

A Pathway to EcoVillages

By Phil Hawes Ph.D., 28 March, 2015

"Though the problems of the world are increasingly complex, the solutions remain embarrassingly simple." - Bill Mollison, co-founder with David Holmgren

It's All Very New

The understanding of living systems and how they function is all very new to "civilized" humanity. Our ancestors were able to fit into their niche in Earth's networks for perhaps two million years, apparently without doing any permanent damage, but that changed about 10,000 years ago, with the invention of cities, and we lost the sense of, and the desire for, how to harmonize with nature.

During the last two hundred or so years, our cumulative intellectual knowledge has begun to refocus on the world of life, with its transmission made readily accessible through the prior inventions of first written languages, and then the printing press. We are now rapidly piecing together at least a rudimentary understanding of how living systems work. To give an idea of both the newness, and the rate of acceleration of our knowledge, here is a partial list of developments in life-sciences and supporting fields. It is interesting that the time period approximately matches the historic era called the "Industrial Revolution."

Considering the newness of our scientific understanding, it is no wonder we have had difficulty in checking our destructive behavior. However, little by little, a self-conscious realization is creeping over the world-around human family, just what impact we are having on the planet.

As recently as 1926, Vladimir Vernadsky wrote his book, "The Biosphere," and as the founder of the science of Biogeochemistry, he showed for the first time the enormous impact humanity was making on the Earth. Since he was Russian, he remained essentially invisible to the English-speaking scientific community, until about 1985, when a small condensed version of "The Biosphere," and translated from French into English, was published by Synergetic Press, the publishing affiliation of the builders of the Biosphere 2 Project in Arizona. In 1991, eight people entered, and stayed for two years in Biosphere 2, the world's first large Closed Ecological Life Support System (CELSS) capable of supporting humans. This was a scientific first, and of great value in furthering the study of ecological systems and their powers of air and water purification and recycling. (Another crew spent six months sealed inside in 1994.)

- Early ecological awareness - "*The Economy of Nature*" -1750c.- Carl Linnaeus
- Tropics have highest biodiversity -1807- Alexander Humboldt
- *Evolution Theory* - 1859 - Charles Darwin
- Concept of an ecological community -1865c.- Karl Mobius
- "Ecology" coined and defined - 1866 - Ernst Haeckle
- "Plankton" coined - 1875 - Victor Hensen (measured sea productivity)
- "Biosphere" coined and defined - 1875 - Eduard Suess
- Biosphere and biogeochemistry as developed concepts - 1926 - Vladimir Vernadsky
- "Holism" coined and defined - 1926 - Jan Smuts
- "Ecosystem" coined and defined - 1936 - Arthur Tansley
- "*Fundamentals of Ecology*" - American Book - 1958 - Howard and Eugene Odum
- Chaos and Complexity - "discovered" - 1960's
- "Emergy" coined and defined - 1973 - Energy flow through ecosystems - Howard Odum
- "Fractals" coined and defined - 1975 - Benoit Mandelbrot
- "Integrative Science" coined and defined - 2002 - Roy Walford, in his article, "*What Is Biosphere 2 Good For?*" (BioScience Journal, 1 March, 2002)

Integrative Science

“There is currently an ongoing discourse about what has been termed "the two cultures of ecology." One is reductionist, experimental, disciplinary, oriented towards the testing of well-formulated hypotheses, and in effect represents the traditional methods of science.

"The integrative approach, on the other hand, attempts to deal with nature on a larger dimension, where knowledge of the system remains incomplete, where surprise is inevitable, prediction hazardous, and where emergent properties may be encountered, springing from the internal nonlinear dynamics of complex systems." (Dr. Roy Walford, "Biospherian" in Biosphere 2, BioScience Journal, 1 March, 2002)

To use the word "EcoVillages" has a specific meaning. The two capitalized but combined words describe a new type of town that includes, not just some, but all of the aspects necessary for a true economically and ecologically sustainable community.

A basic characteristic of an EcoVillage is its primary emphasis on generating local industries, and making local replacements for items formerly imported from elsewhere. This "import replacement" has a three-fold effect:

It is obvious that these same benefits can be enjoyed by increasing local food production and processing, and many other areas of potential trade or services. (Including training in indigenous construction, mechanical trades, building and installing renewable energy systems, and so on.)

The key to survival for almost any town is industry, and some of us also believe the same is true for a country. (There are exceptions, like the avowed "white-collar" city-nation of Singapore)

Suggestions for Key Industries

If the key to viable towns, or group of towns, is industry, what kinds of industries? It is those that address the primary foundations of modern life, with an emphasis on using "polytechnics;" technologies acquired from any time and place. A partial list includes:

1) Food -

Greenhouses:

Wooden framed

Glass manufacturing

Steel (for greenhouses, reinforcing, ferro-cement, etc.)

Community gardens with forest gardening (and other perennials)

Facilities for canning, pickling, drying skills

Livestock, fish and game

2) Fiber -

Flax

Wool

Cotton

Silk

Hemp

Kanef, sisal, etc.

3) Shelter -

Architectural ceramics (floors, counters, baths, roofs)

Woodworking (doors, windows, cabinets, furniture)

Timber framing

Granite road and building blocks

Marble

Cements:

Rosedale, NY "natural cement"

- Magnesium oxide other ceramic cements
- Lime cements
- Slate (roofs)
- 4) Energy -
 - Micro hydro-electric
 - Photovoltaics
 - Wind generators (50kw to 500kw)
 - Solar furnaces
 - Biochar (to sequester carbon in the soil)
 - Electrolysis (for hydrogen and oxygen)
 - LED lights
- 5) Transportation -
 - Pedal-powered transport and equipment (forklift, pickup)
 - Electric and hydrogen-powered vehicles
 - Trolley cars and small monorails (See: Gromeco, Skyweb)
 - Lighter than air craft
 - Horses (and their equipment)
- 6) Water -
 - Hydrogen peroxide for water/sewage purification
- 7) Other Important Industries -
 - Ceramics
 - Metal-working:
 - Machining
 - Foundry
 - Sheet metal

Obviously, one small town, like Norway, probably can't generate all of these industries, but, by cooperating, a regional alliance for industry of 10 or 20 towns each with 5,000 population could plan to have all.

The technologies that are most attractive for small communities are those that ordinary people can do for themselves. Thus, they are more or less independent of high-tech, and without having over reliance on the highly-developed "Industrial Complex."

Everything possible should be done to preserve any key technologies that still survive in our small urban centers. Time is of the essence, and many old-time businesses are barely clinging to life in the face of today's economic impact from big-box and corporate franchises.

Designing an EcoVillage is not just a matter of taking a sheet of paper and starting to draw. I have spent over a decade working on how to design and build a truly sustainable EcoVillage for 5,000 people, and in that time I've done relatively little drawing. Drawing a design is actually the easiest part.

The hard part is figuring out what a sustainable community actually is in real-life terms, meaning, what must we do to be truly sustainable, and how do we get there from here, since we, as a species, are currently un-sustainable in all the critical areas of our lives.

Once developed to a workable form, running any EcoVillage's Integrated Systems array can probably be done with a set of fairly uniform, though constantly evolving, programs. But, the physical configuration of the community design will vary with each different location. Also, from culture to culture, social needs will change, which will influence a community's physical patterns.

Before building Biosphere 2, the question that loomed above all others was, "Can humans build and survive in a tiny closed system that regulates its own atmospheric and water purification cycles essentially by biological methods, rather than exclusively by electrical, chemical and mechanical means?"

Now, before building an EcoVillage, the question that looms is, "Can humans overcome enough of our bad habits, accumulated over the past 10,000 years since the rise of urbanism, and actually learn to bring ourselves back into balance with the rest of the Earth's living beings, the environment, and ourselves, while still retaining any of our crucial inventions?"

EcoVillages are human communities that are planned to remain small and distributed, and which will function best in collaboration with other like-minded towns. The smallest size for a town that can still be considered a "full-service" community is probably about 5,000 population.

This size for an EcoVillage is chosen partly on the basis of historic precedence of over 2,500 years, and partly based on the conviction that above that size it would become increasingly unwieldy for the citizenry to guide the town's course by having direct democratic control of the community for establishing the EcoVillage Values, Goals, Characteristics, Policies and Programs. A large population results in a social-gap, keeping you from knowing who your neighbors are, and also produces a drop in a community's continuity of political will and action.

Due to my belief that a democratic form of government would be a superior and workable possibility, the EcoVillage concept that I propose, emphasizes a town government being run as a true democracy, where the citizens vote on all issues. The internet has given new meaning to the tradition of the Town Meeting. The old forum, held in the town hall meetings, we now carry around in our iPads, and laptops.

Smallness of population, whether a committee or a town, also gives an advantage of rapid decision making in crises, and a brisk resolution of even the more mundane matters. For the community to have from its beginning a determined set of Values and Goals is a great asset. Such guiding principles are the equivalent for any town that a Mission Statement is for a company. Its purpose is to keep the participants aware of what they are doing, and to remind them that the basic Values and Goals of the community are to be used as the foundation of all Policies and Programs of the EcoVillage.

If EcoVillage's are kept small, they will be able to respond quickly. Democracy is quite slow enough in functioning, and whatever can facilitate and nurture the still historically young democratic process, is to the good. Thus, town size must be a balance between the ability to act quickly and democratically, and still be large enough for a full-service community.

The primary guidelines in creating EcoVillages are in the phrase, "distributed, but collaborative." This distribution, or decentralization, of urban life into small communities, can also be used to stimulate greater local production and control of:

- food
- energy
- shelter
- transportation, and
- many other necessities, such as water and sewage, and create an abundant and satisfying, "modern" life.

Modern, as used here, implies that we are able to retain the human technologies invented and discovered through the ages, but most predominantly during the last 300 years of "industrial revolution."

Widespread distribution of small vibrant communities increases opportunities for inter-city collaboration, and there are many historic precedents for towns having close trading, and mutual support ties. For small, weaker cities, collaboration has always made sense, and they joined together in trading-consortiums, and other forms of economic and defensive alliances, and to create other social advantages.

Among the more famous examples are the Greek city-states of 2,500 years ago, and the Hanseatic League that dominated the economics of northern Europe from 1200 to 1600. Also, during this European medieval period, in the two hundred years from 1200 to 1400, over 700 new towns were built in South-Western France, and linked together, primarily to secure what was then a wild, forested and sparsely-populated frontier.

An EcoVillage Philosophical Framework

The philosophical foundations on which to create an EcoVillage, includes:

- 1) Goal for the EcoVillage to become a genuine sustainable human-ecosystem
- 2) Economic and Ecological Sustainability, internal and between towns, where the economic base is one of small networked industries
- 3) Town population limited to 5,000 by restricting the number of dwellings built
- 4) Urban, Rural and Wilderness conditions included as part of each community
- 5) City policy is to build second EcoVillage, when the 5,000 population limit is reached
- 6) True Democracy on all decisions, voted by the entire community
- 7) Developing, and adhering, to community Values, Goals, Characteristics, and the Policies and Programs, which includes a list of the community's "Immutable Essentials." (Those are the essential principles that must not be compromised in the name of efficiency, "common sense," or financial profit. See a proposed list of Essentials in Key Technologies and Systems, below.)

Key Technologies and Systems Defined and Discussed

- 1) Permaculture
- 2) Sustainability
- 3) EcoVillage
- 4) Economy and Ecology
- 5) Rules of the House
- 6) Ecosystem and Biome
- 7) Biosphere
- 8) Holistic
- 9) Synergy
- 10) Emergent-Properties
- 11) Integrated Systems
- 12) Immutable Essentials of a Sustainable Community
- 13) Benefits, Attractors and Key Features of EcoVillages
- 14) Values and Goals for Designing Sustainable Communities
- 15) The Third Industrial Revolution

1) Permaculture:

Permaculture was founded by Bill Mollison and David Holmgren in the 1970s. The word "Permaculture," is a contraction of 'permanent agriculture' and 'permanent culture.' No culture can survive long without a permanent agriculture; a way to provide food and fiber, and the other necessities of life.

Mollison and Holmgren (1974) (started with focus on food self-reliance)

Bill Mollison has described permaculture as:

"A philosophy of working with, rather than against nature; of protracted and thoughtful observation rather than protracted and thoughtless labor; and of looking at plants and animals in all their functions, rather than treating any area as a single project system."

Permaculture has to do with plants, animals (including humans), their buildings, and infrastructure (water, energy, communications, etc.), their interacting relationships and how they are placed in the landscape. Nature is at the center, and humans depend on it for knowledge, inspiration and survival.

Permaculture Principles are a comprehensive design strategy based on the knowledge gained through observing patterns in nature. Its five components are:

- 1) Working with nature instead of against it.
- 2) The problem is the solution.
- 3) Make the least change for the greatest possible effect.
- 4) The yield of a system is theoretically unlimited.
- 5) Everything has an effect on the environment.

Permaculture principles form a comprehensive design strategy for designing human settlements and agricultural systems modeled on the relationships found in nature, and based on knowledge gained through observing those natural ecological patterns. The aim is to create systems that are ecologically-sound and economically viable, that provide for their own needs, do not pollute, and are sustainable in the long term.

Permaculture is a design system that provides a path that the Western mind can follow to better understand the landscape and make decisions about how to meet our needs within it. It can be applied on micro and macro scales. Someone who is developing a piece of land, but hasn't gone through the process of Permaculture Design, does not have a "Permaculture." This doesn't mean that everyone with a project is doing a bad job if they're not fervently following the ideas of Bill Mollison, but they almost surely don't have a permanent operation.

To become familiar with the Permaculture Design principles, its methods, and what it has to offer as a design system, read Bill Mollison's *Introduction to Permaculture*.

2) Sustainability:

"For something to be sustainable, it must be capable of being held up, or supported and maintained, without interruption, without weakening or losing power or quality, and it must endure indefinitely, without degradation or failure in a prolonged and unflagging manner." (Compiled from various Webster's Dictionaries)

"Indefinitely" means that there is no known time limit, and it is useful to think in terms of a thousand years or more, since any shorter period fails to express the long-term nature of sustainability, and also lacks the power to hold the listener's attention, and our own.

Most promoters who claim their products, projects, places are sustainable, are in fact only saying, "I'm more sustainable than what we can see going on around us." They are seeing sustainability as a continuum, a gradient, wherein it is possible to be "more" or "less" sustainable. They are trying to gain competitive advantage by claiming to be somewhat more responsible and "green" than someone else's offerings.

However, sustainability is not a continuum. It is accurate and strict in its meaning. By its very definition, sustainability either describes a genuine condition, or it does not. Either a process, a community or an entire culture is following principles, policies, and methods that can be sustained indefinitely without degradation or failure, or not. To complicate the situation, it's not always easy to know enough of the systems of life to determine what real sustainability is in each instance.

Still, some things are more important to be sustainable than others, and sustainability-priorities need to be set for our most critical activities:

- food production and processing
- water harvesting and replenishment
- energy production, storage and distribution
- healthcare
- transportation methods
- sewage and other "waste" products treatment
- building materials

Although there are many other important activities to consider, these can be called the "Central Seven."

Our contemporary world-around situation is that, with the possible exception of some remote tribal people in deserts and forests who have almost no contact with the "modern" industrialized world, no one today is living sustainably, according to its definition. "Modern," as used here, involves the use of metals and electricity, and an ever-increasing dependency on a highly-developed, complex and inter-woven, tool and information culture, based on literacy, engineering and science.

