Energy

There are times when an editor's lot is not an easy one. I had developed something of an idée fixé *for an article on energy for this issue. Wouldn't it be a good idea, I thought, to have someone write an assessment of the state of the art as of the early eighties. The author would discuss such things as the present or near-future applicability of wind generators and photovoltaics as well as small-scale hydropower and biofuels. It would help people begin to mull over various forms of renewable energy deciding which could be best adapted for their own use in the next few years.*

Luckily, I have access to quite a few experts. I approached Ty Cashman, Joe Seale, J. Baldwin, and Gary Hirshberg, but for a variety of reasons none of them felt comfortable about complying with my request. I received instead Ty's article, which appears in the New Alchemy section that, based on his own experience, describes the kind of mind set that proceeds attitudinal and social change. From Joe came a profile, or geographic overview, of the country's renewable energy potential—somewhat closer, but still not what I had had in mind. J. presented me with "Autologic," which is included in this section and is about good and bad thinking about technology. Gary turned the assignment over to Greg Watson and Michael Greene, who described the forming of a local energy cooperative.

Once my editorial huff at having my directive sidestepped or ignored had subsided, it began to dawn on me that their response was suitable. The energy question is thorny and complex. (No single shot answers, remember, editor?) It is political and attitudinal and one that will force us to rethink what we really need and want and to do so clearly this time. Mollified, I find myself grateful to my recalcitrant writers. As Amory Lovins concludes his article in the Explorations section, "Using energy to worthy ends for right livelihood is profoundly difficult, and not a technical issue at all."

N.J.T.

Greasing the Windmill

It took Dad and me from afternoon on one day
Until sundown the next
to grease the windmill.

The first afternoon we went to town
for a six-pack of beer.
put the beers into a gunny sack
and hung the sack in the well on clothesline.
The mill above the well looked shorter than forty feet.

The next morning after milking and breakfast
we walked into the pasture.
Dad had an empty bucket to drain the old oil into
and I new oil in a new tin can.

Dad sighed
and started up the ladder,
each foot on a step for five steps,
then both feet on one step for three steps,
and then stood on the eighth step
complaining of dizziness.
He came back down.

It was my turn.
I made it twelve steps up,
one foot on a step but breathing hard,
when Dad called up that I had the new oil.
I had to go back for the empty bucket.

It was harder my second time
and slower with the bucket. The whole mill
shivered in sympathy. I managed only to peek
onto the platform, to lift the empty bucket above
my head with my free hand, and tip the bucket
onto the platform. Then I too was dizzy.
I came down, the old oil
still undrained.

Getting the better of ourselves
proved time-consuming. By now it was
coffee time. In the kitchen we admitted
to Mother that all we had achieved
was an empty bucket
on the platform.

Mother reminded us that my brother Klaas,
now, alas, in service,
used to grease the mill on his way to catch
the school bus,
starting out a half-hour early. And he never
even had a drop
of grease on him at school that day.

Mother reminded us that Gerrit Henry,
Klaas's friend around the corner,
not in service and available,
went up his dad's windmill
with the full can and
the empty can,
drained the old
oil, spread-eagled
himself flat against
the wheel, and had his dad
put the mill in gear. Afterwards
he said it had been better than a
ferris wheel. Running the mill
had got the last drop of oil
out, and he had added new oil
before coming down, all in one trip.
Why couldn't we be like that?
She might as well have said,
"Napoleon:
now there's a hero for you!"

In the pasture after coffee
Dad said, "We'll never make it
without the beer." He had hoped
he could bring the sixpack back to
Doc's Cafe, untouched. The trickle
and then the drip from the gunny sack,
the haul of the cold clothesline, and then
the beer itself, all would have restored us
if we had been thirsty and tired. We were
afraid, not thirsty and tired, and the
beer was our bitter anesthetic.
We needed a bottle apiece
for a full dose.

It was guilt
and not the beer
that got Dad to the top.
He had to prove to himself
that the beer had been necessary.
How explain the beer to God come Judgment
Day if he couldn't show that the beer had helped?
I cheered when he made it: Oranje boven! And I cheered
again when he opened the petcock and drained the old oil out
into the bucket I had delivered earlier at such pain. But his eyes
were bright as brimstone looking down, the guilt still there.
How could he ever know for sure he hadn't faked the fear
to justify the beer? He trembled all the way down,
step by step, rung by rung, the full bucket
tilting ominously as he changed it from
one hand to the other. The wind
whipped spatters over his bib-
overall and cast-off Sunday
tie. I remembered Klaas
greasing the mill,
clean.

After dinner
the windmill had doubled in size
in the full glow of an Iowa afternoon.
Dad and I began with a beer apiece on the ground.
Who knows? If I failed again, he would need to be ready.
Actually, I surprised us both. I scrambled up, poured the oil in,
closed the petcock, and threw the empty tin down. It bounced higher than Dad's
head! What a height, to make a can bounce higher than Dad's head.
Promptly I was paralyzed.
"You done real good," Dad called, "come down."
"Wait till I get a notion," I said, and didn't budge.
"I'll go home for tea without you."
I could no nothing.
"You got a piece of pie coming."
I could do nothing.
"There still are two beers in the well."
I still could do nothing.
"Must we get Gerrit Henry to fetch you down?"
Mention of Gerrit Henry
made me go prone on the platform,
clutch the edge, hunt for the spokes
and undertake my quavering descent.

Then it was tea-time.
Mother poured us tea
but gave us no hero's welcome.

