REGENERATION ARCHITECTURE

by

Daniel Alexander Hudson

A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master of Architecture

in

Architecture

MONTANA STATE UNIVERSITY
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APPROVAL

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Daniel Alexander Hudson

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David Fortin

Approved for the Department of Architecture

Dr. Fatih Rifki

Approved for the Division of Graduate Education

Dr. Carl A. Fox

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ABSTRACT

In a world of excess, people rarely stop to realize their impact on their environments. Our built environment is especially feeling the effect of our irresponsibility, and the solution is only a matter of re-wiring our perceptions of energy usage. Many technologies make it possible to have the impossible, but nobody stops to question whether or not these advances are beneficial.

A presumably sustainable system turned out to be one of the most energy wasteful ones in existence. In the complex process of getting food from the field to your house, the best solution is to simplify. Nature will do most of the work; we need to learn to work with it. Current building practices can benefit greatly from this concept, to rethink the existing process by simply cutting out the unneeded steps and using the free energy available to us every day. Our values need to change.

Because the corporation controls so much of our daily lives, they are the ones that will bring about the change in consciousness we desperately need. By re-designing Sysco headquarters to do everything that the company claims to do (and currently doesn't), and interact with the public in a new and radical way, not only can we make changes to how we think about the built environment, but we can also start to show that a change in awareness is entirely possible.

If we can change the values of those that make the biggest differences in our world, then we've effectively changed an entire populations' way of thinking.

Dedicated to my father, who has always taken
an active interest in all of my endeavors, and has
always shown me endless support.

A thesis submitted in partial fulfillment
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_____

David Forton, Committee Chair

_____

Chris Livingston, Second Advisor

_____

Bruce Wrightsman, Third Advisor



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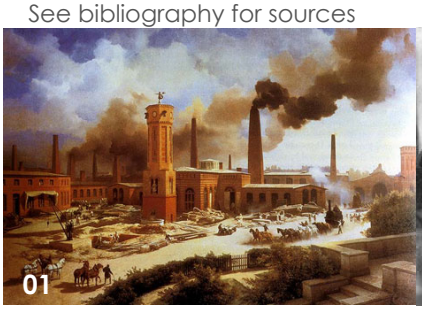
Introduction

"Every species is part of a system. Humans are the only ones that don't benefit the Earth."
Michael Braungart, William McDonough, Cradle to Cradle

Sustainable architecture is constantly evolving with the times, constantly changing its definition to the sway of the cultural waves. It seems that as a global society we are becoming ever more aware of our impact on our planet, and as new problems arise, so do new solutions.

The industrial revolution encompassed the idea that the Earth is full of infinite resources. If you can make it bigger, faster, and stronger, why not use as many resources as we can to do so? After all, they are all available, right? This transcends from the realm of architecture into just about every other realm as well. In the automobile industry for example, the first steam engine ran at less than 5% efficiency. Modern diesel engines run at over 90% efficiency, not including the new hybrid cars that save even more fuel by using electric power. The trend in society has gone from the mind frame of infinite resources and producing large amount of waste, to one of finite resources and lessening the waste we produce. As a whole, architecture (and

See bibliography for sources







everything else for that matter) went from gas guzzling mega-structures to gas sipping mega-structures. Al l organizations aimed at improving how we design the built world merely set rules to lessen our impact, because somewhere on this planet the ice caps are melting and oil is running out. It's time to stop being "less bad" (McDonough, Braungart) and start being what I term "energy positive". Why couldn't our built world contribute just as many resources to the environment as it takes in its construction and maintenance? It's not building on or off the grid, but rather building *for* it.

In setting out to this new approach to sustainability one can look at several different models to act as a guide. This already exists in many forms, such as Biomimicry[1], but all of which still aim to make an energy neutral building. What system is self sustainable and produces more resources than are used to run it? The answer lies in one of the oldest processes of all time, agriculture.

People have farmed since the beginning of time. Apart from gathering, it's one of the oldest methods of sustaining a society, being in tune with the environment, growing crop off it, rejuvenating it, and repeating the process using seed from the previous crop. As the scale of land changed, so did the scale of need and the scale of technique used. As the population grew, so an acre of crop turned into several thousand acres. Livestock driven plows were quickly replaced with diesel running tillers. It is unfeasible for a pair of oxen and a farmer to maintain 2000 acres of land by themselves.

Another result of the industrial revolution: mechanization.

The scale of resources needed to run a plot of land increased, but so did the yield, exponentially. When looking at the resources needed to grow crop, such as wheat, they are dwarfed compared to the amount of resource that is created. The wheat model is existent everywhere and seems to be the most sustainable. Much of the wheat seed is saved and bred over thousands of years to make certain crosses that become naturally immune to new predators and provide plentiful food, and the hay that is left over is returned to the livestock

[1] Biomimicry - an emerging discipline that studies nature's best ideas
and then imitates these designs and processes to solve human problems. www.biomimicry.net

as food. There are many processes in this system that are upcycled[2] and returned both to a society as nourishment and to the system itself to maintain itself in a natural and harmless way. Some of these processes and practices can be learned from and perhaps applied to architecture, to create a new form of sustainability that not only eliminates its impact on the environment, but actually produces more resources than it consumes.

The result: a new form of architecture, based off of the wheat farming model, which actually regenerates resources, feeding them back into the grid, and into itself.

This connection may be considered as a bit of a stretch, however; what does farming have to do with our built environment? One approach to this question is answered in part by philosopher and sociologist Manuel DeLanda. In his book A New Philosophy of Society DeLanda outlines the idea of an assemblage theory, how every part of a system is itself unique and holds its own purpose, but in a larger system works towards the greater whole of that system. Parts hold their own identity and definition, but together with other parts define the resultant identity of the entire assemblage (DeLanda, 8). The key to his theory is that this system is scaleless. That is, in the age old analogy, as the organs in our body work together to make us function, so do we as people work together to create families, families combine to create neighborhoods, neighborhoods combine to form towns, and so on. This means that just as architecture works within a built environment, and farming within a rural setting, one influences and depends on the other when looking at it in a larger scale. Similarly, architect William McDonough says, "Stop thinking about the city and the suburbs and the exurbs and the rural areas as separate entities and you really consider them as united ecosystems (Mau, 38). Architecture can directly impact agriculture just as much as agriculture can directly impact architecture, as will be explored in this thesis. In the assemblage of a city, all of its parts need to have a symbiotic relationship if they truly are to survive. This includes all parts, from the buildings within a city to the rural outlying areas which in some way feed the city. Is there some way that sustainability can be approached from a different angle to learn from a successfully sustainable and existing practice?

[2] Upcycle - according to McDonough and Braungart, converting waste material into a useful resource ("food") for another material or process



Inter-American Institute for Cooperation on Agriculture

Why Wheat?

Many crops are grown in vast quantities all over the world with a high yield of product. Staple crops like rice and corn are grown in different parts of the world to sustain large quantities of people and have a high monetary value.

So why wheat?

Wheat is the crop that supports life all around the world simultaneously. Being part of the grass family, it can grow in virtually any region of the world, and in any climate, season, or altitude. It is responsible for 40-60% of the calories in diets of developed countries, and feeds more people around the world than any other crop. Wheat is also used in more foods than any other crop, due to its concentration of carbohydrates, proteins, and essential vitamins and minerals ("All About Wheat").

The result is an indestructible plant that exists in every region of the world that feeds every culture and every society in some way. When looking at the potential for architecture to take on certain aspects of the life of a crop, wheat seems to be the obvious choice. Architecture, like wheat, is existent all over the world and provides shelter, recreation, and the organization of space for every society. If there were one crop that is to serve as a model for the process and adaptability of building, why



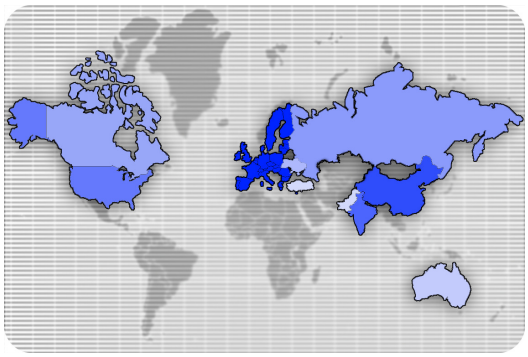
Martin LaBar

shouldn't it be the crop that is just as universal and versitile as architecture, and, just like architecture, undergoes several different practices depending on the area of the world it exists?

Ultimately, the goal of this thesis extends far beyond Montana's borders. In a hypothetical world, all nations and cultures should be able to look at natural processes to learn a sustainable way to coexist with their environment. Wheat is the most versatile crop, exists all over the world, and can essentially teach everybody a new way of living.

Top 10 Wheat Producing Countries (2008)	Metric Tons
1 European Union	151,274.00
2 China	112,500.00
3 India	78,600.00
4 United States	68,026.00
5 Russia	63,700.00
6 Canada	28,610.00
7 Ukraine	25,900.00
8 Australia	21,500.00
9 Pakistan	21,500.00
10 Turkey	16,800.00

http://www.pecad.fas.usda.gov/cropexplorer/cropview/CommodityView.cfm



Trends in Agriculture

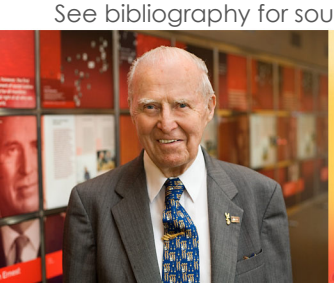
The age old practice of farming has existed since the first people learned to control the growth of food on land for their own consumption. Every civilization in every part of the world has farmed since the beginning of their stories. Several different practices emerged, of course, because the Inca couldn't farm the same as the North Americans or the Egyptians on the Nile. Each civilization must rely on different practices based on their location and crop. Farming is not a universal practice. That is to say, what works in one region may not, and in some cases simply will not, work in others. This is the first most important lesson to apply to architecture. In modern times with the ease of transportation and availability of materials it is easy to apply one system in all environments which may not house that system correctly.

Onset of the Green Revolution

Agriculture is not innocent, however. In 1945 began the first green revolution, and it had nothing to do with architecture. Norman Borlaug, known as the "Father of the Green Revolution," was an American Agronomist who first stepped into the picture by helping Mexico's wheat problem. Mexico at the time was exporting virtually its entire crop yield (albeit a very small amount of yield) to the US and other countries, leaving almost nothing for their own people. This food crisis, coupled with the growing population and poverty, presented a dire need for a solution. Borlaug introduced the first genetically engineered seed, bred to withstand extreme temperatures and repel disease and insects. The native crop was then replaced with the higher yielding "super seed" that created more food in less time, effectively solving the food crisis problem in Mexico (Borlaug).

The news of success spread throughout the world starting with India and Pakistan, and soon all third world countries with a food crisis wanted a part in the Green Revolution, as did Borlaug. Now, this genetically modified seed is used so widely that it's hard to find any locally grown, organic food anymore. Nearly all packaged food contains genetically altered genes to make more for cheaper. This has subsequently raised much controversy over labeling food with genetically altered genes, for example. The Green Revolution can be described as a globalization of crop, analogous to the industrial revolution but in the food sector. A universal practice has been set into place for regions that simply do not have the same resources and characteristics, much like many practices put into place today in the realm of architecture.

See bibliography for sources









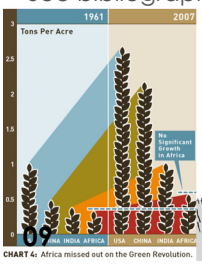


So what's wrong with this?

People are getting fed all around the world; food is grown faster, cheaper, and with higher yields. This Revolution has not quite solved every problem however. Africa is still a problematic area. Many attempts have been made to introduce this genetically modified seed with little success, producing the same amount of crop as is natively grown. The conditions in Africa are just too extreme still to grow this kind of foreign crop. Apart from that, as Borlaug puts it, "In spite of biotech's great potential, access is a problem." By this he means that the GM seed (Genetically Modified) is patented by large national corporations and some countries can't afford this seed to feed themselves (Borlaug). So in other words, Borlaug and other researchers worked hard to create a hardy wheat seed to feed starving populations all over the world, but only as long as those countries can afford it.

There are many practical repercussions to this industrialization of crop. First, all native biodiversity is being wiped out all over the world. Where once there were vast fields of squash or potatoes, there now exists a GM potato or wheat plant, the same one that exists down the road, in the next county, in a neighbor-

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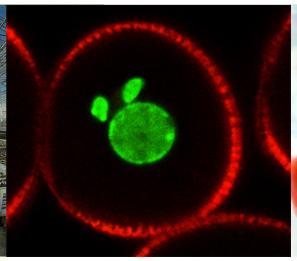














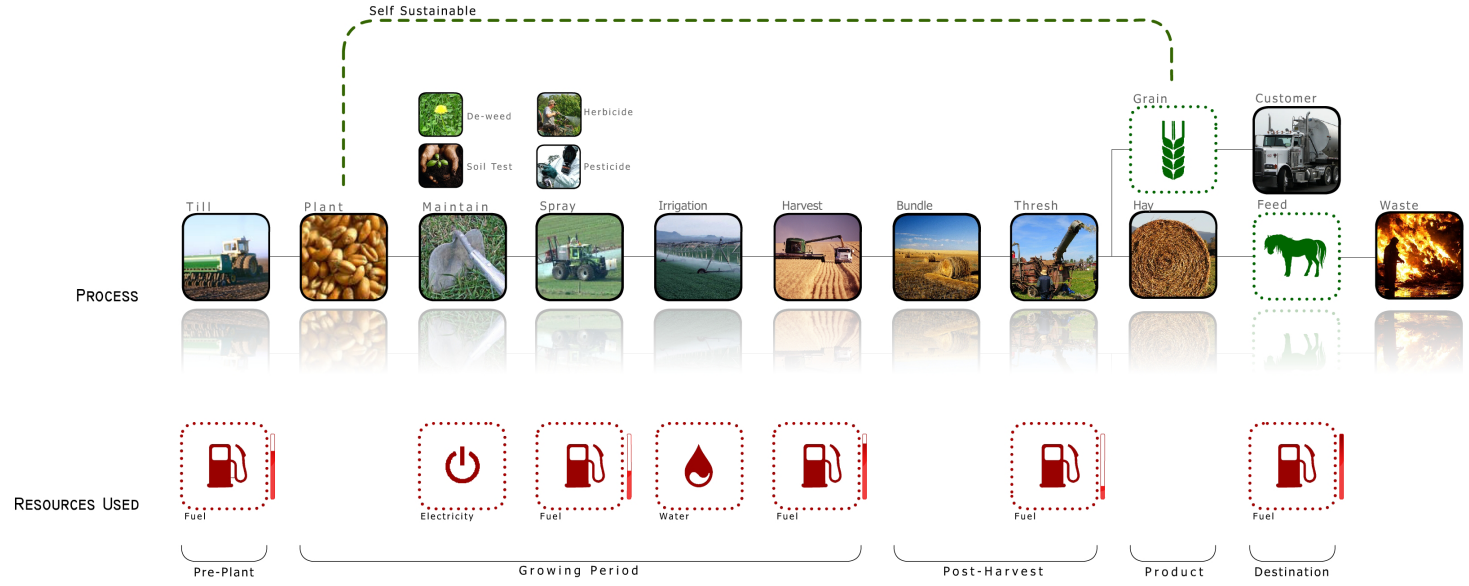
ing state, country, and across the world. Altering natural habitats in this way has dire consequences on an area's wildlife population and biodiversity. Apart from biodiversity, this crop destroys the small amount of arable top soil on our planet. In a natural cycle, farmers would alternate crops and grow several different kinds at a time, keeping some sort of diversity on their plot. This acts as a natural insecticide. As Michael Pollan reveals, when the pea plant is attacked by spider mites, it releases pheromones that attract another kind of mite to eat the spider mites (Pollan). Similarly, in a plot of diverse crop, each crop attracts a certain predator that preys on another creature that may attack a certain crop. For example, spiders and grasshoppers attracted by wheat fields keep the sawfly population in check that attacks the oat crop. "Monocrops," as are being grown nowadays (vast fields of the same crop), don't exist in nature (Hawkins, Lovins, 195), and create an "all you can eat buffet" for pests. This in turn means farmers have to use increasingly higher amounts of pesticides that destroy the nutrients in the soil and affect its reusability. Soil productivity in the Great Plains has already fallen 71% in the last ten years. Since the 1990's, the USA has been losing topsoil 17 times faster than it is being formed (Hawkins, Lovins, 192).

On the subject of health, the transgenic seed increasingly affects greater percentages of the human population. This can be explained by looking at what a GM seed really is on a micro-biological scale. How can scientists make genetically altered seed in the first place? To change a cell's genes you must first infiltrate the cell. This is done through bacteria, whose purpose is to do just that. Certain bacteria that have certain traits, such as resistance to a certain bug or herbicide/ pesticide (RoundUp Ready crop) are injected into a cell, effectively breaking the cell's natural composition. If the different composition of genes could be color coded, a wheat cell under a microscope would look like a splatter of colors. This makes the cell potentially uncontrollable, allowing unforeseen genetic mutations, which in food cause a good amount of the population to develop allergies. In one case, a woman actually had an almost fatal allergic reaction after eating a simple sandwich, not knowing that the reaction was brought on by the grain in the bread (The Future of Food).

On an economic scale, these large corporations, such as Monsanto (who recently bought out Montana's WestBred company), use intimidation and malpractice to scare and force local farmers to destroy their seed, thousands of years in the making, in order for them to go out of business and for these national corporations to take over and grow more of their GM seed.

For these reasons, even agriculture is leading globalization in the food industry just as architecture is in the construction industry. Investigating the general pre-revolution farming model can still act as a teaching tool to learn how self sustainable farming can be.

Current Wheat Model
Based on Spring Season



1. http://www.ext.colostate.edu/pubs/farmmgt/05006.pdf
2. http://waterquality.montana.edu/docs/irrigation/wheatirrigation.shtml
   http://www.pecad.fas.usda.gov/highlights/2008/05/images/Syria_wheat_irrigation_graphs_may08.jpg

Diagram information pieced together with help from the following sites:
http://www.allaboutwheat.info/production.html
http://www.fao.org/inpho/content/compend/toc_main.htm#TopOfPage

The current spring wheat model is used to show the worst case scenario for a typical farming season. It is important to note that not all practices are done on every farm in every region; therefore certain steps could be left out. For the purpose of this diagram and of the study, all possible steps are included to show what could happen.

Generally, the crop starts with the previous year's saved seed. After growth and maintenance the crop is harvested and threshed to separate the grain from the straw. At this point, the grain is shipped by plane, train, or automobile, or a combination of the three to its destination, often time overseas. The hay is typically sold, fed to livestock as feed, or burned. The hay, like the grain, can grow mold if improperly kept or becomes too old, and then becomes waste.

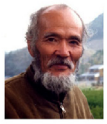
Agriculture currently takes up 2/3 of all the water extracted from lakes, rivers and aquifers, and is the single most water-intensive process on our planet. From a processing standpoint, 87% of all the food we eat comes from 18% of the farms (Hawkins, Lovins, 191). The following calculations are based on a 2000 acre wheat farm, which is average as far as commercial wheat farms go. Tilling the land requires at least 3,360 gallons of fuel at 1.68 gal/acre of diesel, and spraying (fumigating) requires 200 gallons at 0.1 gallon per acre. Harvesting requires at least 2000 gallons of fuel at 1.00 gallons per acre of diesel. About 326 million gallons of water will be used throughout the season on one plot. This data is based on 162,924 gallons per acre to irrigate 6" throughout the season. Most crop (spring wheat) require 18"-21", however, data shows more than half of that requirement will be fulfilled from rainfall. Winter crops in turn do not need irrigation if in a snowy climate. Although they sound like a tremendous amount of resources, and they are, they are minimal when considering the amount of work that is done over the square footage, and how many more resources are created in the end.

Overall, the current model is not quite as efficient as expected. While much food energy is created at the conclusion of each cycle, much more fuel and water energy are used to make this process work that are not returned or upcycled. Is there a way to modify the process to make it energy-positive?





Natural Farming/ Permaculture



Japan, China, Southeast Asia

Creator: Masanobu Fukuoka

Masanobu Fukuoka's method of natural farming has revolutionised how many farmers in Asia grow crop. This Japanese farmer created a "do-nothing" system by which the only work required is one to two people every few days to hand sow and harvest.

How is this possible? Fukuoka plants fields with a variety of crops. He has found the right combination of plants that, when planted in a certain sequence, naturally control weeds, pests, and naturally compost the soil, maintaining a healthy environment. This "biodynamic farming" requires no maintenance , and his yields have resulted in 22 bushels of rice and winter grain per 1/4 acre. In Montana, we have reached 100 bushels per acre (25 per quarter acre) but with much more damage to the environment[1]. Fukuoka's method is very comparable to our standards and definitely better than many practices abroad.

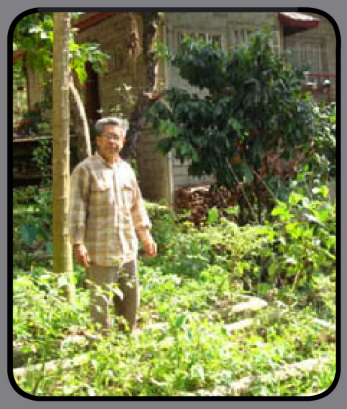




http://fukuokafarmingol.info/fover.html

[1]http://www.montana.edu/cpa/news/nwview.php?article=5704











Natural Farming within an urban context

Natural Farming in Japan

Natural Farming in Saudi Arabia

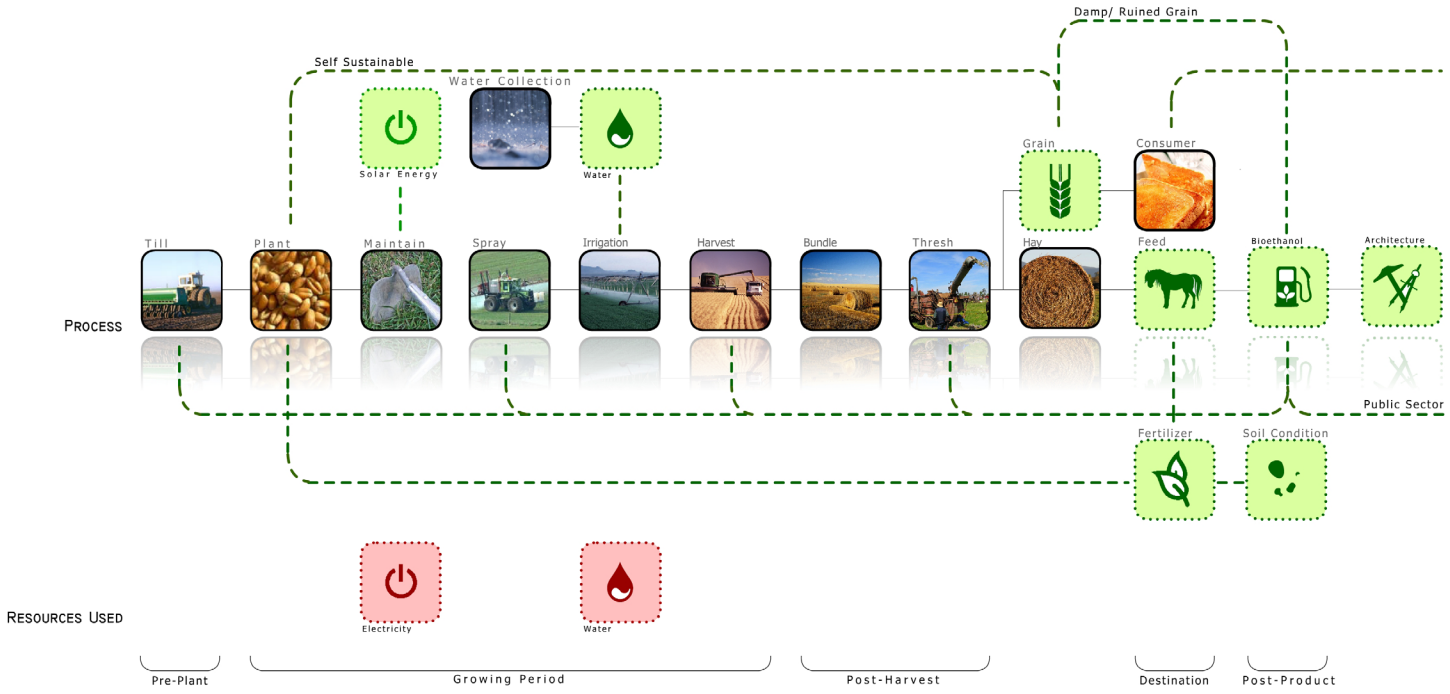
Removal

Regeneration

Upcycling

Fukuoka's farming practice exemplifies a completely sustainable method of farming. He uses the free existing resources to his advantage to remove the unneeded energy use in watering and fertilizer.