At present, in modern society, which for all intents and purposes means in the entire world, not one of the items mentioned above is being dealt sustainably to any meaningful degree. This overall lack of performance by our global society, and particularly the failure of our "leaders" whom we expect to be aware of the situation and to act responsibly, lurks beneath the great fear now widely experienced.

Sustainability, as a design principle, uses ecosystems as models. The most critical activities are those by which a culture provides for its members: their food, water, building shelters, energy, waste treatment, health, transportation, clothing, education, security and so forth.

Creating conditions of sustainability requires:

- promoting diversity of life forms, both plant and animal,
- using cyclic processes of natural environmental systems to provide water, food, energy,
- natural solutions for the buildings' internal climate control,
- clean water, clean air, fertile soil,
- elimination of environmental pollution, and
- using the "waste" from one process as "food" for another one.

History now appears to be demanding that we must learn to live sustainably. Many of us believe it is possible to do in a modern world, where we still retain many of the inventions and advantages since towns appeared over the last 10,000 years of human development. Others think it is not possible to keep much of our industrial, medical or cultural benefits; e.g., the generation and use of electricity.

The list of **Integrated Master-System Components** comprise the most important systems and technologies needed in a modern sustainable communities. Variations of many of the issues have challenged our ancestors for millennia. (See **11) Integrated Systems**, below)

There are many arguments that have been put forth in support of our current industrialized methods of doing these things. But, based on the definition of what sustainability is, many of us are taking a stand that a complete review of all these processes is needed.

The starting assumption, derived from many examples, is that our "time-honored" methods of doing most, if not all, of these processes are founded on a lack of understanding of the environment, ignoring the consequences of our actions, and basic errors in judgment. These questionable processes will need to be radically changed, and in many cases stopped altogether.

To be un-sustainable means to not persist, and to not be sustained into the future, and essentially to become extinct, both individually or collectively. Since humans are either sustainable, or they are not, we must either learn to combine the older uncivilized human skills, together with those developed since beginning the dependence on agriculture, or humanity will join the many other extinct species that have briefly lived on Earth.

Now, the Primary Question is, "Can a modern human community provide its members with food, water, clothing, shelter, energy, health, transportation, education and other necessities over an extended time, such as a thousand years, and still be in harmony with itself, its neighbors, and the natural world?"

If the answer is No, how does that answer differ from saying that our species will go extinct as soon as the fossil energy that now supports it is radically reduced or exhausted?

Here then, are the challenges implicit in the word “sustainable,” as applied to human activity and human habitation.

- 1) Can we learn to live sustainably, and can we do it quickly enough?
- 2) What will we have to sacrifice from the past 10,000 years of civilized human effort?
- 3) Will we make those sacrifices intelligently, willingly, and in such a fashion as to proceed gracefully into a sustainable future?

These are the critical issues of our times.

Additional Definitions of Sustainability

- A. “Sustainable settlements result from the integration of human beings together with nature so as to meet the requirements of each in ways that preserve, upgrade, enrich and evolve the biosphere. A sustainable society is one that can persist over generations, one that is far seeing enough, flexible enough, and wise enough not to undermine either its physical or its social systems of support.” (David Orr: Director of the Environmental Department at Oberlin College, and author of *Ecological Literacy*, and *With Earth In Mind*.)
- B. “Sustainability means living, working and behaving in a way that will sustain, or support, the integrity and biodiversity of the local regional and planetary ecosystems on which all life depends. It means finding ways to achieve the quality that we seek in our own lives without sacrificing the quality that earth's many and varied ecosystems need.” (Guy Dauncy in the "Manifesto" for the proposed ecovillage of Bamberton, BC, Canada)
- C. “Sustainability occurs when a system, like an ecosystem, produces enough energy in its lifetime to provide for its requirements and for those of the environment, and is so constituted as to be able to repeat this for future generations.” (Penelope "Penny" Livingston - Director, The Regenerative Design Institute of Northern California, Bolinas, CA)
- D. “Sustainability refers to the ability of a society, ecosystem, or any such on-going system to continue functioning into the indefinite future without being forced into decline through exhaustion of key resources.” (Robert Gilman, founder of In Context Institute)
- E. "A dynamic equilibrium in the processes of interaction between a population and the carrying-capacity of an environment, such that the population develops to express its full potential without producing irreversible adverse effects on the carrying capacity of the environment upon which it depends."(Ben Eli, Founder of Sustainability Initiatives.)
- F. “Sustainability falls into the "either you are, or you aren't" mentality. I believe that, with the possible exception of some tribal people with minimal contact with the modern world, no one on earth fits this definition today. To be truly "sustainable" (i.e. able to continue doing everything you do exactly as you do it, perpetually) one must be very selective about making use of any resources that are not biological in nature. As biological systems are the only ones that operate in opposition to entropy, everything in a truly, 100% sustainable system will be based on living systems.” (Dave Bullock)

3) EcoVillage:

Robert Gilman, co-founder with Diane Gilman of *In-Context Magazine* proposed this excellent basic EcoVillage definition:

"It is a human scale, full-featured settlement which harmlessly integrates human activities into the natural world in a way that is supportive of healthy human development and can be successfully continued into the indefinite future. An EcoVillage also must have multiple centers of initiative."

An EcoVillage resembles a natural eco-system, since both are communities of organisms interacting with each other, and with their environment.

An eco-system includes the basic components, both living and non-living, needed to maintain the cycles that are re-

quired to sustain it indefinitely into the future. Constituted in the same way as an eco-system, an EcoVillage also:

- gains its energy from non-fossil fuel sources
- produces, or otherwise captures, enough food to equal the caloric and nutritional needs of its population
- gets its building materials and other resources locally, when possible
- spends its energy (money) locally whenever possible

An EcoVillage interacts positively with the local surrounding communities, and with the natural environments. It recycles water, sewage, and other waste products so they become resources for other parts of the EcoVillage, or other communities.

A true EcoVillage is designed using the same patterns of self-support as an ecosystem, and an EcoVillage provides incentive programs to create sustainability by:

- a) promoting real affordable housing, and a way whereby people can build their own homes
- b) creating and encouraging local enterprises of production, and inter-community trading
- c) encouraging employees to own shares in companies whose businesses further sustainable community building
- d) community citizens owning shares in the incorporated EcoVillage itself
- e) developing non-automobile transportation systems, both local and external
- f) conserving energy, but also generating it locally from renewable sources
- g) conserving water, but also generating it locally from renewable sources (i.e. rainwater harvesting, storage, treatment, purification, distribution, reuse, balancing aquifer withdrawal with recharging)
- h) purifying wastewater and recycling it into agricultural production
- i) using locally obtained building materials, and local people for the work of community building
- j) producing food locally - no pesticide pollution, or un-proven GMO species
- k) developing a community healthcare system
- l) developing a community educational system
- m) developing a community financing system
- n) recycling 'waste' products, including wastewater and solid waste, to provide resources for other segments of the community's "metabolism,"
- o) providing a local transportation system that emits no carbon, or toxins
- p) assisting its local Community Development Company to initiate businesses that support the overall EcoVillage mission and operating principles, while returning a moderate profit, but great social and financial benefits to the community
- q) supporting a social and financial structure to encourage a wide diversity of people to immigrate
- r) preserving extensive community open space accessible to all
- s) spending its energy (including money) locally when possible
- t) teamwork to create conditions for ongoing community survival

Mark Roseland, in his book, "Eco-City Dimensions," provides us with this very succinct description of an ecological community:

"The eco-city vision links ecological sustainability with social justice and the pursuit of sustainable livelihoods. It is a vision that acknowledges the ecological limits to growth, promotes ecological and cultural diversity and a vibrant community life, and supports a community-based sustainable economy that is directed toward fulfilling real human needs, rather than just simply expanding."

The greater the degree of self-sufficiency that exists in a community, the easier it is to calculate that community's level of sustainability.

4) Economy and Ecology:

"Ecology is the ultimate economy, the true test of how the citizens of an ecosystem make their living and sustain themselves over time. To live well, a realistic human community must first provide and care for the basics which are re-

quired to live, that is, a healthy environment." (Barbara Ward Jackson)

In 1749, Carl Linnaeus founded what is now considered an early branch of ecology, that he called the "economy of nature," a static concept, in which organisms in nature interact with each other according to a set, designed plan.

Then, in 1866, Ernst Haeckle, a German biologist, coined the word "ecology," which he defined as:

"The body of knowledge concerning the economy of nature and the study of all those complex interrelations." (Since one definition of "knowledge" is, "the totality of facts and information on what is known about some specific subject," some students think Haeckle may have intended ecology to be synonymous with the economy of nature.)

Both economy and ecology are words derived from Greek roots:

Economy:

Eco means "house," plus **-nomia**, "law." So, economy is defined as, "the management of household affairs," or "household law." (Webster's Dictionary)

By accepting Planet Earth as our greater "house," economics can be defined as, "The Rules of the House."

Ecology:

Eco in Greek means "house," plus **-logy**, "a science, body of principles, rules, discipline, studies, or knowledge of the economy of nature." (Webster's Dictionary)

The word "ecology" was coined in about 1870 by the German biologist Ernst Haeckle and defined by him as:

"The body of knowledge concerning the economy of nature and the study of all those complex interrelations."

By viewing Planet Earth and its biosphere, that thin film of life and life's products that surround it, as our greater House, and referring to the body of principles and rules of science, ecology can also be defined as, "The Rules of the House."

So, both Eco-nomy and Eco-logy mean, "The Rules of the House." This interpretation produces a startling, but pleasant, psychological juxtaposition of economy and ecology. This causes a small psycho-shock that puts the whole idea of human economics into a different category and focus of our attention.

The conscious realization of similar meaning of these ideas, liberates "economy," intellectually and emotionally, from the confines of being a series of confused academic theories, makes it more accessible, and allows economy and ecology to be splendid new friends, ready to sally forth, comrades together into a fresh world.

This moment of realization can create a beneficial change in the way that anyone who actually "gets it" will thereafter think of economy and ecology. They are now fused, with our attention now on the unity of their essences, and their roles as Planetary-Household "principles," the "rules" of the natural world.

It is clear that when building a framework for a human community, the integration of Economy with Ecology is of the utmost importance.

Considering the interconnectedness of all living things, in 1887, Stephen Forbes believing that ecological knowledge was fundamental for human well-being, wrote:

"[One] will thus be made to see the impossibility of studying any form completely, out of relation to the other forms, the necessity for taking a comprehensive survey of the whole as a condition to a satisfactory understanding of any part." (The National Academy of Sciences acknowledges Forbes as "the founder of the science of ecology in the United States.")

EcoVillage design is not restricted to a mere physical layout with drawings of structures, or solely concerned with valuable amenities like parks and trees or swimming pools. To be comprehensive and significant, design must involve both a community's ecological relationships, and its economic structure. They are inseparably entwined, and while

-serving the common ecological good, it is also essential for an EcoVillage to simultaneously promote each individual citizen's economic wellbeing.

Any true EcoVillage, is structured in a way similar to a natural eco-system, and it includes all basic components, both living and non-living, necessary to maintain the cycles for sustaining the community indefinitely into the future. Essentially, a true EcoVillage will exhibit conscious autopoiesis, or "self-creation."

5) The Rules of the House:

The use of the word "rules," indicates that there is some obligation for us to obey these rules (or principles), if we expect to insure the ecology and economy of our species can enjoy a healthy continuation into the indefinite future.

The rules of Earth's house, are the rules of sustainable life. Assuming humans can carefully learn these rules, and then correctly apply them, we should be able to consciously create ecologically and economically sustainable modern human communities as a form of Human-Ecosystem. If we adequately understand and follow the rules, we can be very confident of the community's sustainability, since, even with all its diversity and variations, life, by adhering to these rules of Earth's house, has been sustaining itself for about 3.8 billion years.

Even within our current very limited level of understanding, any true EcoVillage will strive to resemble a natural eco-system. Both are communities of organisms interacting with each other, and their environment. Both are assembled using similar patterns of recycling of material and energy "waste" products as input for other processes; heat and light to create biomass, water back into the ground, and so on. Ecosystems and EcoVillages maintain self-supporting cycles that sustain them; such as water conservation, purification, storage and distribution, nutrient recycling, air purification, and solar energy transformations into various life forms.

If ecosystem-like-towns, can be built that mimic complex natural systems, we will be able to persist indefinitely without continuing to destroy our supporting environment. Any EcoVillage communities based on the "Rules of the House," will be able to adjust quicker with their surrounding ecosystems, and absorb more readily the natural impacts of fire, flood, drought and earthquake.

Some of the Rules of the House that have been identified are:

1. Everything in the Earth's biosphere is recycled:

Essentially, nothing enters or leaves Planet Earth, except energy and information. Air, water, and food are all recycled and used over and over by living entities that are members of ecosystems.

The overall environment receives the benefit of this natural recycling, and the individual members "earn their living" by participating properly in the cycles.

Since life is based, and maintained by cyclic patterns, in natural systems there is no such thing as waste, as everything is re-assimilated and reintegrated into the ecosystems. Thus, waste equals food, and it is important that all waste be edible for some form of life; meaning that all waste must be "biodegradable."

Hence the term "re-cycle" has come into use to indicate that a true cyclic process for all materials, organic or otherwise, is not only desirable, but necessary. Natural recycling is an infinitely greater and more important process than our current rudimentary recycling of tin cans, plastic, glass and paper, although those activities at least point us in the right direction.

2. Ecosystems have high structural diversity, and compact spatial efficiency:

Diversity strengthens an ecosystem, as well as the entire biosphere. By having a variety of organisms available to do each ecological task, the biosphere remains a stable environment, and the eco-work gets done, even if occasional environmental changes, or human activity, results in an extinction of one or more species. However, there are limits to the amount of destruction that an ecosystem can experience before it dies.

Spatial efficiency in terrestrial ecosystems is expressed in the dispersion of life-forms according to local water availability, soil types, sunshine and shade, wind, and other such factors.

3. Natural ecosystems are sustainable over time:

Unless we can live in a Sustainable fashion, as shown by the definition of “sustainable,” we will become extinct and will either cease to exist or humanity may just revert to a very “pre-agricultural revolution” level of hunting and gathering. That was the human situation prior to about 12,000 BCE (Before Current Era), and was certainly not all bad. However, for humanity to collapse back to that level now, would be untenable, as it would deposit the now huge population of humans into the midst of a vastly degraded environment, not the one of natural abundance of prehistoric times.

4. Ecosystems are in Dynamic Equilibrium:

An ecosystem is in dynamic equilibrium, if it is operating sustainably, with its inputs and outputs balanced over time.

5. Energy is imported:

In natural ecosystems, energy is usually imported through sunlight, and the ecosystem's energy export is heat. (Some rare ecosystems have geothermal heat energy as an input, such as a few deep ocean—ones that use hot chemically-laden water as a basis for their chemosynthesis, rather than photosynthesis.)

6. Ecosystems have numerous channels of interaction:

These channels carry feedback to other ecosystem communities, ensuring a high environmental control and overall system stability.

