Regional Planning, Urban Design and Sustainability

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A concept model for urban-rural linkage

A simplified ecological model of the urban/rural environment is used to develop a set of **strategies** -- from individual user to city and regional sectors -- that enable participation at many different user levels and need conditions. We look at the urban environment (including its adjacent rural counterpart) from the standpoint of different sets of **individual players**, from homes to businesses, each possessing certain **metabolic needs** while each supplying certain **metabolic outputs**, both considered useful resources. Each of these players is viewed, therefore, as a **metabolic unit** having specific input and output needs to keep it (the business, industry, or household) functional. Since in a well coordinated urban system input needs are provided by outputs of an **adjacent** metabolic unit (materials, products, services), a degree of sustainability in the urban environment is achieved simply by better **connecting existing inputs to existing outputs**.

By conceptualizing the urban environment not only as an energy resource consumer/producer but also as having an inward and outward flow of many different processes and at many different scales it becomes possible to better optimize flows through a number of accepted practices. Conceptually and, in some cases, analytically, **four types of flow resources** and their associated metabolic or transformation processes are studied. These flow resources are **material, energy, money and information**. Each of these contains particular characteristics as to units of transfer, and each may be dealt with in combinations so that the necessary bridging topic unit can occur. **Waste** is studied only as a **resource** resulting from transformation processes associated with any of these four flows. By thinking of what is normally considered waste as a potential resource from the start we are able to establish new sets of networks by infilling metabolic units (particular enterprises) which bring together normally unattached entities, thus producing a more stable urban environment.

See diagram below.

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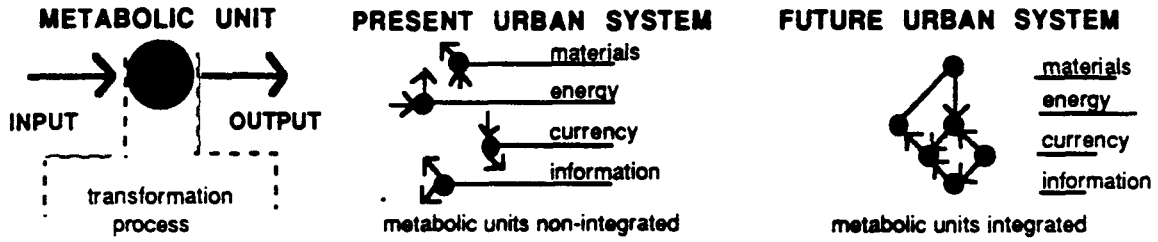


We refer to such infill metabolic units as **gap units**. When a need is expressed by the regional or local population but has not been fulfilled by a local regional resource even though this regional resources exists, we introduce what we call a **trigger unit** or **trigger industry**. These trigger units are so-named because they literally trigger entire sets or chains of metabolic units from the physical production sequences through the supporting service sectors.

This method is applied at four metabolic scales within the study area:

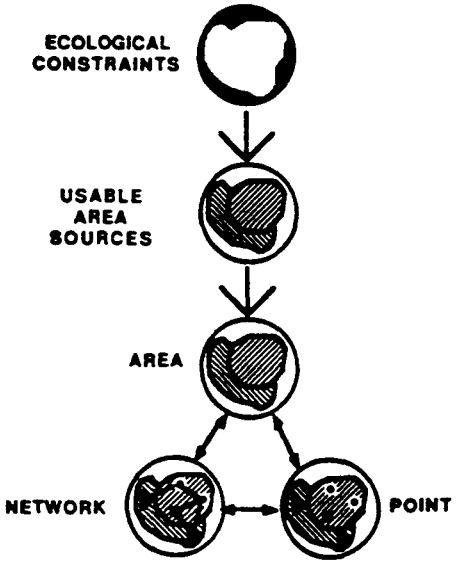
1 the singe unit - home/business to block to neighborhood scale
1 the district or sector
3 the city
4 the city region

The purpose of this scale distinction is multi-fold. First, it enables us to utilize **existing** organizing and outreach **tools** operating at these scales while accessing existing data acquisition, census, and correlation techniques for purposes of needs assessment. It may be politically more adroit to begin at one level or another. Second, it enables us to apply our approach so that the **need residual** at each scale, those needs left unsatisfied after the saturation point of integration at each progressive scale, can be applied to the next scale for possible satisfaction. To this unsatisfied need are added the **new needs** required at each progressive urban scale. Full extension of the process into the fourth level enables us to address the **region** itself as the final level of need satisfaction, this time with the natural resources of the surrounding rural areas themselves.

From the beginning, this entire process is goal oriented to favor renewable and abundant indigenous resources of all types to fit need assessment categories with the objective that these find their ultimate level of use capacity as determined by the holding capacity and efficiency of transport within the ecological parameters of the surrounding region. Just as with the four scales previously mentioned, the region can also be analyzed using existing data and governmental planning bodies such as

regional planning commissions which, in turn, can utilize existing ecological land analysis planning methods. These methods need only be slightly modified to include the full spectrum of land uses that meet need assessment at all four scales. We have referred to this addition as our **Appropriate Technology Sustainability Inventory**. The important addition that develops from this approach is that unlike the usual no touch policy to land conservation or, on the other hand, the full use policy of land development, there is an acknowledgment of the **many potential** uses of the land: energy plantations, integrated food factories, high rate compost facilities, building material processing units derived from energy and food waste, high efficiency water treatment facilities, etc. The distinct advantage of this approach is that ultimately all infrastructure and superstructure need requirements can be **spatially represented in map form** and thus subjected to ecological land planning methodology.

