental footprint.

With the goal of attaining One Planet Living, BioRegional has modeled the lifestyle changes at BedZED necessary to dramatically reduce a resident's ecological footprint. Called “BedZED keen” these change would include zero car usage, zero air travel, 41% reduction in consumable items, a vegetarian diet, a 30% reduction in food waste, and renewable systems to meet all the electricity and thermal needs. If all these changes were implemented, a resident at BedZED could attain a carbon footprint of 6 tons per year and a planet equivalent of 1.7. Even with these dramatic changes, the Biogional report concluded that:

> “The results clearly show that residents living in BedZED are unable to get to a one planet living level [and that] the BedZED community is not large enough to reduce its impacts from public services and capital investment which make up 21% of the UK average ecological footprint” (“BedZED Seven Years On”).

Based on this finding, Biogional has increasingly focused on larger communities which are able to “support local infrastructure such as medical centres and schools (also built to one planet living standards)” (“BedZED Seven Years On”).

A Question of Scale

In terms of scale, there our many advantages to BeZED's size. With 100 units, BeZED has more opportunity for saving from shared infrastructure. At the same time, BeZED's relatively small size has helped to foster relationships and a sense of community. A survey of residents found that the average inhabitant of BeZED knew 20 neighbors while the average social housing resident only knew 8 (“BedZED Seven Years On”). However, there are also notable disadvantages to BeZED's size. The failure of the CHP plant was a problem of scale as the plant was not sufficiently large to justify the amount of maintenance required. In addition, BioRegional found that BeZED was not large enough to allow its residents to achieve One Planet Living.

An ideal combination might be communities of the scale of BedZED combined into larger One Planet Communities which would be able to support larger infrastructure changes. This is exactly what Biogional is attempting to do with its One Planet Sutton project that seeks to bring the whole town of Sutton up to One Planet Living Standards. Other One Planet Communities are being planed on a large scale. One of the most ambition is Sonoma Mountain Village in California, a 1892 home development with 26849 m^2 of office space and 16995 m^2 of commercial space. In these large scale projects, the goal is reach a scale such that a community can provide for all the resident's needs, including housing, employment and transportation all at the One Planet level.

Social Justice.

Within the principles of One Planet Living, there is a fundamental social justice ideal: that every inhabit of the earth should have an equal access to its resources. This idea is very different than the ideas of capital and resource concentration which capitalism is based on. In order to continue our current standard of living, One Planet Communities seek to use technology as a bridge to allow 1st world standards of living with 3rd world resource consumption. This goal is very admirable and should be applauded. Reducing resource consumption alone, however, will not result in solving massive global inequities. The fundamental question which Bjorn Lombor posed still remains: is it better to invest money in benefiting the world, especially the disadvantaged, indirectly through reduced environmental impact or directly by improving standard of living, curing disease and reducing poverty in 3rd world countries? The work of BeZED and Biogional in promoting the idea of One Planet Communities is strong in that it can be implemented with relatively minor adjustments in standard of living and lifestyle. However, while the One Planet program is based on global resource equity, it does not address economic equity. This is the missing piece to the puzzle of the One Planet concept. Merely using the wealth of 1st world countries to reduce resource consumption will not be sufficient to solve the problems of poverty, disease and social unrest if the issue of economic inequity are not addressed as well.

Mindful of this issue, let us look at the second case study, Lopez Island Common Ground. Not as technologically remarkable as BeZED, the Common Ground project is equally innovative in its community and economic model.

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Lopez Island Common Ground

What were they Trying to Accomplish?

The Common Ground project was a product of The Lopez Community Land Trust (LCLT), a non-profit organization dedicated to preserving land for farming, forestry and affordable housing on Lopez Island, WA . Through innovations such as mobile agricultural processing units, community supported agriculture and the promotion of local products, this organization helps the viability of small-scale farming on the island. Many of the residents of the island have difficulty finding affordable housing and thus LCLT also builds housing for low and middle income residents. The Common Ground development is LCLT's fourth housing project and the first to attempt at net zero energy. The objectives for for the project were:

- Reduce electricity energy use by 48% by using passive solar design features.
- Attain Net Zero Energy within the first five years of occupancy.
- Reduce water usage through rainwater harvesting and water conserving appliances.
- Education and direct feedback are essential. Meters were placed inside each home and financial incentives reward those who use less.