Proposed Wheat Model
Based on Spring Season



This model exemplifies several approaches to sustainability. By-products are recovered and upcycled at every step to act as a "technical nutrient" (McDonough) to restart the same process, or to aid in another. Psychologically, if people could consume food locally, this would essentially cut out the need for transportation over long distances. It is estimated that trucks currently drive an average of 1,300 miles to deliver grain to processing plants (Hawkins, Lovins, 192).

The hay and possibly rotten grain is broken down by bacteria and made into ethanol, used to power all the diesel-requiring processes along the way, and if possible, makes enough bioethanol to sell commercially. The transportation step has been removed, suggesting that the transportation could be handled with the same bioethanol or that the location of the farm has moved to a more urban context. The hay is also used to feed livestock, as was done before, the waste of which is used to naturally fertilize the crop along with other natural fertilizers, maintaining soil health. Any leftover hay, or any allotted amount of hay, can be applied to an architectural use. Agri-board can be made by compressing the hay into sheets that can be structural or aesthetic, adding to the list of upcycled uses. Finally, a new structure was added, a water collection system, which would help reduce the amount of grid irrigation needed. Perhaps this exists as smaller water collection nodes throughout the farm as opposed to one larger collection system at the central barn, or a combination of both.

These techniques result in a positive yield of resources at the end of each cycle, while a high amount of food resources are still being created. There are several kinds of methods used in the sustainability of this proposed model that can be applied to all systems in all industries:

1. The addition of new infrastructure, a water collection system, to catch this natural resource and alleviate demand from the grid.

2. The recycling of natural byproducts such as grain to replant the next season's crop, and using free re sources such as solar energy to power natural processes rather than completing them artificially. For example, drying the grain could be done using an extreme amount of energy with heaters and fans, or can be done using the sun and natural ventilation methods.

3. The upcycling of other byproducts such as manure for fertilization, and hay for bioethanol, feed, and architectural purposes used throughout the process and beyond.

4. The removal of unneeded processes, such as transportation or fumigation. This method is essentially "cutting the fat" from existing processes.

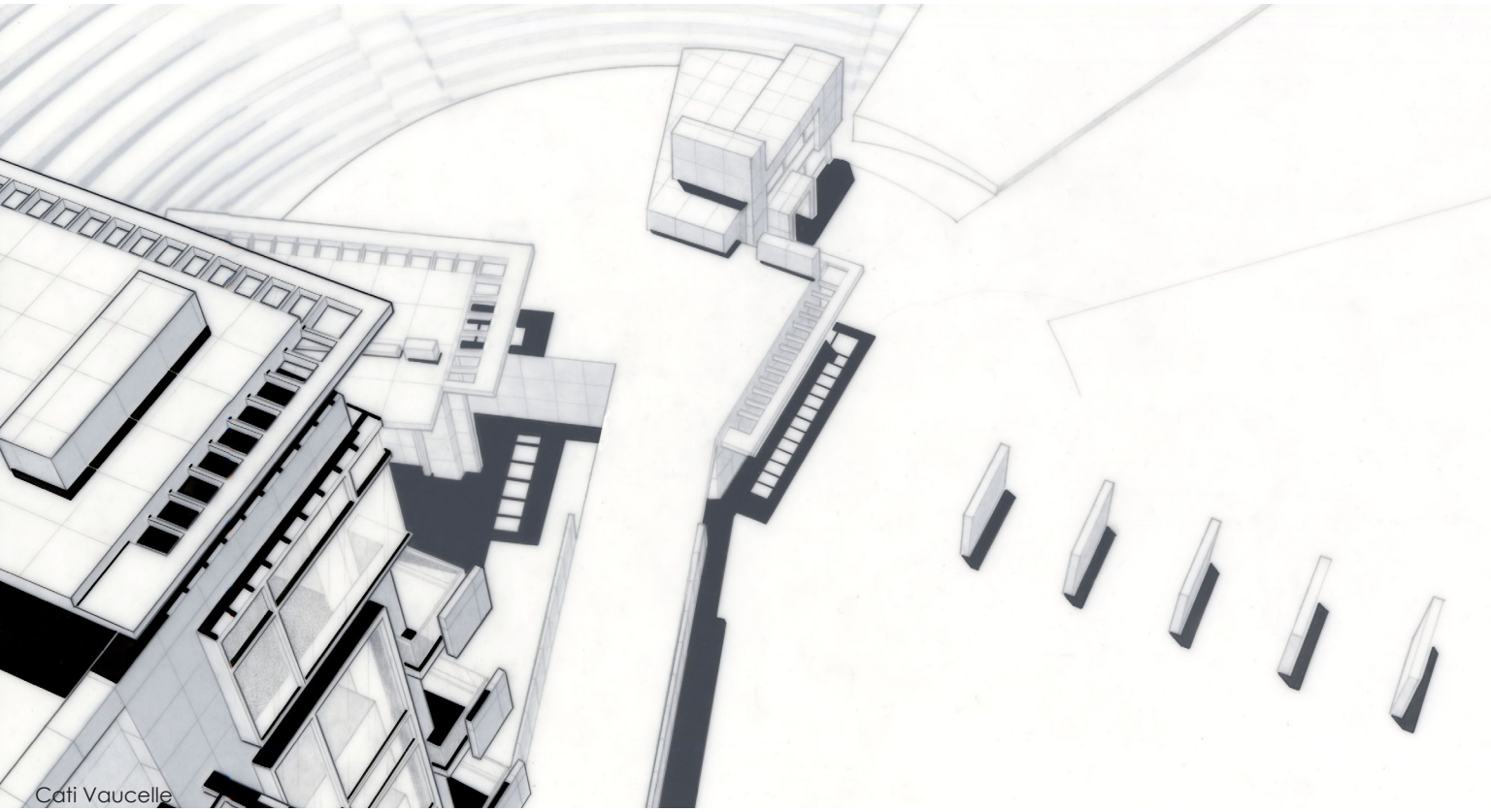
With these changes in mind, can architecture now start to take some of these aspects and apply them to how we design our built environment?

Conclusions

While the agricultural model may not have been as efficient as expected, at least with the process used in developed countries, it still served as a valuable experience. It presented an opportunity to make the system as sustainable as possible and learn from what changes were made, as well as what systems were already in place that are sustainable and energy-positive. To recap the 4 methods applied or observed from the proposed agricultural model:

1. The addition of new infrastructure
2. The use of existing and free renewable resources
3. The upcycling of by-product
4. The removal of unneeded energy use

These four methods are key components for the application of agriculture into architecture. They do not involve a linear style of thinking, but rather, keep in mind the start of the new cycle. The seed is not just shipped off, but also re-used in the next season. Crops are alternately planted to diversify the soil for future use. In the proposed system, every step is in some way feeding another; at the very least it is ensuring its own reusability and therefore not taking up any energy. These standards can easily be applied to architecture and will perhaps change how we think about our built environment. Our current system implements linear models/ project delivery methods with one goal in mind: the completion of a building using the least amount of monetary resources possible. It's time to change this linear method and implement a more cyclical model, whereby the completion of a project is not the end product, but rather just a midpoint in the overall lifespan of a building. We need to design with end-use in mind. After a building has served its purpose, what happens to it? Instead of demolishing it, can its parts be used to feed another system or building, as explained by William McDonough and Michael Braungart?
Architecture now behaves much like the modern methods of agriculture in developed nations. There is much waste, complications, and solutions that create more problems. Can we approach our built environment in a new way?



Cati Vaucelle

Trends in Architecture

The current practice is a very complex negotiation between several parties trying to balance out their needs with time, money, and quality. Architecture in the commercial and residential world is, similar to the agricultural Green Revolution, aimed at creating the most buildings and homes for the least amount of money: a globalization, or standardization, of design. All Wal-Marts, Targets, and K-Marts are made with essentially the same materials and layout. Most houses in a suburban context are appropriately named "cookie cutter" houses due to their sharing of a single plan that may be mirrored, at most, to "break up" the lackluster monotony of a street. This is seen increasingly all over the world for the simple reason that it saves money. The problem is, just like agriculture, there is no standard solution to any design problem. What may work in one environment may not work in another the same way.

The industrial revolution framed a path for architecture that used an extreme amount of raw material. It is important to understand this mechanization of the world because it led us directly to how business is negotiated now. This time period ushered in an era of industrial construction. Design philosophy revolved around the idea of economical office design. The market really only demanded two typologies: the downtown high rise building, made possible due to the advent of steel construction, and the company headquarters in a rural landscape (Gossel, Leuthauser, 321-322). Art historian Alfred Gotthold Meyer commented that architecture could be described with three elements: Iron, Machine, and Light (Gossel, Leuthauser, 21). The automobile at this time dominated the transportation sector, and as more Americans owned cars, more architects designed for the automobile (Gossel, Leuthauser, 395). This began to inform modern day urban planning.

By the 1900's, iron had evolved into steel, and the construction industry changed tremendously. It was the era of the modern factory, heavy buildings, longspans, concrete, and masonry in large scale proportions. Concrete, for example, was treated as a large scale material with no attention to detail (Gossel, Leuthauser, 381). High rise buildings sprouted all over the country in downtown areas, creating a new set of zoning and building safety codes. The new options in materials and construction methods started taking shape and evolved into the current methods that exist today. In terms of energy, we are becoming increasingly aware

of our impact on the environment. We are preoccupied with global warming, carbon emissions, and the end of our oil supply. In a materialistic society, our materials are running out!

So came about the architectural Green Revolution, the start in a shift towards an environmentally friendly attitude towards construction. Although the idea of sustainability could be traced as far back as the early Roman Empire, who placed their baths facing south to naturally heat the water (Steel, Carolyn), it isn't until today that certain practices are being taken seriously on a global scale: solar energy heat gain, thermal mass, low energy lights, water efficient toilets, and sun shading devices. In fact there are many practices still being created to help lower the energy used by buildings. Several organizations such as LEED[3] came out to reward a building for how little energy it uses (for the right price, of course). What all of these methods amount to is what Braungart and McDonough term "less bad." We aim to improve our buildings' energy use from "a lot," to "less, but still a lot". Is this the goal we should have as architects? How beneficial is it to build structures that take up less energy? The same raw materials are still extracted, electricity used, and water drained because while we make buildings "less bad," we are building twice as many (current economic times excluded).

As briefly mentioned earlier, the way in which a building is carried out is a very linear method of thinking. There is a design (sometimes you may start with the construction manager depending on the delivery method), it moves into construction documentation to be prepared to build, next comes the bidding of a construction manager, the building is built, and everyone is paid. Many sub-steps have been left out but the overall idea is still there. From conception to construction to conclusion, the process is very linear. Architects base the success of their designs in part by how long the building will last and how well it will perform over its lifespan. This suggests that we construct buildings not caring what will happen at the end of their use, and so they become slums or waste that need to be demolished, requiring more energy still.

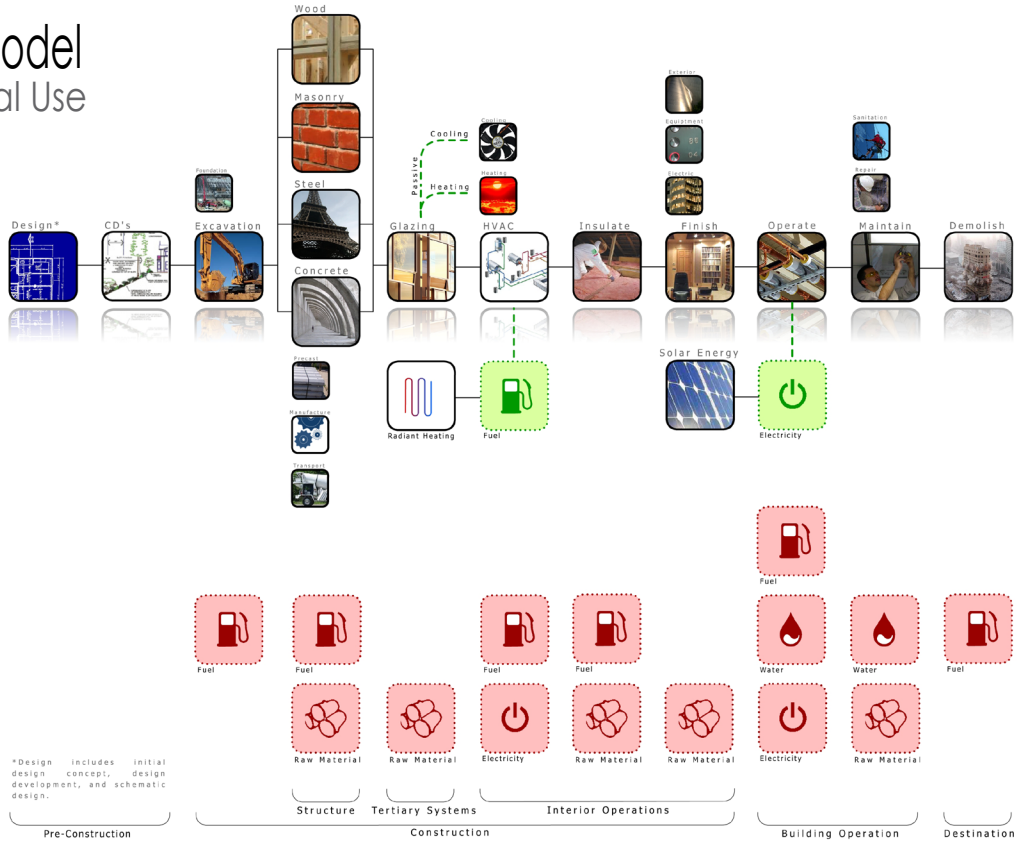
[3] Leadership in Energy and Environmental Design. An organization that awards buildings on their sustainable features and its overall efficiency. http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988

To study the inefficiency of the construction world it is appropriate to look at several models to determine which building typology actually uses the most energy. When applicable, high rises will be explored due to their greater use of energy and resources in construction, maintenance, and daily operation. The US Department of Energy categorizes building energy use into three sectors: commercial, residential, and industrial (this includes federal as well). All three sectors are diagrammed in a qualitative analysis backed by quantitative data to determine the energy and resource consumption of each typology.



Current High Rise Model

Based on Commercial Use



1 http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=3.1.1
2 http://geospatial.blogs.com/geospatial/2007/09/convergence.html
3 http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=8.1.1
Mathew Wells.Skyskrapers: Structure and design.
Charles Jencks. The Iconic Building
Allen, Iano. The Architect's Studio Companion
Allen, Iano. Fundamentals of Building Construction

Commercial Model

The current high rise model requires a large amount of energy and resources both in the construction and in the operation of the building. This diagram exemplifies a generic model of high rise buildings, all those elements that all high rises have in common, so that there may exist differences between high rise housing complexes and business models.

At this point, every step in the life of a building uses an extreme amount of energy, regardless of the sustainable approaches that may be taken to lessen the impact on the power grid. Materials are used in vast quantities and must be transported. The sheer size of the spaces naturally requires more heating and cooling power, as well as adequate lighting.

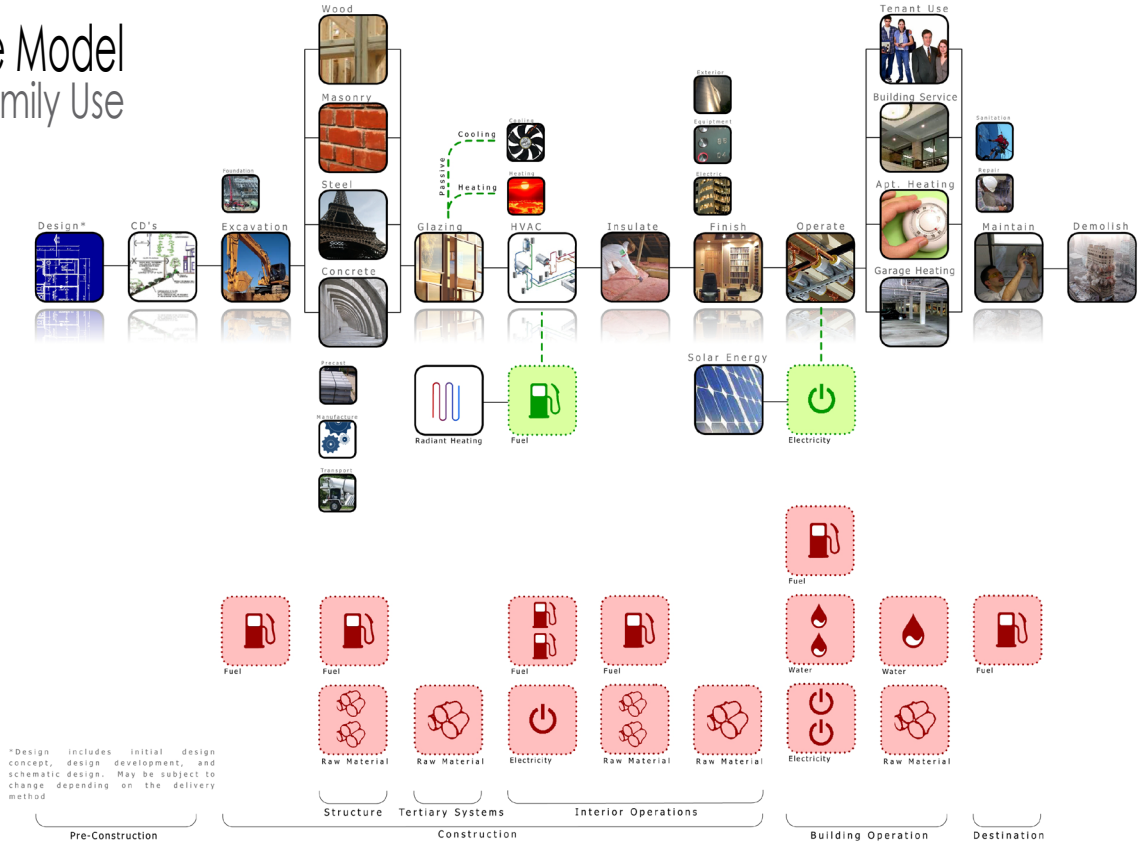
Is there a way to incorporate the principles and practices of a sustainable agricultural model into an urban high rise scenario?

According to the US Department of Energy, the construction industry takes 39% of all energy in the US, 79% of the electricity, and is responsible for 38% of carbon dioxide emissions. At this point, buildings take up more energy than can be sustained in some places, contributing to rolling blackouts or brown outs in some cities. In 2000, commercial buildings used 10.3 billion gallons of water, accounting for 2.5% of the total water used in the US. At this current rate of energy use, and with the fast growing urban and suburban sprawl, there will simply not be enough resources to sustain towns and cities. When taking into account the resources required not only to build, but to operate and maintain, and even demolish buildings it is clear that we simply won't be able to sustain the modern world. In a parallel to agriculture, the region in the lower midwestern US is simply not able to sustain much more food-yielding crop. It is instead producing great bio-feed crop for livestock, leading some, such as Montana State University's Professor and researcher Tom Blake to project that this area will become a dustbowl in the near future, pushing many inhabitants to move further north.

Although some practices are put into effect, such as the use of solar energy for passive heat gain and thermal mass, or in the form of photovoltaic cells or solar panels, the amount of energy gained from these practices are minimal in comparison to how much is still being used. Other practices, such as the more efficient radiant floor heating, may reduce the energy required in maintenance, but may require a higher installation cost or a more advanced technology for them to function, which in the end may lend to more use of resources fabricating the advanced technologies. Over the long run they may make a difference but perhaps we are simply using a different set of resources that are more expensive and may deplete faster.

A study done by the Division of Building Research in Canada shows that a single elevator, for example, can take up to 9% of all the energy usage in a high rise building. That is almost a tenth of all the energy used. Now multiply that by the several and evermore complex elevator systems that many high rise buildings have and the energy use rises by a substantial amount. Problems like these can be lessened through the use of more efficient systems, but a great amount of energy will still be drained from the grid.

Current High Rise Model
Based on Multi-family Use



1 http://buildingsdatabook.eren.doe.gov/docs/xls_pdf/2.7.1.pdf
2 http://nparc.cisti-icist.nrc-cnrc.gc.ca/npsi/ctrl?action=rtdoc&an=5376554&article=4
3 http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=8.1.1

Allen, Iano. The Architect's Studio Companion
Allen, Iano. Fundamentals of Building Construction

Residential Model

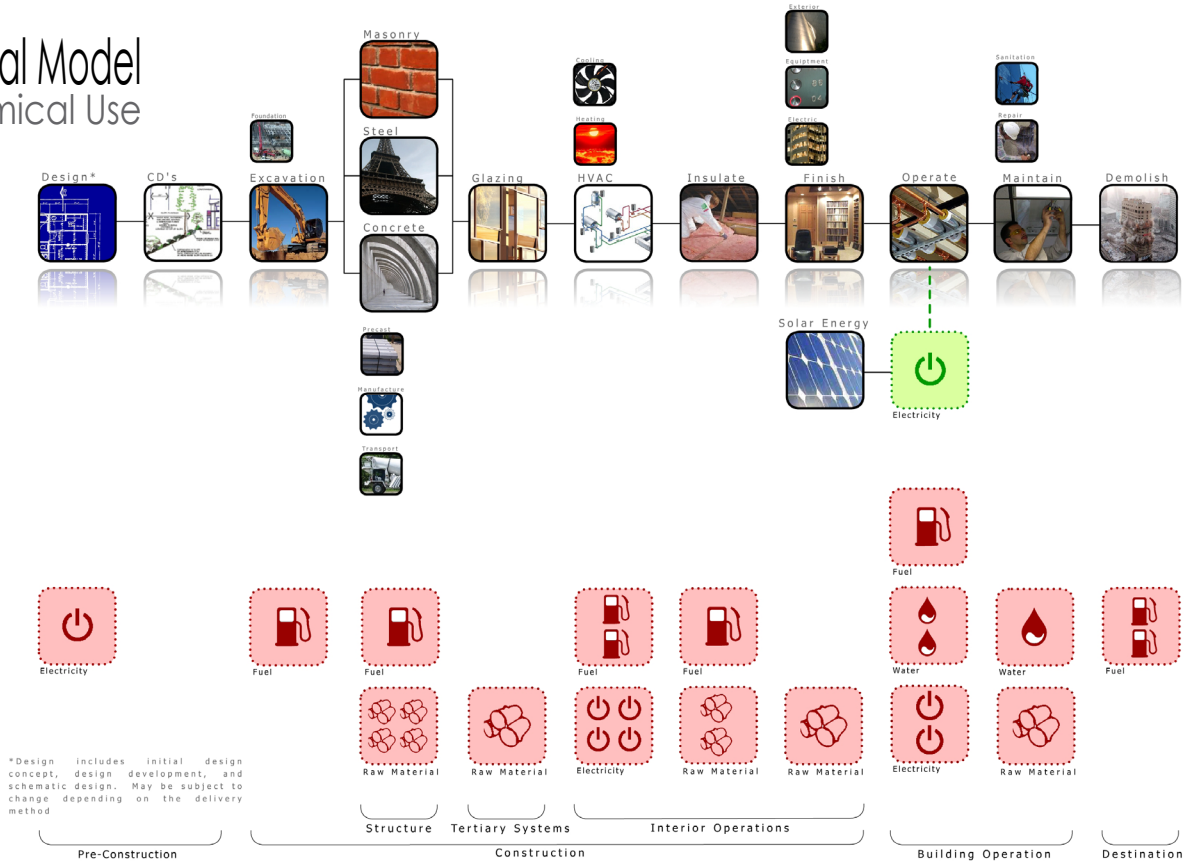
The residential mid to high rise model requires essentially the same energy requirements as the commercial high rise model with a few more addendums. The key difference in this model is the operation of the building, which requires substantially more energy to support the individual apartments.

