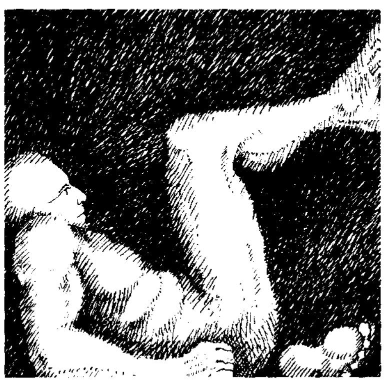


URBAN DESIGN BEYOND THE SOLAR PANEL

A British barrister, printer, and graduate of the University of Cambridge, Sandy Walkington is currently studying the political implications of the energy dilemna at the Tulane School of Urban Studies. Acting as consultant to City Hall, Mr. Walkington is also engaged in developing a comprehensive energy conservation plan for the City of New Orleans. Using the energy dilemma as subject, this article examines solutions within a holistic and realistic context. Consequential impacts on present and future behavior are of particular interest as Mr. Walkington applies them to urban design.

In 1938, Neville Chamberlain, Prime Minister of Great Britain, returned from his meeting with Hitler waving a piece of paper and promising "Peace in Our Time!" It was a wildly popular slogan. It was also wildly optimistic. Two years later, France, thought to be the greatest military power in Europe, was beaten. Britain survived by the grace of God, German incompetence, and American benevolence. Any thinking person should have perceived the German threat. But nobody wanted to believe it, and so Churchill remained a voice in the wilderness.

We have pursued a similar policy of appeasement with the energy problem no less than we did with Nazi Germany. Twenty years ago geologist M. K. Hubbert predicted that U.S. oil production would peak in the early 1970's, and then go into decline.[1] Other experts queued up to prove him wrong. U.S. oil production did indeed peak in 1970, natural gas production in 1973.[2] They have been declining ever since. Yet these two energy resources supplied seventy-five percent of U.S. energy needs 1974:[3] three quarters of industrial needs, transit, agriculture, home heating, cooking, clothing, etc. Hubbert further predicts that world oil production will peak in the 1990's (see Figure 3), which will close outside avenues of supply.

So we have twenty years to develop new power sources, which is a very short time in terms of world history. Everyone knows the billions of dollars which have been poured into nuclear energy in the thirty years since World War Two, yet nuclear energy only supplies a miserable three percent of U.S. energy needs.[3] The problem seems to be unmistakable, yet cities still happen—I hesitate to use the word "design"—as if energy is going to be no problem. At best some token solar panels are presented as burnt offerings, or skyscrapers are built with windows that open. It is my contention that this is not even scratching the surface of the problem. Therefore this article concerns itself not with architecture in a singular sense – although it has a vital role to play in conserving energy—but with how structures and activities relate to one another and the potential theory for energy conservation.

American cities are uniquely high energy places. Periclean Athens housed a population of 150,000 in a few square kilometres. Phoenix, Arizona, requires a thousand square kilometres to house a million inhabitants. Aristotle wrote of the ideal city having a population of no more than 10,000, so that the whole should be comprehensible at a glance. Robert Moses devised the urban expressway. Highway designers rather than philosophers have become the arbiters of urban design and, outside densely packed downtown cores, sprawl has become the norm for urban development.[1]

These new cities are high energy cities in a fundamental sense. The people who inhabit them use a great deal of energy both at home and at work. The distances between the two are measured by minutes in an automobile, not by yards on foot. The city itself, because of its extended nature, requires a large amount of energy to function, both for fixed services such as sewerage and electricity supply, and for transit, ambulance services and police. Energy availability must now become a tightening constraint rather than a permissive factor in urban design.

It is unfortunate that the western intellectual tradition, particularly the discipline of economics, has ill-prepared us to face up to an analysis of the energy situation. Classical and neo-classical economics miss the point that fossil fuel resources are finite, and do not deal with the effects of resource depletion. Instead they concern themselves with the mechanisms of resource distribution and relative scarcities, presuming adequate substitutes for every resource on which humanity now depends. M. K. Hubbert once wryly suggested that oil companies should employ economists, not geologists, as their prospectors, since economists always know that the resources are there.

