DOC 1

70's

ABSTRACT OF PROPOSAL TO BUILD AN ECOTECTURAL HOUSE

Sim Van der Ryn
November 1972

All the evidence indicates that within the next generation we must design and live more in harmony with the earth's finite resources, or an exhausted, ravished and depleted earth will no longer support human life.

One cannot escape the statistic that America, with 6% of the world's population, uses 35% of the world's energy. Our high standard of living is dependent upon an ecological suicide technology. Our privileged status can be maintained only at the expense of the rest of the peoples of the world. The hopes of enlightened technocracy have not come true. The standard of living of the poorer non-industrial nations is failing in absolute terms. Gross national product in industrialized nations continues to rise, but it seems as though the quality of life is falling. The scenarios seem clear. The present imbalance between materially rich and poor can only be maintained through a mighty war establishment in the industrial nations. But this military and technological might contains the seeds of a fatal weakness: its insatiable and non-regenerative appetite for resources including people. Earth nature, human nature is rebelling.

Improving the education of technicians with regard to energy and its conservation necessarily involves consciousness in the feeling and spiritual sense in addition to intellectual knowledge and technique. One without the other is little learning at all. The most damaging aspect of technical education is the development of an attitude of confidence that all conditions in the world are "problems" that can be "solved."

The problem of energy conservation is not a problem that can be solved in any technical sense. Energy sources, patterns of consumption, distribution and disposal ultimately reflect our values about ourselves and the world around us. Future techniques of energy consumption -- if they are to be significant -- will probably involve major changes in patterns of consumption and life style. Improvements in the design of buildings through better insulating materials, total energy systems, etc, are not likely to affect the present exponential growth in energy consumption.

Design for energy consumption is as much a redesigning of intent as it is of hardware and techniques. I don't believe in the engineering of human values. Yet, in developing a house for ecologically sound living, it is clear that many of its features will be strange to the way most Americans now live.

Resources could be saved and community life improved if, instead of each household having the complete spectrum of bathing, laundering and cooking facilities, these devices were shared among a cluster of homes. Prominent social scientists, including the anthropologist Margaret Mead have suggested that the isolated American nuclear family, materially secure in its well-equipped house, in itself is dysfunctional, and suggest extended and communal family forms as likely to replace nuclear families in the future.

So we do not propose the autonomous dwelling unit as the solution for the future, but rather as a unique laboratory to study and become aware of the pattern of energy use, its inputs and outputs. It seems to me that present wasteful patterns of consumption and disposal are themselves rooted in our ignorance of where energy comes from, and where waste goes. The average layman, and the average architectural student, knows that electricity comes out of the wire, water out of the tap, piping and garbage men carry away waste.

Our dependence on highly centralized public and quasi-public agencies to produce, transmit, distribute and dispose of energy, water and sanitary waste -- not to mention food energy -- means that to the individual, where the juice comes from is somebody else's problem, like everything else. Our whole approach to the energy crisis should be to design for individual responsibility and control.

I see no paradox in a mass urban society to returning to the democratic ideal of design for individual responsibility. Indeed, our social and material survival and health depend on it, as massive technocratic institutions prove themselves unable to meet the crisis.

The concept of a habitat that tends toward autonomy, maximizing the use of resources within its own system in order to maintain itself and its inhabitants has captured our imagination since Robinson Crusoe, receiving new impetus from the space program and the renewed sense of ecological awareness. Some may see it as an escapist vision, a rejection of the overwhelming collectivism and interdependencies that are at the heart of a high consumption urban technocratic society, seemingly insulated from natural forces.

We do not reject either cities or technology. Yet an insidious aspect of modern urban life is to disconnect our actions from their effects, so that we become insulated from nature, from others, and finally from ourselves. The idea of ecotecture is to design in terms of the smallest coherent system, so that we become aware and thus responsible for the effects of our actions. The design, construction and use of a house that tends towards autonomy in its life support is not offered as a panacea to problems of housing, life style or system, but may help us experience what Stewart Brand of the Whole Earth Catalogue defines as the basic principles of design:

> "Everything is connected to everything else.
> Everything has to go somewhere.
> There's no such thing as a free lunch."