7. Nature's ecosystems develop in patchy patterns:

Nature's designs link together the profuse patches of ecosystems and enhance ecological connectivities. This is contrary to the way modern humans usually like to order things: such as in rows. The shape and distribution of patchy patterns are determined by combinations of influences, such as soil types, solar exposure, rainfall, water runoff, topography, and micro-climatic conditions. (For example: the north side of a hill in arid lands will often have more trees and other plants, since it gets less sunlight, and therefore less evaporation of moisture than on the south side.)

8. "Indicator Species" serve to measure ecosystem health:

In any given locale, there will usually be some species that respond to variations in environmental condition before other members of that ecosystem. These can serve as early-indicators of reduced water, heat damage, frost, and so forth.

9. A "Keystone Species" governs biological diversity:

Keystone Species usually govern biological diversity in their given habitat through intensive ecosystem interaction. A Keystone Species is defined as one that exerts a large stabilizing influence throughout an ecological community, despite its often relatively small numerical abundance. If it is removed, dramatic changes result in the varieties and populations of all other species in the community. The introduction of alien species can also have the same sort of radical effects on ecosystem processes.

10. "Keystone Predators":

Keystone Predators are living beings, whether microbial or larger, that keep other species in check to avoid environmental destruction. These predators are often animals like mountain lions, bears, owls, coyotes, and in some instances, humans.

11. Ecosystem Form:

"Ecodesign," whether natural or human, requires a holistic arrangement of its built-systems, and the sustainable integration and management of its energy and materials together with the local ecosystems biotic and abiotic components.

6) Ecosystem and Biome:

In 1935 Arthur Tansley, the British ecologist, coined the term “ecosystem,” the interactive system established between the biocoenosis (the group of living creatures), and their biotope, the environment in which they live. Ecology thus became the science of ecosystems. (Wiki)

An Ecosystem is a sustainable community of life, which is why creating modern human-ecosystems is such a pressing goal, without which other human activities and political goals are mostly temporary and absurd posturing.

Ecosystem:

Like Ecology and Economics, Ecosystem starts out with the Greek “-eco” meaning house, plus “system,” and a definition of a **system** is:

"A set of connected things or parts forming a complex whole, in particular a set of things working together as parts of a mechanism or an interconnecting network."

By its own definition then, any system is a complex entity; a whole thing! Thus, when we are involved with systems and complexity, we have entered the world of unpredictability and can expect to find "**emergent properties**" that were previously unknown.

A moderately complex system, is the system one develops to measure, purchase and prepare, a week's food needs for a family of four. It requires buying in the proper quantities, keeping track of the things to determine when the vegetables or fruit for dinner in seven days will be ripe, wilted, or overripe. The food is first estimated as to required pounds, that amount is bought, perhaps with a small excess for unexpected guests, and track is kept of the use as the week progresses. Good food managers for four, need to be as efficient as possible, since they will be planning, measuring, and preparing 84 meals in a one week period. (And, someone has to do clean-up.) No matter how smoothly this system is set up and operated, we all know there will be unexpected things that emerge.

An extremely complex system is an ecosystem:

To paraphrase Wikipedia:

"An ecosystem is a complex community of living organisms (biotic), interacting with each other as a system (the plants, animals, protoctista, fungi, bacteria, and archea), in conjunction with the non-living (abiotic) components of their environment. (air, water, energy, basic elements and organic and inorganic chemical compounds, minerals in soil, sunshine, rain, wind, temperature.)"

But, as we might imagine, all is not quite that simple, and the Wiki definition then goes on to say:

"The biotic and abiotic components are linked together through nutrient cycles and energy flows. (Emergy is the study of how energy flows through ecosystems.) Ecosystems are defined by the network of interactions among organisms, and between organisms and their environment, ecosystems can be of any size, but usually encompass specific limited spaces. (Although some scientists consider the whole planet to be an ecosystem.)"

Both biotic and abiotic components are needed to maintain the cycles required to sustain an ecosystem indefinitely as it interacts with its local environment, and other living communities. Without some cataclysmic disruption, an ecosystem can expect to persist indefinitely.

It turns out that an ecosystem is a matter of scale, and as Norman Myers puts it:

"How many ecosystems are there on Earth? Well, the biosphere itself is one huge ecosystem. And a grain of soil is an ecosystem, too. This means that the total number of ecosystems becomes a non-issue: too big to grasp, and hardly relevant anyway. So it is more to the point for us to focus instead on large amalgams of ecosystems—zones where many similar ecosystems exist side-by-side, making up a super-ecosystem, or **biome**.

"An easily recognizable example of a biome is the tropical forest. From one part of a biome to another, the tropical forest looks pretty much the same, and it works pretty much the same, too. True, the forest of Amazonia contains a basically different set of species from that of Borneo, whether trees or birds or insects; and these species, being different, necessarily interact in somewhat different manners. But these two sections of tropical forest are more akin to each other than either is to the conifer forests of Canada or Russia.

"So the tropical forest deserves to rank as an ecological zone in its own right; and scientists call it a biome.

"An ecosystem must be a continuous entity, and tropical forests (around the world) are not connected to each other. So there is no such thing as a tropical forest ecosystem. But there certainly is a tropical forest biome." (The Biosphere Catalogue, -Ed. D.P. Snyder -Synergetic Press-1985)

Biome:

"A biome is a major regional ecological complex of communities extending over large natural areas and characterized by distinctive vegetation and climate, as in a freshwater lake, a forest, a grassland, a desert, a tundra." (Wikipedia)

Like ecosystems, biomic systems include not only biotic, but also abiotic, components.

Each "Biome" then, is a larger ecological grouping of ecosystems. (Some scientists only consider terrestrial biomes, but other scientists include aquatic systems.)

There is some disagreement as to how many there are, but generally:

Terrestrial Biomes:

- Arctic Tundra
- Temperate (mid latitude) Broadleaf Deciduous Forest
- Desert
- Desert Scrub (Thorn Scrub)
- Tropical Broadleaf Evergreen Rain Forest
- Tropical Savannah
- Temperate Grasslands
- Mediterranean Scrub (Chaparral)
- Boreal Evergreen Forest (Taiga)

Freshwater Biomes:

- Ponds and Lakes

Marine Biomes:

- Estuaries
- Intertidal Zones
- Coral Reefs

A biome is composed not only of the predominant vegetation, but also of associated successional communities, persistent sub-dominant communities, fauna and abiotic factors such as:

- temperature
- water
- sunlight
- rocks and soils
- wind
- periodic disturbances (fire, hurricanes, tornados, volcanos, typhoons)

7) Biosphere:

"A biosphere may be defined as a complex, stable, regenerating, adaptive, evolving system, containing life-recycling in the various ecosystems, operating in a synergistic equilibrium, essentially closed to material input, but open to energy and information exchange, and capable of large scale and comparatively rapid cycles of transport and rearrangement of atoms and molecules. As a negentropic force, a biosphere acts as an apparatus which utilizes life to generate and store the energy free to do work." (John P. Allen, 1985, during the design of Biosphere 2)

Earth's biosphere is the global sum of all ecosystems. It can also be called the zone of life on Earth. From the broadest biophysiological point of view, the biosphere is the global ecological system integrating all living beings and their rela-

tionships, including their interaction with the elements of the:

- Atmosphere
- Hydrosphere
- Lithosphere

All three of these parts of Earth's biosphere are occupied by, and to some degree were created by, living organisms.

The biosphere is postulated to have evolved beginning through a process of biogenesis, or biopoesis, (biological creation) at least some 3.5 billion years ago." (Wikipedia)

The "products of life" of the biosphere of Earth also include the kilometers-thick limestone deposits, made from the calcium carbonate remains of life-forms such as ocean phytoplankton, which extract the carbon from atmospheric carbon dioxide to build their tiny structures. Upon dying these small coccolithophores' body structures drift down to the ocean floors, and eventually are compressed into limestone.

8) Holistic:

As an adjective, it is characterized by comprehension of the parts of something as intimately interconnected, such that they cannot exist independently of the whole, and cannot be understood without reference to the whole, which is thus regarded as greater than the sum of its parts. Holism is often applied to mental states, language, medicine, and ecology." (Wikipedia)

9) Synergy:

"A synergy is a dynamic state favoring combined action over the sum of the individual parts." (From Greek, meaning working together) "Synergetic properties of some combination of things cannot be predicted from what is previously known of the constituent parts. This is the dynamic version of the concept of "the whole being greater than the sum of its parts." (See Holistic) (Wiki and Webster's Dictionary)

10) Emergent-Properties: (From the journal "Emergence")

Emergence can be defined as: "the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems, and its common characteristics are:

- 1) Radical novelty (features not previously observed in systems);
- 2) Coherence or correlation (i.e. integrated wholes that maintain themselves over some period of time);
- 3) A global or macro "level" (i.e. there is some property of "wholeness");
- 4) It is the product of a dynamical process (i.e. it evolves);
- 5) It is "ostensive" (it can be perceived). (Corning, 2002)"

11) Integrated Systems:

The complex route to sustainability requires that a group of over twenty crucial Integrated Systems be intermingled with themselves and the natural environment. This blending of the technospheric and biospheric forms, creates the matrix to manage a community, so the community can then proceed to serve its citizenry adequately, and persist indefinitely. We need to undergo a basic alteration of the predominant paradigm, and if we manage to succeed, it will involve a transition to an "Eco-System Era," or Lewis Mumford's era of "Biotechnics," with its life-enhancing technologies.

Integrated Master System for EcoVillages (Defined)

An Integrated Master System is an interwoven combination of the important systems that serve a community or any

other large complex organized construct.

The idea is to assemble the systems in a way to further possibilities that they will self-organize and produce unpredictable, but beneficial, emergent properties. However, it doesn't always work out that way and success depends on the thought and skill with which the integration is done and developing the art of the process.

In any attempt to integrate systems, luck or good fortune will play a role. This good fortune is what happens in those breakthrough moments, when a human mind is able to significantly connect things together, that before were concealed through a lack of vision of some part of the pattern. A general rule might be that any arrangement in the integrating process should not be designed or established too rigidly in order to allow easy alterations during the evolution of integrating many diverse sub-systems.

Integrated System Nets and How They Work

Here is a brief example of how an integrated network of systems can be expected to emerge from systems interwoven relationships:

- We know that a community's domestic and commercial water, after use, is turned into sewage, "wastewater" as it drains and mixes with contaminated water coming from the various point-sources of pollution.
- n. (toilets, factories, car washes, food canning operations)
- Sewage effluent, if sterilized, can be used for irrigation of certain food crops. This completes the nutrient cycle by returning the nutrients from the sewage to the soil and to the plants to produce more food. Thus, the true nutrient cycle is: Food to Sewage, and back as Fertilizer for Food (FSFF).
- Electricity generated renewably on site, by solar collectors, wind generators, or flowing water, runs the agricultural irrigation pumps.
- The same electrical energy, plus a catalyst, can transform water into hydrogen-peroxide to sterilize sewage effluent and other contaminated water to drinking standards.
- Electrolysis of water, also using a catalyst, can produce pure hydrogen to bottle for use later as an energy "battery" or directly as fuel for engines, cutting torches, cooking or heating.
- Oxygen is also produced during this process. It can be used in cutting torches, or cleaned further, and used to breathe.
- In this Integrated System, the food produced is cultivated with machinery, and transported in vehicles that burn hydrogen and have fuel cells that create electricity. They can use electricity stored in batteries, or in tanks of hydrogen to be burned in an electrical generator.
- A factory that makes the hydrogen holding tanks is also powered by renewable energy, and uses the hydrogen stored in the tanks it makes, to use for electrical generation during periods of no wind, and as a fuel for their equipment and vehicle motive power.
- The water from which the hydrogen is extracted, comes from rain run-off, and is stored in the ground aquifer, where it is not subject to evaporation. When it has carried the sewage to an enclosed bioremediation system based on a marsh, or an algal scrubber, or if it is used to irrigate plants in the greenhouses, the evapotranspired moisture from the plants in these systems can be reclaimed by condensing it out of the atmosphere inside these two apparatuses.
- The cold source, needed for the condensation process, can be derived through phase-change equipment using wind, solar, or hydrogen-powered sources of electricity. Cold for refrigeration can also come from a flame of hydrogen, or methane from the community's anaerobic digester, that converts green wet garbage into methane, and a residual soil conditioner for the planting beds.
- A garbage truck manufacturer (Heil) is now marketing anaerobic digesters to communities, so they can use the garbage to make methane, which powers the garbage trucks.

And, so it goes, with the connectivities reaching into all areas of our lives, creating an intricate, mutually-supporting tapestry of systems and sub-systems; an anthropogenic, human-generated, ecosystem. (At this point in history, a true human-ecosystem is still just a "wannabe.")

As with all ecosystems, the greater the mutual-support by its components, the greater their functional-redundancy is.

That is, with multiple species available to do the work if one vanishes, the more resilient and stable the overall ecosystem becomes. Such duplication, or overlapping of functional capabilities within the ecosystem, puts that community into a better position to resist crashes and other disrupting impacts.

An example of this overlapping, or redundant ecological capability, is introducing predator-insects near and in a vegetable garden, and also building a chicken-run around it, so the chickens will catch insects before they reach the central garden. This is a complementary synergy of insect control, called "Integrated Pest Management" (IPM).

In a similar fashion, other living ecosystems have a multiplicity of plants, animals, fungus, bacteria, and other life-forms that do work in this overlapping way. Having several species that do the same work as part of their natural behavior increases the ecosystems chances for survival. Often this natural work is simply the activity of one organism eating another, a vital part of IPM.

A community can get its energy from direct sunlight or from a combination of the various other forms of solar energy inputs, including wind, running water, and garbage and manure anaerobically digested for their methane. These spinoff sources of solar energy can be changed into electrical energy or can also make hydrogen gas. There are other forms of energy that can contribute to the overall energy system's flexibility, such as mechanical energy of a flywheel, chemical energy of ordinary batteries.

A falling water for generating renewable energy can be created by pumping from a low-lying lake into an elevated one during the hours of wind or daylight, and releasing it to drop back down through a generator at night or as otherwise needed. If the energy for raising the water is essentially free from the sun and wind, the energy produced when it drains back down is also free. (Of course, that's after amortization of the equipment costs, and the system's ongoing costs of operation and maintenance.)

There are many ways solar energy can be stored for later use, like harvesting dead wood from trees. However, the use of biomass for fuel is a delicate subject, due to the CO₂ created. However, gasification units in a series can use the still burnable gases of combustion to fuel the next unit, and so on. As the charcoal-making process cascades from chamber to chamber, much of the carbon content in the flammable fumes is sequestered and produces "BioChar" (Tera Preta), a beneficial soil-additive, which can lock the carbon up for thousands of years, while greatly improving soil quality.

It is easy to see that our present electrical grid is susceptible to sabotage and other damage and is less reliable than a system with several inter-connected electrical production methods would be. Such a system, with its redundancy of energy sources, under local ownership and management, improves the community's generation capabilities and its ability to survive disruptions of any kind.

It will be necessary to extensively sample and monitor the integrated systems, and follow their action to determine how their interlocking relationships are performing in concert. If the system integration was not well done, there will be plenty of data gathered for later improvements. From the brief description given above, it is easy to see that an integrated system does not necessarily have a finish point, where no more connectivities or improvements are possible. It appears to be the ultimate in a work in progress—a fitting companion for the likewise imperfect but still developing human beings.