Appropriate Technology vs. Changing Behavior.

While BeZED is remarkable in its innovative use of technology, the Common Ground project is equally remarkable in its innovative community and economic model. Designed by the Seattle-based firm, Mithun, the project was constructed by an eclectic team of homeowners, interns, volunteers, staff and sub-contractors. To effectively utilize this diverse group, the project had a unique construction system. An open wood structural frame mimics the function of a heavy timber frame with low-cost standard wood construction. Once this frame was constructed by building professionals, the walls were filled in with straw bales which were locally harvest from the island. The easy to install, forgiving nature of straw was a perfect fit to the college students and young apprentices who assisted the homeowners in building their homes. Using this combination of community labor and professional oversight kept the project costs low while also educating students and homeowners in the building trades.

In the use of the technology, the design team selected commonly available off the shelf products coupled with good design. Optimized solar orientation and high insulation levels were used to reduce heating loads. Additional heating was provided with low-cost electric resistance heaters, sacrificing some efficiency for dramatically lower cost. High efficiency lighting, and timed ventilation fans reduced electric loads and electricity usage was offset through the use of PV panels. Solar hot water heaters reduced electricity for water heating. Using all these measures, so far the project has reduced energy use by 60% relative to code with some households actually attaining net zero.

Water use by the project was reduced by 30% through the use of low flow fixtures and visible use meters. An additional 40% of the water used in the project came from rainwater collected from the roof of each house and stored in a 38,000 gallon cistern.

Whereas BeZED utilized many novel and untested technologies, the Common Ground project focused on small-scale, proven technologies which could be easily maintained by residents. The contrast with BeZED can also be seen in the scale of the technologies used. BeZED utilized large-scale technologies such as the CHP plant which required specific knowledge and expertise to operate. In contrast, the focus at Common Ground was on educating homeowners to be responsible for maintaining their sustainable systems. Thus technologies which were large or complex were avoided in favor of simple technologies which could be easily understood and maintained. In the use of smaller systems there was also more individual accountability as each home had its own renewable energy system and was individually metered. Although the Common Ground project has not yet attained net zero, a few individual households have attained this goal. Using the example of these households and a combination of education and financial incentives, the hope is that Common Ground can eventually attain net zero energy.

The use of Market Forces vs. Community and Social Structures.

Fundamental to the Lopez Island approach is a focus on education. As part of the Common Ground project, the Lopez Community Land Trust produced a 104 page operating manual that defined the vision of the project and how that vision translated into the decisions made at every stage. The Common Ground manual begins with the Hannover Principles created by William Mcdonough and Michael Brawngart. The 1st Hannover Principle states:

“Insist on the rights of humanity and nature to coexist in a healthy, supportive, diverse and sustainable condition. (Notice we use the word 'insist', which clearly doesn't mean 'please hope that someone else will do it for you')” (Land, Water, Energy, Resource Use, 10)

From these broad principles, the project manual presents the thinking that translated these principles into specific decisions. The goal of this manual is to educate the homeowner and the community in the principles of the project and how these principles translate in the specifics of design, construction and operation . Great care was taken to make the technologies in the project simple to use. For instance, the heating thermostats had three different modes: a daytime heating mode, a nighttime heating mode and a minimal frost protection mode for when the residents were gone. Using this easy to use system, residents could easily maximize energy saving while maintaining comfort.

A Question of Scale

The LCLT model is to build small housing developments with strong community involvement. The Common Ground project consists of 11 homes and 2 rental units, much smaller than the 100 units of BeZED. Although not sufficient to sustain the large-scale infrastructure that was present at BeZED, this scale has many advantages. The main advantage is that residents of the project can be active participants in design, construction, maintenance and future improvements. Whereas extensive surveys were necessary at BeZED to judge resident desires, the direct involvement of residents at Common Ground provides a more direct path for residents needs to be addressed at all stages of the project. With the mission of LCLT as an educator, the scale of the Common Ground project allowed a level of involvement by the homeowner's which would become more difficult at larger scales.