Discussion of General Systems

A. Space Heating and Cooling

About 25% of all forms of energy consumed in the U.S. is used in the home, and half of this energy goes into heating and cooling.[1]

1. Energy Conservation Through Natural Design
An important way to reduce energy consumption in home heating and cooling is by understanding and paying attention to micro-climate in designing and locating the dwelling and in the intelligent use of building materials. During the forties and fifties, there was a surge of architecturally-based research on climate design resulting in many excellent publications. It appears that at many architectural schools, the 60's concern to jump on the bandwagon of "urban problems" and "systems design" dulled sensitivities. The architectural and engineering professions and the schools of architecture seem to take it for granted that "environmental control" means mechanical control rather than full exploration of natural means of adapting building to climate.

2. Alternate Energy for Space Heating and Cooling: Solar Energy
Over 99% of all available energy on earth comes from the sun. The direct conversion of solar energy offers the greatest potential for reducing reliance on the centralized distribution of fossil fuels for heating and cooling. On a sunny, cold January day, the average Pittsburgh house need capture only a quarter of to solar energy radiated directly on it in order to maintain a comfortable temperature.[2]

   Over the past 30 years, many experiments and applications of solar space and water heating have taken place. In Israel, Japan and parts of Florida, roof-mounted solar collectors have been used for years to heat water supplying household needs. Numerous individuals and institutions have constructed solar houses.

   The cost of solar heating systems is offset by the minimal or zero cost of operation. At the present rate structure for fossil fuels, it may take 20 years or more for a solar system to pay for itself. However, this equation is likely to hold true only in the short run, as the price of natural gas and other fuels is rising steeply (40-60% in the six months June 1973-January 1974.) In a recent conversation, Steve Baer, an engineer, inventor, and builder (author of Domecookbook and inventor of Zomes) explained that when dealing with a "free" commodity such as

---

1. See Scientific American, September 1971, "Energy Issue" for very graphic picture of U.S. energy flows.
2. Calculated for an average radiation of 737 BTU/sq. ft. on a 25x35 sq. ft. house, with a heat loss of 400,000 BTU/day.

the sun, low efficiency was not a handicap, particularly when it permitted low cost, low maintenance designs, incorporating commonly available and "junk" materials. For example, his recently completed solar house incorporates a solar wall of standard 50-gallon drums filled with water. The specific heat of water permits solar absorption during the day without a large increase of dry bulb temperature inside. At night, the heat is dissapated into the room. The amount of absorption is controlled by manually operated sun shades in front of the water barrels. Baer's system is designated for the Southwest, but similar principles apply elsewhere.

The cost and efficiency of individual solar household space heating units needs to be compared against the actual costs -- economic, social and environmental -- of conventional systems and the energy network required to supply fuel. In the production of electrical energy from fossil fuels, two thirds of the potential energy is lost in the generating plant and in transmission to consumers. Moreover, energy and dollars are required to extract, process, transport and refine conventional fuels, whether natural gas, petroleum, coal or uranium. Generating plants and distribution systems require huge capital investments and require lots of land.[1]

Then there are the very real social and environmental costs inherent in large-scale energy production: air pollution, thermal pollution, destruction of the environment (Four Corners, Storm King, Morro Bay, etc.) and the existence of large unresponsive supra-states -- the energy suppliers and the captive consuming public. The dream of capturing solar energy directly within the individual dwelling is a necessity.

B. Water, Waste and Nutrient Recycling

The need for alternatives to present systems of waste disposal is every bit as great as the need for alternatives to present sources of energy production and distribution. Some wise man defined "waste" as a "misplaced resource." Certainly nothing could be truer of sewage and other organic wastes. More often than not, these systems have resulted in the destruction of marine and plant life in our oceans and streams, and the pollution of neighboring water supply. Tom Lehrer's song "Pollution" puts it succinctly: "The toilet water you flush today, someone drinks tomorrow in San Jose." The paradox is that these "wastes" which become somebody else's problems, are rich in the very nutrients that are needed for photosynthesis. The develop-

---

I. Architect Richard Stein estimates that the projected U.S. quadrupling of electrical energy consumption and production will require an additional 4,700 square miles -- an area equal to the state of Connecticut -- for the location of power plants and transmission lines.