According to the Department of Energy, the energy use in residential buildings accounts for 33% of the electricity, and 43.4% of the natural gas, an average of 68.3%, of the energy used in the construction sector in the US. In 2000, residential buildings accounted for 28 billion gallons of water used per day, 6.9% of the total water usage in America.

Energy use in residential buildings could be broken up into two categories: Tenant use and building use. Tenant use refers to the power supply on an individual apartment basis: refrigeration, and appliance usage, such as electric stoves. This may take up the bulk of the buildings resources on a consistent basis. TV's, computers, and stereos are just some of the common appliances that may remain plugged in for extended periods of time. There is also a considerable amount of water usage for each unit that puts a different stress on the grid. Building services refer to those processes which the building provides publicly for its tenants. This includes lighting in the lobbies or the running of laundry facilities. There may be a pool facility that will require maintenance and heating as well. Building heating also takes up many resources depending on the HVAC systems utilized and the climate in which the building is located. In particularly cold climates, with older systems, a great deal of natural gas may be used per unit to heat it up. Heating costs also include water heating per unit. Garage heating also takes up a lot of energy, being another major component of the building, due to its large open space. Most garages must remain at a constant temperature and depending on the location, will require heating.

Water use may account for a good chunk of a building's resource use. Many buildings are starting to incorporate grey water recycling systems that greatly improve the water use, however many more buildings use the city's water supply and return it into sewage systems.

Current Industrial Model
Based on Chemical Use



1 http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/pdf/table5.3_02.pdf

Ching, Winkel. Building Codes Illustrated

Allen, Iano. The Architect's Studio Companion

Allen, Iano. Fundamentals of Building Construction

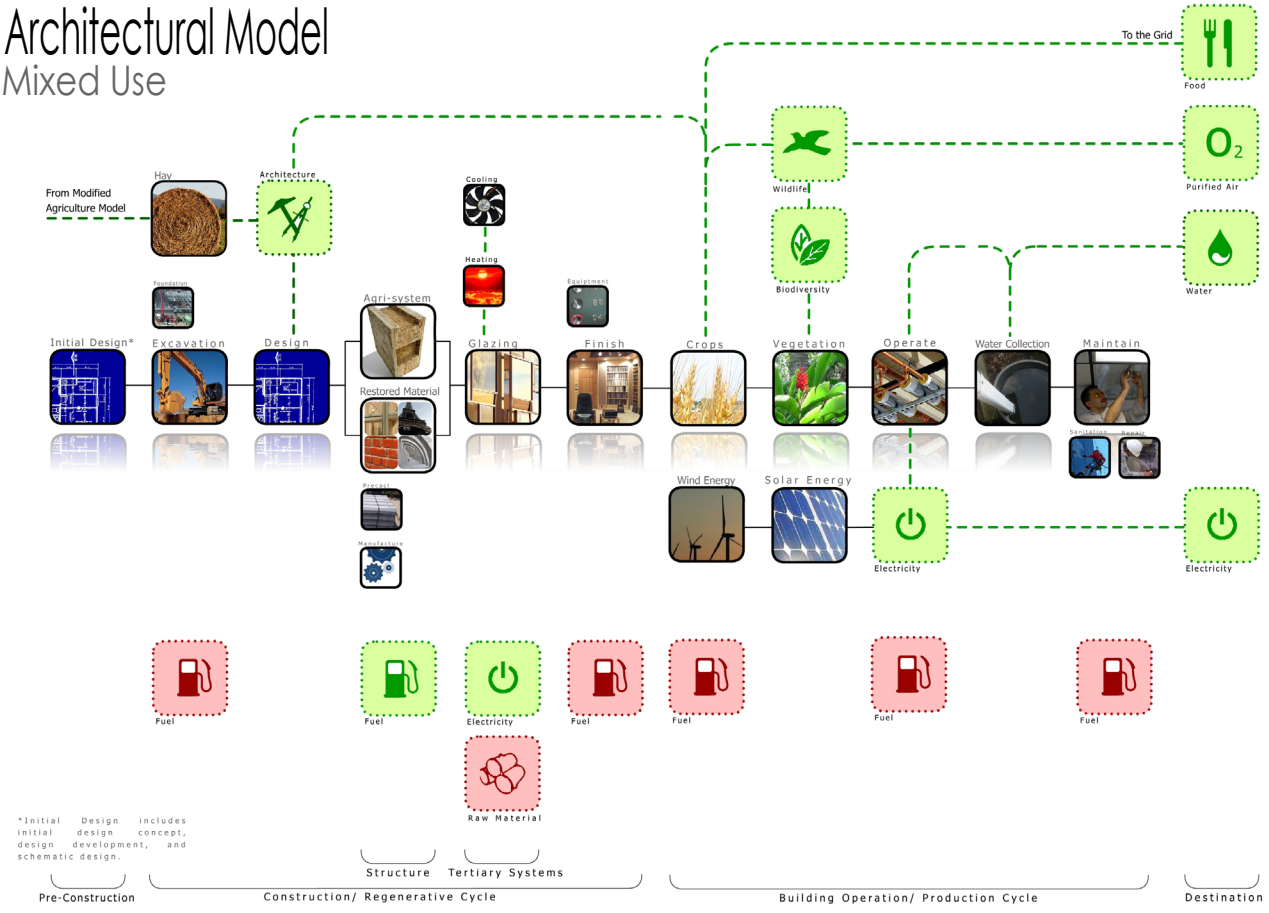
Of all the industrial building in the US, chemical storage and manufacture far exceeds energy requirements of any other type, followed surprisingly by paper mills (according to the Energy Information Administration). What makes the chemical industry such a resource needy construction type is the material that is handled and stored inside. This construction falls under the occupancy group F and H: F encompassing the factory sector while H covers the hazardous sector which includes the handling of any materials that are extremely "toxic, combustible, or explosive" (Allen, Iano, 5). Many of these buildings will be mixed use, which is why F is included in the analysis. Regardless, the special care needed to handle certain chemical materials means that the construction will require extra raw material to build and energy to maintain. In some cases, separate structures will be required in the need for vibration resistance, for example. Extreme temperature control will be needed especially for the storage of certain chemicals at certain stages, which will need a constant supply of electricity. Equipment will also use a significant amount of energy to operate.

Looking at statistics will reveal that this building type uses 203,890 Million kWh of electricity for 2002; 1,634 billion cubic feet of natural gas, 8 million bbl (barrels) of residual fuel, distillate fuel, and diesel fuel, and 14 million short tons of coal, far exceeding any other industrial use (USDOE).

Specifically in the construction, type I heavy construction is probably preferable over light frame due to the safety of the inhabitants inside and outside the building. Four hour rated walls are needed on the interior in case of a chemical fire. As mentioned earlier, separate structures may be necessary depending on the needs of the material, as well as adequate and complex ventilation systems. All these extra measures of safety require more raw material and resource use.

Proposed Architectural Model

Based on Mixed Use



Proposed Model

There are many changes to note in the proposed architectural model of design. The typical steps present in the current process essentially still exist in the proposed model, but are perhaps approached from a different angle. The linear model of design has now become circular, where certain steps within the process are never completed but rather are constantly being re-done. This model is not concerned with the end product, a building, but rather with the process of construction, and shows it to be an ongoing cycle.

This architecture includes the growing of crop and native plant species which contribute to the environment and the building itself. When vegetation is growing, it is converting carbon emissions and releasing oxygen into our air. Native plants that were once destroyed for new transgenic farming practices now have a home to flourish, contributing to biodiversity and helping to restore the native animal and insect population that depends on the native plant life, as well as acting as an appropriate icon in every location. When plant-life dies, it decomposes into the soil supplying it with the nitrogen it needs to remain fertile and grow more plant life. When the crop is harvested, you are left with a local food source that requires little to no transportation, as well as bioethanol that can be made from a natural process and used to power all functions of the architecture, or could be compressed into a modified, modular "Agri-board" system that would then build on itself to continue the process of construction. This architecture would also act as a net, catching all the available free renewable resources: water, sunlight, and wind, and use them in its own function as well as distribute them to surrounding architecture. What you are left with is a resource power station that supports a certain radius of the grid. As more of this architecture sprouts up around a city, the city itself could become entirely self sufficient, while minimizing its environmental impact.

Looking at the process of this construction reveals a very different approach to construction. The design and construction phase are never completed, but are rather practiced every year. As crop by-product is up-cycled into architectural elements, they are redesigned and rebuilt into the existing structure, so a building is constantly "growing itself." There is no need for construction documents, because you can't have finished plans for something that hasn't been designed yet. This poses a radical change to how we think about building and is based on the idea that as times change, so do needs; this system allows architecture to constantly adapt to those needs. There is also no demolition phase, because once a building reaches a point where it perhaps is not useful in its location, all of its parts can be upcycled into other processes or into construction. This architecture is constantly producing earth-friendly resources to contribute back to the grid, while requiring no resources to maintain itself.

In comparison to the proposed agricultural model, this model acts in very much the same way. Just as the agricultural model repeats itself constantly from season to season, so does the architectural model repeat itself constantly, giving emphasis to the process and not necessarily the product. Resources are produced in either model that not only feed itself for future use, but also feed its environment. The unnecessary steps are taken out, to eliminate unneeded resource use. We are very dependant on technological crutches to fix problems, but we often overlook the solution of removing steps and rethinking the process in general. Often times, the simplest solutions are the most effective.

Conclusion

Each typology uses resources in different ways. Based on previous research, many of the resources and raw materials used in the industrial model are used in the construction and operation of the building due to the special needs of this typology. This is a front and back-loaded model, meaning that the heavy resource use occurs both during the construction as well as the operation and maintenance. The residential model, for example, is back-loaded, where the main energy use occurs in the operation and maintenance, due to the need for resources amongst the individual tenants of a residential typology. In contrast, the commercial model is front end, so all resources are mostly consumed in the construction of the structure. Regardless of the resource use, whether it is in the construction, maintenance, or both, all architectural typologies share commonalities.

The general process is at best an example of unnecessary energy use, in material resources and time. Many building materials are imported from other states or countries, because in most cases it has become cheaper to obtain building materials from a mass source far away, rather than from a local source, whose material availability and existence limit the architect's ability to use certain desired materials and processes. Certain sustainable practices are not utilized for the simple fact that they have a higher up-front cost for installation and maintenance. Once again, financial resources are the true client behind design. Sustainability is often times bought instead of being achieved through intelligent design, which then results in an unnecessary use of resources throughout the lifetime of a building.

The principle commonality between all typological models is the emphasis on a product. A good example of where our market's emphasis is aimed today is outlined in Hawkin's and Lovin's Natural Capitalism. In the food sector, "participants [are rewarded] for how much they manufactured (or, often, consumed) not how efficiently they produced (Hawkins, Lovins, 191-192)." It has come to the time when a shift in building philosophy needs to occur. We need to award process, not product. After all, in almost all cases, the process is what takes up the majority of energy use. In the proposed architectural model, the process is an ongoing

step. The emphasis is not placed on a finished product, but rather an evolving process. Once the process of construction can become sustainable, then our built environment will become more beneficial to the natural environment. This shift in focus would unfortunately require a tremendous shift in human behavior, and where our values lie as a society. It will not happen overnight, or even in just a few years, but the sooner we can realize this the sooner change will come.





Cuba

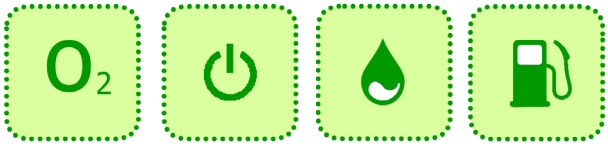
Architects: Cuban Government

When thinking about the most sustainable nation in the world, one rarely thinks of the true answer: Cuba. Not too long ago, during the "Periodo Especial" (1991) right after the collapse of the Soviet Union and the economic embargo from the United States, the Cuban people experienced an extreme lack of resources: there was not enough oil (Cuba became one of the largest producers of bicycles in South America) or electricity (they experienced daily blackouts for unknown periods of time). In 2006 however, they finally decided that they needed to rely on themselves for energy, thus implementing the "Revolucion Energetica."

This Energy Revolution demanded change throughout the country. As the International Program manager at Solar International explains, "In two years, residents have replaced almost two million refrigerators, over one million fans, 182,000 air conditioners and 260,000 water pumps. Compact fluorescent light bulbs were handed out for free and within six months, over nine million - or almost 100% - of the island's incandescent bulbs had been replaced. At the same time, Cubans were discouraged from cooking with kerosene. Families have consequently purchased almost 3.5 million rice cookers and over three million pressure cookers.To encourage conservation, Cuba introduced a new residential electrical tariff. People consuming less than 100 kWh per month pay 0.09 pesos per kWh (a fraction of a cent). For every increase of 50 kWh per month the rate rises steeply. Consumers using over 300 kWh per month pay 1.30 pesos per kWh."

Change was also brought on in schools, teaching children in their preschool years the value of conservation. Social Workers, made up of the country's youth, parade the streets showing people how to use their new appliances and teach conservation to the public. The country also dedicates much of the media, through TV, radio, and billboards, to remind the people of renewable energy and conservation. They implemented a series of new energy micro-plants, spread throughout the country to provide energy for smaller areas at a time, which effectively erased blackouts from their history. Inefficient electric cables and trasformers were replaced with newer more efficient ones, also tied to new wind turbines and solar power plants, greatly reducing the need for oil to make electricity.

"We need a global energy revolution," says Mario Alberto Arrastia Avila, an energy expert with Cubaenergia, an energy information centre. "But for this to happen we also need a revolution in consciousness."



http://www.cubaenergia.cu/index.php?option=com_content&view=category&id=1&Itemid=2



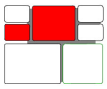




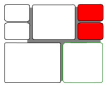




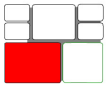




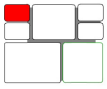
Public Propaganda promoting conservation



New energy structures for the electric grid



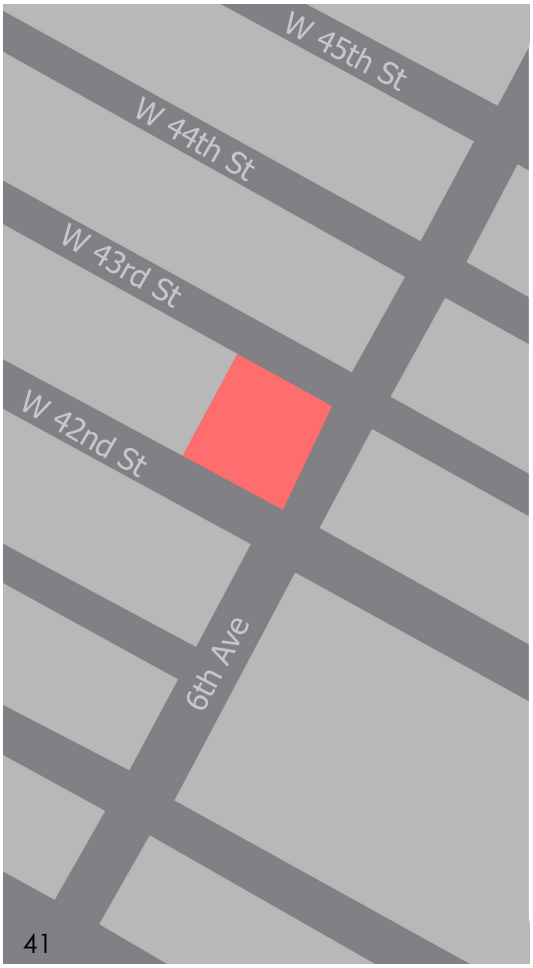
Replacing refridgerators for newer, more efficient ones



Teaching young students about renewable energy and conservation

- Replacement
- Regeneration
- Addition
- Upcycling

Cuba has successfully achieved sustainability through all the key points. They've cut out unnecessary energy transportation by setting up renewable energy stations around the country, also contributing to the building of new structures to attain sustainability. They removed all unneeded energy use by replacing old appliances with energy-efficient new ones.





Bank of America Tower

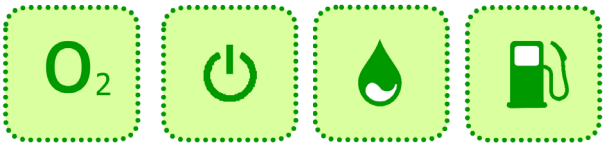
1 Bryant Park
New York, NY 10007
212.571.2404

Architects: Cook+Fox Architects

This 1200 foot tall, 1billion dollar project in New York City is able to find itself a home in the list of the most sustainable skyscrapers in the world. Despite it's overwhelming mass, the architects found ways to achieve LEED platinum.

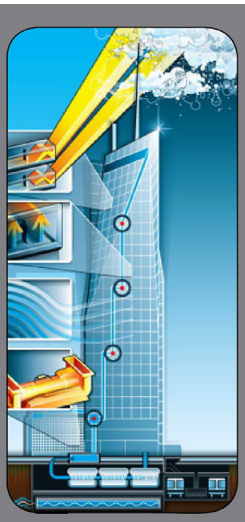
Upon first viewing the building, it is obvious that there is an abundance of glass. The glass used is an insulative floor-to ceiling glass that controls the heat gain/loss and maximizes the use of natural light for these purposes. The building also features a rainwater collection system, to reuse rainwater within the building. The toilets are also water-less, projected to save about 8 million gallons of water per year. The air inside and outside the building is taken into careful consideration as well. The air entering the building is filtered, as well as the air being exhausted out. In this way, the skyscraper acts as a large plant, releasing clean air into the atmosphere. Inside the building, the air is distributed through an under-floor air system, which is cooled by ice, frozen during off-peak hours.

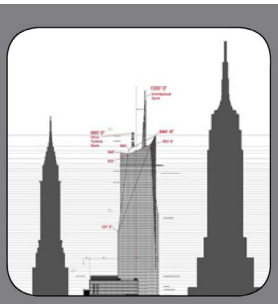
Materials were also acquired in a careful manner. The CEO of Bank of America states that the tower will be made mostly of recyclable materials. The concrete, for example, is made of slag, a byproduct of blast furnaces. This reduces the amount of actual concrete needed, and passivly lowers carbon dioxide emissions from the concrete that does not need to be produced.



http://www.cookplusfox.com/index.php?id=1018

----- Projects >BofA Tower

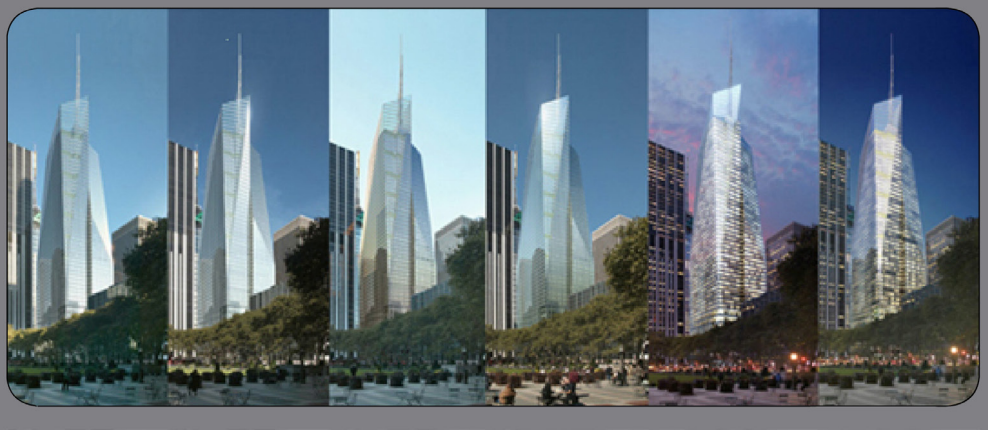




Sustainable analysis

Renderings



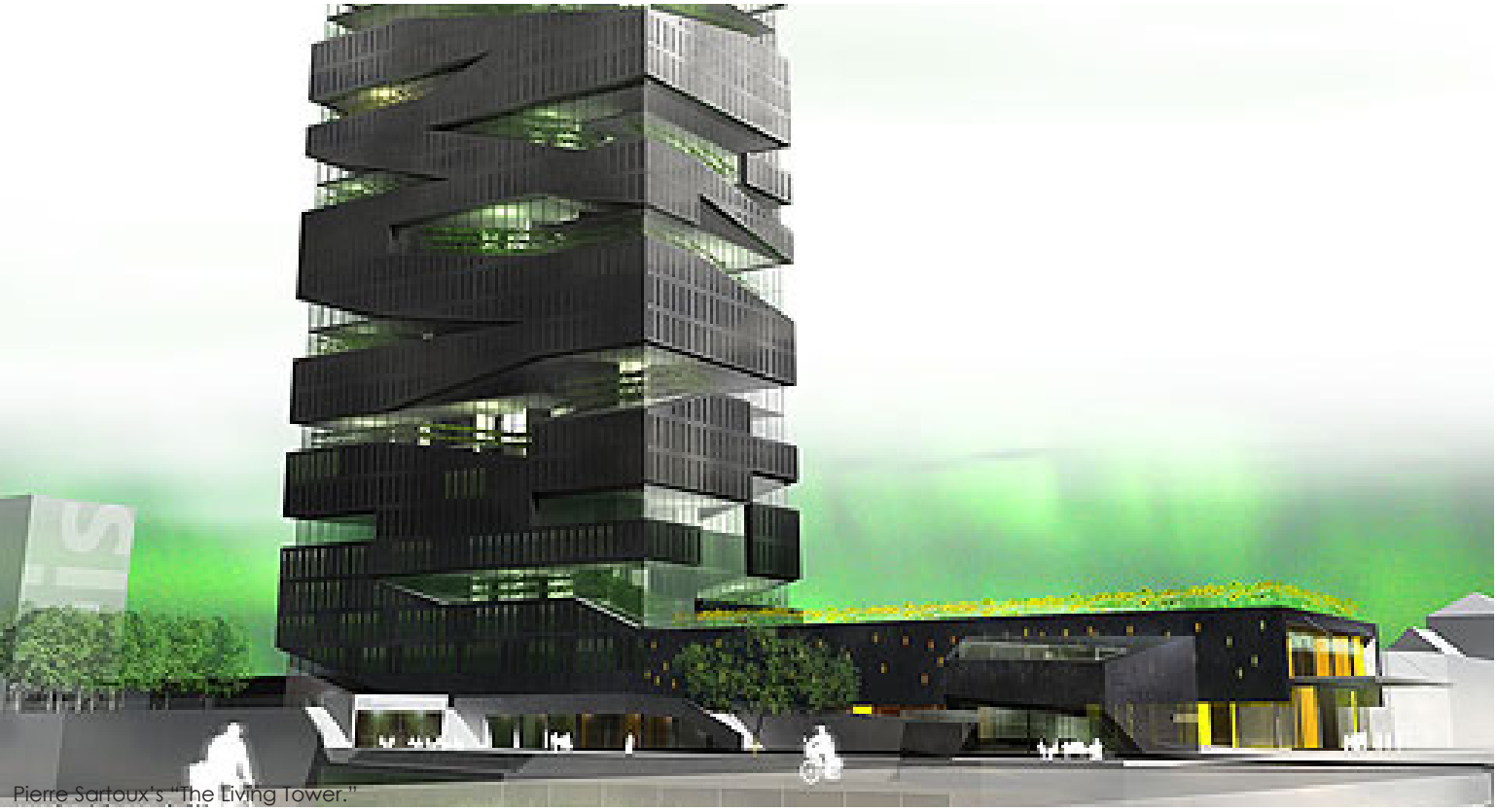


Free Resources

Regeneration

Exception

The Bank of America Tower utilizes almost all the sustainable points. The building uses all the available free resources, as well as generates its own to run daily operations.



Pierre Sartoux's "The Living Tower."

Conclusion - A Thesis Redefined

Through the journey of research in the two separate sectors of architecture and agriculture, several conclusions have been attained. As a general overview, the problem addressed is the creation of architecture that works symbiotically with its environment, giving back more over time than it takes for itself. It was approached by looking at a system that was believed to have this characteristic: farming. Through research it was discovered that the agricultural model of energy use is not exactly as efficient as once thought, especially when considering current and future farming practices. Looking at the entire cycle also reveals that farming itself is not so much the energy consumer, but rather the food processing and distribution sector. This discovery has not thwarted the theory, however. Its fall in concept has actually given rise to the opportunity to create and understand a solution. In this exercise, I have targeted four key points and issues in sustainability, both from what was existing in the process and from what I proposed to include to make the process more sustainable.