Metabolic units are the core of an entire methodology that can be approached at the level of the single household to information transfer at the global level. **People and their technology, at whatever level of expertise or technical complexity, are the core resource**. In a more general sense, metabolic units are referred to as **point resources** which transform a natural resource into a useful item with a regional application. This usefulness may be **"hard" of "soft."** People with experience and a product to show, both representative of how a region's resources can be responsibly used within the context of the ecological parameters of a region, are identified. In order to be indentified at all, a point resource must fit into one of eight life support need categories. Only then is it considered a hard, immediately useful point resource. Soft point resources are also valuable in that they may only be at the level of investigation, research or simply a depository of useful regional information such as a library, the archives of a bioregional radio station, or even the printing/editing of a regional newsletter which respects the region's resources together with its human needs.



Point resources therefor may or may not be actual metabolic units or transformation processes but, instead, may simply be viewed useful as a storage or depository of (starting from the soft end of the spectrum) information, currency, energy or materials. But point resources themselves are a subset and find themselves in partnership with two other important ingredients of sustainable planning and design: area resources and network resources.

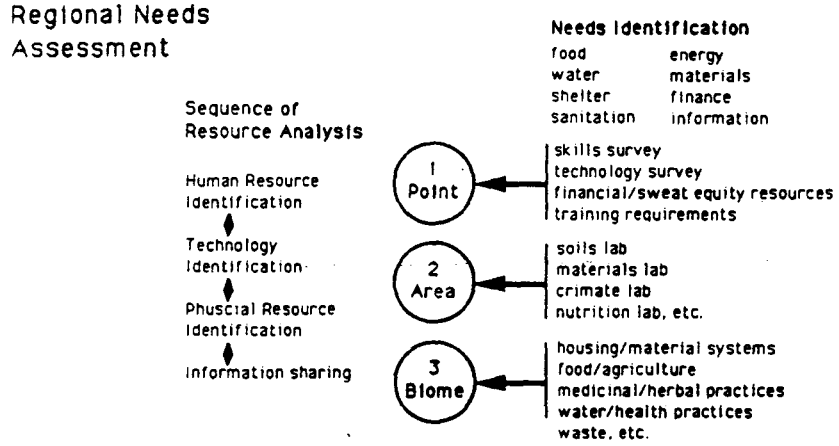
Area resources are the spatial representations or fields showing the physical location of a plentiful raw

resources base. When subject to ecological land analysis, as briefly mentioned above, these area resources become useful through the regions' point resources which are coupled directly to them. A newly discovered or renewed (rediscovered) use of an area resource at times brings a new level of regional sustainability and thus is directly connected to a trigger industry.

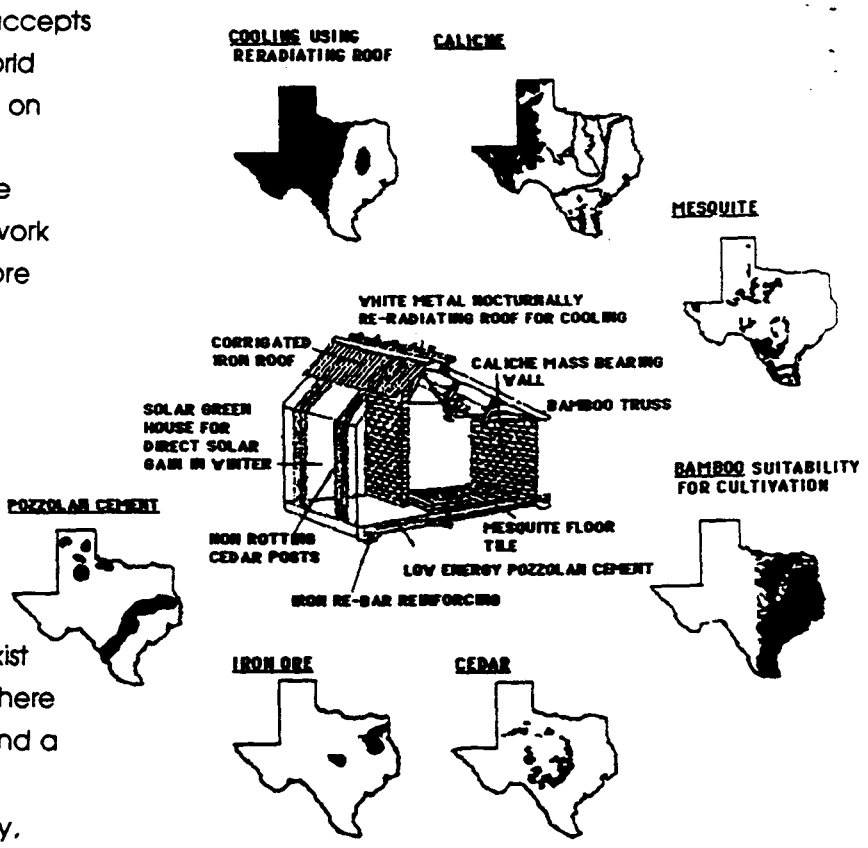
Network resources are identified as a separate category because their existence or non-existence is intimately connected to the extent to which the region or subregion is operating as a system of coordinated inputs and outputs. Networks are the arteries of information, currency, energy and material flow. These arteries, or network resources, contain different types of channels -- from electronic to typical transport means -- and are subject to conditions of flow capacity, ease of transport, noise, etc. The channel itself has its own scales of efficiency and use. Information flow through electronic media not only has great speed but also has wider potential impact on the actions taken by point resources. On the other hand, the transport of raw materials is limited by energetic considerations to the region itself. The discrepancy between information transfer and its effect on the sustainability of the local region -- if its message is exogenous to the resources at hand -- becomes detrimental to sustainable development.

