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Regional Stimulus - Closed Loop Design EcoSciencePark: Net Zero Energy, Water, Food, Waste and Biofu

Parallel 1

STPs and the mobile society

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Regional Stimulus - Closed Loop Design EcoScience Park©: Net Zero Energy, Water, Food, Waste, and Biofuels.

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I. EXECUTIVE SUMMARY

The Closed Loop Design EcoSciencePark© is to be; Net Zero Energy, Water, Food, Waste, and Biofuels Science Park, promoting environmental, economic, and educational sustainability. The "Life Style Science Park" development catches and reuses water, produces it own food, recycles everything on site, and makes biofuel for the farming. The Magnet University and adjancent incubators /accelerators will develop intellectual property and thereby create companies with future high technology employment. The design is to be "customized" for the "regional technology" of a specific area that it is meant to support, thereby becoming a "Technology HUB" for a technology cluster. In developed counrties the "Technology HUB" is a systematic why to customize technology support: 1) economic development, 2) high technology education, and 3) low energy and environmental "footprint". A smaller version could be developed for developing countries to promote: 1) economic development, 2) sustainable water and soil solutions, and 3) educational develeopment.

Net Zero Energy, Water, Food, Waste, and Biofuel Technology Cluster HUB

II. INTERNATIONAL ASSOCIATION OF SCIENCE PARKS (IASP) AREAS OF INTEREST

The Closed Loop Science Park Highlights Issues and Trends:
There is a trend toward life style science parks or "live, work, play, and educate environments", "sustainable design" and "regenerative environments". The Closed Loop Design EcoSciencePark© addresses all of these issues toward sustainable economy, environment, and education.

The Closed Loop Science Park is active in coordinating and fostering innovation and a knowledge-based economy:
The concept of "Magnet University" speaks to a focus of fostering innovation and technology. The university, technology incubators, and community synergy are meant to promote innovation and commercialization.

The Closed Science Park and other areas of innovation are becoming more urbanized, slowly evolving to be more and more integrated with cities:
The Closed Loop Science Park in an urban design solution promotes a mixed use synergistic philosophy that becomes very integrated into the city focused on low energy and a low environmental footprint. The campus housing, campus buildings, training facilities, school, convention center, hotel, K-12 school, churches, professional offices, commercial, restaurants, cafes, and piazza market spaces are all net zero energy and centrally located around the community water feature.

Global financial crisis and the effect of restrictive budgets force STPs to seek new approaches:
The Closed Loop Science Park solution focuses on a Public Private Partnership approach where each entity contributes their expertise. Entrepreneurs are encouraged to lend their unique expertise. The short term economic benefits are in 1) design and construction, 2) university education and training employment, and 3) intellectual property creation, and 4) long term corporate growth from the IP.

THEME 1: STPs and the mobile society:
1a: Moving people:
The Closed Loop Science Park Design is focused on reducing commuting, saving energy, and becoming a "smart city" in energy, communication, and transportation. A high volume transportation link via high speed rail would be in close proximity to the science park development.

1b: Upload cities and 1c: Smart citizens:
Up loading and down loading data is very important. This needs to be accomplished where the high-volume centrally located links that facilitate this but do not degrade the electromagnetic environment that is needed to conduct "nanotechnology research". These links are connected via "fiber distribution" to the science park.

THEME 2: The new role for STPs: driving city change:
2a: Intelligent infrastructure:
The Closed Loop Science Park embraces an "intelligent infrastructure" to: 1) Coordinate energy generation and use from renewable resources and 2) Coordinate the natural rain storage, water use / aquifer recharge, gray / black water use and recycling, waste to algae to biofuel interface, and interface with agricultural irrigation.

2b: New ways of urban life:
The Closed Loop Science Park is in itself a model for the integration of science, research, life, work, play educate environment. The project will become a "living laboratory" for this new science park model. The "smart grid" and state of the art fiber distribution will promote a more "connected and media friendly" population. The net zero energy, water, food, waste, and biofuels approach is at the forefront of urban change.

2c: Local governments promoting science and technology as a development policy:
The Closed Loop Design was “tested” in both an “Existing Urban Science Park” and a “Greenfield Science Park” and “Rural Developing Country Approach”; and worked well.

2d: Urban problems as business opportunities for STPs:
The “Existing Urban Science Park” model is used to foster an improved environment, stimulate the economy, reduce energy use, and improve education. The PPP can help define and prioritize development as required to solve specific urban problems such as education, training, environmental quality, waste management, and water management.

2e: STPs, science cities and urban strategies:
The Closed Loop Science Park “urban strategy” is to engage the science park leadership and the city leadership to work together to solve the economic, environmental, and educational urban issues.

2f: Personalized tech solutions on a large scale as opportunities for STPs:
The Closed Loop Science Park design needs to accommodate many different people types: students, researchers, commercial owners, restaurant owners, hospitality managers, and other professionals.

THEME 3 Managing STPs and innovation:
The Closed Loop Science Park, “Magnet University”, Village and the incubators / accelerators work as an integrated concept to research and solve the local technology problems.

3a: Making STPs livable *and* lovable:
The Closed Loop Science Park design started with a global analysis of 19 different pedestrian and Science Park environments from around the world. The analysis defined not only the positive to include but also the negative features to avoid.

3b: New business models for incubators in STPs and 3c: Innovative business models for STPs response to city challenges:
The Closed Loop Science Park design integrates the “Magnet University”, incubator / accelerators, and training facilities, focused solving technology issues and foster communication.

3d: Unusual experiences in clustering science and technology and 3e: High-tech and sustainable STPs & areas of innovation:
The Closed Loop Science Park design is a “first of its kind” a Technology Cluster HUB that is meant to lead the way in both sustainable environmental, economic and education regional design.