No one has looked at this problem in terms of dynamics, recognizing not only that resources are finite but also—and it is a big "but also"—that there are lead and lag problems in their substitution. The fact that nuclear power exists does not mean that it can supply all our power needs tomorrow, oil shale does not mean an immediate abundance of oil. Nor can any country simply rely on world supplies of fossil fuels. The world is an abstraction. It has no government and has no way of allocating resources except by trade and self-interested aid. No country, not even the U.S.A., can afford to plan its future on the assumption that the rest of the world, motivated by kindness, will keep it in the style of energy consumption to which it aspires.

In 1975, U.S. energy consumption was 2,349.5 million metric tonnes of coal equivalent.[2] In the last fifty years its energy demand has grown at four percent per annum, that is, doubling every seventeen years.[1] This demand leveled off after the first Arab oil price hike, but this demand plateau merely reflected a general downturn in the economy, and demand rose considerably last year. Between now and 2,000 A.D., the U.S. population is expected to increase by 60 million (U.S. Census Bureau); that is a growth rate of nearly one percent per annum. Energy supply will have to match this if energy consumption per capita is to be maintained, and history has shown that a higher growth rate is required to maintain full employment in a capitalist economy. Nevertheless, one should be aware of over-simple energy/GNP ratios. The Ford Foundation "zero energy growth scenario" still requires an overall increase in annual energy supply of fifty percent for the U.S.A.[4]

Any examination of the American energy situation must begin with petroleum products. Oil and natural gas supplied seventy-five percent of U.S. energy needs in 1974.[3] This dependency has scarcely changed over the last ten years.[2] However, U.S. oil production peaked in 1970, natural gas production in 1973.[2] They have been in inexorable decline ever since. My discussion will concentrate on oil, with which natural gas goes hand in hand.

Taking outside estimates, the U.S.A. has remaining oil reserves of 135 billion barrels(See Figure 4).

(Please note that *total official* U.S. reserves barely exceed 32 billion barrels.)[2]

U.S. annual production in 1975 was three billion barrels.[2] This suggests a further 45 years of production at present levels. In fact, it would be physically impossible to maintain production to the bitter end at these levels, but there is hope that production can be held fairly steady until the year 2000, after which it will go into increasing decline in accordance with the depletion curve of Figure 4.

The potential for synthetic oil from tar sands (no proven process), oil shales (environmentally disastrous, and only 80 billion barrels with present technology) and coal (the entire world coal production would be required to supply the U.S.A. with its oil needs) have been vastly over-emphasized. They will provide a few years grace, no more.[1]

Let us return to that annual production figure of three billion barrels. This is not nearly sufficient to satisfy U.S. needs and the difference must be imported. The percentage of total U.S. oil demand now represented by imported supplies ranges between forty-five and fifty percent, costing circa $45 billion per annum, almost half the U.S. defense budget. The prime goal of the Carter energy plan was to reduce oil imports from 8.5 million barrels per day in 1977 to six million barrels by 1985.[5]

Look at Figure 4 and see what that will require of the U.S. demand curve: an unlikely complete turnabout. The latest report of the Petroleum Industry Research Foundation (October 1977) thinks we will be lucky to hold imports to present levels, while Exxon thinks the 1985 figure will be more like

12.5 million barrels per day. I wonder where they hope to get it from.

Hubbert and Warman suggest world oil production will peak sometime in the 1990's, roughly in accordance with the depletion curve of Figure 3.[6] Furthermore, oil is not a world resource. It is an Arab resource, or at least sixty percent of it is. The Arabs can only absorb so much foreign capital, and as the price of oil goes up they will want to produce less, not more, although they cannot afford to ignore the potential collapse of the capitalist system. They will produce their own needs, export enough to pay for their own imports, and only coincidentally will this meet the demands of the buyers.The U.S.A. will have to compete in this market with the other developed countries of the world, and has at present a rather weaker trading position than many of them due to the decline of the dollar.