The global move towards sustainable development has raised the issue of useful information transfer. To this end, we have found that the work done by the **International Union for the Conservation of Nature (I.U.C.N.)** to identify regions as a basis for information sharing regarding sustainable development issues to be particularly useful. The **Biome System** as developed by biogeographers demonstrates the existence of global patterns showing statistical repetition of flora and fauna. Since all life forms depend on **similar sets of resources**, as do any of the ecologically based technologies upon which man depends, we find all human life support able to be correlated to a region's biotic life as well as to life's physical basis for existence. Thus clothing, building materials, waste assimilation, water treatment, food production, etc. all can depend, at the local level, on the soils, surface geology, hydrology, climate, fibers, biota, etc. of the area. Locally based appropriate technologies in particular are derived from similar sets of resources and are therefore appropriate to the region and its capacity to supply given needs. **Appropriate technologies** as they are intimately connected to a region's metabolic processes can almost be considered as **living metabolic units** themselves. Ideally they can occupy the same ecological niche in similar communities of different biogeographic regions within the same **global biome**. We could label such technology transfer as technological equivalents much the way ecologists refer to life forms as ecological equivalents. Point resources at the global biome level should exist solely as transformers and senders of information as it relates to global information fields for use in

sustainable development and not processors of goods to be sent inefficiently throughout a global biome. Therefore in a perfect world one finds a natural hierarchy of scale regarding the extent to which our **four flows -- information, currency, energy, and materials** -- can be energetically distributed.



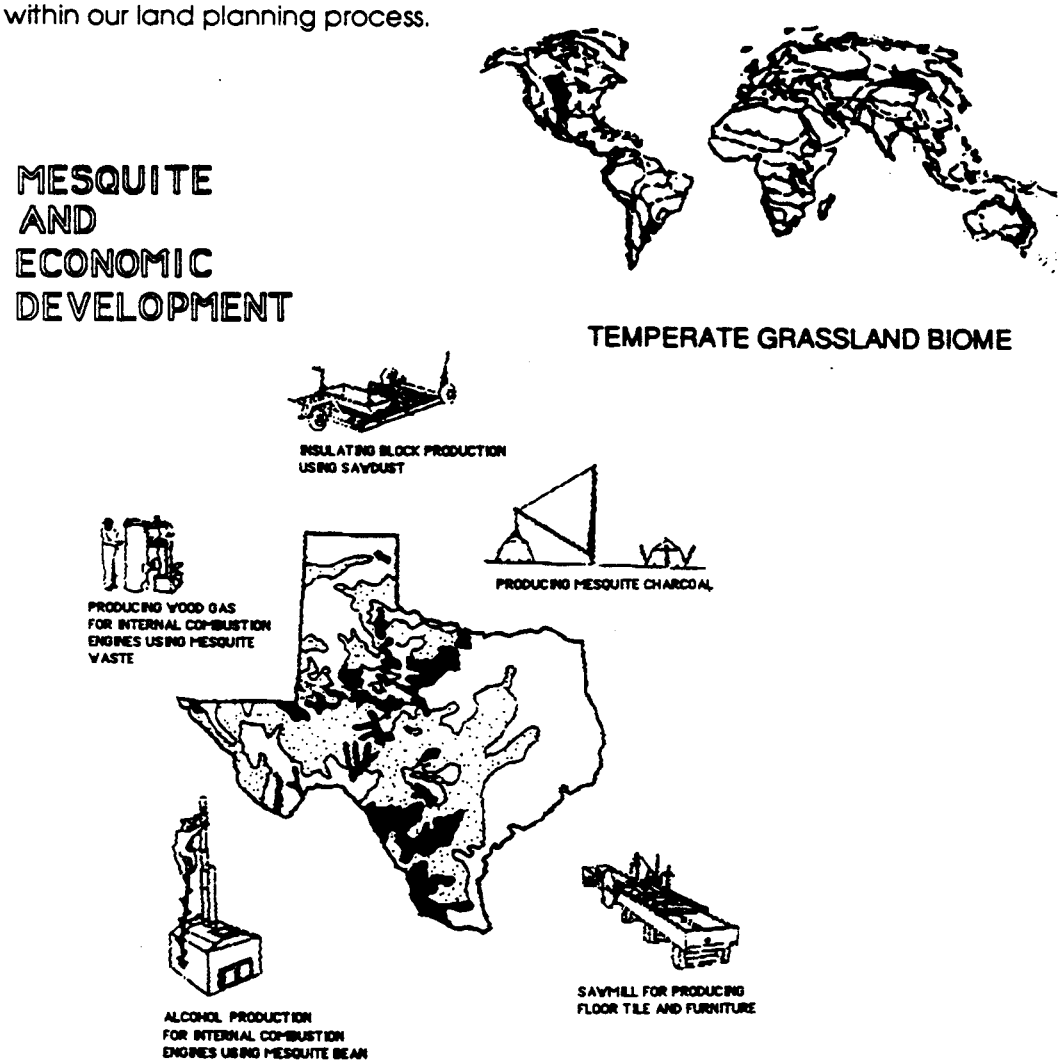
It is clear that once on accepts planning and design in a world whose wealth is dependant on sustainable development practices, or view of how we accomplish our everyday work changes. We become more aware of the total cause and effect of each design decision, where things come from, where things go. In our own work we have been mapping what raw material resources our buildings derive from, what climatic processes exist and how far they extend, where the biological process behind a given waste treatment can spatially operate effectively, there becomes a **method of sharing our work** with those who should know about it by the fact they then too possess similar