III. THE NZ4 GLOBAL ALLIANCE SCIENCE PARK EXPERIENCE / LESSONS LEARNED; APPLIED TO THE PROTOTYPE:

Bruce Haxton:
Mr. Haxton was involved in the master planning of 14 USEPA Research Campuses nationwide. He was also involved in the SOHIO Oil Company, 80 acre research campus master plan. More recently, he has been involved in Net Zero Energy and Water Science Park Prototype designs and Closed Loop Science Park Design prototypes. He has been the moderator for six nationwide in net zero energy teleconferences with 44 of the leading net zero architects and engineers resulting in articles and lectures about net zero architecture. Some of the lessons learned:

- The science park designs are moving toward life style science parks and toward net zero energy and closed loop design.
- When starting a net zero life style science park science park design start with an analysis of sustainable infrastructure: 1) define renewable energy available, 2) develop sustainable water , soil, and air quality parameters, 3) work backwards to define the amount of square footage that can be supported sustainably, 4) identify Energy Use Intensity (EUI) for all uses and square footages anticipated.
- Pedestrian, vehicular, and service circulation systems are critical for good master planning; resolve the circulation networks early.

- Try to develop a Public Private Partnership where numerous entities contribute to the common good and a solution that is environmentally, economically, and educationally sustainable.

Peter Why:
Mr. Why is the Vice President of Commercial for GNS China. He works out of his offices in China and Brazil, on projects worldwide. He was involved in the United Nations World Bank development of 53 Science Parks in China and has been a President of the International Association of Science Parks (IASP) and host of the 1998 IASP World Conference in Perth, Australia. Some important lessons learned:

- Look at the big picture of science parks and technology incubation as a part of a larger system of global technology development and transfer.
- Science Parks can promote regional economic development and can act as a bridge between countries.
- Work as an advocate of human development to creatively help foster commercial development and understanding between nations.
- Long term relationships are important in business development and establishing trust between people and nations.

John Andary:
Mr. Andary is a principal with the Integral Group, specializing in high performance engineering. He was involved in the design of the world recognized NREL RSF (National Renewable Energy Laboratory Research Support Facility, the largest NZEB in the North America), in Golden, Colorado and he continues to be involved in the NREL campus plan development. He and the Integral Group are continually involved at the cutting edge of Net Zero Energy building design and research. A few noted lessons learned:

- Start early with passive design strategies to reduce energy requirements; reducing plug loads is a good place to start.
- Develop an integrated design approach with engineers, architects, and consultants working in a synergistic manner to creatively solve the design problems.
- Create an energy budget for the project early on and develop an energy contingency strategy.

Fred Meade:
Mr. Meade has enjoyed an extensive career in economic and technology development on an international scale and served as an officer and board of director's member of the Association of University Research Parks. He directed the economic the development offices of Sarasota, then Tampa, Florida before becoming the director and chief operating officer for the Virginia Tech Corporate Research Center and the Penn State Research Park. Fred Meade developed the 110-acre conceptual master plan for the Virginia Tech Corporate Research Center, Blacksburg, Virginia. A few noted lessons learned:

- Make sure Science Park is focused on the end users.
- Actively seek out desired technology sectors and make sure the park reflects their needs.

Jason Loiselle:
Mr. Loiselle is a Senior Associate with the Sherwood Design Engineers, with offices in New York and San Francisco. The company specializes in sustainable infrastructure design and has written the book: Sustainable Infrastructure published by Wiley. The Sherwood team continues to design large scale regional infrastructure solutions worldwide. Some of the lessons learned:

- Conduct an opportunities and constraints analysis of regional and local systems of green and grey infrastructure to form the framework of land use and its holding capacity.
- Developing a water, energy, and nutrient balance of sources and sinks from hydrology and ecology to water treatment and reuse.
- Develop stakeholder consensus on project goals for resource management and protection.
- Create a kit of parts of strategies to implement the established goals within the various project conditions.

- Work with the architects and engineers to develop sustainable water and green infrastructure solutions that use the water as a valuable resource that maintains the local aquifer in quality and quantity.

IV. OVERVIEW OF THE CLOSED LOOP LIFESTYLE ECOSCIENCE PARK USED AS A TECHNOLOGY CLUSTER HUB

The Regional Stimulus - Closed Loop Design EcoScience Park©: Net Zero Energy, Water, Food, Waste, and Biofuels takes the following concepts: "Life Style Science Park", "sustainable design", "net zero energy concept"; "closed loop design" and "regenerative design" and integrates them into a self-sufficient urban form that can be used as a regional stimulus. Depending on the climate type, degree of technology development, population educational factors, and other factors; the science park can accomplish economic, environmental, and educational development. The team has already developed concepts to accommodate 1) Urban renovation of an existing science park, 2) Developing Country science park with agriculture,3) Urban Science Park on a new site, and 4) Developing country "starter city and science park to be". The complex is meant to be implemented with a Public Private Partnership (PPP). The regional economic stimulus is derived from: 1) Architectural engineering and design, 2) Facility construction, 3) Educational employment, 4) Student derived economy, 5) Intellectual property development, Employment from incubator "start-ups", 6) existing corporate growth, 7) Attracted corporate growth, and 8) Urban infrastructure development.

V. SITE SELECTION

Science Park site selection is related to many factors: 1) country government type, 2) country technology development, proximity to educational institutions, 3) proximity to research and development corporations, 4) catastrophic loss potential, 5) heating and cooling energy demands, 4) training employee proximity and other factors. Some other factors need to be taken into account when developing a "stimulus strategy": 1) what is the unemployment rate in the region, 2) what is the population of the region, 3) is there a urban renewal strategy needed, 4) are there "breakthrough technologies" that need to be supported, and other factors too numerous to mention. In the "implementation" section; the site selection process is analyzed from a "stimulus perspective". Where and how do you stimulate a region? How do you prioritize the areas that need stimulus?

Description of the Life Style Science Park Concept:

The "Net Zero Energy Life Style Science Park Prototype" is not a proposed plan but rather an idealized demonstration of what a science park of the future could become. The country, culture, climate geography, site, transportation infrastructure, educational concepts, housing standards, availability of land, and a number of other parameters will of course influence the design for any real science park.

The overview concept for these life style science park facilities is to integrate the functions of a small fully functioning community to accomplish a number of goals: 1) the grouping of research facilities in a science park facility creates an image for the companies that enhance their marketability. 2) the quality of life for researchers and the community is increased, 3) services are shared at a reduced cost, 4) travel time to work is reduced, 5) energy for transportation is reduced, 6) the coordinated community creates a market aggregation for retail shops, restaurants, and services, 7) educational opportunities between research, business, and education can become stronger due to their close proximity, 8) enhanced proximity between teachers and incubator functions will promote enhanced incubation activity leading to job creation, 9) shared environmental sustainability and energy conservation can become a show place to foster sustainable lifestyles and businesses, and 10) increased proximity of researchers will foster more interaction and synergy of research interchange.