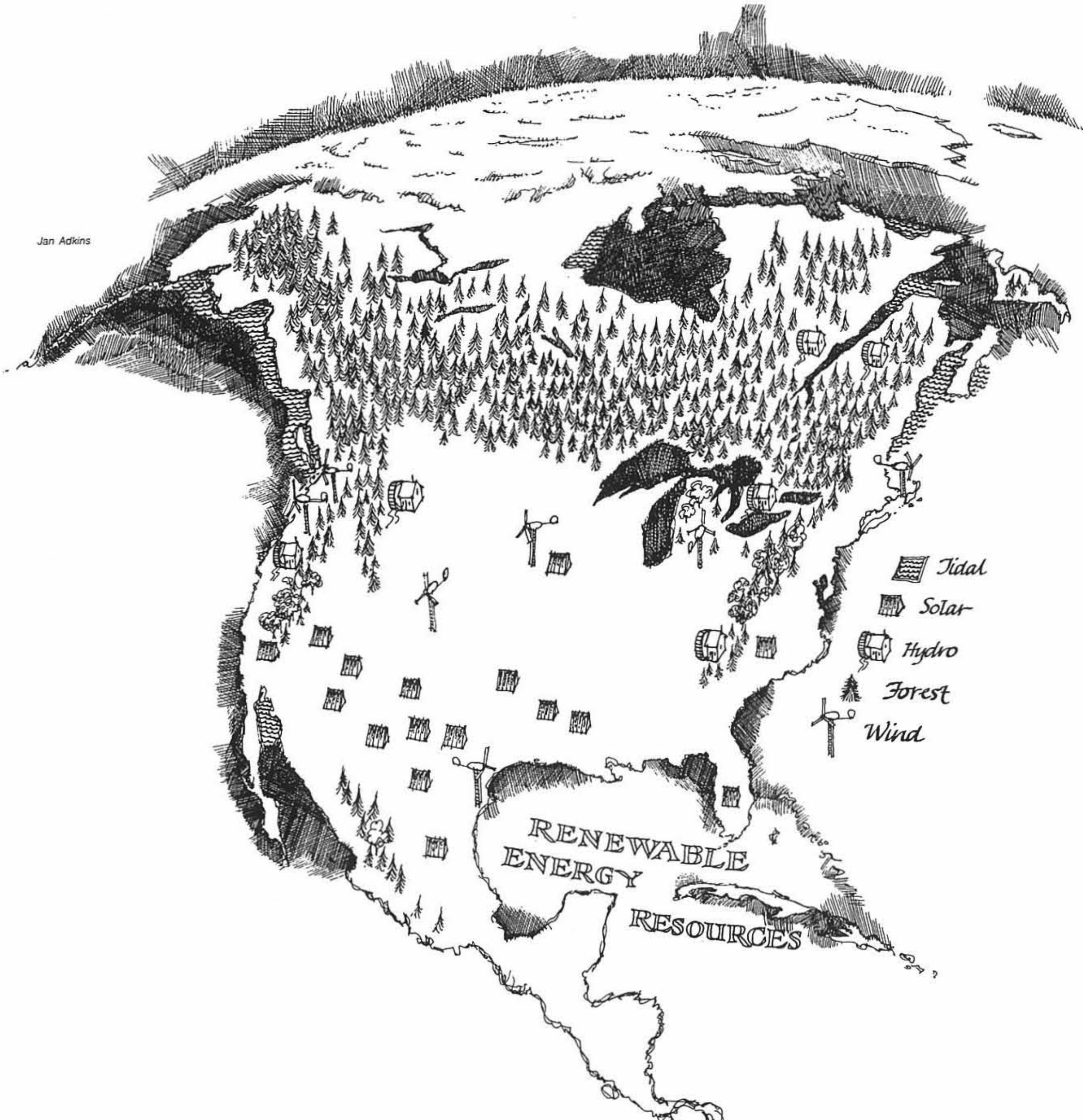
After tea, we did chores,
after chores, we milked,
after milking, we ate supper,
and after supper, Dad remembered the beers.
You couldn't return two beers out of a six-pack to Doc's Cafe.

That beer—
with Dad in twilight
at the mill
all fear gone,
well, as gone as fear ever gets—
that beer is the only beer I have ever enjoyed.

But Mother's diary is too spare for June 11, 1944:
"Dad and Sietze greased the mill today."
If ever I did a day's work, I did it that day.

Sietze Buning June 11, 1944

Jan Adkins



Scale and Diversity in Energy Systems

Joe Seale

It is possible for the energy needs of this country to be supplied by applied solar technologies, if energy sources are matched to specifics of location and end use. The form of solar-derived energy must vary from place to place. Half of the United States lacks decent windpower sites. Both the wind and biofuel potentials of most of Nevada, Utah, Arizona, and New Mexico are poor. The Southeast and southern California have few good windpower sites. Solar energy prospects are poor for the Pacific Northwest, especially near the Pacific coast, as well as for the eastern Great Lakes region extending into Pennsylvania and New York. But few regions lack the capacity for some form of solar-derived energy. The windpower-deficient Southeast and Southwest (in addition to the windy South Central region) have excellent solar potential. Biofuel prospects for the Southeast are favorable. The highest windpower-potential regions in the United States are the darkest corner of the Pacific Northwest, the cloudy eastern Great Lakes region, and the much sunnier coasts of southern New England. The less windy and not-so-sunny stretches of northern New England have forests that could, with good ecosystem management, provide indefinitely renewable biofuel energy for that region. The many hundreds of abandoned mill dams in New England could be outfitted to generate a total of many megawatts of hydropower. The Grand Coulee Dam, now rated at 6,000 megawatts and expandable to 10,000 megawatts within the capabilities of the watershed, could keep Washington state in the ranks of energy exporters.

Hydropower scale is limited by the flow and head available at a site. Because the cost of additional turbine-generators is small once the dam is there, the economics of rising energy costs will cause hydropower sites to be developed to their maximum potential. The scale and locations of good hydropower sites will play a large role in determining village scale and economic activity. The economics that caused mill towns to be built may well return with the depletion of nonrenewable energy resources.