sets of conditions.

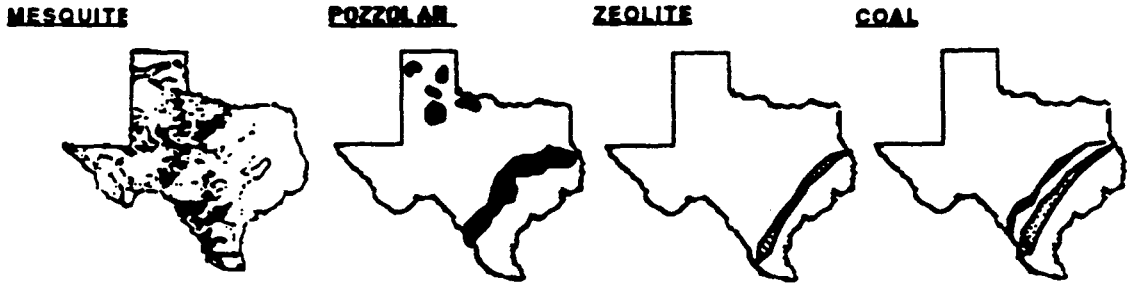
Taking purposeful steps to design and plan with these new tools can be extended into nearly every realm in the development process.

Our information base for developing the necessary technical prospects and uses can start at the biome level in order to share the total spectrum of possible technical equivalents. Below is a map of a pesty shrub tree called mesquite in the southwest. In Texas the application of agent orange has been used to rid the tree from crop land and cattle ranches. By searching within or temperate grassland biome, we find that Argentina and Uruguay the use of the tree, even though it is jagged in shape, has been very successful as a wood for hardwood floors when cut into small pieces. Other uses have been discovered and together mapped for good economic and environmental use. We find that through the use of resources mapping, we are essentially mapping technology and by so doing the prospect for indigenous economic development is built within our land planning process.



We have now collected may catalogues of organizations and groups worldwide who's knowledge base we can scan given the **spatial coordinates of the biome**. These point resource catalogues cover topics in all forms of renewable energy, indigenous building materials, arid lands farming, medicinal plants, waste treatment processes, etc.

Spatial resource planning at the regional scale itself hints at a different type of optimization even at the crude levels we already work at. A major lignite coal vein (at 0 - 200 ft.) runs from Laredo (app. 35% unemployment) to just north of Houston (app. 15-20% unemployment). This vein has an overburden comprised of bentonitic clay, pumicite, zeolite, and the pesty tree species called mesquite. Bentonitic clay can be used for a variety of building processes. The pumicite has proven to be a primary U.S. source of pozzolanic cement (natural cement or volcanic ash) and has been used to build Rome and to construct the Falcon Dam across the Rio Grande River. It can produce a high grade concrete when combined with other abundant regional materials such as lime. The zeolite has proven to be an excellent absorption medium in solar refrigeration, in which, for example, a ten square foot solar collector can produce as much as 15 pounds of ice per day. Zeolite is also a good water retainer in agricultural soils useful in our desert environment, and has proven to be a useful dessicant. Finally, as many know, the mesquite tree provides a top grade charcoal that in addition to providing flavor enhancement, produces one of the highest B.T.U/lb. of any domestic charcoal (over 13,000 B.T.U/lb.). The unprocessed mesquite wood that literally grows on top of the coal produces 8200 B.T.U/lb., or nearly twice the energy value of the coal beneath it. Another materials optimization question rarely recognized with coal is that the minerals and trace elements found in coal could be as valuable as an additive to fertilizer as coal is as a fuel source.