Central Village Center:

The village center is the heart of the community. To create vibrate village center the "Magnet University" and the Student housing form a base of activity for the village. The water feature is also meant to be a focal feature to provide identity to the entire complex. The lifestyle will focus community activities that interact with the water feature: restaurants, cafes, tavernas, shops, and piazzas.

Housing:

The researcher housing is located outside the city center but within a 10 minute walk to the village. This configuration promotes a quieted lifestyle for the researchers with easy access to the Village for access to restaurants and entertainment. The housing has its own recreational facilities and common areas for use by the residents. This was specifically designed to be a low energy design that promotes walking. The K-12 schooling is within a 10 minute walk where the children do not have to cross streets to get to school.

Recreation:

There are a number of different recreational facilities: 1) 18-hole golf course around the village center, 2) recreation at each housing cluster, 3) water recreation at the village water feature, and 4) water recreation (fishing) in the water storage areas used for heating and cooling the buildings.

Educational (University and Distance Learning):

Education is focused on continuous lifelong learning. This approach relies on 1) K-12, 2) Magnet University, and 3) Distance learning via teleconferencing facilities (Hotel /Convention Center), and 4) Educational options from home based on a robust broadband fiber net work integrated to the entire community.

Hotel / Convention Center:

The Hotel / Convention Center permit a broader range of options for the science park. One of the most important for the new global economy is the use of microwave and broadband access worldwide. This expensive

Equipment would be housed in the Hotel / Convention Center to maximize the multiuse opportunities, globally.

Research Facilities:

There are 60 research sites within the science park. The research facilities are close to the water features, since the water features are used as a "heat sink" to help heat and cool the buildings with the use of high efficiency water heat pump technology. The research facilities have a wide range of "energy use intensity or EUI" this is a rating relative to their potential year long energy use per square foot. Similar to the other buildings these are net zero energy buildings, which produce more renewable energy than they consume on a yearly basis. The buildings are oriented with their long axis in the east-west direction so as to "harvest" as much daylight as possible. This orientation is also used to shield the building from east and west solar heat gain.

Solar Collector Arrays:

Solar collector arrays would be placed on all buildings, parking shade structures, and roof tops. If the electrical demand exceeds the solar rooftop and the wind turbines and a ground mounted solar array could be accommodated on an adjacent site.

Wind Turbines:

Wind turbines if cost effective at the site would be located to the perimeter of the site to provide for less turbine to turbine wind problems. The placement of the wind turbines to the perimeter of the site will also help reduce vibration at the research sites. This is very helpful in reducing vibration sources near nanotechnology facilities.

Rainwater Catchment:

Rainwater will be caught on the buildings and will be collected, treated and used for potable purposes. Water sourced for irrigation and toilet flushing will be from onsite treated water supplies. The entire water system will be considered a "closed system" approach as possible thereby using and recycling water numerous times. The rainwater catchment concepts will be in use in the Village Center and all facilities on site.

VI.ONSITE RENEWABLE ENERGY

Solar Technologies:

Photovoltaics:
Solar cells, also called photovoltaic (PV) cells, convert sunlight directly into electricity. PV gets its name from the process of converting light (photons) to electricity (voltage), which is called the PV effect. The PV panels are mounted at a fixed angle facing south, or they can be mounted on a tracking device that follows the sun, allowing them to capture the most sunlight.

Photovoltaics are readily available, easy to install and maintain, and the cost is well understood (becoming more cost effective each year). As such, a popular method of including this technology on commercial building projects is through a "Power Purchase Agreement" with a third party that will install and maintain the system at no first cost of construction, then sell the energy back to the building owner for a pre-determined payoff period. The NZE Life Science Park has been designed for maximum solar access to take the greatest advantage of photovoltaics as the prime renewable energy source mounted both on the building, over the parking, and ground mounted.

Solar Water Heating:
Most solar thermal systems for buildings include solar collectors that work along with a pump, heat exchanger, and storage tanks to provide hot water renewably from the sun's energy. Solar hot water heating is a simple, cost effective renewable energy option. The Net Zero Energy Science Park will utilize this technology, with the panels mounted on the roof of most buildings, to provide domestic hot water throughout the year.

Wind Electrical Generation Technologies:

Site Mounted Wind Turbines:
The scale and variety of site (ground) mounted wind turbines available on the market today is vast. Wind energy is only useful when there is an adequate wind resource at the site of the desired energy production. The Net Zero Energy Science Park will utilize this technology at strategic locations on the perimeter of the site or within the crop production areas, only when there is adequate wind resource available. There will be no "building mounted wind turbines due to the positional for vibration into the buildings.

Waste-to-Energy Plant:
The on-site Waste-to-Energy plant will burn non-recyclable waste products from the buildings and site. Current stack scrubber technology allows for the clean burning of these waste feedstock sources. Boilers will be used to burn the waste feedstock and the steam produced from this process will used in a co-generation or tri-generation system that can produce electricity from a steam turbine, chilled water from absorption chillers, and hot water for space and domestic water heating.

Central Utility Plant Strategies:

Water Source Geo-Exchange Technology:
The overarching concept for a central energy plant is to provide a consistent source of water to each of the buildings on the site for use as a heat source or heat sink depending on the season and the nature of the building program. The water is primarily distributed around the site via the manmade water feature, and then it is piped within proximity of all the buildings so that the resource can be easily used by each. For the purposes of the Net Zero Science Park concept this concept will be called the Thermal Distribution Network.