If correctly assembled, the results of an Integrated Master System can be expected to produce higher efficiency, a more integrated and harmonious functioning, and a clearer understanding of possibilities for sustainability and community wealth. Here again we recall Bucky Fuller's definition of wealth as, "The ability to forwardly organize life and life's processes."

Working toward a community Integrated Systems format, and striving to be "Green" in all possible ways, contributes to our overall "sustainability," and builds a role-model for similar efforts elsewhere to emulate.

Considerations of health and safety are a priority in any pursuit of sustainability, and EcoVillage building codes require that construction methods reduce heating and cooling, lighting, and the other energy loads.

As defined, any system by itself is already a "complexity—a set of connected things or parts forming a complex whole working together as parts of an interconnecting network." So, we are left knowing that every system is by itself a complex holistic assembly, and what's known of the individual parts is insufficient to comprehend the whole system clearly, or reveal its true nature, or predict either its behavior, or what emergent properties may arise from its action.

To reiterate, the definition of Holism "is the tendency in nature, through creative evolution, to form wholes that are greater than the sum of the parts. Small units must develop into bigger wholes, and they in their turn must grow into larger and ever-larger structures without ceasing, and this is the pathway of advancement."

When we combine several of these elusive systems into ever-greater systems, we are participating in weaving a fractal stream, the outcome of which is a mystery until it manifests. No wonder there is a fear of science and scientists, and of biological engineers and their creations.

Fractals are "a graph-curve or geometric figure, each part of which has the same statistical character as the whole. Fractals are useful in describing partly random or chaotic phenomena such as crystal growth, fluid turbulence, and galaxy formation." (Galaxy formation is a very important cosmic activity, and order, in the form of galaxies, can appear out of chaotic phenomena such as clouds of interstellar gas and debris, if fractals can describe what's going on there, they seem to have high status in the Universal makeup.)

As an example of advanced integrated design, 22 primary systems are included in the discussion of the Integrated Master System Components, shown below. This is not to say that there may not be other systems equally important in the task of designing a sustainable EcoVillage.

Although often unspoken, the health and safety considerations for all systems are critical, and are an underlying priority, for determining the meaning of true community sustainability.

This list was generated by reviewing the known basic EcoVillage systems needed for community sustainability. Some may have been missed, but these are among the most critical.

When forming up the systems' interlocking relationships, it is necessary to have a clear understanding of the community's physical system patterns, and their sequences in space and time. In correct association, these systems become synergistically supporting of each other.

The situation is clear, we need to practice a bit with all this.

Integrated Master System Components:

The interconnections of the important systems of a community create its Integrated Master System. By the definition of integrated, whatever individual characteristics the component parts had when separate pieces, now form a "whole." This assembled whole carries with it the assumption that (with good fortune), its inherent holism and synergy (i.e. the whole being greater than the sum of its parts) will function "properly" and produce a self-organizing system, with beneficial emergent properties.

In the beginning, success in this will depend on the practitioner's understanding, their skill in the actual integration, and, naturally, a certain amount of luck. The systems' arrangement should not be designed to be rigid, so alterations are easy during system evolution, or changing conditions. If improperly done, there will be plenty of data gathered for later improvements.

Systems are very powerful, and the basic EcoVillage systems combined, will show how an Integrated Master System is created through holistic integration of the primary systems. To develop human ecosystems from the existing complex framework of disintegrating communities, new patterns and relationships for human settlements need to blend with the old, to forge state-of-the-art patterns of sustainability. By this action, many fresh properties will emerge, most of which may be unpredictable.

"Self-organizing structures evolve autonomously from the interaction of individual elements." Haken's study of self-organization by investigating laser light provides an instructive example of this. He observed that, after supplying individual light waves with energy, they autonomously arranged themselves from a chaotic system-state to a profoundly structured-state, that he called the laser. (Haken, 1987)

"Maturana and Varela (1987), and Odum (1987), found that natural systems, unhindered by human interference, also seek stability and balance." (From "Research in Competence-Based Management")

The Biosphere 2 systems, including the living ecosystems combined inside the facility, were studied as a complex entity by Dr. John Corless (Biosphere 2 Scientific Director at the time, who previously worked on complex systems at NASA), and Dr. Christopher Langton, from the Santa Fe Institute. Unfortunately their studies were only preliminary, and never completed. (Langton is also one of the early originators of the idea of "Artificial Life.")

A natural ecosystem is extremely complex, as will be any successful human-ecosystem. To create an EcoVillage that even comes close to the stability and performance of an ecosystem, numerous community sub-systems must be integrated, ranging from water and sewage, to food and fiber production, renewable energy, building materials, healthcare, construction methods, utilities and services, and community financing. There are at least 22 systems that are currently identified as comprising a typical EcoVillage's Integrated Master System.

Below, are some of the individual systems that are to be joined to make up a Master Integrated System. All vital utilities' systems and services are to be community-owned and community-operated, or carefully over-seen and regulated. There may be other unlisted systems, equally important to the task of designing an EcoVillage. In correct association these systems become synergistically supporting of each other.

List of Components:

- 1) Air purification (plants and soil bacteria; biological decomposition of industrial by-products using Soil-Bed Reactors)
- 2) Water (collection and purification by H₂O₂ and UV light; store aquifer; distribute)
- 3) Sewage and other "wastewater" (bioremediation treatment for reuse by: root-mat, constructed wetlands, algal-scrubber, vermiculture, mycorrhiza, then sterilize by hydrogen-peroxide and UV light, or ozone)
- 4) Food, Fiber (produce/process locally, all caloric/nutrient community needs)
- 5) Energy (renewable: sun, wind, water, biomass methane, geo-thermal, hydrogen for fuel and/or as "battery")
- 6) Building Materials, Methods of Construction and Housing (indigenous, local, natural where possible, avoid using civilization's trash to build our homes)
- 7) Temperature control (interior-climate regulation; solar space-heating/cooling)
- 8) Transportation (car-free community; non-fossil fuel for inter and intra transport)
- 9) Communications (phone/TV/internet; WiFi; cable TV; cellular ; fiber optics)
- 10) Solid Waste (control and recycling)
- 11) Health and Medicine (preventative, community-insurance-healthcare)
- 12) Utilities and Services (publicly owned; increasingly-technical and ephemeral)
- 13) Financing:
 - a) Individuals (work building EcoVillage; community credit union; housing programs with zero-interest home loans; bulk-buying)
 - b) Community Development Company (CDC) (sale of land, buildings, Development Rights (DR), start-up businesses needed to build the community; stock, monetized as partial-wage payments)
 - c) Total EcoVillage community enterprises; real estate capital gains tax on buildings' resale; EV credit card; leases; local currency; Utilities and Services; condo fees; DR sales; local building materials; bulk-buying; tourism; housing programs; (See Income Vectors section)
- 14) Government (proposed: representative for debate; voting 100% democratic)
- 15) Fire and Natural Disaster Response (volunteer and local government)
- 16) Police (local government)

- 17) Recreation: parks, markets, fairs, contests, paths, pool, playing fields, parades, rituals, dramas
- 18) Insurance (all types by community or community-negotiated contracts)
- 19) Education (apprenticeships, parents, elders, tutors, life-experiences, church and religious rituals, verbal stories; integrated-systems taught as necessary for the community's "urban ecosystem" viability and health)
- 20) Housing and property ownership (both self and companies)
- 21) Soil-Building and retention (garbage/methane, Biochar, composting, natural fertilization)
- 22) Living Systems (all kingdoms of life, urban, rural, wilderness)
- 23) Social Services (youth/elderly; parks/recreation/hostel; community-outreach; employment; enterprise-training/coaching; daycare; volunteers)
- 24) Economics (community currency forms, roles and the real meaning of wealth; taxes; industry; commerce)
- 25) Outreach relationship systems with other communities
- 26) Community data collection and self-monitoring
- 27) Industry and commerce (the products and by-products)
- 28) Relationship to the cycles of nature
- 29) Care of the disadvantaged (of all ages)
- 30) Self-monitoring (data collection and system performances)
- 31) Employment (including personal enterprises, as well as jobs)
- 32) Extractive industries or "Primary Production":
 - a) Wood (forests, not monocultural farms)
 - b) Fishing (global restraints)
 - c) Animal husbandry (all types of grazing animals)
 - d) Mining (dangerous by-products, environmental destruction)

The alternative to our learning how to create sustainable communities is not acceptable, since, by definition, if "sustainability is not reached," the implication is we will experience a rather abrupt final chapter to the human experiment, and a probable end to our existence as a viable species.

We have too much to learn to quit now. Just as there are some glimmerings that we're on an evolutionary path to a higher understanding of our place in the Earth's BIG PICTURE, and perhaps even the cosmic one. There are those who disagree that this is happening, but controversy is fine too.

There are also those who still don't think that human activity is big enough to impact the atmosphere, even though Vladimir Vernadsky, in his milestone book "The Biosphere" in 1926, could calculate that humans were a force rivaling geology in terms of annually moving tons of material about the world. Recent calculations also claim humans are appropriating perhaps as much as 40% of all biologically-intercepted solar radiation for our own use in our agriculture, tree plantations, and other biomass manipulations.

Almost everyone is willing to admit without much argument, that humans are doing much that is environmentally destructive and counter-productive, like dumping our products, including CO₂, methane, nitrous oxide, dioxin, heavy metals, radioactive waste, pesticides, fungicides, and herbicides, into the world with little thought or control.

Quite a few people also agree this is not a good idea, and should be curtailed, or stopped altogether. There is also a fairly large agreement that regardless of the cause, Earth is getting warmer, and our activities aren't helping change that. So, whether global warming is all, mostly, partly, or not human-generated, we need to change our ways.

12) Proposed Immutable Essentials of a Sustainable Community:

a. Intention vs. Compromise

From personal experience I assert that if the prospective EcoVillage citizens accept as valid, the overarching premise that a human community can approximate to the ecological unity of a "natural" ecosystem, and if they can retain a

steadfast commitment to that end, they will find the strength to avoid the inevitable pressures that will work to introduce divergent and diluting compromises into the EcoVillage's principles; that is those principles such as the Rules of the House, the EcoVillage's Values and Goals, and its Immutable Essentials.

For such a project, distractions and friendly doubting must be expected, but, under such pressures, "Keep the faith!" is not an idle exhortation.

b. Immutable Essentials

The Immutable Essentials of an EcoVillage are those elements that are absolutely necessary for creating community sustainability, and must not be forfeited in the name of compromise, "common sense," or financial profit.

The Immutable and Essential components that constitute an EcoVillage, are generated and derived from the community's Values, Goals and Characteristics that are, in general, agreed upon by the citizens. The ethical basis of our actions springs from our basic Values, and their associated Goals, and a community's agreed-upon principles, such as its Immutable Essentials, are crucial for its appropriate development.

Both current and prospective citizens need to understand this essential point, because as the EcoVillage new paradigm unfolds, and community development progresses, there will be pressures to "compromise" and to alter the community's innovative solutions out of existence.

The EcoVillage Immutable Essentials need to be introduced by various means, so as to educate and attract customers who can consciously recognize, accept and share in the EcoVillage community's values and goals. To fully reach the widest audience, and to make certain that the audience actually receives the message, repetition is useful, but particularly when stimulation is through at least these three traditional ways of transmitting information:

- 1) the emotions (through art, music and theater presentations),
- 2) the intellect (by readings, other local media, and public discussions), and
- 3) the instincts (transmit at picnics, barbecues, or real hands-on workshops)

Internal pressures to resist fundamental changes in the status quo will come from human inertia, laziness, fear of the unknown, and from the loss of the mental comfort that familiar solutions to urban issues provide.

External pressures, from special interest groups and individuals, and from society as a whole, will be based on these same reasons, but also more specifically from anyone who profits from maintaining the existing paradigm. (The time honored, and often true adage, "Follow the money," is a useful exercise when faced with "unreasonable" resistance to proposed, and obviously superior Policies and Programs.)

Another restraint to innovation is the fact that the old ways of doing things may be cheaper, at least for a while, and this will be a deterrent to acceptance of the EcoVillage principles and goals. One significant cause of the cost increase is that ecological costs of construction are usually "externalized" at present. This externalization refers to such costs of providing clean air, pure water, or topsoil that are not taken into consideration when Nature is called on to do the work. However, local and world awareness of this accounting fallacy is increasing, as is the importance of including these items in calculations for development.

An EcoVillage, being a human social creation, is capable of self-observation, self-critique, and self-adjustment, and can give itself direction and encouragement, provide its citizens with incentives to create and increase the community's sustainability.

One of the most important roles of the management of an EcoVillage will be to create policies and programs to cultivate these skills, and the community must give itself encouragement and direction on the path toward becoming an environmentally healthy and financially abundant town.

The ethical basis of our actions springs from our basic Values, and their associated Goals, and so, a community's agreed-upon principles, such as its Immutable Essentials, are crucial for its appropriate development.

A primary goal of an EcoVillage is to serve as a viable example of a small, healthy, and financially abundant community, continually striving for greater economical and ecological sustainability, and maintaining fair-play and socio-economic justice, in all aspects of its community's life.

It must be left up to the local community to choose their own directions, but a possibility for expediting the process is to check into how innovative, vibrant and successful programs have come to pass in the past. Many projects of the WPA during the Great Depression in USA were well done, as were those of Jaime Lerner in Curitiba, Brazil. Denmark is able to quickly place those whose jobs have become obsolete, and many other countries have managed to break through the hard skin of bureaucratic reluctance to produce useful, stimulating responses to their tasks of the day. Reviewing opinions as to why programs have failed should also produce interesting results. (Think FEMA and Katrina.)

(*The Progressive City* by Pierre Clavel, 1987, has many useful examples of city Policies and Programs that created superior communities.)

Although, there may be many other unidentified factors, the following are at this time considered to be essential elements of a truly sustainable EcoVillage:

1) For-Profit Community Development Company (CDC)

A for-profit Community Development Company (CDC) will be formed to design and construct the project, and building and selling the community will provide the primary source of income for its on-going development. It is chosen as a for-profit company to show that a corporation can voluntarily limit its income, and fill a role as a responsible, positive force in developing a community as a sustainable Human Ecosystem. The CDC transfers all public buildings, and financial surpluses to the community by the project's end.

Following initial financing, building and selling of the community will provide the roll-over source of funding for the project's on-going development.

2) Community-Wide Ownership of All Land Under Condominium Law

The EcoVillage as a whole owns all land under condominium law, a land trust, or similar form. This ensures that all future appreciation in land value as the town develops, goes to the community, rather than to speculators. This increases the community's asset base, and together with item 3), below, should insure the community will have no need to resort to bond issues for financing community improvements. (Other sources of community income will also be outlined.)

Community-wide ownership of all land means that an "undivided interest," or a percentage of all the land in the community belongs to each individual, or group, that owns any building, or Development Right (DR). A DR is the equivalent of an undeveloped "lot" and is located in space by its x-y-z coordinates, defining the future dwelling "envelope."

3) Capital Gains Tax on Real Estate Resale Profits

CDC is dedicated to creating and attracting industries and businesses to produce the goods and services necessary for building the EcoVillage, and for its on-going operation and long-range commercial health. Local enterprises should eliminate most commuting, and local business cooperation promotes ingenuity in using the "waste" of one enterprise as "food" for another to strengthen economic sustainability.

