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ENERGY SELF-RELIANT NEIGHBORHOODS

ABSTRACT

The development of energy efficient homes has progressed more rapidly and much further than comparable work on energy efficient subdivisions. This is unfortunate because careful planning, design, and construction at the subdivision or neighborhood scale can offer substantial energy savings. These savings extend beyond space conditioning to water, transportation, waste management, and food supply that are not as easily treated at the individual house.

Integrating cost-effective home and neighborhood energy systems will provide many economic and environmental benefits compared to the systems used today. The development of neighborhoods that are much more energy self-reliant is not only possible but economically sound and essential for the nation's future security and prosperity.

1. INTRODUCTION

The last ten years have seen a dramatic improvement in the understanding of climatically adapted, energy efficient building design. The marriage of passive solar and super-insulated design[1] has led to the evolution of an approach to building that can create structures that are virtually 100% self-reliant for space conditioning. These have the added advantage of improved comfort, quiet, and low life-cycle cost.

Unfortunately, subdivision designers have not embraced these new design methodologies and continue to neglect the many other energy issues that are involved in subdivision design. This is unfortunate because the subdivision scale offers great potential for saving money through energy conservation and renewable energy systems, as a result of savings of scale and specialization. This failure has arisen for several reasons, including the over specialization of most development specialists, e.g. the civil engineer who designs the streets rarely considers the effect lot orientation will have on the architect; the critical path of development, with design and layout complete before the landscape architect is called in to beautify it; and absence of real cost accounting--due to a myriad of subsidies, incentives, and programs that mask the real cost of development.

2. THE PROBLEM IS

While the educational system may justly be criticized for the lack of ecological literacy[2] and the skills required for sustainable development[3] in graduating engineers, architects, landscape architects, and business majors, it must be conceded that the real problem is the difference between economics as the accountants and business people know it, and economics as the ecologist views it.

The gulf between these two world views is perhaps most easily demonstrated by their different treatment of present and future value and cost. The businessman for example, with a planning horizon of six months to a year, will emphasize the present with a high discount rate, while the ecologist, with a planning horizon of 50-100 years or more, would put a much higher

value on the future and use a very low discount rate. Cost to the business person in often confined to production cost and sales price, while the ecologist would use, a larger, but often difficult to calculate, total cost including what are now externalized costs of environ-mental damage, the opportunity cost of options denied by spending, and the risk of future impacts of current actions.

This difference in accounting is largely the result of a deliberate, but hardly conspiratorial, effort by politicians to manipulate the market and provide *seemingly* cheap food, energy, water, and housing. The mechanisms used to manipulate prices include a variety of government policies, primarily tax and investment related, which obscure the actual costs and transfer direct and indirect costs from the buyer to other individuals, groups, or Society.

These subsidies have not been well studied, but are enormous. The annual subsidy for non-renewable fuels, for example was estimated at more than 44 billion dollars in 1984[4], $523 dollars per household, not including environmental costs.

If these subsidies were removed and environmental costs and risks were added, energy prices would certainly be double, and more probably triple what they are today. This would have a dramatic impact on the type of home and neighborhood consumers want and developers provide.

Subsidies and false accounting is crucial even on a much smaller scale. For example, a builder who chooses to add 55 square feet of West facing window in a hot climate would not do it if he (she), or the home buyer, had to foot the $4,000-6,000 cost the utility bears to increase peak power generation capacity to carry the larger air conditioner required for cooling, and the 25¢ per kwh (real cost) for the power to run it.

Progress toward energy self-reliant neighborhoods will be slow until the market more accurately reflects costs and benefits. The failure of recent attempts to provide solar incentives to counter existing subsidies for non-renewable energy is a clear indication of the need for change. Only the well-to-do, who had little need for energy saving, benefited from these programs. Attempting to counter the clear market signals presented by existing subsidies by either regulation or counter- subsidies <u>has not and is not likely to work</u>. Having been involved, enthusiastically, in the development of the City of Davis Climatically Adapted Building Code[5], and, more skeptically, in the development of the Passive Solar Tax Credits,[6] for the State of California, I learned first hand the enormous cost of regulation and subsidies. This has been confirmed by the limited effect and effectiveness of the State Energy Conservation Building Code.

The costs involved include not only the funds required to collect the money to run the regulatory operation (as much as 50% of the operating cost), but also the cost of compliance and the perhaps the greatest cost of all, the time and energy of the people preparing the regulations, defending them, and evading them.

We would have been further ahead if we had managed to remove some of the existing subsidies for non-renewable fuels[7] and invested in improved education. Hopefully, the rising Federal deficit signals the incipient end of the enormous investment in collective stupidity characterized by our current planning and development activity. This investment produces houses and neighborhoods that are not particularly comfortable, enjoyable, healthful, or durable, barely affordable, and certainly not sustainable.

Jack Goody's studies of dedevelopment in Ghana[8] offer a rather hopeful view of

what may occur. Ghana had the highest per capita income in Africa at independence. It is now one of the poorer countries, but has maintained a good educational system and for better or worse, a large government. Yet, because of the decline in government revenues everyone has to maintain their own home, garden, and trees for food and fuel in addition to their government job. He calls this "Sunlighting" and it is one of the more positive scenarios of what may happen here in the U.S. as we come to terms with national debts, both economic and ecological.

Current design decisions and educational efforts will to a large extent determine how easy this transition will be. Design strategies for neighborhoods are suggested in the following sections. These would evolve naturally if the market more accurately reflected costs.