This concept emphasizes utilizing the constant temperature of the aquifer as a source of cooling (heat sink) and heating (heat source). This resource is intended to be used in conjunction with the site water features. These water features are located in close proximity to all of the site buildings for two reasons. The first is to allow the water feature to be a retention area for rainwater that will be used for irrigation throughout the site. The second use for the water features is to allow it to be the natural Thermal Distribution Network for the water source geo-exchange system, maintained at a relatively consistent temperature throughout the year. Aquifer water will be pumped into the water features and then re-injected back into the aquifer at equal or greater quantity depending on the quantity of rainwater collected. The temperature of the water that is re-injected into the aquifer shall be equivalent to eliminate the potential for thermal pollution of the aquifer (rise or decrease in the overall temperature). Other spaces requiring cooling will need additional equipment to lower the temperature of the network water. As such, each of the buildings on the site shall utilize high efficiency, water-to-water heat pumps, or heat-recovery chillers to provide basic cooling and heating water for space conditioning, utilizing the Thermal Distribution Network as a heat source or sink as required. This strategy provides an integrated approach to the NZE site design by allowing all cooling and heating equipment in each building to be located in mechanical rooms within the structure instead of on the roof, which will be reserved for photovoltaic and solar thermal panels.

Additional Central Utility Plant Strategies:

Large Body Water Source Technologies (ocean, river and lake water):
This strategy simply utilizes other natural bodies of water in the same concept as noted above "Water Source Geo-Exchange Technology", if such a resource is located in close enough proximity to the site.

Ground Source Technologies:
Horizontal and vertical geo-exchange systems utilize below grade piping systems to transfer heat to and from the earth with water. This ground-tempered water system is then typically coupled to a high efficiency, water-to-water heat pumps, or heat-recovery chillers to provide basic cooling and heating water for space conditioning.

Facility Design Strategies:
At the forefront of the design is a whole building or integrated design strategy. This strategy starts with interactive programming, goal setting, and site analysis. All team members are involved in the interactive search for reducing the resources, energy, and costs to achieve the needed facility solution. The design starts with finding passive design opportunities even at the programming and site selection stage. Refer to the resources portion of the text to be directed to Net Zero Energy interactive design session information and process. The design strategies are focused on: 1) reducing the amount of building needed, 2) maximizing passive design, 3) developing an integrated design process that develops integrated architectural / engineering solutions that are both cost and energy sensitive, 4) creating solutions that embody environmental psychology principles that improve the user functioning on a day to day basis, and 5) remembering that we are producing architecture that is meant to inspire the human spirit not just provide a roof and walls.

Building Engineering Strategies:

Cooling / Heating:
Radiant cooling is the predominant strategy for all appropriate occupied and non-occupied spaces on the site. Radiant cooling in this context refers to utilizing large surface areas such as floors, overhead slabs and ceilings as the cool surface that provides the necessary cooling as relatively high cooling water temperatures (close in temperature to the Thermal Distribution Network). These same radiant surfaces will also be used for heating. In humid climates like Charleston, South Carolina the radiant cooling systems must be coupled with a low energy desiccant dehumidification ventilation air system that is capable of controlling the relative humidity in the buildings.

Another significant component of energy use for cooling and heating in buildings is the energy required to temper the fresh air that is supplied to these structures. This applies to all the occupancy types represented on the Net Zero Energy Science Park. All buildings will utilize heat recovery systems to allow the “free” heating or cooling of the fresh “ventilation” air streams by capturing the hot or cold energy of the building exhaust air stream, which at the temperature of the building occupied zones.

Plumbing:
Low flow fixtures shall be utilized throughout the site to minimize potable water usage and, therefore, the quantity of domestic hot water for significant energy savings. Non-potable water from the site water features will be used for toilet flushing and each building will be provided with a secondary piping system for this purpose.

As noted in the renewable energy section above, domestic hot water for all buildings will be provided by solar thermal systems, which will utilize the building heat pump(s) as back-up on low-solar days.

Lighting:
Low energy lighting is critical to the design of net zero energy facilities. Critical issues include low lighting power density both outside the building and inside, implementing specialized task lighting in as many spaces as possible. This allows typical work spaces to function at levels of 0.5 to 0.7 watts per square foot with fluorescent lighting, most importantly controlled to reduce levels for occupancy and daylighting levels. External site, parking and building lighting, as well as certain building interior spaces, will be lighted with LED fixtures to further reduce total site energy.

Power / Plug Loads:
Net zero energy design that uses appropriate passive and active low energy building concepts noted in this document will reduce the energy demand of all aspects of the project to the point that “plug loads” can become the largest energy consumer. Plug loads include everything that is plugged into a power outlet, plus additional electrical power consumers like server rooms, telecom rooms, kitchens, etc. Plug load reduction and control strategies include computer options (laptops versus desktops) and occupancy control strategies for workstations. This is critical to lowering total site energy use and is directly related to the implementation of site renewable energy to directly offset that energy demand.

VII. WASTE STRATGIES

Recycled Waste:
Recyclable waste will be collected at each facility (housing, research, education, café, restaurant and commercial facilities) and will be taken to the collection, compaction, and recycling area located at the cogeneration plant. Those elements that were not recyclable would be used for co-generation energy production.

Biodegradable:
Biodegradable waste would be handled in two different ways: 1) the housing related biodegradable waste will be immediately placed in the compost system adjacent to both the housing and local gardens for use as future soil. 2) Soft solid food wastes and other biodegradable waste from non-housing will be collected and taken to a central compost area located at the waste to algae to biofuels facility.

Black Water Sewerage:
The highly potent, black water sewerage for all facilities would be collected similar to most cities via underground sewerage system network. The sewerage would be then take to a location a short distance from the science park to be treated and further remediated in algae ponds for use producing butanol which can be mixed with gasoline, diesel, or further processed into aviation fuel. This process is referred to as a “solid catalyst method”.

The Grey Water from all facilities will be collected and sent to the algae production ponds as described above.

Farm Animal Waste:

Farm animal waste from the surrounding farmland would be used for fertilizer as is currently done on many farms today. There is a move in the farming industry to used “close-loop” thinking related to feed, animals, and animal waste.

VIII. WASTE TO AQUATIC SPECIES TO BIOFUELS AND PROTEIN SOURCES

Nutrients for grey and black water, as well as soft food wastes from science park restaurants/schools are the building blocks of a sustainable biofuel/protein dual production system. Outputs include biomethane, bioethanol, and high grade protein for an integrated fisheries plant. Effluent water is remediated to either agricultural irrigation standards and/or potable standards for human reuse.