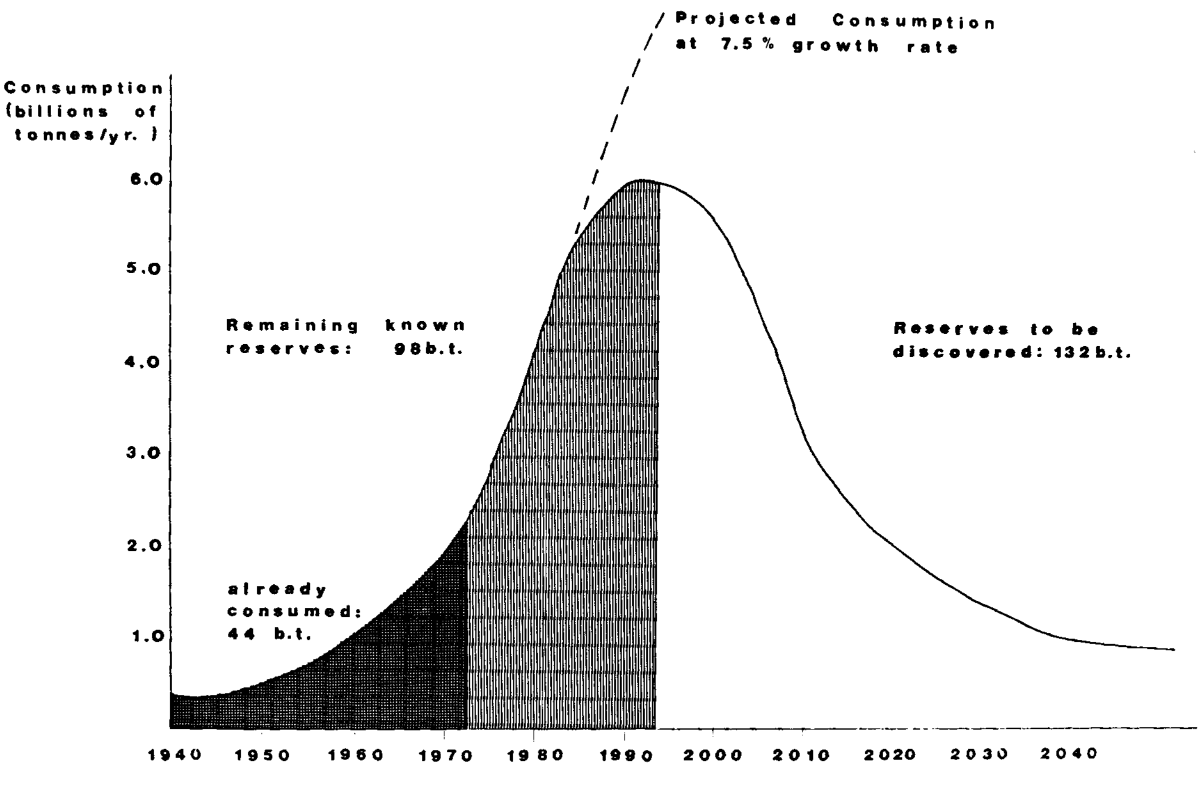
It has, of course, got the Bomb and the Marines, but military might, while encouraging extraction, is not going to create new supplies.

A major new source of energy has to be found, and one that is suitable for the continuous processes of a great industrial nation. It has got to be of a high enough grade to provide electricity; it must provide a reasonable net energy gain; it must be clean and it must be constant. Finally, it must be quickly accessible with present technology.

This rules out most of the alternative resources which environmentalists are so fond of citing. They should not be ignored, but they are essentially placebos, not panaceas, many no more practicable in the short term than perpetual motion machines.