By the condominium joint-ownership of community-lands, a huge financial advantage is created for the EcoVillage and its individual members, while it develops and appreciates in value when properties are sold and resold.

Appreciation in any community's property values is commonly acknowledged to be from the community's amenities and attractiveness, and are not simply attributable to the seller's real estate acumen. The EcoVillage itself should therefore benefit from any resale of property, along with the seller. To facilitate creating a wealthy community, and a well-provided for citizenry, a 50% capital-gains tax is paid to the community, on only the profit portion of any resale of any building. This ensures that the town will receive its fair share. "Fair share," herein means that both the community and the seller will share approximately equally any increase in property value. This tax will also help discourage property

speculation.

The tax is only on any profit over building's initial cost, minus verifiable and approved improvements, and taking inflation into account, if any has occurred. Thus, when any property is resold, it routes a significant share to the community. Based on past experience with appreciation rates for well-built homes located in an attractive and vital community setting, the resulting payments to both the owner and the community can amount to about 10% per year. This income, in conjunction with other financial benefits accruing from community-owned utilities and other sources, should help to eliminate the necessity in any well-administered EcoVillage to have bond issues, or other loans for community improvement programs.

By the end of the project, all public buildings are sold to the community, and any CDC corporate financial surpluses are transferred to the municipality. (As with many other details of the EcoVillage unfolding as a process, these transfers remain to be worked out as to their specifics.)

To reiterate, this tax approximates to a 50% community tax on the profit of the resale of a property, after all adjustments for inflation, home improvements, etc. The tax revenue is earmarked for the EcoVillage's infrastructure development, or other uses as determined by a vote of the community as a whole. (If a house increases in value 100% in five years, the owner and the community both get about 10% per year profit over the 5-year period.)

4) Water Sources

Water is to be collected primarily from rain, and from atmospheric-moisture condensed from greenhouses and wastewater treatment system enclosures. Water purification will use either hydrogen peroxide in combination with ultraviolet light, or possibly ozone treatment, but not chlorine.

Current estimates are about 85% to 90% of the water used in greenhouse irrigation and the sewage treatment systems can be reclaimed, and recycled. Any required make-up water will be drawn either from the aquifer or collected from precipitation.

5) Aquifer Recharge

Rainwater runoffs 100% from all hard surfaces, will be collected, purified and pumped into the local aquifer, to be removed as needed. Rain runoff from ground surfaces that cannot be readily captured, will be slowed down and directed into contoured swales, and other rapid-absorption areas, to stop undue loss from evaporating or draining from the site. These catchments will be planted as orchards, and other perennial agricultural crops, such as edible or structural bamboo, and all excess ponding go into the aquifer. On permeable surfaces, steps will also be taken to facilitate aquifer recharging, and reduce undue evaporation.

The Nabateans of 2,000 years ago, with only 2 to 3 inches of rain per year, managed to build a viable civilization in the Negev desert. We should be able to do as well, given our current technology, and with a little commitment. The guiding principle is to not draw more water out of the aquifer, over the period of a year, than is put back.

6) Sewage Purification

Sewage purification is achieved through bioremediation purification systems, such as constructed wetlands, or similar, with final sterilization of the effluent by hydrogen peroxide and ultraviolet light.

Bioremediation can remove contaminants such as volatile organic compounds, non-volatiles, heavy metals, etc., and after further sterilization to eliminate any residual pathogens. The purified high-nutrient effluent will be used for various agricultural purposes, thus completing the food-sewage-food natural cycle.

A similar process is being used in Orange County, CA, which then injects the purified water into the local aquifer as recharge. El Paso, Texas is said to operate a similar system. Bioremediation itself is a centuries-old process. (See books: *Farmers of Forty Centuries* and *Constructed Wetlands for Wastewater Treatment*.)

It is well documented that our soils have been deteriorating through the farming practices of the last two hundred years, and it is imperative that a community's nutrient loop should be closed to recycle sewage effluent into soil build-

ing and for fertilizing human food crops. Burning human or animal manure to produce electricity is not a sustainable recycling of nutrients.

A closed nutrient-loop is not open to losses through dumping, burning to produce electricity, or frivolous uses, like golf courses, or even non-edible tree plantations. Burning human or animal manure to produce electricity is not a sustainable recycling of nutrients. However, recent documentation affirms that only pesticide, antibiotic and hormone-free human and animal waste is safe for use as agricultural fertilizer, and/or composted for soil amendment.

Human and animal waste can be purified by various natural means. Some sources of contamination in the case of human waste are:

- Prescription medications, hormones, antibiotics,
- and for animal waste:
- Hormones and antibiotics again, pesticides from feed and feedlot pest treatment.

It may be that mycoremediation (treatment of sewage with fungi of various species) or algal-scrubbers can adequately address these issues. In some cases more ordinary methods may also be effective, as with using constructed wetlands, which are known to transform some pesticides and render them harmless.

7) Local People, Local Materials

Local people and local materials are employed in the construction, and other work on an EcoVillage, whenever possible. This policy keeps money recycling within the community. If people and materials are not available locally, they are drawn from as close as possible, preferably from locally-owned, community-supported enterprises. This policy will determine to a large extent what materials are used.

When suitable, local stone and soils are used, and clays for architectural ceramics. Wood, for doors and cabinets is purchased locally, or from a more remote CDC or community-owned timber stand and lumber mill, and is solar-kiln-dried. Recycled materials are also used where applicable.

Rammed earth, adobe, clay-slurry with straw, strawbales, daub-and-wattle, earthen plasters, lime plaster and mortar, bamboo, wood, ceramic-cements, and stone, are typical of the materials to be used. (Steel and Portland cement will be used sparingly.)

Non-natural, “value-added” materials will be restricted to those with very long “lifetimes.” Some examples of high embodied-energy materials with great longevity are: ceramic tile, copper, ferro cement, cast iron, bronze, and Corten-steel. Recycled materials are used when applicable, and solid waste recycling of paper, glass products, and some metals, will contribute to the local community wealth and stimulate inter-community trade. All materials are reviewed and approved, on a case-by-case basis.

All dwellings are spaces designed for beauty and practicality, with common areas and with edible landscaping incorporated into each dwelling cluster and neighborhood. Walking paths, bikeways, sports fields, swimming pools, and other recreation areas are easily accessible.

8) Food Production and Processing

Water, sewage treatment, and food production are integrated, and addressed as a synergistically whole system.

Nutrients and calories equivalent to the community's overall annual requirements are produced, grown and processed locally, and without the use of pesticides, or unproven Genetically Modified Organisms (GMOs). Locally, in most cases, means within 25 miles.

Each Dyad, a module of 32 dwelling units, with about 85 residents, has a half-acre greenhouse (21,800 square feet), and the edible community landscaping includes fruit and nut orchards. The greenhouse, being a year-around climate-controlled environment, is the equivalent of almost two acres of outside garden. In a Northern US location, some plants will grow four vegetable crops per year. Based on experience with the enclosed agriculture of Biosphere 2 in Arizona, this should meet all of the vegetable needs for 85 people, and can also produce some of the more delicate

fruits indoors. (Grains or the necessary food for eggs or meat animal is not included in this greenhouse estimate.)

In times of adequate rainfall, grain crops can be grown in or around the outside catchment basins. More protein can be generated from agro-forestry than from grains, so the community food production system will tend to focus more on orchard technology.

Both inside and outside the greenhouses, personal "allotment gardens" are available for those interested. There is a community food-processing center in each neighborhood (of about 320 persons), with classes in canning, drying and pickling, and other preserving needs of the community, for local use or export. These are part of, and promoted by, the EcoVillage educational system.

Food storage is provided in each Dyad, for a two-year supply, which is replenished as it is used. Bookkeeping and tracking of food from the growers to the stores, and their payments are made simple by community computer links.

After human and animal needs are filled, any garbage or other inedible biomass is processed by anaerobic digestion to produce methane (natural gas), and the remaining high-grade soil additive, is returned to agriculture. (An additional use for inedible biomass will be as food-stock for mushroom production.)

Permaculture techniques and methodology will be a primary source of inspiration and a guideline for the development of the entire project. Permaculture is not limited to food production and preparation, and applying its principles provides a viable approach to many areas of sustainable living.

9) Renewable Energy

All community energy comes from renewable sources, and EcoVillage commercial and manufacturing facilities will be restricted to non-fossil fuel energy sources. An EcoVillage is essentially free of the electrical grid, but may contribute to it, if it's of economic benefit. Sun, wind, water power, methane, and hydrogen from electrolysis, are the usual renewable energy sources, unless geothermal is easily available.

Hydrogen will serve as a secondary backup, and all surplus energy from the primary sources will be converted to hydrogen for use as a "battery back-up" during nighttime and unusually low wind or sunshine periods. Space heating, cooling, and refrigeration will be done without use of greenhouse gases or ozone-layer depleting refrigeration materials.

Sliding-scales, based on volume of use, can promote conservation, when used in pricing utilities. Charging practices will need periodic review, and rethinking to best fit the situation of community-owned utilities. Any such system will have emergency backup.

Electricity from burning methane generated by garbage helps reduce the greenhouse effect, since methane is a much more serious greenhouse gas than CO₂. (Some sources quote methane being 25 times more powerful than CO₂ as a greenhouse gas.) The EcoVillage also plan to investigate importing additional wet garbage from nearby towns, to generate methane, and for soil-building amendment at the end of the anaerobic process.

10) Transportation with Zero Emissions

Automobiles, trucks, and other fossil-fuel powered internal combustion engines are major contributors to CO₂ production. In an EcoVillage, all transportation has zero CO₂ and other hydrocarbon emissions, and no cars or trucks are allowed within the core of the community, except emergency vehicles, usually electric, and specifically designed for the EcoVillage, and its streets. Fossil-fuel powered engines for other uses are also not permitted.

Parking spaces are available at the edge of town for tourists and residents with vehicles, with quick and convenient transit to within 500 feet of every home and business in town. A community-fleet of hydrogen, methane, or electric powered vehicles are available for rent on a trip-by-trip basis for outside the community, and longer-term arrangements are available. Using renewable energy sources, water is split electrically into oxygen and hydrogen. It is a well-established technology, and not an unusual, esoteric process.

The motor pool supplies a wide variety of inexpensive rental vehicles to substantially reduce the need for individually owned cars or trucks. Employment and commercial establishments within the EcoVillage will radically reduce the need for commuter trips to jobs or shopping elsewhere.

In addition to a sophisticated system of freight and small package delivery, there is an electric trolley transit system, and an elevated Personal Rapid Transit (PRT) monorail planned. Taxi service in the form of small electric vehicles will be available, horse-drawn cabs are also feasible, and a strong equestrian component is encouraged. Electric bicycles and scooters, as well as the traditional, aerobic forms of transport, walking and cycling, are designed for and encouraged. Almost all personal needs are less than a mile from every residence or business.

Annual direct costs attributed to the automobile in the US, are currently estimated at about \$16,800 per car (254.4 million cars), which adds up to a whopping \$4.274 trillion per year. But when including the estimated "indirect costs" of sickness, death, property loss, parking, pollution, injury, climate change, petrol subsidies, sprawl, defense budget defending oil fields and shipping lanes, land lost, money and production lost to those factors, or to grid-lock, and more, the added costs probably exceed another \$3,930 per US car per year, for at least an additional \$1 trillion.

11) Local Enterprise

The CDC and the EcoVillage itself, are committed to creating or attracting industries and businesses to produce the goods and services necessary for building the EcoVillage, and for its on-going, long-range healthy local economy. Enterprise is encouraged, particularly in manufacturing, as are other local businesses, and trading arrangements with other communities, companies, or individuals. In 1959 there were 27 businesses per 1,000 people in the US. Using that as standard, a typical EcoVillage, with a population capped at 5,100, will contain at least 138 businesses.

Local EcoVillage startup business are a part of the development plan. Small-scale industrial factories with their complementary workshops aim to provide most of the community's construction supplies and materials, and many of the manufactured components for constructing the EcoVillage.

Commercial businesses and small industrial facilities and their complementary workshops are important in the EcoVillage's development plan. Some of these businesses may need to be initially set up, or sponsored, by the CDC. Manufacturing is oriented to provide the EcoVillage's initial construction needs, to begin the production of replacements for critical community imports, and to serve customers and trading partners outside the EcoVillage.

Typical construction goods for local manufacture are doors, windows, cabinetry, light fixtures, ceramic tile, kitchen ware, and some paints. Ideally, manufacturing will be established for glass production, some steel, adobe brick and rammed earth, sheet metal fabrication, foundry work, hardware-products, pipe, ferro-cement and possibly precast concrete structural members. Depending on the location of an EcoVillage, it may have access to materials, such as stone, wood, clay, silica sand, iron ore, and other natural resources.

The basic process for determining what businesses or manufacturing the CDC will initiate, will be decided during the EcoVillage planning and design stage.

12) Finance

EcoVillages are designed to function within the current economic framework of the society, but have added innovations calculated to produce individual and community independence and prosperity. For example, the Community Development Company (CDC) is established as a for-profit corporation, but it spins off various non-profit companies for specific educational or philanthropic purposes.

The CDC policy of monetizing its stock when possible, as partial wages, payments for consulting, materials and services, will strengthen the CDC financially. It will also assist the EcoVillage community in general by finance construction, and financially boot-strapping up individual employees through CDC bulk-purchases of goods and services. Employees of an EcoVillage's CDC, or a spin-off business, can choose to trade labor for company shares, which may be converted later into home-ownership, into shares of the community's Utilities Infrastructure, or into some other EcoVillage-owned or supported venture.

Citizens can also own shares in the EcoVillage itself, set up as an incorporated entity in the state. The basic concept is to monetize the community's stock, by having it backed by real values, either labor, and/or tangible products or resources.

A Community-owned credit union, provides zero-interest loans for homes and selected business buildings. The credit union is initially set up and owned by the CDC, but is sold at cost to the EcoVillage community. A community-wide currency is planned and when developed will be important for both the individual's and the community's economy, as a trade-exchange system.

When interest costs are eliminated, and superior housing becomes available for the common person, freedom abounds, and democracy arrives. This may sound like it comes from the I-Ching but "truth will tell," and elimination of interest on home loans provides a huge incentive boost to anyone who has up-rooted themselves and their families and migrated to work on building an EcoVillage, a community that is aiming for a condition of symbiosis and harmony between residents and their surrounding biotic and abiotic natural systems.

As it gains construction momentum, the CDC increases in ability to negotiate lower costs for food, utilities, housing, insurance, education, medical expenses, and transportation for the financial well-being of both the CDC employees, and the community's home-owners. (Often the same people.)

Utilities and Services, and other components of the infrastructure, are gradually sold to the community as a percentage of the price of homes and other buildings. The profits for various CDC incomes vary, but is intended to average 10%. For example, the CDC profit on buildings may be 20%, which is averaged with incomes from all other sources to stabilize the CDC's profit at 10% annually. The EcoVillage Trust Fund is non-profit, established to serve the community. It acts as a temporary capacitor, through which all income vectors are tracked and averaged until completion of the project.

There is a sales tax of 3% (not on food) planned on purchases by non-EcoVillage residents, tourism helps support the community, and taxes collected go to the EcoVillage for further development, improvements or other uses voted by the community as a whole.