IX. FOOD PRODUCTION / DELIVERY STRATEGIES

Food production can be considered in four forms: 1) traditional farm grown food, 2) private and semiprivate food production, 3) emergency food production, 4) recreational food production.

Traditional Food Production:

Traditional food production at farms would be similar to that found on most farms throughout the USA and in other countries. There are a few systems that could be used as models; USA model for efficiency, Austrian farming for clean organized farming, and organic farming. The focus on the new farming techniques is to produce high quality organic food with: 1) no petroleum based fertilizers, 2) minimal if any insecticides, and 3) no herbicides.

X. SMART GRID CONCEPTS

Smart grid concepts are starting to be refined for use in the future for: 1) security of “the grid”, 2) efficient energy production and use, and 3) emergency energy control.

With the generation of solar, wind, geothermal, biomass, and other energy forms, control of production and greater knowledge of energy generation and use is not just useful it is required. A central energy control and management system today is needed to efficiently manage the system. This control and monitoring system needs to be designed and monitored on a daily basis. Just as current Net Zero Energy facilities are used today, the users are a large part of the energy production and use system. The user energy interface changes over time as the users learn how to use the new buildings and complexes.

XI. SCIENCE PARK / VILLAGE PROGRAMMING PARAMETERS:

Functional Program	(EUI) KBtu/per Sq. Ft. / yr.	Sq. Ft.
Research (EUI Level 1-5) Buildings	100- 230	2,367,370
Educational Laboratories	100-190	269,040
Technology Incubators	125	125,090
Educational (University)	24	1,000,000
Educational (K-12)	24	55,000
Hotel (210 rooms)	40	120,000
Hotel Conference Area	78	75,000
Office Buildings	24	75,000
Commercial Buildings	24	263,920
Restaurants/ Cafes / Shop	24	150,000
Housing (532 units at 1060sf per unit)	25	563,920
Golf Facilities	24	23,400
Co-Generation	N/A	20,000
Total		5,107,740

Functional Program Summary:
Note: Refer to the IASP 2011 Net Zero Science Park Presentation for program user and staff breakdown by building type.

Land Use Area Summary:	Hectares	Acres
Total Science Park / City area	445	1,100
Total Farm Land	3,896	9,627
Total Area for Biofuel production facilities	4	10
Total Regional Roads outside Science Park within Farm Areas	78	192
Total Regional Recreation Lake (Fishing and Water Skiing)	118	400
Area for Forests (Included in Farm Land Calculation)	*SO	
Water Areas on Farms (Included in Farm Land Calculation)	*SO	.
Grand Total	**4,541**	**11,329**

Note: All figures have been rounded
*SO=Simultaneous Occupancy

XII. REGIONAL ECOLOGICAL PLANNING PARAMETERS:

Nutrient balance drives the waste reduction, recycling and reuses solutions. The material and human waste not recycled will be used for energy generation at the co-generation facility located in the southeast quadrant of the Science Park. Black and grey water sewage is anticipated to be turned into algae for use as a feedstock for butanol production. The Science Park will include the surrounding farm area that supports the Science Park / City. This will become a good example of “closed loop/ nutrient balanced” regional design.

Constructed Wetland will intake waters and remove heavy metals, excess nutrients, pesticides and other chemical pollutants, as well as suspended sediment to clarify the water. Wetland will be adapted to both urban setting and farmland regions. Their presence will also encourage habitat restoration.

Land Management will drive the site’s Ecological Connectivity within its region. Connecting the existing and planned regional ecological networks will enhance the site biology and ecological importance. These connections will be enhanced through constructed crossing at major barriers such as highway and urban zones. Establishing an integrated pattern of land-use to promote a diverse collection of flora and fauna specific to local ecology systems will drive the land use selection.

XIII. PROJECT IMPLEMENTATION STRATEGIES and OPPORTUNITIES

Support and Enhance Technology Cluster to be More Competitive Globally:
As per the book “The Next American Economy” by William Holstein; he suggests strengthening the existing technology clusters to make them more competitive globally. The USA clusters are: 1) Science Parks adjacent to Universities (MIT and Harvard, etc.; 2) Industrial Clusters (San Diego, CA etc.); 3) Military Research and Development (NASA, Oak Ridge NL, etc.); 4) New Technology Clusters focused on new commercial ventures (J.C. Venter Institute, CA, etc.); 5) Cities establishing local stimulus (Austin, Texas, etc.). These are all considered technology clusters and capable of being enhanced by a “Magnet University Cluster HUB” concept.

Suggested Federal, State, Local, and Entrepreneurial Incentives:
The process will use a public private partnership between: 1) Federal Government, 2) State Government, 3) Regional Economic Development Agency, 4) City Government, 5) local and national science park developer, and 6) Financial Institution. The expertise and contributions of the entities are as follows: 1a.) Federal Government is to provide land and buildings currently owned by the government; these are to be “donated” to the PPP; 1b) the Federal Government will provide a 10 year tax holiday with increasing taxes rates after the ten years, in 5 year increments until the full taxes are incurred in the 25th year; 2) the State Government will provide the funding for the Magnet University,

teaching staff, distance learning capabilities, and student housing. 3) The Regional Economic Development Agency will fund and staff the technology incubation and the coordinate the "venture funding council" and "corporate mentorship program"; 4) The city will provide a 10 year tax holiday with increasing taxes rates after the ten years, in 5 year increments until the full taxes are incurred in the 25th year; 5) the local developer and the national development partner will provide the development strategy expertise, managing and financial funding in exchange for the 10 year tax holiday and the increasing taxes to the 25th year. (0-10 years @ 0 taxes; 10-15 years @ 25% taxes; 15-20 years @ 50% Taxes; and 20-25 years at 75% taxes; 25 years and beyond 100% taxes). These rates would apply to Federal, State and Local taxes.

The Intellectual Property produced in the Magnet University, Technology Incubators, and Technology accelerators would be owned (75% by the IP originator, 12.5% by the University, and 12.5% by the Regional Development Group owning and managing the Technology Incubator / Accelerator).

There needs to be time set on incubator / accelerator discounted rent; suggestions are: 50% off for year one, 40% off for year 2, 30% off for year 3; and 20% off for year 4, and 10% for year 5.