3 ENERGY SELF-RELIANT NEIGHBORHOODS

A. SPACE CONDITIONING

Buildings would certainly optimize climate responsive design[9,10]. Super-insulation, or more properly--adequate insulation[11,12], would be used in all structures. All buildings would be oriented properly[13,14] to work with solar resources for heating and to provide economical solar control, access to cooling breezes, and a clear view of the night sky for radiant cooling (if needed). Daylighting design for interior lighting would be standard[15,16]. All home buyers would receive a homeowner's manual[17] describing the operation of their home's energy systems. Movable insulation would be included and seasonal changes in system orientation or operation would be common. Building materials would be simple, wood, plaster, and concrete and finishes would be non-toxic[18]. Backup heating would be by wood where air quality allows, burned in catalytic stoves--efficiency 70%+, or by compost heat, either house or district based.

Compost heating is a traditional method of heating greenhouses and has more recently been tested for home and water heating[19]. It is an excellent option, for although output is low it is a clean fuel and the compost is a valuable soil amendment. Bruce Fulford's work at the New Alchemy Institute[20] is worth careful review. Compost heat would never be practical on a current code house, but would be feasible on a super-insulated, passive solar house.

The neighborhood scale would offer several advantages for designers[21]. Microclimates could be manipulated to improve summer cooling and winter heating[22]. Wood for heating would be collected locally, as a by-product of orchard and landscape operations[23], managed by a subcontractor or by the utility. The compost operation would be integrated with the neighborhood farm and landscaping operations.

B. MISCELLANEOUS USES, LIGHTING, ETC.

Photovoltaics would be used to meet primary electrical demand, which would be kept to less than 10% of current demand by skilled design. Refrigerator design would incorporate the features of the horizontal energy-saving refrigerator[24]. The larger scale of development planning would reduce the per unit cost of more advanced systems, such as district total energy systems[25] (which could also provide super-efficient freezer storage space--and laundry facilities), fuel cells, and wind energy or solar pond facilities. Neighborhood energy systems would be interlinked for resilience and backup. Utility employees would

helping operate and maintain energy systems (control system checks, monitoring, seasonal orientation, night ventilation, battery testing, etc.)

C. HOT WATER

Water heating would be solar, primarily integral systems[26] with some thermosiphon models. Backup water heating would be done with natural gas, compost, wood, or alcohol.

D. FOOD

The current food system produces one calorie of energy for every ten calories invested while traditional agricultural systems may return ten calories for every one invested[27]. Food production would be an integrated and important function of the neighborhood[28,29]. Many homeowners would maintain their own gardens (America's 34 million home gardeners currently produce about 9 billion dollars worth of vegetables a year[30]) others would have them operated by garden services.

The kitchen gardens of many areas of the world suggest what can be done[31,32]. These gardens, rarely operated as a primary occupation, provide a very high percentage of vitamins and minerals[33], and often a substantial portion of calories and cash income as well[34]. Residential developments would establish farm areas for intensive production of basic commodities and biofuels. Landscaping for the neighborhood would be chosen for food[35], fodder, and biofuels, just as it currently is in the highly evolved garden/forest systems of Indonesia[36], Mexico[37], and many other parts of the world.

E. TRANSPORTATION

The design of neighborhoods and communities to a large extent determines transportation requirements and preferences. The City of Davis, with more than 30,000 bicycles and 15,000 daily riders, and Village Homes, with pedestrian and bicycle circulation emphasized and autos inconvenienced offer clear proof that it can be done, and is enjoyable. It is also very economical. Davis residents save more than 20¢ per mile by biking rather than driving and city residents save more than a million dollars a year by riding bicycles, money that stays in the community and stimulates local businesses.

Pedestrians are even more at the mercy of the developer and urban planner[38]. If proper attention is paid to microclimate, ease of access, safety, and convenience walking will remain popular, after the current "walking fad" has passed.

F. WATER

The water system would include rainwater harvesting, home or neighborhood cisterns, and considerable recycling. While current water consumption in the U.S. is about 500 liters per day (v/s 160 in the UK)[39], the Minimum Cost Housing Group[40] and others have demonstrated that use could probably be cut to 10 liters per day, with full conservation, including mist showers[41], and recycling. The neighborhood scale is most appropriate for water systems, allowing investment in more elaborate storage and treatment facilities. The utility specialist could also oversee and manage home water systems.

G. WASTE MANAGEMENT

The most effective management of wastes is source control. This would be an integral part of an energy self-reliant community. Waste streams must be

minimized and kept clean of hazardous materials so they can be biologically recycled. This would require a dramatic shift in marketing but a very small change in lifestyle. Household wastes would be composted or treated in ecologically engineered aquatic systems.

4. CONCLUSION

Energy self-reliant neighborhoods could relatively easily be incorporated in mainstream development activities if more accurate and complete cost accounting were done, based on the author's experience with the Cities of Davis, Indio, and Sacramento, California; numerous developers, Sacramento County, and the Sacramento Municipal Utility District. If the current market dislocations are allowed to remain intact we will continue to see uncomfortable, energy inefficient, and very costly developments built.

Ideally, we would approach development regionally[42], with a careful consideration of resources and human needs[43,44], and the determination to provide an enjoyable and healthful environment for living.

"*... ere long the most valuable of all arts will be the art of deriving a comfortable subsistence from the smallest area of soil. No community whose every member posses this art can ever be the victim of oppression in any of its forms.*"

Abraham Lincoln, 1859

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