13) Utilities and Services

The community owns and operates its Public Utilities and vital Services, which form a substantial part of its economic base, and should help ensure that an EcoVillage never has to float loans or bond issues to finance improvements. It is required that they be transparent in management and accounting, and financially sound, as established by the community.

14) Monitoring and Technical Expertise

The entire EcoVillage is considered a field-laboratory, and the community owns and operates laboratories for sampling and monitoring air, water, soils, chemicals, sewage, and other waste products.

They will determine the existence and identification of any local occurrence of heavy metals and other contaminants in the environment, such as volatile or non-volatile organic compounds (VOC), inorganic compounds. The labs will also measure the uptake, concentration, and transmutation efficiency of the community's wastewater treatment system.

All dwellings and businesses utilities are metered for tracking the flow of energy, water, and other utility data, which are then refined to extract meaningful data for water need and other utility requirements and costs.

15) Education

Education is free for EcoVillage citizens, from K through graduate school level, and is provided through the Institute for Applied Ecology (IAE), a non-profit organization owned by the community. The overall educational goal is to develop understanding of the systems for economic and ecological sustainability and the life-style this requires. The humanities are an important part of the curriculum, in addition to the scientific and engineering content. The primary emphasis is on learning by doing.

The IAE also creates educational programs for day-visitors and other students from outside the community. Boarding schools, and an EcoVillage College will be established as early as feasible during the building process. For-pay programs for non-residents will fit a wide variety of student needs and time-periods, from as short as a few hours for day-visitors, to primary and secondary schools, to years-long academic schedules leading to degrees at the college and graduate levels, to technical/professional seminars for special skills training.

16) Healthcare

The EcoVillage goal is to encourage a healthy lifestyle, with locally-grown organic food, and opportunities for exercise as a natural quality of daily life. Healthcare facilities and treatment are provided for all EcoVillage citizens at little or no cost. A community clinic is staffed by a nurse-practitioner, for routine health-checks and minor emergencies. This, and other preventative measures will reduce incidences and expenses of “catastrophic occurrences” for which insurance companies analyze. Thus, insurance policies need not cover minor ailments, which lowers costs. There are also salaried physicians, and a community diagnostics center is planned, with other medical facilities for full service.

The basic attitude toward all EcoVillage medical needs is shown in the community motto, "We take care of our own."

17) Insurance

Initially, insurance will be negotiated by CDC for bulk rate benefits. Later on, the EcoVillage plans to have its own insurance company to cover illnesses, homes, lives, transportation, and the other aspects of life made more secure by having an insurance hedge. Innovative approaches will also be copied, and further developed, to generate self-insurance programs, such as is currently used by many private businesses in the US.

In basic terms, the EcoVillage community is the individual citizen's "greater family" and in a well-run culture, the community assembles the necessary resources to care for those who fall ill, are poverty-stricken, old or feeble, or for any other reason are without means, marketable skills, or any other advantages of life. If a community is wealthy as a totality, the act of caring for its citizens when they need help of any sort, should not pose a problem. An EcoVillage is designed to be wealthy enough to handle all contingencies of health care, education, and the other basic needs of its citizenry.

At certain points in the past, this was understood as the duty of the community, and also of those who claimed alignment with the religion of the time and place. Charity and Almshouses have both been a strong threads in Christian communities, and the tithe, a one tenth tax to support the clergy and church, included money for its "good works." In the Jewish tradition, Jews giving help is not considered charity, but is called *tzedakah*, meaning “righteousness” and “justice.” and is considered to be 10% of one's income. In Islam this is called *Zakat*, and is one of the five pillars upon which the Muslim religion is based, where 2.5% of one's savings is to be given each Islamic calendar year.

A friend recently had brain surgery, costing approximately \$1 million. He was lucky to have a job with a branch of government where insurance covers that level of care. That is the sort of insurance any worthwhile community should have for all its citizens, not just those lucky enough to have a certain skill set or the right job.

Again, the EcoVillage attitude toward all health care needs, is seen in its motto, "We take care for our own."

18) Affordable Housing

EcoVillage property buyers will have access to zero-interest loans, and to further facilitate affordable housing, can participate in the construction of their own homes under direct supervision, ensuring adherence to the town's standards of quality construction .

19) Community Activities and Government

For an EcoVillage to be able to run its own affairs, it needs to be incorporated as a city, and these laws vary from state to state.

In addition to certain city tax benefits, there are many state and federal governmental programs still available and beneficial for small rural communities. Incorporation also negates any possibility of the community being annexed by

adjacent cities, and in many states an incorporated city must give permission for any other community within a certain distance to also incorporate. (This distance is five miles in Arizona and Texas.)

Incorporation allows the EcoVillage to proceed with its own plans for community utilities, government, and sales-tax structures. It provides the freedom for the local population to decide its own rules for water and electrical conservation, ownership and management of other utilities, pass ordinances, and write and enforce its own building and zoning codes if desired. This is only a short-list of the advantages of incorporation.

Social services and cultural amenities are available to all members of the EcoVillage community. These include: membership in the EcoVillage Credit Union, access to low-cost insurance, education from K through post-graduate studies, and a wide variety of places for spiritual pursuits. Governmental activities, such as town-hall meetings and planning meetings, will be transparent and open to citizen participation. There will be many special events, with lectures, workshops, festivals, and musical and theatrical performances regularly scheduled in the EcoVillage's public meeting halls.

EcoVillage government is currently considered as representative for conducting preliminary discussions in committees, but totally democratic for voting, with all registered voters able to vote on all issues. Completely democratic hearings and discussions are also a possibility, but may prove too unwieldy in a community of 5,000. Qualifications for local voting are to be set by the community, but age 18 is suggested. (A mandatory voting requirement, as in Australia, is a subject open for discussion.)

The structure of local government is now planned to be based on an elected representative from each Dyad to be a member on the EcoVillage City Council. (A Dyad has about 32 dwellings, and averages 80 to 100 people.) There will be 64 Dyads in a completely built EcoVillage, meaning the City Council would have 64 members. The Council then forms subcommittees to study, discuss and report back on the various issues, which the Dyad's representative then relays to their constituents. (An alternative idea is for an elected representative from each Cluster of 16 Dyads, or about 40 to 50 people, which would increase the City Council members to 128.)

All City Council meetings are televised live and are also on the community's broadband service and local radio. EcoVillage Council and Sub-Committee meetings are open and public, although discussion is seen now as being limited to the representatives, unless otherwise ruled.

The arguments pro and con for each issue are possibly best summarized while in committee, and then transmitted back to the Dyads. The representative may or may not make recommendations to the Dyad residents. The pro and con data for each issue can also be summarized and sent by email to all citizens, or printed as it is for all elections in some states, like Arizona.

After a specified time for discussions in the Dyad, the whole community votes on each issue and voting is done, either in person or on the internet. To date, there has been no discussion or research on the pros and cons of a mayor vs. city manager type government for an EcoVillage, so that and other structural questions of organization remain to be settled.

13) Benefits, Attractors, and Key Features of EcoVillages:

The question is sometimes asked: "Why would someone chose to buy, live, and work in an EcoVillage, rather than in a more ordinary development?" In response, the following list of features has been compiled to show what an EcoVillage offers that other communities generally do not. Below are brief descriptions of some of the policies and programs that form the EcoVillage's benefits, attractors, and other key features of its sustainability.

Some of the special features that set EcoVillages apart from the ordinary development and ensure its attractiveness are:

- condominium land-ownership over the entire property
- pedestrian and bicycle oriented community

- bio-diversity, and an “edible landscaping”
- a total open-space “Commons” of over 250 acres inside the immediate fabric of each EcoVillage, held in a perpetual land-trust, and up to another 5,120 acres of surrounding community lands for grazing, woodlands and wilderness
- energy from locally generated renewable energy
- a community transportation system eliminates the need for personal cars
- wastewater is recycled into agricultural production, after sterilization
- on-site, or local building materials used extensively
- rainwater harvesting used for community water and aquifer recharging
- local food production for increased community sustainability/self-sufficiency
- community-owned credit union, with low or no-interest loans for citizens
- group-plans for health, and other insurance, for citizens
- financing incentives encourage home-ownership with programs for:
 - affordable housing, and sweat-equity credit,
 - creating local enterprises to eliminate commuting,
 - stimulation employee-ownership of local businesses and industries,
 - zero-interest home loans, and for selected small businesses

Children growing up and educated in an EcoVillage dedicated to economical and ecological sustainability will learn of the various roles that human agents can properly play in the service of the living Earth and the evolution of the biosphere.

An EcoVillage intention is to serve as a functioning, viable example of a small, healthy, modern and financially abundant community, that continually works in all aspects of the community's life, toward greater economical and ecological sustainability, and socio-economic justice.

EcoVillage's are planned to be independent, modular units, to illustrate how integrating their key components can result in a sustainable community. They are small-scale, but still full-service communities. By several criteria, this means populations of up to a maximum cap of about 5,000—still a size where you can expect to find all functions necessary for a well-rounded urban life-style.

Local control of the necessities of life: food, energy, water, building materials, sewage recycling, transportation and communication, is crucial to any EcoVillage's success. The term "sustainability," used in the context of an EcoVillage venture, must be kept to a high standard so both the Economy and the Ecology of the community can be meaningfully gauged. The CDC policies and programs comprise the benefits, attractors, and the key features that reveal the level of a community's true sustainability; its ability to persist into the far distant future.

News articles and limited advertising will be placed in selected periodicals, chosen for their specific readership, but, initial attraction for a potential EcoVillage citizen, will also come from hearing about the community by word of mouth, and about the principles around which it was organized. Another factor of attraction is its employment potential, and the unique home ownership programs with no interest loans. (See also below: 14)

Values and Goals Defined: For the Design of Sustainable Communities

Here are some specific examples of CDC programs that further community sustainability and attractiveness. They can be used as a checklist for a "Systematic Critique" to evaluate the performance of any town, community development or activity that lays claims to being sustainable:

1) Living the Gaia Theory

An EcoVillage will consciously include humans as part of the community's ecology and environmental context in such a way that the EcoVillage will mimic the ability of natural ecosystems to regulate and regenerate themselves. Feedback mechanisms will be used to simulate nature's living homeostatic systems. If this sounds too visionary, observe how a complex woodland or prairie ecosystem becomes an environmentally wealthy, stable, community. It is quite clear that it is not by consuming more water, food, or other forms of energy than are readily available, or by polluting its own

environment, etc.

As in any thriving ecosystem, all EcoVillage policies aim to contribute to creating the conditions necessary for long-term community survival and health. A member of the greater Gaia community, the EcoVillage strives to discover and practice those activities by which it can create the conditions necessary to ensure its ongoing survival.

An EcoVillage challenge is to learn how to create and operate a balanced combination of the human-created technologies and the use of natural systems of bacteria, protists (that fascinating kingdom of life), plants, animals, and fungi. The more integrated the living systems are into the whole pattern, the fewer of Earth's non-renewable resources will be needed, and the farther the community can progress toward its goal of functioning as an ecosystem, and better its resilience to disruptions, natural or man-made.

2) EcoVillage as Ecosystem

The EcoVillage works toward functioning as much like an ecosystem as possible, and therefore sustains its primary-producers. A natural ecosystem's primary-producers are usually green plants, but the primary-producers of an EcoVillage are its citizens.

Of course, they also ultimately depend on green plants as their primary source of life. If you wish, just call it a paradox, but it is the responsibility of the citizenry to deal in an integrated and mutually beneficial way with the plants, animals, members of the other Kingdoms-of-Life, and with their own human neighbors, and in this way they become the community's as primary-producers.

In addition to human beings, the EcoVillage must be concerned with other species, their protection and preservation, and will promote the re-establishment of rare breeds, heirloom plant species, and the conservation of life and ecosystems in general.

3) Sustainability

The EcoVillage strives to honor the basic concepts of sustainability, which can be distilled as:

Being able to support whatever activity you are engaged in, into the far distant future, without destroying the environment that gives us life. A good way to think of it is to pose the question:

"Can we continue for a thousand years without interruption, weakening, losing power or quality to:

- obtain food for ourselves and our animals,
- build our homes and other buildings,
- dress ourselves,
- get energy for our cooking, heating and transportation needs,
- have adequate water,
- dispose of our human, animal and industrial wastes,
- medically care for ourselves,
- provide for the young, old and otherwise dependent,

and do all the above without destroying, or seriously damaging, the natural environment that we depend on to keep the world alive by recycling and balancing the atmosphere, purifying the water, regulating temperatures and so forth?"

The answer to this is:

With great effort, our species may be able to, but at present we are not doing so, and it will take a substantial and widespread effort to learn how to be sustainable as quickly as is necessary to avert a major disaster. At this point in history "Primitive people" stand a much better chance of surviving to carry on the Human Experiment than do "civilized" urbanized people.

An EcoVillage's citizens work consciously toward sustainability, and its ecological relationship with the surrounding environment, as well as their needs for food, fiber, water, energy, transportation, building materials, healthcare, necessary security, and a viable community economy.

4) Condominium Land Ownership

All land, Public Buildings, Utilities and Services in the EcoVillage are held in a Condominium legal structure. This

discourages speculation, since the land itself cannot be sold except as a small percentage of "undivided-interest" that accompanies the sale of each house or other building.

Community-owned assets, such as businesses, non-public facilities like the City Hall, Library, Fire Stations, Sewage Treatment, Credit Union, Utilities and Services, etc., are not allowed to be privatized, although the buildings themselves can be sold, if and when new structures supersede them.

EcoVillage-owned businesses when sold can be structured legally as co-ops or ordinary corporations, but they are still subject to the overall condominium land-ownership rules. Essentially, community-owned and run Utilities and Services may not be sold, even though the buildings might be, and all EcoVillage-owned and operated functions, vital to a community's wellbeing, are not to be turned into private for-profit ventures.

5) Housing

An outstanding feature of the EcoVillage will be the methods applied to the socio-economics of keeping housing, and other living expenses, low.

Low-cost Group-Housing and Co-Housing programs are available for employees of the CDC and the EcoVillage, and other residents, as space is available. These housing systems greatly reduce the amount of cash needed for an abundant life, and can be either permanent living arrangements, or temporary programs used while waiting for a home to be built.

Building truly affordable housing is a CDC mandate, and includes integrating in the total lifestyle of the community, particularly the economics of making necessities inexpensive through bulk buying, initially by the CDC, and later by the EcoVillage government itself. The local production of food, water, and the other necessary utilities and services makes living better, for less, a reality. There will also be programs in which people can work on the crews to construct their own homes. (See also below: **9) Bulk Buying**)

6) Dwelling Size

Home designs have 440 square feet of usable interior floor space per person, and 200 sq. ft. per person of private exterior open space in patios, balconies, or roof decks.

7) Development Rights

Development Rights (DR), as well as structures, can be sold to individuals, and perhaps in some cases, corporations, as determined by EcoVillage by-laws.

8) Building Materials

Homes will not be ordinary tract, or factory-built houses, but will be constructed predominately of natural, indigenous and renewable construction materials such as earth, stone, and wood, along with other traditional techniques such as ceramic tile.