Forest biofuel production per square mile is ultimately limited by the forest's capacity to replace biomass. The energy costs of wood shipment keep the practical radii from forest to generating plant down to a few tens of miles. An area with a 20 mile radius cannot renewably support a net electric power yield greater than approximately 100 megawatts. The income from that scale of operation would support no more than 1,000–2,000 workers engaged in plant upkeep, harvesting, forest management, business, and accounting, etc. Adding worker families and service industry workers and families gives a rough order of magnitude of the size of the community that might derive support from forest energy export: 10,000–20,000 at most. Space heating for the community ideally would come from waste heat. If some export took the form of manufactured goods that used the energy from the power plant and perhaps some of its heat (in a co-generation process), then the potential size of the community supported by forest energy would increase considerably. These figures indicate upper limits, not optimum size. They suggest a significant potential dispersion of population supported by biomass forest income.

In level windy regions, windpower potential can be fairly good at sufficient tower altitude, regardless of location. But the most economically attractive windpower sites will be determined by topographic features: ridges, coastlines, mountain gaps, and accessible mountain tops. These sites will generally not support large arrays of wind turbines, but more frequently a single row of turbines limited to the length of the ridge or the width of the wind gap. It turns out that the maximum power potential for such sites depends on the characteristic length or width of the topographic feature and on the vertical distance swept by rotors over that horizontal span. The implication is that large wind turbines extract more power at prime sites than small turbines when site saturation is achieved. There will be therefore pressure to install the largest practical wind turbines. The most economical scale for wind turbines is subject to debate, but it seems that a rated capacity of 1–3 megawatts is an upper bound beyond which complexity and sheer weight outweigh any further advantages of increased scale. Lest this scale cause some readers to flinch, it is worth recalling that the first megawatt-scale machine to operate (excepting the 1945 Smith-Putnam turbine on Grandpa's Knob, Vermont) was the 2 megawatt turbine that was designed, constructed, and financed almost entirely by students and faculty members of the Danish Technical High School/Junior College at Tvind in the mid seventies.

The examples so far have dealt with maximum scale for solar technologies and have assumed significant economic activity oriented around the energy supply. A more usual energy system for a village would serve the ordinary demands of residences, commercial establishments, and perhaps light industry, but not energy-intensive industries such as metal forging or glass production (from recycled materials or otherwise). The largest quantitative energy demands would be low-temperature thermal end-uses: space and hot water heating, refrigeration and freezing, and possibly air conditioning. Where solar potential was good, heat demands would best be met on a house-by-house basis using passive solar architecture, and trees should be the first defense against heat. If nights are cool, as at high altitudes and in the desert, passive storage of night coolness should be a function of housing design. But two factors may favor neighborhood (or larger) scale thermal systems. The first is existing housing that is difficult to retrofit. The other is regions of poor solar potential or air cooling needs. In these situations, large-scale insulated water tanks could store summer heat and winter cold on a seasonal basis. Hot water could be stored using year-round active solar collection or wind-driven heat pumps. Cold water could be stored using wintertime convective heat exchange to ambient or wind-driven mechanical refrigeration, perhaps with the same device whose other end is generating stored hot water. The advantage of the relatively large scale for seasonal thermal storage is declining cost per unit capacity and an improved surface-to-volume ratio that makes tank insulation relatively more efficient. Diseconomies of scale would arise in the distribution system, though the viable size range for seasonal thermal storage systems could be from 10 families up to a town.

Baseload electricity (electricity that is there when you want it) and energy-storing fuels will become increasingly costly, especially in places where hydropower and biofuels are not local resources. There will be ample incentive to conserve and convert organic wastes into methane or alcohol. Hydrogen from surplus electricity that cannot be stored will find a role in high-quality heat uses such as cooking; it will perhaps even be used in mantle gas lights. Refrigerators that can store ice during electricity surplus periods will find a market in a solar energy economy. But a few energy uses will continue to demand baseload electricity.

To meet baseload demands from local solar (photovoltaic) and wind energies will be difficult. The prospects for storage batteries and fuel cells are not very encouraging. The manufacturing energy costs of storage batteries averaged over their relatively short lifetimes are a discouragingly large fraction of the energy they handle. This makes them dubious prospects for a sustainable solar energy economy. Pumped-water energy storage for hydroelectric recovery is expensive and inefficient, and requires high places to locate storage ponds. Still, pumped-water storage has better prospects than batteries. Flywheel energy storage will mature to provide another alternative, but again a fairly expensive one.

The most likely prospects for baseload electricity in a solar economy are for decentralization of generation combined with interconnection through the existing electric distribution grid. Hydropower plants with sufficient stored-water volume could be fitted with more turbine-generators than average river flow would support and then used intermittently as premium backup energy stations. This would be an excellent complement to wind and solar electricity since no extra pumping equipment or energy conversion by pumping would be required. The energy of the river would simply be stored for short periods. Mathematical studies of windpower statistics are showing that as wind plants are interconnected over large regions, power fluctuations average out and the power source requires much less storage for "firm" power. The role of end-use thermal storage has been emphasized; this leaves a greatly reduced demand for hydropower, and possibly biofuel, backup. But the overall problem of energy supply seems economically soluble only by interconnection of villages, towns, and regions to take advantage of the diversity of their energy technologies. If the utility grid investment were yet to be made, there might be less incentive to create such a network from scratch. But there it is, bigger than we should ever need if we use energy as frugally as we must in order to get along with renewable resources. Only minor distribution branches need be added. Such an interconnected system would not be as vulnerable to disruption as our current system with centralized generation. With predictable hardships, the parts of such a dispersed system could survive without their interconnections.

The Forming of the Cape and Islands Self-Reliance Cooperative

Greg Watson and Michael Greene

Humanity is about to discover
That whatever it needs to do
And knows how to do
It can always afford to do
And that in fact is only
And all it can afford to do
R. Buckminster Fuller

In the eleven years since the birth of New Alchemy, complex processes of societal evolution have triggered some profound shifts in the public consciousness of humanity's relationship with the natural world. Large numbers of individuals have come to realize the importance of confronting issues surrounding our personal, community, and regional patterns of food and energy production and consumption. This growing maturation of environmental awareness is honing some potential (perhaps even inevitable) new directions for New Alchemy as we enter the eighties.