ment of modern sewage disposal, including Mr. Crapper's invention of mass-produced ceramic water closets, remains one of the great cultural aberrations of Western Man. For thousands of years, oriental cultures have returned "night soil" back to enrich the earth with negligible negative consequences for public health. Western man developed more haphazardly, dumping waste in odorous open public ditches and perhaps justifiably out of this experience, the Victorian distaste for the human body and its products was born. Its hygiene is still largely with us, in egaggerated technological form. (I noted with some amusement some years back that a major piece of architectural research, "The Bathroom," by Alex Kirk of Cornell, while providing a full and exhaustive synopsis of the phenomenon (including detailed descriptions of excreta), never seriously considered alternatives to the flush toilet as a means of "disposing" of human waste, and even went so far as to blank out the faces of subjects (clad in bathing suits) who were photographed showering and bathing in Cornell's experimental bathroom. To protect the innocent, I suppose.

1. <u>Composting human and organic waste</u>
   In recent years, largely through the efforts of the Rodale family and their publications, organic farming based on returning organic nutrients to the soil is enjoying a growing acceptance in this country. The energy base of organic farming is composting: the bacterial decomposition of organic materials -- by-products of garden, farm and kitchen -- and their return to the soil. Human waste can be composted in much the same manner as other organic materials to produce a swett-smelling disease-free humus, rich in nutrients. The Lindstrom brothers, Swedish engineers, developed the patented CLIVUS system for the aerobic decomposition of human and organic wastes. Aerobic decomposition uses bacteria that consume oxygen (as contrasted with anerobic decomposition which we will discuss later) and is characterized by the lack of objectionable odors connected with the decomposition process. The CLIVUS system differs from the aerobic treatment processes used by modern sewage treatment plants in that no mechanical means - such as spraying and aeration -- are used to induce aerobic decomposition. The system consists of a fibreglass tank connecting to the stool and garbage chute and equipped with dampers, air vents, etc. No water is introduced, and the system used by a family of five produces approximately two cubic feet of odorless humus per year. Several thousand units are in operation in Sweden where the unit has the full approval of the government public health authorities.

2. <u>Methane production from human and organic waste</u>
   Besides nutrients that can be returned to the soil, the decomposition of organic wastes can produce methane gas. It has been estimated that all U.S. organic waste -- some 1.5 billion tons annually (much of it from cattle and other domesticated animals) could yield enough methane to supply half of our total energy needs (3×10^{16} BTU). The production of methane requires digestion

chambers in which organic wastes decompose anerobically, without oxygen. The methane is then siphoned off into pressure tanks. At present, there are two drawbacks to the household production of methane. The average household doesn't produce enough organic waste to produce significant amounts of methane. A pound of waste yields about a cubic foot of methane. Thus, in the average household, waste might yield enough methane for cooking purposes.

3. Grey water recycling/water conservation
Many American cities, particularly in the West, are located in areas that do not average 20 inches of rainfall a year. Ecologically speaking, Los Angeles, Phoenix, etc., are deserts. Many other American cities must import water over great distances. Much of the urban East, traditionally rich in water, has polluted and drained its watersheds and water tables, limiting sources and supply of potable water. Yet the average American uses 16 million tons of water in his lifetime, and the figure is going up. Today, water is one of our cheapest resources, costing on the average about 5¢ a ton delivered to the faucet. Most Americans are ignorant of the extremely complex ecological and technological systems that permit him to turn on the tap. In fact, most people's experience of water starts at the faucet and ends at the drain.

The design of an ecotectural house can easily reduce the average 80-100 gal./person/day consumption by half or more. The water closet alone accounts for half of total water consumption. We have already discussed the irrationality of using 100 parts of water to flush one part of waste, spending huge sums to collect it, "treat" it, and dumping it back into water supplies. Thus, a major aspect of water conservation is the elimination of the flush toilet. The other major aspect of water conservation is the recycling of "grey" water -- waste water from sinks and baths, for use in food and nutrient production within the household.

There are many other devices and techniques for water conservation, including rain water catchment, low water consumption bathing, showers using fog sprays, (water that has been aerated and pressurized), vacuum toilets, etc., which should be considered.