Whenever humanly possible, construction materials used are to be found, or manufactured locally, and community policy is to carefully review the use of any materials that are value-added or manmade, such as steel, cements and concrete, aluminum, etc. A community must sometimes extend its concept of local, but an EcoVillage basically conforms to the practice of using "local people and local materials" and as a primary town policy, spends its energy, including money, in its own locality.

EcoVillage policy also encourages individuals, or small companies to produce things commonly thought of as being only in the purview of big industry, but which are quite possible to manufacture locally, and on a small scale. (Examples are: iron, glass, wind generators, photovoltaic panels, hydrogen electrolyzed from water, and hydrogen peroxide for use as a water purification agent.)

In determining construction materials and materials and techniques, the idea of "polytechnics" is used, whereby building techniques may come from any era, past, present, or even new and innovative. More modern materials, such as ferro cement, and some of the newer high-tech materials, like carbon fiber composites, macro-defect-free (MDF)

and ceramic cements, rigid-rod polymers, and other nano-technologies, will be reviewed for approval on a case-by-case basis.

An earlier example of polytechnics was a design-build residential project in Santa Fe, New Mexico (1974-1978). This complex of over thirty adobe houses was built of sun-dried mud bricks, and clustered in the traditional local Hispanic family compound form. However, the homes also had radiant heated brick floors, planned for retrofitting to solar hot water, to eliminate the gas-fired boilers.

9) Bulk Buying

By cooperating in food buying and other necessary purchases, there is a great reduction in living costs, effort, and time. The CDC/EcoVillage purchasing departments will buy in bulk and/or negotiate:

- basic foods and medical supplies (stored in an ongoing two year rotating back-up plan),
 - insurance policies (health, auto, home, life, educational, etc.)
 - diagnostic and all other medical work,
 - fuel and other energy, until such a time as the community is self-sufficient with solar, wind and hydrogen energy sources,
 - any other desired products or services that can be negotiated in bulk)
- (See also below: **11) Health and Health Care**)
(See also below: **12) Insurance**)

10) Employment and Enterprise

An EcoVillage is designed an available source of useful, interesting and well-paying work. Greater emphasis than is now customary, is placed on human labor as opposed to automation of all manufacturing and the usual mechanization of even small-scale projects.

The CDC and the EcoVillage is oriented toward the creation of a strong local agricultural, industrial and commercial base to foster local enterprise and citizen's wealth, and living near one's work to eliminate the need to commute. Personal enterprises are encouraged by official community help through low, or no-interest loans, and legal advice to reduce taxes as larger corporations do. Cooperative and corporation structure, and other business information is taught in the school system from the early years, with students creating their own small businesses and means of production.

Working in the CDC is a unique opportunity to share in the creative process of building the community, and many positions are planned so as to continue after construction is completed, and CDC has left.

Since CDC is a for-profit company, and its business is designing, building, and selling small sustainable communities, after selling an EcoVillage, the CDC moves on to the next project, and retains no financial interest, or governing control of the finished project.

CDC employment opportunities include:

- positions in the Administration Department
- work in planning and designing the EcoVillage
- training in new and traditional building construction or manufacturing techniques,
- work in EcoVillage construction, sales, Utilities and Service Departments, or other EcoVillage Departments

11) Health and Health-care

Health options as planned, include a community Nurse Practitioner and a community-owned and operated health clinic, with salaried Doctors, diagnostic equipment and staff, medical laboratories, and a surgery. (There are also community lab facilities for testing of air, water, sewage, soil, and materials outgassing.)

12) Insurance

In the spirit of true free-enterprise, and an actual market economy, the CDC plans to provide low-cost access to insurance coverage for citizens of the community. There are currently many self-insurance programs in operation by private businesses in the US, in addition to over 372,000 insurance companies. So, forming a local EcoVillage insurance

company is not an unreasonable or unattainable goal. If successful, it could be expanded to serve similar communities, to spread risks and reduce costs.

Although the EcoVillage will create its own insurance system, as many private companies are now doing, in the beginning it will negotiate group-rates for health, car, home, life, education, etc., as it explores alternative possibilities.

13) Finances

Essentially, the EcoVillage economic support base is:

- 1) For the CDC - profits are from building and selling homes, commercial, office, industrial and public buildings, and from sale of the overall community land, business CDC sets up develops and sells, and from sale of the community infrastructure.
- 2) For Individuals - There is a wide variety of local businesses for employment; official CDC assistance in starting or buying private enterprises; interest-free home and business-structure loans; bulk buying of necessities; community-owned, or negotiated, insurance (including health, auto, disaster, home); and low-cost utilities.
- 3) For the EcoVillage itself, income-vectors are from Utilities and Services, and other community-owned, or joint public-private owned businesses; tourism fees and taxes; out-reach educational facilities; fiestas, Bartertowns; and other special events; agriculture; other primary production, etc.

The financing of the initial phases of the project is based to a substantial extent on monetizing of the CDC stock. The main business of the CDC is to design, build and sell sustainable communities, including the infrastructure and some businesses necessary for the community's construction. Employees of the CDC are encouraged to participate in owning shares in the company, which can be returned to the CDC as payments on homes and business buildings, up to about 25% of the buildings' cost. (The actual percentage (above about 15%) depends on the ability of the CDC to use similar stock payments to professional consultants, and vendors of construction materials, supplies and equipment.)

From the moment stock is paid to an employee for their work, is backed up by something real; by hours of human labor, and is not just a piece of arbitrarily-printed paper. (Such as today's fiat money, which is based solely on trust in the government that prints it.)

14) The EcoVillage Municipal Fund (EVMF)

The EVMF is a non-profit corporation, is set up separately from the CDC, and its purpose, during the time of the project, is to annually receive any CDC income that is in excess of its stated yearly profit-limit, while still allowing CDC funds for maintenance and facility replacement costs. The EVMF is spent on infrastructure development, and other community needs, but could also be structured to serve as a capacitor to finance a community insurance fund, and/or to back up CDC for its income fluctuations.

15) Food

Urban agriculture, combined with more-remote farming sites, owned or leased by the community, will produce the equivalent calories, vitamins and minerals required for a balanced, nutritious diet available to all EcoVillage citizens. Food is grown locally, usually meaning less than ten miles from town. It is produced without pesticide pollution or planting of unproven Genetically Modified or Engineered species.

16) Greenhouses

In the EcoVillage, half acre greenhouses are owned and operated by each Dyad, and food production is for their use or sale. Any necessary additional farmlands for food self-sufficiency are owned, or in some cases leased, by the EcoVillage.

17) Renewable Energy and Community Utilities

All community energy is derived from non-fossil fuel sources (e.g. sun, wind, water movement of rivers or tides, geothermal, hydrogen, manure.) Energy is made locally by the community and all Utilities and other vital Services are community-owned and operated. Community-generated energy, symbolized by money, is spent locally whenever possible.

18) Fuel

Fuel for the EcoVillage, for cooking, transportation and electricity is generated in a community-owned Utility in the forms of:

- wind, solar, water, geo-thermal
- natural gas (methane) from green wet garbage and some sewage effluent
- hydrogen gas from wind and sun electricity that splits water into hydrogen and oxygen. The oxygen is used for welding and cutting, or to compliment the respiratory cycles of local plants, animals, and people. The hydrogen and natural gas are used for:
 - vehicle motive power
 - electrical generation
 - energy storage (essentially a "battery" for sunless, windless times)
 - cooking and heating

19) Transportation: Autos Out, But Free Local Mass Transit

The EcoVillage will phase out the private auto ownership as we know it, in favor of local and inter-urban mass transit, and other alternative means of mobility. For example, there is to be an inexpensive, hydrogen/natural gas powered, on-demand car/pickup rental fleet, as an alternative to having to own personal vehicles for outside trips.

Most internal EcoVillage movement will be by foot, bicycle, other pedal-powered vehicles, handicapped-electrics, electric scooters, roller skates, blades, and boards. Horses and buggies, can also be used in the community, and electric golf cart-type taxis will be allowed.

The design and manufacture of a hydrogen powered/electric hybrid is a proposed community enterprise. It is intended to rely on materials mostly available locally, and even the more exotic ones would be from within the US. This is intended to move transportation, and design in general, away from high tech materials (such as rare earths), and exotic methods of manufacture and fabrication.

Transit stops to get to shopping, schools, recreation, medical and work are all a short pedestrian distance from every home. (About 500 ft. maximum. As I recall, Paris, France allows 1,200 ft. as the distance from all parts of the city to a bus or subway stop.)

Cars and trucks are not allowed inside the fabric of the town, and are parked on the periphery, where the local intra-urban transit on-demand Personal Rapid Transit (PRT) system begins, and where a traveler can also connect to an outside high-speed inter-urban one. (Another on-demand system, the 150 mph CyberTran, developed over 20 years ago by the Idaho National Laboratory, shows great unrealized promise, and at much lower expense than ordinary trains, or even light rail.)

Citizens of the community travel free on trolleys or small people-movers, and there is very low cost delivery for all local purchases, or those brought into the community parking area.

Elimination of in-town autos, radically shrinks the community's space requirements for wide streets, garages, drive-ways and car-parks distributed throughout the town. The lengths of utility runs, and their costs, are estimated to be reduced by a third. Hydrocarbon combustion pollution and many other disadvantages of today's vehicles and traffic are eliminated.

20) Water

Water is collected, stored, treated, purified, distributed, and reused in an ecologically sound manner, and without chlorine. (Hydrogen peroxide and UV light is the preferred purification treatment.) Water is conserved, and generated locally from renewable sources such as rainwater harvesting, surface flows, atmospheric-vapor, and from groundwater, where any withdrawal is balanced by recharging the aquifer annually, with at least as much water as has been taken from it.

Water abundance, and completion of the hydrologic cycle will be assured, by harvesting rain, and by condensing atmospheric vapor from the bioremediation sewage treatment cycle.

21) Education

The educational system for the community is local, public, of very high quality, and is provided by the community itself, or by contract with The Institute for Applied Ecology (IAE), a non-profit educational and research company. The AEI will be created to create and direct the community educational system from pre-school through university post-graduate levels. The overall emphasis is on ecological observation and research, and its integration into all aspects of everyday life and practical applications for ecosystem restoration and up-grading. When and where appropriate, "synthetic" ecosystems for ecologically degraded environments may also be created as part of the educational process.

Teaching practical economics begins in the early years. Children are taught the components of the community's Integrated Systems, the biology of ecosystems, EcoVillage community Values and Goals, and other principles of sustainability that keep the community alive, healthy and in harmony with natural systems.

There is a low student-teacher ratio (planned to be 10:1 to 15:1), and a curriculum from an early age that emphasizes environmental regeneration, the development of micro-economics, and soil-building as a key enterprise.

22) No Local Sales Tax for Citizens

There is no town sales tax for citizens of the EcoVillage, although tourists and other visitors are charged a 3% town sales-tax on purchases, and certain other fees, such as a hotel tax, parking fees, and cable hook ups. There are other sources of EcoVillage revenue from the county, state and federal governments, as with other incorporated cities.

23) Sewage

The intention is to complete of the nutrient cycle. First, is the purification of sewage and other wastewater by biological treatment known as "bioremediation." Bioremediation uses combinations of living systems for purification, plus either ozone, or hydrogen peroxide and Ultra Violet light, to thoroughly sterilize this high-nutrient content effluent, which is then recycled to agricultural production. Atmospheric vapor is collected from the wastewater treatment plant and sterilized until pure enough to start back through the hydrologic cycle as drinking water. (This was done successfully for three years in the Biosphere 2 project in Arizona; 1991-94.)

24) Solid Waste and Recycling

The EcoVillage recycles its waste products (as does an ecosystem) so that they serve as "food" resources for the "metabolism" of other segments of the local community, or for that of others.

25) Tax Assistance

Personal enterprises are encouraged by having an official community-sponsored legal service to assist citizens in reducing and circumventing their tax loads.

26) Marketing

There are simple methods for marketing the EcoVillage and its products that to some extent can determine the type of person who will be attracted to living there. There is no point in attracting someone who will later realize that the more cooperative EcoVillage life is not for them. For example, there is the 50% capital gains tax on the profit, when reselling a home or other building. This is intended not only for community revenue, but to discourage speculation and immigration by those who do not wish to share their good fortune and/or do not accept that the reason their property values grow is because the community as a whole is attractive to buyers. (This tax is calculated minus any costs of verifiable property improvements by the owner.)

27) Government

The EcoVillage is democratic and the entire community is able to vote on all issues. Voting rights are based on proof of residency, or property ownership, for any absentee persons. (Such as I might be, given my own vagabond ways!)

Proportional representation should be explored and instituted, or some other form of voting than the current American majority "winner take all" method.

At some point the citizens may even be interested in separating the voting in the community along the lines of owners and residents, so that when issues involving property are the question, only owners vote. For now, all foreseeable questions are expected to be well decided on the basis of one person, one vote. But later, let them decide for themselves.

That's what it's supposed to be like when you run your own affairs. All the planner can do, who is designing the town fabric and the architect who is designing the buildings, is make a framework. All that socio-economic planning can do is to give the best advantage possible for the community to smoothly make the transition into a modern human-eosystem, that symbiosis of man and nature, which we need, but don't have any more.

Let's not forget that for a couple of million years we must have been in tune, simply because we sustained ourselves in the environment for that enormous length of time. I suppose it was until the agricultural revolution, about 10,000 years ago, although, according to Hamblin and Karlovsky in *The First Cities* (1973) there were substantial communities, cities, long before there was anything but hunting, gathering.

It is truly doubtful that an EcoVillage would ever be tempted to levy a local property tax. For one thing, records show that in the case of new towns over the last 50 years, at least in the state of Arizona, not one city tried to levy a city-based property tax. It is one of the most unpopular and fought against taxes, and no one wants to pay more than the county already takes, usually for the school system.

28) Total Community Size

Ideally, the total area of an EcoVillage for roughly 5,100 residents, should average about 5,760 acres; nine square miles, or slightly over one acre per resident. The built-up area is only about 300–400 acres, and includes all of the community's residences, public buildings and spaces, commerce, and industry. The rest of the acreage is used for recreation, agriculture, woodlands, cemetery, grazing and water catchment.

29) EcoVillage Policies

Community policies are officially directed, and consciously crafted to contribute to the conditions needed for ongoing community survival and abundance.

30) Communications

- a) Fiber optics lines will be run to each home and business
- b) A community Broadband will also be available
- c) A TV multi-channel service will be standard through the community up-link.
- d) The EcoVillage has its own internet server free or low-cost for its citizens.

31) Climate-Change Response

Biological CO₂ sinks of native plants will be created, to absorb all CO₂ produced internally or externally by the EcoVillage activities. BioChar (Terra Preta) will also be made, and used as a soil improvement. Other promising methods for permanent CO₂ sequestering will also be investigated.

32) Miscellaneous Amenities

- a) Storage rooms and outdoor areas for RVs and boats will be available.
- b) Swimming pools, mini-parks, picnic areas, and community rooms will be located in Dyads, in addition to facilities in the general public areas or for tourists.
- c) There will be a free EcoVillage public lending library.
- d) Special passes for town-citizens will admit them free, or at much lower cost, to any tourist-attraction events.
- e) Since the EcoVillage is expected to attract thousands of visitors interested in first-hand observation of a modern economically and ecologically sustainable community, special pains will be taken to ensure that the local citizens will have privacy and safety.