For the past decade the New Alchemists have focused on designing and testing small-scale, ecologically sound food and energy-producing systems that are not dependent on fossil fuels. Early on we were primarily devoted to ascertaining the feasibility of this goal and, in turn, convincing a rather skeptical public of its practicability. Back then there was but a modicum of public interest in our work. Few people were concerned about society's ninety-five percent reliance on our "capital" energy sources. Fewer still believed that an eclectic collection of scientists, artists, and philosophers growing vegetables and raising fish in geodesic domes on Cape Cod were doing much that was even remotely relevant to their lives. Consequently, as far as most people were concerned, there was ample reason to question both the need for and the practicality of our research.

As time passed many of the dangers inherent in energy-intensive strategies that had been adopted to meet our food and energy needs were becoming all too clear. Indeed, the latter part of the seventies seemed a harbinger of doom, with marathon gas lines, water shortages, acid rain, hazardous wastes, Love Canal, and Three Mile Island—to name just a frightening few. As the seventies drew to a close we found that we didn't have to work as hard to convince people that we had little choice but to develop and implement life-support systems that recognized not only the needs of the human community but those of *Gaia*, or the natural world, as well. A most welcome turn of events.

Change, of course, brings about more change. Mutual causality plays as important a role in social process as it does in biological, ecological, and physical interaction. It was only expected that the change in public attitude to meeting energy and food needs that New Alchemy had been instrumental in creating should in turn create a new niche for us in the social fabric.

Society's "back-door" discovery of the divine law of interrelatedness (bury enough chemical wastes in the earth, and sure enough, they'll come back to haunt you) which is the cornerstone of ecology, has inspired a growing interest in what is generally called appropriate technology. The demand for solar collectors, solar hot water systems, windmills, organically grown foods, and so forth, has increased dramatically within recent years, as has the demand for technical assistance and guidance in implementing these systems.

This is the niche that our environmental concioiusness-raising has helped to create: there is a need for community appropriate technologists or in Byron Kunard's words, community-based innovation. To be sure, this is a role quite different from our former one as researchers/educators. It is nonetheless one that many of New Alchemy's supporters are now asking for and expecting us to assist in filling. The time has come, they seem to be saying, for us to put our reputation (and designs) on the line.

New Alchemy's education and outreach programs have accepted this challenge by committing more of the institute's resources to addressing the food and energy needs of the Cape Cod community. During the winter of 1979, along with three other local service agencies we were contacted by the Community Action Committee (CAC) of Cape Cod and asked to take part in planning and implementing a regional food and energy assistance agency for Cape Cod—the Cape and Islands Self-Reliance Cooperative.

The Community Action Committee is the Cape's antipoverty agency. Since its formation in 1965, it has been committed to the Cape's low-income residents. It has been successful in bringing about major changes in housing and health care for the Cape's poor. This work made CAC aware of the burden of rising fuel and food costs on the elderly, unemployed, and underemployed.

Cape Cod and the islands of Martha's Vineyard and Nantucket are at the top of the Massachusetts charts in both fuel and food costs. In many cases, families with annual incomes of less than $7,700 spend up to a quarter of that for heating. Thousands of Cape residents are forced to apply for fuel assistance. Having spent twenty-five percent of their income for fuel, Cape residents face the prospect of going to supermarkets where food prices are at least six percent above the national average.

While government programs such as fuel assistance and food stamps do help many families to meet fuel and food costs, they do next to nothing to lessen the recipients' dependence on fossil fuels, agribusiness, or future assistance. In contrast, the Self-Reliance Cooperative will offer individuals and families opportunities to achieve some measure of self-sufficiency in food and energy, and along with it, some promise of hope and increased dignity.

The goal of the Cape and Islands Self-Reliance Cooperative is to combine the technological expertise and the innovations of New Alchemy, the community organizing experience of the Community Action Committee of Cape Cod, the housing and energy financial counseling of the Housing Assistance Corporation (HAC), the energy auditing and weatherization skills of the Energy Resource Group (ERG) of Martha's Vineyard, and the fishing, farming, and aquaculture expertise of the Wampanog Tribal Councils of Mashpee and Gay Head. This collective organization will provide residents of the Cape and Islands with a vehicle through which they can achieve a measure of food and energy self-reliance and reduce overall regional dependence on fossil fuels. There is a kind of magic involved here called synergy—the increased capability resulting from combining and coordinating the actions of formerly separate individuals and groups with similar goals.

For many of us the Self-Reliance Cooperative offers a unique chance to be at once practical and idealistic. Philosophical ideas such as mutual aid, cooperation, synergy, self-reliance, and nonviolent social change that were in danger of being reduced to rhetoric or clichés have taken concrete meaning in the context of the co-op.