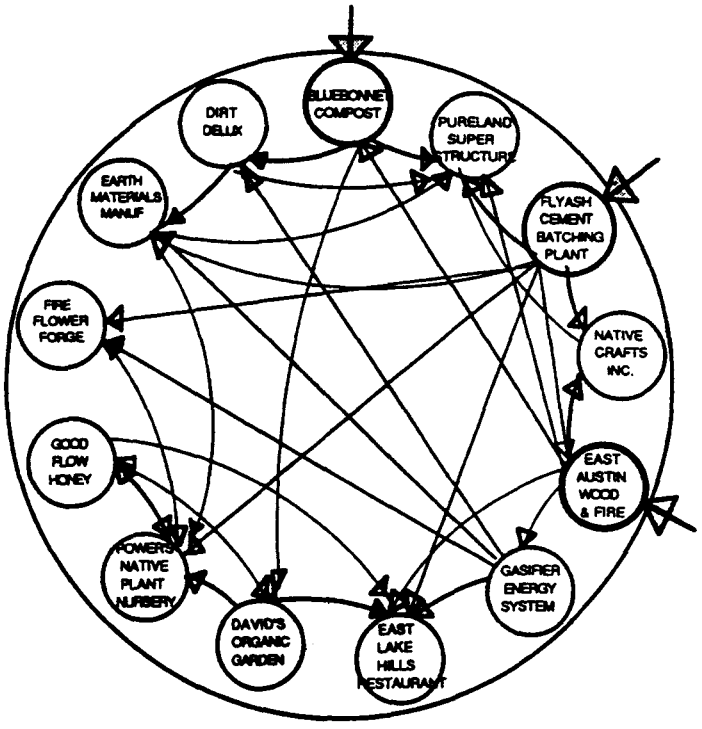
POTENTIAL RESOURCE OPTIMIZATION WITH METABOLIC DEVELOPMENT OF COAL

Another application we have been working on is the concept of developing a new type of **industrial/commercial complex** that is planned around the necessary metabolic units to bring a town or city back into contact with its rural counterpart, as well as its own integrated us of existing business enterprises within the city, by **connecting them through the use of gap units.**

We call the project **City Gates** because it in essence becomes and economic development filter closing inter urban gaps but most importantly preparing rural resources for urban use, and urban for rural in a world where waste no longer exists. This metabolic incubator often must rally around a specific need that triggers the necessary funds to kick off a series of gap industries. It could be a housing incubator or a demonstration farm, or a biomass cogenerator using waste wood as shown below or many others.

PURELAND

INTEGRATED POINT RESOURCES USING TRIGGER INDUSTRIES IN A REGIONAL INDUSTRIAL PARK



There is a structure among cells in higher life forms called a synapse. It takes up the space between two nerve cells in a nerve chain and acts to connect or not connect information in a chemical form from one cell to another. Many nerve cells apparently can be connected to a single synapse with a few to several hundred chemical inputs possible. It becomes a system of a kind of distributed intelligence, with no wiring, nor so called advance technology - it is as though the cells and the body they live within know

what to do. A former teacher, Ian McHarg, often would mutter in his late night studio jaunts while seeing if his troops were at work changing the world before its imminent disaster, "This times no brains!"

City Gates: Enterprise Zones Using Metabolic Planning

The concept of the city has certainly changed since the era of city gates. In the old days, a city's gates instilled a sense of protection. The gates were a control mechanism designed to admit only those thought to be friendly. Yet, if we look more closely at those city gates, we realize that in many ways they served as a **selection gate**, admitting only those who supplied the city with essential life support needs of food, water, building materials, information and, conversely, ridding the city of unwanted people, wastes, diseases, and other unsavory things. In many ways the old city gates were a critical juncture between urban and rural that differentiated as well as combined roles in a kind of selection partnership.

Unfortunately in contemporary planning and design, if city gates are recognized at all they are limited to a symbolic image manifested as arches to signify that everything and anything is welcome as long as it promotes the immediate economic survival of those within. Instead of the important functions that a city's gates once served, we no longer have selection criteria nor bridging criteria. The economic vitality of the city is more and more at the mercy of those whose interests are not so much what becomes of the city as whether it serves a frenzied global economy.

Today we need city gates to be even more than those of the castle and hamlets of bygone eras. If our modern day cities are to survive, we need to start again being selective as to what enters and leaves them. What are these new city gates and how can be again build them into the importance they once held?

I believe a new type of city gate must emerge that reinstates a symbolic relationship between man and nature – that builds not only a clean rural environment but, just as important, a healthy urban and regional economy. The recent interest in healthy businesses can be viewed, in essence, as the bare beginnings of the links that convert a region's raw materials into useful products. "City Gates" could be thought of today as a **complex of metabolic units** that have inputs, conversion processes, and outputs which in may ways mimic processes of healthy natural systems, especially when they are continually linked in chains so that the input required by one process is actually derived as the output (waste?) of another. In this way, as was the case in the past, the gates of

the future become the selectors which fit the city into its region, and which affirm the future of the world as primarily dependent on the health of its cities. And, as in the past, our city gates of the future not only prepare raw resources to fulfill human requirements, but also prepare the by-products from our own metabolic processes for use in the natural world.

In order to understand better the many levels on which this new approach to community and regional economics works and how we could place the designer/developer as one of many actors in a key role we offer some explicit examples.

The first example is a materials related scenario which, from a different viewpoint, is a metabolic incubator based on housing need as its local triggering mechanism to rally the necessary financing. This housing incubator capitalizes on huge quantities of a region's natural and waste materials to supply low energy and climatically relevant building shells. As one will find, there are many other important city gate components to this housing incubator park that turn housing and its various support systems once again back into a regionally relevant activity.