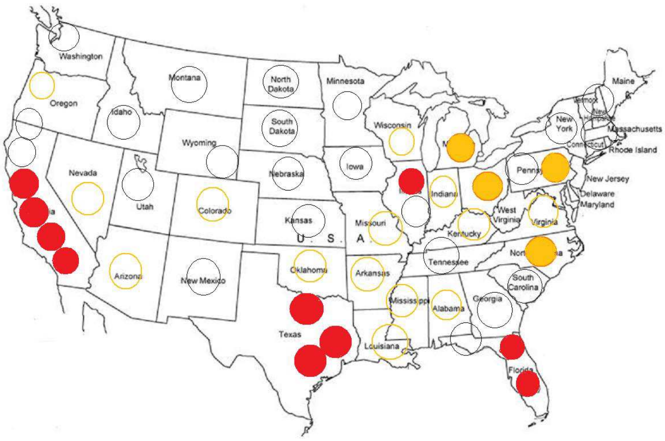
Note: For depressed areas called "major redevelopment regions" by the federal government such as the city of Detroit and redevelopment of parts of New York City; the Federal government will issue "Invest in America Bonds" very similar to the "War Bonds" of the World War II era. The major redevelopment areas may also contain special tax incentives to overcome the "additional risk" the developers are taking.

Implementation of the Closed Loop Design EcoScience Park© USA and European Model Suggestion:
In the United States one of the easiest ways to implement the concept is to work with the Federal government and a state government to use a "BRAC" (Base Realignment And Closure) site for economic development. The federal government identifies which sites are available for "transfer" to this type of project. The state will need to "back the project" by investing in the university system in "trade" for this "transfer" opportunity. The federal government, state, and local governing bodies may need to promote the development by creating an "economic zone for a special tax holiday". The federal government and state government may need to create a "special tax holiday" for the entrepreneur/developer to take the risk and developer skill to be involved.

Another concept could be to identify a high unemployment area, re-training opportunity area, STEM Education opportunity area, urban development, environmental improvement area. It may work best as a Public Private Partnership thereby spreading the risk and increasing the reward opportunities. That partnership may include large corporate sponsor or philanthropic sponsor.

Implementation of the closed Loop Design EcoScience Park© China and Brazil Model Suggestion:
China or Brazil could establish an analysis to identify the most cost effective locations to provide "regional investment" in a PPP basis. This again would be best if the federal, state, city, and entrepreneur/developer where involved. An active development and business leader is needed to make it a "cost effective" and "market driven" success. The analysis may include but not be limited to the following: high unemployment area, re-training opportunity area, STEM Education opportunity area, urban development, environmental problem area, or area of needed population redistribution. In China this may help alleviate the vast population movement to the cities of the eastern coast to a more "western" area thereby evening out the population impacts.

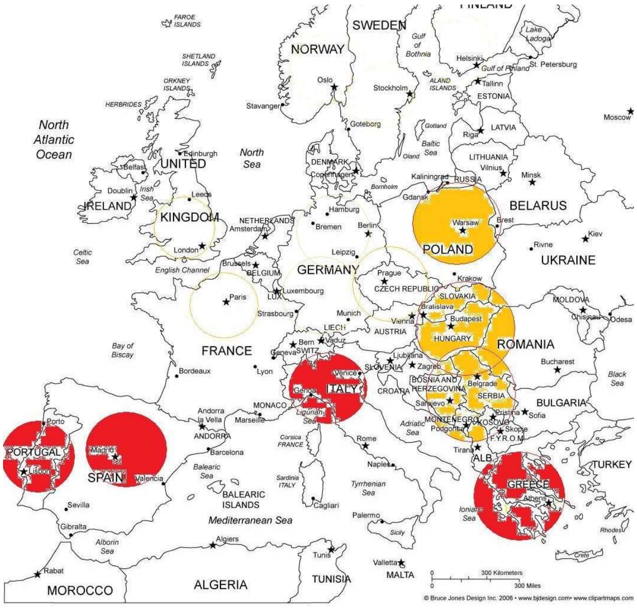
XIV. PROPOSED USA STIMULUS TECHNOLOGY CLUSTER “HUBS”



Priority 1 Solid Red Circle
Priority 2 Solid Orange
Priority 3 Outline Orange
Priority 4 Outline Black