From this conclusion, the concepts could then be applied to how architecture should behave, changing the existing linear model of construction to one of a cyclical nature, so that buildings are never truly completed but are constant works in progress and then upcycled at the end of their usable lifespan: process, not product. In research, however, it has become apparent that there is more to this new approach to sustainability than just providing a new way to consider and modify the existing process.

Studying a model on the basis of its natural sustainability, to apply its processes to architecture, is not flawed. In fact it should be practiced more frequently (as it currently is through Biomimicry). Looking at the entire spectrum, agriculture has been one of the most efficient and sustainable systems since the beginning of time, until the onset of the Green Revolution. It's advantageous to learn from the processes that work naturally, that have worked naturally for millions of years, to benefit our artificial world. It should be noted too that agriculture is not the only system existing that possesses these traits. There are thousands of systems that can inform us as to how we can shape and have a relationship with the modern environment.

In consolidating all the results and data it has become apparent that efficient or "energy-positive" design does not begin with meager technological reform, but rather with a change in societal behavior and consciousness. We design structure and implement technology with failure in mind, so that one solution creates two more problems. Contemporary architecture is a good representation of contemporary society; it is plagued with transgression and patched with temporary solutions, rather than getting to the source of the issue.

This realization brought on a flood of examples in all sectors apart from architecture. Consider grocery stores for example. Major stores are now selling cloth grocery bags that are re-usable. They are "eco-friendly" bags that essentially eliminate the need for plastic bags, and the need to make plastic. Some people are catching on and using them, but the majority of us still grab a plastic bag. The eco-friendly bag is just another temporary solution. Sure, it takes away some use from plastic bags in theory, but as long as people still *want* to use plastic bags, they will remain in production. If you, the reader, were to never use a plastic bag again, the chemical industry that produces the bags would not just stop making them; in fact the same amount of bags would still be created because there are certain quotas that must be reached at the plant. Up until this point, this thesis has been nothing more than a metaphorical "eco-friendly" bag. While it is obviously more complex than that, it essentially behaves the same; it is just another temporary solution.

Referring back to the proposed architectural model, this proposed method of architecture not only acts as an icon, but also serves as a model for environmental-human relationships. It makes a statement for everyone that it exists and cohabits with its environment to give back to it, and acts as a way for people to realize that they too can exist in the same way. Touching back on DeLanda's theory, we are all part of an assemblage in the greater scale. Architecture is made by people, but it can also act as a model for how people should live their lives, and it is a good representation of how we currently *do* live our lives.

So what's the underlying issue?
Changing how people value and interact with their environment: a psychological change.

The medium with which to bring about change?
Architecture.

The reference for design?
Agriculture.

If we can control how we design our built environment, then we've effectively changed our behavior towards it, and only then can we start to truly have a symbiotic and sustainable relationship with our planet Earth.

"We need a global energy revolution, but for this to happen we also need a revolution in consciousness."

- Mario Alberto Arrastia Avila, an energy expert with Cubaenergia

The Project Defined

Now that a theory has been established, it must be implemented. Where can this architecture be applied, to start changing how a community values and interacts with its environment? If it's change that needs to be brought on in the energy sector, then it needs to occur in the worst case scenario, for if it can work there, it can work anywhere. It is crucial to look at energy use by state to pinpoint the most resource intensive area of the US. This will be investigated more closely in the proceeding book.

At this point the project can truly be applied in virtually any way. Before locating a site, it may be important to find a general type of project that would best illustrate and define the proposed architectural model.

David Ronfeldt, part of the RAND Corporation, hypothesizes that a coming age of networks will transform how societies are structured and interact, and that "The rise of network forms of organization and strategy will drive long range social evolution in radical new directions (Olson, Rejeski, 89). If social change is the goal of this project, then perhaps this quote suggests, along with the results of case studies and research, that this project should take on the form of a "network" or infrastructure. After all, the way in which we interact with our environment is not simply by staying in one location. This project needs to be considered on a city-wide scale. Looking at a singular building may not be enough to determine change in society. This again emphasizes process, not product. The project should modify the process of commute, nourishment, fueling, consumerism, and all the activities that occupy our daily lives.

Ronfeldt also states that "In the years ahead, the [environmental] movement's strength (and sometimes its weakness) will continue to be asserted through social network-based wars against the unresponsive, misbehaving, or misguided corporate and governmental actors (Olson, Rejeski, 89)." Large corporations guide our everyday lives. They have more money, and therefore more power, and oftentimes are also partly involved in governmental decisions. Instead of trying to subvert one of these corporations, it may be more beneficial to use their resources and redirect their focus.

By redirecting a corporation's symbol in the public eye, It will represent a full scale model for how to bring change to our world while still fitting within the urban mesh of society. As R. Buckminster Fuller states:

"You never change things by fighting the existing reality.
To change something, build a new model that makes
the existing model obsolete." (Farr, 31)

Works Cited

"All About Wheat." Wheat, a Plant that Changed the World. 2009. John Innes Center and the Institute of Food Research, Web. <http://www.allaboutwheat.info/default.html>.

Allen, Edward, and Joseph Iano. The Architect's Studio Companion. 4th. New Jersey: John Wiley and Sons, Inc., 2007. Print.

Allen, Edward, and Joseph Iano. Fundamentals of Building Construction: Materials and Methods. 4th. New Jersey: John Wiley and Sons, Inc., 2004. Print.

Blake, Tom. Personal Interview by Daniel Hudson. 14, Oct, 2009.

Borlaug, Norman. ActionBioscience.org, 2002. by ActionBioscience. November 2002. Web. 3 Sep 2009. <http://www.actionbioscience.org/biotech/borlaug.html>.

Brune, Geoffrey. "Tastefully Prepared." Texas Architect November/December 2008: Print.

Farr, Douglas. Sustainable Urbanism - Sustainable Design with Nature. Hoboken, New Jersey: John Wiley & Sons, 2008. Print.

Garbage Warrior. Dir. Oliver Hodge." Perf. Dennis, Weaver. Open Eye Media, UK: 2007, Film.

The Future of Food.Dir. Deborah Koons Garcia. Lily Films, USA: 2009, Documentary.

Hawken, Paul, Amory Lovins, and L. Hunter Lovins. Natural Capitalism- Creating the Next Industrial Revolution. 1st. Boston: Little, Brown and Company, 1999. Print.

Mau, Bruce. Massive Change. New York: Phaidon Press, 2004. Print.

McDonough, William, and Michael Braungart. Cradle to Cradle: Remaking the Way we Make Things. 1st. USA: Vintage, 2009. Print.

Olson, Robert, and David Rejeski. Environmentalism and the Technologies of Tomorrow, Shaping the Next Industrial Revolution. Washington: Island Press, 2005. Print.

Pollan, Michael. "Plants Eye View." Ted Talks. Web. 11 Sep 2009. <www.ted.com>.

R.E. Evenson, D. Gollin, Professor. "Assessing the Impact of the Green Revolution, 1960 to 2000." Scienc Magezine, Vol. 300 Number 5620. May 2, 2003: 758-762. Web. 23 Sep 2009. <http://www.sciencemag.org/cgi/content/full/300/5620/758>.

Steel, Carolyn. "How Food Shapes our Cities" Ted Talks. Web. 24 Nov 2009. <www.ted.com>.

"Sysco Foods." Sysco Human Resources. 2009. Sysco Corporation, Web. <http://www.sysco.com/services/features/sysco_green/sysco_green.html>.

Viljoen, Andre, Katrin Bohn, and Joe Howe. CPULs Continuous Productive Urban Landscapes. Burlington, Massachusettes: Architectural Press, 2005. Print.

Wells, Mathew. Skyscrapers, Structure and Design. New Haven: Yale Univeristy Press, 2005. Print.
Jencks, Charles. The Iconic Building. New York: Rizzoli International Publications, Inc., 2005. Print.

"Why Open a Business Downtown?." Houston Downtown. 2008. Houston Downtown Management District, Web. 10 Nov 2009. <http://www.houstondowntown.com/Home/Business/DoingBusiness/Retail/TrafficCounts/>.

Case Study/ Diagram Sources

http://www.pecad.fas.usda.gov/cropexplorer/cropview/CommodityView.cfm

http://www.ext.colostate.edu/pubs/farmmgt/05006.pdf

http://waterquality.montana.edu/docs/irrigation/wheatirrigation.shtml

http://www.pecad.fas.usda.gov/highlights/2008/05/images/Syria_wheat_irrigation_graphs_may08.jpg

http://www.allaboutwheat.info/production.html

http://www.fao.org/inpho/content/compend/toc_main.htm#TopOfPage

http://www.cubaenergia.cu/index.php?option=com_content&view=category&id=1&Itemid=2

http://fukuokafarmingol.info/fover.html

http://www.montana.edu/cpa/news/nwview.php?article=5704

http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=3.1.1

http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=8.1.1

http://buildingsdatabook.eren.doe.gov/docs/xls_pdf/2.7.1.pdf

http://geospatial.blogs.com/geospatial/2007/09/convergence.html

"2006 Summary Annual Report." ExxonMobil Corporation.

"Sysco Corporation 2008 Summary Report." Sysco Food Corporation

Wells, Mathew. Skyscrapers, Structure and Design. New Haven: Yale University Press, 2005. Print.

Jencks, Charles. The Iconic Building. New York City: Rizzoli International Publications, Inc., 2005. Print.
http://nparc.cisti-icist.nrc-cnrc.gc.ca/npsi/ctrl?action=rtdoc&an=5376554&article=4v

http://www.city-data.com/us-cities/The-South/Dallas-Economy.html

http://www.city-data.com/us-cities/The-South/Houston-Economy.html

Wright, Frank Lloyd. Edited by Bruce Brooks Pfeiffer. The Essential Frank Lloyd Wright - Critical Writings on Architecture. Chicago: Princeton University Press, 2008. 235. Print.

Small Image Sources

Industrial Revolution Pictures (Page 1):

http://tjmarsh.wordpress.com/2009/12/12/360/
http://www.nyu.edu/classes/persell/aIntroNSF/Documents/Field%20of%20sociology033108.htm
http://www.saburchill.com/history/chapters/IR/images/091107001.jpg
http://www.istp.murdoch.edu.au/ISTP/casestudies/Case_Studies_Asia/urbwater/E12.jpg

Green Revolution Pictures (Page 8,9):

http://www.gatesfoundation.org/annual-letter/PublishingImages/chart-4-no-green-revolution-for-africa.gif
http://southasia.oneworld.net/ImageCatalog/gm-food-1.jpg
http://nobelprize.org/nobel_prizes/peace/laureates/1970/borlaug4_fredscenter_photo.jpg
http://www.greenpeace.org/raw/image_full/india/photosvideos/photos/out-of-the-frying-pan-the
http://thesquigglyline.com/blog/wp-content/uploads/2008/06/worldwide-increase-in-gm-crops-report-shows-1.jpg
http://i.treehugger.com/



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Introduction

A theory has been established to lay the ground rules for the project. Based on the proposed architectural model, the theory can truly be applied to any typology and any scope of project. In the future, this architecture should be applied to every city of every state, so that one day all towns and cities may be self sufficient and beneficial to their environment. It is appropriate, therefore, to present this project as a change over time, to show its growing effect on a location.

This isn't the first time this has been investigated. Douglas Farr, in his book The New Urbanism, pinpoints these exact issues. He also believes that there is a great schism between those who take the rising global environmental issues seriously and those who believe the current system is a positive one. This new urbanism is defined as an infrastructure where people are encouraged to reconnect with their exterior environment, live healthy and sustainable lives, and includes a redesign in how we design urban layouts so that there are mixed uses everywhere (which promote walking, for example). In his mind, we need to take three steps to achieve this "new urbanism."

Step 1: Creating an effective market for the new urbanism. This will mean a compromise between opposing sides, and starting to take a proactive approach towards change. The current human psyche values money above all. This greed causes processes to work the way they do, to maximize profit, and (inadvertently) cause a great amount of harm to our environment.

Step 2: Departing from the current commercial model. Those companies making the "big bucks" have successfully made sure that every American is dependent on their product (oil, for one) to survive. This mentality must be changed, and must begin with these large corporations.

Step 3: A "National Campaign to Implement Sustainable Urbanism." This new urbanism must somehow be marketed to the mass public in such a way that everyone begins to take it seriously, to see that it does impact contemporary issues. This change affects the public on a mass scale.

Although these are the same issues that form this thesis, the solutions are somewhat different. With a plan set in track, the only thing missing is an appropriate site with which to begin such tremendous changes.



Site

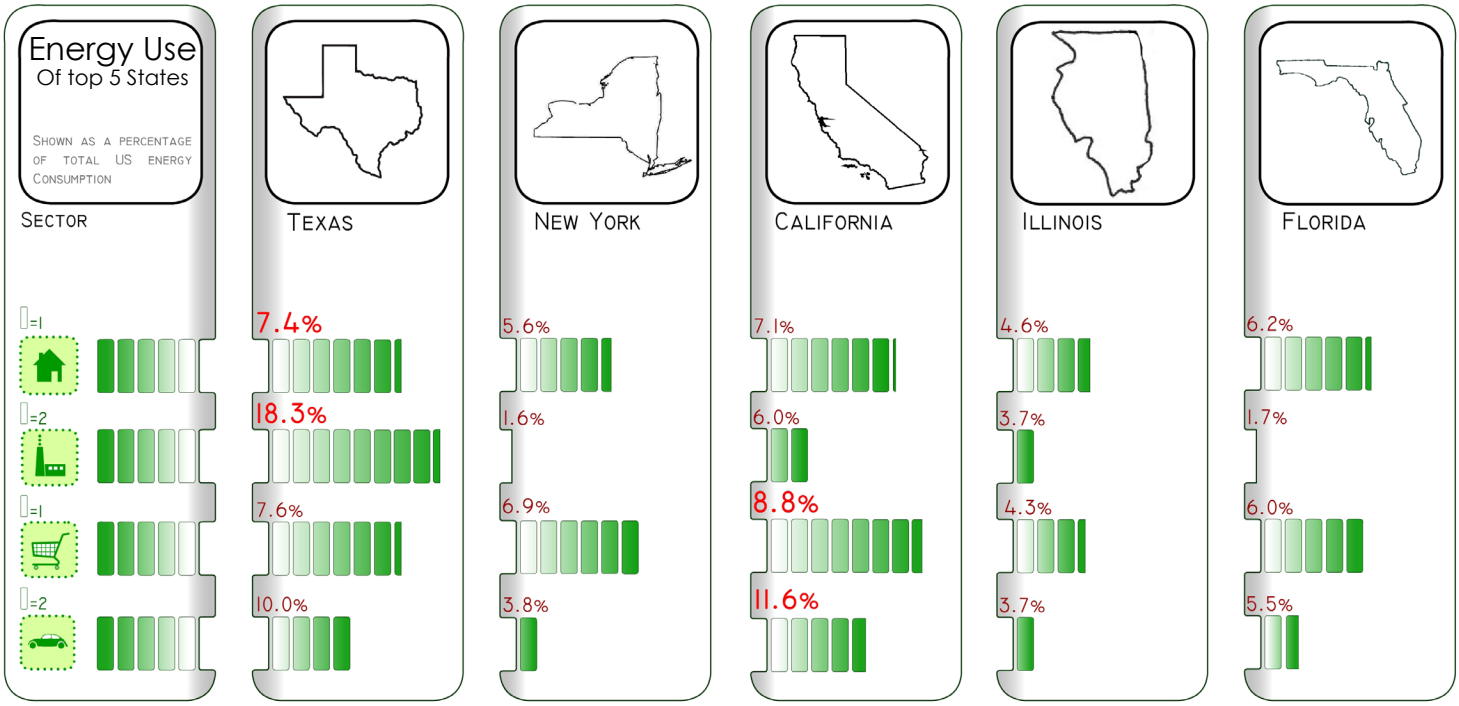
02

Locating the Site

To begin to narrow down on a site, certain factors must be researched in order to pick the most appropriate site to achieve the goals of the thesis. If it's the worst case scenario that this project should be located in, then it's pertinent to look at energy use in every city of the US. Before looking at cities, however, we can narrow down the search by finding the most energy consuming state.

The following data has been found through the United States Department of Energy, the Buildings Energy Data Book, and the Energy Information Administration. The first diagram (right) shows a comparison of energy use per sector, looking at the residential, commercial, industrial, and transportation sectors, among the five most energy consuming states in the US.

Looking at the data, it is clear that Texas radically leads the industrial sector as well as slipping by with the top residential use, while California seems to dominate the commercial and transportation sectors. Perhaps Texas and California are valid candidates for a site. This comparison is not enough, however, to make an educated decision. This data does not take into consideration the type of energy use or the population. New York City has a very dense population, for example, so even though the entire state of New York does not top Texas or California, perhaps it is a question of energy use per capita and the type of energy used.


Energy Use
Of top 5 States
Shown as a percentage of total US energy Consumption
Sector
=1
=2
=1
=2
Texas
7.4%
18.3%
7.6%
10.0%
New York
5.6%
1.6%
6.9%
3.8%
California
7.1%
6.0%
8.8%
11.6%
Illinois
4.6%
3.7%
4.3%
3.7%
Florida
6.2%
1.7%
6.0%
5.5%

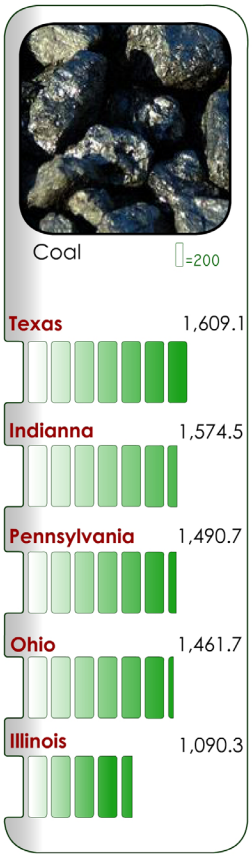
The first set of charts show energy use organized by resource type and display the top five states for that respective resource use. Once again we see that Texas is leading the country in resource use with every resource: coal, natural gas, petroleum, and electricity. California seems to be a close second to Texas, but is not quite as consistent. With this data we also see the emergence of new states not present in the last charts, such as Pennsylvania and Ohio.

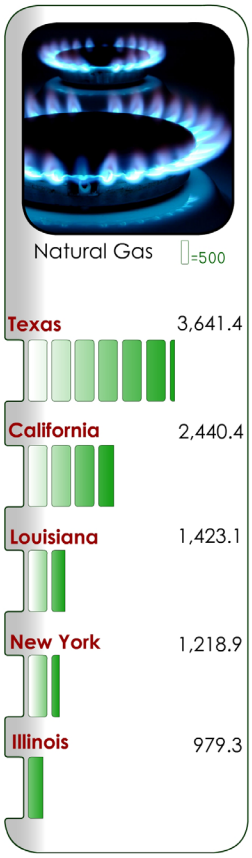
This set of charts helps us illuminate the most energy-wasteful state, but still does not tell us anything about per capita energy use, which may be the determining factor. All facets of energy use must be taken into consideration to get an accurate picture.

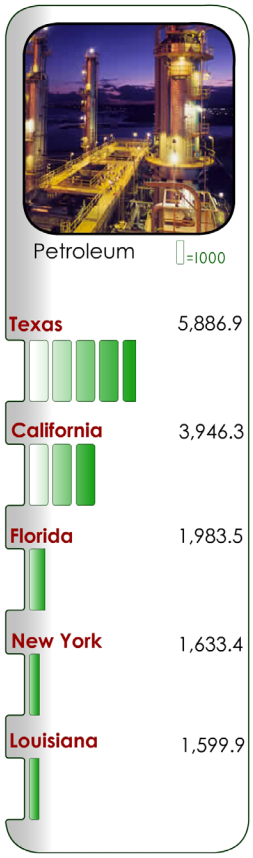
The last chart shows us energy use per capita, complete with populations, to see the variance in results. Alaska tops the chart with 1062.3 million BTU per person. This makes sense due to the amount of heating required in the cold temperatures. On the opposite hand, the extreme heat is also a reason for high energy consumption per capita, due mostly to cooling costs.

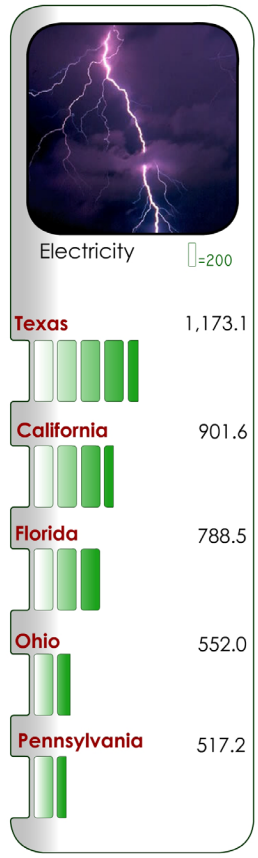
In summing up all the data found, there is one common link between all the results: Texas. Although it may not have the highest energy use per capita, there are also six times more people than in the next most populated state on the chart, Louisiana. With such a high number of populants, and the chart topping energy use in both a sector-use chart and a resource-use chart, it is appropriate to target the state of Texas as the state with the highest resource use.

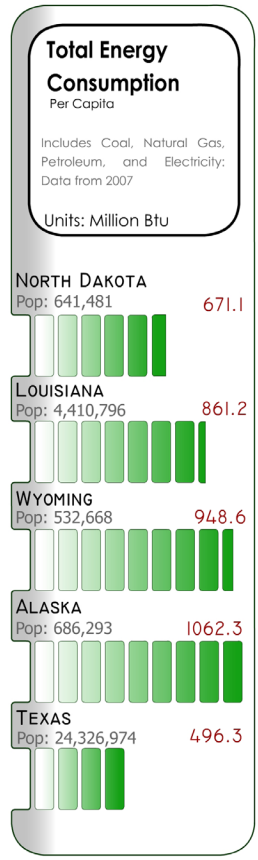
Now that a state has been selected, the search must be narrowed down to a city comparison. Due to the inability to find specific data on energy use per city, the best approach is to investigate the top industries between Texas' two major cities: Dallas and Houston.











State Energy Data: Complete Data: http://www.eia.doe.gov/emeu/states/_seds.html

Dallas



Dallas is concentrated mostly in technological industry, with 43% of Texas high tech workers stationed in Dallas alone.

The following data characterizes the top industries in Dallas and the top companies in each.

Telecommunications
- Nortel
- Ericsson
- Alcatel
- Southwestern Bell

High Technology
- Advance PLS
- Texas Instruments

19 Fortune 500 Companies
- Dean Foods
- ExxonMobil
- Kimberly-Clark
- Niemen Marcus
- Southwest Airlines

http://www.city-data.com/us-cities/The-South/Dallas-Economy.html

Houston

Houston is known as the "Energy Capital" of the US. There are about 3600 energy related companies headquartered in the Houston area, and has the most elaborate pipeline system in the world.

Houston is considered a world leader in the chemical industry:

- 40% of the nations capacity to make common chemical compounds are produced in Houston
- There are 405 chemical plants
- All together, the chemical industry holds 36,000 employees

Top Companies:
- BASF AG
- Bayer Corp
- Chevron Phillips Chemical Co.
- E.I. Du Pont de Nemours Co.
- ExxonMobil Chemical Co.
- Shell Chemical LP



http://www.city-data.com/us-cities/The-South/Houston-Economy.html

The data shows that Houston is the logical choice for a site. Considered the "energy Capital" of the world, it is a great place not only to change statistics but also give it a new image in the public eye. Change here can occur on the the level of infrastructure as well as architectural icon.

As mentioned earlier, it is the mighty corporation that has the most power in our lives, so which one has the biggest infrastructure? There are several large corporations that have a taxing effect on resource use. The first sector of study will be the petrochemical industry, which runs the city of Houston. These companies make hundreds of billions of dollars extracting raw material from the Earth and using resource-intensive processes to get them to our cars and homes. The six largest publicly traded oil companies, dubbed "Big Oil" are shown below.