The second example is a farm that uses as its trigger the economic plight of 175 Texas farmers who lose their farms each week. This example relates to a slightly different global condition – CO2 build-up which, along with ultra-violet radiation, will significantly impact farming. Let us first review and gain some global perspective on some key material issues.

Sulphur dioxide (SO2) poses one of the most serious environmental health hazards to modern society, and results primarily from burning high sulphur coal and other hydrocarbons, thereby producing acid rain. It is widely known that sulphur can be collected out of the precipitator stack of a coal plant. So far such procedures have been justified almost exclusively on environmental rationale, rather than on the basis of metabolic unit economics (except by the Japanese). It happens that sulphur is not only a useful chemical in many industrial processes but also is proven to be quite useful in a number of applications in the building industry. When used with gypsum, sulphur becomes almost totally fireproof. Structurally, sulphur concrete is able to achieve a compressive strength of over 5000 psi, and an adhesive strength of about 30,000 psi. Additionally, sulphur can be sprayed for structural surface concrete applications or shells, foamed to form reasonable insulation and used as a natural pesticide to retard home insect infestation. In many areas of the world, sulphur is less expensive than

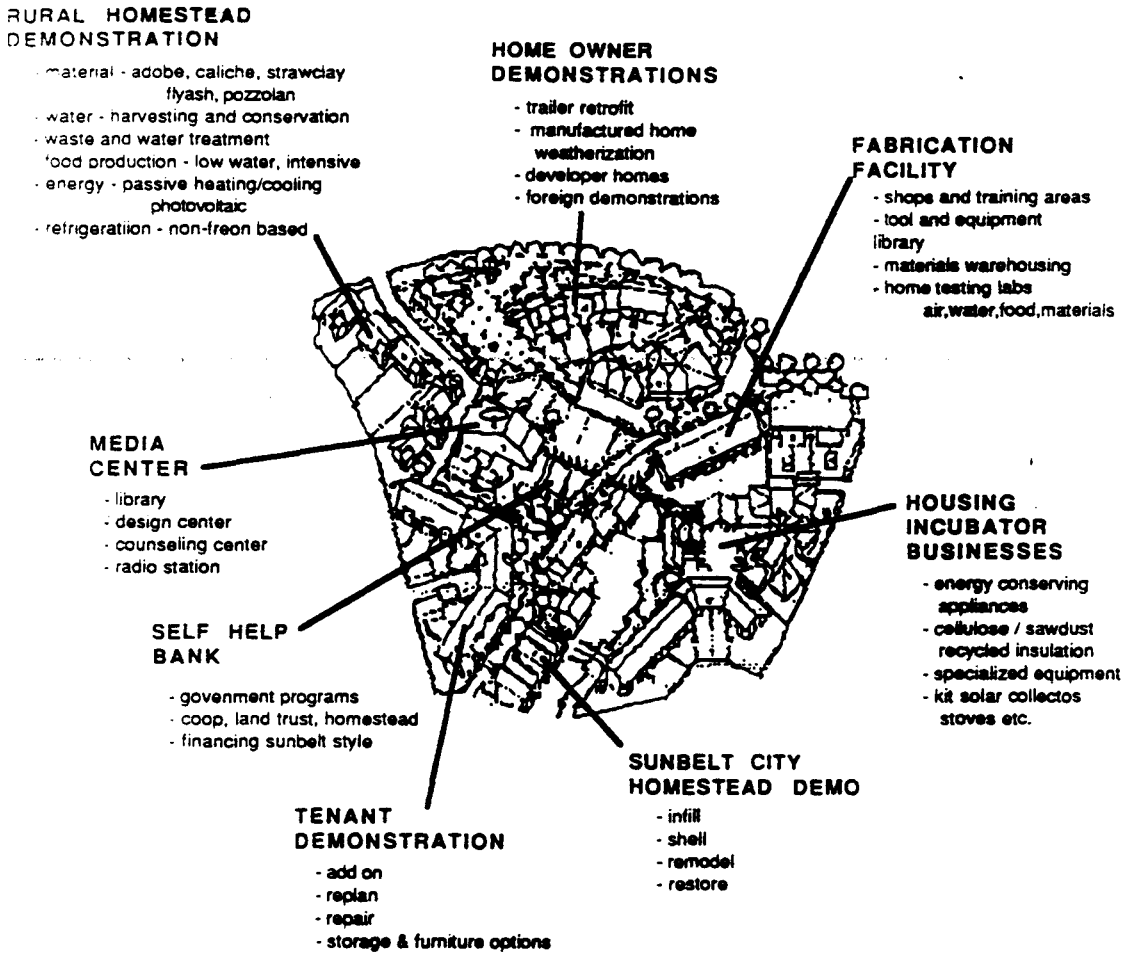
concrete; it is also the 14th most available element in the world.

A sister material also derived from coal fired power plants is fly ash. **Fly ash**, derived from a high calcium coal, when mixed with the lime slag after it has been used in the sulphur precipitating process, produces a concrete with compression strengths tested to exceed 12,000 psi. Both sulphur and fly ash require a fraction of the energy needed to produce portland cement. Not only have we successfully used both sulphur and fly ash for building, but we are presently developing a method to foam fly ash using organic, renewable foams to produce a lightweight porous concrete. We are particularly interested in applying this technique for use as a porous paving to increase groundwater replenishment, the lack of which presents a serious condition in many parts of the U.S..