C. Food Production: Energy Flows in Agriculture

The centralized production of food is an energy sink. It takes about 8 calories to grow, process, distribute, and prepare food with an energy value of 1 calorie. And this doesn't count the soil depletion and pollution caused by agri-business.

The aphorism "waste is a misplaced resource" is particularly applicable to the American situation in which gigantic volumes of organic waste pollute the land and water while agricultural lands are fertilized with chemicals producing tremendous pollution, yet the disposal of the wastes, the purchase of agricultural chemicals and the pollution resulting from both processes costs billions.

We return to the principle of designing the smallest coherent system. Human wastes are rich in phosphates and nitrates that are the basic foods for protein rich algaes. Even sewage which has been subject to modern primary and secondary treatment is so rich in these nutrients that, discharged into fresh water, they cause algae "blooms" and resulting eutrophication. These nutrients cause multiplication of algae to the extent that the available oxygen in the water is removed and all life, including the algae, dies.

At least one municipal sanitary district (Tiburon, California) has constructed a pilot plant[1] to purify sanitary waste while producing protein-rich algae. Several researchers are experimenting with translating this technology to household scale purifiers, which could allow waste waters to be reused as potable water while producing algae and other byproducts to be used as fertilizers for household greenhouses.[2]

In addition to algae production, water purification and the creation of rich byproducts for use in the garden, this cycle is also being used experimentally to raise fish. Carp thrive on an algae-rich diet. At least one municipal utility district (Bolinas, California) is experimenting with aquaculture in its sewage ponds, and the magazine Organic Gardening and Farming, together with the New Alchemy Institute of Woods Hole, Massachusetts, is conducting a number of aquaculture experiments at the household scale.[3]

The greenhouse is the oldest and most proven way of growing food under controlled conditions. Our proposed house would include a greenhouse using one or more of the techniques discussed above, perhaps in combination of hydroponic growing, in which plants are raised in an inert medium such as vermiculite, together with water and nutrients. Hydroponic principles have been applied to large-scale commercial agriculture with great success and seems ideally suited to the home.

D. Other Sources of Natural Energy: Wind, Water, Geothermal

1. Wind Energy.

The windmill is one of the earliest devices to harvest available energy, and should be investigated for possible incorporation into an ecotectural house. Two technical difficulties occur in the possible use of wind energy in the household. First, size of vanes and height of the rotor tower to achieve maximal results. Several

1. "Plan to Recycle Sewage," S.F. Chronicle, May 15, 1972, p. 8.
2. "A New House for Natural Man," S.F. Chronicle, October 8, 1972.
3. Dr. Oswald, U.C. Sanitary Engineering Research Lab, has designed a single house with an autonomous energy-nutrient system using 50 chickens and 1 cow methane generation, solar heating, algae ponding, etc.