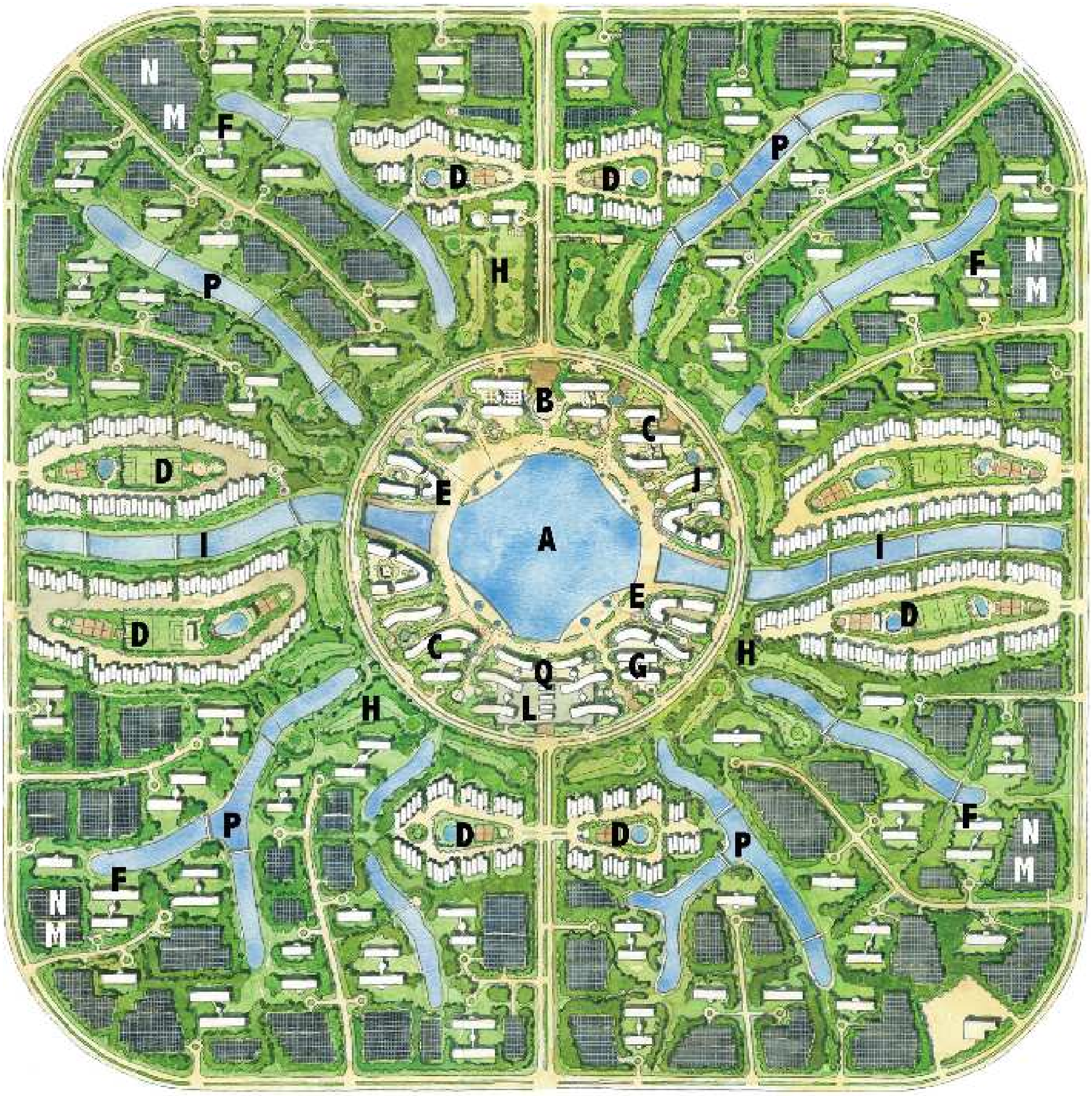
The red solid circles indicate the highest priority “HUBS” related to the greatest need to provide stimulus to resolve unemployment. The priority levels are indicated above. The above illustrates a nationwide “Magnet Eduction Program” fostered by Public Private Partnerships to foster the creation of high technology investment and employment. The above priorities were established after analyzing unemployment, population, and advanced technologies by state.

XV. PROPOSED EUROPEAN STIMULUS TECHNOLOGY CLUSTER “HUBS”



A similar analysis is suggested for the European Union to identify unemployment needs, thereby identifying countries to provide investment, thereby stimulation by “Magnet University HUBS” that will help in both intellectual property stimulation and the resulting high technology employment and corporate formation.

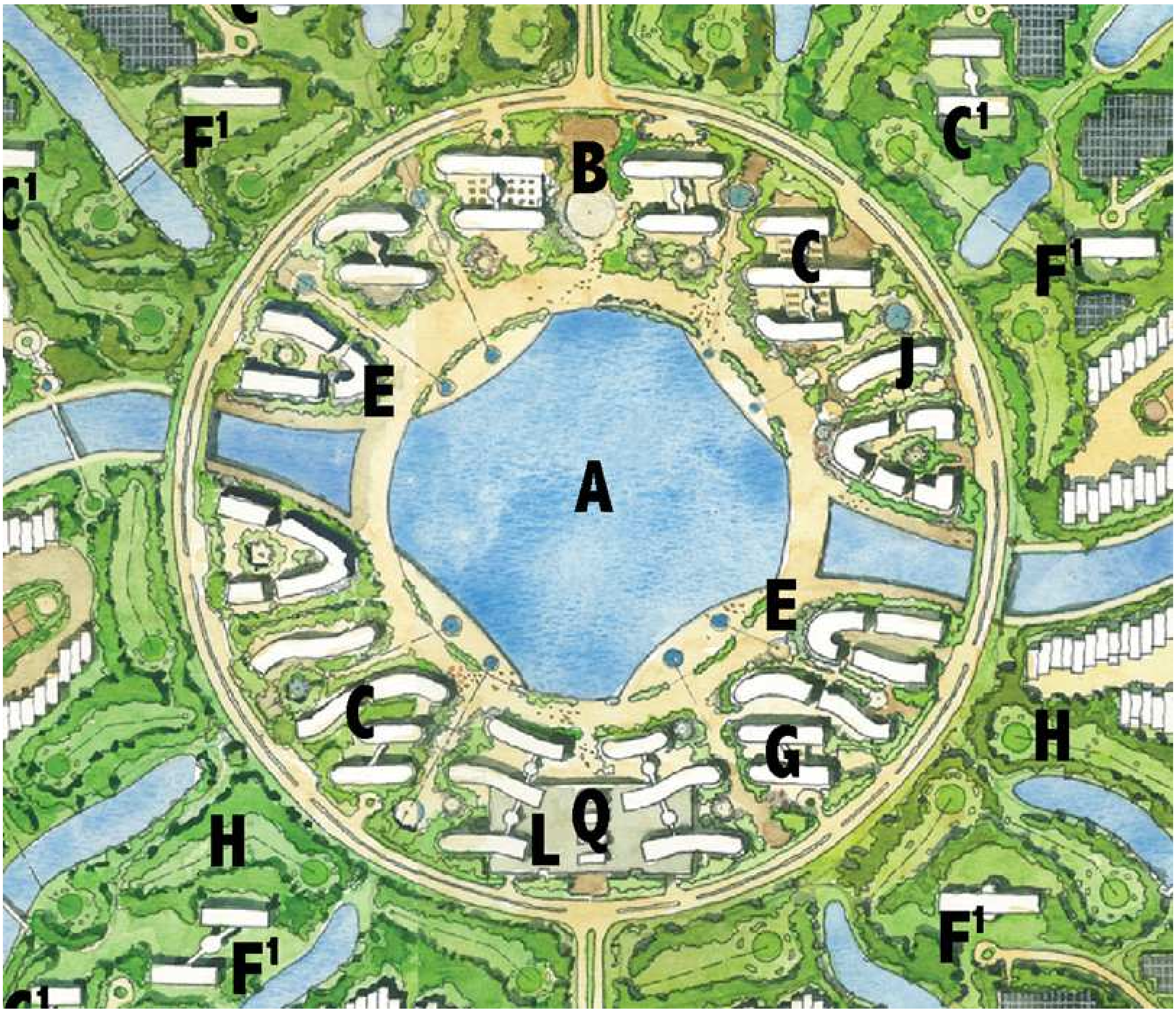
XVII. GREEN NET ZERO ENERGY LIFE STYLE SCIENCE PARK PROTOTYPE DESIGN SITE PLAN



Legend

A Main Water Feature	B Main Piazza	C Magnet University
D Housing w/ Recreation	E Village Promenade	F Research Laboratory
G Hotel / Conference Center	H 18-Hole Golf Course	I Water Storage
J K-12 School	K Wind Turbines (Large Site Plan)	L Central Parking
M PV Structure over Parking	N PV Site Mounted	P Water Storage
Q Microwave Link		