1 ExxonMobil
Exxon
Mobil
Esso

2 Royal Dutch Shell
Shell

3 BP
BP
Arco
Aral

4 Chevron Corp.
Chevron
Texaco

5 Conoco Phillips
Union
Conoco
Jet
Phillips 66

6 Total S.A.
Total
Elf



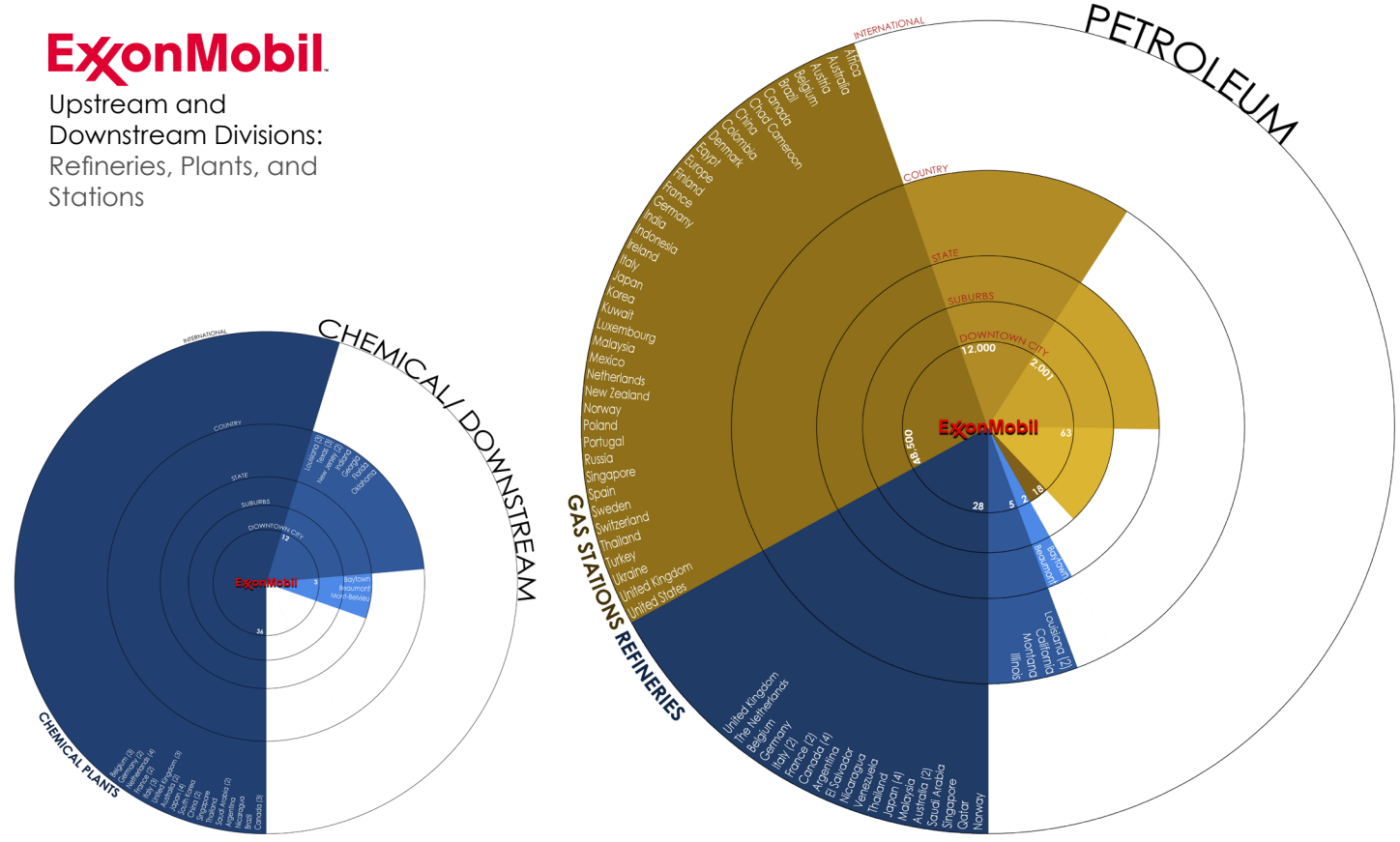
ExxonMobil Corporation

ExxonMobil is the largest publicly traded oil company in the world, headquartered in none other than Houston, Texas. In 2007 it boasted 72 billion BOE (Oil-equivalent barrels) of petroleum on reserve, and has the capacity to produce 6.3 million barrels of oil daily between all its refineries. Overall, 70% of its 404.5 billion dollar revenue comes directly from it's upstream division: the exploration, extraction, and refinement of oil (2008 Summary - Annual Report). Of the 106,100 employees worldwide, 63% of them are employed overseas, while roughly 75% of the remaining US employees are employed in Houston in the upstream division alone. ExxonMobil alone produces 3% of the world's oil and 2% of its energy. The wide scope of the company can be seen in the following diagram, showing ExxonMobil's reach on a variety of scales, from downtown houston to overseas countries.

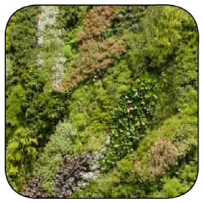
ExxonMobil has a plentiful supply of financial resources and a large existing infrastructure that provides plenty of opportunity to interfere, to change their existing processes to match that of the proposed architectural model.

ExxonMobil

Upstream and Downstream Divisions: Refineries, Plants, and Stations







La Caixa Forum Green Wall

Address:
Paseo del Prado, 36
28014 Madrid
Tel.: 91 330 73 00
www.laCaixa.es/ObraSocial



Architects: Herzog and De Meuron

The Caixa Forum cultural museum, designed by Herzog and De Meuron, restores the original electric building in Madrid, Spain. At the entrance one is greeted by a large green wall, designed with french botanist Patrick Blanc.

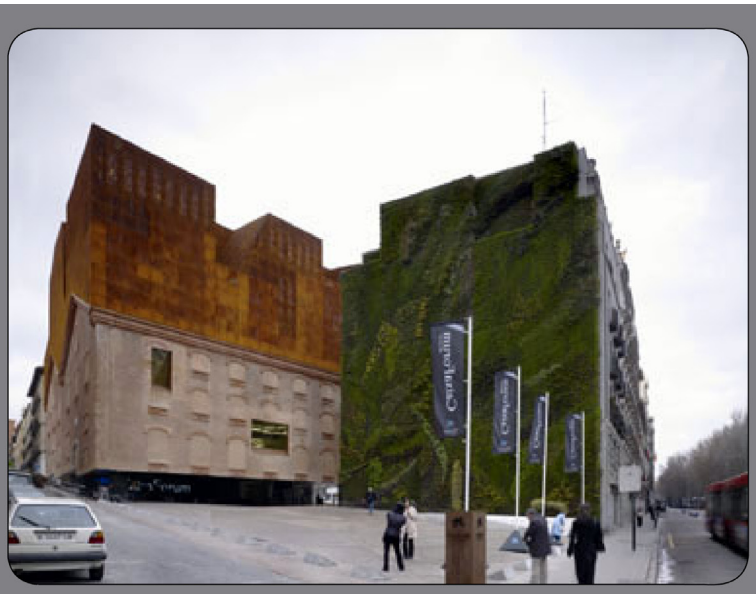
The wall stands 24 meters high and covers a total area of 460 square meters. The wall houses a total of 15,000 plants and 250 plant species that survive without dirt, only water and the proper nutrients. It is the first green wall in Spain and the largest green wall in the world without windows or gaps.

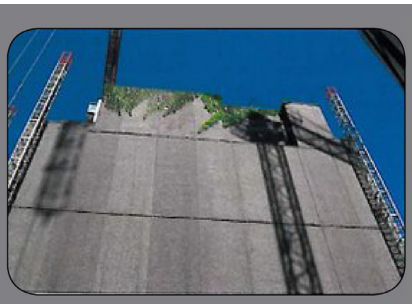
The garden wall, or "garden mosaic," performs key functions for the structure. Between summer and winter the wall helps maintain a constant temperature in the building at around 65 degrees, and serves as a sound insulator. Because the museum is located in the heart of Madrid, the wall takes the carbon dioxide emissions from the heavy vehicular traffic and helps purify the air by converting it to oxygen, meanwhile feeding the plants.

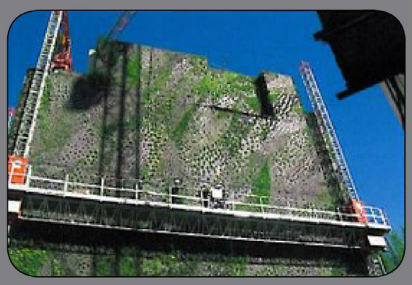
This green wall at the Caixa Forum museum is an example of architecture that starts to give back to the environment in the form of purified air, and insulative properties, without using any resources

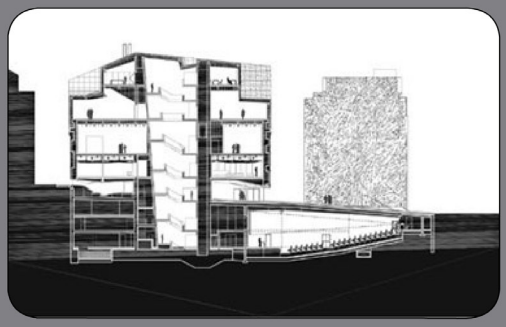
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Caixa Forum. "Que Es?" Obra Social Fundacion "La Caixa." Informational Pamphlet.











Construction of the garden mosaic wall.

Section of Caixa Forum showing green wall.

Entrance to museum.

Performance

Regeneration

This case study represents a project who's sustainable design is not only beneficial to itself and saving energy, but also generates resources for its invironment in the form of converting automobile carbon emissions into purified air.

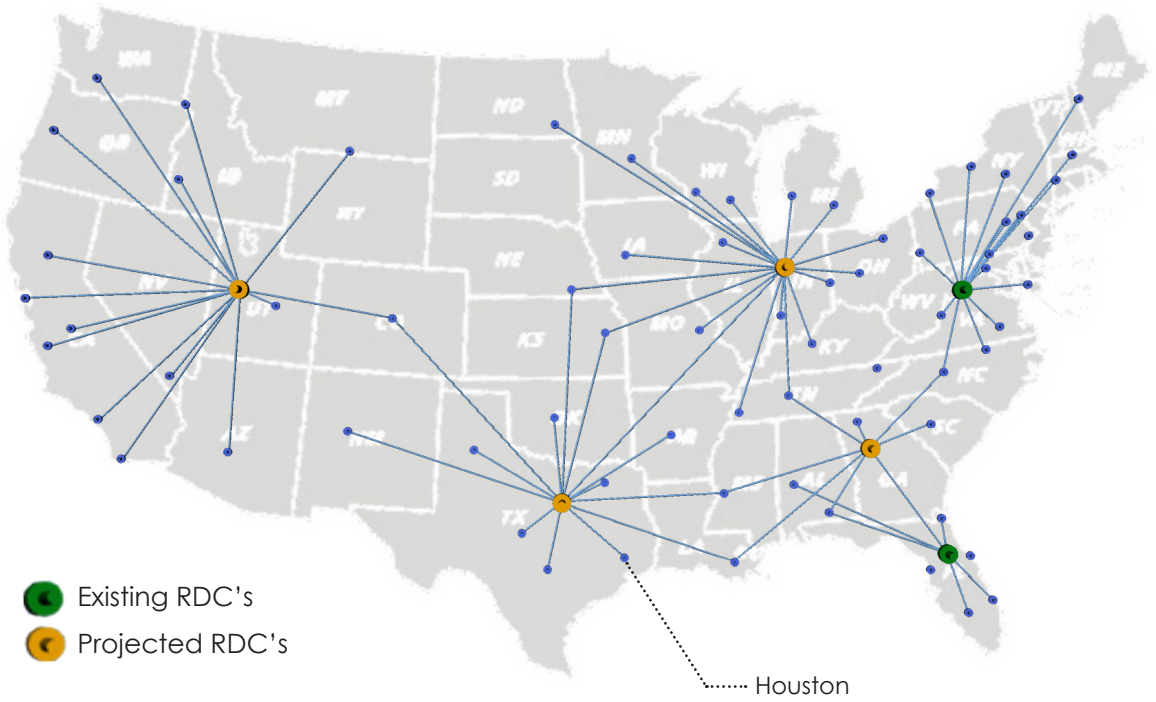
Sysco Food Corporation

Petroleum is only one of the resource giants in the world, however. Oil and chemical plants do exploit a great amount of resources, but reaching back to one of the main focuses of this thesis, agriculture uses quite a lot of resources as well. Food is needed all over the world and is grown all over the world, but only processed in specific locations requiring large amounts of this fuel energy to transport, process, and re-transport the food product. The largest food distribution company in North America is Sysco Foods, who collect, process, and transport food product from and to all parts of the United States. The corporation has a grasp on such a large number of farms around the country that it is virtually impossible to find out exactly where the raw food is coming from. Sysco Foods does not grow the crop itself, but rather owns smaller privately owned distribution companies. Houston is home to not only the nation's corporate headquarters but also their local food distributors, Fresh Point Corporation, conveniently located in the same business park. Trying to find their food sources reveals that the FreshPoint Corporation owns still more privately run distribution centers in more areas around the US. The list is seemingly endless, and accounts to Sysco Foods only being the marketer in the grand scale of food distribution (Sysco Foods).

The Sysco Corporation stresses their importance on their "green practices," such as the reduced use of pesticides from their food sources, or their state-of-the-art "x-y routing" transportation system that calculates the shortest distance between drop-off points. Another factor contributing to their supposed efficiency in transportation is the use of centrally located distribution centers. In the last years they have begun constructing Redistribution Centers (RDC's) to hypothetically reduce travel distance. Currently there exist two: one in Florida and one in Virginia. These RDC's increase productivity and sustainability, according to Sysco research. The following diagram illustrates the 4 other RDC's to be built throughout the US, to better meet customer's orders at maximum efficiency.

Good things come from Sysco™

Location of the existing and projected Redistribution Centers in the Sysco network.



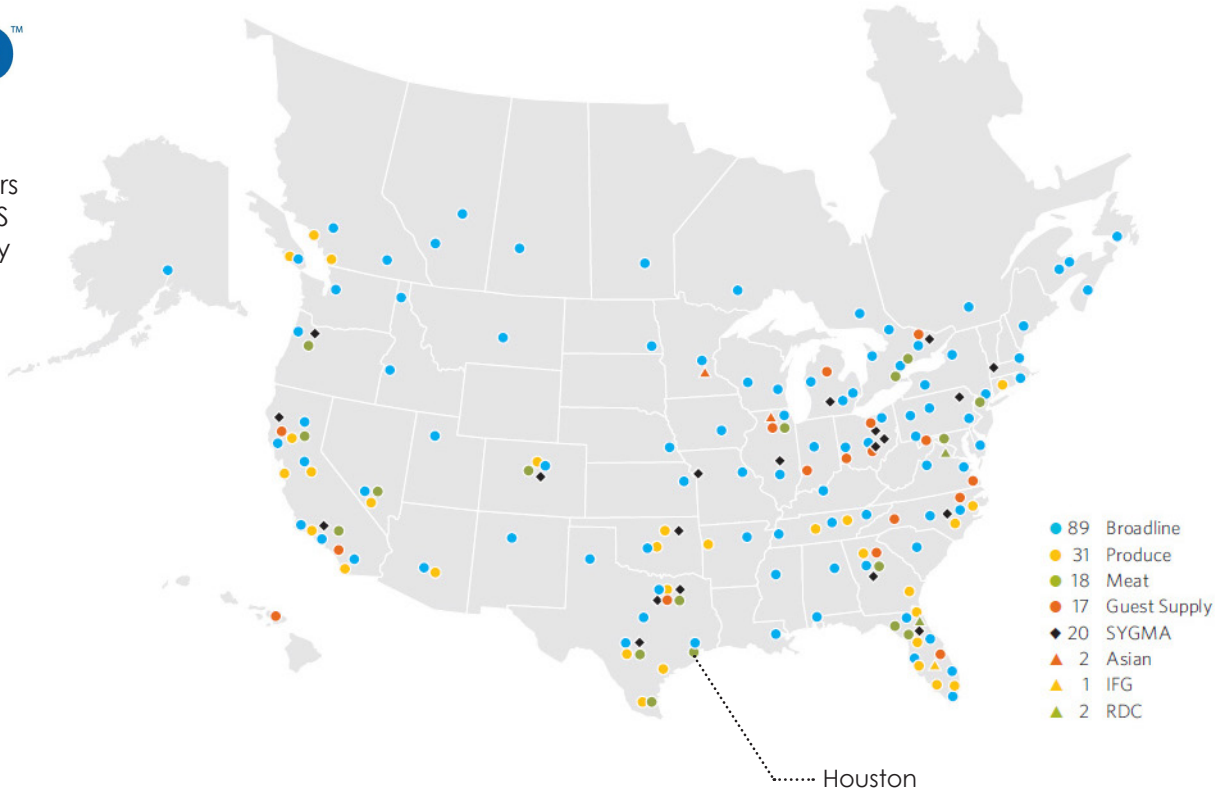
Sysco 2008 Annual Report: "The Quality of Our Operations." Page 9

A closer look into the corporation will show that perhaps their efforts are much better supported in writing than in reality. As the chain of command from farmer to Sysco corporate headquarters grows, so does quality control. Once food gets to a Sysco warehouse, it may be more sustainably shipped to its final (or perhaps not final) destination, but how does the food get to Sysco? The farmer harvests crop, sends it off to a local distributor who may send this food to larger and larger warehouses owned by increasingly larger and different distributors. Somewhere along the way the food is processed into ingredients, separated by end-use, processed into specific foods, then re-delivered to a Sysco distribution center that takes the food product and delivers it to a client. Sysco is merely a facilitator, or mediator, between the farmer and the client, analogous to the architect's role between the construction manager and the client. The entire system is overall very unsustainable, and not all steps in the process can be monitored by the Sysco Corporation, despite their claims.

In a similar study, which calculates the exact embodied energy of a loaf of bread, the process remains essentially the same. The Farm uses 19.3 % of the total fuel, 11.3% taken up during the fertilization, while the remaining fuel is used up by tractors and other miscellaneous farm processes. The next 13% of the fuel is used during the milling stage, where fuel is used up in transport, milling, and packaging. From there the bread is transported again, baked with other ingredients which also need processing, and re-packaged, all of which take up 41.3% fuel. The last step is retail; the bread is packaged again, and cared for by the specific store until it is sold, accounting for 20.8% of the total fuel use (Viljoen, 23). All food products must undergo more or less this amount of travel: some market ready products such as vegetables and fruits may go through less of a process where as other products such as prepackaged meals may go through a more extensive process, but all of which undergo a very inefficient lifecycle.

Good things come from Sysco™

Locations of the various types of processing centers that exist in the US directly owned by Sysco, along with the SYGMA centers.



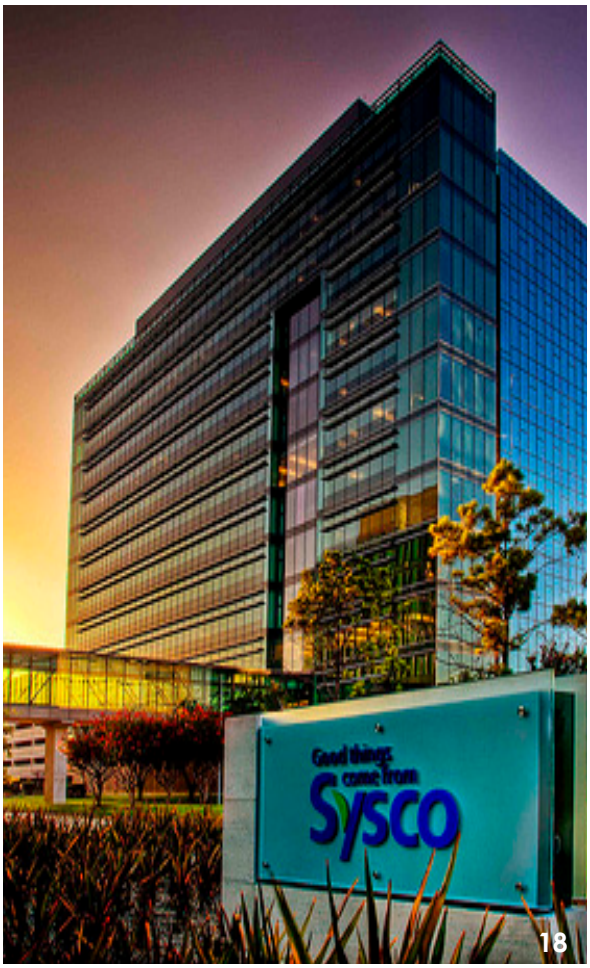
Sysco 2008 Annual Report: "A Quality Year." Page 5

In a project that bases its sustainable practices off of agriculture, it is appropriate to include this food model. While eradicating gas stations out of the Houston area would be an ideal way of instantly cutting off all fuel demand in the city, it is trying to take away something so integral to Houston that it could not realistically be done. Houston, as the nation's energy capital, would not support a city without the abundance of fuel. Instead, the project should perhaps focus primarily on the energy use in the food sector, and passively try to curtail fuel use in the petroleum sector. In recounting DeLanda, both the petroleum and food industries may seem as separate entities, but on the larger scale rely heavily on one another. Without the food industry, the fuel industry would not have a client, and without the fuel industry, the food sector would have no way of transporting goods. By affecting one you impact the other. Perhaps this project can even impact other sectors or processes as well

Touching back on the idea of corporate influence in daily life, the more appropriate company to target would be the Sysco Corporate headquarters, also located in Houston. In 2004 the Sysco Corporation released a statement that they wanted to produce two more headquarters in Houston, a 500,000 square foot high rise and a 200,000 square foot mid rise. In 2008 the project was realized, resulting in two new office buildings adding up to 532,000 square feet, along with a parking garage capable of holding 1,832 cars. This project, located in the outskirts of West Houston next door to the original headquarters, is the first building in Houston to achieve LEED Gold status (Brune). Although this new headquarters is equipped with all sorts of sustainable strategies, it does not quite achieve the purpose of this thesis, to change social consciousness through a regenerative architecture. For this reason the headquarters needs to be re-designed. A new headquarters for Sysco, as an icon and symbol, could truly lead the way to a future of modified human behavior within our collective environment. This project is simply re-doing the recently finished project, to take full advantage of a well known corporation that could change our future.

The new project, as mentioned earlier, is located in West Houston, adjacent to a residential area and vast lands sprouting warehouse architecture for other corporations. This is not the ideal place to locate a beacon of change. The true exchange of ideas, the center of culture, lies within the downtown area of any city,

including Houston. The city is where all residents and visitors alike congregate for the density of entertainment, business, and ideas, and is therefore the ideal place to locate an icon. As a project strategy, the site (or sites) is located on the pre-existing plague of parking lots, which seem to take up about as many blocks as those taken up by buildings. The new headquarters will fit within the local food system of the downtown area, while simultaneously subverting the fuel industry. By taking over parking lots, either eradicating them entirely or controlling their nature, the use of cars in the city slowly starts to dwindle. In the future this could lead to a pedestrian city, whereby the entire city as a system, or assemblage, can operate in a completely energy-positive way. The headquarters, which may become a series of headquarters, will utilize parking lot space to grow crop and vegetables, which will be sold to local markets and therefore require almost no transportation. The structures will also be completely self reliant, perhaps even contributing to energy needs in neighboring buildings, while diminishing fuel use, resulting in an overall energy positive system. Crop by-product will be upcycled either into the creation of energy or into the application of architecture, letting the headquarter sites grow and improve themselves over time. This kind of project suggests a new way of designing buildings as well as our lives. It exemplifies how one piece of a system can fit within a process and actually benefit it, as well as be benefitted by it: a project that defines the very nature of the proposed architectural model.



Site Analysis - Climate

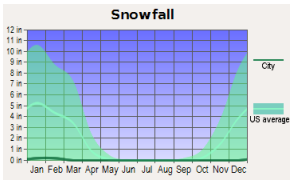
Houston is classified as a humid subtropical climate. The graphs show that Houston enjoys plentiful days of comfortable to extremely hot weather complete with sunny days. It also experiences an average of 90% humidity in the mornings, with an average precipitation of 54 inches yearly, not including flooding situations. There is no snow year round, and relatively low wind speeds compared to the US average. During the rainy season, which often dominates the better part of a year, there are more cloudy days with more extreme rain and wind conditions, making Houston more consistently suitable for water and solar collection, whereas wind energy may only be beneficial during certain circumstances.