This outline of EcoVillage Benefits, Attractors, Key Features helps illustrate how limited and simplistic most current

thinking is with respect to questions of true sustainability, including community economics. But it does not pose impossible problems, and the necessary integration of the functions and systems of an EcoVillage community is doable, though it will require some effort to switch to a new mode of thinking and a new way of life.

If we manage to succeed, it will make the transition to an "Eco-System Era" possible—a new time of what Lewis Mumford termed "Biotechnics" or life-enhancing technologies in his 1934 book, *Technics and Civilization*. Biotechnic, as used here, is not necessarily connected to genetic engineering. I interpret it to imply an era that's focused on life and living systems, as opposed to mechanical, electrical, petro-chemical ones. That is a time when we move toward creating communities that function as sustainable human ecosystems.

Most of the current activity we see, and verbiage we hear concerning the idea of sustainability doesn't go very deeply into the questions of what true sustainability is, or how to achieve it. This failing was recognized by Arne Næss as early as 1973, when he created the term "Deep Ecology." Here, deep means going below the surface to explore the issues of ecology, economy and their relationship to real sustainability.

The remedies for most of our urban problems, and many that aren't strictly urban, can be relatively easily resolved, even though some will require an effort of will that currently is lacking. We will have to undergo a basic alteration of the predominant worldview or paradigm. If humanity can actually make this transition the result will be a new, and I believe, easier and more harmonious way of life.

Effective "ecodesign" requires a holistic arrangement of a community's built-systems—specifically the integration and management of its energy and materials in a positive relationship to the energy and materials of the local natural ecosystems.

No matter what our individual work now involves, by developing a personal eco-database, and judiciously using a combination of its principles and functional components, each of us can be in a position to make useful contributions to creating a truly sustainable community. To help those interested in learning an approach to sustainability, and the methodology we promote, is to combine both the Reductionist and the Integrated scientific approaches.

(A useful approach to the controversy concerning "Growth Economics" can be found in Herman Daly's book *Steady-State Economics*, 2nd edition, 1991, Island Press)

14) Values, Goals and Policies for Designing Sustainable Communities:

Where do the Values and Goals come from?

From developing the community's proposed Benefits, Attractors and Key Features.

Of particular importance to an EcoVillage project is the development of its guiding Values and Goals, since the Policies and Programs of the community stem from these principles, at least in theory. Thus, values and goals are necessary guides for any community claiming to reach for sustainability.

When homes and business buildings are sold, all prospective buyers will be required to read the Values and Goals and to sign that they have understood them. This does not imply the buyers believe in the Values and Goals or even agree with them. Such an agreement is not intended to be legally binding, but it does create a transparency with respect to the overall community philosophy and direction. This may help to avoid later misunderstandings concerning questions on where community Policies have originated and why. At the very least, buyers may not later claim ignorance of the stated the community philosophies. If the citizens and their governmental representatives are true to the agreed-upon Values and Goals, they will together form the basic characteristics built into the community structure.

The Values and Goals chosen guide both the CDC and the EcoVillage itself. The Values and Goals use the same headings. In the first case a Value is considered in the sense of **what** ethical or moral standard is proposed as the value to follow and **what** is trying to be accomplished. In the second place, the Goals start to illustrate **how** the community can

approach actualizing the Values in real time and space. A Goal is viewed as the application of the Value to an action, intended to produce a physical manifestation of the community's aspirations.

The ethical basis of our actions in life springs from our basic Values, and their associated Goals, and how well we adhere to our stated code of behavior. Thus, a community's agreed-upon Values and Goals, and other community principles, such as its Immutable Essentials, are crucial factors in community development.

The Values and Goals, and their resulting Characteristics, have a powerful influence on many of the physical arrangements of a community. Those we have developed for this document are not to be considered as complete and immutable, but rather as a starting place.

One of our tasks as designer/builders is to provide both the physical and philosophical framework, within which the EcoVillage residents will be free, well-educated, encouraged and inspired to create their own improved version of "Community," which is considered to be a level above what can be created by planning, architecture, engineering and government. The physical and regulatory disciplines provide a framework for a viable, harmonious community, but nothing can be guaranteed by any system, no matter how well and carefully crafted.

All systems are complex, and therefore have unpredictable emergent properties.

The essential characteristics of the EcoVillage are introduced to prospective citizens by means of various educational methods, such as brochures, videos, meetings and retreats with related physical work sessions. The intention is to produce and attract an ecologically-conscious group of customers for the EcoVillage concept. They can be people who already share specific community values, goals, and have a feel for the characteristics found in the Immutable Essentials, Values and Goals. The educational outreach programs can help others come to understand the benefits of living in a modern economically and ecologically sustainable community.

The Values and Goals shown here are guides for any community claiming to strive for sustainability.

1) Values:

“A value is an abstract concept of what is right, worthwhile, or desirable; it embodies principles and standards.”

“A value has inherent excellence based on spiritual and moral qualities. It is the worth, quality, or goodness of something.” (Webster's Dictionaries)

1) Ecological Sustainability and Resource Consciousness:

- a) Eco-systems are used as models for the community to emulate, with particular attention to the energy flows within, and between, the EcoVillage Utilities and Services systems, as with garbage to methane, or water to hydrogen to electricity.
- b) Diversity is paramount, including people, housing, economic levels, physical spaces, ambiance, etc. Diversity stabilizes ecosystems and makes them more flexible and able to respond to change, disease, political rigidity, etc. (Authoritarian regimes quickly move to eliminate all diversity!)
- c) Every “waste product” is food for something else in the ecosystem. Cycles of natural processes and their applications to human activities are used in the purification and reuse of sewage effluent, the recycling of construction waste, and other solid waste, composting of organic materials for soil building, rainwater recycling into ground-water aquifers by injection, etc.
- d) Natural cooling and heating of buildings will be used for climate control, including such techniques as design for air flow and evaporative methods of cooling, active and passive solar systems of radiant heat, and high-mass materials to moderate temperature changes.
- e) Pure water, air, and soil is required, and must be consistently monitored and purified. Domestic and industrial outputs of noxious gaseous, liquid, and solid compounds must also be strictly monitored and controlled, and every effort made to avoid use of any toxins.
- f) Energy generation without fossil-fuels is the rule. In most areas these will include wind, sun, methane,

and hydrogen. The community must own its Utilities.

- g) A healthy community knows itself. As residents involve themselves in understanding sustainability with regard to its Water, Air, Soil, Energy production, the control and reduction of all types of pollution (including packaging), and the recycling of Solid Waste, the community can better adapt to climate and other changes in the wider natural and economic region.

2) Community:

- a) A healthy community is a “full-service community.” This implies having all the normal functions and desirable amenities built into the community footprint. Obviously these are more rudimentary for a community of 5,000 than are needed for a city of 200,000, but all basic needs should be met within the EcoVillage. Extra-ordinary needs and amenities are provided regionally.
- b) A healthy community has “mixed-use,” meaning an appropriate mixture of residential, commercial, and industrial uses.
- c) Networking with like-minded individuals, organizations and communities builds community strength through sharing of experiences, contacts, goals, and technologies.
- d) A healthy community is locally based. Local people and local materials are used both in building the EcoVillage, and in its operation and maintenance.
- e) The Ecological Footprint is calculated, along with the EcoVillage's environmental impact, and is used as a checklist and a guide for self-monitoring. Ideally the EcoVillage size is congruent with local political boundaries and those of the local watershed.

3) Self-Determination:

- a) A healthy community has a strong local (village) government. (Ideally, this involves incorporating the EcoVillage as soon as possible, with the citizens in control of the land development, water, energy, and other critical issues.
- b) A healthy community knows its ideal, sustainable size and maintains it. When there is pressure to grow beyond a sustainable size the EcoVillage spins off a new community. (This was often done by the ancient Greek city-states)
- c) Community sustainability includes the future of all living beings within it, human and non-human.

4) Social Conscience and Socio-Economic Equity:

A healthy community:

- a) Provides equitable opportunity for all with respect to education, work, shelter, and health.
- b) Encourages diverse enterprises for citizens, rather than just jobs. This is done through programs to attract those types of enterprises the community needs.
- c) Emphasizes home ownership, including self-help programs for individuals to participate in building their own homes under safe conditions and consistent quality control.

5) Synergies are Promoted at All Levels:

- a) Old and Young
- b) Urban-Rural-Wilderness, with partnership between the natural and the built environments.
- c) Local-Global-Cosmic, integrated into the village philosophy and its education
- d) Internal-external integration of the economy, transportation, and communication.
- e) Attention to scales, such as a small village in large bioregion; individuals in an EcoVillage of thousands of persons, etc.

6) Citizen Access and Participation Encouraged at All Levels:

- a) Local, Bioregional, National, Global. Ideally administration of all environmental issues is based locally and works within the context of the regional drainage basin, and the greater national and international scenes.
- b) Leadership for the Future, The village provides leadership, where leadership is defined as, “the creation of new opportunities and possibilities for others.”
- c) EcoVillage government is politically transparent, user-friendly and accessible to all.
- d) Access to all facilities is physically easy for all citizens, including children, seniors, and handicapped.

- e) Safety from fire, wind, flood, animal and human interference is provided.

7) Beauty:

A healthy community is beautiful in all its aspects.

- a) Parks and plazas
- b) Building materials and color
- c) Three-dimensionality
- d) Views, internal and external
- e) Village focal points, civic, cultural, recreational, commercial, etc.
- f) Greenbelts and water catchments, buffer rural and wilderness from the urban

8) Strong Local Economic Stability:

- a) Community-owned utilities.
- b) Local economics based on useful production, not on unnecessary work.
- c) Publicly owned and operated insurance, educational system, bank and credit union, and inter and intra-EcoVillage transportation systems.

I. Other Pertinent and Notable Values That Apply to Communities:

Friendship	Participation
Honor	Ecological Sustainability
Beauty	Community
Discipline	Rootedness
Freedom	Luck
Order	Daring
Reliability	Conflict
Concentration	Conservation
Expansion	Sharing
Efficiency	Service
Identity	Compassion
Fun	

2) Goals:

“A goal is the result or achievement toward which effort is directed; an aim, an end.”

“A goal is the terminal point in a race.” — Webster’s Dictionaries

The Goals retain the same headings as the Values, as reminders of **what** is trying to be accomplished, whereas the Goals start to illustrate **how** the community can approach actualizing their agreed upon Values in terms of Goals.

1) Ecological Sustainability and Resource Consciousness:

- a) The community works to alter the existing world-paradigm to one of sustainability and living from the direct, self-renewing solar increase, rather than the fossilized solar energy. This is called living on Natural Capital Income.
- b) Community education from early childhood onward is based on an understanding of ecological principles and processes and how to live sustainably within them.
- c) To reach sustainability with respect to the available community resources, including food, water, solid waste, sewage and the nutrient cycle, renewable energy, materials and methods of construction, transportation, etc. Maintain a community population level that can be sustained by the community resources.

2) Community:

- a) Develop a strong town esprit de corps, based on shared ecological values, ethics of sustainability and joy in solving problems and working cooperatively.
- b) Be pro-active in promoting those values beyond the EcoVillage.
- c) Create a community with a committed ecological stance and ethic.
- d) Build a community politically and physically easy of access to its citizens.
- e) Develop sustainable design experience for community leaders and citizens.

3) Self-Determination:

- a) If feasible incorporate the EcoVillage legally. If that isn't possible, strive to be an active positive influence on building and infrastructure codes, and other legislation influencing the surrounding environs.
- b) Place limits-to-growth restrictions on the village population and area, to create a compact EcoVillage. To do this, "clone" similar allied villages, rather than growing beyond the sustainable carrying capacity of any one site.

4) Social Conscience and Socio-Economic Equity:

Create town-administered sustainability programs for socio-economic equity. Base them on ecological principles such as: credit unions or banks, seed-capital loans for startup local enterprises, community-currency, health & education insurance, etc.

5) Synergies are Promoted at All Levels:

A positive creative synergy of the differing: village environments, age groups, income and educational levels, religions, internal-external village issues, etc.

6) Citizen Access, with Participation Encouraged at All Levels:

- a) A goal for any ecological community is to provide leadership for its wider environment, and make a positive difference to the larger bioregion.
- b) Participate in any greater-community's efforts at bioregional watershed planning and support their plans for regional administration.

7) Beauty:

To create a community which is known world-wide for its unique beauty.

8) Strong Local Economic Stability:

- a) Each village owns its own utilities; "profits" above replacement and maintenance costs, going to the community.
- b) Business is not subsidized, and pays its fair share to the community.

3) Policies:

"A Policy is a governing principle, plan, or course of action."

POLICY FORMULATION (Negative) POLICY FORMULATION (Positive)

1. No Pesticides, fungicides, herbicides, chemical fertilizers

2. No genetically engineered food-animals at this time.

3. No big-boxes, or national franchises.

1. Use permaculture and organic methods

2. Develop and use perennial crops or foods.

3. Encourage local enterprises.

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|--|---|
| 4. No air or ozone-depleting gases. | 4. Use natural heating and cooling |
| 5. No cars inside town. | 5. Provide adequate local transport. |
| 6. No locally generated pollution. | 6. Revere the soil, air, and water. |
| 7. No community land fill/incinerator. | 7. Seriously address the waste issue. |
| 8. No economic, intellectual, or spiritual poverty | 8. Strive always for freedom and socio-economic equity. |

15) The Three Industrial Revolutions (As Created by Energy Sources and New Communication Methods)

The *Third Industrial Revolution* (TIR) is the idea of Jeremy Rifkin. In his book, by the same name, he is particularly interested in the role that energy and communications has on a culture. Rifkin proposes that great economic transformations in history occur when "a new communication technology converges with a new energy system." At that point, he observes that an unpredicted and changed infrastructure emerges that has the effect of "annihilating time and shrinking space." A synergy has thus been created, in which the whole is obviously greater than the sum of its parts.

It is useful to keep in mind that the ideas of synergy, holism, complexity

Rifkin has identified the creation of three of these socio-economic transformations emerging during the industrialization of the last 250 to 300 years:

- 1) The First Industrial Revolution was the convergence of steam-power applied to printing presses, which encouraged mass-literacy for the first time in history. Coal was the energy source.
- 2) The Second Industrial Revolution was the convergence of electrical communication (telegraph, telephone, radio, TV), and oil was its energy source.
- 3) The Third Industrial Revolution is the convergence of electronic Internet communication with non-fossil fuel renewables as the energy source. (Both the communication system and the energy production are suited to being distributed spatially, with decentralized and localized control.)

I think Rifkin has performed a real service with his leaps in historic reasoning and pulling the ideas together in a coherent form that promotes energy decentralization. He currently focuses his own efforts on dealing with nation-states and major corporations, at the highest possible management levels, and I wish him the best of luck in that approach. He may actually make a difference and help move the big-boys toward a saner cleaner economics.

But, with minor modifications, I believe the basic ideas can also be applied with good results to small-scale local conditions. The five pillars that Rifkin thinks will support the new Third Industrial Revolution are:

- 1) Switch quickly and entirely from fossil fuels to renewable energies
- 2) Energy generation is decentralized onto essentially all buildings
- 3) Hydrogen, and other methods store the energy to burn, or fuel cell use
- 4) Internet type technology manages power grids as energy networks
- 5) Vehicles/equipment are electric, use fuel cells, or burn hydrogen