Conceptually the co-op is intended to foster cooperation on at least two levels: between organizations and between individuals and small groups. On an organizational level, each of the agencies brings a unique set of skills. Together they propose to provide a number of direct services to members, who will pay dues on a sliding scale depending on income. These services include:

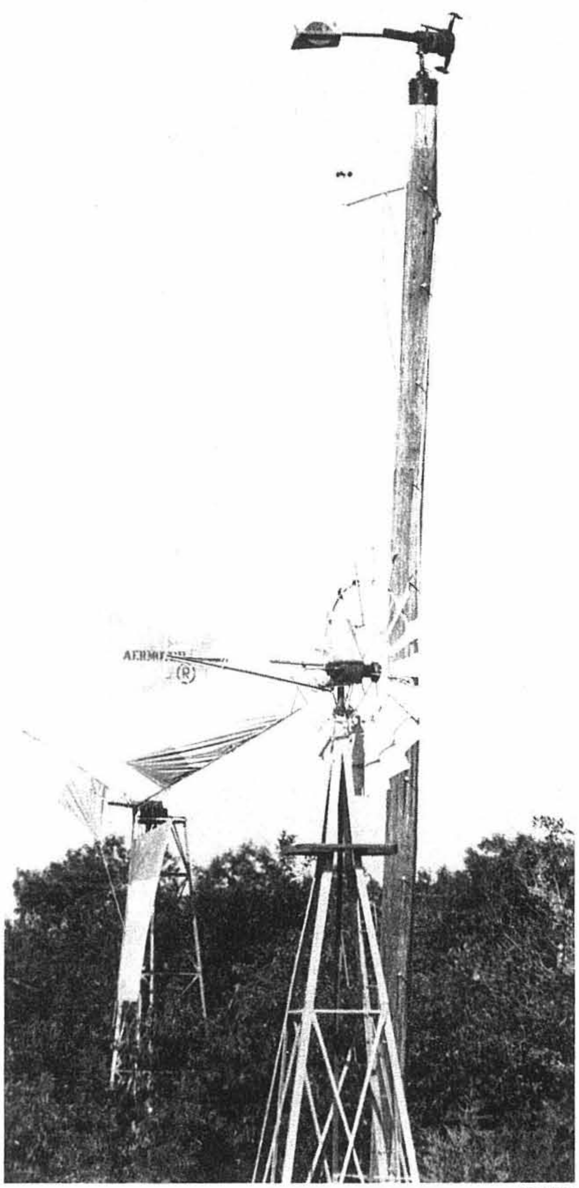
1. Home energy and agricultural audits. This means a complete assessment of each member's house or apartment in terms of energy and water conservation, alternative energy potential, and food growing capabilities.
2. Financial counseling on federal, state, and local loan or grant programs available for weatherization and alternative energy efforts.
3. Discount and wholesale purchasing privileges for conservation, alternative energy, and food production materials and equipment, including insulation, tools, seeds, solar glazings, and so forth.
4. Access to services of home improvement and weatherization contractors at reduced rates.
5. A complete workshop/education program, including on-site courses in the member's house, special forums on subjects such as food production, pest control, energy conservation, and so forth.

The first and perhaps the most important part of the program is the home energy and food audit. Each member will be interviewed by a trained staff person to determine living pattern and financial status, evaluate space heating and domestic hot water, inspect and analyze the residence from basement to attic, and appraise general site conditions and potential for alternative energy production and intensive small-scale agriculture.

The audit will give detailed information on present energy use and the economics of energy and food-related home improvements. It will estimate the cost, first-year savings, payback, and rate of return for each applicable energy conservation, renewable resource, or food-production step. Each suggested strategy will be presented within the context of available financing.

The audit will provide the basis for a member's personal plan to improve the operating efficiency of his or her home and to begin to develop a home energy and food-production system.

The plan will identify a range of possibilities based upon cost-effectiveness and potential payback. Products and materials including solar glazings, wood stoves and stove pipe, solar water heaters, seeds, garden tools, compost starters, and so forth, will be available through the co-op at reduced prices. The co-op will offer training and instruction to members interested in their own home food and energy projects or will arrange for construction at preferential rates by contractors experienced in appropriate technologies.



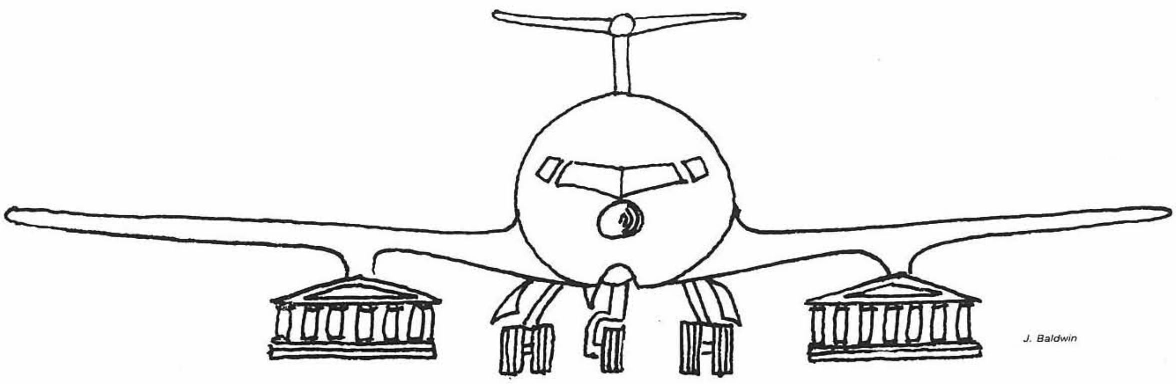
Ron Zweig

The co-op expects to be of service to about two thousand Cape and Islands residents. Membership will be open, although special emphasis will be placed on recruiting low-income families. The membership will be encouraged to interact and cooperate in part through community networks that the co-op will assist in facilitating. Establishing a community network is critical to the success of the co-op, as we realize that many of the skills and resources needed to effect a shift to self-reliance exist already in our neighborhoods and communities.

Whereas the community network might appear the least tangible of the co-op's goals, it is critical in that it speaks to and demonstrates those values that must complement our technologies whether we are aware of it or not.

Initially, New Alchemy's role will be to train future co-op staff in specific technical areas. We are beginning an apprenticeship program for co-op trainees in which they will: (1) gain skills and knowledge in intensive agriculture, aquaculture, tree crops, solar, wind, and energy conservation by working with us for a full year; and (2) simultaneously assist local residents who require help in their particular interest areas. Thus, we shall be developing a professional staff who possess useful skills and are available to apply their knowledge to residential situations. New Alchemy will be conducting the initial food and fuel audits offering a comprehensive yearlong program of seminars.