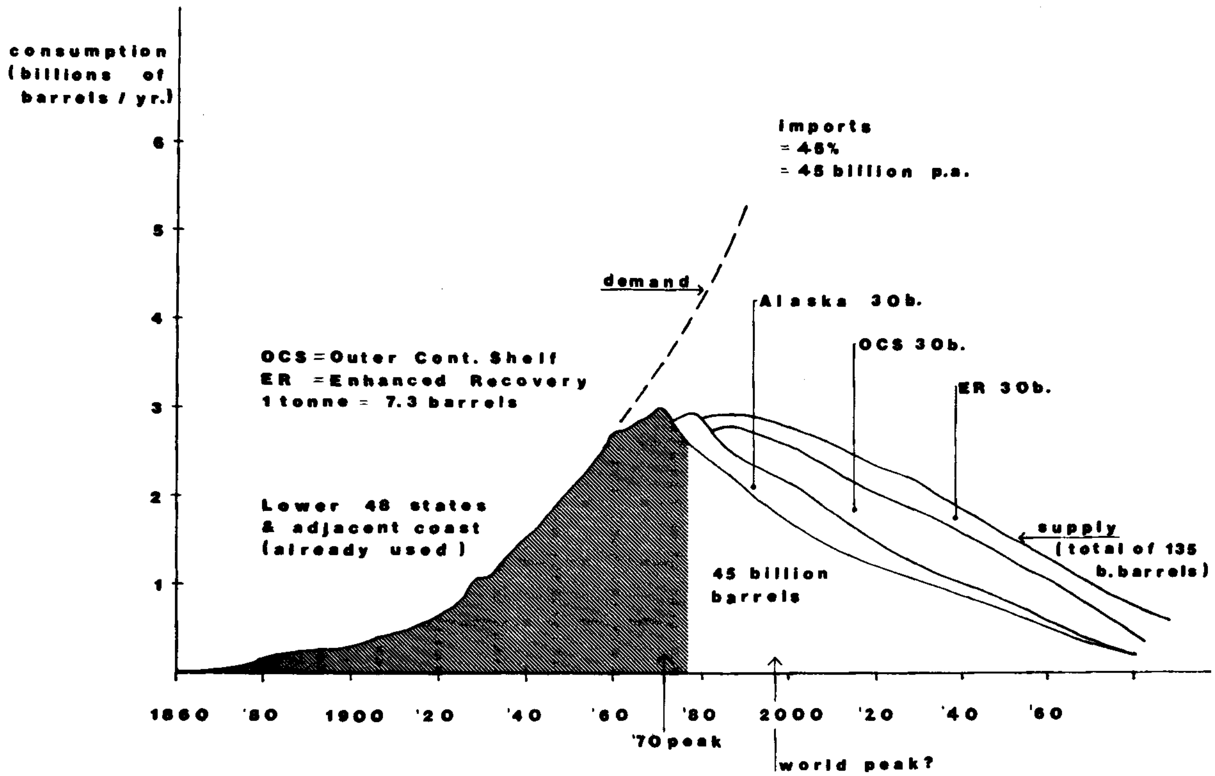
If we can solve the problem of storing excess energy for use in low periods, then the variable sources, sun and wind, have potential. Otherwise their use is largely confined to "Walden II." Nuclear fusion, in spite of massive research expenditure, remains technological gobbledygook. Geothermal is minor. Energy from waste is absurd–better to stop that waste at source and save far more energy, rather than encourage flatulence. Ocean thermal is perhaps the most promising, a form of solar energy which provides fairly constant power: but even its most enthusiastic proponents do not see it making a contribution until the 1990's.[1]

FIGURE NO. 3



THEORETICAL DEPLETION CURVE FOR WORLD OIL RESERVES OF 274 BILLION TONNES

FIGURE NO. 4



Depletion curve for U.S. oil production

My contention is that we must still be looking at conventional "off-the-shelf" technologies for short term solutions. This does not mean that we should ignore alternative energy resources. On the contrary, but they must be seen as a long-term investment for our children.

But in the short term, I think we have three choices: coal, nuclear fission, and conservation. For reasons I will enumerate below, I regard conservation as being by far the most practical of these, hence the importance of examining and redesigning our concept of the city.

Coal and nuclear fission are by far the most immediately practical alternatives to oil and natural gas, although both pose considerable problems. I will begin with nuclear fission. Not wishing to be accused of being a wet liberal, I will ignore the civil liberties and environmental issues and proceed to a problem scarcely anyone seems to have contemplated.

It is a problem inherent in the whole resource substitution plan, specifically the heavy energy investment required in developing a new energy supply. Nuclear power at present supplies a mere three percent of total U.S. energy needs, ten percent of its electrical energy.[2] Gerald Leach has suggested that a nuclear programme expanding at an annual rate of seventeen and one-half percent (i.e., doubling every four years) would absorb all the existing nuclear energy output *simply to keep the construction program going.* My own figures suggest a growth ceiling of fifteen percent per annum. There would be no net energy gain to society until that rate of increase was slowed down, and a net energy loss if the rate was increased.[7] Yet something like the seventeen and one-half percent growth rate is required to raise nuclear's contribution from its present three percent to a meaningful level by the end of the century. What is more worrying is that there may be the same sort of constraint on the development of coal and on all other technologies.

Amazingly, no one seems to have done any research on this, yet we may find ourselves manuevered into a position where we need our exponentially declining resources simply to exist, having none to spare developing new resources.

There is no shortage of coal in the U.S.A. At present consumption rates there is enough for 2,000 years.[1] However, it at present supplies a mere twenty percent of energy needs, considerably less than most other advanced industrial nations.[2] This means that there are going to be immense substitution problems.