XVIII. VILLAGE CENTER, MAGNET UNIVERSITY CAMPUS, AND CENTRAL WATER FEATURE



©2011 Image Courtesy of Bruce Haxton and Tom Kubala

The Village Center is focused on a 900’ diameter water feature “**A**”. The water feature promenade provides access to the water feature and 16 circulation paths that connects the Village Center with the community.

XIX. ENGINEERING SYSTEM CONCEPT SKETCHES

Thermal Distribution Network Concept:

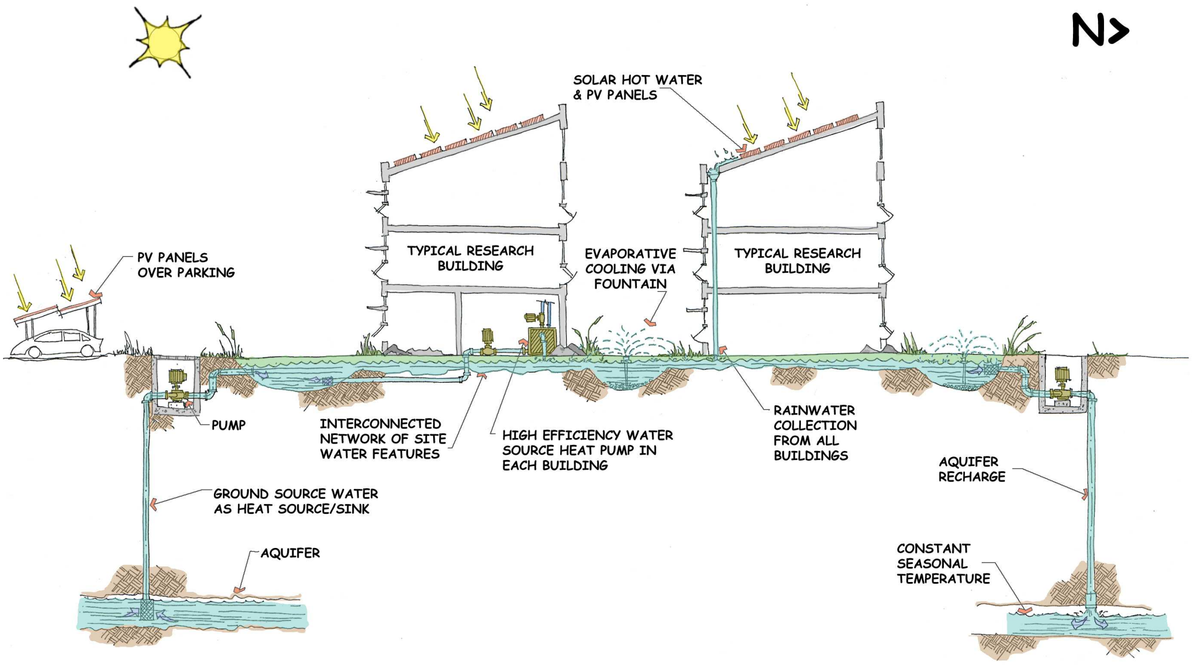


Image Courtesy of John Andary

Input and Output Nutrient, Ecology, Water Cycles

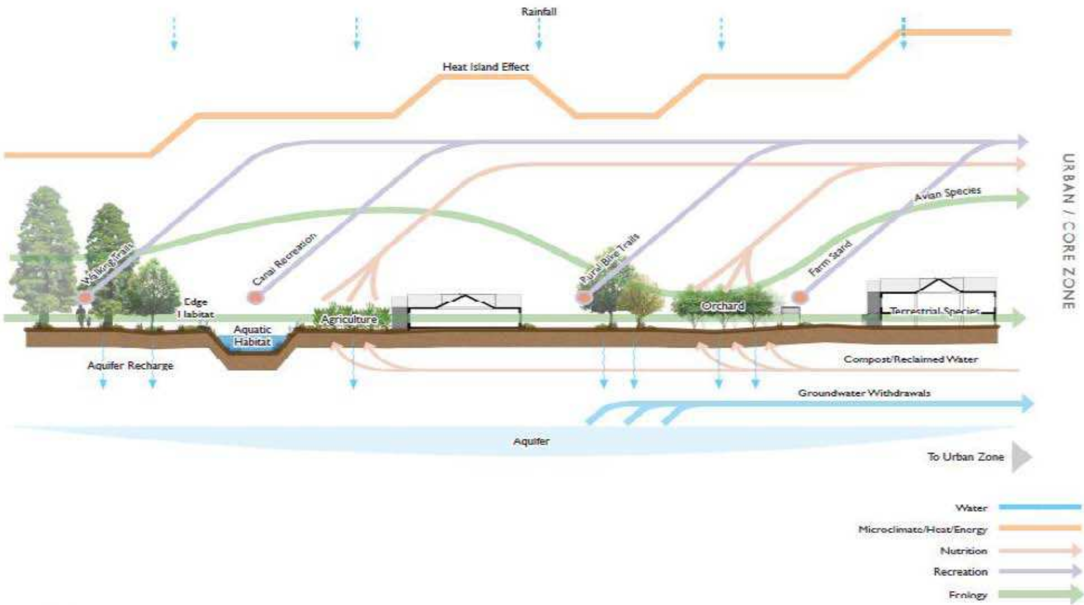


Image Courtesy of Bry Sarte and Jason Loiselle; Sherwood Design Engineers

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