The **housing-based incubator**, diagrammed below, combines **indigenous material** applications in a business park atmosphere. This means that nearly every element in the park that is materially based is derived either from the development of an area resources of the inter-linking of existing metabolic units for the purpose of better cycling materials and therefor financial resources within the community. **Alternative cements** such as flyash, pozzolan, calcrete, organic based cements, enzymatic stabilization, as well as many earthen based and organic waste-based building systems with technical and economic efficiencies behind each technique are displayed. **Straw clay, straw bale and straw panel construction** serve as a gate to the farming sector; poured adobe using the efficiency of pumping earth into form boards as though it were concrete, poured caliche, pressed block that spill from the machine at a rate of 840 per hour (a machine that goes behind a pick-up truck and costs $18,000 to get into business) each provide a point of entry into the other sectors.

The cost savings through the use of local materials, as we all know, cannot be very great because housing costs have much to do with land prices, financing etc. However, what is often forgotten is the fact that how we build our houses has a lot to do with how money is spent in our communities. Tracking the impact of materials as we had been so prone to do in building our argument for the use of renewables can be equally or more impressive as to the extent that this sector has in the job multiplier category. Once one tracks the entire house support system, ie. utilities, such as water and waste water, food production, transportation etc., one would find many where immediate cost savings might not be too great in sustainable community planning until one realizes that where all this money goes could be back to the community itself. Such a housing incubator attempt among the many other incubator types that are triggered by a need combined with highly available community and regional resources, needs to

be highly visible, highly accessible and well supported politically and otherwise by the community.



In addition, our housing-based metabolic incubator addresses crucial contemporary social needs: affordable housing, the homeless, innovative finance mechanisms for addressing these issues, combinations of self help, "I'll help you if you help me" -- in short, mechanisms that open up the many options within the housing sector that are usually confined to a small minority in rural areas and only at an informal level. We are creating and excuse to demonstrate how self help zones within the urban environment can happen in a way quite different from the urban homesteading model, which was predicated on an abundance of old housing stock not characteristic of the newer sunbelt cities. It is an information center, a training center, an entrepreneurial center for opportunity to those wise enough to want to understand and put into action businesses that are viable economic opportunities while helping the region come with its own problems using its own resources. It introduces new transportation forms such as The Center for Alternative Transportation's bike and ride depot. Any paved areas are done with recently developed continuously surfaced permeable paving - in some

cases debuting their use in this region so desperate for alternative water catchment methods. The landscape is a live demonstration of the same -- native plants -- but also new backyard farming methods that need nothing but a roof cistern and deep composted soil to sustain themselves through a climate considered impossible to exist without heavy dependence on pumped water.

As we progress through each level of integration, we understand more detailed attributes at the levels of community and regional economics. We find that there are **compatible scales of use**, from the individual unit to the inputs and outputs of entire regions. For example, the solid waste under which some cities are drowning could be fed back to where it came from -- the farm. The farm, of course, desperately needs a replenishment of organic matter, with some farms losing an acre of topsoil each minute and a half. Liquid waste becomes an equally precious asset, supplying the nitrogen so essential to balance the carbon-to-nitrogen ratio within the organic solid waste. In this instance we have a different type of metabolic unit developing -- it could be waste-triggered or it could be triggered by farming in combination with an innovative agricultural commissioner such as we have in the State of Texas. Whatever the cause, the important issue is , can it be done?