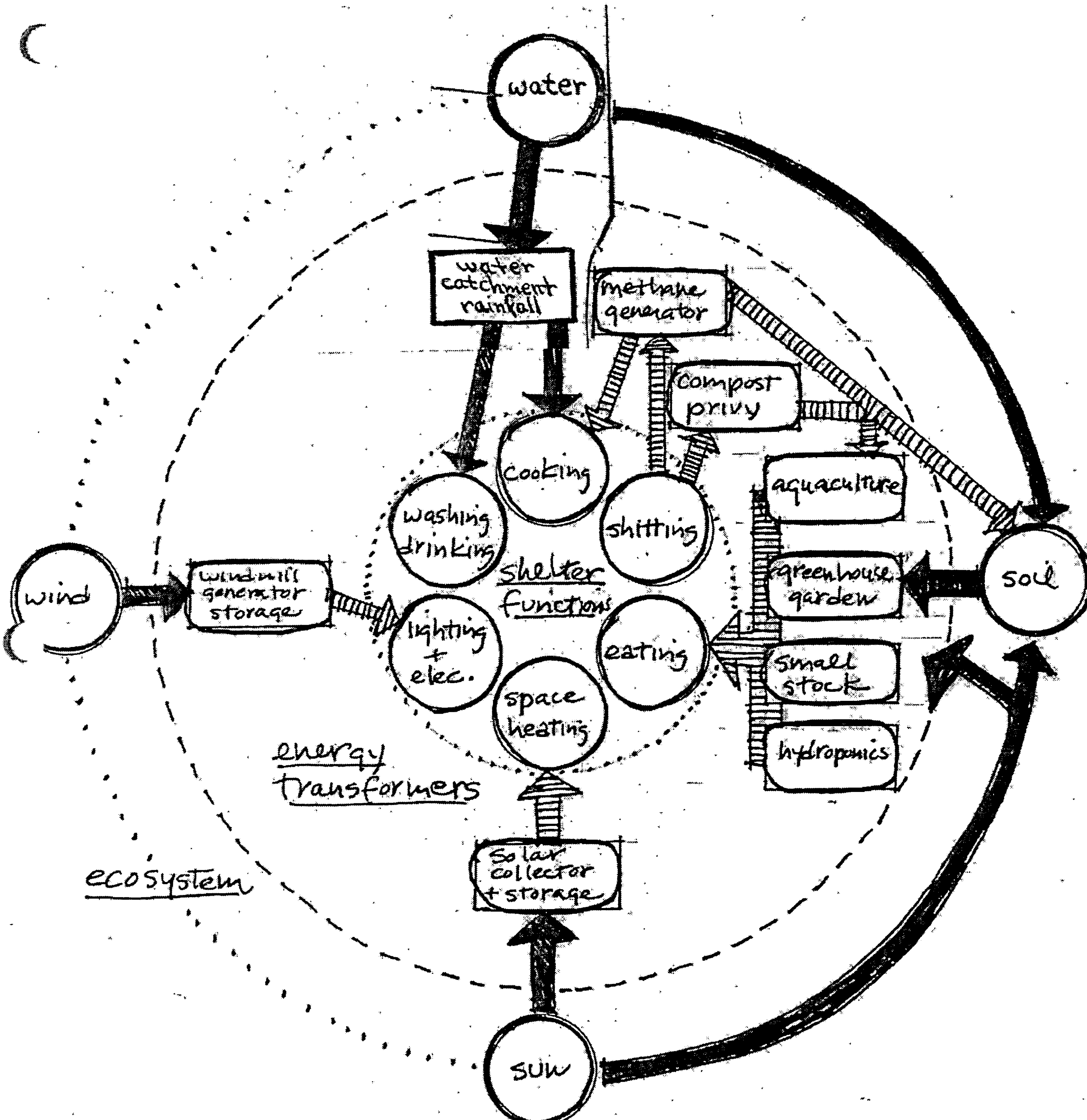
researchers are attempting to develop small high efficiency designs using the venturi principle to funnel air to relatively small vanes. The second, more serious, problem is the means of storage. Most windmills convert energy into a direct mechanical form such as a water pump. The traditional means of storing wind power as electrical energy has been through the use of conventional six and 12 volt lead storage batteries. Compressed air has been suggested as a possible storage medium.