We are very excited about the co-op. In our minds it is a logical outgrowth of nearly eleven years of work and the beginning of a valued and hoped for partnership. The new cooperative will enable us to continue our research efforts while providing technical assistance to those who need it now.



Autologic

J. Baldwin

Here comes the Parthenon! It's whizzing down the road on the nose of what is supposed to be the finest car built, a Rolls Royce. The finest automobile made today shoves a chrome-plated model of a Greek temple through the air and pays about ten miles per gallon to do so. "Built like a Rolls," we say. Countless manufactured items are compared to the Rolls. This hurtling place of worship is but one minor example of what I call *autologic*, a way of thinking that makes sense only if many realities are ignored and only if you are selling cars. The Greek facade calls up a "classic" image. Lesser cars call up an expensive image by resembling the Rolls or other expensive cars. Thus we see most cars sporting ludicrously unaerodynamic, gas-eating styling that now has implications as a threat to national security. Yet the shape of cars is not questioned in popular media, and government regulations ignore styling as well as other essentials of the automobile.

The way that cars are designed and integrated into our society seems to be the result of some irrefutable natural law. Cars are so convenient. They work. There's an irresistible magic in being able to go where you want when you want. It's all so easy that there doesn't seem to be any reason to question the phenomenon. Question-raisers are also greeted with less than enthusiasm politically. There's good reason for that too; about half of American paychecks come from some sort of involvement with the automobile. The economy of our nation rests largely on the auto and its "accessories" such as roads, bridges, parking lots, signs, fuel, repair, shelter, administration, the auto-caused damage industry (hospitals, body shops, and insurance), parking meters, meter maids and their scooters, unions, retirement plans, scooter mechanics (and their unions, etc.) . . . if you carry things all the way back to the raw materials you can see how pervasive the car has become to our nation's smooth operation. Even car-haters have become so entangled in autologic that rational criticism becomes difficult and academic analysis subject to severe distortions arising mostly from unsystematic examination of one small facet of a very complex matter.

Distortions of reality should not be too surprising considering the character of the industry involved. Generally speaking, the auto industry isn't too much different from others; the idea is to make a profit. But to make that profit, Detroit has to sell cars in large numbers. In a good year three cars are made for each child born. Because cars have so many parts, and the parts come from so many sources, about a three-year lead time is necessary to get a new model into the showroom. A completely new model may require an entirely new factory. A recent front-wheel-drive compact was developed at a cost well over a billion dollars. Obviously, more profits can be made if the new model is not, in fact, new, but only seems that way.

Another ploy is to make the same car but with different nameplates at various levels of prestige. A cheap car gussied up to sell at a higher price brings in more profit. Prestige is mostly due to advertised image anyway. Remember the uproar when Olds owners discovered their cars had Chevy engines? That's nothing new! Anyway, to make a model seem new or more expensive, the selling points cannot be the parts that are not new, the expensive parts. Consequently, you see very little in advertising that refers to engines, axles, brakes, steering, and roadholding. What you do see is "features." These tend to be fluff such as speeding temples, dashboard change bins, hidden headlights, and black vinyl roofs that make it necessary to run the air conditioning on mild days. Features tend to be added on rather than part of a concept. (Mechanical concept, that is . . . they certainly are part of marketing concepts.)

To generate the needed mass market, the features are heavily advertised as if they were important. The vital parts are not mentioned and consequently the public is never usefully educated. The public doesn't know enough to demand better brakes, for instance. Thus there is no incentive to develop good brakes, and you can still buy cars that cannot be stopped fast in a straight line. People assume that such things as brakes are automatically taken care of by the engineers, much in the same way one expects a Winchester to refrain from exploding in one's face. Not so in the auto industry. Brakes could be extolled as a sales feature, of course, but market surveys have shown that such talk makes people think about safety and accidents, and that does not lead to a buying mood. In this way, essential issues are masked. About fifty thousand people are killed every year in cars in the U.S.A. and not much is done about it despite studies showing that each death costs society nearly two hundred thousand dollars in lost wages and work. (Grief isn't measured.) In the eyes of many designers, "safety features" as they are known, are optional or hated add-ons mandated by excessive government regulation.

Other issues are masked too. The whole pollution controversy is one, and I'll not belabor it here except to say that there is more than corporate malice involved in the industry's attempt to discourage improvement except under duress. Not only does the pollution issue require an admission of corporate social responsibility, it requires expensive tooling for parts that can't be featured on the sales floor.

There's a mask on the actual costs of running a car too. Hertz has come up with figures so high they are hard to believe—up to forty cents per mile. But even that price doesn't cover the less-obvious costs such as repairing the hole in your driveway, and doesn't admit social costs such as the physical damage and work-hours lost from accidents. "Life-cycle costs," the long-range total costs of owning a machine, are not available. I recently retired my trusty Citroen at three hundred thousand miles without an overhaul. At an extraordinarily low nine cents per mile overall, it still comes to about thirty thousand dollars! It's not exactly a conspiracy, but it is hard to come up with this sort of information. User costs could be cut by better fuel economy and easier repairability, but at the expense of the formidable oil industry and the repair trade. Comparative costs of repair could be compiled from flat-rate repair rate books and parts price sheets, but even Consumer's Union doesn't attempt such a complex task. It'd be futile anyway; new cars are less and less repairable by owners with common tools.

Giving little thought to making cars easy to fix is typical of an industry that gives little thought to human beings except in their role as buyers. Most cars have poorly shaped seats designed to look good in the showroom. Those seats allegedly fit ninety-nine percent of the customers. That sounds fine until you figure that with an annual production of six million cars there are tens of thousands of cars with uncomfortable drivers. Sharp trunk-lid corners menace unsuspecting heads. Irritating reflections of the radio speaker mar the view through an often optically distorted windshield. More seriously, many cars become uncontrollable when they encounter a soft shoulder. The remedy for this has been known for decades, and being a matter of geometry, it doesn't cost anything. Yet millions of cars are made every year with this potential for disaster built in.