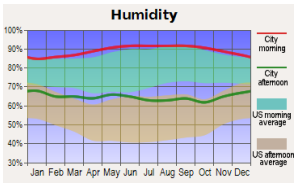
Houston does experience some severe weather, however. Due to its higher humidity and location, it is subject to severe flooding, and although not part of tornado alley, spring thunderstorms may bring on small tornadoes. During hurricane season Houston also may suffer substantial damage from hurricanes in the Gulf of Mexico. These extreme weather factors are not only important to keep in mind for safety, but extreme weather conditions also provide for extreme energy collection. Floods create a plentiful water supply, as hurricanes bring strong winds, all of which can be properly harnessed and used.

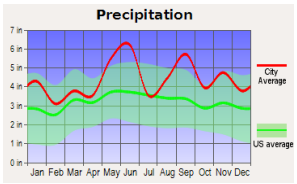
In summing up the data, it actually provides quite an ideal environment in which to grow plant life and vegetation. Virtually any crop can grow in Houston, as well as plants, or trees. This versatility makes Houston a perfect candidate to introduce an urban agricultural project.

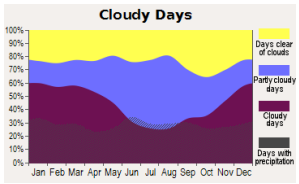


Houston Climate Analysis



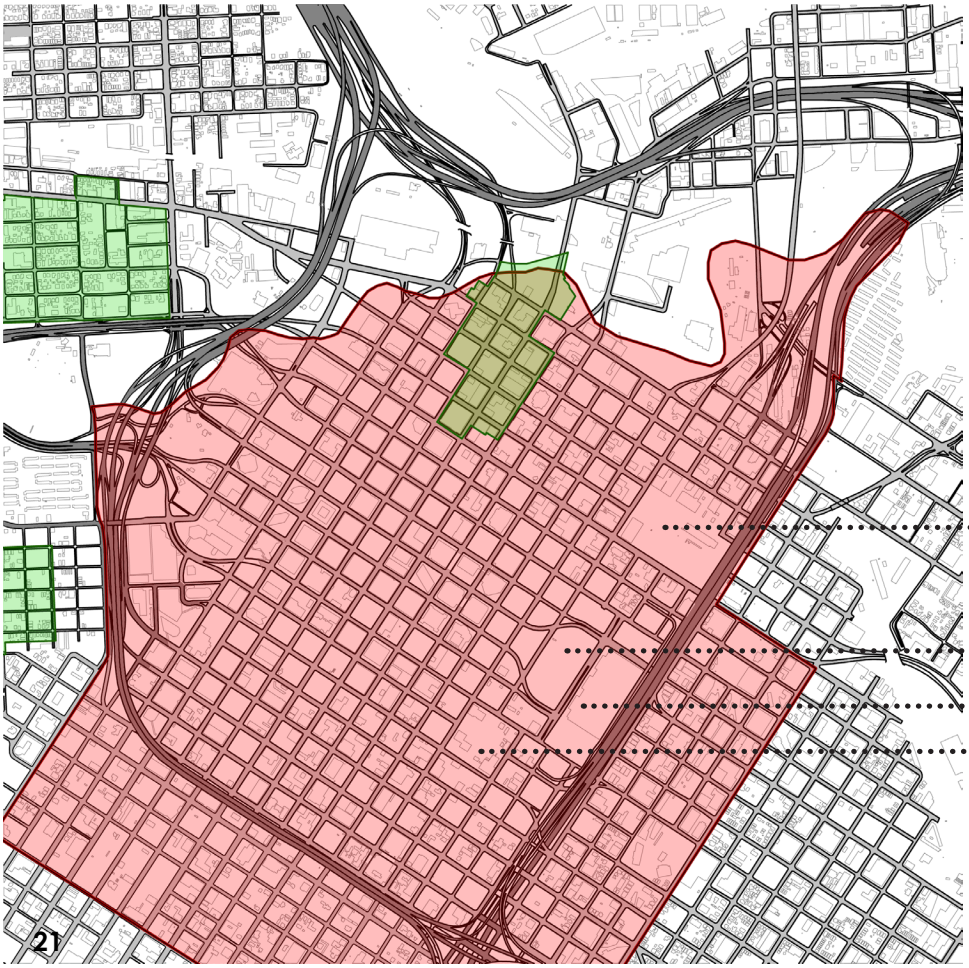






	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Average High (°F)	63	67	74	79	86	91	94	93	89	82	73	65
Average Low (°F)	45	48	55	61	68	74	75	75	72	62	53	47
Precipitation (in)	4.25	3.01	3.19	3.46	5.11	6.84	4.36	4.54	5.62	5.26	4.54	3.78
Sunshine (hours)	144	141	193	212	266	298	294	281	238	239	181	146
Windspeed (mph)	8.25	8.90	9.25	8.75	7.80	7.10	6.50	6.20	6.75	7.35	7.80	7.95

http://www.usclimatedata.com/climate.php?location=USTX0617
http://www.city-data.com/city/Houston-Texas.html



Houston City Information

Green - Historic District
Red - Central Business District

A map showing the general lay-out of downtown Houston, show-ing the Central Business District and outlying historical districts.

Minute Maid Park
Home of the Astros

Discovery Green Park
Urban green revitalization

George R Brown Convention Center

Toyota Center
Home of the Houston Rockets

Site Information

The proposed initial sites include 8.5 adjacent blocks.

This provides for 518,670 square feet of land, almost enough to fit the entire existng Sysco head-quarters on one level.

This is equal to 11.9 acres.

The sites are exposed to direct sunlight throughout the entire day, open mostly to the south and east, with no tall obstacles other than a few buildings towards the upper two blocks.

Proposed Site



The next scale of study looks closer at the down-town Houston area. In diagramming the existing parking lots, as well as parking structures, it is easy to see that parking exists plentifully throughout the city. According to statistics:

> More than 4,000 people live in the core of downtown with more than 74,000 in a 2 mile radius and a rapidly increasing 380,000 people live within a 5 mile radius. Over 140,000 people work downtown, 17,000 students attend downtown colleges, and approximately 30 million people visit downtown annually for conventions, sporting events, and entertainment purposes. (Why Open a Business Downtown?)

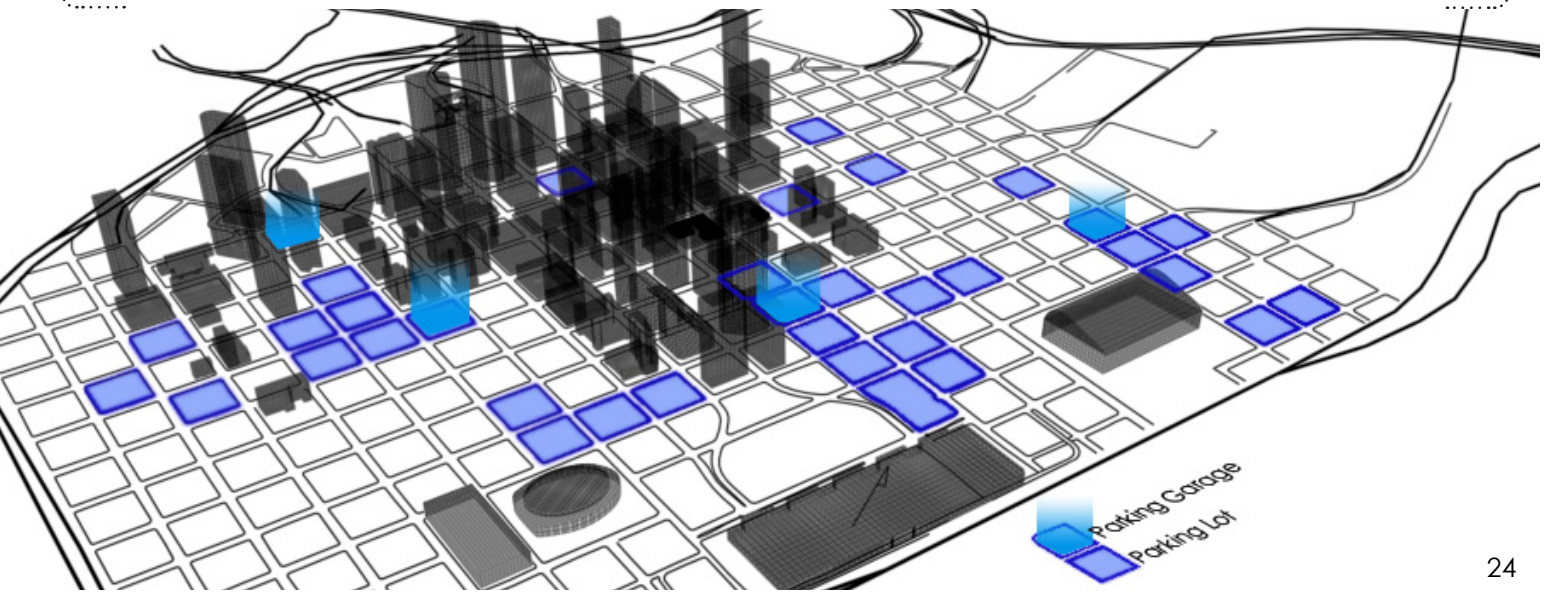
Logically, due to all the people that either live in, work in, or visit Houston on a daily basis, there needs to exist an adequate number of parking. This parking creates great opportunity, as it provides a city block (or approximately 61,020 square feet of space) to use as a portion of Sysco's headquarter re-envisioning. By taking over these spaces, not only is Sysco being transformed as an icon but is also passively decreasing the amount of parking available downtown, suggesting a move towards a pedestrian city. In this way, both food and gas energy titans are being controlled effectively to create a new model for living and interacting with our environment.

The parking lots are scattered throughout the city, typically remaining in the outskirts; only one truly exists surrounded by tall skyscrapers. A large cluster of parking lots is situated around the Minute Maid Stadium on the northeast side of Houston, in an area away from the tall buildings, allowing plenty of exposure to the eastern and southern sun, ideal for plant growth. Another smaller cluster exists on the southwestern end, on the other side of the convention center (which splits the city exactly in half), which gets plenty of southern sun. The rest



of the lots are more sheltered by buildings, and may not get as much sun as the two groups already mentioned, but may be good clients for the funneled wind in the area.

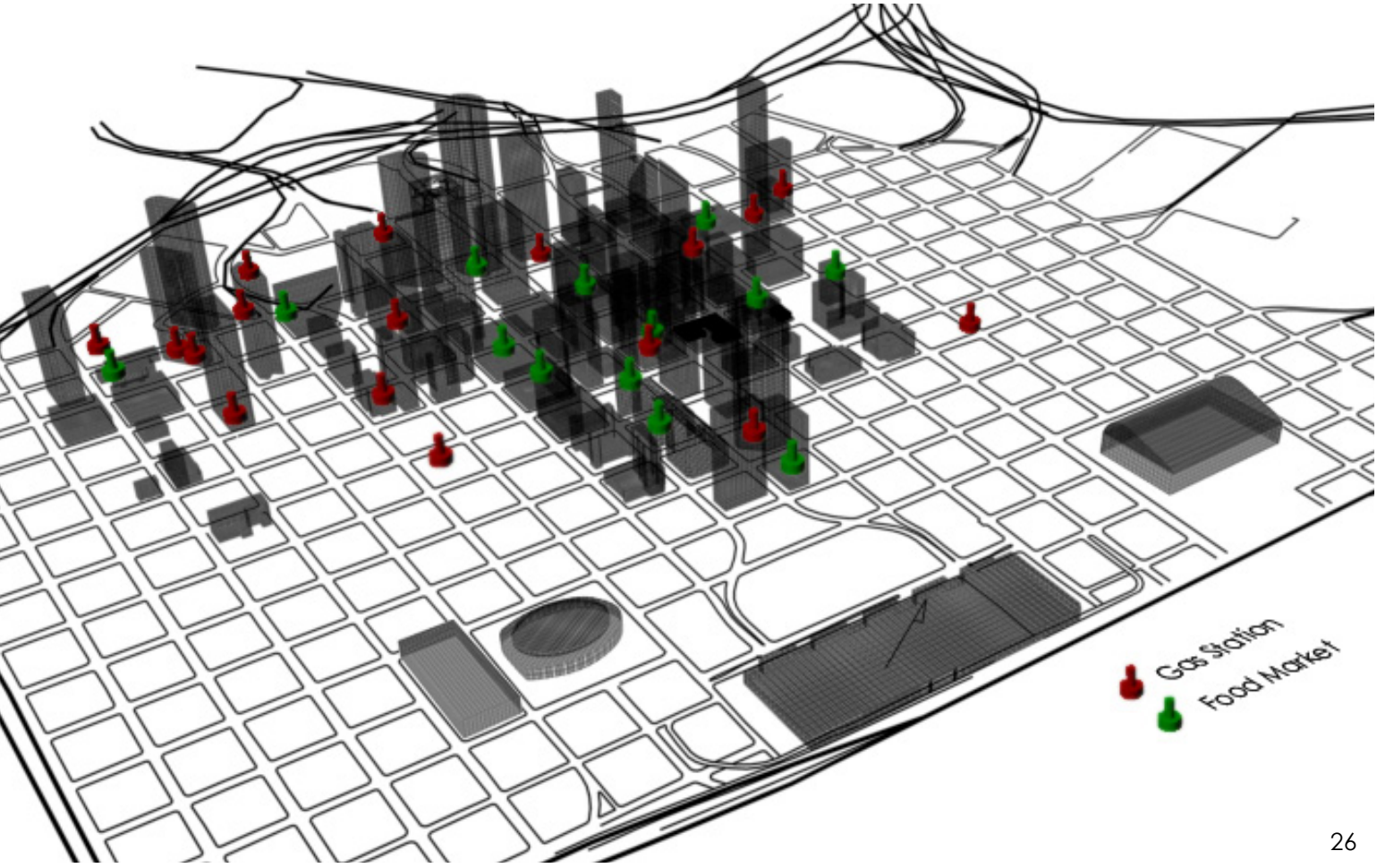
Due to the plentiful solar exposure of the northeast and southwest lots, they may be appropriate candidates for heavy growth areas. The 22 northeast lots altogether provide for 1,320,462 square feet of land, or just over 30 acres. The 14 southwest lots provide for 840,294 square feet, about 20 acres. This could be an adequate amount of square footage to produce enough food to sustain the downtown area, as well as contribute to the outlying city. The waste can then be used to produce architectural material, to be used on the structures themselves, to produce even more resources without actually using any. While only a few lots may be designed at first, over time all lots will be taken over, greatly controlling heavy traffic through the city.



The downtown area is also home to several gas stations and grocery stores. If the Sysco Headquarter redesign can produce a variety of market ready crops, then they can be delivered to the local markets, effectively cutting down on transportation and processing. All other crops can be sent to Sysco's processing plant in Houston and then redistributed through their existing infrastructure to its final destination. This way the unnecessary embodied energy of most food in the city can be cut out, since all food will originate in the city itself. This theory, along with the right farming practices, begins a self sustainable food resource cycle.

The gas stations will undergo change over time in contrast to the food sector. Initially they will remain as they are, as they will not be directly affected by the new headquarters. Over time, however, when most available parking is occupied by green fields, not as many people will be using vehicles, which will reduce the need for gas stations. They can be turned into public spaces as either recreation or urban green space. With two major resource-heavy corporations being controlled in a positive way, a new era will emerge in which the top corporations that exist in our everyday lives start to act positively and beneficially towards our environment, beginning to awaken social consciousness.




Gas Station
Food Market

Site Analysis - Zoning

Interestingly, Houston is the largest city in the United States that does not have formal zoning laws. CBRE Investors LLC explains it best in their publication in Investment Research Quarterly:

Houston is well known as the only major U.S. city with no formal zoning code. Such a seeming lack of order is difficult to grasp by those unfamiliar with the area. The absence of a comprehensive land use code conjures up images of a disjointed landscape where oil derricks sit next to mansions and auto salvage yards abut churches. To some degree these anomalies exist, yet for the most part Houston is like any other large North American city.

What is unique about Houston is that the separation of land uses is impelled by economic forces rather than mandatory zoning. While it is theoretically possible for a petrochemical refinery to locate next to a housing development, it is unlikely that profit-maximizing real-estate developers will allow this to happen. Developers employ widespread private covenants and deed restrictions, which serve a comparable role as zoning. These privately prescribed land use controls are effective because they have a legal precedence and local government has chosen to assist in enforcing them.

Some investors are understandably apprehensive about the lack of clearly defined rules. Houston developers have long recognized these concerns and have responded, particularly in suburban markets, by producing planned business and industrial parks that have rigorous covenants and deed restrictions. Not surprisingly, the sites receiving the attention of institutional investors, especially in suburban markets, tend to be in planned parks.



The lack of zoning offers freedom in design, but should be executed carefully, as there are many pros and cons with the no zoning policy.

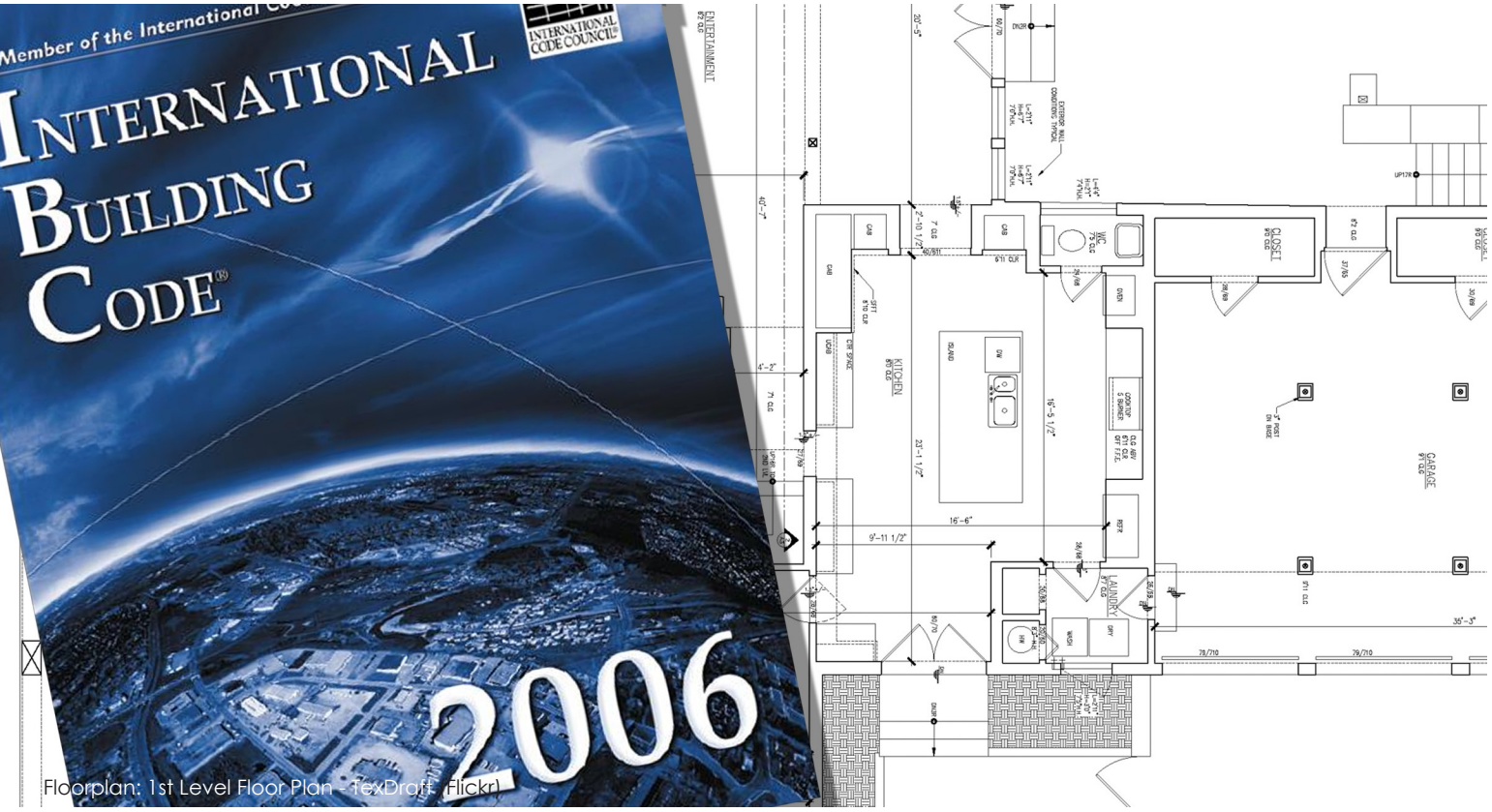
The absence of zoning regulations on one side has made Houston a very unique city. Many opinions state that they love seeing such a variety of uses on one single street. This can make it convenient to get certain things possibly in your own neighborhood, rather than driving down to a hardware store area. Some people consider it fun to be able to see such large differences in architecture juxtaposed with one another. This has been especially helpful in the residential sector. Builder's Magazine has ranked Houston #1 in 2009 for the healthiest housing market. It was the only major city to be seemingly unharmed by the housing crisis, and actually issued out almost 43,000 building permits in 2008 (securing its number one spot in the poll).

Apart from selling real estate, however, no zoning means that there must exist responsible design. There are many existing downsides to the lack of zoning, pedestrian unfriendliness being one of them. Because the city has no real plan for its expansion since anything can be built anywhere at any time, the city has really been designed for the automobile. This does not give any priority to an environmentally friendlier pedestrian city.

While some do enjoy the proximity and variety of such different uses on a single street, nobody enjoys an 8 story and 12 story tower next to single family housing, as is the case with the newly built Sysco headquarters. It is true that zoning is somewhat offset by strict private land-use regulations; this micromanaging, however, only works within the perimeters of a landowner's property line. Houston needs to start tackling this problem at the larger assemblage. The city, from suburbs to uptown to downtown, works realistically as a whole, but right now it is being built and managed as smaller microcosms that do not take into consideration the larger picture.

Zoning in Houston is an issue that could be another topic in itself, but for this project means a certain freedom in what is designed and built. In this case, it is important, with this freedom, that the project be designed intelligently based on the larger infrastructure of the city, to also serve as a model for how to build in a zone-less environment.

This freedom also conveniently supports this thesis. It allows the designer to have a certain civic responsibility. If it's change in consciousness that needs to happen, then what better place to start than the place that allows one to build absolutely anything they want? Because this project will contain a variety of occupancy types and uses, to essentially create a small "community," the lack of zoning provides that freedom. As author Douglass Farr states as his 2nd step to a new urbanism, we need to change societal values and create a market for a new way of life. The current zoning actually achieves the opposite, restricting the mixture of certain building types, and actually forcing society to be more transient, more automobile driven. This has a direct affect on our physical and emotional health (Farr, 21). Perhaps, with this in mind, all cities should consider a shift towards a zone-less urban planning coupled with intelligent design.