U.S. coal is very dirty. It poses almost as considerable pollution problems as does nuclear fission: experiments are at present being made with a fluidised bed generating process, but they are still in their infancy. The coal industry is beset with vicious management-union disputes, which will hinder quicker extraction, if any extraction at all, according to recent experience. It takes ten years of development before a deep mine starts producing. Strip mining is quicker but immensely destructive of the environment, potentially conflicts with agricultural interests, yet it is U.S. agriculture that is paying for the current oil deficit. Most of the coal is in the west where it is not needed, but the U.S. railroad system has been wantonly destroyed, so there is a major problem of transportation. Coal slurry pipelines have been suggested as an alternative, but the west is short of water, so water will have to be piped in in order to pipe the coal out, creating yet another energy merry-go-round.

The simplest way to postpone the energy crisis is to consume less energy.

There is no question that the U.S.A. is horrendously wasteful of its energy. With five percent of the world's population, it consumes twenty-nine percent of its energy.[2] More to the point, an American consumes at least twice as much energy as a European (except, curiously, for a Luxembourgeon, consuming half that of other Europeans), for a quality of life that some would argue inferior.

If U.S. cars were built to the energy consumption standards of European ones, they would save eighty million tonnes of crude oil per year, twice the annual consumption of China.[1] Detroit is being dragged kicking and screaming into the real world, but it is too little, too late. While useful, eighty million tonnes (which equals 584 million barrels) does not make an enormous dent in U.S. oil imports (see Figure 4).

Big savings could be made in domestic consumption through better insulation and more thought. The best way to encourage this is going to be by fairly hefty price increases for energy. But industry—the biggest energy consumer—is generally fairly efficient in its energy use. It is argued that products should be examined for their benefits and utility. But who is to judge that people are to be thrown out of work for producing unnecessary packaging or whatever? There are no easy answers.

Waste has been institutionalized into American society. It will take time to change that, and time is perhaps our first finite resource. Organizational theorists discuss the inertial factors which hinder adaptation. There are problems of transferring capital investment (e.g., converting oil-fired generating stations to coal, etc.). There are constraints on information flow (M. K. Hubbert accurately predicted the U.S. oil production peak twenty years ago and was derided or ignored). There are the normative restraints generated by history, (the institutionalization of waste, etc.). There are the political constraints inherent in democracy and exaggerated in the U.S.A. with its over-democratic constitution (at least President Carter has tried).

Of course the U.S.A. will cope, although I suspect that its world hegemony will have gone for good. Man has surmounted past resource crises. But never before have so many people with so much capital investment been involved in the need to make resource substitutions. The fact that the U.S.A. is a highly interdependent society, hooked into certain limited resources, makes change much more difficult. That is why a comprehensive national energy plan is required now. As major energy consumers, cities will have an integral part in any such plan.

I am neither architect nor planner. I would like to think that the above information should encourage members of these two professions to think through the implications of the energy crisis for themselves. So my concluding remarks will be brief.

It should go without saying that our starting point is the present. We have our cities, towns, industries, and social organization; the future will necessarily incorporate this heritage. Alternative technology has an emphasis on personal freedom and responsibility delightfully reminiscent of the ideas of Kropotkin, but it will make a negligible contribution towards sustaining life in Paris, Stockholm or New Orleans.[1]

There are two problems. The first is how we convert our present cities to a less energy consumptive state. The second is in what form do we design our new cities. These are separate issues, for I believe that further expansion of our existing conurbations is not desirable, since it will only exacerbate the problem of internal mobility.

I view the so-called right to mobility as a cuckoo's egg laid by the road-transport lobby. People do not really want mobility: they want access to facilities. Gerald Foley suggests that movement could be regarded as an index of disorder, in that it measures the extent to which things are not in the desired relationship to each other! This is a concept basic to the design of kitchens, factories, offices. But for some reason, traffic flowing along a road is seen as demonstrating the need for that road and the cleverness of the traffic planner in providing it. Future U.S. urban planning should be far less reactive, much more willing to take the initiative. The right to mobility should be replaced by the right to what Ralph Knowles has called "close contact diversity."[9]

Lessons might be learned from the older European cities. An immediate end to zoning seems desirable to encourage more uniform dispersal of employment, accommodation and services. Far from being a disaster, I believe this would liberate the terrible suburban compounds which have blighted so many American cities, destroying the sense of urban community and responsibility.

New towns can be designed so as to eliminate most unnecessary journeys. But in older cities public transit will have to be developed. This is going to be a major priority as the middle class use their economic muscle to return to the city centre, forcing the poor into the suburbs: a complete turnabout of traditional white flight. The problem remains that some suburbs are so sprawling that it is questionable whether an economical transit service can ever be provided. It is a political as much as a planning problem.