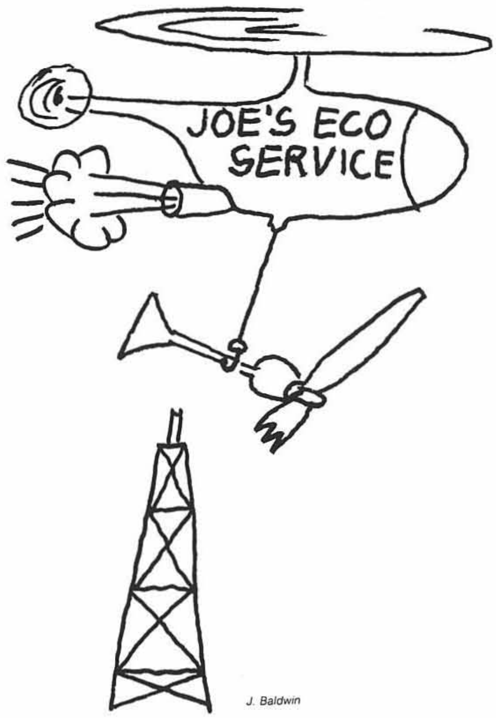
How can this happen?

One reason is that cars are designed by teams that may not have similar goals. The people designing steering systems don't talk to safety engineers. The result is steering mechanisms that can spear the driver in a crash. The autological answer to this problem has been to add on an expensive complex "feature"—the collapsing steering column—only after being forced to by legislation. By contrast, many European cars do not need a collapsing column because the steering engineers had safety in mind from the beginning and designed systems that didn't have parts that threatened the driver in the first place.

Even when Detroit designers are trying to do their best, years of autologic paralyzes clear thought. Consider the Jeep, a supposed all-terrain vehicle. In concept a Jeep is but a small conventional pickup with the front axle driven too. It clears the ground by the same distance as a Buick, although it appears to be up there out of harm's way. It sinks in mud and doesn't float in water. The belly is a tangled mess of parts that catch on things that mire the vehicle. Vital parts are exposed to damage from stones, and critical components are difficult to repair in the field. The Jeep's length is less than half loadspace, and it is inordinately heavy at no gain in strength. It is easily overturned. Not a very good show! It doesn't last long either. Similar ineptitude may be found in the design of tacked-on smog equipment and sadly (some say criminally) ineffective safety hardware.

The lifespan of a vehicle is another autological fact of life that we have come to accept without much question. We've been trained to agree that a car lasts around one hundred thousand miles. This is not a law of nature, but is carefully engineered. The subject of planned obsolescence here rears its ugly head. The hundred-thousand-mile lifespan is arbitrary, and the manner in which the car deteriorates is purposefully chosen. On most cars such things as seats, door latches, and window mechanisms are designed to live just until the payments are finished. The engine and transmission are better because if they failed early, you'd never buy another of that brand. But a tacky interior is shameful when transporting friends, and is a considerable incentive to buy a new car. Many new cars have styling details made from plastic that is eaten by sunlight, resulting in a tacky exterior as well. Time for a new one! In this day of growing concern for resource depletion, such an attitude is no longer appropriate, but in an industry with a captive market (our country has been built in a way that requires a car in most circumstances) changing that attitude may mean even more legislation or other coercive action. A voluntary change seems unlikely.

Unfortunately, the problem goes far beyond the auto industry. It is my opinion as a designer that autologic has invaded all but a few enterprises, and is actually taught, by implication, in our universities. In times of cheap energy, the only recognized standard of performance is market performance. Catering to the demands of the consumer is what I call a political matter—that is, the constraints are largely a question of psychology. Market psychology is not "natural," as the buying public is manipulated by advertising aimed at maintaining the necessary mass demand for the product that must be mass produced in order to remain affordable to Mr. and Mrs. Front Porch. In effect, the public is told what it desires—mostly, as has already been pointed out, the unimportant sales features. Until recently such desires were easily satisfied. But when energy efficiency is a factor, there are different masters to satisfy: physical laws and the realities of resource supply. A primary concern with physical law does make a difference in the quality of design. Compare the auto and the airplane. As inventions they are about the same age, but look at the difference in the state of their development. The most modern Ford is conceptually only a Model T with a fatter body and detail improvements, while the latest Boeing is a far cry from the Wright brothers' Flyer. Airplanes must first and foremost fly reliably. If one fails, you can't get out and walk. Automobiles permit all manner of engineering carelessness as long as they go, stop, and within acceptable limits refrain from overturning—those limits being incestuously provided by the industry itself. However, the limits of resource management, the accumulative effects of pollution, and the political effects of inefficiency are not amenable to self-regulation. The auto makers and users are in trouble at last. They are not the only ones.



Regrettably some of the problem industries are ones close to our hearts—the soft technologies. Wind machines are an example. They must live outdoors without much maintenance under the worst possible conditions. Ice, lightning, hail, salt air, hurricanes, and inattention must all be accommodated in the design. Easy maintenance (or none) is essential to long life, and long life is not an arbitrary figure in this case. For if the machine doesn't last long enough to at least pay for itself, it isn't worth buying in the first place. And, more important, if the machine doesn't last long enough to make or save more energy than was used to make it, then it is in effect one more fossil fuel device. Yet I see all too many machines on the market with aluminum parts fastened with steel rivets, a practice sure to cause early failure from galvanic corrosion. I see machines that must be taken down from the pole for the most simple service. I talk to the president of a (still-respected) wind turbine company and he tells me that their machines must be completely dismantled every two years to replace the many swivel joints that are totally unprotected from weather and are undersized to begin with. I note with alarm the popular Windcharger with its governor mechanism built without bushings, so that the bolts soon wear egg-shaped holes and the speed regulation deteriorates to disaster. Bushings would have added at most twenty-five dollars to the retail cost of that six-hundred-dollar product.