2. Water power

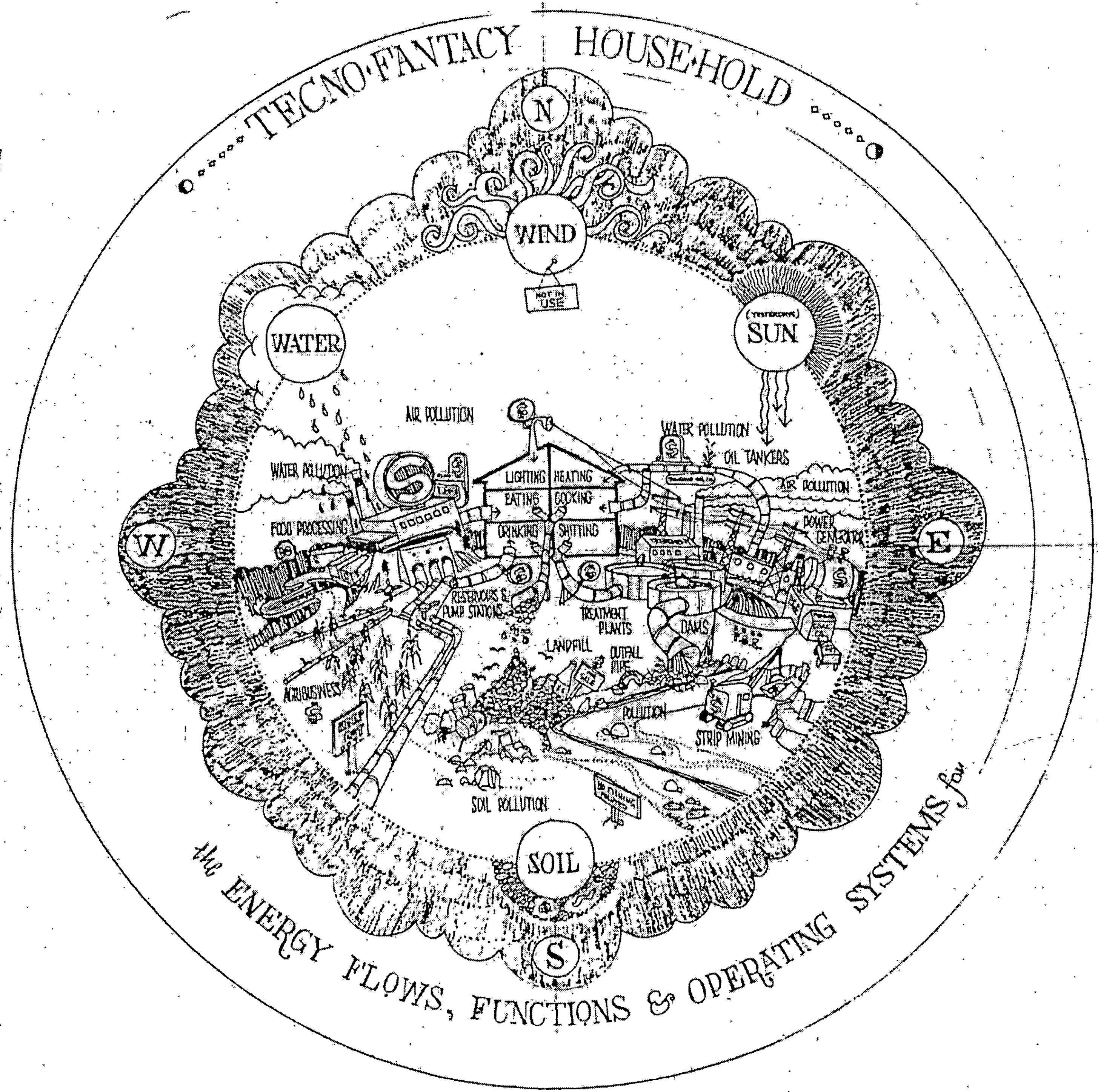
Energy production through the conversion of tidal action or the potential energy of moving water, are also among the oldest mechanical inventions for the conversion of energy. The design conditions in which such devices can be used are not general enough to warrant their incorporation into the average household.