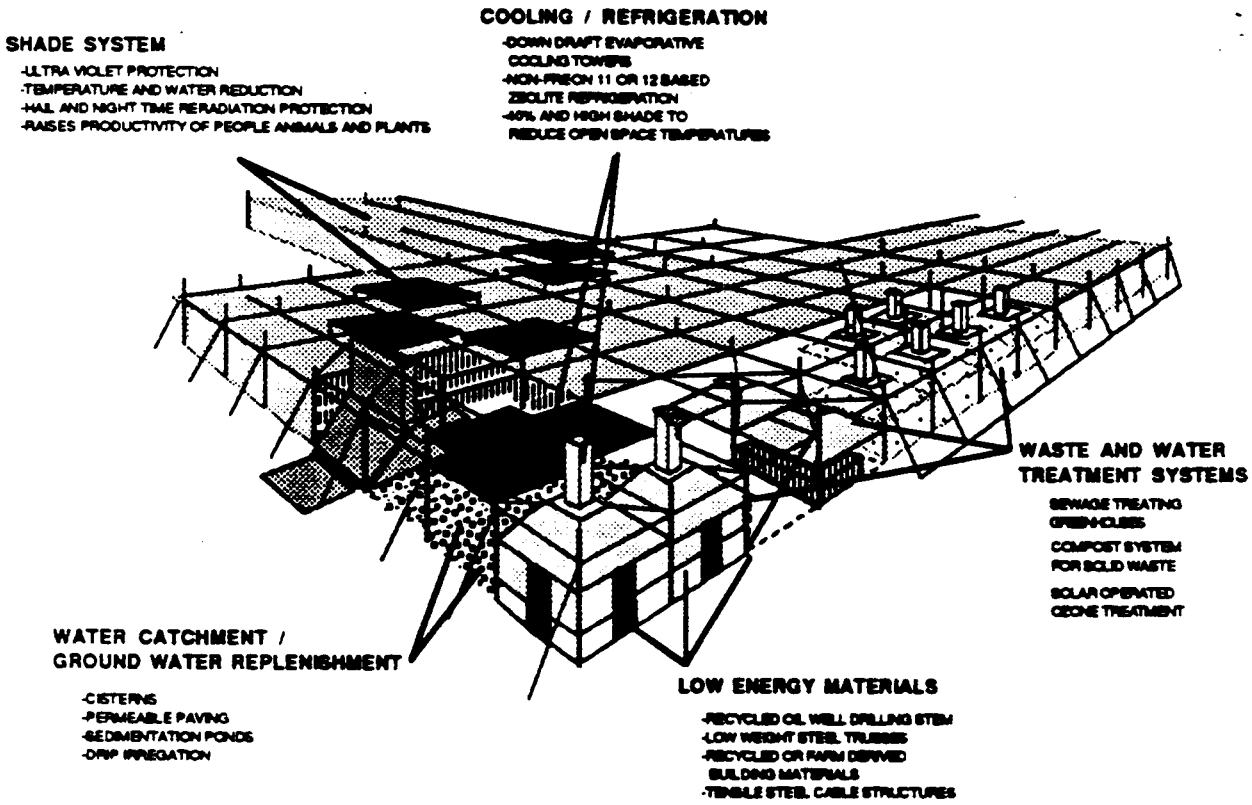
The **Laredo Demonstration Farm** in Texas, for which we are designer, engineer, and site supervisor, is a case in point. This "Blueprint Farm" demonstrates the many critical links between the farm and the city that must take place if either is going to survive and live a healthy existence. The farm is constructed as a multi-use three dimensional field where canopy layers of the forest are replicated using variegated shade materials whose strobe effect and color stimulates plant growth 20% to 30% beyond normal yields. With its filtering capacity of ultraviolet light, it is in itself a model for future urban open space environments. With buildings within the farm complex covered by a continuous shade system, one can imagine whole modern towns and cities with built-in shade components just as many of the ancient desert cities have always possessed.

But there are other examples which alter one's view as to how the city is built by how the farm is built. Using straw building on the farm so that the farmer can lower the initial expense for purchased building materials is borrowed from old European practices, where **entire cities were actually built with agricultural materials**. A similar straw process used to stuff the classic German half timber framed cities of the past finds a new vernacular on the farm where all buildings are plastered straw bales made with a mainstay farm implement -- the straw baler cum straw brick machine.

The flows between city and farm are among the most crucial linkages upon which

sustainability rests. These functional "bridges" become the city/region of the future. **Liquid waste is treated as an asset** to feed water treatment greenhouses that, in turn, produce flowers and animal feed. This treatment process is then connected to the fields where the water is joined with the built-in compositing unit which transforms the cities' garbage to valuable much and water-retaining medium for the nutrient rich liquid waste. So what is usually considered a farm is now a waste treatment plant and a water supplier.

METABOLIC INCUBATOR USING FARM NEEDS AND WASTE AND WATER TREATMENT AS TRIGGERS



But one other metabolic example in our city gates scenario holds particular importance today -- the use of non-freon based refrigeration. In place of freon, known now to contribute to the depletion of the earth's ozone layer, we utilize an absorption process based on a mineral called zeolite that can use a refrigerant as simple as water. Similarly, the insulation around our refrigerator is organically-based to demonstrate that non-plastic CFC-produced styrofoams can work as well as the CFC-based materials.

My fascination is not with any one of these technologies, but rather with their **synergistic potential to develop an ecologically-based regional economy**, and with reversing a mindset that focuses on the negative aspects of economic and environmental problems instead of on their potentials. Our metabolic unit scenario to create a new kind of city gate can be accomplished through very real means even from the analytical standpoint. **Input/output analysis** is not uncommon in economics, neither is the identification of gaps between these inputs and outputs.

At one level, one often finds the existing inputs and outputs among and between regional enterprises unorganized, providing an opportunity for better integration. At another level, we find certain obvious gaps that can be filled by introducing another industry or business to better connect the inputs and outputs of local businesses. This linking process relies on what we refer to as **gap industries** or gap businesses. And, at yet another level, we at times discover an absence of knowledge related to a high potential industrial/commercial enterprise that could exist due to demand and the existence of an available natural resource that has not been tapped. Due to the high multiplier effect resulting from the use of such a resource, potentially producing many secondary and tertiary business potentials within the region, we refer to this effort as the development of **trigger industries**.

According to the **World Watch Institute** "At the current growth rate of 2.5% yearly - half again as fast as world population - the number of people living in cities throughout the world will double in the next 28 years." It is clear that if we dare to tackle the issue of sustainability, which we must, we must admit to working in the urban environment. It seems that one of the most exciting prospects for the type of developments needed in the private and public sectors could lie in the concept of a new generation of industrial/commercial centers at our urban fringe that we in our shop like to refer to as City Gates.