In fairness, there are some well-designed wind turbines, but not many, and there is a deplorable tendency to design machines that have high output in high winds, a condition that is uncommon. The big numbers look well in a brochure though, especially to a public used to reading biggest-is-best in auto advertising. There is also very little research visible (and even fewer results) concerning the design of efficient devices that use windpower, despite the obvious benefits to be gained by systemic design. There are a lot of disillusioned wind machine purchasers out there if my mailbag is any indication. Apparently many wind machine manufacturers are using the public as a test program, another Detroit tactic. This practice is giving a fledgling industry a bad name that it can ill afford, for its market is not captive.

The same can be said for solar energy devices and architectural schemes. A shocking number of solar collectors are made in a way that is ignorantly and sometimes deliberately intended to require expensive repair or replacement before the device has paid for itself either in money or energy. Even reputable firms are shy about warranties extending into the payback period. And just as there has been little work done to reduce the need for electricity and consequently the need for electricity-making equipment, there has not been much done to reduce the need for solar collectors and the like. People seem to desire "things." A passive home that doesn't sport visible hardware on the roof somehow is not as appealing to an uneducated buyer. The principal passive work has thus been done by nonindustrial builders and experimenters whose "product" is an idea, rather than something that comes in a box. There has been some resistance to passive houses in many subtle forms, even overt disparagement from industry and from government as well, as a result of lobbying. I have attended government-sponsored "solar workshops" in which passive designs were derided openly as impractical when there were at least fifty successful passive houses operating within a half-hour drive of the lecture hall.

Though not the only guilty group, the auto industry has tended to be at the forefront of such shenanigans, and its enormous advertising budget spreads its attitude. (Witness the recent reduction in federal gas mileage standards in the same week as a supply-threatening Middle East war!) It's easy to see autologic in household appliances, but the house itself is harder to analyze. Regrettably, the expensive and tasteful houses many of us call "nice," are as much energy pigs as tract homes, apartments, and mobile homes. I call them Buick Houses, referring to Buick's long tradition of "giving you a lotta car for the money." It's hard to think about your house, isn't it? Have you ever thought that a separate bedroom might be silly for your needs? It sits there eating energy and mortgage payments but is used only one-third of the time—the rest of the day IT sleeps. There is a tendency to make your house a showplace of your belongings and mementos. The trend toward fake period furniture (molded from highly dangerous urethane foam) gives the illusion of expensive pieces, but it's not the real thing, just as autologic has photographs of wood glued to the dashboard in a Chevy. In a twenty-thousand-dollar Cadillac, you get more fake wood instead of the real thing, never mind the inappropriateness of wood in a car in the first place. In northern Europe there are many highly satisfactory houses—for our familes of four—of about six hundred square feet. That's practically a closet by our standards. Being big and showy is becoming expensive to run in a house just as it is in a car. Attempts to render a huge house acceptable environmentally by adding a solar hot water heater and insulation is rather like retrofitting a Buick with a Briggs & Stratton—you may save some fuel, but the real problems are still there. It's time we rewarded designs that are less wasteful. More with less. I like Bucky Fuller's term *ephmeralization.*

A more insidious product of autologic may be seen in the bicycle business. Bicycles make a lot of sense as soft-tech. A person on a bike represents the most efficient means of transport known, exceeding even such a natural system as a running deer. The average auto trip is less than ten miles at an average speed of less than fifteen miles per hour, with a load statistically less than two people. That's bike talk. Then why are more bikes not used for commuting and other chores? Yes, there are questions of weather and safety. The weather we can't help, but safety questions arise from two sources. The first is that bikes are not accorded public funds to accommodate their needs. "Cars first" is another example of autologic. Second is that the bikes themselves are not very well designed for everyday use. The typical ten-speed, the most common type, is ill-suited to conditions met every day. It's fragile, easily stolen, difficult to store, park, and take on public transport. Its vital parts are heartlessly exposed to the elements, and many parts are made from materials that cannot withstand the assault of something as common as sunlight. Tires are easily popped by running over seeds and the inevitable glass crumbs. The lack of suspension is not only uncomfortable, but is unsafe on the rough edges of the road where bikes are most often used. Brakes don't work in the wet. All in all not a means of everyday transport for someone who might be dismissed for being late. The ten-speed is unsuitable largely because it is a weak imitation of a racing machine instead of being a strong statement of utility. The auto equivalents of the ten-speed, the pseudoracers like Camaro and Mustang, are among the least-useful cars. The thinking behind all these is the same. Sell dreams instead of elegant, useful, economical transport. Things need not be dowdy either. The idea that workday transportation has to be crude and ugly is also autologic intended to encourage the sales of luxury models. There was a time when selling illusions made good market sense even if it didn't mean a high degree of usefulness. But now that the energy and resource crunch is upon us, such frittermindedness is not only folly, it isn't even good business.

So what do we do about it? Well, it looks as if the American public is beginning to see what's going on, if only at a glimpse. Fat cars are not selling. Sale of insulation is booming. I think banks should give loans on solar houses only; in twenty years fossil-fueled housing may not be worth very much as collateral. Specification building codes should give way to performance codes. Five-dollar-per-gallon gasoline would do more for auto design than any number of government regulations. These are easily made changes—merely paperwork, but they could have a great impact.

Lastly, we have a responsibility to become increasingly critical. Those of us who know about net energy must be really tough when we propose another piece of hardware, regardless of the righteousness of the concept. We have to think in terms of whole systems instead of components. We must encourage people to look at life-cycle costs of technology, both economic and energetic, and we should pressure lending institutions to take this into account. But most of all we should look into our own minds to see how much of what we consider "reasonable" actually is so. The best antidote to autologic is to make everything you do a demonstration of clear thought.

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