3. Geothermal

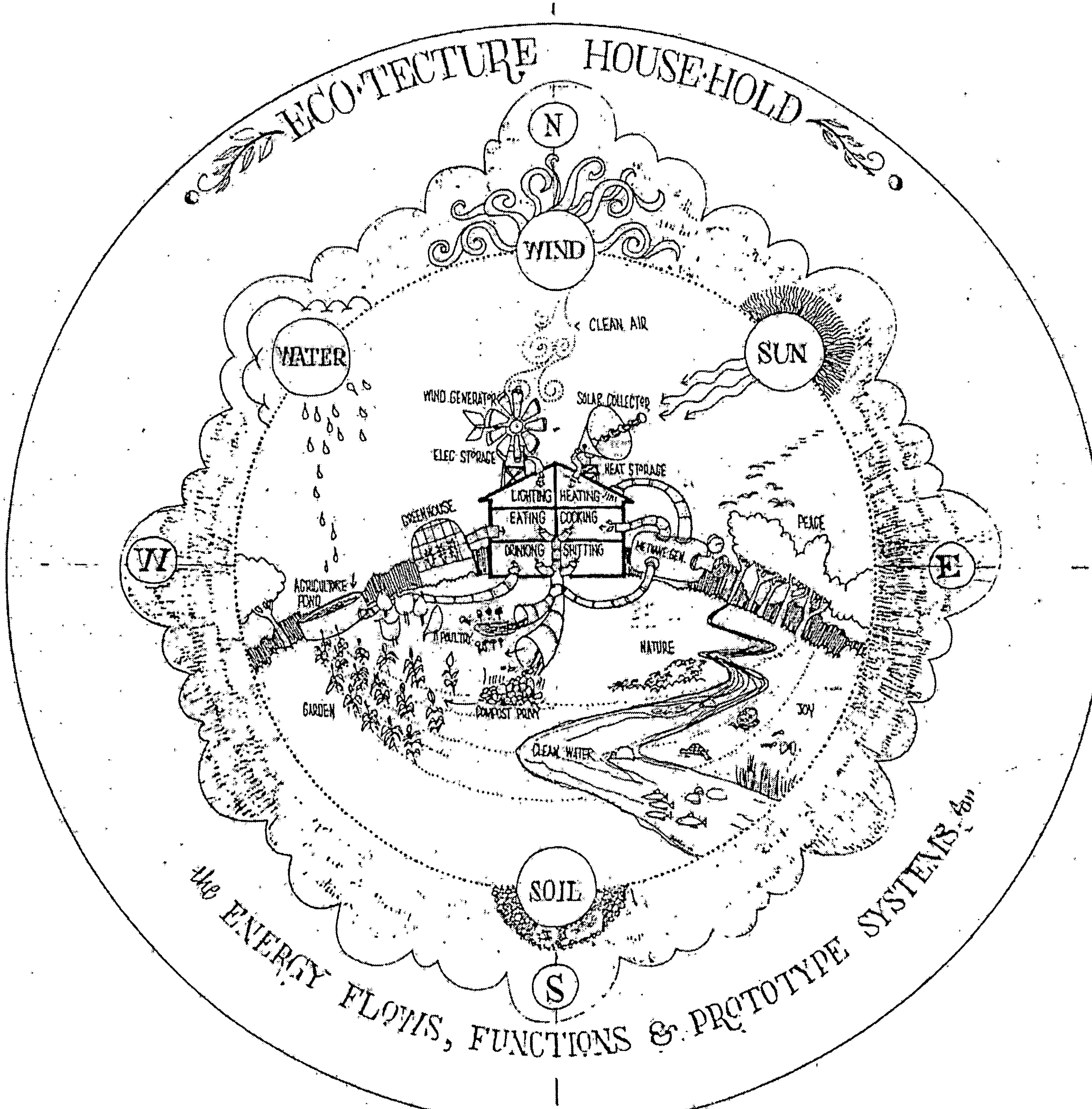
The design parameters of geothermal energy preclude their direct incorporation in the household.



ENERGY FLOWS IN CLOSED SYSTEM HABITAT SW sept 73



TECNO·FANTACY HOUSE·HOLD
N
WIND
NOT IN USE
WATER
SUN
W
E
S
SOIL
AIR POLLUTION
WATER POLLUTION
LIGHTING
HEATING
EATING
COOKING
DRINKING
SHITTING
WATER POLLUTION
OIL TANKERS
AIR POLLUTION
POWER GENERATI
FOOD PROCESSING
RESERVOIRS & PUMP STATIONS
TREATMENT PLANTS
DAMS
LANDFILL
OUTFALL PIPE
AGRIBUSINESS
POLLUTION
STRIP MINING
SOIL POLLUTION
the ENERGY FLOWS, FUNCTIONS & OPERATING SYSTEMS for


ECO·TECTURE HOUSE·HOLD
N
WIND
CLEAN AIR
WATER
SUN
WIND GENERATOR
SOLAR COLLECTOR
ELEC STORAGE
HEAT STORAGE
LIGHTING
HEATING
EATING
COOKING
DRINKING
SHITTING
GREENHOUSE
METHANE GEN.
PEACE
W
E
AGRICULTURE POND
POULTRY
NATURE
GARDEN
COMPOST PRIVY
JOY
CLEAN WATER
SOIL
S
the ENERGY FLOWS, FUNCTIONS & PROTOTYPE SYSTEMS of an