Bicycles should be encouraged. Cycle lanes completely separate from and better maintained than the road system should be provided after the pattern of Stevenage new town in England. New buildings should incorporate cycle parks, showers and locker rooms. Electronics in the shape of videophones could probably eliminate many business journeys.

There must be an end to the construction of high energy buildings. Most skyscrapers have an indiscriminate design suitable for nowhere. What happens when blackouts and brownouts stop elevators and air-conditioning, and windows will not open?

Buildings and the city layout should once more respond to their environment, as they did traditionally. Ralph Knowles examined the pueblos in New Mexico as energy systems designed to mitigate seasonal variations in insolation, and found remarkable precision in their construction. The fullest benefit was taken of the sun's heat in winter, maximum protection was afforded against its rays in summer.[9]

On the basis of his research, Knowles suggests that urban growth should concentrate on transformation through increasing complexity in the same space, rather than on traditional crude expansion. With increasingly sophisticated computer technology, it seems to me not difficult for architecture and urban design to concentrate on energy conservation as function. I believe it would make for a welcome discipline in the design of cities, and would create its own aesthetic of exigency.

Materials would reflect a conservative ethic. Spatial hierarchies of use and activity would be carefully considered to minimize waste of time, energy, and matter. I think this would provide for a much more positive reactions to criticisms of modern architecture than the rather ineffectual posturings of people such as Charles Jencks.

Gerald Foley's idea of a "high cost energy scenario" is, I think, a useful architectural and planning tool.[1] All energy costs would be multiplied by a factor of ten in real terms. This would not pretend to be a prediction, but it would break through the assumptions and habits of thought conditioned by the conventions of past decades. Urban form and infrastructure and the transport patterns to which these give rise are the determining features of much of urban life. But they are often manifestations of affluence and the easy availability of low-cost energy. A high cost energy scenario would force reappraisal at this level and indicate the direction in which change should be guided.

Yet all this will require a level of planning and control that is anathema to most American politicians. We must have freedom and if that includes the freedom to commit suicide, so be it. Thus most municipal action has been on the level of energy audits of city buildings, retroditting of insulation, purchasing on the basis of life-cycle costing. While admirable in their intent, these measures' effectiveness can only be proportional to the city government's ten percent share of community energy consumption.

A stronger commitment to energy conservation must, as I have indicated, take local government into a wide variety of programs and policies. Davis, California has grasped the nettle of building codes and, by prescribing standards of insulation and permitted areas of glazing, found to have cut energy consumption in new housing by up to fifty percent with an increase in capital cost of some $50 per unit. But Davis is a civilized, liberal, university community. Normally hell hath no fury like a contractor confronted with new building codes.

No city has really faced up to the mobility problem. More than a quarter of energy consumption is in transportation. New York City, for all its faults, is an excellent example of the energy benefits of a concentrated urban area. Whether fiscally irresponsible or not, it is clearly responsible on any ethic of energy conservation. While comprising nine and seven-tenths percent of the U.S. population and disposing of twelve percent of the income, New Yorkers consume only six and four-tenths percent of the energy. Partly this reflects the lack of heavy industry, but it also emphasizes the benefits of density and good urban transportation.[10]

Seattle in many ways has become the energy utopia of the U.S. Faced with the dilemma of taking part in a third nuclear project in Washington State, they estimated future energy demands and opted instead for aggressive conservation measures. Along with insulation standards and other individualized projects, they have recognized the need for a holistic approach. So they are committed to developing high density housing in and around the downtown core, encouraging new housing construction within existing suburban areas on developed land previously ignored in their rush for the country, and limiting the expansion of housing in new suburban areas.[10]

Much of this is opposed to traditional American political ideology and yet, without a political base, comprehensive, integrated energy policies can never be brought into effect. This is a problem for local governments, and can only be solved through debate and discussion, trial and error. It is only such a solid electoral base that permits Davis and Seattle to act effectively. And it will only be with the support of such a nationwide base that the federal government will be able to emulate them in producing a national energy plan.

One final thought. It is impossible to conceive of an energetically ideal city, more so if it is large. A city designed on the principle of minimizing energy consumption would provide no roads or services. The most miserable squatter camp would be the pinnacle of urban design. Clearly there will have to be compromises. I hope that I have sketched out the boundaries within which those compromises will be made.

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