Floorplan: 1st Level Floor Plan - TexDraft, (Flickr)

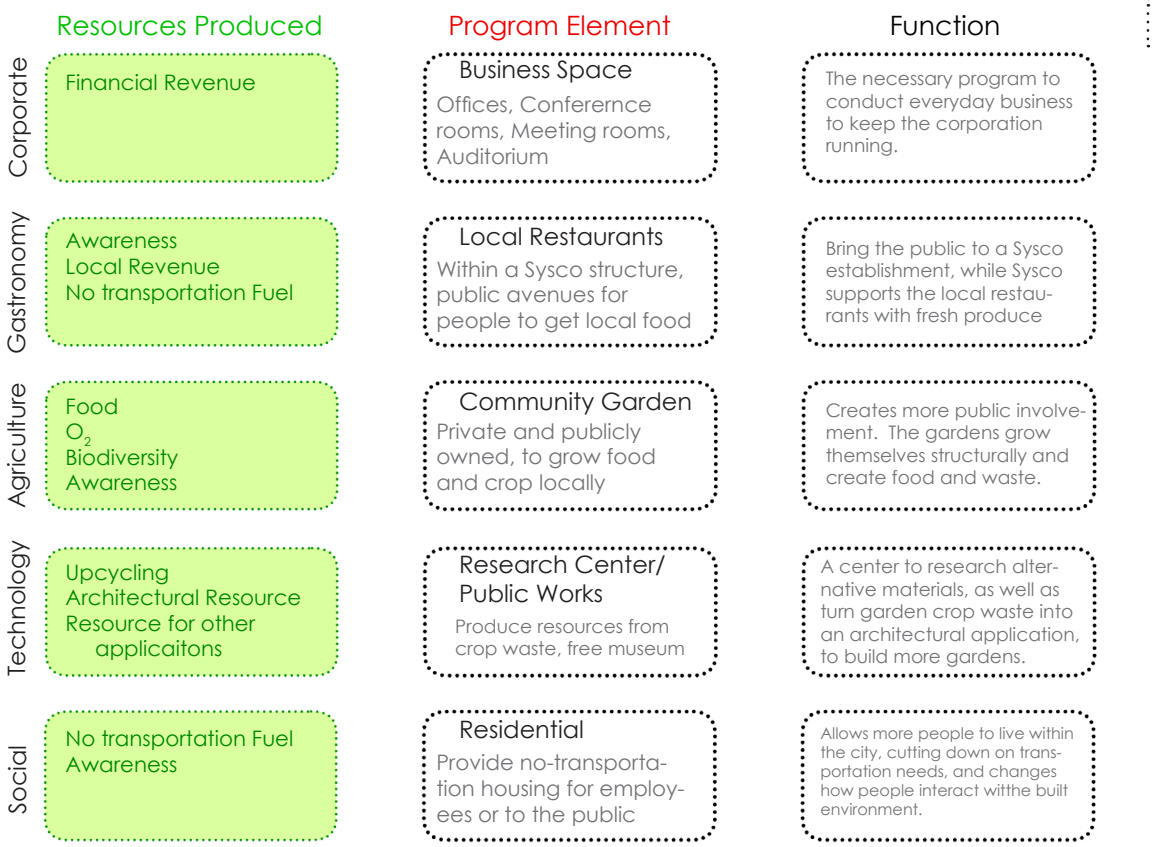
Program Analysis

The current headquarters already has a set program. As mentioned, it consists of two towers totaling 532,000 square feet. which includes the following:

- Offices
- Auditorium
- Conference Rooms
- Meeting Rooms
- Dining Room
- Public/ Vendor Lobbies

This program is very typical in defining the corporation's goals. Sysco does not directly handle food, although they boast their expertise in the food sector. They instead manage those smaller companies, who manage other companies, who then manage the food. Sysco is a facilitator. Exploring their website will show an emphasis on customer service and food variety, not so much about the food itself. Their new headquarters' program is a direct reflection of this. All program elements are aimed at customer service, meeting with clients, or allowing other companies to sell their products: business. The modification to the program should include food. If Sysco means fresh food, then it should reflect this through its headquarters, and instead of being a high profile business machine, should scale its emphasis to the public civilian level, to change the very nature of large corporations.

Qualitative Program Analysis



Quantitative Program Analysis

Business Spaces:

Offices		150,000
Meeting Rooms		40,000
Conference Rooms		40,000
Restrooms		
	total sq ft:	200,000

Local Restaurant

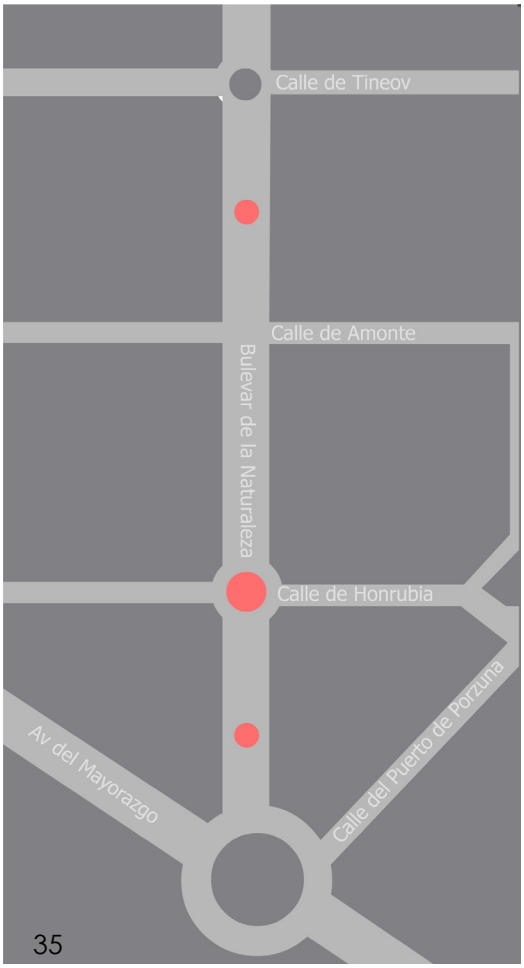
Kitchen (cooking, storage)		3,000
Common Space		20,000
Restrooms		
	total sq ft:	30,000

Garden Spaces

Modular Community Gardens		100/ module
Tool Storage		40/ module
Grain Storage		300/ 10 modules
	total sq ft:	400,000

Research/Manufacturing		
Material Storage		10,000
Laboratory Space		20,000
Testing Space		30,000
Offices		1,000
Restrooms		
Exhibit Space		2,000
	Total sq ft:	64,000
Residential		
Housing Units		
Bedrooms		950
Bathroom		150
Kitchen		200
Common Space		800
Access to Gardens		200
	Total sq ft:	2,300
Common Space		4,000
Public Lobby		600
Mail Room		500
	Total sq ft:	300,000

Total Program Area: 994,000 sq ft





EcoBulevar Redux

Address:
Estanislao Figueras 6
28008 Madrid, Spain
tel (+34) 915591601
info@ecosistemaurbano.com



Architects: Ecosistema Urbano

This project, also in Madrid Spain, takes the idea of a green wall and turns it into a single structure whose sole purpose is to serve as a completely self sustainable power station that requires no energy and actually produces solar energy while creating a dynamic space definable by anyone who wants to use it.

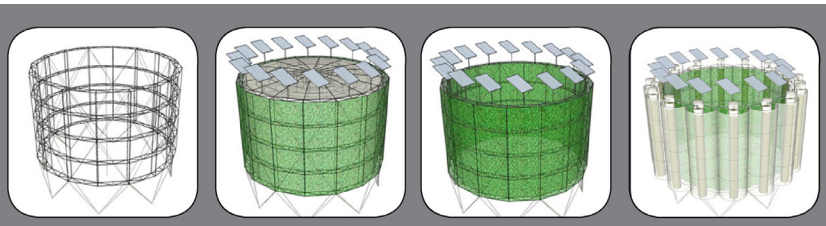
The designers at Ecosistema Urbano explain: "The whole proposal for the eco-boulevard in Vallecas can be defined as an urban recycling operation consisting of the following actions: insertion of an air tree-social dynamizer, over an existing urbanization area, densification of existing alignment trees and reduction and asymmetric arrangement of wheeled traffic circulation. Superficial interventions reconfiguring the existing urbanization (perforations, fillings, etc.) that defaces the executed kerb development1."

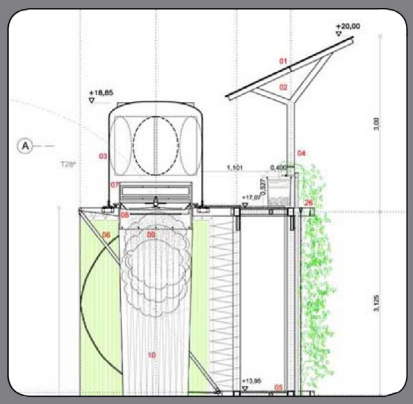
A structural metaphor for a tree, a living system that provides shelter, food, and energy for all that use it, has never been so clearly executed as in this project. These mechanical "trees" that are planted along a walkway provide for all of these things, while also providing beneficial energy. Perhaps this concept can be taken even further in a larger scale or in a slightly different environment, where resources are desperately needed.





1http://landscapeandurbanism.blogspot.com/2008/09/eco-boulevard-redux.html



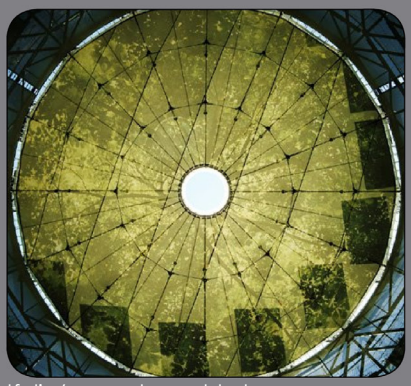


Structural diagrams showing the vegetative layers

Wall sections showing layers of vegetation, structure, and sustainable features (PV cells)

Structure and interior space

Canopy structure and PV Cells







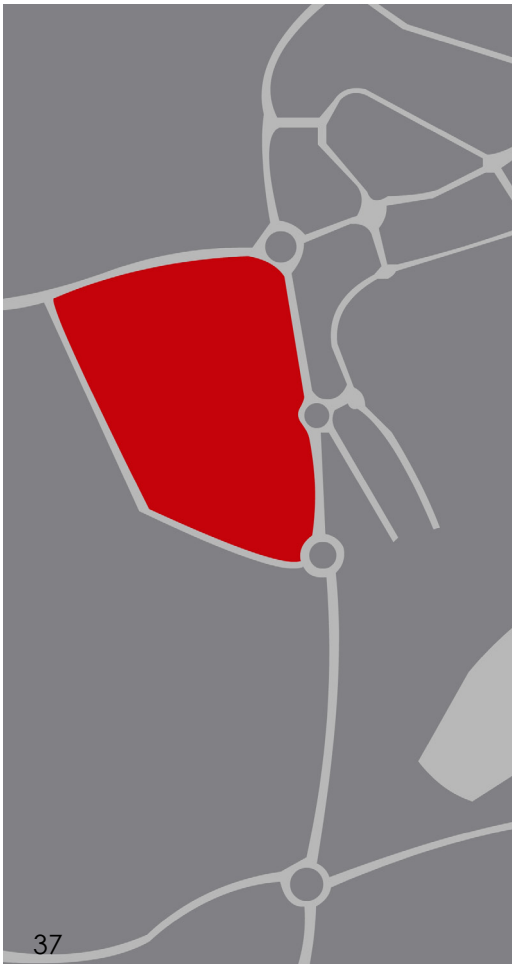


Upcycle

Regeneration

This case study represents a project who's purpose is to provide a versatile space for public use as well as generate and collect resources for the surrounding housing complex. In this case, it does not use sustainable processes for its own use because the structure does not require maintenance or interior comfort like an office or home would require.

http://www.ecosistemaurbano.org/portfolio/cargador_es.html





Upton, England

Northampton, England
New Urbanism Neighborhood Design

English Partnerships
The National Regeneration Agency

Architects: English Partnerships

Upton, a community of about 1400 houses, is leading the way in new urbanism in a neighborhood context. The neighborhood is complete with ample outdoor space spread throughout the area, and a mixture of occupancies within a close proximity, lending to increased social interaction with neighbors.

The housing complexes adhere to strict EcoHomes Excellent Standards, complete with a strict CO2 emissions cap. The newer phase of houses also contains mini wind turbines to create electricity readily used in the house, photovoltaic systems, microcombined heat and power systems, rainwater collection, green roofs, upgraded insulation, solar water heating, and higher internal air quality.

The urban design also manages its water very carefully. They utilize a Sustainable Urban Drainage System (SUDS) to control the flow of drainage water entering and exiting the sewage systems. All waste water is directed at bioswales that act as natural environments for many species.

The neighborhood also features an efficient bus system that promotes public transportation. English Partnserships also mandated that 22 percent of the homes be permanently affordable housing, which are spread throughout the community, so nobody can distinguish them from any other market-rate

http://www.englishpartnerships.co.uk/upton.htm
Farr, Douglas. Sustainable Urbanism. 238-242



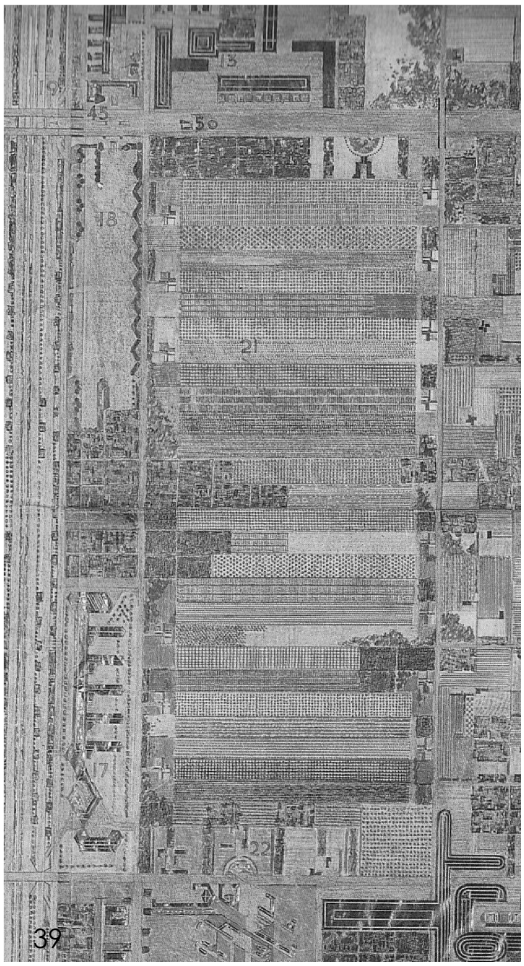


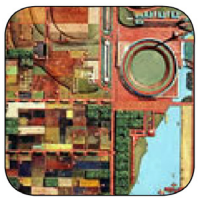




Upcycle

Free Resources





Broadacre City



1932-1958

Architect: Frank Lloyd Wright

Broadacre City was designed as a theoretical city by Frank Lloyd Wright. It was created during the automobile explosion and the beginnings of the urban/suburban schism. The experimental city was a way to create an automobile centered living community whereby the inhabitants could grow crops to sustain themselves.

Each member of Broadacre City is given one acre of land. Within this acre the pedestrian can do whatever he/she pleases, but transportation outside of this acre revolves around the increasingly intrinsic automobile. Each citizen would produce crops for themselves, as well as for the Roadside Market, which as Wright explains, is "the most attractive, educational and entreating single modern unit to be found among all the features of the Broadacre City."

This city is an experiment as an option on how to deal with the everpresent suburban condition. Wright believed that the suburban phenomenon can be extremely harmful to the human psyche. It transforms how people think towards land use and how to live daily life. The big city was a "monstrous aberration built by greed, destructive to both efficient production and to human values."

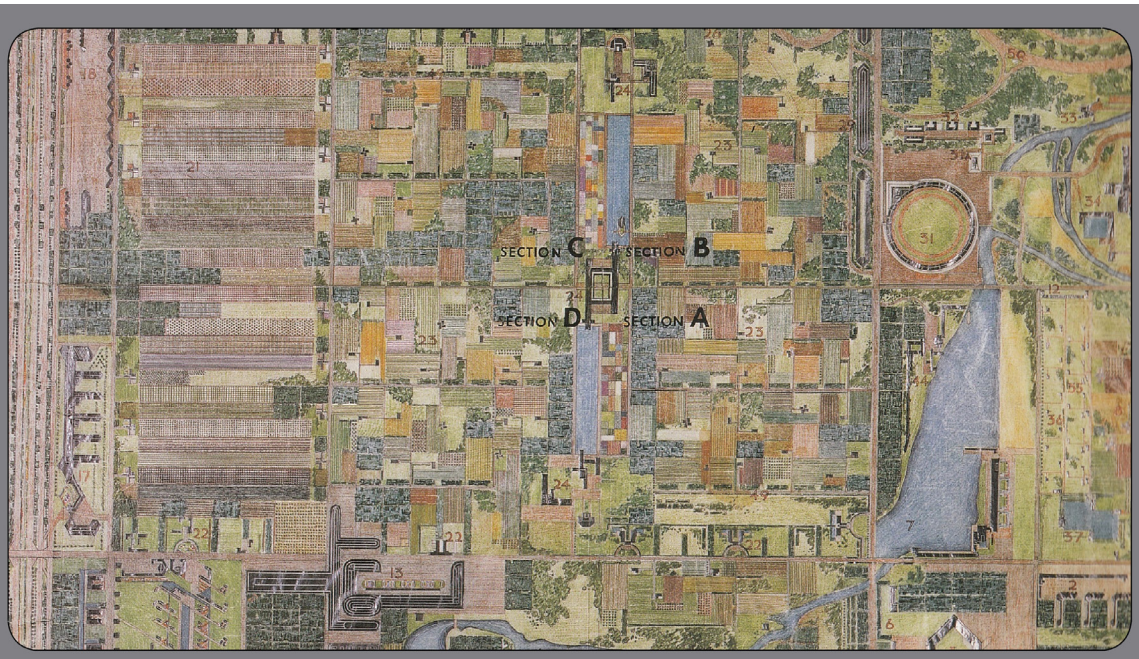
There are several factors to be taken from this living experiment. Although it may be too late to apply this idea to modern suburbia, many of the values can still be applied within a modern context.

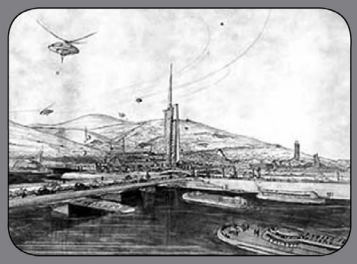




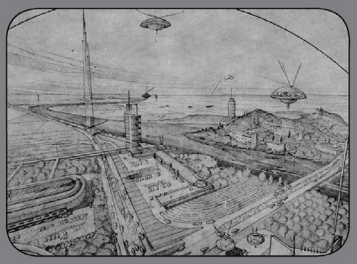


Wright, Frank Lloyd. Edited by Bruce Brooks Pfeiffer. The Essential Frank Lloyd Wright - Critical Writings on Architecture. Chicago: Princeton University Press, 2008. 235. Print.





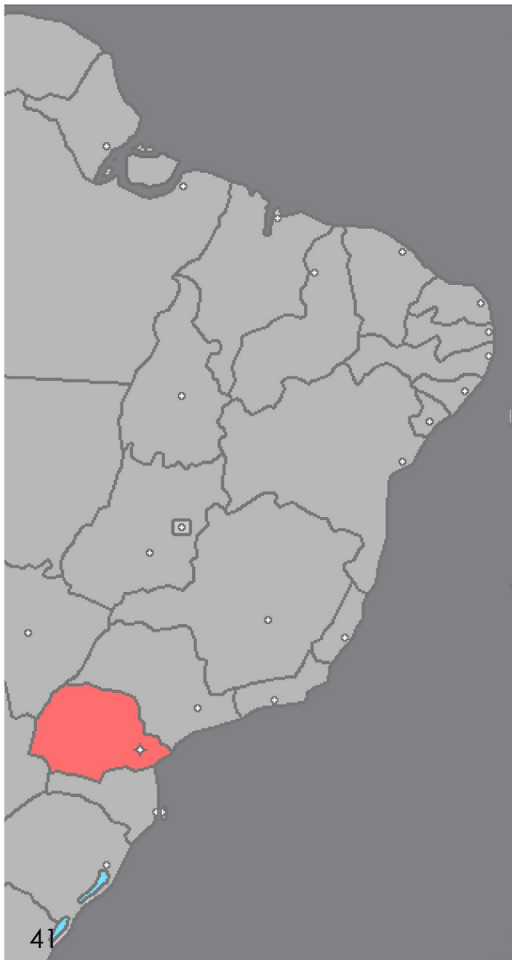




Upcycle

Regeneration

This case study is a possible solution to an upcoming problem. Although today it has already rooted itself deeply into the global society, the suburban condition could have been dealt with very differently in Wright's mind. This project represents a study in designing infrastructure, not individual buildings (although it was a component).





Curitiba, Brazil

Architect: Jaime Lerner

Curitiba, Brazil, survived in 3rd world conditions for quite some time. When the city decided that it was time to take a step away from corrupt political figures, they decided to elect an architect as governor, in big part due to his inexperience as a political official.

With the mind of an architect, Governor Jaime Lerner began to transform the city. His first experimental street, November 15th St, was converted to a pedestrian street, and included plentiful green spaces. His primary changes revolved around the idea of "change in human behavior, not technological advance (Hawken, Lovins, 288)." He understood that in order to change people's interaction with their world, you must change how they value it.

His plans also included an improved metro system to get people around the city without relying on the automobile. He essentially brought on change through "hundreds of multipurpose...people-centered initiatives (288)." Through his efforts as an architect and planner, he effectively turned Curitiba into a first world area. The city was completely turned around and everyone within it had an improved quality of life, solely due to careful planning and consideration for what a site truly needs.



McDonough, Braungart. Cradle to Cradle.

Lovins. Natural Capitalism.











Architect/Governor Jaime Lerner



Before reform, packing unto a bus



First experiment, November 15 st.



New efficient bus system.

Upcycle

Regeneration

Removal

Addition

The complete redesign of the city utilizes all sustainable principles. The use of the principles together, along with intelligent urban planning, have successfully changed the lives and lifestyles of every citizen.

Master Plan

Phase 5: All states combine networks to create an interconnected network based on local needs. One person's surplus fills another's demands, similar to the Broadacre City.

Phase 4: At this point, all cities are self sustainable. Theoretically, the entire state could rely almost solely on itself through one large local system.

Phase 3: Tie the city infrastructure to other growing bases from other cities, creating a large network.

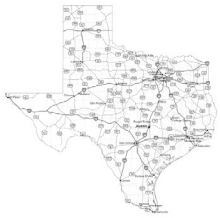
Phase 2: Expand the base condition to the outlieing city, to create a symbiotic relationship between two zones.

Phase 1: Establish a base point in the downtown zone, "planting the seed" to create an entire future infrastructure.

Country



State



Region



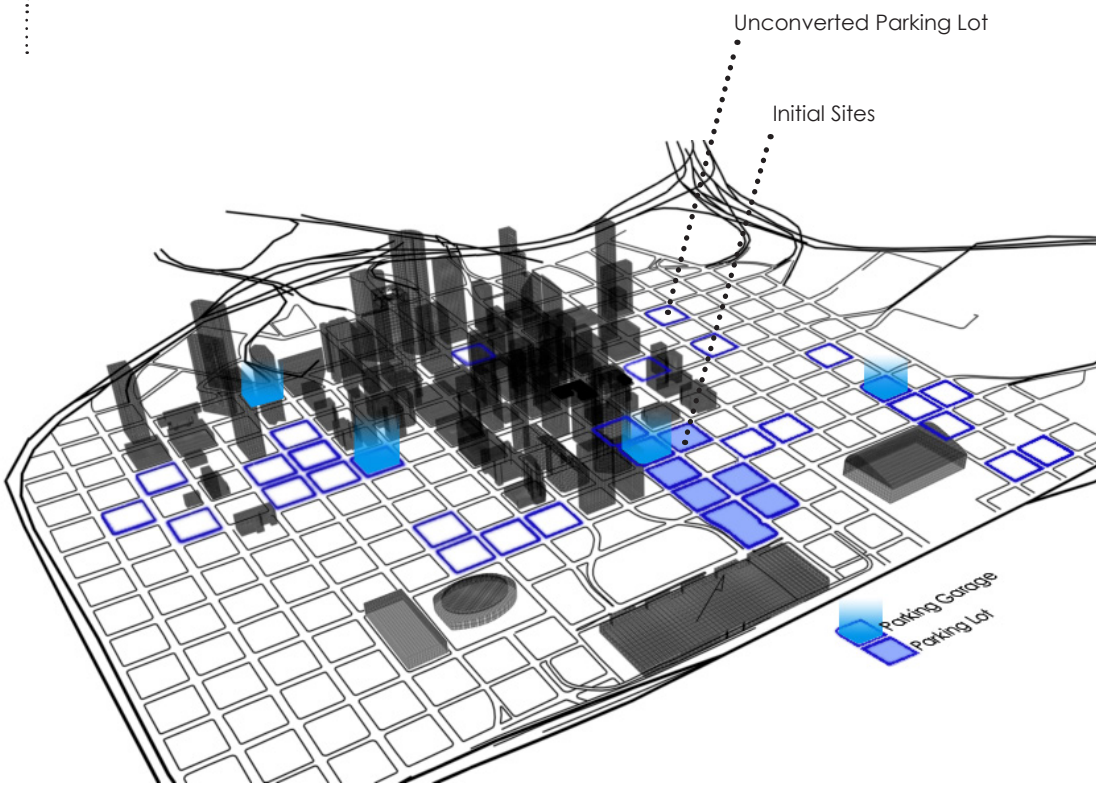
City



Downtown



Houston Timelapse



Within two years, Houston will experience the new Sysco headquarters, which will provide a different and more hands on public interaction with the company and city. Some of the parking lots will be taken for this program, leading to a loss of parking spaces.