Social Justice.

The Common Ground project is remarkable in its social mission. The project was intended for residents of the island who increasingly have difficulty in finding housing with the low wages they receive. In contrast to BeZED and other One Planet Communities which are largely aimed towards middle and higher income residents, Common Ground was designed to allow low and middle income residents to live cheaply and sustainably. Grants and rebates provided a significant portion of the funding for the project. The average cost per unit was $236,000 with grants/incentives providing $124,000, so that the average net cost to the homeowner was $112,000. The units ranged from 700-1000 sq ft. with a cost range of between $80,000 to $150,000. Two revolving funds were used to finance the project: The Len Kanzer Memorial Fund and a loan through a state grant exclusively for affordable housing.

LCLT's mission is remarkable in simultaneously providing a model for sustainable housing while improving the lives of small-scale farmers and other local producers who's work is essential to sustainability but receives little value from society. The Common Ground project simultaneously addresses small-scale local production and affordable housing with a fundamental focus on education to empower residents of the island. Thus the strength of LCLT's grass roots approach is that it simultaneously addresses multiple components of sustainability with an aim of continuous improvement through a community process.

Conclusion

What was Achieved

BeZED and Common Ground reduced resource use by similar amounts. BeZED reduced energy use by 70% while Common Ground has been able to reduce energy use by 60% so far. Water usage was reduced by 50% at BeZED and 70% at Common Ground. Both projects had a commitment to long term monitoring and using the results of this monitoring to change user behavior.

Difference in Approach.

Although both of these project achieved similar resource savings, the approach of these project was very different.

BeZED was a social housing project with ambitious performance goals but no defined user group. As a Bioregional prototype for future social housing developments, BeZED sought to dramatically reduced resident ecological footprint through innovative technology and extensive monitoring.

The monitoring results at BeZED found that technological changes alone can only reduce the footprint of a community residents by a small amount. The average resident of BeZED only reduced their ecological footprint by 10%. Using the most stringent conserving measures, Bioregional calculated it would be possible for a resident of BeZED to reduce their footprint by 41%. These results demonstrate that individual behavior has a much greater impact on ecological footprint then changes in technology. Based on these results, Bioregional has increasingly focused on promoting changes in individual behavior.

Thus BeZED has moved from an explicit approach of defining specific goals and technologies to promoting more implicitly sustainable lifestyles among residents. The lesson of BeZED is that even with the most sophisticated approach to design and technology, it is not possible for a community to accomplish the highest level of sustainability unless residents adopt implicitly sustainable lifestyles and continuously seek to do more with less.

With this lesson in mind, the focus on education and community in Common Ground project makes perfect sense. What LCLT understands is that the process of ongoing education of homeowners and the community is of primary importance. The specifics of design, construction and technology are also very important but are secondary to changing individual behavior. The Common Ground project began with shared principles for a sustainable future and through a community process translated these broad principles into the specific decisions at every stage of the project.

The strength of the Common Ground approach was based on a strong existing commitment to sustainable principles on Lopez Island and LCLT's success in promoting community agriculture and housing. From the bases of shared community principles, the Common Ground team defined explicit goals for the project based on what was technologically and economically possible at the time. In seeing the Common Ground project not as an end in itself but rather a step in a long process of increasing sustainability on the island, LCLT's approach acknowledges both the difficulties and long-term nature of achieving real change.

In these two project we have two very different but equally successful models for community development. BeZED used excellent design, technology and specific targets to bring together community based with an increasing awareness of living sustainably. Common Ground began with strong shared community principles and used a grass roots community process to transform these principles into explicit goals for design, construction and ongoing operation.

Both of these projects demonstrate the importance of human relationships and community as a catalyst to changing behavior and thinking. Although technology has a role to play, the importance of individual decisions was more significant in these projects. Thus as a way of promoting more sustainable lifestyles based on a common vision for the future, community is perhaps one of the most powerful tools for creating change.

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