The newly implemented MetroRail system will see a rise in passangers, as some people will not be able to park in the city.

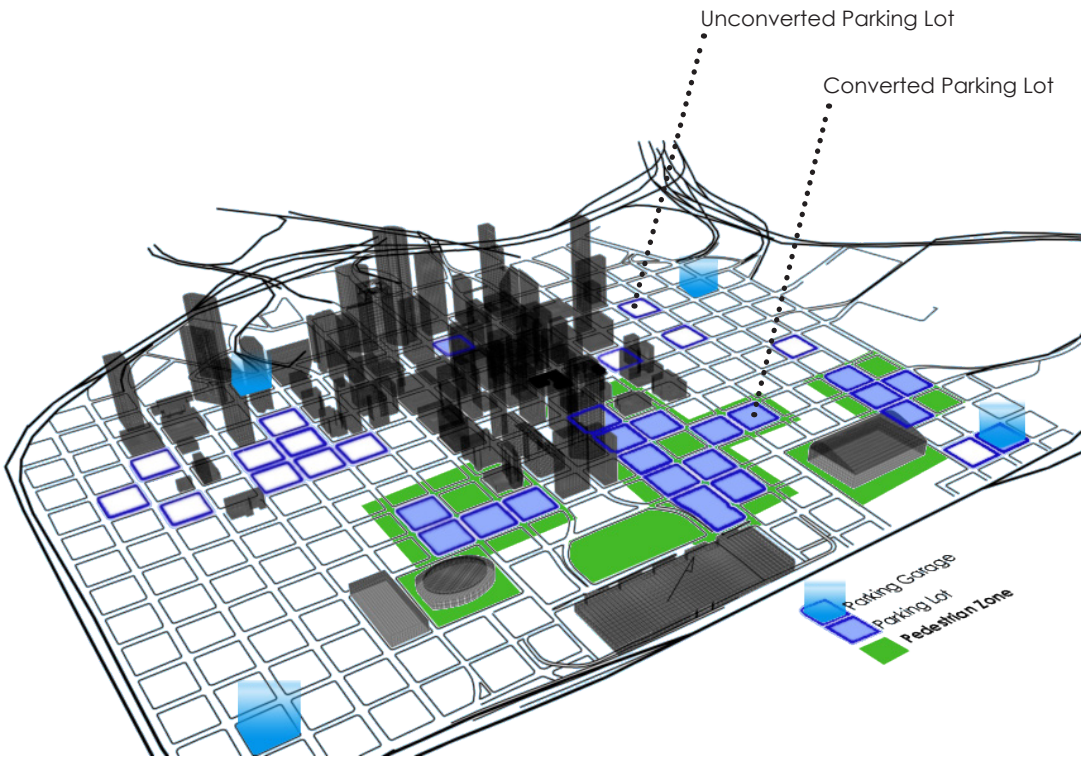
2 YEARS



About half of the parking lots have been redesigned to fit Sysco program needs. This has caused a parking crisis, with many people commuting to the city but not being able to park.

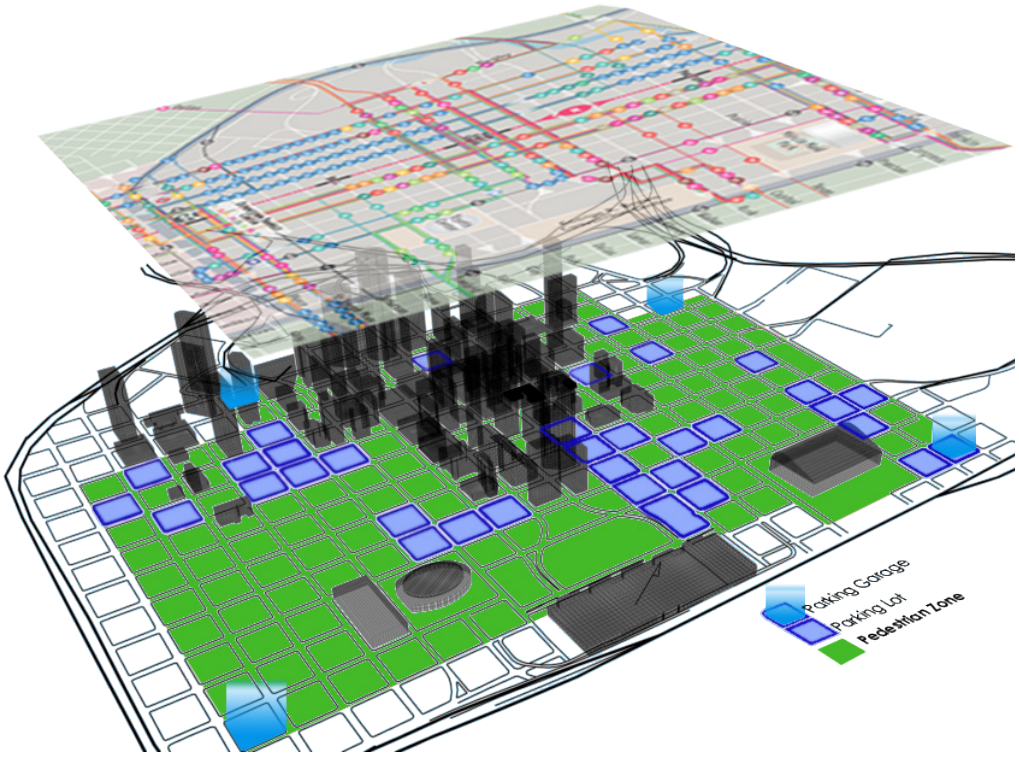
The light rail system has improved and expanded out of necessity, being powered by the program elements around the city.

New parking garages have been built at the freeway entrance into the city, forcing people to leave their cars and commute through efficient public transport within the city.



10 YEARS





By this point, all parking lots have been re-purposed for Sysco community gardens. The vehicular traffic in the city is reduced to almost nothing, with a vast amount of passanger traffic in the large and more developed light rail system.

Houston has effectively become a pedestrian city, self sustainable in food, with a newly established relationship between person and environment, as well as person and corporation.

20 YEARS

Code Analysis

Group Occupancy Types

A

303.1 Assembly Group A. Assembly Group A occupancy includes, among others, the use of a building or structure, or a portion thereof, for the gathering of persons for purposes such as civic, social or religious functions; recreation, food or drink consumption; or awaiting transportation.

B

304.1 Business Group B. Business Group B occupancy includes, among others, the use of a building or structure, or a portion thereof, for office, professional or service-type transactions, including storage of records and accounts.

F

306.1 Factory Industrial Group F. Factory Industrial Group F occupancy includes, among others, the use of a building or structure, or a portion thereof, for assembling, disassembling, fabricating, finishing, manufacturing, packaging, repair or processing operations that are not classified as a Group H hazardous or Group S storage occupancy.

R

310.1 Residential Group R. Residential Group R includes, among others, the use of a building or structure, or a portion thereof, for sleeping purposes when not classified as an Institutional Group I or when not regulated by the International Residential Code in accordance with Section 101.2.

U

312.1 General. Buildings and structures of an accessory character and miscellaneous structures not classified in any specific occupancy shall be constructed, equipped and maintained to conform to the requirements of this code commensurate with the fire and life hazard incidental to their occupancy.

A

A-2 food and/or drink consumption

Construction Type IB

Local Restaurants
30,000 sq ft

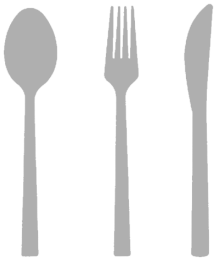


Table 602: Fire-Resistance Rating Requirements for Construction Types

Fire Separation Distance (ft)	Type of Construction	Group Occupancy A, B, E, F-2, I, R, S-2, U
<5	All	1
5-10	1A	1
	Other	1
10-30	1A, 1B	1
	IIB, VB	0
	Others	1
>30	All	0

Table 1004.1.1: Occupant Load Kitchens, Commercial - 200 sq ft gross

Table 503: Allowable Height 11 Stories, Unlimited Area

1017.2 Corridor width: Shall not be less than 44"

1009.1 Stairway width: Shall not be less than 44"

1017.3 Dead ends: Shall not be more than 20 ft

Table 1016.1: Exit Access Distance: (A,E,F1,I1,,M,R,S1) Sprinkled, No more than 250 ft

Table 1015.1: One Exit Requirement: (A, B,E , F, M, U) No more than 49 max occupants

1015.2.1 Exits Placement: Placed no closer than half of the distance of a diagonal from two extremes of the floor plan



B Buiness

Construction Type IB

Offices, Meeting Rooms, Conference Rooms
200,000 sq ft

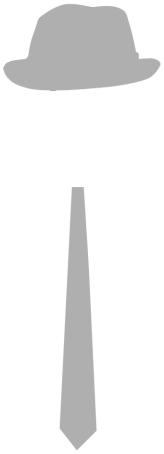


Table 602: Fire-Resistance Rating Requirements for Construction Types

Fire Separation Distance (ft)	Type of Construction	Group Occupancy A, B, E, F-2, I, R, S-2, U
<5	All	1
5-10	1A	1
	Other	1
10-30	1A, 1B	1
	IIB, VB	0
	Others	1
>30	All	0

Table 1004.1.1: Occupant Load: Business Areas - 200 sq ft gross
Table 503: Allowable Height 11 Stories, Unlimited Area
1017.2 Corridor width: Shall not be less than 44"
1009.1 Stairway width: Shall not be less than 44"
1017.3 Dead ends: Exception 2: If Sprinkled, shall not be more than 50 ft
Table 1016.1: Exit Access Distance: (B) Sprinkled, No more than 300 ft
Table 1015.1: One Exit Requirement: (A, B,E , F, M, U) No more than 49 max occupants
1015.2.1 Exits Placement: Placed no closer than half of the distance of a diagonal from two extremes of the floor plan

F

F-1 Moderate-hazard Occupancy - Construction and Avgricultural Machinery

Construction Type IIIA

Research/Manufacturing Center
64,000 sq ft

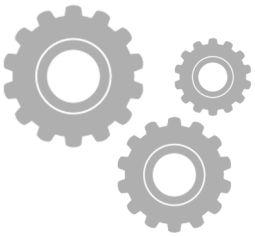


Table 602: Fire-Resistance Rating Requirements for Construction Types

Fire Separation Distance (ft)	Type of Construction	Group Occupancy F-1, S, M-1
<5	All	**2**
5-10	1A	2
	Other	1
10-30	1A, 1B	1
	IIB, VB	0
	Others	1
>30	All	0

Table 1004.1.1: Occupant Load Kitchens, Commercial - 200 sq ft gross

Table 503: Allowable Height 11 Stories, Unlimited Area

1017.2 Corridor width: Shall not be less than 44"

1009.1 Stairway width: Shall not be less than 44"

1017.3 Dead ends: Exception 2: If Sprinkled, shall not be more than 50 ft

Table 1016.1: Exit Access Distance: (A,E,F1,I1,,M,R,S1) Sprinkled, No more than 250 ft

Table 1015.1: One Exit Requirement: (A, B,E , F, M, U) No more than 49 max occupants

1015.2.1 Exits Placement: Placed no closer than half of the distance of a diagonal from two extremes of the floor plan

R

R-2 Residential occupancies containing sleeping units or more than two dwelling units where the occupants are primarily permanent in nature

Construction Type IB

Private Residences/ Multifamily Housing

300,000 sq ft



Table 602: Fire-Resistance Rating Requirements for Construction Types

Fire Separation Distance (ft)	Type of Construction	Group Occupancy A, B, E, F-2, I, R, S-2, U
<5	All	1
5-10	1A	1
	Other	1
10-30	1A, 1B	1
	IIB, VB	0
	Others	1
>30	All	0

Table 1004.1.1: Occupant Load Residential - 200 sq ft gross

Table 503: Allowable Height 11 Stories, Unlimited Area

1017.2 Corridor width: Shall not be less than 44"

1009.1 Stairway width: Shall not be less than 44"

1017.3 Dead ends: Shall not be more than 20 ft

Table 1016.1: Exit Access Distance: (A,E,F1,I1,,M,R,S1) Sprinkled, No more than 250 ft

Table 1015.1: One Exit Requirement: (H-4, H-5, I-1, I-3, I-4, R) No more than 10 max occupants

1015.2.1 Exits Placement: Placed no closer than half of the distance of a diagonal from two extremes of the floor plan

1107.3 Accessible spaces: Rooms and spaces available to the general public or available for use by residents and serving Accessible units, Type A units or Type B units shall be accessible

U

U Utility and Miscellaneous

Construction Type IIA

Community Gardens, Green Houses, Grain Silos accessible to type R 400,000 sq ft



Table 602: Fire-Resistance Rating Requirements for Construction Types

Fire Separation Distance (ft)	Type of Construction	Group Occupancy A, B, E, F-2, I, R, S-2, U
<5	All	1
5-10	1A	1
	Other	1
10-30	1A, 1B	1
	IIB, VB	0
	Others	1
>30	All	0

Table 1004.1.1: Occupant Load Kitchens, Commercial - 200 sq ft gross

Table 503: Allowable Height 11 Stories, Unlimited Area

1017.2 Corridor width: Shall not be less than 44"

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1017.3 Dead ends: Shall not be more than 20 ft

Table 1016.1: Exit Access Distance: (A,E,F1,I1,,M,R,S1) Sprinkled, No more than 250 ft

Table 1015.1: One Exit Requirement: (A, B,E , F, M, U) No more than 49 max occupants

1015.2.1 Exits Placement: Placed no closer than half of the distance of a diagonal from two extremes of the floor plan

Code Analysis

General Code Analysis

1004.9 Multiple occupancies: Where a building contains two or more occupancies, the means of egress requirements shall apply to each portion of the building based on the occupancy of that space. Where two or more occupancies utilize portions of the same means of egress system, those egress components shall meet the more stringent requirements of all occupancies that are served. (2006 International Building Code)

Ordinance Number 09-762, § 3, dated 8-19-09

Minimum Building Setback (ft)

Location	Urban	Suburban
Central Business District	0	NA
General	15	NA
Commercial	5	NA
Multi-family Residential	10	10

Sec. 42-151. Exceptions to building line requirement.

(a) Property within the central business district shall not be subject to a building line requirement.

Sec. 42-231. Private streets--General standards.

(a) A development plat that contains a multi-family residential building shall provide at least one private street. The private street shall remain clear at all times for emergency vehicle access. No parking shall be allowed within the private street. Except as provided in section 42-235 of this Code, a private street shall comply with the requirements of this section.

(b) Width:

(1) The minimum right-of-way width for a private street shall be 28 feet, which is coterminous with the pavement width measured from edge-to-edge across the surface of the pavement.

Sec. 42-235. Performance standards.

A multifamily residential development with a density of 30 dwelling units or more per acre that meets each of the performance standards of this section shall be exempt from the requirements of sections 42-231, 42-232(a), 42-232(b), 42-233(a), and 42-233(b) of this Code:

(2) Fire hydrants are located no further than 20 feet, measured perpendicularly, from the edge of the pavement of the fire lane, private street or public street. Access to the fire hydrants through any fence is provided by gates with 911 access;

(3) One fire hydrant is located within 100 feet of the property line on any fire lane or private street, as shown in figure 4.

(5) The maximum distance between fire hydrants is 600 feet, as shown in figure 6.

Sec. 42-236. Open space.

(a) Except as otherwise provided in this section, each multi-family residential development in the extraterritorial jurisdiction shall provide open space in accordance with the following schedule:

Unit Size	Open Space per Unit
Efficiency	200
1 Bedroom	240
2 Bedrooms	320
3 Bedrooms	440
4 Bedrooms	500

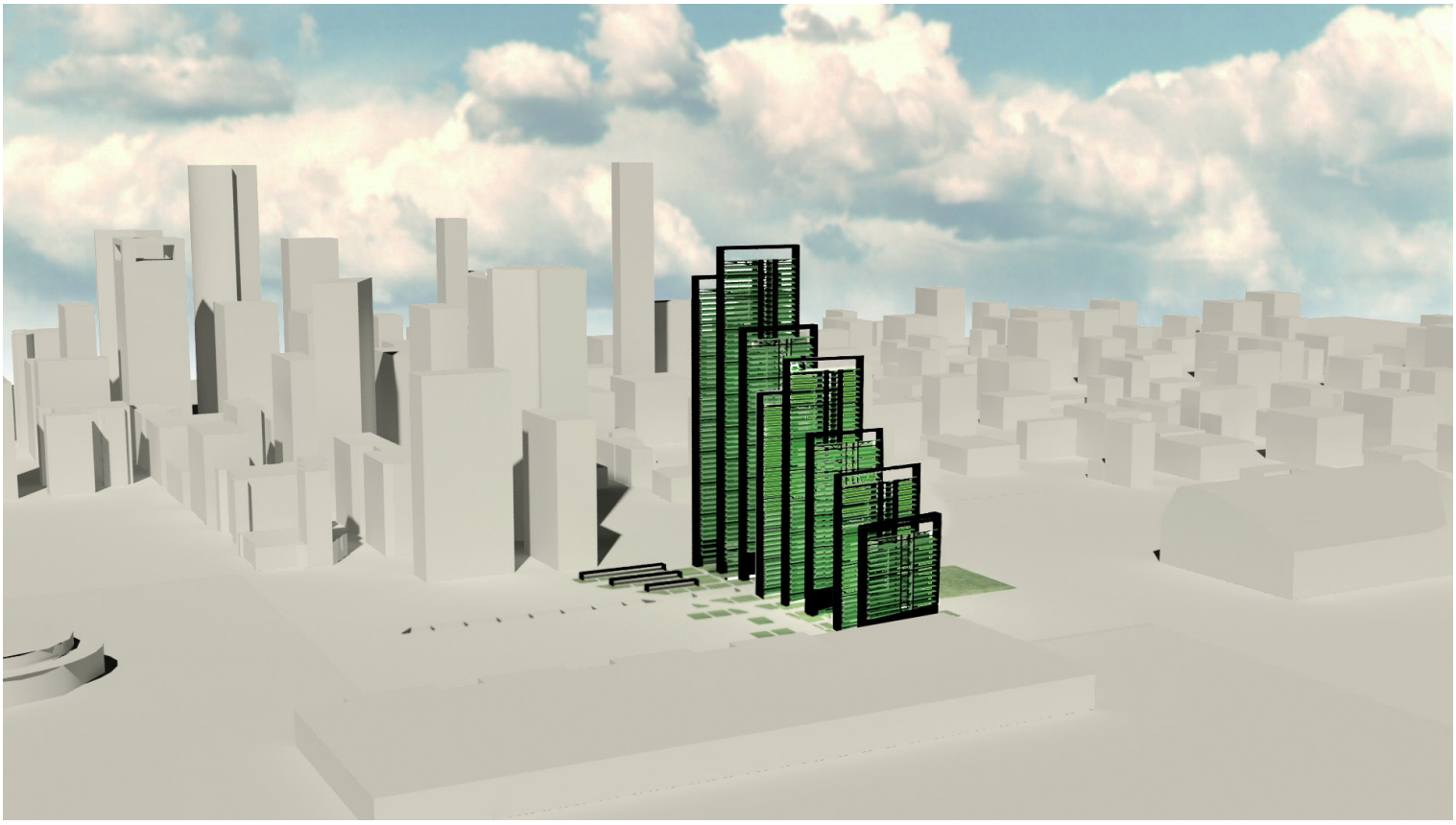
For purposes of this section, "open space" shall mean land within the multi-family residential development that is not covered by buildings, covered walkways, parking spaces, private streets or driveways.

1012.2 Handrail Height: Handrail height, measured above stair tread nosings, or finish surface of ramp slope shall be uniform, not less than 34 inches (864mm) and not more than 38 inches (965 mm).

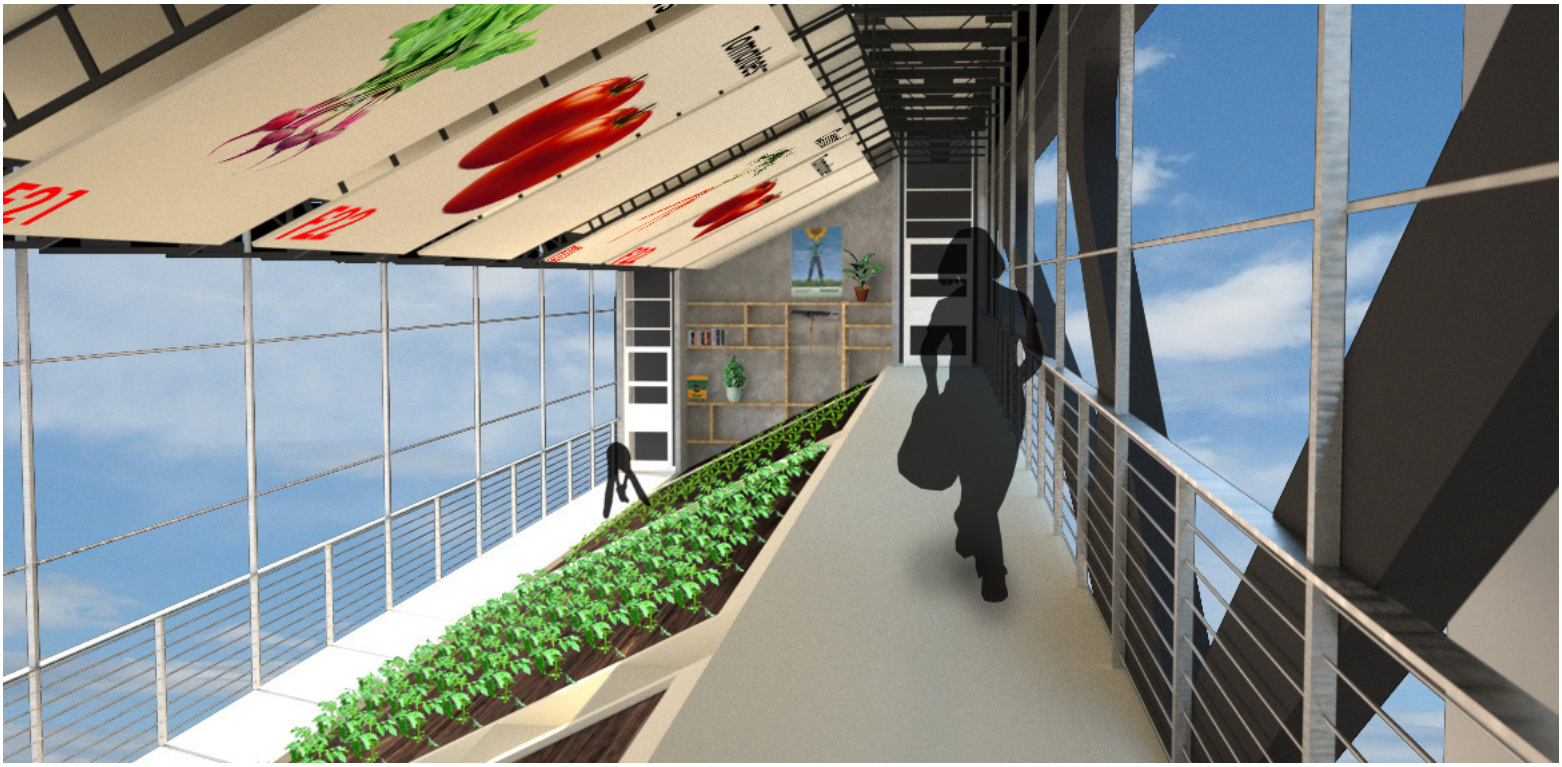
1009.2 Stairway Headroom: Stairways shall have a minimum head-room clearance of 80 inches

1009.3 Stair treads and risers: Stair riser heights shall be 7 inches (178 mm) maximum and 4 inches (102 mm) minimum. Stair tread depths shall be 11 inches (279 mm) minimum










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